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Socioeconomic Position as a Common Cause for Smoking, Drinking, and Psychiatric Distress over the Transition to Adulthood

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Submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy

College of Social Sciences

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2014

Abstract

Psychiatric distress, smoking and excessive alcohol consumption are common health problems which often occur together and are patterned by socioeconomic position. Smoking and drinking behaviours and mental health problems tend to develop over the transition from adolescence to adulthood, so this thesis aimed to investigate the mechanisms by which socioeconomic factors influence their co-development during this stage of life as young people make transitions into adult social roles. Data were primarily taken from three UK cohort studies (two nationwide birth cohorts respectively born in 1958 and 1970, and a cohort of adolescents from Glasgow who were also born in the early 1970s), so it was possible to examine whether mechanisms were context-dependent. Additional data from the youth sub-sample of the British Household Panel Study allowed investigation of socioeconomic inequalities in early adolescent smoking development in more recent history (1994-2008). A combination of person and variable centred analysis techniques (latent class analysis, structural equation modelling, propensity weighting, and event history analysis) were employed to investigate the role of socioeconomic background and transitions to adulthood in development of smoking, drinking and psychiatric distress in adolescence and early adulthood. Inverse probability weighting and multiple imputation were employed to account for missing data. A strong association was identified between socioeconomic disadvantage and adolescent smoking, despite recent increases in tobacco control in the UK. Smoking appeared to be an important mechanism, or at least a marker for other mechanisms, linking socioeconomic disadvantage to heavier drinking, psychiatric distress, and early school-leaving. Aside from smoking, there were other mechanisms leading to heavy drinking and psychiatric distress. For psychiatric distress, these were still mainly associated with socioeconomic disadvantage, especially in early adulthood, whereas for drinking there were mechanisms associated with socioeconomic advantage. Participation in tertiary education appeared to be an important example of such a mechanism, linking socioeconomic advantage to heavier drinking in early adulthood. Remaining in education was strongly linked to delaying other adulthood transitions, but different patterns of early transitions exhibited different associations with smoking, drinking and distress in different contexts. Tackling inequalities in smoking may help reduce inequalities in drinking and distress in adolescence and early adulthood, and policies increasing access to tertiary education should consider the deleterious effects on drinking behaviours.

Table of Contents

1 INTRODUCTION 1-1

1.1 BACKGROUND, PERSPECTIVES AND FRAMEWORK 1-1

1.1.1 Background 1-1

1.1.2 Conceptual framework 1-3

1.1.3 A lifecourse perspective 1-4

1.1.4 Social epidemiology and SEP 1-6

1.1.5 Gender 1-10

1.1.6 Interdependence 1-10

1.1.7 Epistemology 1-11

1.2 AIMS AND RESEARCH QUESTIONS 1-12

1.3 SUMMARY OF SUBSEQUENT CHAPTERS 1-14

2 THEORY AND EVIDENCE 2-15

2.1 LIFECOURSE CONCEPTS 2-15

2.1.1 Epidemiological approaches to the lifecourse 2-15

2.1.2 Sociological approaches to the lifecourse 2-18

2.1.3 Psychological approaches to development 2-22

2.2 THEORETICAL MECHANISMS 2-23

2.2.1 Interdependent mechanisms 2-24

2.2.2 Mechanisms related to SEP 2-26

2.2.3 Mechanisms related to transitions to adulthood 2-31

2.3 REVIEW OF EVIDENCE 2-35

2.3.1 Framework for review 2-35

2.3.2 Associations among smoking, drinking and psychiatric distress 2-36

2.3.3 Associations between SEP and substance use 2-38

2.3.4 Associations between SEP and psychiatric distress 2-39

2.3.5 Summary of evidence 2-40

3 DATA AND METHODS 3-42

3.1 DATA 3-42

3.1.1 Description of datasets 3-42

3.1.2 Contextual differences between datasets 3-44

3.1.3 Previous findings from NCDS58, BSC70 and T07 3-49

3.2 MEASUREMENT 3-52

3.2.1 Measurement of SEP 3-53

3.2.2 Measurement of smoking, drinking and psychiatric distress 3-61

3.3 ANALYSIS METHODS 3-69

3.3.1 Analytical principles 3-69

3.3.2 Specific techniques 3-73

4 SEP AND ADOLESCENT DEVELOPMENT 4-85

4.1 INTRODUCTION AND AIMS 4-85
4.1.1 Smoking, drinking and psychiatric distress 4-85
4.1.2 SEP as a common cause 4-86
4.1.3 Aims and hypotheses 4-86
4.2 METHODS 4-87
4.2.1 Sample 4-87
4.2.2 Measures 4-87
4.2.3 Analysis 4-88
4.3 RESULTS 4-92
4.3.1 Descriptives and missing data 4-92
4.3.2 Establishing optimal number of classes 4-93
4.3.3 Measurement equivalence by gender 4-94
4.3.4 Adjustment for age 4-95
4.3.5 Description of classes 4-97
4.3.6 Associations with SEP 4-100
4.4 DISCUSSION 4-103
4.4.1 Summary of findings 4-103
4.4.2 Limitations 4-103
4.4.3 SEP as a common cause 4-104
4.4.4 Opposing mechanisms 4-104
4.4.5 Conclusion 4-106

5 SEP AND DRINKING OVER THE TRANSITION TO ADULTHOOD 5-107

5.1 INTRODUCTION AND AIMS 5-108
5.1.1 Opposing mechanisms 5-108
5.1.2 Smoking mechanism 5-108
5.1.3 Tertiary education mechanism 5-108
5.1.4 SEP indicators 5-109
5.1.5 Contextual variation 5-109
5.1.6 Aim and hypotheses 5-110
5.2 METHODS 5-110
5.2.1 Samples 5-110
5.2.2 Measures 5-111
5.2.3 Analysis 5-112
5.3 RESULTS 5-116
5.3.1 Descriptive statistics and missing data 5-116
5.3.2 Structural equation models 5-119
5.4 DISCUSSION 5-128
5.4.1 Summary of findings 5-128
5.4.2 Limitations 5-128
5.4.3 Smoking mechanism 5-129
5.4.4 Tertiary education mechanism 5-129
5.4.5 Residual association between SEP and drinking 5-129

5.4.6 *Differences according to gender and SEP indicator* ... 5-130
5.4.7 *Contextual heterogeneity* ... 5-130
5.4.8 *Conclusions* ... 5-131

6 SEP AND PSYCHIATRIC DISTRESS OVER THE TRANSITION TO ADULTHOOD ... 6-132

6.1 INTRODUCTION AND AIMS ... 6-132
6.1.1 *Inconsistent findings on SEP and psychiatric distress* ... 6-132
6.1.2 *Smoking mechanism* ... 6-133
6.1.3 *Tertiary education mechanism* ... 6-134
6.1.4 *SEP indicators* ... 6-134
6.1.5 *Contextual variation* ... 6-134
6.1.6 *Aim and hypotheses* ... 6-135
6.2 METHODS ... 6-136
6.2.1 *Samples* ... 6-136
6.2.2 *Measures* ... 6-136
6.2.3 *Analysis* ... 6-137
6.3 RESULTS ... 6-138
6.3.1 *Descriptive statistics and missing data* ... 6-138
6.3.2 *Structural equation models* ... 6-142
6.4 DISCUSSION ... 6-152
6.4.1 *Summary of findings* ... 6-152
6.4.2 *Limitations* ... 6-152
6.4.3 *Smoking mechanism* ... 6-153
6.4.4 *Tertiary education mechanism* ... 6-154
6.4.5 *Residual associations with SEP* ... 6-154
6.4.6 *Heterogeneity* ... 6-155
6.4.7 *Conclusions* ... 6-156

7 CAUSAL EFFECTS OF EARLY TRANSITIONS TO ADULTHOOD ... 7-157

7.1 INTRODUCTION AND AIMS ... 7-158
7.1.1 *Early transitions and unfavourable contexts* ... 7-158
7.1.2 *Selection* ... 7-158
7.1.3 *Aims and hypotheses* ... 7-160
7.2 METHODS ... 7-161
7.2.1 *Samples* ... 7-161
7.2.2 *Measures* ... 7-161
7.2.3 *Analyses* ... 7-166
7.3 RESULTS ... 7-172
7.3.1 *Missing data and descriptive statistics* ... 7-172
7.3.2 *Establishing optimal number of classes* ... 7-175
7.3.3 *Measurement equivalence by gender and cohort* ... 7-177
7.3.4 *Description of classes* ... 7-178
7.3.5 *Structural model of paths into transitional classes* ... 7-182

7.3.6 Propensity weighting analyses ... 7-188

7.4 DISCUSSION ... 7-196

7.4.1 Summary of findings ... 7-196

7.4.2 Limitations ... 7-197

7.4.3 Context and transitions to adulthood ... 7-198

7.4.4 Patterning of transition classes ... 7-199

7.4.5 Causal effects of early adulthood transitions ... 7-199

7.4.6 Conclusion ... 7-202

8 SEP AND EARLY ADOLESCENT SMOKING DEVELOPMENT ... 8-203

8.1 INTRODUCTION AND AIMS ... 8-203

8.1.1 SEP and smoking ... 8-203

8.1.2 SEP and smoking development ... 8-204

8.1.3 Contextualising smoking development ... 8-206

8.1.4 Gender ... 8-208

8.1.5 Aims and hypotheses ... 8-208

8.2 METHODS ... 8-209

8.2.1 Sample ... 8-209

8.2.2 Measures ... 8-210

8.2.3 Analysis ... 8-215

8.3 RESULTS ... 8-219

8.3.1 Descriptive statistics ... 8-219

8.3.2 Event history models ... 8-224

8.3.3 Relative contribution of transition stages to inequalities at age 15 ... 8-231

8.4 DISCUSSION ... 8-232

8.4.1 Summary of findings ... 8-232

8.4.2 Limitations ... 8-233

8.4.3 Smoking development ... 8-235

8.4.4 Contextualising smoking development ... 8-236

8.4.5 SEP and smoking development ... 8-238

8.4.6 Gender and smoking development ... 8-241

8.4.7 Change in associations over time ... 8-242

8.4.8 Conclusion ... 8-244

9 DISCUSSION ... 9-245

9.1 SUMMARY OF FINDINGS ... 9-245

9.2 LIMITATIONS ... 9-248

9.2.1 Generalisation ... 9-248

9.2.2 Comparing secondary datasets ... 9-249

9.2.3 Pragmatic decisions ... 9-250

9.2.4 Missing data ... 9-252

9.3 IMPLICATIONS FOR THEORY ... 9-253

9.3.1 SEP as a common cause ... 9-253

9.3.2 Smoking as a 'gateway' *9-253*
9.3.3 Tertiary education and drinking *9-256*
9.4 IMPLICATIONS FOR POLICY AND PRACTICE 9-257
9.4.1 SEP as a common cause *9-257*
9.4.2 Tobacco and alcohol policies *9-258*
9.4.3 Health education *9-260*
9.4.4 Health resources and services *9-262*
9.5 FUTURE RESEARCH DIRECTIONS 9-263
9.5.1 Causal influence of smoking *9-263*
9.5.2 Measuring SEP *9-263*
9.5.3 Multinomial propensity weighting and latent class analysis *9-264*
9.5.4 Opposing mechanisms leading to drinking *9-264*
9.5.5 E-cigarettes *9-265*
9.6 CONCLUSION 9-266

10 APPENDICES 10-267

APPENDIX TO CHAPTER 7 10-267
APPENDIX TO CHAPTER 8 10-280

11 LIST OF REFERENCES 11-295

List of Tables

Table 3-1: Ages of measurement and survey modes 3-43

Table 3-2: Contextual differences between datasets 3-49

Table 3-3: Smoking measures by cohort 3-63

Table 3-4: Drinking measures by cohort 3-66

Table 3-5: Psychiatric distress measures by cohort 3-69

Table 4-1: Descriptive statistics for baseline covariates and attrition 4-92

Table 4-2: Frequency of smoking, drinking and psychiatric distress 4-93

Table 4-3: Model fit statistics for determining number of latent classes 4-94

Table 4-4: Model fit statistics for males and females 4-95

Table 4-5: Model fit statistics for age-adjusted models 4-96

Table 4-6: Comparison of modal class from age-adjusted and unadjusted models 4-97

Table 4-7: ORs for latent class membership (Vermunt 3-step method) 4-101

Table 4-8: ORs for latent class membership (modal assignment method) 4-102

Table 5-1: Additional measures included in imputation models 5-114

Table 5-2: ORs for being in analysis sample from NCDS58 5-115

Table 5-3: ORs for being in analysis sample from BCS70 5-116

Table 5-4: Descriptive statistics and missing data 5-117

Table 5-5: ORs from models without smoking and tertiary education mechanisms 5-124

Table 5-6: ORs from parental occupational class model by gender 5-125

Table 5-7: ORs from income model by gender 5-126

Table 5-8: ORs from parental education model by gender 5-127

Table 6-1: Descriptive statistics and missing data 6-140

Table 6-2: ORs from models without smoking and tertiary education mechanisms 6-148

Table 6-3: ORs from parental occupational class model by gender 6-149

Table 6-4: ORs from income model by gender 6-150

Table 6-5: ORs from parental education model by gender 6-151

Table 7-1: Availability of transition data in three cohort studies 7-172

Table 7-2: Proportions with missing data on background factors 7-173

Table 7-3: Descriptive statistics for transition timing in each cohort 7-174

Table 7-4: Descriptive statistics for background factors in each cohort 7-175

Table 7-5: Model statistics for models with different numbers of classes 7-177

Table 7-6: Chi-square tests for measurement invariance 7-178

Table 7-7: Description and prevalence of transitional classes in each cohort 7-181

Table 7-8: Associations between background factors and transitional class 7-185

Table 7-9: ORs for early adult smoking 7-193
Table 7-10: ORs for early adult heavy drinking 7-194
Table 7-11: ORs for early adult psychiatric distress 7-195
Table 8-1: Age at first observation cross-tabulated against age at last observation 8-210
Table 8-2: Illustrative coding examples for smoking histories 8-213
Table 8-3: Descriptive statistics from observed and analysis samples 8-221
Table 8-4: Imputation details 8-222
Table 8-5: ORs for smoking transitions (parental education) 8-226
Table 8-6: Relative importance of different transitions 8-232
Table A-1: Associations between parental factors 10-268
Table A-2: Associations between adolescent and other background factors 10-269
Table A-3: ORs for smoking transitions (parental occupational class) 10-282
Table A-4: ORs for smoking transitions (income) 10-283
Table A-5: ORs for smoking transitions (housing tenure) 10-284
Table A-6: ORs for smoking transitions (parental employment status) 10-285
Table A-7: ORs for complete case analysis (parental education) 10-286
Table A-8: ORs for complete case analysis (parental occupational class) 10-288
Table A-9: ORs for complete case analysis (income) 10-290
Table A-10: ORs for complete case analysis (housing tenure) 10-292
Table A-11: ORs for complete case analysis (parental employment) 10-293

List of Figures

Figure 1-1: Conceptual framework 1-3
Figure 1-2: SEP and health over the lifecourse 1-9
Figure 1-3: Conceptual framework 1-13
Figure 2-1: Epidemiological lifecourse models 2-16
Figure 2-2: Bronfenbrenner's socioecological model 2-19
Figure 2-3: Review framework 2-35
Figure 2-4: Review framework with findings 2-41
Figure 3-1: An example of a structural equation model 3-76
Figure 4-1: Emphasis of Chapter 4 within conceptual framework 4-85
Figure 4-2: Stages of analysis for developmental clustering 4-89
Figure 4-3: Latent class response probability profiles 4-99
Figure 5-1: Emphasis of Chapter 5 within conceptual framework 5-107
Figure 5-2: Analysis model and hypothesised direction of effects 5-113
Figure 5-3: ORs from model for parental occupational class 5-120
Figure 5-4: ORs from model for income 5-121
Figure 5-5: ORs from model for parental education 5-122
Figure 6-1: Emphasis of Chapter 6 within conceptual framework 6-132
Figure 6-2: Analysis model and hypothesised direction of effects 6-138
Figure 6-3: ORs from model for parental occupational class 6-143
Figure 6-4: ORs from model for income 6-144
Figure 6-5: ORs from model for parental education 6-145
Figure 7-1: Emphasis of Chapter 7 within conceptual framework 7-157
Figure 7-2: Hypothesised structure of associations 7-159
Figure 7-3: Overlap of propensity scores in NCDS58 7-189
Figure 7-4: Overlap of propensity scores in BCS70 7-190
Figure 7-5: Overlap of propensity scores in T07 7-191
Figure 7-6: Standardised mean differences in gender 7-192
Figure 8-1: Emphasis of Chapter 8 within conceptual framework 8-203
Figure 8-2: Smoking stages for early adolescents aged 11-15 years 8-205
Figure 8-3: Smoking prevalence by parental education among 15-year olds (1994-2008) and contextual changes (1990-2012) 8-224
Figure 8-4: Smoking transitions probabilities by year 8-228
Figure 8-5: Smoking transition probabilities by parental education and year 8-230
Figure 8-6: Probability of initiation by age and parental education 8-231

Figure 9-1: Conceptual framework 9-245
Figure 9-2: Summary of thesis findings 9-247
Figure A-1: Standardised mean differences in parental occupational class 10-271
Figure A-2: Standardised mean differences in parental education 10-272
Figure A-3: Standardised mean differences in low income 10-273
Figure A-4: Standardised mean differences in family structure 10-274
Figure A-5: Standardised mean differences in parental smoking 10-275
Figure A-6: Standardised mean differences in parental drinking 10-276
Figure A-7: Standardised mean differences in adolescent smoking 10-277
Figure A-8: Standardised mean differences in adolescent drinking 10-278
Figure A-9: Standardised mean differences in adolescent distress 10-279
Figure A-10: Flowchart of inclusion in complete cases analyses 10-280

Acknowledgements

This thesis is dedicated to Mannie, whose love and support helped me do it. Thanks also go to Molly, Hannah and Grace, for being excited whenever I come home. I'd also like to thank: Michaela Benzeval, Helen Sweeting and Alastair Leyland for their encouragement to do this in the first place, and for their continuing supervision and support; Frank Popham, Linsay Gray and Robert Young for helpful comments at various stages; my examiners for taking the time to read and consider my work; everyone at the Social and Public Health Sciences Unit, especially my fellow students, for making it such a great place to work; the Chief Scientist Office of the Scottish Government Health Directorates for supporting me to write this with a doctoral training fellowship (DTF/11/16), and for thinking I was a worthy investment; and the many scholars cited herein, for giving me giant shoulders to stand on. Given the content, it would be remiss of me not to also thank my parents for giving me such a good start in life, and for their continuing support and encouragement.

I am especially grateful to all of the survey participants and staff, without whom none of this would have been possible. The West of Scotland: Twenty-07 Study was funded by the UK Medical Research Council (MC_A540_53462). I am grateful to the Centre for Longitudinal Studies, Institute of Education for collecting the 1958 and 1970 cohort data, to the Institute for Social and Economic Research for collecting the youth data from the British Household Panel Survey, and to the UK Data Archive and Economic and Social Data Service for making data from these studies available. However, they bear no responsibility for the analysis or interpretation of these data.

Author's declaration:

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

[redacted]

Michael J Green

Definitions/abbreviations:

SEP: Socioeconomic Position
NCDS58: National Child Development Study of 1958
BCS70: 1970 British Birth Cohort Study
T07: West of Scotland: Twenty-07 Study
BHPS: British Household Panel Survey
SHeS: Scottish Health Survey
GHQ: General Health Questionnaire
MCAR: Missing-completely-at-random
MAR: Missing-at-random
MNAR: Missing-not-at-random
DHSS: Department of Health and Social Security
ASH: Action on Smoking and Health

1 Introduction

Smoking, alcohol consumption (hereafter referred to as 'drinking'), and psychiatric distress are often found to co-occur and to be patterned by socioeconomic position (SEP). Smoking and excessive drinking can have serious health consequences, and psychiatric distress can represent a serious burden for people. Since these problems could make strong contributions to socioeconomic inequalities in health it is important to understand how they develop and cluster together. Improved understanding of developmental processes can lead to more effective interventions to reduce inequalities and improve health. Much of the development of smoking and drinking behaviours and poor mental health occurs in adolescence and early adulthood, so the thesis focuses on this stage of life, considering the influence of the lifecourse transitions made between adolescence and adulthood. Smoking, drinking and psychiatric distress are examined together because they may be interdependent, and this thesis considers SEP as a potential common cause for smoking, drinking and psychiatric distress.

Chapter 1 starts with some background material, identifying the perspectives taken and the aims of this investigation, then finishes with a brief overview of subsequent chapters.

1.1 Background, perspectives and framework

1.1.1 Background

This thesis deals with three major public health issues. The first of these is smoking. Smoking has various adverse consequences including increased risk of cancers, diabetes, pulmonary diseases, and mortality (Shopland, 1995, Cullen et al., 1998, Will et al., 2001, Doll et al., 2004, Schepis and Rao, 2005, Gruer et al., 2009). Smoking during adolescence has an immediate and cumulative effect on health, with greater risks for heart disease and cancer for those who start smoking earlier (Flay, 1993). In Scotland, for example, cigarette smoking has been decreasing since 1995, but still approximately 25% of those aged 16 or over in the Scottish Health Survey (SHeS) are smokers (2009), and smoking has been estimated to cost Scottish society £837 million annually (Taulbut and Gordon, 2007). People in disadvantaged socioeconomic circumstances are more likely to smoke (Tyas and Pederson, 1998, Gilman et al., 2003) and start earlier (Dishion et al., 1999, West, 2009a, Tjora et al., 2011). Thus, the unhealthy consequences of smoking will be unevenly distributed and smoking is often acknowledged as major contributor to socioeconomic inequalities in adult health (Jarvis and Wardle, 2006, Gruer et al., 2009, Hill et al., 2013, Whitley et al., 2014).

The second public health issue considered is drinking. Excessive drinking has been linked with increased mortality risk (Hart et al., 1999) as well as incidence of liver disease (Becker et al., 1996) and various other chronic diseases (Fekjær, 2013). Further, excessive drinking in adolescence can hamper brain, bone, liver and growth hormone development (Donaldson, 2009) and is associated with the three most common types of mortality among young people: accidents, homicides, and suicides (Mason et al., 2008). Alcohol misuse was estimated to cost Scottish society around £2.25 billion in 2006/7 (Scottish Government, 2008). Socioeconomic patterning of drinking is complex, for example among adults aged 16 and over in 2008 there were higher levels of excess drinking among more advantaged socioeconomic groups, especially for women, but the mean units consumed per week for males was highest in the most deprived areas (SHeS, 2009). Deprived areas also have higher rates of deaths due to alcohol for both men and women (Leyland et al., 2007) and strong associations have been shown between both early life and adult socioeconomic adversity and excess and problem drinking in late middle age for Scottish men (Batty et al., 2008). Thus, drinking may also contribute to socioeconomic inequalities in adult health.

The third public health issue dealt with in this thesis is psychiatric distress (denoting symptoms of anxiety and/or depression). Anxiety and depression symptoms are common (Fryers et al., 2003), are often co-morbid (Merikangas et al., 2003, Wittchen et al., 2003), and are associated with burdens such as disability, impairment, and heightened mortality risk (Eaton et al., 2008, Hannah et al., 2013). Psychiatric distress has economic costs (Eaton et al., 2008), both direct, in terms of treatment and services, and indirect, in terms of lost economic output. Psychiatric distress also tends to be concentrated among those in disadvantaged socioeconomic circumstances (Fryers et al., 2003, Lorant et al., 2003) and inequalities widen with increasing age (Green, MJ and Benzeval, 2011).

It is therefore little wonder that the Scottish government identified smoking, excessive drinking, and mental health, as priority areas in its plans for improving Scotland’s health. A focus on these areas also links with another priority area: the reduction of health inequalities (Scottish Government, 2007). If interventions and policies to improve health in these areas are to be designed and implemented effectively, it is important to understand how smoking, drinking and psychiatric distress develop and interact. Further, if such interventions are to reduce rather than widen inequalities in these outcomes, then it is important to have a good understanding of how these inequalities develop.

1.1.2 Conceptual framework

Figure 1-1 displays a conceptual framework for this thesis. This section gives a brief overview of the framework before further detail in subsequent sections.

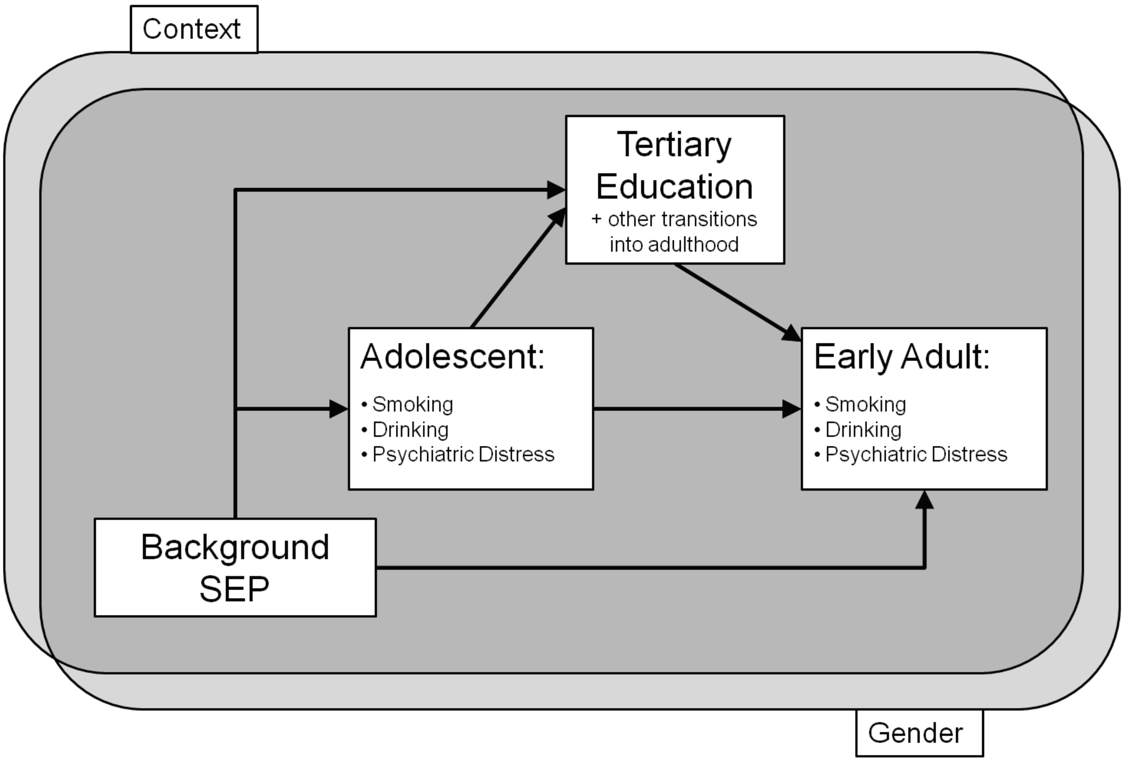


Figure 1-1: Conceptual framework

On the left of the diagram, a young person's socioeconomic background is positioned as a key factor stratifying development of smoking, drinking and psychiatric distress in adolescence and early adulthood. For simplicity of presentation, smoking, drinking and psychiatric distress are grouped together, but there may be complex patterns of interdependence between these phenomena. The arrow leading from the adolescent to the early adult box acknowledges that adolescent development of smoking, drinking and psychiatric distress may exert a strong influence on early adult outcomes. Also included in the framework are participation in tertiary education and transitions into adult social roles. These are viewed as influenced by background SEP and adolescent development but also as an influence on smoking, drinking and distress in early adulthood. Thus, adolescent development and transitions to adulthood may represent mediating mechanisms or pathways between background SEP and early adult outcomes. The two over-lapping boxes labelled ‘context’ and ‘gender’ encompass all of the above and indicate that the mechanisms linking these phenomena may differ in operation across different contexts and may be different for males and females. The next few sections elaborate on various elements of this framework.

1.1.3 A lifecourse perspective

This thesis takes a lifecourse perspective on how smoking, drinking and psychiatric distress develop. Lifecourse paradigms are explained in more detail in section 2.1 but three points are iterated briefly here: the importance of life-stage, that development occurs within a context, and adolescence and early adulthood represent an important period of transition.

1.1.3.1 Importance of life-stage

The lifecourse perspective recognises that factors may be more or less important at different stages of life and that factors in earlier stages of life may be important for later outcomes (Kuh and Ben-Shlomo, 1997, Lynch and Davey Smith, 2005). From this standpoint, the thesis focuses particularly on adolescence and early adulthood as these are key periods of risk for psychiatric distress, especially among young women (Furlong and Cartmel, 1997, Kim-Cohen et al., 2003, Furlong, 2013), as well as the stages in life when smoking and drinking behaviours are most likely to be initiated (Kandel and Logan, 1984, Giovino et al., 1995). Adolescence and early adulthood can be viewed as ‘impressionable years’ where there is a relatively high potential for development or change in smoking, drinking and psychiatric distress, compared to later in life when these characteristics remain relatively stable (Alwin and McCammon, 2003). Since the aim of this thesis is to understand the development of these phenomena, it makes sense to be looking at the stage of life in which they mainly develop. Indeed, virtually no initiation of smoking or drinking occurs beyond early adulthood and so understanding development in adolescence and early adulthood is critical to preventing or intervening against smoking and drinking behaviours that extend further into adulthood (Bachman et al., 1997) and have serious implications for adult health. Thus, the conceptual framework displayed in Figure 1-1 focuses on smoking, drinking and psychiatric distress in adolescence and early adulthood, rather than at other stages of life, and acknowledges that what happens earlier in life (i.e. in adolescence), may influence what happens later (i.e. in early adulthood).

1.1.3.2 Development occurs within a context

Another pertinent aspect of a lifecourse perspective is acknowledging that development takes place within a context, and the course or nature of development may be influenced by that context (Elder et al., 2003, Heinz, 2009). The importance of factors such as SEP may vary across time and place, so it is important to be sensitive to the geographic and temporal contexts in which development is studied. Hence, the conceptual framework in Figure 1-1 places the study of SEP, smoking, drinking and psychiatric distress over the transition to adulthood within the box labelled context. Context is conceptualised as covering temporal differences, i.e. from different periods of history, as well as differences of place or geography.

1.1.3.3 Transitions to adulthood

Adolescence and early adulthood can also be important because they largely determine socioeconomic trajectories for later life (DHSS, 1980). Indeed, this stage of life is an important period of transition for young people as they begin to leave parental homes and education and adopt adult social roles such as employee, parent or romantic partner (Schulenberg and Maggs, 2002, Côté and Bynner, 2008, West, 2009b, Schoon et al., 2012). Participation in tertiary education is strongly associated with the timing of transitions into these adult roles, with transitions tending to be delayed when a young person remains in education (Chassin et al., 1992, Bachman et al., 1997, Schulenberg and Maggs, 2002). These transitions may be an important influence on early adult smoking, drinking and psychiatric distress (Bachman et al., 1997, Schulenberg and Maggs, 2002, Burton, 2007), but may also be strongly influenced by socioeconomic background and adolescent smoking, drinking and psychiatric distress (Chassin et al., 1992, Bachman et al., 1997, Burton, 2007). Thus, the conceptual framework in Figure 1-1 singles these transitions out as a mediating mechanism of particular interest, placing an emphasis on tertiary education, given its strong associations with the timing of these transitions.

1.1.4 Social epidemiology and SEP

This thesis applies a social epidemiology perspective to the study of smoking, drinking and psychiatric distress. Epidemiological studies attempt to relate the distribution of health problems to population characteristics, which can then provide clues regarding aetiology (Langner and Michael, 1963, Dohrenwend and Dohrenwend, 1969, Bhopal, 2002). Social epidemiology aims to understand the pathways or mechanisms by which the social environment, or the structure of society, translates into health (DHSS, 1980, Berkman and Kawachi, 2000, Krieger, 2001, Viner et al., 2012). A key concept is that of "Socioeconomic Position", which is discussed in more detail below, but defined as "the social and economic factors that influence what position individuals or groups hold within the structure of a society" (p7; Galobardes et al., 2006a). The primary goal of this thesis is to better understand the role of a person's SEP in the aetiology of smoking, drinking and psychiatric distress. Hence, the conceptual framework displayed in Figure 1-1, shows paths or mechanisms leading from SEP to smoking, drinking and psychiatric distress in adolescence and early adulthood.

1.1.4.1 Conceptual definition of SEP

SEP is a broad and heterogeneous concept which is referred to using a variety of terms (e.g. socioeconomic status, social class etc) and measured using a variety of indicators (e.g. occupation, income, education; Liberatos and Link, 1988, Galobardes et al., 2006a). However, these terms and indicators are often used interchangeably despite differences in theoretical grounding and interpretation (Krieger et al., 1997, Macintyre et al., 2003b, Braveman et al., 2005, Galobardes et al., 2006a, Geyer et al., 2006), and SEP has long been considered difficult to both conceptualise clearly and operationalise (Liberatos and Link, 1988). Given this complexity, and the central role of SEP within this thesis, it is important at the outset to define what it meant when this term is used.

SEP is viewed here as indicating social positions or "particular structural locations within society" which are "powerful determinants of the likelihood of health damaging exposures and of possessing particular health enhancing resources" (p13; Lynch and Kaplan, 2000). That is, SEP is of interest primarily as a causal mechanism, leading to the social stratification of health and health behaviours, via the stratification of relevant exposures and resources. A range of social positions might contribute to the stratification of health relevant exposures and resources within society, including concepts such as race or gender

(Graham, 2007), but not all such social positions are *socioeconomic* positions: a socioeconomic position is a social position that is grounded in economic as well as social factors. The economic grounding is necessary, but the term socioeconomic is used to indicate that social forces are intrinsically bound up with, and generated by, economic positions.

Many of the different approaches to conceptualising SEP are grounded in the theoretical work of Marx and Weber. Marxist conceptualisations of SEP are often referred to using the term 'class' (Krieger et al., 1997, Lynch and Kaplan, 2000, Bartley, 2004) and specify positions in terms of employment relationships and ownership or control over assets, often distinguishing between those who exploit and are exploited by such economic relationships (Krieger et al., 1997, Lynch and Kaplan, 2000, Galobardes et al., 2006a). Stratification occurs as processes of exploitation accrue benefits to those in more favourable positions and disadvantages to those in less favourable positions.

Weber, in contrast, viewed socioeconomic stratification as occurring along three particular dimensions: class, based on economic factors; status or prestige, relating to how people were regarded by others; and power, describing political influence (Liberatos and Link, 1988, Lynch and Kaplan, 2000). From this perspective stratification occurs as people in similar positions along these dimensions experience similar opportunities and constraints or "life chances" (Dohrenwend and Dohrenwend, 1969, Lynch and Kaplan, 2000, Galobardes et al., 2006a). A multi-dimensional view of SEP means it can be heterogeneous (Lenski, 1954, Braveman et al., 2005), i.e. it is possible to be simultaneously advantaged in some respects and disadvantaged in others (Townsend, 1987). For example, a scientist might experience high status with low pay (Bartley, 2004), but such discrepancies are more the exception than the rule. Despite conceptual distinctions between Weber's three dimensions (class, status and power) they are often closely related: economic factors contribute to the generation of prestige which is in turn closely bound up in power relations (Powers, 1982).

More recent formulations of SEP have tended to drop the power dimension and focus primarily on class and status (Krieger et al., 1997, Bartley, 2004). Krieger *et al* describe SEP, for example, as, "an aggregate concept that includes both resource-based and prestige-based measures... Resource-based measures refer to material and social resources and assets, including income, wealth, educational credentials…Prestige-based measures refer to individual's rank or status in a social hierarchy, typically evaluated with reference to people's access to and consumption of goods, services, and knowledge, as linked to their occupational prestige, income, and education level." (p345; Krieger et al., 1997)

Thus, SEP is viewed as a social position defined within the Weberian dimensions of class, meaning material and economic resources, and status, meaning prestige. Whilst other social positions such as gender or ethnicity are often related to SEP, in such cases the direction of flow is viewed as going from the social to the economic, rather than from the economic to the social. The term SEP as used in this thesis refers to economic positions that generate status or prestige, with the two dimensions of class and status viewed as closely, but not perfectly, correlated.

1.1.4.2 SEP over the lifecourse

The three most commonly used indicators of SEP are education, occupation and income, and they are most relevant to working adults, who already have an educational level, an occupation and receive an income. However things get more complicated when considering SEP over the lifecourse. Figure 1-2 shows a simple model of how SEP is related to health over the lifecourse, which is adapted from various other formulations (Lynch and Kaplan, 2000, Graham, 2007). A key point of this diagram is that a person's SEP develops over the lifecourse. Education represents skills or credentials that directly increase a person's status whilst increasing economic resources indirectly through access to better jobs and higher pay (Liberatos and Link, 1988). Occupations confer economic benefits via income and may confer status advantages in their own right (e.g. where a person is employed in some morally approved activity such as doctors or firemen), but much of the status associated with different occupations will be an indirect result of either the required educational level or the associated remuneration (Bartley, 2004). Income reflects a direct economic resource and therefore contributes to the generation of but does not entirely determine status. Besides these three key measures, some other indicators are also often employed to represent SEP. These might include: employment status, indicating whether or not a person is in employment; aspects of housing; measures of accumulated wealth or assets; or features of a person's immediate socioeconomic context, such as area level deprivation. Wider societal structures (the macro context) are also seen as influencing aspects of educational, occupational and income distributions, and perhaps also the strength of the links between these positions (Leisering, 2003), e.g. in a very distributive welfare state context, the link between occupation and income may be less strong than in a context with limited re-distribution of wealth.

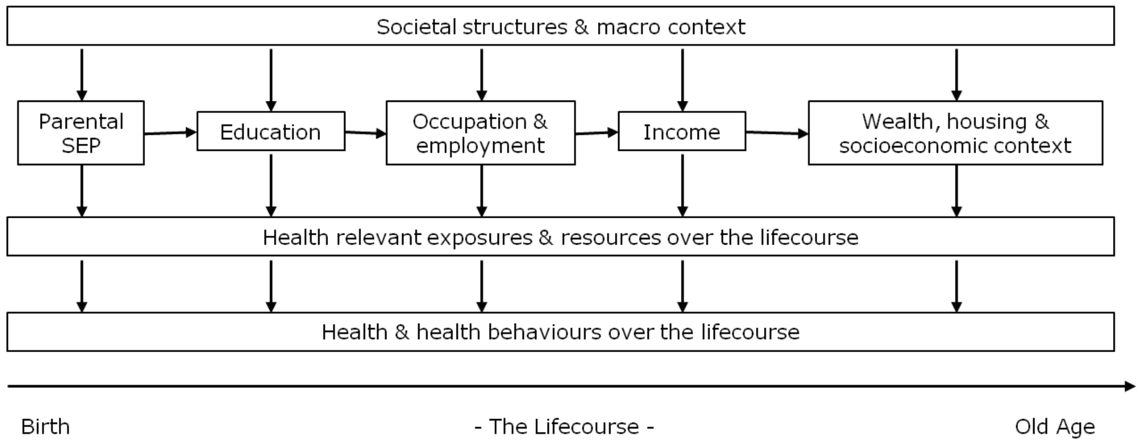


Figure 1-2: SEP and health over the lifecourse

These various positions occupied throughout the lifecourse will all have influence in stratifying health relevant exposures and resources (as explained in section 2.2.2), which then in turn stratify health and health behaviours (Lynch and Kaplan, 2000, Adler et al., 2012). Health behaviours are grouped together with health as both are outcomes under study here, and exposures and resources may be as relevant for stratifying behaviours as they are for health.

Thinking about SEP over the lifecourse it is particularly relevant to this thesis that a young person who has not yet finished with their education, entered the labour market and begun drawing an income cannot be located within any of these socioeconomic hierarchies, at least not by reference to their own, personal characteristics. However, a key influence determining a young person's future place in these three socioeconomic hierarchies will be their parent's place within these distributions. A young person's societal status and access to economic resources as they grow up is also likely to be strongly linked to the SEP of their parents. The use of parental characteristics to represent the SEP of children or young people who have not yet achieved their own, personal SEP can be referred to as 'downwards extension', in the sense that the SEP of the parents is extended down to their children (Platt, 2011, Furlong, 2013). Both class and status are viewed as heritable. A child will largely rely upon the economic resources of its parents during childhood and parental resources (or lack thereof) may supplement (or drain) the child's own resources later in life. Children may also be perceived to be of similar status to their parents by simple association. Parental SEP could be directly instrumental in providing (or limiting) educational and occupational opportunities for children. Parents could also contribute indirectly by passing on certain qualities, characteristics, modes of behaviour or knowledge that contributed to their own achieved status and class (Elder, 1974, Furlong, 2013). Hence, the conceptual framework set forth in Figure 1-1, specifies background (or parental) SEP as the initial stratifying factor influencing development of smoking, drinking, and psychiatric distress as well as participation in tertiary education and transitions into adult roles. Tertiary education will then represent a key connection between background SEP and young people's own future occupations and income.

1.1.5 Gender

Gender is another important issue in a study of smoking, drinking and psychiatric distress over the transition to adulthood (even if gender is defined as a social rather than a socioeconomic position). Gender is associated with differences in rates of smoking (Tyas and Pederson, 1998), drinking (Fillmore et al., 1991, Wilsnack et al., 2009) and psychiatric distress (West and Sweeting, 2003) as well as patterning of transitions to adulthood (Schoon et al., 2012). This does not necessarily mean that SEP-related mechanisms will be different for males and females, but such differences are a strong possibility. The focus of this investigation is on the role of SEP, not on gender (hence gender is not included in the main aims of the thesis; see section 1.2), but it is nevertheless important to remain sensitive to potential gender differences in the mechanisms under study. This is indicated in Figure 1-1 by the box labelled 'gender' which encompasses the associations of interest.

1.1.6 Interdependence

This thesis focuses on smoking, drinking and psychiatric distress, not just because they are all important public health issues, but because they tend to occur together. In Scotland, for example, associations have been shown between smoking and excess drinking (SHeS, 2009). Depression predicts progression to daily smoking among smokers, and daily smoking predicts depression onset (Breslau et al., 1998). Hazardous drinking is associated with higher levels of anxiety and depression, as well as tobacco use (Caldwell et al., 2002). Anxiety and depression are also often co-morbid over the lifecourse with substance use disorders such as nicotine or alcohol dependence (Cerda et al., 2008). There is added value in studying these issues together, as inter-dependent rather than as independent problems. Such an approach can provide insights as to when secondary prevention efforts might be most effective (i.e. if one problem tends to follow some time after another, then the intervening period may be an important prevention window). Since the processes which lead to one of these outcomes occurring in isolation can be different from those which lead to them occurring together (Beard et al., 2008) it can also improve understanding of aetiology (Cerda et al., 2008). This is represented in Figure 1-1 by the packaging together of smoking, drinking and psychiatric distress into the boxes for adolescence and early adulthood. The arrows connecting the adolescent and early adult boxes to each other and to the other concepts in the diagram are intended to represent a more complex mix of patterns and mechanisms; the thesis aims to start unpacking these boxes and the intervening mechanisms.

1.1.7 Epistemology

A range of different approaches to scientific knowledge exist and there are a range of different methods that could be used to investigate the mechanisms depicted in Figure 1-1 (Blaikie, 2000). This thesis will mainly rely on quantitative analysis of observational survey data. Considering that real-world phenomena are often more complicated than a simple, deterministic, X-causes-Y-relationship some have referred to a 'web of causation', denoting many inter-linking associations between a variety of factors, and speak of contributory rather than necessary or sufficient causes (Susser, 1977, Bhopal, 2002). Observational survey research can be ideal for investigating and understanding such a 'web', where SEP may be only one part of a more complex system. There may be a wide range of mechanisms linking SEP to health (Link and Phelan, 1995). Understanding the web of associations around a health problem using observational data can help direct and prioritise intervention research so that investigators know what factors to manipulate and for which groups or populations those interventions are most likely to be effective and therefore which groups and populations they should be tested on. It may help identify intervention points which are likely to be easier, require fewer resources, or be more effective than others (Langner and Michael, 1963).

An alternative to this quantitative approach would be to use qualitative methods to explore the understandings and experiences of smoking, drinking, and psychiatric distress over the transition to adulthood for young people from different socioeconomic backgrounds. Quantitative methods are sometimes criticised because the research questions and findings are framed in the researcher's understandings and interpretations of the phenomena in question, rather than in terms of the actual participants' understandings and interpretations of those phenomena (Blaikie, 2000). However, increasing individualisation of young people's lives in modern societies draws attention away from societal structure towards individual agency, sometimes referred to as an "epistemological fallacy" (Furlong and

Cartmel, 1997). Whilst proximal individual level factors may be important causes of poor health (or health behaviours), it is important to ‘contextualize’ such risk factors by assessing what distal factors determine individual level risk, and what social conditions modify or moderate individual level risks (Link and Phelan, 1995). Unemployment, for example, could be seen as an individual failure or as a result of an economic downturn or poor education (Furlong and Cartmel, 1997). Individuals will also differ to the extent that they privilege internal or external causes to their experiences (Myers, 2002). This is a particularly important issue for smoking and drinking as they are behaviours which are engaged in by choice, so it easy to dismiss persistence in these behaviours as fecklessness and ignore questions as to what it is about the circumstances of smokers and heavy drinkers that means they are drawn to these behaviours (Jarvis and Wardle, 2006). Thus, while this quantitative investigation of survey data may miss causes that individual survey respondents would ascribe to their health or behaviours, it may also identify structures and social mechanisms that individual survey respondents would be less aware of, or less likely to mention.

Additionally, whilst qualitative research is well-suited to exploring potential mechanisms and the meanings that particular experiences have for people, it is less well-suited to investigating the frequency with which particular mechanisms operate, and the prevalence of particular experiences within a given population. The latter points about frequency and prevalence are critical pieces of information for allocating resources between different intervention approaches in order to maximise health benefits.

1.2 Aims and research questions

The foregoing has described a conceptual framework for this thesis, which, for ease of reference, is presented again in Figure 1-3. The focus is on development of smoking, drinking and psychiatric distress from adolescence to early adulthood, on how this is influenced by young people’s socioeconomic backgrounds, and on how tertiary education and transitions to adult social roles may operate as mediating mechanisms. Contextual variation in these developmental mechanisms is also of interest, and there may be further heterogeneity between males and females.

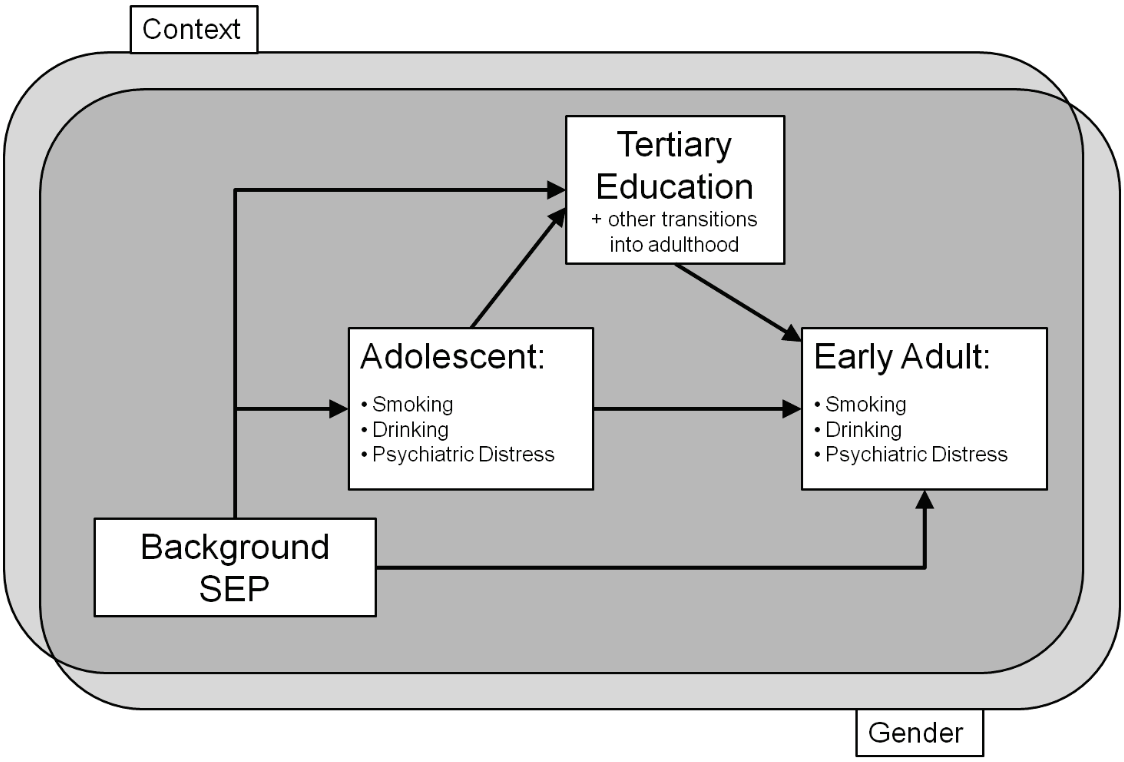


Figure 1-3: Conceptual framework

The aims of the thesis can be expressed in the following research questions:

1) What is the role of SEP in adolescent development of smoking, drinking and psychiatric distress?
2) What is the role of SEP in the development of smoking, drinking and psychiatric distress from adolescence to early adulthood?
    i) How is this mediated via adolescent development of smoking, drinking and psychiatric distress?
    ii) How is this mediated via transitions to adulthood?
3) How do these developmental mechanisms vary between different geographic and temporal contexts?

The first question addresses the arrow leading from background SEP to adolescent smoking, drinking and psychiatric distress. The second question addresses the mediating mechanisms between background SEP and smoking, drinking and psychiatric distress in early adulthood via i) adolescent smoking, drinking and psychiatric distress, and ii) adulthood transitions, particularly tertiary education. The third question addresses the box labelled context and how this influences the mechanisms contained therein. Answers to these questions are explored using data from observational surveys of young people in different contexts, and with sensitivity to gender differences in the developmental mechanisms, as well as to the potential interdependence of smoking, drinking and psychiatric distress.

1.3 Summary of subsequent chapters

Chapter 2 reviews relevant literature covering: perspectives on development and the lifecourse; theoretical ideas about links between SEP, smoking, drinking and psychiatric distress; and existing evidence of associations between SEP, smoking, drinking and psychiatric distress. Chapter 3 includes general discussion of data and methods used in subsequent chapters, with more specific methodological details provided in the relevant chapters.

Chapters 4 through 8 detail the findings of the thesis. Each of these chapters is structured with an introduction, methodological section, a report of results, and a discussion of those results. Chapter 4 addresses the role of SEP in adolescent development of smoking, drinking and psychiatric distress (1st research question), reporting findings that have already been published (Green, MJ et al., 2013). Chapters 5 and 6 examine how socioeconomic influences on early adult outcomes are mediated via adolescent development (2nd research question, part i) and participation in tertiary education (2nd research question, part ii). Chapter 7 investigates a range of transitions to adulthood and how these mediate between SEP and outcomes in early adulthood (2nd research question, part ii). Contextual differences in the answers to the second research question are considered throughout Chapters 5 to 7 (3rd research question). Chapter 8 returns to SEP and adolescent development and considers contextual influences (1st and 3rd research questions), again reporting findings already published elsewhere (Green, MJ et al., 2014).

Finally, Chapter 9 provides some further discussion, picking up some of the over-arching themes from the more specific discussion in Chapters 4 to 8. It addresses some broad limitations, discusses implications for theory, policy and practice derived from the findings, and sets forth some specific plans for further research in this area.

2 Theory and evidence

Chapter 2 reviews theory and evidence related to the aim of understanding socioeconomic inequalities in the development of smoking, drinking and psychiatric distress. It starts by describing a lifecourse perspective in greater detail, drawing on models from various disciplines. Next, it considers theoretical mechanisms linking SEP, smoking, drinking and psychiatric distress. The chapter then concludes by reviewing evidence for these associations, focusing particularly on evidence from systematic reviews.

2.1 Lifecourse concepts

One of the earliest studies of SEP and mental health acknowledged the importance of longitudinal data, as SEP could both influence and be influenced by mental health (Langner and Michael, 1963). Longitudinal data can help in understanding causation by establish the temporal ordering of events (i.e. if A precedes B, then B cannot be a cause of A), but lifecourse research is about more than just longitudinal data. It is about recognising that the influence of SEP may vary depending on one's position in the lifecourse, or within a developmental process (DHSS, 1980). This section explains useful concepts from epidemiological, sociological and psychological approaches to the lifecourse. These sections are not comprehensive reviews of different disciplinary approaches to the lifecourse, but rather draw out especially relevant insights. The epidemiological perspective focuses on how associations between risk factors and health outcomes, can depend on the timing and sequence of exposures. The sociological perspective embeds lifecourse development within a context and emphasises the transitional nature of the period between adolescence and adulthood. The psychological perspective emphasises potential heterogeneity in lifecourse exposures and outcomes, and that stage-based heuristics can be useful for thinking about lifecourse development.

2.1.1 Epidemiological approaches to the lifecourse

2.1.1.1 Epidemiological perspective

As epidemiologists sought to understand the aetiology of chronic diseases they recognised potential time-lags between risk-exposure, disease initiation, and clinical recognition (Kuh and Ben-Shlomo, 1997, Lynch and Davey Smith, 2005). Epidemiological models of how an exposure such as SEP relates to health over the lifecourse are in three main categories:

critical or sensitive period models; cumulative risk models; and pathway models (Lynch and Davey Smith, 2005, Chittleborough et al., 2006, Viner et al., 2012). These are illustrated in Figure 2-1. Reality may be more complex than this simple diagram, but even these models can be difficult to distinguish empirically (Lynch and Davey Smith, 2005). The arrows A, B, C, D and E represent relationships between SEP and health in both early life and adulthood. Critical or sensitive period and cumulative risk models relate to the relative strength of A and B, while pathway models focus on mediated pathways such as B and C, or D and E. The following sections briefly describe the three models.

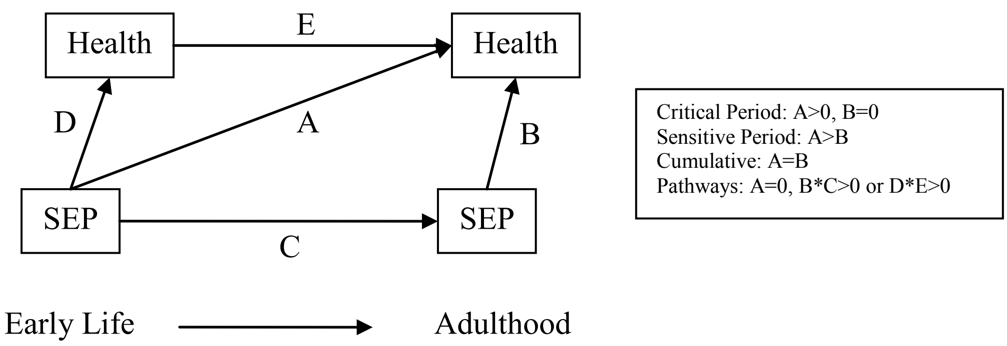


Figure 2-1: Epidemiological lifecourse models

2.1.1.2 Critical or sensitive period models

The critical period model suggests there is a particular time window within the lifecourse in which an exposure may have an effect, and that the risk exposure has no effect outside of this window (i.e. A>0, B=0). The sensitive period model is a ‘softer’ version which states there are particular life-stages where the effect of an exposure is magnified compared to exposure at other times (i.e. A>B). The implication of this model is that risk factors may have different effects depending on the age that they are experienced (Caprara and Rutter, 1995), for example, the acute economic deprivations of the great depression had more adverse effects on younger children than on older adolescents, as many adolescents had developed the necessary coping skills and maturity to benefit from the additional family responsibilities they experienced (Elder, 1974). Another example relevant to this investigation is that depressive symptoms in adolescence can have long-term effects on health behaviours through young adulthood, despite subsequent changes in symptom levels (Wickrama and Wickrama, 2010), which is an example of adolescence as a critical or sensitive period for links between depression and substance use. Some extensions of these models allow for critical or sensitive period effects to be modified by later life exposures (Lynch and Davey Smith, 2005, De Stavola and Daniel, 2012), e.g. if childhood SEP interacts with adult SEP. As noted in section 1.1.3.1, adolescence and young adulthood may be sensitive periods for the outcomes of interest here, as this is often when these symptoms and behaviours first develop (Kandel and Logan, 1984, Giovino et al., 1995, Kim-Cohen et al., 2003). Thus, the influence of SEP across this key developmental period is of particular interest.

2.1.1.3 Cumulative risk models

Cumulative risk models propose, in their simplest form, a dose-response relationship whereby health damages increase proportionally to the duration and/or number of risk exposures (i.e. A=B). They focus therefore more on the accumulated volume of risk exposure over time than on specific developmental periods. Both the duration and the number of accumulated risks may be important: a health problem might be caused by consistent exposure to a particular risk factor over time, or by experience of multiple risk exposures which cluster together. Extensions of this model allow for developmental periods of increased susceptibility such that the sequence of exposure becomes important (Lynch and Davey Smith, 2005), though it then becomes quite similar to the sensitive period model.

2.1.1.4 Pathway models

In response to the models above, some have suggested it may be more important to ask whether early life exposures increase the likelihood of experiencing risk exposures in later life, or affect an individual's vulnerability to those later life risk factors, suggesting 'indirect cumulative chain effects' of early exposures (p42; Caprara and Rutter, 1995). For example, early life SEP may only have an effect on adult health by influencing adult SEP (i.e. B*C>0). These lifecourse models were developed for thinking about diseases that occur late in life, but for mental health or substance use, another likely pathway is via health (or health behaviours) in early life (i.e. D*E>0). Thus, SEP may impact on health behaviours or mental health during adolescence, and problems may then track into adulthood; SEP may even affect how stably these problems track into adulthood (Due et al., 2011).

2.1.2 Sociological approaches to the lifecourse

2.1.2.1 Contextualising the lifecourse

Sociological approaches to the lifecourse have emphasised the following key principles: each life stage may affect the entire lifecourse; individual lifecourses are embedded within and can be influenced by their historical and geographic context; individuals exercise agency within the opportunities and constraints of historical and social circumstance; the same events or experiences may have different impacts depending on when within a person's life they are experienced; and lives are lived inter-dependently so the lifecourse can be influenced by social relationships and networks (Elder et al., 2003, Heinz, 2009). This acknowledges a complex network of factors from individual, micro- and macro-social levels interacting together and with life-stage to produce health outcomes. For example, it is important to recognise that there may be interactions between SEP and context, such that mechanisms associated with SEP function differently in different contexts, or contextual influences are felt more keenly at a particular end of the socioeconomic distribution.

Embedding development within a historical and geographic context is a particularly valuable contribution. People who grew up within the same historical period in a similar geographical area will have experienced the same world events at the same time in their lives and will have had similar contextual experiences that may have enduring influences on them (Alwin and McCammon, 2003). Thinking about historical contexts, lifecourse influences can be broadly categorised into: age effects, which are processes associated with natural maturation as an individual gets older; period effects, which are processes associated with the historical context in which a person is living (but independent of age within that historical context); and cohort effects, which represent an intersection of period and age, i.e. the effect of experiencing a particular context at a particular age (Alwin and McCammon, 2003). It can be difficult to empirically separate these three effects as they are inter-dependent.

2.1.2.2 Socio-ecological model

The socio-ecological model (Figure 2-2; Bronfenbrenner, 1979) provides a useful framework for thinking about contextual influences on development. Context is conceptualised, not as a single entity, but as a nested set of structures. Different levels of context can each influence development, as can aspects of the connections or ties between levels.

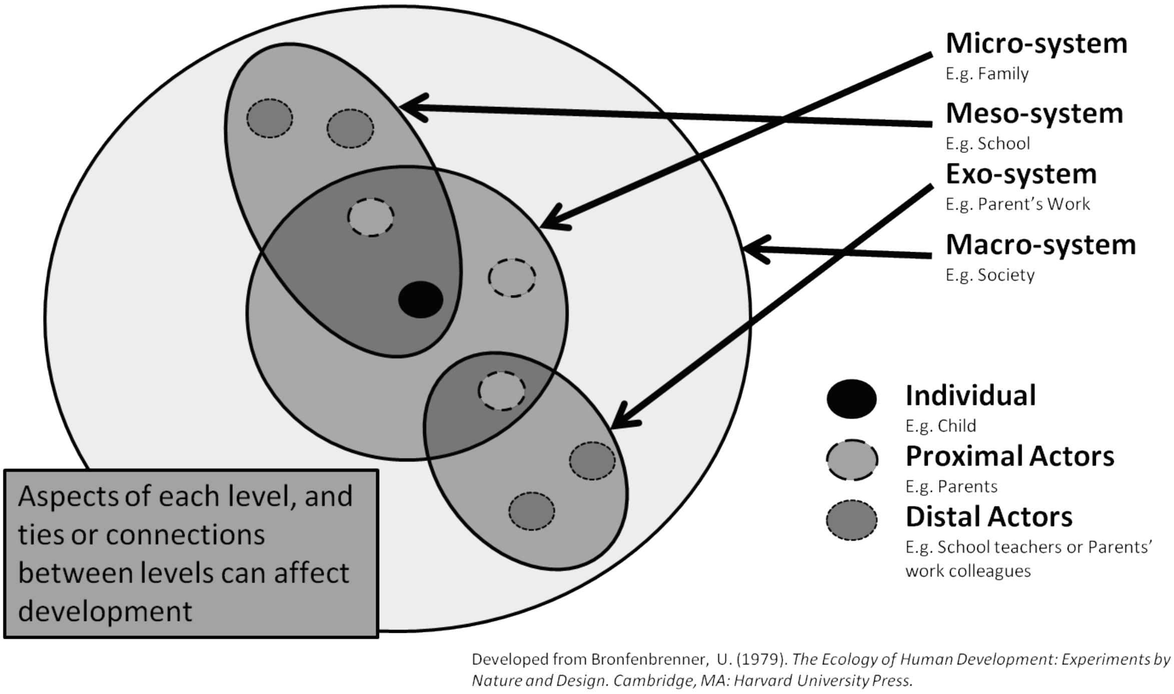


Figure 2-2: Bronfenbrenner's socioecological model

Individual development is seen as taking place within a 'micro-system' such as a family, where development is influenced by proximal actors such as a child's parents. 'Meso-systems' are extensions of the micro-system to include other, more distal actors, such as school teachers or other children. Development can also be influenced by 'exo-systems' which do not involve the developing individual, but affect actors within their micro- or meso-systems. An example of this would be a parent interacting with work colleagues in their occupation. If these interactions are stressful or demanding, then they may consume parental resources leaving less for the developing child to draw on. Finally, all this takes place within a broader 'macro-system' which can be conceived of as the society, or sub-cultures within societies. The macro-system structures the norms and procedures for the functioning and inter-connection of all the subsidiary systems (e.g. compulsory schooling at certain ages within the UK). Each level of the overall system can influence development, but so can the connections or ties between levels. For example, when schools work closely with parents one might expect benefits for child development, compared to both working relatively independently.

Obviously, a developing individual does not remain within a single system for their whole lives. The term 'ecological transition' is used to describe changes in the structure of developmental systems (Bronfenbrenner, 1979). Ecological transitions have been defined as changes in settings or roles (or both). Thus, the structure of developmental systems may change because of a physical change in setting, such as a transition from school to work, but can also happen if there are changes in a person's role, such as when a young person has a child of their own. A change in role is seen as an ecological transition because it alters the perceptions and social expectations that other actors have of an individual. Transitions are thought to be facilitated when there are strong links between the two systems (e.g. a school might have an employment placement scheme for school-leavers), and when there is similarity or continuity between the two systems (e.g. going from nursery school to primary school).

2.1.2.3 Transitions to adulthood

Another useful contribution from sociology, which follows on from the socio-ecological model, is an understanding of adolescence and early adulthood as a transitional stage of life, structured by SEP and the broader societal context. Sometime between their teenage years and late twenties young people tend to start making transitions into more adult roles. There is little uniformity in this transition to adulthood, with considerable variation in the ages and rates at which various adult roles are adopted (Bachman et al., 1997). This period of life also often involves changes or restructuring of young people's social environments, alongside changes to the physical settings in which they live their lives (Bachman et al., 1997, West et al., 1999, Schulenberg and Maggs, 2002). Some of the most important transitions into adulthood are: leaving school (or full-time education), leaving home and living independently, entering employment, entering a cohabiting partnership, and becoming a parent (Schulenberg and Maggs, 2002, Côté and Bynner, 2008, Schoon et al., 2012). Each of these transitions could be considered an ecological transition in terms of the socio-ecological model (see section 2.1.2.2), involving changes in settings and/or social roles. However, remaining in education can also represent an ecological transition: both the physical setting of the educational institution and the perceptions and social expectations attached to the student role may change in the move from secondary to tertiary education.

These transitions do not occur at fixed ages or in a specific order (Elder, 1992), but the timing of entry into adult roles is structured by a young person's own socioeconomic background (Wickrama et al., 2010); those from disadvantaged backgrounds may find themselves taking on adult responsibilities earlier because they do not have the resources to delay (Sacker and Cable, 2010). The premature imposition of adult roles, especially on those in disadvantaged circumstances, has been described as ‘adultification’ (Burton, 2007). A key structural mechanism that differentiates between delayed or early transitions is the educational system. Young people who engage in tertiary education tend to postpone entry into other adult roles such as work, partnership or parenthood (Chassin et al., 1992, Bachman et al., 1997, Schulenberg and Maggs, 2002). Engagement with tertiary education however may depend on both earlier educational success and on having the time and resources to devote to studying whilst delaying earning an income, both of which tend to be more likely for young people from better resourced and more affluent families.

Some suggest that societal structuring of the timing of entry into these adult roles has weakened over the last few decades, with individual, agentic processes becoming relatively more important (Furlong and Cartmel, 1997, Sacker and Cable, 2010). With a trend towards delaying these transitions, the term ‘emerging adulthood’ has been coined to describe a stage of life which is distinct in terms of demographic heterogeneity, subjective experience, and identity exploration (Arnett, 2000). This period is viewed as a time of relative freedom, with parental control lessening and adult responsibilities only being taken up gradually. The emphasis is on individual choices exercised within a range of opportunities.

However, descriptions of emerging adulthood as a stage of exploration in the absence of responsibility may be overly rooted within the experiences of young people who progress into tertiary education. It is important to recognise this experience depends on cultural norms or contextual features that postpone the adoption of adult roles, and in cultures (or sub-cultures) where adult responsibilities are taken up earlier, this period of relative freedom and identity exploration may be constricted or even non-existent (Arnett, 2000). Others view trends towards delayed transitions, not so much as a new and distinct life-stage but as a reaction to contextual conditions that favour delay (Côté and Bynner, 2008). These could include labour market shifts away from relatively unskilled manual work towards service industries, increasing outsourcing of unskilled entry-level positions to developing countries, increasing competition to young people from an expanding population of older workers, and increases in the formal qualifications employers expect from prospective employees. These changes have reduced the opportunities available to young people who leave school at the minimum age without any educational qualifications, whilst at the same time access to tertiary education has expanded considerably (Côté and Bynner, 2008). In such circumstances, increasing numbers of young people are choosing to delay transitions and remain in education.

A related suggestion is that adoption of adult roles tends to be postponed during times of economic affluence as there are more resources and opportunities available to support extended transitions, whereas adult roles tend be adopted earlier in periods of economic down-turn, e.g. as young people move into employment so that they can contribute to family finances (Elder, 1974). Thus, whilst the notion of 'emerging adulthood' emphasises choice and agency during the period of transition, structural constraints may still apply. Further, those with more resources may be more able to delay transitions when conditions are not conducive, as described above (Côté and Bynner, 2008), whilst those with fewer options may find they still have to make transitions into some adult roles, despite the unfavourable context.

2.1.3 Psychological approaches to development

2.1.3.1 Equifinality and multifinality

"Equifinality" and "Multifinality" denote two relatively simple, but important principles from developmental psychology which emphasise potential heterogeneity around associations between risk exposures and outcomes (Glantz and Leshner, 2000, Schulenberg and Maggs, 2002). Equifinality means that a given endpoint can be reached via multiple starting points or pathways, i.e. different combinations of exposures and risks can lead to the same outcome. Multifinality means that a particular combination of risk and protective factors can lead to a variety of alternative outcomes.

An implication of equifinality, in the context of this thesis, is that different paths to an outcome could be stratified by SEP, even if the outcome is not. In such circumstances, interventions focused on pathways that are more relevant to those of more advantaged SEP would be unlikely to reduce, and may even increase, inequalities. It is important to understand such stratification of processes or pathways so that more effective interventions can be implemented.

An implication of multifinality is that a disadvantaged socioeconomic background might be associated with multiple (but not necessarily all) alternative combinations of negative outcomes (e.g. smoking and heavy drinking, heavy drinking and psychiatric distress, or smoking and psychiatric distress).

2.1.3.2 Stages of change

The stages of change theory (Sutton, 2005), most commonly applied to smoking, describes the uptake of a behaviour as a process with a number of stages (Flay, 1993). Development is conceptualised as a developmental sequence with various stages of differing intensity. With respect to smoking, a person could proceed through stages of preparatory knowledge, initial trying, experimentation (involving repeated but irregular or situational-specific use), regular use and nicotine dependence or addiction. Smoking cessation could also be viewed as a staged process including precontemplation (i.e. not seriously contemplating quitting), contemplation and preparation followed by action and maintenance, with relapses frequent at all stages (Fisher et al., 1993, Sutton, 2005). These stages of change are viewed as stochastic, 'with the probability of advancing from one stage to another always less than one' (p367; Flay, 1993), and individuals may skip stages or relapse to earlier ones (Fisher et al., 1993). They are perhaps best viewed as a heuristic device rather than a concrete, universal description of how behaviour develops.

Transitions between developmental stages can be influenced by a variety of factors and different factors may be important at different stages (Fisher et al., 1993, Flay, 1993, Glantz and Leshner, 2000), for example, the factors that influence the likelihood of a person experimenting with smoking may be different from those which influence progression from experimental to regular smoking (West et al., 1999).

2.2 Theoretical mechanisms

Mechanisms linking substance use and psychiatric distress might broadly be placed in three categories: first, mechanisms whereby those with psychiatric distress 'self-medicate' with psychoactive substances such as cigarettes or alcohol; second, mechanisms whereby the use of these substances predisposes a person to psychiatric distress; and third, mechanisms where some other factor independently causes problems with both substance use and psychiatric distress (Cerda et al., 2008, Mason et al., 2008). This section therefore begins with discussion of interdependent physiological, psychological and social mechanisms linking smoking, drinking and psychiatric distress (i.e. covering the first two categories of mechanisms). Next, the section moves on to consider theoretical mechanisms which may link SEP, smoking, drinking and psychiatric distress. SEP is a candidate for a common cause, as associations have been found between smoking, harmful drinking, and psychiatric distress (Leyland et al., 2007, Batty et al., 2008, SHeS, 2009, Green, MJ and Benzeval, 2011). It is important to understand the mechanisms by which SEP leads to health, as different mechanisms tend to imply different interventions aimed at alleviating inequalities (Link and Phelan, 1995). The landmark 'Black Report' divided theoretical explanations of socioeconomic health inequalities into four categories: materialist or structural explanations; artefactual explanations; theories of natural or social selection; and cultural or behavioural explanations (DHSS, 1980). Later commentary by Macintyre on the contributions of this framework after a decade or so of research has further identified 'hard' and 'soft' versions of each argument (Macintyre, 1997). Each is considered here, starting with a brief overview of arterfactual, selection, and cultural explanations before focusing on materialist and structural explanations. Since socioeconomic disadvantage is associated with earlier transitions into adult roles, whilst more advantaged young people tend to delay transitions and participate in tertiary education (see section 2.1.2.3), mechanisms related to these transitions may mediate between socioeconomic background and health outcomes. Thus, the section concludes by considering mechanisms related to the timing of transitions to adulthood. This final section on transition mechanisms draws on a number of models from developmental psychology which have been used to explain early adult substance use (Schulenberg and Maggs, 2002).

2.2.1 Interdependent mechanisms

2.2.1.1 Self medication

The self medication hypothesis suggests that people experiencing psychiatric distress use smoking and drinking behaviours as coping mechanisms for managing their distress (Kassel et al., 2003, Kuntsche et al., 2006, Cerda et al., 2008, Mason et al., 2008). Smoking, for example, may function to alleviate distress by diverting attention away from distressing stimuli, enhancing cognitive performance (which might be seen as a coping resource) or by alleviating withdrawal symptoms (though the latter would not explain initiation; Kassel et al., 2003). These behaviours may be viewed as maladaptive coping mechanisms, both in terms of the associated health risks, and because they may lead to progressive avoidance of more active coping strategies (Elder, 1974).

Poor mental health in adolescence can also impede development of social, cognitive, and psychological competencies, creating a propensity for risky behaviours (Wickrama and Wickrama, 2010). For example, when development of social relationships is impeded, a young person experiences fewer social constraints not to engage in risky behaviours such as smoking and drinking. In addition, the low sense of control associated with depression may lead to behavioural choices emphasising short-term consequences and easy gratification, which could lead to behaviours such as smoking and drinking being adopted as coping mechanisms.

2.2.1.2 Physiological mechanisms

Some suggest that the physiologic effects of substance use can actually increase a person's vulnerability to psychiatric distress (Kassel et al., 2003, Cerda et al., 2008, Mason et al., 2008), for example, alcohol use may increase risk for depression by altering the brain's natural reward system (Mason et al., 2008). Smoking may be causally related to depression because nicotine exposure can damage neurochemical pathways such as monoamine transmission (Chaiton et al., 2009).

In addition, there is a potential physiologic link between smoking and alcohol use. Experimental studies in both animals and humans have demonstrated that doses of nicotine increase self-administration of alcohol (Lê et al., 2003, Barrett et al., 2006) so it plausible that smoking would lead to heavier consumption of alcohol in more natural settings too.

2.2.1.3 Social mechanisms

There are also social processes by which substance use may lead to psychiatric distress. Both smoking and drinking behaviours are often social in nature, frequently forming a component of social exchange or interaction with others (Pavis et al., 1998, Engels et al., 2006). Engagement with these behaviours may have as much to do with being part of a group, and acting in a similar way to others in the social environment, than about the behaviour itself. Smoking is increasingly stigmatised as a behaviour (Bell et al., 2010, Graham, 2012), and has often been perceived as associated with general delinquency. Thus, smoking may both strengthen and hamper social relationships. If smoking hampers more conventional social relationships, e.g. with parents or school teachers, it might lead to poor social integration, fewer coping resources and subsequent depression. Further, tobacco has been described as a 'gateway drug' that provides an introduction to the culture of substance use and leads on to the use of other substances, such as alcohol (Bachman et al., 1997, Mathers et al., 2006). Similarly, drinking may aid social integration in some circumstances, but it can also prompt socially inappropriate behaviour, which may disrupt social relationships, again leading to isolation and depression (Mason et al., 2008).

2.2.2 Mechanisms related to SEP

2.2.2.1 Artefact

The hard version of an artefactual explanation suggests that socioeconomic inequalities in health are not real phenomena but represent some artefact of the way that either health or SEP is measured (DHSS, 1980). However considering the ubiquity of observed socioeconomic gradients using a wide variety of health and SEP measures (Link and Phelan, 1995, Shaw et al., 2006) this is unlikely to be true. A softer version suggests that features of measurement may influence the observed magnitude of socioeconomic inequalities in health (Macintyre, 1997). This relies on the premise that measurement error biases away from a null relationship. If measurement error biases findings towards the null, then observed socioeconomic inequalities are unlikely to be the result of a measurement artefact.

Considering the outcomes in question here, there is evidence in each case to suggest that measurement error might bias towards the null, rather than towards finding a gradient, making artefactual explanations implausible. With smoking for example, there is evidence that smokers in disadvantaged circumstances smoke more ‘intensely’ achieving a higher nicotine intake from a smaller number of cigarettes (Jarvis and Wardle, 2006) and thus measuring smoking by reports of the number of cigarettes smoked may tend towards masking real socioeconomic inequalities in smoking behaviours. Similarly, a commonly-used drinking measure identifies whether people are drinking in excess of 14 units a week for women, or 21 units for men (Royal College of Physicians et al., 1995), but socioeconomic patterning in this indicator (2009) does not match socioeconomic patterning in deaths due to alcohol (Leyland et al., 2007), and thus it may not be adequately reflecting the characteristics of drinking patterns that are most important for health or the real differences in health risk between social strata. Finally, those in more disadvantaged circumstances may tend particularly towards stoicism in the face of health problems (Blaxter, 1997), and such a stoic attitude might be associated with under-reporting of anxiety and depression symptoms (Stansfeld and Marmot, 1992). Thus, measurement error in smoking, drinking, and psychiatric distress might all be thought to lead to under- rather than over-estimation of inequalities by SEP.

2.2.2.2 Selection

'Hard' versions of selection theories suggest that health is one of the key dimensions upon which socioeconomic opportunities and resources are stratified and therefore that it is poorer health which causes lower SEP rather than vice versa (DHSS, 1980), e.g. excessive drinking could disrupt social relationships and work performance, constraining socioeconomic opportunities. The 'soft' version is that health selection contributes to observed inequalities, but does not fully explain them (Macintyre, 1997). Socioeconomic conditions may cause mental disorder, for example, but mental disorders might also have a causal role in determining socioeconomic conditions, creating vicious or benign circles between the two concepts (Langner and Michael, 1963). However, selective explanations of socioeconomic inequalities tend to revolve around selection into adult SEP, i.e. that problems with heavy drinking or psychiatric distress, would affect young people's educational and occupational success as they move into adulthood. It is less often considered, and less plausible (though still possible), that adolescent health behaviours or mental health problems would lead to downward socioeconomic mobility for their parents. Thus, parental SEP is usually assumed to be antecedent to adolescent health or health behaviours.

2.2.2.3 Culture and behaviour

Cultural or behavioural explanations posit that socioeconomic stratification corresponds with stratification of unhealthy choices and behaviours which then leads to stratification of poor health (DHSS, 1980). The 'hard' version is that individual behavioural choices explain away inequalities in health, whilst the 'soft' version pushes the explanatory task further back, maintaining that behavioural choices contribute to inequalities because they are also stratified by social, structural processes (Macintyre, 1997). Obviously, considering that two of the main outcomes in question here are health behaviours, it would be circular and uninformative to use the 'hard' version to explain these behaviours. However, if use of tobacco and alcohol promotes psychiatric distress, then socioeconomic inequalities in distress could potentially be explained by behavioural choices or smoking/drinking cultures. It would remain unclear how smoking and drinking behaviours came to be stratified by SEP. Alternatively, cultural influences could also be directly related to socioeconomic inequalities in psychiatric distress, for example, by transmission of norms around family interactions and social relationships, which can be important determinants of distress (Sweeting and West, 1995). Again though, this would leave questions of how such inequalities in social norms arose.

Stratification of health behaviours has been explained by reference to a ‘culture of poverty’, whereby unhealthy choices result from the transmission of social norms around behaviour (DHSS, 1980). For example, inequalities in unhealthy behaviours could become entrenched over successive generations as parents model these behaviours for their children (Green, G et al., 1990, Green, G et al., 1991, Flay, 1993). This could of course involve transmission of positive as well as negative behavioural norms, e.g. more affluent children may tend to learn to drink at home under the supervision of their parents, and thereby learn more moderate drinking practices, whereas children in less affluent homes may tend to learn to drink with their peers outside the home (Green, G et al., 1991).

Peer networks may constitute another means of transmission for social norms around behaviour (Furlong, 2013). Peer networks can be pivotal to young people’s identities and provide a normative reference group who are experiencing a similar social context, in contrast to parents who experienced a very different social context. They can provide social support, validation and reassurance but do this best when they come from similar social backgrounds and therefore may paradoxically reinforce socioeconomic inequalities, whilst buffering against their effects. Structural processes may even constrain opportunities for socialising with those from different socioeconomic backgrounds. Peer networks are additionally likely to be influenced by individual socioeconomic trajectories (Pavis et al., 1998, Bell et al., 1999), for example, leaving school might increase interaction with adults in home and working environments where smoking and drinking behaviours would be more prevalent, and this may then influence young people’s own behaviour (Flay, 1993, West et al., 1999).

Perhaps the most important point here though is to avoid the epistemological fallacy of attributing outcomes to cultural or behavioural characteristics whilst ignoring stratification by societal structures (Furlong and Cartmel, 1997). If there is a causal influence of culture on the outcomes in question, it is important not to ignore the causal influence of SEP on culture, even if there is no separate direct relationship between SEP and the outcomes.

2.2.2.4 Materialist or structural theory

Materialist or structural explanations maintain that SEP stratifies social and economic resources making it easier for those in socioeconomically advantaged conditions to achieve and maintain good health (DHSS, 1980, Krieger et al., 1997, Lynch and Kaplan, 2000, Duncan et al., 2002, Oakes and Rossi, 2003, Adler et al., 2012). Explanations invoking artefact, selection or culture may all contribute to observed socioeconomic inequalities in health or health behaviours (Macintyre, 1997), but structural accounts are often viewed as the primary causal mechanism (DH, 2009, Adler et al., 2012). Indeed, it has been argued that SEP represents a "fundamental cause" of health because it is associated with multiple health outcomes, and with each of those via multiple mechanisms (Link and Phelan, 1995). SEP may be related to health outcomes via a diverse range of social and economic resources which make it easier in a variety of ways for poor health or health behaviours to be avoided or negated by those in more advantaged circumstances. As the absence of a stressor could be considered a resource (and *vice versa*), the resources referred to here could include exposures, stressors or adverse social and economic conditions. A 'hard' version of this approach suggests that physical, material resources are stratified and influence health, whilst a 'soft' version extends out to include psychosocial as well as material factors (Macintyre, 1997). Versions of this approach emphasising material and psychosocial resources are sometimes seen as competing explanations but there is no reason that both could not be at work, having additive or synergistic effects.

With regard to what parental SEP indicates for their children, consider material resources first. Money can be converted by individuals into commodities or services that enhance health either directly or indirectly (Galobardes et al., 2006a), though of course it can also be used to acquire things that are detrimental to health such as tobacco or alcohol (Pavis et al., 1998, Laaksonen et al., 2005). For drinking and smoking, moderate use (in the case of drinking) or no use (in the case of smoking), is both cheaper and healthier than higher levels of use. Based on differences in material resources alone, one would expect a higher SEP to be associated with more extensive use as more resources would be available for the purchase of these substances. Therefore, if associations are observed in the opposite direction then associations might be expected to be dependent on factors other than material resources (Laaksonen et al., 2005). Paradoxically though, young people from more disadvantaged backgrounds can have more spending money available to them than those from more affluent backgrounds (West et al., 2006). Limited access to economic resources might also restrict access to mental health services (or other mental health promoting resources) in certain social contexts or health care systems.

In terms of psychosocial resources, parental SEP may represent something about the quality or richness of the developmental environment within which young people are growing up (Wickrama et al., 2010). SEP can be a social resource (or lack thereof); a form of social education whereby the family environment prepares young people for encounters outside the home and coaches them for a particular position in the socioeconomic hierarchy (DHSS, 1980, Furlong, 2013). Parents in households of higher occupational standing, for example, have been described as offering their children “a wider range of problem-solving experience and skills and [providing] greater emotional support”, as well as tending to know more about community resources and being “more familiar with available avenues for solving problems” (p36; Elder, 1974). On the other hand, parents in disadvantaged socioeconomic circumstances are more likely to be stressed, irritable, and engage in less effective parenting practices (Wickrama et al., 2010).

It might be worth returning briefly here to the socioecological model (see section 2.1.2.2; Bronfenbrenner, 1979) and re-iterating the importance of interactions between different levels of context for development: “...whether parents can perform effectively in their child-rearing roles within the family depends on role demands, stresses, and supports emanating from other settings...parents’ evaluations of their own capacity to function, as well as their view of their child, are related to such external factors as flexibility of job schedules, adequacy of childcare arrangements, the presence of friends and neighbors who can help out in large and small emergencies, the quality of health and social services, and neighborhood safety. The availability of supportive settings is, in turn, a function of their existence and frequency in a given culture or sub-culture.” (p7; Bronfenbrenner, 1979)

SEP might be considered to represent gradations of ‘sub-culture’ (i.e. a macro-system) structuring some of the resources mentioned above, like job schedules, childcare availability, or the quality of local resources. Many of these may have either a direct impact on the developing child (such as poor quality health services), or an indirect impact via the diversion of parental resources (e.g. parents with inflexible, demanding shift patterns may be less available for interaction with their children). The extent to which SEP structures these resources may also depend on the broader, societal macro-system (for example, some governments might make some form of childcare universally available, whilst parents in other contexts have to pay for the privilege).

Another relevant idea, which applies regardless of the particular SEP indicator in use, is that of stress. There are many ways of conceptualising stress, and one useful distinction is between external stressors and strain (or adverse reactions to stress; Langner and Michael, 1963). External stressors such as adverse life events, social isolation or financial difficulties probably accumulate at the lower end of the socioeconomic distribution. Both psychiatric distress and substance use could be viewed as strain (or reactions to stress), for example, smoking may be viewed as a means of coping with the stress of socioeconomic disadvantage (Kassel et al., 2003, Laaksonen et al., 2005, Jarvis and Wardle, 2006), and a similar argument could be made for heavy drinking. This is similar to the self-medication hypothesis (see section 2.2.1.1) except that it is external stressors which are viewed as directly eliciting the coping behaviour, and not the level of internal distress. However, if experience of external stressors is stratified by SEP and then causes higher levels of psychiatric distress, then self-medication could form an indirect path between SEP and substance use via psychiatric distress.

The degree of strain probably depends on some constitutional properties or vulnerability of the individual exposed to stress (Langner and Michael, 1963, Caprara and Rutter, 1995, Glantz and Leshner, 2000). SEP may stratify stressors and coping resources, i.e. factors that could alleviate or negate the effects of external stressors (Thoits, 1999). Indeed, the absence of coping resources may be as important as the presence of stressors (Glantz and Leshner, 2000). For example, living in disadvantaged circumstances may hamper socialisation into conventional family and school environments, which might have provided social support, with smoking and drinking then adopted as coping mechanisms in the absence of this support (Flay, 1993, Glendinning et al., 1995). Another potentially important stress process is that of social comparison (Kawachi, 2000); comparisons against others in society are likely to be more stressful or frustrating for those at the lower end of the socioeconomic distribution, who experience many constraints and few opportunities, than for those at top, who are well-resourced and have many opportunities.

2.2.3 Mechanisms related to transitions to adulthood

2.2.3.1 Socialisation

As young people move from adolescence to early adulthood and make transitions into new environments, settings, social networks and roles, desires to fit in within these new social contexts may mean that young people are more susceptible to conforming their behaviour to match others around them (Schulenberg and Maggs, 2002). Considering the social nature of smoking and drinking (see section 2.2.2.3), they may represent an adaptive element of negotiating these transitions (Schulenberg and Maggs, 2002). The social aspects of these behaviours may be particularly valued during transitions between social networks when relationships are new and explorative, and this immediate social value may be prioritised over any longer-term health risks. This may be particularly important for alcohol use in tertiary education where perceived norms of drinking behaviour are often falsely inflated (Helmer et al., 2013).

Additionally, since the legal use of substances such as tobacco and alcohol is generally restricted by age, use of these substances can be an important way in which young people construct their age identities, using these behaviours to signify their own maturity, or adult-like status (West, 2009a). Drinking alcohol is often viewed as a culturally normative rite of passage into adulthood (Pavis et al., 1998, Furlong, 2013). Moving into new environments and social networks may increase motivations to present a mature front by emulating these behaviours (Bachman et al., 1997).

For young people on educational trajectories, following the emerging adult pattern of delayed transitions, the transition to adulthood can be a peak period for smoking and drinking behaviour, perhaps because this period can be characterised by low monitoring from parents and few personal adult responsibilities (Arnett, 2000, Schulenberg and Maggs, 2002). Indeed, young people on educational trajectories (who thus tend to delay other transitions) tend to have lower levels of substance use in secondary education, but higher levels in the years immediately after as they move into tertiary education (Schulenberg and Maggs, 2002, Bewick et al., 2008). Heavy drinking levels among students in tertiary education have remained relatively constant over time, despite numerous intervention efforts, suggesting that there is something structural about the educational experience and the transitions associated with it which prompts heavier drinking (Schulenberg and Maggs, 2002).

For those transitioning out of education, greater involvement in adult roles, e.g. moving from school to an adult working environment, can also increase young people’s exposure to adult behaviour such as smoking and drinking (Burton, 2007), making them in turn more likely to adopt those behaviours. Smoking and drinking may also be an important part of social interaction with co-workers (Pavis et al., 1998).

After peaks in late adolescence or early adulthood, reductions in substance use when young people are in their mid-20s are common as they begin to take on more responsible, adult roles (Bachman et al., 1997, Glantz and Leshner, 2000). Many of the changes in substance use during this period of life are thought to be associated with the new roles, relationships, and environments that young people are moving into, rather than simple age-related maturation (Bachman et al., 1997, Glantz and Leshner, 2000). This is sometimes referred to as 'role socialisation' or 'role incompatibility'; the premise is that substance use reduces because it conflicts with conventional adult roles such as work, partnership and parenthood (e.g. by impairing role performance; Chassin et al., 1992). Involvement in adult roles may increase feelings of responsibility, leading to less risky behaviour. Young people who become parents, especially pregnant women, may reduce their cigarette and alcohol use to protect children from harmful effects and set a good example (Bachman et al., 1997). Restructuring of social networks could also constrain opportunities for social use or spending time with substance-using peers, for example, those who marry tend to spend more time exclusively with each other, and less time with their peers (Bachman et al., 1997). Many of these social processes to reduce use could be expected to be more powerful for alcohol than for smoking as smoking is more addictive (Chassin et al., 1992), and alcohol can be more strongly tied to sociability (Pearson et al., 2006).

2.2.3.2 Overload and developmental mismatch

Transitions to adulthood may also be associated with either psychological benefits or stresses (Burton, 2007), and, as previously discussed (section 2.2.2.4), stresses could lead to psychiatric distress and/or to the use of tobacco and alcohol as coping strategies (Schulenberg and Maggs, 2002), whilst psychological benefits may make these outcomes less likely. The Overload Model posits that when multiple developmental transitions occur over a relatively short time they may overwhelm coping capacities and wellbeing may suffer (Schulenberg and Maggs, 2002, Elder et al., 2003). Further, if transition timing deviates from societal or institutional norms, then individuals may need to play a more active role in managing those transitions, which can be more demanding and more likely to lead to overload (Settersten Jr., 2003), with associated distress and coping behaviours. Alternatively, greater spacing or more normative timing of transitions can avoid overload, whilst securing satisfaction from engagement with valued roles.

The Developmental Mismatch Model (Schulenberg and Maggs, 2002), posits that health will suffer if a young person's immediate contexts do not meet their developmental needs, whilst health is affirmed by contexts that do meet a person's needs. Delayed transitions and their associated trajectories through tertiary education can be seen as offering developmentally appropriate opportunities that match needs for identity-exploration and autonomy and could therefore be hypothesised to improve mental health. Early transitions, on the other hand, may leave young people feeling forced into adult roles before they are ready for them, decreasing feelings of control over their lives, and potentially increasing feelings of anxiety and depression. Alternatively, it has been noted that early transitions may be beneficial for young people who have the psychological maturity to cope with them (Benson and Elder, 2011, Benson et al., 2012). Earlier involvement in adult roles could, for example, provide opportunities to learn valuable adult skills, or enable feelings of making a valuable contribution within one's environment (Elder, 1974). Thus, the effect of timing may depend "on the degree to which it constrains or promotes later opportunities, whether it accelerates or delays subsequent experiences, and how well it fits within, or gives shape to, a trajectory or set of trajectories" (p93; Settersten Jr., 2003).

2.2.3.3 Selection

However, associations between adulthood transitions and substance use or psychiatric distress may not be causal. There may be confounding factors associated both with these outcomes and with the likelihood of transitions. This is often referred to as role selection, where people are selected into making transitions on the basis of background characteristics (Chassin et al., 1992). A disadvantaged socioeconomic background, and adolescent smoking and drinking, for example, have all been associated with earlier transitions (Bachman et al., 1997, Sacker and Cable, 2010, Wickrama et al., 2010), and may themselves be associated with smoking, drinking and psychiatric distress in early adulthood.

The transition from adolescence to adulthood is particularly interesting as this is where young people move from their socioeconomic background into their own adult SEP (Blane et al., 1993). Socioeconomic mobility could plausibly be influenced by the development of substance use or psychiatric problems during this phase of life (Blane et al., 1993, West et al., 1999). This would be especially true if such characteristics were associated with early transitions and a tendency not to remain in education (a course which would tend to result in a more disadvantaged SEP in adulthood; see section 1.1.4.2).

2.3 Review of evidence

2.3.1 Framework for review

Hypothesised associations between SEP, smoking, drinking and psychiatric distress are depicted in Figure 2-3. Whilst the conceptual framework set forth in Chapter 1 grouped smoking, drinking and psychiatric distress together, this section begins to examine and explicate the interdependencies between smoking, drinking and psychiatric distress. Arrows in the diagram represent sets of possible mechanisms as described in section 2.2. Those labelled ‘A’ represent the notion that SEP is a common causal factor for all three outcomes. Those labelled ‘B’ show hypotheses about substance use leading to psychiatric distress, or smoking leading to drinking via physiological or social mechanisms. The ‘C’ arrows represent the self-medication hypothesis that people experiencing psychiatric distress use tobacco and alcohol as coping mechanisms. Some relationships may be confounded by or mediated via others, for example the association between SEP and distress might be mediated via substance use (smoking or drinking), or the associations between smoking and psychiatric distress could be confounded by the common cause of SEP.

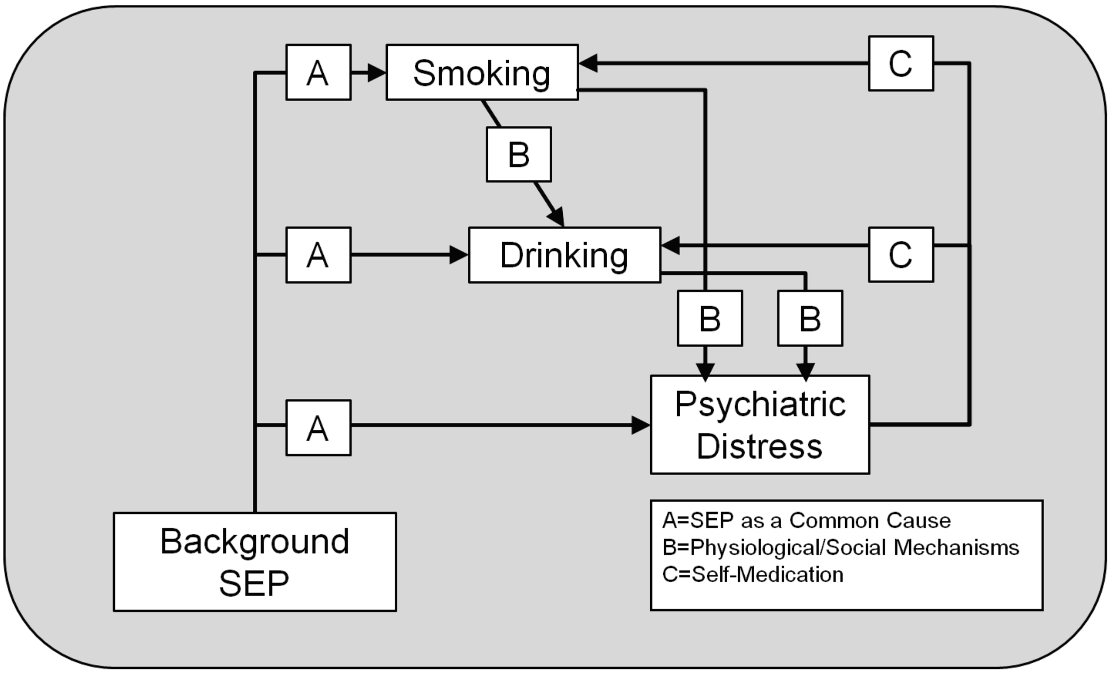


Figure 2-3: Review framework

The purpose of this section is to review evidence for each of the associations in the diagram. Given the vast amount of research in this area, this section focuses particularly on review-level evidence (i.e. from meta-analyses and systematic reviews) for each association, though other relevant literature is discussed throughout the rest of the thesis. The reviewed evidence is grouped into three broad categories. Studies investigating pathways between substance use and psychiatric distress are addressed first. These are grouped together since many studies simultaneously investigate both types of substance use and/or associations in both directions. Evidence of associations between SEP and substance use are examined next. Again, these are grouped together since many studies of SEP address associations with smoking and drinking simultaneously. Studies examining associations between SEP and distress are examined last. The focus here is on evidence of these associations from adolescents and young adults, as this is such a key developmental stage for these outcomes. Since the hypothesised associations are prospective, prospective evidence where available is considered more robust.

Searches for this section were conducted in Medline and the Social Science Citation Index using terms related to smoking (e.g. smoking, cigarette, tobacco), drinking (e.g. alcohol, drinking, binge), psychiatric distress (e.g. distress, depression, anxiety, internalising), the age range of interest (e.g. adolescence, youth, early adulthood, young people), and terms to focus on review-level evidence (e.g. review, meta-analysis). Eight systematic reviews were identified; three examined associations between smoking and mental health, and two of those also examined associations between drinking and mental health; three examined associations between socioeconomic background and either smoking or alcohol consumption; and two related to associations between SEP and mental health.

2.3.2 Associations among smoking, drinking and psychiatric distress

A meta-analysis established bi-directional prospective relationships between smoking and depression in adolescents aged 13-19 years (Chaiton et al., 2009). A combined estimate from six studies indicated smoking predicted later depression, and another from 12 studies indicated that depression predicted later smoking. Of six studies that examined relationships in both directions, three used clinically-based measures of depression and three used symptom-based measures (and were therefore based on a higher prevalence of depression). Those using clinically based measures of depression showed stronger effects for depression predicting smoking than for smoking predicting depression, whereas those using symptom based measures found the reverse. These relationships were evident even in those studies which had adjusted for SEP (parental education or family income). However, whilst four of the studies on depression predicting smoking were adjusted for SEP and showed consistent effects, only two studies had controlled for SEP in examining smoking predicting depression. The smoking effect in the larger of these two studies was well below the average effect size across all the studies examined (including those not adjusted for SEP), suggesting that the relationship between adolescent smoking and later depression may be partly, but not entirely, explained by the socioeconomic position of adolescent smokers. The review also noted the possibility of effect modification by gender and peer-smoking.

Another systematic review examining adolescent smoking as a predictor of early adult mental health outcomes (age 18-27) found robust effects in five cohort studies, even with control for baseline psychiatric problems, however only one study had clearly adjusted for any measure of SEP (household income; Mathers et al., 2006). Other studies were reported as adjusting for various demographic factors but it was not clear what these were. This review also examined prospective associations between adolescent smoking and problematic drinking in early adulthood. Evidence for this association was again robust in five cohorts, with some studies having included adjustment for prior psychopathology, but only one having clearly adjusted for SEP (parental education).

A systematic review of literature on psychiatric disorders occurring with substance use in adolescence (though including ages 9-22) showed that anxiety and depression were more common among youths who used alcohol, cigarettes, or other drugs than among those who did not, but most studies were of cross-sectional concurrence (Armstrong and Costello, 2002). Whilst there was evidence for each relationship, they were not found in all studies. More severe substance use problems did not appear to be associated with particularly larger odds ratios for depression, and many studies examining substance use disorders and anxiety did not find significant associations (perhaps due to amalgamation across different anxiety disorders with associations in different directions). With respect to prospective relationships, the review found evidence of tobacco use predicting later depression and of tobacco and alcohol use predicting later anxiety (not all associations were significant, but those that were not were in the same direction). However, the review also found depression predicting earlier onset of alcohol use, and anxiety predicting onset of drinking.

A non-systematic review also indicated prospective associations in both directions between smoking and depression or anxiety (Kassel et al., 2003). Here the age of the samples was not clearly specified but was simply described as adolescent. This review maintained that anxiety and depression were more consistently related to heavy smoking and nicotine dependence than to smoking initiation or intermittent, non-dependent smoking. This emphasises the potential importance of considering the natural history or stage of development of the behaviour, that different factors may be operating at different stages, or be associated with particular trajectories. Smoking initiation was quite heavily influenced by peers and the review found some evidence that anxiety symptoms could strengthen such influences. This review also suggested gender interactions were at play, but not in any consistent manner, with some studies showing stronger associations for males and others for females.

2.3.3 Associations between SEP and substance use

A large systematic review of associations between SEP and health behaviours in adolescence suggested that young people of a disadvantaged SEP are more likely to smoke (Hanson and Chen, 2007), though it was not clear whether any of the 44 included studies had adjusted for symptoms of psychiatric distress. This review included some prospective studies, and those which were not mainly used measures of parental SEP and could be assumed to represent prospective relationships. The evidence for the association with socioeconomic disadvantage was more consistent for early adolescence (ages 10-14) than for late adolescence and early adulthood (ages 15-21), where some associations in the opposite direction were found. This supports an idea that family socioeconomic factors recede in importance as adolescents become more involved with peers and other social environments (West et al., 1999, Hanson and Chen, 2007). Studies using measures of family income or the adolescent's spending money to represent SEP tended to show more smoking for those with more money (Hanson and Chen, 2007), suggesting affordability is an influence on this behaviour.

This review found inconsistent evidence regarding associations between SEP and adolescent alcohol use (Hanson and Chen, 2007). Studies were split between finding associations in either direction or no association. There appeared to be a tendency for studies reporting higher drinking levels among more disadvantaged youths to have used SEP measures focused more on status (e.g. occupation, education), and for those reporting higher drinking levels among more affluent youths to have used more resource-based measures such as income (Hanson and Chen, 2007). Again, the review article did not include information on whether these associations were adjusted for psychiatric distress.

A meta-analysis of associations between SEP and adolescent alcohol use at ages 9-17 years showed a significant association with SEP but was heavily influenced by one study and also included some estimates of marijuana use so the pooled estimate cannot be taken as purely relating to alcohol use (Lemstra et al., 2008a). Of the eight studies identified in this meta-analysis which looked purely at alcohol use in adolescence, 14 separate effect estimates were reported (many included estimates for adolescents at different ages, males and females separately, or for different measures of parental SEP). Six of the 14 effects were non-significant, five showed more alcohol use for disadvantaged youths, and three showed more alcohol use for advantaged youths. Only two of the studies were formally prospective, one of which showed more use among disadvantaged youths and the other no relationship (Lemstra et al., 2008a), though parental measures of SEP were used throughout and could be assumed to primarily represent prospective relationships (Langner and Michael, 1963). All of the studies showing more use among advantaged adolescents, but only two of those demonstrating more use for disadvantaged adolescents, had used income to represent SEP (Lemstra et al., 2008a), which suggests a tendency for measures emphasising material resources to exhibit different associations, from other SEP indicators.

A systematic review looking at the relationship between early life SEP and alcohol use in young adulthood found weak and inconsistent evidence of a relationship (Wiles et al., 2007). Stratifying the results by the measure of SEP or alcohol consumption (including measures indicative of abuse or dependence) did not suggest any clearer pattern. The authors suggest that the lack of consistent findings may be attributable to opposing mechanisms, whereby socioeconomic disadvantage is generally associated with poor health (including unhealthy use of alcohol), but that ‘those with more money can afford more alcohol’ (p1561). An alternative explanation is that SEP has no effect, but then it would be surprising to find many studies showing an association in one or the other direction. Such evidence suggests opposing mechanisms which vary in strength across contexts, such that the net effect is in either direction. If true, this idea regarding opposing mechanisms is an example of equifinality (see section 2.1.3.1) in that the same outcome, i.e. drinking, can be arrived at through different mechanisms (which happen to be stratified by SEP, even if the outcome is not clearly stratified).

2.3.4 Associations between SEP and psychiatric distress

A meta-analysis of associations between parental SEP and various measures of depressed mood in adolescents aged 9-19 showed significantly higher rates of depression in adolescents with parents of disadvantaged SEP (Lemstra et al., 2008b). All of the 13 results from nine studies identified in the review (some studies had separate results for different groups such as males and females) showed higher rates of depressive symptoms among adolescents with parents of disadvantaged SEP, and only four of these 13 associations were not statistically significant ($p<0.05$). Five of the nine studies included were longitudinal in design. No information was presented on the degree to which smoking and alcohol consumption had been adjusted for in the original papers.

A more recent systematic review of socioeconomic inequalities in mental health problems among children and adolescents (age range for inclusions was 4-18 years; Reiss, 2013) also found consistent evidence of an association. Socioeconomic disadvantage was associated with a greater likelihood of mental health problems in 52 of 55 studies examined. Although this review included younger children as well as adolescents, 41 of the included studies had respondents in the adolescent age-range. The association with SEP was observed in all age groups, but was found to be stronger in childhood than among adolescents (i.e. those aged 12 years or over). This review also covered any kind of mental health problem, and findings for internalising symptoms (i.e. anxiety and depression) were generally weaker than for externalising symptoms (i.e. conduct disorder, attention deficit hyperactivity disorder) though some studies showed inconsistent patterns in this regard. Again, the review presented no information on adjustment for smoking or drinking behaviours.

2.3.5 Summary of evidence

In order to help summarise review-level evidence in relation to smoking, drinking, psychiatric distress and SEP in adolescence and early adulthood, Figure 2-4 displays the review framework, with indications of what was found. The strongest evidence was for prospective associations in both directions between smoking and psychiatric distress, even with adjustment for SEP. Reviews were found showing evidence for almost all the other associations in Figure 2-4, but it was not generally clear from the reviews to what extent the associations would be robust to the possible confounding or mediating pathways in the diagram. The main exception was the association between SEP and drinking. Here the evidence was inconsistent, with studies showing associations in either direction, or no association. It was suggested that this might be due to opposing mechanisms associated with SEP, some promoting drinking among more advantaged young people, and others promoting drinking among disadvantaged young people.

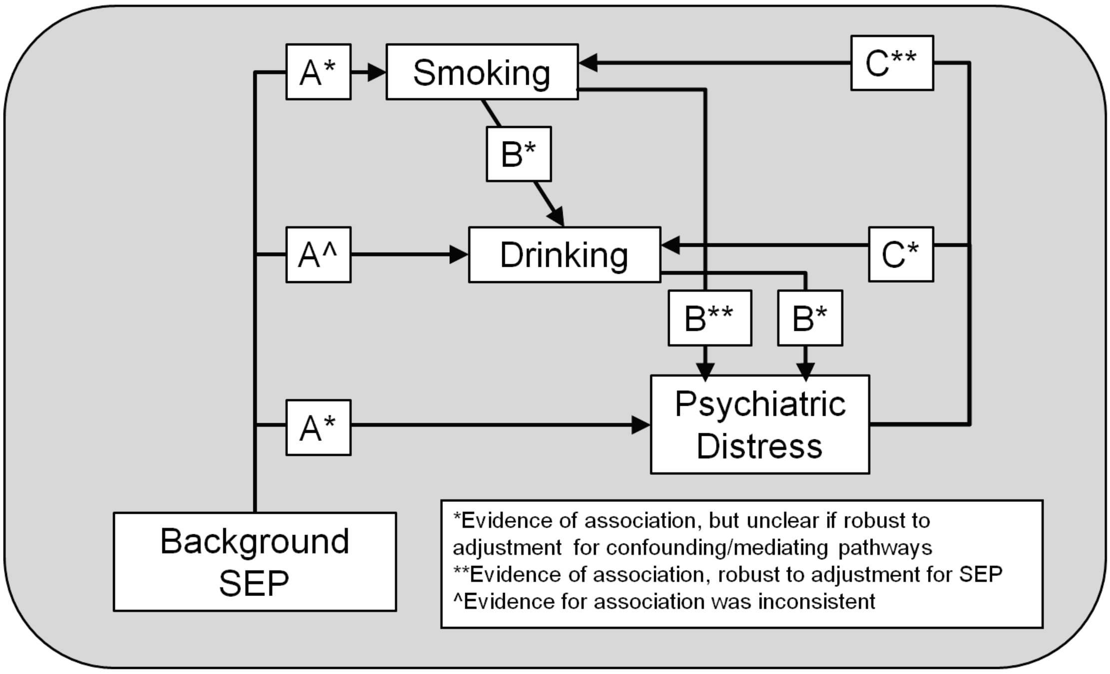


Figure 2-4: Review framework with findings

Overall there was a good deal of existing evidence for associations between SEP, smoking, drinking and psychiatric distress, but it was largely unclear how robust associations were to potential confounding or mediation via the inter-relations between these concepts, thus highlighting the need to look at them together. One of the aims of the thesis was to examine the interdependence of adolescent and early adult smoking, drinking and psychiatric distress, especially in terms of how adolescent experiences mediate between background SEP and early adult outcomes (research question 2i). The strong evidence for prospective associations in both directions between smoking and psychiatric distress, suggest that either has potential as a mediator between background SEP and later outcomes. For example, socioeconomic disadvantage might be associated with adolescent smoking, and lead from there to psychiatric distress in early adulthood. Additionally, the inconsistent findings relating SEP and drinking potentially indicate mechanisms working in opposing directions. It may be important to examine whether such patterns are present, and see if and how they vary between contexts (research questions 2 & 3).

3 Data and Methods

This chapter starts by introducing some of the datasets that were used for the thesis, describing the contextual settings of these datasets and relevant prior research using them. Measurement of SEP, smoking, drinking and psychiatric distress is discussed next. The third section discusses analytical methods for investigating the role of SEP on development using longitudinal data, including methods that take a holistic approach to the data. Specific further details of missing data, measurement and analysis are included within each of the results chapters.

3.1 Data

Thinking about data to answer the aims of this thesis (see section 1.2) there are a number of important points to consider. Interest is in development through adolescence and early adulthood, so datasets that follow individuals longitudinally with measures of smoking, drinking and psychiatric distress in adolescence and/or early adulthood are needed (including both males and females for consideration of gender). Considering the focus on background SEP datasets would ideally contain a range of information about the SEP of respondents' parents. In order to investigate contextual differences in developmental processes, data from different geographical and temporal contexts are required. Finally, as the aim is to make cross-context comparisons, it is important that each sample is representative of the context considered.

This section briefly describes three of the datasets chosen on the basis of these criteria. It starts by giving basic details of each sample (e.g. baseline response rates, ages measured etc), before giving more contextual information about the samples, which may be useful for interpreting differences in findings. Finally, relevant prior research from these samples is summarised.

3.1.1 Description of datasets

Details of the three datasets used for most of the thesis are presented here in the following order: the 1958 National Child Development Study; the 1970 British Cohort Study; and the West of Scotland: Twenty-07 Study. These datasets are utilised in Chapters 4 through 7. Another more recent dataset is utilised in Chapter 8 only, so is described in the methods section of that chapter. Table 3-1 details the mean ages and mode of survey administration for the most relevant waves of the three cohorts.

Table 3-1: Ages of measurement and survey modes

	Mean Age Survey Modes NCDS58	BCS70	T07
Adolescent Waves	**16.0** Teacher questionnaire, parental interview, medical exam and in-school respondent questionnaire	**16.1** Teacher questionnaire, parental interview, medical exam and in-school respondent questionnaire	**15.7** In-home parental and respondent interviews
			17.1 In-home respondent questionnaire
			18.6 In-home respondent interviews
Early Adult Waves	**23.6** In-home respondent interview	**Approx. 26** In-home respondent questionnaire	**21.7** In-home respondent questionnaire

3.1.1.1 1958 National Child Development Study

The 1958 National Child Development Study (NCDS58) has followed all children born in the UK within a particular week in March 1958 with repeated surveys at different ages (Plewis et al., 2004). The baseline interviews obtained data on 17,415 births (response rate was 98.8%) and a further 1,143 individuals were included at later follow-ups (mostly immigrants into the UK after birth, though 219 were born in the UK and did not have baseline data) bringing the total eligible sample for analyses of adolescence and early adulthood to 18,558. The two most relevant surveys for this thesis occurred in 1974 (mean age=16.0 years; s.d=0.11), and in 1981 (mean age=23.6 years; s.d=0.07). However, data from surveys at other ages were also used e.g. for weighting, imputation, or calculating the timing of transitions to adulthood.

3.1.1.2 1970 British Cohort Study

The 1970 British Cohort Study (BCS70) is similar in design and methods to NCDS58 but has followed a cohort born within a particular week in April 1970 (Plewis et al., 2004). Respondents to BCS70 were growing up twelve years after those in NCDS58. Baseline interviews covered Northern Ireland, but these were never followed up and were therefore excluded (n=614), except for 14 cases who later moved into England, Scotland or Wales (counted as immigrants below). The total eligible sample size for analyses of adolescence and early adulthood in BCS70 was 18,488 including an original sample of 16,568 (response rate was 95.9%) and a further 1,920 who were added later (1,205 immigrants and 715 who were born in the UK but had no baseline data). An adolescent survey took place in 1986 (mean age 16.1 years; s.d=0.26) and the next survey was in 1996 (approximate age 26 years). Data from other waves were used for weighting, imputation and calculation of transition timing. Unfortunately, strike action among teachers in 1986 coincided with the adolescent follow-up of the BCS70. This obstructed fieldwork since many of the questionnaires were delivered through schools (Goodman and Butler, 1987), meaning response rates in adolescence were relatively low.

3.1.1.3 West of Scotland: Twenty-07 Study

The West of Scotland Twenty-07 Study (T07) followed three cohorts of people from in and around Glasgow for 20 years (Benzeval et al., 2009). The youngest cohort, who are the focus here, had a mean of age 15.7 years (s.d=0.33) at the baseline interviews in 1988 and so were growing up within approximately the same historical period as respondents to the BCS70. However, they represent the experiences of people from the particular geographic region in and around Glasgow, a large Scottish city which had been experiencing rapid de-industrialisation. The baseline response rate was 85% and respondents (n=1,515) were representative of the same-age population within the sampled area (Der, 1998). A postal follow-up occurred in 1994 (mean age=21.7 years; s.d=0.31), though the study also surveyed respondents in late adolescence (mean ages=17.1 years and 18.6 years). These additional surveys mean that T07, compared to NCDS58 and BCS70 is particularly useful for exploring late adolescent development.

3.1.2 Contextual differences between datasets

Each of the datasets described in the previous section represents a different context. NCDS58 and BCS70 both represent young people growing up within the UK as a whole, separated by 12 years in historical time. T07 represents young people growing up within the same historical period as BCS70 but within the specific context of Glasgow. Understanding differences in the contextual features of these datasets is critical to interpreting any differences in findings. Thus, this section reviews some of the major temporal trends between NCDS58 and the two later cohorts, taking special note of any features particular to the Glasgow cohort as compared to BCS70, and of how these may be relevant to the outcomes in question. Where there are temporal trends it is additionally important to note whether these are patterned by SEP, since such patterned trends may be most likely to affect mechanisms linking SEP and smoking, drinking or psychiatric distress. Additional contextual changes in tobacco control from 1990-2012 which are particularly relevant to Chapter 8 are described there.

3.1.2.1 Family dynamics

Section 2.1.2.3 alluded to trends towards delaying parenthood and partnership formation in more recent cohorts, e.g. the average age at first birth rose from 23.7 years in 1971 to 27.5 years in 2007 (Clarke and Roberts, 2011). There have also been trends towards cohabitation before or rather than marriage, and more lone parenthood, e.g. in 1961 2% of British households were lone parents with dependent children, compared to 6% in 1991 (Clarke and Roberts, 2011). Delays in parenthood and partnering may be associated with more freedom and less responsibility in early adulthood, which may result in more adverse behaviours (see section 2.2.3.1; Arnett, 2000). Delaying partnership and parenthood has been more common for those with a more advantaged SEP (McLanahan, 2004, Ashton and Bynner, 2011, Clarke and Roberts, 2011). If delays are associated with adverse behaviours in early adulthood, then such a trend might weaken associations between socioeconomic disadvantage and poor health behaviours in more recent cohorts.

Section 2.2.3.2 explained how adulthood transitions such as these can cause overload when demands exceed individual capacities, and this may result in distress or coping-motivated substance use. Trends to delay transitions may mean that cohort members are more mature and stable when they do become partners or parents (McLanahan, 2004), with less risk of overload (though this effect would be concentrated in more advantaged socioeconomic strata). In contrast, trends towards lone parenthood will be associated with less financial and emotional support (McLanahan, 2004), with greater risk of overload. Indeed, early partnership and parenthood have remained common routes to adulthood for those from lower SEP backgrounds (Ashton and Bynner, 2011). Lone parents particularly tend to be among the most disadvantaged in socioeconomic terms (Clarke and Roberts, 2011), though this is probably at least partly selective. This would suggest larger associations between socioeconomic disadvantage and distress/poor health behaviours in more recent cohorts, where those in lone parent families would constitute a greater proportion of those in socioeconomic disadvantage.

More recent cohorts have also seen increasing rates of family breakdown and step-families (Clarke and Roberts, 2011) and thus members of later cohorts may be both more likely to have experienced breakdown of parental relationships as children, and to have such experiences themselves as they transition into adulthood. Family disruptions in childhood are associated with greater tobacco and alcohol use (Galea et al., 2004), and unsuccessful relationships in early adulthood could also cause distress. Cohabitating parents (who are more likely to break-up or have unstable relationships) and divorce are more likely among more disadvantaged groups (McLanahan, 2004, Clarke and Roberts, 2011), so again stronger relationships between socioeconomic disadvantage and distress or substance use might be expected in more recent cohorts where such experiences would have been more common for those in more disadvantaged socioeconomic strata.

It has been argued that demographic changes in more recent cohorts have created divergent trajectories in resources for young people: older child-bearing, and increasing maternal employment (see next section) can mean more material resources for the children of advantaged families where these trends are proceeding fastest, but unstable relationships and single-parenting can mean fewer resources for those in disadvantaged circumstances where these trends are expanding fastest (McLanahan, 2004).

3.1.2.2 Economy and employment

The distribution of income in the UK has become increasingly unequal since the 1970s, with those at the lower end of the distribution experiencing little if any growth in their income, while those at the higher ends have experienced considerable growth (Machin and Vignoles, 2004, Pemberton, 2011). Thus, a low position on the household income distribution in adolescence may signify greater relative disadvantage in more recent cohorts.

Youth employment tends to be hit hardest during recession, as firms cut back by reducing intake (Ashton and Bynner, 2011). Recession hit the UK economy just as the NCDS58 cohort turned 16 in 1974, and again when they were interviewed in early adulthood in 1981, whilst the adolescent and early adult surveys in BCS70 and T07 were undertaken during periods of economic growth (Pemberton, 2011). Nevertheless, national unemployment rates were substantially higher (around 10%) when BCS70 and T07 respondents were turning 16 in the late eighties than when NCDS58 respondents turned 16 in 1974, when the national unemployment rate was approximately 2.5% (Ashton and

Bynner, 2011). Thus, despite the recession, school-leavers might have had greater expectations of work in NCDS58 than in BCS70 or T07. Deindustrialisation and other changes in labour market structures have tended to concentrate jobs in the South of the UK leaving northern areas like Glasgow with high unemployment rates (Pemberton, 2011), meaning T07 respondents might have faced especially poor employment prospects if they left school early.

A move towards service industries has resulted in an expansion of female employment (Ashton and Bynner, 2011, Pemberton, 2011), and this means that maternal employment rates have risen in more recent cohorts (Clarke and Roberts, 2011), e.g. in 1951 around one in six mothers were employed, compared with four in six in 2008. Primarily, mothers have been working in addition to, rather than instead, of fathers. This could mean fewer parental social resources to devote to children, with greater material resources (McLanahan, 2004), potentially leading to less monitoring and more opportunities for poor health behaviours. Less time for social interaction between parents and children could also conceivably lead to distress. These maternal employment trends have been most concentrated amongst the more advantaged (Clarke and Roberts, 2011) and so this might mean socioeconomic disadvantage is less strongly associated with smoking, drinking and distress in more recent cohorts.

As mentioned above, labour market trends have been towards non-manual rather than manual work (Ashton and Bynner, 2011), which means that having a manual occupation in a more recent cohort represents a more select and perhaps more disadvantaged group than having a manual occupation in a less recent cohort. Further, a move towards service industries and technological revolutions in other industries has resulted in a contraction of the kind of unskilled manual work that young people would traditionally have entered if they had left school early (Côté and Bynner, 2008). Young people from disadvantaged backgrounds are more likely to leave school early (see section 2.1.2.3) and, considering these trends away from unskilled manual work, those in more recent cohorts may have found it more difficult to be competitive in labour markets as they left school, especially with educational qualifications being increasingly valued on the job market (Côté and Bynner, 2008). Where transitions from school into the labour market were previously relatively structured and linear, irrespective of SEP, this contraction of the industries that had previously employed unqualified school-leavers means transitions to employment became less stable, linear and structured for those from a disadvantaged SEP (Ashton and Bynner, 2011). Additionally, over time, young people have made up a smaller proportion of the potential labour market, leaving them less competitive overall (Côté and Bynner, 2008). Part-time work, self-employment and short-term contracts have also become increasingly common (Ashton and Bynner, 2011), and the latter two at least would contribute to increased occupational instability. Thus, early school-leavers in more recent cohorts may have faced poorer prospects and greater instability, potentially causing heightened stress and resulting in stronger associations between background SEP and distress or substance use.

3.1.2.3 Education

Participation in tertiary education has expanded considerably in more recent cohorts in both England and Scotland (Machin and Vignoles, 2004, McCulloch, 2011), e.g. percentages staying on beyond the compulsory school-leaving age of 16 years were 42% in 1979, rising to 52% in 1988, and 71% in 1999. However, this expansion has been unequally distributed, with children from higher income families or from the highest occupational class households increasing their participation in tertiary education much more rapidly than children from lower income families or from lower occupational class households (Machin and Vignoles, 2004, Côté and Bynner, 2008). In Scotland, compared to England and Wales, participation in tertiary education has generally been higher across all socioeconomic strata, despite greater inequalities in participation than in England & Wales (Iannelli, 2007). To the extent that participation in tertiary education is a mechanism promoting poorer health behaviours, such as heavy drinking (see section 2.2.3.1), these trends might be expected to result in socioeconomic advantage being more strongly linked to early adult substance use in more recent cohorts, and especially in the Scottish cohort, where inequalities in access to tertiary education have tended to be greater.

Shifting educational norms also mean that parents of later cohorts would have stayed in school longer (McCulloch, 2011) so low levels of parental education may represent greater relative disadvantage in more recent cohorts and especially in T07, considering the higher overall levels of participation in Scotland (Iannelli, 2007).

3.1.2.4 Substance use

Overall, smoking prevalence has declined between cohorts (Roberts, 2011), and declines have been stronger among those in a more advantaged SEP (Jarvis and Wardle, 2006, Bell et al., 2010). This is consistent with what would be expected with increased understanding of the negative health effects of smoking. As understanding of health effects increases, those with most resources will be most able to avoid or quit the behaviour (Link and Phelan, 1995). These trends may mean that smoking was more closely associated with socioeconomic disadvantage in more recent cohorts, and more generally, may mean that smoking came to be less normative and more deviant (Bell et al., 2010).

In contrast, alcohol consumption has risen over time (Pemberton, 2011), with total recorded consumption in Britain doubling between 1960 and 2002 (Maggs et al., 2008). Alcohol has also become more easily available, (e.g. costing less, more licensed premises), in more recent cohorts (Maggs et al., 2008, Roberts, 2011). Thus, since fewer resources are required to obtain it, alcohol may be less strongly tied to SEP in more recent cohorts.

3.1.2.5 Summary

Table 3-2 summarises contextual differences between the three datasets in relation to each of the foregoing domains, with the first column focusing on differences between the two later cohorts and the earlier NCDS58, whilst the second column highlights specific contextual features for the Scottish T07 cohort.

Table 3-2: Contextual differences between datasets

	BCS70 and T07 compared to NCDS58	**Specific characteristics of T07**
Family dynamics	Later partnering and parenthood[a]; more cohabitation, family breakdown and lone parenthood[b];	
Economy and employment	More unequal income distribution; More maternal employment[a]; Higher unemployment rates; Fewer manual jobs available; Less linear transition from school to work[b];	Particularly high unemployment rates;
Education	More participation in tertiary education[a];	Higher overall levels of participation, but more unequal;
Substance use	Declines in smoking prevalence[a]; Alcohol become more available and consumption has risen;	

[a]Trend concentrated among those of more advantaged SEP.
[b]Trend concentrated among those of disadvantaged SEP.

3.1.3 Previous findings from NCDS58, BSC70 and T07

Although this investigation places new emphasis on the inter-related nature of smoking, drinking and psychiatric distress and the role this may have in producing socioeconomic patterning of these outcomes, it is not the first study to examine socioeconomic inequalities in smoking, drinking or psychiatric distress in these datasets. This section briefly highlights relevant findings from previous studies.

3.1.3.1 Smoking

A study of smoking patterns in NCDS58 showed that smoking rates had not risen dramatically between adolescence and early adulthood, indicating most early adult smokers were already smokers in adolescence (Bowling and Fogelman, 1983). Early adult smokers in NCDS58 had been less successful in education and were more likely to be economically inactive and to have had parents from manual than from non-manual households (Bowling and Fogelman, 1983). In BCS70, those who had been less successful in school were again more likely to smoke (de Coulon et al., 2010). A later study in NCDS58 found that smoking status at age 42 was associated with childhood SEP, even after adjustment for a range of possible confounders or mediators (Lacey et al., 2011). There also appeared to be an association between the number of cigarettes smoked and responses to items measuring psychiatric distress, and current smokers were more likely than ex- or non-smokers to drink alcohol on most days (Bowling and Fogelman, 1983), which is consistent with the literature reviewed in section 2.3.2.

A study of two-parent households in T07 showed that parents in manual rather than non-manual occupations and their adolescent children were more likely to be smokers, though the adolescent inequalities in smoking were not fully explained by the inequalities in parental smoking (Green, G et al., 1991). Similar findings, with inequalities not explained by parental smoking, were observed when lone parenthood was taken to indicate disadvantage (Green, G et al., 1990). Later research on the uptake of regular smoking by T07 adolescents suggested that parental occupational class and smoking were significant influences in early but not late adolescence (West et al., 1999). Associations with peer smoking were especially strong and most concentrated for more proximal measures of peer smoking. Inequalities in adolescent smoking were concentrated among those who left school early (Green, G et al., 1991), and adolescent smoking in this sample was associated with unemployment and not being in tertiary education at age 18, even after adjustment for parental occupational class (West et al., 1999), suggesting that smoking status is associated with particular socioeconomic trajectories as well as with smoking peer groups.

3.1.3.2 Drinking

In NCDS58, a study of drinking in adolescence and early and middle adulthood, showed tendencies for those from more advantaged socioeconomic backgrounds and those who were performing better in school (at ages 7 and 11) to drink more, in spite of heavier drinking also being associated with factors such as social maladjustment, truancy and externalising behaviour, which were associated with socioeconomic disadvantage (Maggs et al., 2008). This seems consistent with suggestions regarding opposing processes linking SEP and drinking.

Another study of drinking patterns in NCDS58 found that childhood socioeconomic disadvantage was associated with binge and problem drinking but not heavy drinking, and with non or infrequent drinking in middle adulthood (Caldwell et al., 2008). This raises the possibility that inconsistencies in findings regarding SEP and drinking are due to inadequate consideration of different types of drinking patterns, though this was not apparent in one of the reviews discussed earlier (see section 2.3.3; Wiles et al., 2007). In BCS70, adult respondents who had performed well in school tended to drink less overall and were less likely to binge drink, though in this case there was less of a gradient for binge-drinking (de Coulon et al., 2010).

A study of adulthood transitions in NCDS58 and BCS70, focusing on status at age 26 in terms of educational attainment, economic activity, housing, relationships, and parenthood, identified five distinct patterns: work orientation without children, traditional families, highly educated without children, slow starters and fragile families (Schoon et al., 2012). Those from disadvantaged socioeconomic backgrounds were more likely to be classified as fragile families, and less likely to be classified as highly educated without children, or as slow starters. Those classified as highly educated without children tended to drink more alcohol in adulthood than those in other groups.

Drinking patterns in T07 were also complex. There was almost no difference by parental occupational class in the prevalence of parental drinking, but parents from manual households consumed more units per week than those in non-manual households, and parental drinking patterns were only related to adolescent drinking in non-manual households (Green, G et al., 1991). Adolescents in non-manual rather than manual households were initially more likely to identify as occasional or regular drinkers but this difference disappeared in late adolescence as drinking became more prevalent, almost ubiquitous, though females from manual households remained more likely to be drinkers than those from non-manual households (Green, G et al., 1991).

3.1.3.3 Psychiatric distress

A comparison of adult distress rates in NCDS58 and BCS70, showed that females and those in manual occupations had higher rates of distress, with modest evidence of the inequalities narrowing over time (i.e. a period effect) but not changing with age (Sacker and Wiggins, 2002). In contrast, in T07 inequalities in psychiatric distress by parental occupational class were not apparent in adolescence (West et al., 1990), but emerged in adulthood as the cohort aged (Green, MJ and Benzeval, 2011).

A study of adult psychiatric distress and the timing of transitions to adulthood in NCDS58 and BCS70 indicated that earlier timing of parenthood, leaving home, or leaving school were associated with higher odds of psychiatric distress at age 30/33 (Sacker and Cable, 2010). Those who had not yet made a transition into a cohabiting relationship also had higher odds of distress. This study examined the timing of each transition using variable-centred methods, focusing on independent associations with each type of transition, rather than associations with particular patterns of transitions. The study of adulthood transitions mentioned in the previous section, did use a more person-centred approach, but based on attained status at age 26, rather than on transition timing (Schoon et al., 2012). In that study, those classified as fragile families (few educational qualifications, rented accommodation, often cohabiting or single, and not economically active with children), were experiencing particularly high levels of adult psychiatric distress, and those from disadvantaged socioeconomic backgrounds were more likely to be in this group.

3.2 Measurement

Common measures of parental SEP such as occupation, income and education have already been introduced (see sections 1.1.4). The first section here elaborates briefly on how these indicators may be measured, and what each might mean for young people, before discussing some general issues related to their use in quantitative analysis. Measurement of smoking, drinking and psychiatric distress is discussed thereafter. For each concept, the measurement definitions from the three cohorts which were most commonly used for analysis are included. More specific details of measurement are included in the relevant chapters.

3.2.1 Measurement of SEP

Despite tendencies for most material and psychosocial resources to correlate with SEP, there may be heterogeneity within the resources people hold, for example: a person might own their home, but have a low current income (material resources); or they might have a prestigious position within their society, but have few social connections (psychosocial resources). Different SEP indicators such as occupation, income or education each represent SEP generally to some degree, but each may also represent characteristics that are relatively specific to that measure (Laaksonen et al., 2005, Galobardes et al., 2006a) and may therefore tend to be better indicators of certain resources than others. The discussion of SEP measures below therefore considers the material and psychosocial resources for young people which are represented by particular indicators of SEP.

3.2.1.1 Occupational class and employment

Measures of parental occupation might be thought to represent, for those in those occupations, material resources, prestige or social standing, knowledge and skills, social networks, a person's position within power relations, access to housing or medical care, and parental working conditions such as autonomy, stress, environmental health exposures, job security and job satisfaction (Liberatos and Link, 1988, Gregorio et al., 1997, Galobardes et al., 2006a). Resources such as money, material goods, social standing, social networks, and social skills might all be shared to some degree by members of the same household (Krieger et al., 1997). Obviously, indicators of parental occupation do not mean that young people experience the same working conditions, stresses and health exposures as their working parent. However, these resources may still be important to the young person in the extent to which they impact on parent-child interactions (Bronfenbrenner, 1979). A parent who returns home from work stressed may be irritable, or if they come home drained and exhausted they may have little energy for play or conversation. A parent with respiratory problems from working in a dusty factory may be less likely to engage in sporting activities with their children. Similarly, even if the knowledge, skills or social contacts of the parent are not directly shared or passed on to the child, these may still be useful resources. Parental medical knowledge or skills for example might mean easier access to advice or treatment when a child is unwell.

Parents with poorer mental or physical health may be selected into lower class occupations (Langner and Michael, 1963, Duncan et al., 2002) and this may have implications for the extent to which they can act as a developmental resource for their children. Parental unemployment can also mean that young people are drawn into the household economy, either via more domestic labour, or by making earlier transitions into employment. This could either overload their capacities and be stressful, or provide valuable opportunities to develop their own skills, depending on how mature they are when it happens (Elder, 1974).

There are various different systems for classifying occupations (Galobardes et al., 2006b). Some classifications are more Marxist, focusing on economic relationships, whilst others are more Weberian and stratify on the basis of knowledge, skills and status (Powers, 1982, Liberatos and Link, 1988, Krieger et al., 1997). Examples of more Marxist schema would include the UK National Statistics socioeconomic classification (NS-SEC), which has been adopted by the UK Office for National Statistics since the year 2000 (Macintyre et al., 2003b, Galobardes et al., 2006b), or the Erikson and Goldthorpe class schema (Bartley, 2004). More Weberian classifications would include the classification developed by the British Registrar General (Galobardes et al., 2006b), which has been widely used but is becoming out-dated, perhaps inadequately reflecting recent changes in labour market trends (e.g. rising service industries, or declines in unskilled manual labour; Benzeval et al., 1995, Galobardes et al., 2006b), or the Cambridge scale, which is based on reports of social interactions between people in different occupations, giving a strong indication of the status dimension (Galobardes et al., 2006b).

Occupational classifications exclude those parents who are not currently working, such as those who are unemployed, caring for the home, or retired (Krieger et al., 1997, McMunn et al., 2006). In such cases, the most recent occupation is sometimes used but this may inadequately capture an individual’s current SEP (Galobardes et al., 2006a), and still leave difficulties for classifying those who have never been in work (Duncan et al., 2002). An alternative to an occupational class schema is to use a simple categorisation based on whether or not parents are in employment, with those out of work presumed to be disadvantaged by lack of income, social isolation, and loss of self-esteem (Galobardes et al., 2006b).

3.2.1.2 Education

Education represents qualifications and skills that are important for social standing and access to economic resources such as better jobs and higher wages (Liberatos and Link, 1988, Duncan et al., 2002, Laaksonen et al., 2005, Galobardes et al., 2006a), though education tends to be less closely associated with ownership of capital assets than are occupational class measures (Krieger et al., 1997). Social standing, social connections, vocational skills and economic resources associated with education may represent shared household resources as discussed above in relation to occupational class. Education can also represent knowledge and skill-based assets or value-sets that are relevant to a parent's management of their own health and health behaviour choices (Liberatos and Link, 1988, Mirowsky and Ross, 1998, Duncan et al., 2002, Braveman et al., 2005, Laaksonen et al., 2005, Galobardes et al., 2006a). Education tends to particularly develop problem-solving skills and might be viewed as increasing a parent's sense of individual agency and personal control over their circumstances (Mirowsky and Ross, 1998). This knowledge and these skills may be transmitted from parents to children, either through direct teaching or by behavioural modelling (Mirowsky and Ross, 1998). Additionally, the socioecological model (Bronfenbrenner, 1979) posits that transitions will be easier where there is similarity or continuity between systems. Parents with more education may provide home environments that are more similar to school environments, meaning that transitions are easier and can be managed more successfully.

Education can be measured continuously, e.g. by number of years, or categorically in reference to specific educational achievements (which could be particular qualifications or simply the completion of a particular number of years; Galobardes et al., 2006a). Continuous measurement tends to assume each year of education has an equal effect (non-linear effects are rarely considered) whilst categorical measurement emphasises the importance of specific achievements over the actual time spent in education (Galobardes et al., 2006a). This may be important since perceived status does not rise monotonically with number of years of completed education; equal increments in education have been shown to produce larger increases in perceived status as the number of years in education rises (Liberatos and Link, 1988).

Societal norms around educational achievement vary considerably by cohort, and therefore the meaning of particular thresholds (e.g. post-16 education) or qualifications can vary for different cohorts in terms of the social standing and economic resources signified (Liberatos and Link, 1988, Krieger et al., 1997, Galobardes et al., 2006a). Particularly, higher levels of education are becoming more universal in younger cohorts (Liberatos and Link, 1988, Krieger et al., 1997, Furlong, 2013), though as requirements increase this may leave them no better off in terms of access to better jobs or higher incomes (Platt, 2011, Furlong, 2013). Although education may differentially represent social standing and economic resources in different cohorts, its meaning in terms of the knowledge and skills developed presumably remains relatively constant across cohorts (presuming that the quality of education in terms of developing these skills varies less between cohorts than does the proportion of the population receiving this education).

3.2.1.3 Income and wealth

Income reflects the acute availability of economic or material resources, rather than the longer-term accumulation of wealth (Krieger et al., 1997, Duncan et al., 2002). Income can also represent social standing to the extent that this is dependent on a person's ability to obtain particular material resources or products (Galobardes et al., 2006a), and might represent something about capacities for social participation when this is dependent on paying to participate in certain activities, which again could be an important resource for mental health.

Income is often measured at the household level and will usually be "equivalised" in some way to account for family size or the number of dependents (Galobardes et al., 2006a). Non-equivalised measures of income may mean very different things for different sized households at the same level of income (Krieger et al., 1997). Equivalised household measures of income assume equal access to, or an equal share of, income among household members, though this may not always reflect reality (Krieger et al., 1997, Duncan et al., 2002, Galobardes et al., 2006a, Platt, 2011). Additionally, the same level of equivalised income may have different meanings depending on area-level factors such as the quality and price of goods available in the neighbourhood (Krieger et al., 1997).

Income data tend to be heavily skewed and treatment as a continuous variable assumes that a unit difference in income has an equivalent effect at all levels of income, which is unlikely to be valid (Liberatos and Link, 1988, Krieger et al., 1997). Thus, it can be important to consider non-linear effects in some way (e.g. by categorisation).

There are some concerns over reluctance to report income in social research (Krieger et al., 1997), but these may have been over-stated (Galobardes et al., 2006a), and researchers can probably evaluate on a case-by-case basis whether non-reporting is sufficiently large to be concerning. Even where reporting is high however, people's knowledge of their own household income and hence their accuracy in reporting it can be quite variable (Krieger et al., 1997). Thus, whilst income measures typically have more variability than other measures of SEP, it is worth noting that some of this variation is likely to be noise.

Although, income represents acute material resources, an alternative is to combine income with total assets to create a measure of wealth. Besides income, wealth measures may include the value of owned housing, cars, investments, inheritance, pensions and savings, as well as the negative value of debts (Galobardes et al., 2006b, Platt, 2011), giving a fuller description of economic resources (Krieger et al., 1997).

3.2.1.4 Other SEP Indicators

Other indicators of SEP may emphasise other resources. Housing tenure for example (contrasting those who own their homes, or have mortgages with those who rent their accommodation from private or social landlords), may represent accumulated wealth (in contrast to the acute resources indicated by income; Krieger et al., 1997), the quality of the local resources and area (Dietz and Haurin, 2003, Macintyre et al., 2003a), stability and security in family life (Dietz and Haurin, 2003), and the quality of space available for autonomy and social interaction (Townsend, 1987, Hiscock et al., 2001). Measures of area level deprivation such as the Townsend index (Krieger et al., 1997, Shaw et al., 2006), or the Carstairs index (Mcloone and Boddy, 1994), could be thought of as capturing qualities of a person's immediate social environment that might not be well-represented in individual and household measures (Krieger et al., 1997).

3.2.1.5 Downwards extension

SEP can be measured at different levels, e.g. at the individual, household, and community or neighbourhood level (Krieger et al., 1997). As mentioned in section 1.1.4, it may be difficult to measure SEP at the individual level for young people who do not yet have socioeconomic characteristics of their own, and household or parental SEP may be useful indicators in such circumstances (Galobardes et al., 2006a), extending the SEP of the parents 'downwards' to cover their children.

Considering distinctions between household and individual SEP, an important consideration with regards to downwards extension, is whether to use a household measure (using the highest position occupied by either parent), or to consider each parent's individual SEP. Parental employment might be a good example of the issue. Consider the following possible combinations for couple parents: two employed parents; one parent working and one parent not working; or two unemployed parents. A household level categorisation might group the first two combinations together, despite quite different implications for the resources available to a young person in that household. A household approach has the advantage of summarising data in a single variable, making it relatively easy to analyse and interpret, but ignores potentially important information about the position of the other parent (i.e. the one whose code is not used). Using individual SEP measures for both parents, on the other hand, whilst including more of the available information, produces two (probably) correlated variables which may or may not have independent effects in statistical models. This complicates interpretation and raises questions about whether and how they interact.

A particular issue with this second approach is how data for young people with only one parental figure should be treated. If data for a missing parent are left as missing, then estimation techniques such as maximum likelihood estimation will treat those cases as similar to others who have similar values on other variables but have a parent present, which may not be appropriate. Other techniques for dealing with missing data, such as multiple imputation, would actually impute a value for the missing parent, which seems to ignore the informative nature of the missing data. Alternatively, an extra category for a missing parent might be included within each parental variable. This dilutes the measure however, meaning it should be interpreted as partially about whether a parent is present and partially about the SEP of that parent. Also, from a technical standpoint, this means treatment as a nominal rather than an ordered, categorical variable, which could mean analytical complications. A further alternative would be to create a single, cross-classified variable summarising the information from both measures, but such an approach would not overcome issues of diluting the measure, or the difficulties of working with a nominal variable, and the high number of categories could leave very small numbers in some categories. Considering these difficulties, for any SEP indicators where parents were coded individually the more parsimonious, if somewhat less informative, household approach has been taken, using the higher position from couple parents.

3.2.1.6 Multiple indicators

Some social and economic resources are represented within a range of SEP measures (e.g. status, prestige, or money) and since measures of SEP are usually correlated one could argue that any resource represented by any measure of SEP will be represented by proxy to some degree in any other measure of SEP. However, correlations between measures of income, occupation and education are often not very high; correlations may range between 0.1 and 0.6, indicating that while there is shared variance, there is also room for independent effects (Liberatos and Link, 1988) and at least partially independent representation of some resources.

There is no single, best indicator of SEP (DHSS, 1980, Galobardes et al., 2006a); indeed, where multiple mechanisms are in operation a single SEP indicator which does not fully encompass all these mechanisms will not fully represent the association between SEP and the health outcome (Benzeval et al., 1995, Krieger et al., 1997, Braveman et al., 2005, Galobardes et al., 2006a), and may underestimate the magnitude of the association (Link and Phelan, 1995, Adler et al., 2012). For aetiological purposes, differences in association between measures which emphasise different resources may even be informative. Hence some advocate examining associations across a range of SEP measures and using the differences or consistencies between them to draw inferences about the relative importance of different mechanisms (Gilman et al., 2003).

A common approach to incorporating information from multiple measures of SEP is to mutually adjust for them in regression analyses (see section 3.3.2.1). Whilst the approach of mutually-adjusting for multiple measures of SEP may be sufficient for capturing SEP-related variance where SEP is viewed as a confounder, this approach may hold some interpretative difficulties when focusing on the aetiological role of SEP (Westreich and Greenland, 2013). Studies tend to focus more on the differences between associations for different SEP measures than on the consistencies between them, drawing inferences from the potentially random and often minor differences in the significance or magnitude of associations. There can also be a tendency to interpret statistically independent associations from different measures as representing only the more specific characteristics of those measures, forgetting the conceptual overlap between them. Consider for example an observation of statistically independent associations with measures of education and occupation. The two variables are both viewed as representing some shared and some unique characteristics. However, if the mutually adjusted regression coefficients are interpreted as solely representing the effects of the unique characteristics of each measure then the effect of their shared characteristics has been forgotten or assumed to be nil. It is unclear what portion of the coefficients for education and occupation can be interpreted as representing the effect of these shared characteristics.

Another approach is to aggregate information from multiple measures in one way or another, e.g. by creating an index or defining a latent variable (see section 3.3.2; Krieger et al., 1997, Galobardes et al., 2006b, Lanza et al., 2011). However, whilst latent variable or other techniques for aggregating across measures bring out the commonalities between SEP measures, these techniques also tend to represent SEP as a unitary construct, whilst theory suggests multi-dimensionality (e.g. class and status), or at least differential representation of resources. Since different measures of SEP can give discrepant indications of position, averaging across them can be misleading and may direct attention away from heterogeneity between measures and the potentially meaningful information about SEP that might be contained therein (Liberatos and Link, 1988).

For the purposes of this thesis, I take the pragmatic approach of examining independent associations using a range of SEP measures. This does not necessarily overcome some of the above issues, but at least gives a sense of whether the association is consistent across different measures, or whether particular measures show very strong associations whilst others do not. Consistent associations across a range of measures are interpreted as primarily resulting from their shared characteristics, whilst particular effects for particular measures can be interpreted as representing effects of the specific characteristics of those measures.

3.2.1.7 SEP measures in the three datasets

Measures of parental occupation, income and education from NCDS58, BCS70 and T07 are utilised in Chapters 5 through 7 (and in Chapter 4 for T07). These measures were obtained from parents during the adolescent surveys. Parental occupational class was coded according to the British Registrar General's classification (Office of Population Censuses and Surveys, 1980) as either non-manual (I, II and III non-manual) or manual (III manual, IV and V) using the highest status from couple parents. Parents of respondents in all cohorts reported weekly household income in bands (NCDS58: £0-4, £5-9, £10-14, £15-19, £20-24, £25-29, £30-34, £35-39, £40-£44, £45-49, £50-59, £60 or more; BCS70 & T07: less than £50, 50-99, £100-149, £150-199, £200-249, £250-299, £300-349, £350-399, £400-449, £450-499, £500 or more). NCDS58 and T07 asked about net income, whilst BCS70 asked about gross income. Mid-points of reported bands were equivalised for household composition and split into tertiles. The modified OECD weighting scheme (de Vos & Zaidi, 1997; Hagenaars et al., 1994) was used to equivalise income for NCDS58 and BCS70 whilst the McClements scheme (McClements, 1977) was used for T07 (based on what was available ready-to-use from data providers). Respondents were coded as low income if they were in the lowest tertile within each cohort. Parents also reported what age they left full-time education and a binary variable indicated whether at least one parent had remained in education beyond the age of 16.

3.2.2 Measurement of smoking, drinking and psychiatric distress

3.2.2.1 Smoking

As noted in section 2.1.3.2, uptake of smoking can be a process with a number of stages including: preparatory knowledge, beliefs and expectations; initial trying; a stage of experimentation involving repeated but irregular use; regular smoking; and nicotine dependence or addiction, characterised by increasing physiological tolerance for nicotine and the experience of withdrawal symptoms when nicotine intake is not maintained (Flay, 1993). Measurement of smoking will ideally differentiate between stages. Purely comparing non-smokers and smokers can conflate effects that are particular to the various stages in the process of becoming a smoker (West et al., 1999, Kim et al., 2009). Whilst measurement of smoking in surveys is not necessarily sensitive enough to fully differentiate between all of these developmental stages, a key distinction is between infrequent and regular use (West et al., 1999).

Regular smoking among older adolescents and adults tends to be defined as at least 1 cigarette a day (or 7+ weekly; Blaxter, 1990, Flay, 1993, West et al., 1999). Those smoking less than 1 cigarette a day can be classed as experimental or occasional smokers (West et al., 1999). Adolescents or young adults who identify as ex-smokers are principally former experimental smokers, and those who identify as never-smokers may also have been former experimental or occasional smokers (West et al., 1999).

Smoking differs from drinking alcohol in that most adult smokers are addicted (Flay, 1993). Addiction to smoking may be the result of conditioned responses to a complex web of social cues, as well as physiological responses to actual nicotine levels (Fisher et al., 1993). A threshold of 10 or more cigarettes a day is sometimes used to indicate probable nicotine addiction (Flay, 1993).

Self-reporting potentially limits accuracy, especially in home interviews where young people may be worried about being overheard and under-report (West et al., 1999). Since legal purchase of cigarettes is linked to age, some adolescents may also over-report in order to signify a more adult-like status (Furlong, 2013). Preferred methods of reporting include postal or school-based questionnaires, where a cotinine test (fake or real) can improve accuracy (West et al., 1999).

When measuring quitting, some suggest cessation for more than six months can represent a maintained change (Sutton, 2005). Others maintain that it can be useful to distinguish between those who have quit for more than a month and those who quit more recently, as empirical differences in relapse rates have been established between these groups.

Respondents in NCDS58, BCS70 and T07 self-reported smoking status in adolescence and early adulthood. Daily smoking in adolescence could not be defined in the same way in all cohorts because of variations in question wording and response categories. Thus, daily adolescent smoking was defined as follows within each cohort: smoking 10 or more cigarettes weekly in NCDS58; 6 or more weekly in BCS70; and 7 or more weekly in T07. In early adulthood (i.e. at ages 23, 26 and 22 for NCDS58, BCS70 and T07 respectively) respondents were asked whether or not they currently smoked, and then if they did smoke, how many they smoked per day. Respondents who reported smoking one or more cigarette per day were coded as daily smokers in early adulthood. Precise question wording is in Table 3-3.

Table 3-3: Smoking measures by cohort[a]

Concept	NCDS58	BCS70	T07
Smoking in Adolescence	How many cigarettes do you usually smoke in a week? None Less than 1 a week 1-9 a week 10-19 a week 20-29 a week 30-39 a week 40-49 a week 50-59 a week 60 or more a week (0=less than 10 weekly; 1=10 or more weekly)	How many cigarettes do you smoke in a week? Non-Smoker One a week 2-5 6-10 11-20 21-40 41-70 71-100 More than 100 *Or, if missing then...* Since this time last week, how many cigarettes have you smoked? (0=less than 6 weekly; 1=6 or more weekly)	How many cigarettes (including any roll-ups) do you usually smoke in a week? (0=less than 7 weekly; 1=7 or more weekly)
Smoking in early adulthood	How many cigarettes a day do you usually smoke? (0=less than 1 a day; 1=1 a day or more)	How many of the following do you usually smoke in a day? Number of cigarettes and number of cigars recorded separately (0=less than 1 a day; 1=1 a day or more)	How many cigarettes (including roll-ups) do you usually smoke each day? (0=less than 1 a day; 1=1 a day or more)

[a]Coding used for analysis is summarized in parantheses.

3.2.2.2 Drinking

Individual patterns of drinking behaviour are complex and dynamic, varying over time (Sobell and Sobell, 2003). The main dimensions considered for measurement are quantity, frequency and alcohol-related problems, i.e. where drinking produces adverse consequences such as disruption of social relationships (Colder et al., 2002, Mason et al., 2008). Quantity and frequency are sometimes multiplied to give a measure of intensity but this does not distinguish well between infrequent heavy drinkers and frequent light drinkers; patterns which may have different consequences and aetiological processes (Colder et al., 2002).

Survey studies of alcohol consumption using self-report measures tend to under-estimate true levels of consumption, as measured for example by beverage sales (Sobell and Sobell, 2003). Reasons for this under-estimation may include non-participation of heavy drinkers, associations between forgetting and high consumption, seasonal variations in consumption, and the social desirability of more moderate responses (Sobell and Sobell, 2003, Gray et al., 2013). Features of questions can help with this, for example, questions on frequency might have pre-specified categories, presented in descending order and beginning with a frequency category higher than most respondents would report so as to encourage respondents to believe their drinking lies within accepted norms (Dawson and Room, 2000).

Questions which ask for average quantities or frequencies of consumption within specified time periods also tend towards underestimation (Dawson and Room, 2000, Sobell and Sobell, 2003). Methods that require respondents to retrospectively report drinking levels on each day of a specified time-interval such as a week (daily drinking measures) have greater accuracy (Sobell and Sobell, 2003). However, if the recall period is relatively short (e.g. a week), the proportion of non-drinkers may be over-estimated and rates of high-risk, problem drinking may be under-estimated, as a short time-interval can miss infrequent or episodic heavy drinking (Sobell and Sobell, 2003).

Particularly with adolescents, and especially younger adolescents, a seven-day interval may not capture many drinkers, and definitions of regular drinking that rely on at least one drink per day (or more than seven per week), may not adequately reflect the nature of regular drinking in this age group (Green, G et al., 1991). A more appropriate definition of regular drinking for adolescents might be once a week or more. As with smoking, some adolescents may over-report, wishing to appear more mature, whilst others will under-report, desiring to hide engagement in a prohibited behaviour (Furlong, 2013).

For identifying problem or heavy drinking, questions that require subjective interpretation of terms such as being drunk, heavy drinking or feeling the effects can be ambiguous and may be inconsistently interpreted by respondents (Dawson and Room, 2000, Sobell and Sobell, 2003). A common definition of heavy drinking in the UK is based on reports of the number of units consumed over the past week and identifies heavy drinking as consumption in excess of 14 units for women, and 21 units for men (Royal College of Physicians et al., 1995). However, the 8g unit used for such questions is poorly understood and often misinterpreted by respondents as corresponding to a single drink (Dawson and Room, 2000). Also, these recommended limits only date back to 1995, so respondents in

NCDS58 and T07 would probably not have been aware of them by their surveys in early adulthood.

With regards to NCDS58, BCS70 and T07, drinking was self-reported in all cohorts in adolescence and early adulthood. The most consistent definition of adolescent drinking across the three cohorts was an indication of regular, weekly drinking, which is an appropriate indicator of drinking at this age. This was either based on whether respondents reported drinking alcohol within the last week (NCDS58, BCS70) or on their reported frequency of drinking (BCS70, T07). Since both definitions were available in BCS70, data from the question on frequency was preferred, but past week consumption was used if frequency data were missing (n=332). In early adulthood, respondents in all three cohorts reported their past week's drinking and numbers of alcohol units were derived. Drinking more than 14 units for women or 21 units for men (Royal College of Physicians et al., 1995) was coded as heavy drinking in early adulthood. Precise wordings of questions on drinking are included below in Table 3-4.

Table 3-4: Drinking measures by cohort[a]

Concept	NCDS58	BCS70	T07
Drinking in adolescence	How long is it since you had an alcoholic drink (beer, wine, spirits, etc.)? Less than 1 week 2-4 weeks 5-8 weeks 9-12 weeks Over 12 weeks Never (0=less than 1 week; 1=more than 1 week)	In the last 12 months, about how often have you had anything alcoholic to drink? Every day/most days 4-5 times weekly 2-3 times weekly Once a week Once a month Only on special occasions Never *Or, if missing then...* If you have had any alcoholic drink since this time last week, on how many days did you do so? (0=less than weekly; 1=weekly or more)	About how often do you drink [alcohol]? More than once/day Once/day 4-6 days/week 2-3 days/week Once/week Once/fortnight Once/month Once/3 months Once/6 months Once/year Less than yearly Never (0=less than weekly; 1=weekly or more)
Drinking in early adulthood[b]	In the last seven days, that is not counting today but starting from last [name present day of week], how much beer, stout, lager or cider have you had? In the last seven days how many measures of spirits have you had? In the last seven days how many glasses of wine have you had? (take 1 bottle=6 glasses) In the last seven days how many glasses of martini, vermouth or similar drinks have you had? *Convert answers to units* (0=within recommended limits; 1=greater than recommended limits)	In the last week I have drunk: No alcohol at all (#pints) Shandy (#pints) Beer/lager (#pints) low alcohol beers/lagers (#pints) Cider (#pints) Low alcohol cider (#glasses) Wine (#glasses) Low alcohol wine (#single measures) Spirits (Gin, Whisky, Vodka, Rum, Brandy) (#small glasses) Martini/Cinzano/Sherry (details) Other alcohol drink *Convert answers to units* (0=within recommended limits; 1=greater than recommended limits)	Thinking of last week. How much of each of the following did you drink? If it helps, think back over each day to this time last week. Please write the amount in the space against each type of drink. Beer, lager, cider (pints) Wine (glasses) Martini, sherry or port (glasses) Spirits (whisky, gin, vodka, etc; measures) Other alcoholic drinks (glasses) *Convert answers to units* (0=within recommended limits; 1=greater than recommended limits)

[a]Coding used for analysis is summarized in parantheses.
[b]Recommended weekly limits are 14 units for women and 21 units for men.

3.2.2.3 Psychiatric distress

'Psychiatric distress' can signify anything from relatively mild emotional distress to severely disordered psychological function. For the purposes of this thesis it refers specifically to disturbed mood or affect, or symptoms of anxiety and depression, and does not encompass symptoms of other psychiatric disorders such as substance abuse, eating disorders or psychoses.

Perhaps the most obvious way to measure psychiatric disorder is to distinguish between those undergoing treatment and those not being treated (Dohrenwend and Dohrenwend, 1969). However, such a definition is not well-suited to epidemiological purposes as those treated make up a relatively small proportion of the total number of people experiencing psychiatric distress and treatment rates may be stratified for reasons other than real differences in disorder prevalence (e.g. availability of and subjective norms towards treatment; Dohrenwend and Dohrenwend, 1969).

Another common approach to measurement involves sets of distinct 'diagnoses' with clear and detailed operational criteria of what constitutes a diagnosis of a particular psychiatric disorder (Goldberg and Williams, 1988, Cole et al., 2008). Diagnostic schedules tend to discount symptoms which can be explained by other factors such as substance use (Murphy, 1995), which may be a disadvantage for studies on the concurrence of psychiatric distress and substance use. Additionally, standard diagnostic criteria tend to have been developed for adults and may not be as relevant for adolescents (Glantz and Leshner, 2000). Narrow diagnostic criteria risk under-identification, but broad criteria sacrifice reliability and potentially mask aetiological heterogeneity (Cole et al., 2008). There is particular concern, given high (and possibly under-estimated) levels of co-morbidity and similarities in risk factors, that diagnostic distinctions for anxiety and depression may be invalid, with some suggesting that they be grouped together as 'distress disorders'(Moffitt et al., 2007, Cole et al., 2008). Indeed, concurrent anxiety symptoms are associated with greater persistence of depression symptoms (Coryell et al., 2012, Green, MJ and Benzeval, 2013).

Alternatively, psychiatric illness can be conceptualised as a continuum ranging from psychiatric health to severe disturbance, with symptoms among the general population being distributed across this range rather than focused at the two extremes (Goldberg and Williams, 1988, Cole et al., 2008). Symptoms across this range can then be measured on standardised scales, developed for this purpose. However, there is still a tendency to distinguish between those with and without an illness by setting thresholds for identification of ‘cases’ where symptom levels would be likely to, but do not necessarily, constitute a psychiatric diagnosis (Goldberg and Williams, 1988, Murphy, 1995).

An example of a symptom scale used to measure psychiatric distress is the General Health Questionnaire (GHQ; Goldberg and Williams, 1988). There are a few different versions with different numbers of items, but each contains items measuring disruption to ‘normal’ functioning, and ‘phenomena of a distressing nature’ (p5; Goldberg and Williams, 1988), which means primarily symptoms of anxiety and depression, including somatic symptoms as well as ‘felt psychological disturbance’ (p12; Goldberg and Williams, 1988). GHQ responses can be coded as continuous scores, or in a categorical fashion with specified thresholds to estimate the prevalence or relative odds of psychiatric disturbance in particular populations. Scores above the mean are suggested as indications of probable psychiatric cases (often resulting in a threshold of two or more positive responses on the 12-item version; Goldberg and Williams, 1988), but a threshold of three or more positive responses on the 12-item version has been suggested as more valid for identifying distress in young people (Banks, 1983).

The Rutter Malaise Inventory (Rutter et al., 1970) is another symptom scale, similar to the GHQ. It has 24 yes-or-no items covering symptoms of emotional disturbance, including some somatic symptoms. Those who answer yes to eight or more of the 24 items are considered to be probable psychiatric cases (Rodgers et al., 1999). It has been shown to be equally valid for different socioeconomic groups (Rodgers et al., 1999), whereas there is evidence that more disadvantaged respondents under-report symptoms on the GHQ (Stansfeld and Marmot, 1992). When applied to the same sample, the GHQ tends to classify more individuals as cases than the Malaise inventory (Sacker and Wiggins, 2002).

Table 3-5 shows the different measures of psychiatric distress used in adolescence and early adulthood. The GHQ-12 was administered in adolescence in BCS70 and T07 and in early adulthood in T07, and the cut-off of 3 or more was used to indicate probable psychiatric disorder for this thesis. The Rutter Malaise inventory was administered in early adulthood in NCDS58 and BCS70. There was no standard measure of psychiatric distress included at age 16 in NCDS58 so instead the neuroticism component of the Rutter behavioural scale (Rutter, 1967) as rated by the young person’s school teacher was employed to indicate anxiety and depression symptoms. This consisted of four items indicating whether the young person often worried, appeared miserable, was afraid of new things, or had refused to enter school. This may not have been intended as a measure of anxiety and depression symptoms, but the items have a high degree of face validity for measuring this concept. Each item was scored from 0-2 so the score range was from 0-8. There were no established cut-offs for this scale, but since the majority of the sample had scores of 1 or less, a cut-off of 2 or more was used to indicate probable psychiatric problems.

Table 3-5: Psychiatric distress measures by cohort

Age	NCDS58	BCS70	T07
Adolescence	Neuroticism component of Rutter Behavioural Scale	12-item GHQ	12-item GHQ
	(0=score less than 2; 1=score of 2 or more)	(0=score less than 3; 1=score of 3 or more)	(0=score less than 3; 1=score of 3 or more)
Early Adulthood	Rutter Malaise Inventory	Rutter Malaise Inventory	12-item GHQ
	(0=score less than 8; 1=score of 8 or more)	(0=score less than 8; 1=score of 8 or more)	(0=score less than 3; 1=score of 3 or more)

3.3 Analysis methods

This section introduces statistical methods and principles, beginning first with some background discussion on person and variable centred approaches to analysis, and on dealing with missing data. Next, various techniques for analysis of longitudinal data are discussed including: regression, structural equation modelling, latent class models, and event history analysis, with propensity scoring techniques included as a means of considering causality.

3.3.1 Analytical principles

3.3.1.1 Person vs. variable centred analysis

Respecting analytical methodology, a distinction can be made between variable-centred and person-centred approaches (Lanza et al., 2011). A variable-centred approach aims to identify the strength of a relationship between a variable and an outcome, net of, or adjusted for, other related variables (or risk/protective factors), i.e. the independent effect of that variable with all others held equal. A person-centred approach on the other hand aims to identify typical sub-groups of people with distinct response patterns, focusing on the holistic combination of variables, or on the entire profile of responses, rather than on single variables. Person-centred approaches aim to identify distinct groups, where each group contains individuals who are similar to each other and different from those in other groups (Muthén and Muthén, 2000).

The variable-centred approach has traditionally been quite dominant in epidemiological research but person-centred approaches are beginning to receive greater attention (Bergman and Andersson, 2010), as in some cases the spread or pattern of risk may be more important than individual exposures (Caprara and Rutter, 1995), especially in longitudinal data (Elder, 1974). This is because exposures may have multiplicative effects, e.g. the risk of an outcome in the presence of two risk factors may be greater than the simple sum of the risk from each factor alone (and similar principles apply to protective factors; Caprara and Rutter, 1995). However, given limited statistical power it can be difficult in such situations to identify complex interactive effects using variable-centred approaches, especially where there are many correlated, interacting risk factors. The effect of a variable is often assumed to be constant irrespective of the presence, absence or level of other factors and it can be difficult to interpret such variable-centric information (Bergman and Andersson, 2010, Lanza et al., 2011).

A person-centred approach, in contrast, focuses more on this complexity and interactivity, and thus may be more suited to research on developmental processes (Bergman and Andersson, 2010). It moves away from the paradigm of other things being equal by acknowledging that in most instances they are not. This does not necessarily make it any clearer which of the variables in a combined pattern is the most important determinant of an outcome, but places more emphasis on how variables relate together to produce outcomes.

Where outcomes are related, for example with smoking, drinking and psychiatric distress, it can be useful to identify the common patterns by which outcomes group together, and see how those combinations of outcomes relate to combinations of relevant predictive factors, thus identifying high risk sub-groups of the population who are experiencing particular combinations of exposure variables and/or outcomes. This kind of approach can be especially useful for studying longitudinal development, where the focus is on combinations of responses at repeated measurements (Muthén and Muthén, 2000).

Developmental trajectories can vary between individuals, with differences in initial levels and in patterns of change, as well as differences between groups (Wickrama and Wickrama, 2010). Rather than asking what the average trajectory is in different groups, it can be better to ask what types of individual trajectories are present, and in what proportions, within different groups. A person-centred approach may be especially useful for studying the developmental trajectories of multiple inter-related outcomes as they may relate to each other in complex ways depending on the stage of development of each outcome.

However, person-centred approaches tend to be more inductive than deductive (Bergman and Andersson, 2010), i.e. it is hoped that by examining the holistic patterning of relevant variables, useful conclusions may become apparent from the pattern of data, rather than by testing specific, falsifiable hypotheses (Blaikie, 2000). This may be because it is difficult to construct person-centred hypotheses from previous research that has been mostly variable-centred (Bergman and Andersson, 2010), but inductive descriptions of the data under a person-centred approach may suggest specific hypotheses about interactions or pathways that could be tested in other datasets using variable-centred methods.

3.3.1.2 Missing data

Missing data often complicate analyses of observational survey data (Clarke and Hardy, 2007, Seaman et al., 2012). Data can be missing because individuals fail to respond to particular questions, or to entire waves of a longitudinal survey. Missing data can be missing-completely-at-random (MCAR), missing-at-random (MAR), or missing-not-at-random (MNAR). MCAR means the likelihood of data being missing is equal for all individuals, and is therefore entirely random and unrelated to the data values which are missing. Although data which are MCAR reduce statistical power by reducing the number of respondents who can be included in an analysis, they can be safely ignored as their absence will not bias the estimation of associations from the observed data. Where missing data are not MCAR, an analysis model that utilises only those cases with fully-observed data may provide biased estimates.

MAR means that missingness is random, given other observed variables. The likelihood of data being missing is not equal for all individuals, but the available information gives sufficient indication of who will and will not have data. Missingness may be related to the actual data values which are missing, but only to the extent that these values are predictable from the other available information. Statistical models that are estimated using maximum likelihood estimation, for example, generally assume that missing data are MAR, given the observed data that are included within the model. Estimates would be unbiased under these circumstances, as long as data predicting missingness are part of the model, but this is not always the case.

MNAR means that the likelihood of data being missing is related to the actual data values, independently of any other observed variables. Data which are MNAR may result in biased model estimates. In practice it is difficult to know whether data are MAR or MNAR since the actual data values for the missing responses are not known. This also means that it is difficult to adjust model estimates if data are MNAR. One approach for dealing with this is to assume values for the association between the missing values and the chance of being missing, and assess how robust findings are to a range of different assumed values for this association. In general though, most researchers tend to assume that data are MAR. This means it is important to include enough information from other observed variables for the MAR assumption to be plausible.

Two commonly used techniques work under an assumption of data being MAR, but include an additional step of modelling, allowing for the inclusion of variables which predict missingness but which are not part of the analysis model (Seaman et al., 2012). Inverse probability weighting estimates a logistic regression model where having a fully-observed set of data (for the analysis model) is the outcome. Individuals with fully-observed data are then assigned analysis weights calculated as the inverse of their probability of having full data. The analysis model is estimated using the respondents with fully-observed data, but adjusted with the analysis weights. This provides unbiased estimates assuming that missing data are MAR and assuming that the weighting model is not itself biased.

Multiple imputation, on the other hand, starts with an imputation model which aims to predict missing data values on the basis of other observed variables (again these are not limited to those within the analysis model; Asparouhov and Muthén, 2010b, Seaman et al., 2012). Multiple new datasets are then created with missing values imputed, based on their predicted distributions. The analysis model is estimated within each new dataset and the results are averaged. This produces unbiased estimates assuming that missing data are MAR and assuming that the imputation model is not itself biased. Five imputed datasets are often considered sufficient to capture variability and provide unbiased estimation of the analysis model (Asparouhov and Muthén, 2010b). In contrast to inverse probability weighting which requires full data for the weighting model, multiple imputation does not require full data for all the variables in the imputation model.

In some cases, a combination of these techniques may be appropriate (Seaman et al., 2012). For example, in a longitudinal survey, there will often be a combination of data which are missing because some respondents dropped out of the study, and data which are missing because respondents who did participate did not answer all relevant questions. In such circumstances, inverse probability weighting would need to be based on those who answered all the relevant questions, dropping information from those who did participate but did not answer all the questions, whereas multiple imputation may be imputing values for those who dropped out based on relatively little information, as they would have few observed responses to base imputations on. However, inverse probability weighting could be used to model drop out, with multiple imputation used to estimate values for those who did not drop out but failed to respond to particular questions. When combining these techniques it is recommended that as many as 25 imputed datasets are created rather than only five (Seaman et al., 2012).

3.3.2 Specific techniques

It is important to consider the aims of this thesis (see section 1.2), in deciding which specific analytical techniques to employ. Given the interest in longitudinal developmental processes, methods for analysing longitudinal data will be most appropriate. These might include methods that: can describe developmental trajectories; allow for exploration of mediating mechanisms from background SEP to the outcomes in question; and are sensitive to the timing and sequencing in which developmental events occur. Methods that allow for consideration of the interdependence of smoking, drinking, and psychiatric distress would be especially relevant, and as mentioned above (section 3.3.1.1), triangulation across both person and variable-centred methods has potential value. Finally, considering the aetiological nature of the investigation, methods for making causal inferences from observational data are worthy of consideration.

3.3.2.1 Regression

Regression is a standard statistical procedure for modelling relationships among observed variables (Muthén and Muthén, 2012), and can be used for longitudinal analysis when variables are measured at different points in time. It also forms the basis for many other methods of longitudinal analysis. In its simplest form, a continuous dependent variable (Y) is conceptualised as a linear combination of a constant (a), an independent variable (X) multiplied by a co-efficient (b), and a variable error term (e), such that:

$$Y = a + bX + e$$

Various methods are available for estimating the values of 'a' and 'b' (e.g. weighted least squares, maximum likelihood), but these have the general goal of identifying values for 'a' and 'b' which minimise a function of the error term 'e' to replicate the data being analysed, i.e. a model which is the best fit to the actual data and has the least possible amount of error. X need not be only a single independent variable, there may be a range of these and each would have its own coefficient estimated as below. This means that regression is a variable-centred approach (Lanza et al., 2011).

$$Y = a + b_1X_1 + b_2X_2 + ... + b_xX_x + e$$

Where the dependent variable is categorical, a linear formulation as above is inappropriate. Instead a logit link is commonly employed such that the linear equation above is used to estimate the log odds of the dependent variable, hence the term, logistic regression. One feature of this approach is that the coefficient (b) can be exponentiated to obtain an odds ratio (OR). That is, it describes the ratio of the odds of an outcome (Y) where the independent variable (X) is at a particular value, to the odds of that outcome after a unit increase in the independent variable (X). Thus, an OR of one represents no association between the independent and the dependent variable. ORs greater than one suggest that increases in the value of the independent variable are associated with increases in the odds of the outcome, whilst ORs less than one suggest that increases in the value of the independent variable are associated with decreases in the odds of the outcome.

Independent variables are considered to be associated with outcomes when their coefficients (b) are sufficiently different from zero to indicate real differences within the target population, rather than mere random variation within the sample population. This is commonly expressed in terms of p-values, with a p-value less than 0.05 indicating greater than 95% confidence that the true value of the coefficient within the target population differs from zero, given the sampled data. It also common to calculate 95% confidence intervals (95% CI) for the coefficient (or OR), as an expression of the range within which one can be confident the true, target population value lies (Gardner and Altman, 1986, Cumming, 2009). This 95% confidence threshold is commonly accepted, but arbitrary. Some prefer more stringent levels, e.g. 99% (or a p-value <0.01), especially where multiple comparisons are being made. Others are inclined to view 90% confidence (or p-values <0.1) as indicative of a trend. The common 95% threshold is used here, but some associations at 90% confidence are also highlighted, on the understanding that these represent weaker evidence of an association than those with a p-value less than 0.05.

Inclusion of multiple independent variables is common due to the desire to adjust associations with a particular variable of interest for other variables which may confound the association between that variable and the outcome. There are however a number of ways in which a third variable might be related to another independent variable and an outcome. These might include confounding and mediation. A confounder would be a variable with some causal influence on both the outcome and the independent variable of interest and, without adjustment, may bias an estimate of association between those variables. A mediator would also be associated with the outcome and the independent variable, but in contrast to a confounder, the causal direction runs from the independent variable to the mediator to the outcome. Adjusting for a mediator in a regression analysis, may actually provide a biased estimate of the association between the independent variable and the outcome (Tu et al., 2008, Westreich and Greenland, 2013). Interpretation of regression models with multiple covariates therefore requires careful theoretical consideration of causal relationships between those covariates.

3.3.2.2 Structural equation modelling

Structural equation modelling can be thought of as a combination of measurement models, in which latent variables are defined, and a structural model, which describes relationships between those latent variables and other observed variables. A latent variable is a variable which is not observed directly but which may be inferred from other observed information. Observed variables which all measure a similar construct, but each with some degree of error, might be combined into a measurement model for that construct. Each observed variable is then treated as an indicator for the latent, unobserved variable.

The structural model is essentially a combination of regression relationships (and therefore still variable-centred), which are estimated together, and within which some variables may serve as both dependent and independent variables. Such models can be longitudinal as variables, latent or observed, are measured at different times. For example, in Figure 3-1, the variable X at time 1 is treated as an independent variable predicting the dependent variable Y at time 2, whilst X and Y are both treated as predicting the dependent variable Z at time 3. Formulations such as this can be especially useful for investigating mediating mechanisms (e.g. X to Y to Z).

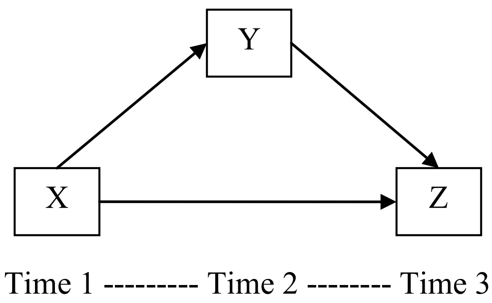


Figure 3-1: An example of a structural equation model

Structural models that do not contain any measurement models of latent constructs (i.e. where all the variables are directly observed) are sometimes referred to as path analyses. However, the path analysis terminology tends to be strongly associated with models using continuous data, which allow for estimation of direct and indirect effects. Estimation of indirect effects is not available when mediators are categorical and so to avoid confusion I refer to models with categorical mediators as structural equation models.

Structural equation modelling can be confirmatory, in the sense that a structural model is described *a priori*. An investigator can then evaluate whether the hypothesised relationships are significantly different from zero (i.e. using p-values) and in the proposed direction, when the hypothesised model is estimated from the observed data. Various model fit indices are additionally available (e.g. CFI, TLI, RMSEA; Muthén and Muthén, 2012) for assessment of models, though these cannot be obtained in some instances, e.g. where a model with categorical mediators is estimated using maximum likelihood.

3.3.2.3 Latent class models

Latent class models are special cases of structural equation models which involve a categorical latent variable, and have been used extensively to describe heterogeneity in individual, developmental processes (Twisk and Hoekstra, 2012). The aim of latent class analysis (LCA) is to identify sub-groupings within the data, termed latent classes, such that individuals within the same class are very similar to one another, whilst individuals from different classes are very different from one another (Muthén and Muthén, 2000, Collins and Lanza, 2010). Thus latent class models are person-centred (Lanza et al., 2011). Model parameters include the probability of membership in each class, and the probabilities of different responses given class membership (or mean responses given class membership where continuous data are used). LCA models additionally provide estimates of the probability of membership in each class for each individual, given their observed responses (these are called posterior probabilities). At its simplest LCA is just a measurement model, where a latent class variable is estimated from a set of observed indicators. However, it is also possible to relate latent class membership to other variables as part of a wider structural model. These methods have been criticised recently for providing inaccurate descriptions of simulated heterogeneity (Twisk and Hoekstra, 2012), but this criticism appears to have been due to an error in the method used to test them (Green, MJ, 2014).

There are various ways of treating longitudinal data in LCA models and these are worth discussing briefly. A repeated measures LCA model does not differ mathematically from a cross-sectional LCA model, but the variables used as indicators of the latent class variable are repeated measurements of the same construct at different time points. Such a model can be a relatively simple approach for describing developmental processes. However, LCA models assume conditional independence (Collins and Lanza, 2010). This means that observed variables are assumed to be uncorrelated within a latent class (i.e. the latent class variable captures all of the covariance between variables). This may be a more questionable assumption when repeated measurements are used than when measurements are of different constructs, as repeated measurements are often highly correlated.

Latent class growth analysis also uses repeated measurements, but class membership is indicated by the intercept and slope of a trajectory derived from those repeated measurements, rather than from the repeated measurements directly (Muthén and Muthén, 2000). These models can be extended to allow for individual variation around the intercept and slope parameters within each class (Muthén and Muthén, 2000, Colder et al., 2002). This is potentially a more efficient way of dealing with within-class correlations between repeated measures, as much of this would be captured by the individual variation in the intercept or slope.

Latent transition analysis is another extension, which focuses on changes in class membership over time (Muthén and Muthén, 2000, Collins and Lanza, 2010). The measures used for a cross-sectional LCA are repeated at multiple time points, and the aim is to study the probability of transitions between classes from one time point to the next.

Whichever method is in use, the object is to find the smallest number of latent classes that can adequately describe the observed data (Muthén and Muthén, 2000, Collins and Lanza, 2010). The number of latent classes in the model has to be specified by the analyst so classes are added incrementally and model fit statistics examined until further classes lead to deterioration in model fit. Various indicators of model fit are available. The log likelihood, Akaike's Information Criterion (AIC) (Akaike, 1974) and Bayesian Information Criterion (BIC) (Schwarz, 1978) are all measures of how well the model fits the observed data. Higher values for the log likelihood and lower values for the AIC and BIC indicate better fit. The AIC and BIC also both take into account the parsimony of the model (i.e. the number of model parameters being estimated), with the BIC being more stringent in terms of parsimony, taking the sample size into account as well as the number of parameters. Entropy indicates how definitively respondents are being classified into latent classes (values range from 0-1 with 1 representing definitive classification; Celeux and Soromenho, 1996). Since, for example, a 1-class model would perfectly classify respondents, but probably have poor fit, entropy is worth considering in a 'tie' situation where models with different numbers of classes do not differ much in terms of fit (in which circumstances a more definitive classification would be preferred).

Model identification can also be an issue. This refers to the extent to which the model parameters can be definitively estimated from the data. Identification problems are more likely when the number of parameters to be estimated is high relative to the sample size. When model identification is low, estimation of an LCA model from a particular set of starting values can sometimes converge on a local maximization of model fit, rather than hitting the global maximum (i.e. each set of starting values does not necessarily converge to the best-fitting model). The general approach is to use a range of starting values and examine how many converge to the same best-fitting solution. If most of the sets of starting values converge to the same solution then one can be more confident that this represents a global maximum. Where the best-fitting solution is hard to replicate (i.e. it is reproduced in only a small percentage of the sets of starting values) it may represent a local maximum or the model may not be identified (Collins and Lanza, 2010).

Since these various model fit statistics often disagree it is possible that more than one model would appear as a viable candidate for an optimal summary of the data, in which case additional criteria relating to the interpretive value of the latent classes might be employed. More parsimonious models, i.e. with fewer classes, are preferred *a priori*. The interpretive value of additional classes can be considered to be related to their prevalence and the uniqueness of the response probability profile. Additional classes that only represent a very small proportion of the sample, or that do not have very different response probability profiles from other classes, would not add much interpretive value and might be accepted as noise within a more restricted classification. In contrast, additional classes that represent a sizeable proportion of the sample and have very distinct response probability profiles would ideally be included.

Once the number of latent classes has been determined and an optimal model has been defined, it is often desirable to examine what factors predict class membership, or what outcomes are associated with class membership (i.e. integrating the measurement model into a structural model). Modal assignment is a common practice for this purpose (Vermunt, 2010): this involves estimating the LCA model, assigning individual respondents to the class where they have their highest (or modal) probability of membership, and then treating these class assignments as an observed variable in subsequent analyses. This can be problematic because the latent classification is usually 'fuzzy', with some degree of uncertainty as to which individuals should be in which class (Colder et al., 2002, Collins and Lanza, 2010). If class membership is then treated as observed, then associations with covariates tend to be underestimated (Vermunt, 2010). This is less of a problem when entropy is high, i.e. when there is little uncertainty about class assignment.

Another alternative is to estimate covariate associations together with the latent class model in a single step (Collins and Lanza, 2010). Uncertainty in class assignment is then built into the estimates of associations. However, each time a new variable is added to the model, this adds information and can potentially modify individual class assignments (Asparouhov and Muthén, 2010a). This means that models with different combinations of covariates are not necessarily comparable, and dilutes the meaning of latent class membership such that it is defined not solely by the latent class indicators, but also by the covariates (Vermunt, 2010).

Modal assignment uses 3-steps: estimation, assignment and analysis. A newer modification of this 3-step procedure by Vermunt (2010) takes account of the uncertainty in class assignments in the analysis step. This procedure performs well at identifying true relationships between latent class membership and covariates in simulation studies (Vermunt, 2010, Asparouhov and Muthén, 2014), and does not suffer from problems with class assignments changing when different sets of covariates are included.

3.3.2.4 Event history analysis

Event history analysis broadly describes another set of methods for use with longitudinal data, which can be particularly sensitive to the timing and sequencing of events (Singer and Willett, 2003). These methods focus on 'whether' and 'when' events occur, particularly on the amount of time it takes for a particular event to occur (e.g. trying a cigarette) beyond some initial starting point (e.g. before anyone has tried a cigarette). The occurrence of an event is defined as a transition from one discrete state to another non-overlapping discrete state. Generally in event history analysis, everyone begins in the same state and the focus is on transitions to one or more other states (with the list of possible destination states being exhaustive). It requires definition of a baseline starting point, at which everyone in the population has potential to experience the event of interest, but no-one has yet. This might be a particular age, or historical year, or could also be the point at which some necessary precursory event takes place (the timing of which differs between individuals). This last formulation could be especially useful for looking at developmental sequences, where one event must occur before another. You might estimate two models: one from a given baseline time-point to the first event, and a second model going from the time of the first event to the second. Different factors could be important for event timing in the first and second models.

A metric for measuring time is also needed (Singer and Willett, 2003). Choice of a metric will often depend on the available data, but finer, more precise metrics would generally be preferred. A distinction can be made between continuous time event history analysis, which uses a fine, relatively precise metric for the measurement of time, and discrete time event history analysis, which uses a coarser, less precise metric, where units represent longer intervals. Continuous time and discrete time analyses use different mathematical models, estimating different parameters, so the choice between these methods is important. Continuous time models would be more appropriate where the measure of time is fine enough to result in few 'ties', where multiple individuals are coded as experiencing an event at the same point in time. If the measurement of time is coarse enough that many individuals have events occurring within the same unit of time, then discrete time models would be more appropriate. Continuous time models utilise the time-to-event as expressed in the units of the chosen metric for estimating the hazard or risk of an event occurring. Hazard ratios are calculated to express differences in risk between respondents with different characteristics. Discrete time models recode the data into a long format, with an entry per respondent per unit of time. A variable indicates, for each entry, whether an event has occurred, and any entries after the occurrence of an event are discarded. An advantage of this technique is that such a data file can then be analysed using standard logistic regression techniques and the resulting ORs represent the associations between the variables of interest and the likelihood of experiencing an event within a given unit of time for those at risk (i.e. those who have not already experienced that event). Thus the interpretation of the ORs from a discrete time analysis is similar to the interpretation of a hazard ratio in a continuous time analysis.

Censoring is another important issue for event history analysis (Singer and Willett, 2003). Right-censoring (so-called because time is envisioned as proceeding from left to right) occurs when respondents drop out or data collection ends before respondents experience an event. For such cases, whether or when they experience the event is unknown: the event may occur shortly after censoring, a long time after, or never. However, these cases should not be ignored as they do provide information about the non-occurrence of events within the time-frame for which they were observed. Event history analysis methods account for right-censoring, using the information that is presented by these cases, under the assumption that censoring is unrelated to the likelihood of an event occurring. This is quite a reasonable assumption when censoring occurs because data collection ended for all respondents at some arbitrary point, but is less reasonable when it occurs because of drop-out; the chance of drop may be related to the likelihood of an event. Left-censoring occurs when individuals are not observed at the starting point, from which the time-to-event is measured. Such cases are problematic because it is ambiguous whether or not an event occurred during the period for which they were unobserved. Generally then, the ideal would be for each respondent to have a fully observed history covering the entire observation period.

3.3.2.5 Propensity scoring

This thesis aims to understand the aetiological role of SEP, but associations established using some of the previously mentioned methods may not necessarily be causal. There may be other confounding factors that account for an association, rather than it representing a causal link between two variables. Consider the experimental design, where subjects are randomly allocated to either a control or a treatment condition to ensure a balance of relevant background factors across both conditions (Austin, 2011). Differences between the control and treatment groups can thus be attributed to the effect of the treatment. In an observational study, those who have or have not experienced a particular exposure might be considered analogous to the control and treatment conditions from an experimental study, but it is rare that an exposure is randomly allocated. Differences between the two conditions might be attributable to either the effect of the exposure, the effects of background factors that influenced the likelihood of experiencing the exposure, or a mix of both.

The traditional approach to this problem would be to simply regress the outcome on the exposure, after adjusting for other background factors that may have influenced both the exposure and the outcome. A more recent alternative is to use propensity scoring techniques (Oakes and Johnson, 2006, Austin, 2011). These use observed background factors to estimate a person's propensity for being in the exposure condition and then use derived propensity scores (essentially the probabilities of being in particular groups) to adjust out any selection biases. There are a number of ways to use the propensity scores to do this. Probably the most popular approach is to match up people with similar propensity scores who did and did not experience the exposure, and there are various matching procedures for doing this. The effect of the exposure can then be obtained from a comparison of the matched samples. Another approach is to stratify the sample into quintiles (for example) of the propensity score. The causal effect can then be obtained by averaging across the differences between the exposed and unexposed within each strata. Others regress the outcome on the exposure whilst adjusting for the propensity score. Another simple technique is to use weighting based on the propensity scores to adjust for the selection biases. The goal of all these techniques is to mimic the experimental design by balancing background factors more evenly across the exposed and unexposed conditions. The different techniques tend to perform similarly well (Austin, 2011).

Both standard regression adjustment and propensity techniques accomplish more or less the same goals conceptually, but the processes associated with propensity analyses include explicit checks on whether sufficient data are present to make the desired inferences, whilst this tends to just be assumed under the regression modelling approach (Oakes and Johnson, 2006, Austin, 2011). The causal reasoning associated with propensity techniques also tends to be a little clearer about what question precisely one is trying to answer. The object is generally to produce an estimate of a counter-factual, i.e. an estimate of what would have happened if X had occurred (counter-to-fact). However, there are different ways of framing the counter-factual which relate to slightly different questions (Austin, 2011, Lanza et al., 2013). One might ask for example, what the outcomes would have been if everyone in the population had experienced an exposure, compared to if no-one did. This is sometimes referred to as the average causal effect. In contrast, one might ask what outcomes would have occurred among those who were exposed, if they had been exposed (which they were), compared to if they had not been exposed (i.e. counter-to-fact). This is sometimes referred to as the average causal effect for the treated (borrowing from the language of experimental design). These different framings of the counter-factual have different interpretations. The average causal effect among the treated has the advantage of recognising that the causal effect of an exposure may be different for the type of people who experience it, than for the type of people who do not; the average causal effect averages across these two, potentially different effects.

3.3.2.6 Overview of methods used in subsequent chapters

Many of the analytical techniques described above are utilised in this thesis. Chapter 4 focuses on background SEP and adolescent development of smoking, drinking and psychiatric distress, using LCA to take a holistic, person-centred view of development across all three outcomes. Chapters 5 and 6 aim at understanding how socioeconomic influences on early adult outcomes are mediated via adolescent development and participation in tertiary education, using structural equation models to examine the mediating mechanisms. Chapter 7 focuses on the timing of transitions to adulthood as a possible causal mechanism between background SEP and early adult smoking, drinking and psychiatric distress. LCA is employed to provide a person-centred description of transition timings, and then propensity weighting is utilised to investigate whether different patterns of transition timing are likely to have any causal effect on early adult outcomes, after adjusting for background characteristics such as SEP. Finally, Chapter 8 investigates early adolescent smoking development. Development of smoking behaviour is conceptualised as progression through a series of stages (see 2.1.3.2). Event history models are therefore employed to model different developmental stages separately, thus allowing different factors to be more or less important at different stages.

4 SEP and adolescent development

Figure 4-1 shows the emphasis of this chapter within the conceptual framework described in Chapter 1; those areas not addressed within this chapter are greyed out. The focus is on the role of SEP in adolescent development of smoking, drinking and psychiatric distress. Rather than examining each independently, as much of the previous literature has done, the aim is to investigate development holistically across all three. Data are from the T07 study only, so consideration of contextual differences is left for later chapters, but gender is considered. Findings from this chapter have already been published elsewhere (Green, MJ et al., 2013).

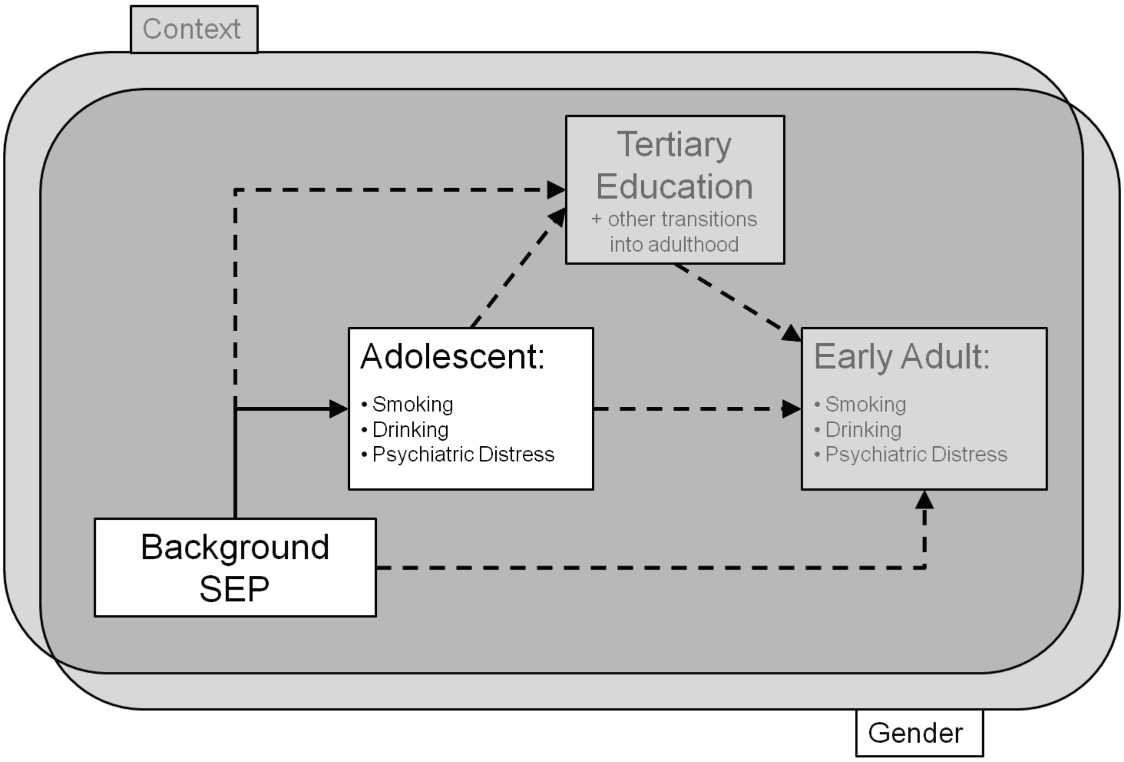


Figure 4-1: Emphasis of Chapter 4 within conceptual framework

4.1 Introduction and aims

4.1.1 Smoking, drinking and psychiatric distress

Chapter 2 detailed how smoking, drinking and psychiatric distress can be related. Prospective data from adolescents suggest reciprocal relationships with distress leading to smoking and drinking and vice versa (Armstrong and Costello, 2002, Mathers et al., 2006, Chaiton et al., 2009). As explained in section 2.2.1, alcohol and tobacco may be used as forms of ‘self-medication’ to manage psychiatric distress, and/or the use of these substances may pre-dispose a person to developing psychiatric symptoms, either through the physiological effects of substance use, or via the disruption of social relationships (Kuntsche et al., 2006, Cerda et al., 2008, Mason et al., 2008, Chaiton et al., 2009). However, as noted in section 1.1.7, considering the interdependent, prospective associations between smoking, drinking and psychiatric distress there could be significant benefits to examining development holistically across all three. This may help provide insights as to when secondary prevention efforts might be most effective, and improve understanding of aetiology.

4.1.2 SEP as a common cause

This thesis is concerned with the aetiological role of SEP. If SEP is a common cause, then this may explain the associations between these outcomes, though an aetiological role of SEP does not exclude further pathways linking the outcomes to each other such as those suggested above. Adolescents in a disadvantaged SEP are more likely to smoke (Hanson and Chen, 2007) and experience depressed mood (Lemstra et al., 2008b), whilst studies on SEP and adolescent drinking vary, showing associations in either direction or no relationship at all (Hanson and Chen, 2007). However, these studies have tended to treat each outcome individually, without accounting for the relationships between them. The role of SEP may be clearer if these outcomes are examined together.

4.1.3 Aims and hypotheses

This chapter aims to identify the most common patterns of adolescent development in smoking, drinking and psychiatric distress and see whether a disadvantaged SEP is associated with all patterns of increased health risk, or only with specific developmental patterns. Latent class analysis (see section 3.3.2.3) is employed to identify distinct groups of adolescents with similar patterns of development, and then relate membership in those groups to SEP. Since different SEP measures may emphasise different characteristics (see section 3.2.1.6), a range of SEP measures are employed to assess whether the associations are robust to measurement differences. Specifically, it is hypothesised that:

- there will be identifiably distinct patterns of adolescent development in smoking, drinking and psychiatric distress;

- and a disadvantaged SEP will be associated with developmental patterns that have higher risk of smoking, drinking and psychiatric distress.

Gender is also adjusted for as an important adolescent correlate of these outcomes (Sweeting and West, 2003, West and Sweeting, 2003).

4.2 Methods

4.2.1 Sample

Data are from the youth cohort of the Twenty-07 Study, which is more suited than NCDS58 or BCS70 for analysis of adolescent development due to the more frequent survey schedule (see section 3.1.1.3). Baseline interviews were conducted in 1988 (n=1,515), a postal survey was conducted approximately one year later (n=1,250), and the first follow-up interviews took place in 1991/2 (n=1,343). The mean ages of the respondents were 15.7, 17.1 and 18.6 years respectively at each of these time-points.

4.2.2 Measures

4.2.2.1 Smoking, drinking and psychiatric distress

This chapter employed slightly different categorisations of smoking, drinking and psychiatric distress than those used in subsequent chapters. For each outcome, a four-category measure was constructed which was intended to cover the range from no use or no symptoms to heavy use or heavy symptoms. Including this full range, rather than just the most severe/harmful categories may help in understanding how the development of each interacts. Smoking was categorised at each survey into: not currently smoking, smoking less than 1-a-day, smoking regularly (1-a-day or more), and smoking heavily (10-a-day or more). At baseline, drinking was categorised into: not currently drinking, drinking less than monthly, monthly drinking, and weekly drinking. At the two later surveys (which asked different questions), drinking was categorised into: not currently drinking; drinking less than weekly; weekly, but under recommended limits in the past week (14 units for females, 21 for males); and weekly drinking with drinking over recommended limits in past week. Psychiatric distress was categorised using GHQ-12 scores at each survey into: no symptoms (0), light symptoms (1-2), medium symptoms (3-4), and severe symptoms

(5+). Across all measures, for convenience, the four categories will be referred to as: none, low, medium, & high.

4.2.2.2 Gender and SEP

Gender was coded 1 for females, 0 for males. All SEP indicators came from the parental interview at baseline. They are viewed as representing the SEP of the households in which the adolescents were being raised and are thus considered conceptually as antecedent to the outcomes. Section 3.2.1.7 described measures of parental occupation, income and education (though, income was included here in three categories, representing income tertiles, rather than with the binary classification described there). Some additional SEP indicators were also utilised in this chapter. Housing tenure dichotomised those in owned or mortgaged accommodation and those in rented or other types of accommodation. Parental employment status was coded in three categories for the most economically active parent in the household: full-time, part-time, or not employed. Area deprivation was based on Carstairs scores for baseline postcode sectors (average population=5,000) derived from the closest Census information (1991; Mcloone and Boddy, 1994). Carstairs scores provide an index of deprivation based on proportions of: households in the area that are overcrowded; heads of household in the area that are in occupational classes IV and V; male heads of household in the area that are unemployed; and households in the area that do not have access to a car. Scores are commonly split into seven groups referred to as deprivation categories. These were further grouped into: least deprived (1-2); middling (3-5); and most deprived (6-7).

4.2.3 Analysis

Analyses were performed using Mplus version 7 (Muthén and Muthén, 2012) and models were estimated using maximum likelihood under the missing-at-random (MAR) assumption (i.e. that missingness is random given the other variables in the model; Clarke and Hardy, 2007). Analysis proceeded in two stages, illustrated in Figure 4-2.

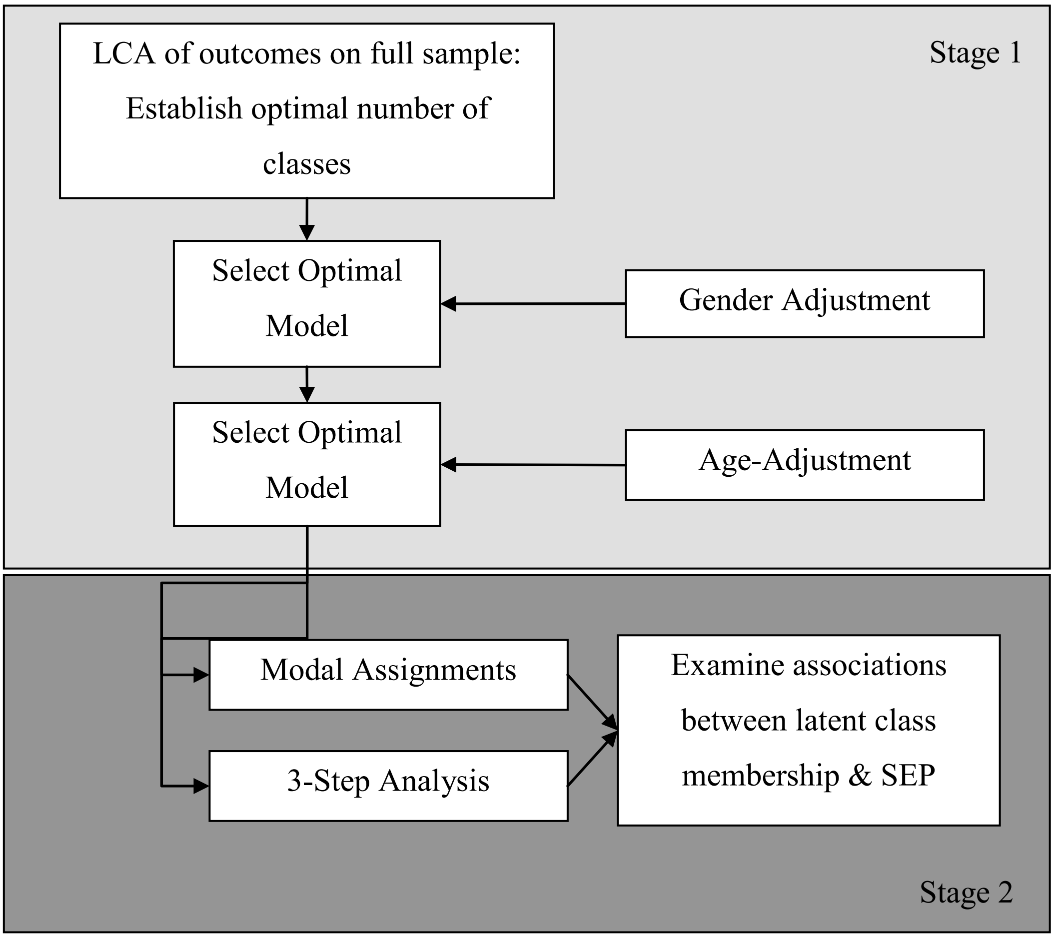


Figure 4-2: Stages of analysis for developmental clustering

4.2.3.1 Latent class model

Latent class analysis (Muthén and Muthén, 2000, Collins and Lanza, 2010) was used to identify the most common and distinct patterns of development within the three outcome variables across the three ages. In terms of representing patterns over time, a repeated measures latent class analysis is preferable over a latent class growth curve model because it allows developmental trajectories to be as non-linear as they are within the data (Collins and Lanza, 2010). Since only three repeated measures were available, a latent growth curve model would have had to have specified linear growth; a quadratic or higher-order polynomial growth model would not have been identified. A linear constraint could also have been particularly problematic for the drinking variables where the questions were different at baseline and follow-up, but this is not a problem within a latent class model, it just needs to be borne in mind when interpreting the response probabilities for these variables. A repeated measures latent class analysis is preferable to a latent transition analysis because in this case the focus is on the overall pattern of development rather than on specific transitions between states within the developmental process.

The aim of the first stage of analysis was to determine the number of latent classes that optimally described adolescent development in smoking, drinking and psychiatric distress (see section 3.3.2.3 for details of this process). Two respondents were excluded at this stage because they had missing data on all of the outcome variables at all measurements (n=1,513).

The next step was to compare gender differences in this measurement model by comparing two nested models: a) a latent class model which allowed latent class membership and the response probabilities for each class to vary by gender (gender-stratified model); and b) a latent class model where only latent class membership varied by gender (gender-adjusted model). The gender-stratified model allows for entirely different sets of latent classes for males and females. The gender-adjusted model specifies that the same patterns are present for both males and females, but with gender differences in prevalence. Since these two models are nested they could be compared with a chi-square test. However, the gender-stratified model had problems with convergence and identification so this comparison could not be made. Instead, separate models were estimated for males and females, in order to assess whether the findings were sufficiently similar to those from the combined model, to justify the more parsimonious, combined analysis.

The optimal model was then compared to a model that was adjusted for the respondents' age within each measurement point. Although the respondents were approximately the same age at each survey, differences in age of even a few months may be significant for outcomes which are rapidly escalating in prevalence during this stage of life, and particularly where the legal use of substances is linked to age (West, 1993, Sweeting et al., 2011). Although these differences in age were probably random, without adjusting for them, the latent class model could have been biased and might have misclassified respondents. However, since adjusting for age was less parsimonious, the object was to assess the extent to which it affected the latent class response probability profiles and the assignment of latent class membership, preferring not to adjust for age if such adjustment did not substantially alter these estimates.

4.2.3.2 Associations with SEP

Associations between SEP and latent class membership were examined in the second stage of analysis using the Vermunt 3-step method (Vermunt, 2010). Each SEP indicator was included in a separate multinomial regression of latent class membership. All models were adjusted for gender, and interactions between gender and SEP indicators were examined. This stage of modelling used only those respondents with full data on all SEP covariates (n=1,383), but for consistency, the response probability parameters of the latent class model were fixed to those values identified in the previous stage. Modal class assignments for those who were excluded because of missing covariate information did not differ significantly from the class assignments of those who were included (chi-square; P=0.12). As a sensitivity test, the analysis was also performed using modal class assignments instead of the Vermunt 3-step method.

4.3 Results

4.3.1 Descriptives and missing data

Table 4-1 shows descriptive statistics for the covariates, and the proportion of those with these baseline characteristics at the two follow-ups. Drop-out was somewhat greater among males and those in a disadvantaged SEP, but these differences were not large.

Table 4-1: Descriptive statistics for baseline covariates and attrition[a]

		Baseline Interview: Age 15		Postal Follow-Up: Age 17		Follow-Up Interview: Age 18	
	N (%)	1515	(100.0)	1250	(82.5)	1343	(88.6)
		N	%	N	%	N	%
Gender	Male	737	48.6	581	46.5	638	47.5
	Female	778	51.4	669	53.5	705	52.5
Parental Occupational Class	Non-Manual	891	59.8	769	62.3	827	62.4
	Manual	598	40.2	465	37.7	498	37.6
Housing Tenure	Owned	641	43.1	574	46.6	607	45.8
	Rented	847	56.9	658	53.4	717	54.2
Parental Education	Post-16	519	34.9	458	37.2	489	37.0
	Left by 16	969	65.1	774	62.8	834	63.0
Parental Employment Status	Full-Time	1059	71.2	911	74.1	975	73.7
	Part-Time	124	8.3	97	7.9	113	8.5
	Not employed	304	20.4	221	18.0	235	17.8
Household Income	Top Tertile	471	33.3	425	36.2	450	35.6
	Mid-Tertile	473	33.4	389	33.1	427	33.8
	Bottom Tertile	472	33.3	361	30.7	388	30.7
Area Deprivation	Least Deprived	242	16.0	221	17.7	233	17.4
	Middling	648	42.8	550	44.0	592	44.1
	Most Deprived	624	41.2	478	38.3	517	38.5

[a]Summary statistics are based on valid responses. Item-missingness was generally lower than 5% except for baseline household income (6.4%, 6% and 5.8% at ages 15, 17 and 18).

Table 4-2 shows the prevalence of different levels of smoking, drinking and psychiatric distress over the three measurement points. Smoking increased in prevalence across the three measurements, increasingly weighted towards heavy smoking; occasional smoking was relatively rare. Drinking increased in prevalence and was increasingly weighted towards heavier consumption, with few reporting no drinking by the second interview at age 18 (after an increase in this group at age 17). Psychiatric distress also increased in prevalence and severity over the three measurements.

Table 4-2: Frequency of smoking, drinking and psychiatric distress[a]

		Baseline Interview: Age 15		Postal Follow-Up: Age 17		Follow-Up Interview: Age 18	
	N (%)	1515	(100.0)	1250	(82.5)	1343	(88.6)
		N	%	N	%	N	%
Smoking[b]	None	1225	81.3	895	72.1	881	65.8
	Low	48	3.2	32	2.6	24	1.8
	Medium	170	11.3	172	13.9	118	8.8
	High	64	4.2	142	11.4	315	23.5
Drinking[c]	None	174	11.5	212	17.0	123	9.9
	Low	1040	68.9	704	56.5	361	29.0
	Medium	210	13.9	274	22.0	497	40.0
	High	86	5.7	55	4.4	262	21.1
Psychiatric Distress[d]	None	778	55.3	573	46.7	367	28.2
	Low	415	29.5	315	25.7	399	30.7
	Medium	132	9.4	165	13.4	319	24.5
	High	83	5.9	174	14.2	216	16.6

[a]Summary statistics are based on valid responses. Missingness was generally lower than 5% except for psychiatric distress at baseline (7.1%), and drinking at age 18 (7.4%).
[b]Smoking: None, Low, Medium & High equate respectively to 0, <1, ≥1 and ≥10 cigarettes daily.
[c]Drinking: At baseline None, Low, Medium & High equate respectively to no drinking, <monthly, ≥monthly and ≥weekly. At the two follow-ups None, Low, Medium & High equate respectively to no drinking, <weekly, ≥weekly & within limits (14/21 units), ≥weekly & over limits (14/21 units).
[d]Psychiatric Distress: None, Low, Medium & High equate respectively to scores of 0, 1-2, 3-4 and 5+ on the GHQ-12.

4.3.2 Establishing optimal number of classes

Table 4-3 shows the model fit statistics for latent class models with two through seven latent classes. Models with additional classes were not considered as it was becoming difficult to replicate the best-fitting solutions (meaning that they could represent local maxima). The BIC had its lowest value at three classes, but values for the log likelihood and AIC continued to improve with higher numbers of classes. Entropy statistics also indicated a preference for higher numbers of classes over the three-class model. Thus it was not immediately clear which model should be considered optimal as some indicators pointed towards a three-class model whilst others pointed towards models with additional classes.

Table 4-3: Model fit statistics for determining number of latent classes

Number of Classes	Log Likelihood	AIC[a]	BIC[b]	Entropy	Identification[c]
2	-11763.78	23637.56	23930.26	0.868	100
3	-11650.07	23466.14	23907.85	0.708	100
4	-11559.13	23340.26	23930.98	0.750	100
5	-11502.42	23282.84	24022.58	0.725	65
6	-11449.76	23233.52	24122.27	0.743	15
7	-11413.17	23216.35	24254.11	0.735	5

[a]AIC=Akaike's Information Criterion.
[b]BIC=Bayesian Information Criterion.
[c]Identification represents the % of times the best-fitting solution was replicated out of 20 sets of starting values. These 20 sets of starting values were identified by following 250 sets of starting values for 20 iterations and selecting those with the best log likelihood values.

In order to resolve this ambiguity, the response probability profiles were inspected, starting with the three-class model, and comparing additional classes, until they no longer suggested a meaningful addition to the model. This process led to the selection of the five-class model. The three-class model indicated patterns similar to the three most prevalent classes in the five-class model, but with less differentiation between these classes in terms of psychiatric distress. A four-class model drew out a class with high levels of psychiatric distress, similar to one found in the five-class model. This was an informative addition, considering that it also resulted in greater differentiation between the distress levels of the other classes. The five-class model distinguished between two groups of smokers, differing in the timing of onset, which seemed to be a theoretically valuable distinction. The six-class model identified a small sub-group (approximately 6% of the sample) of those with low levels on all outcomes, who were particularly late in starting drinking. Since this group was relatively small and was only clearly differentiated from the other low risk class in terms of no vs. light drinking at younger ages, this was not considered a valuable addition and the five-class model was chosen.

4.3.3 Measurement equivalence by gender

Having identified this optimal five-class model, the next step was to see whether this measurement model applied equally well to both males and females. The process of identifying an optimal model was repeated in male and female sub-samples. Model fit statistics from male and female models are shown in Table 4-4.

Table 4-4: Model fit statistics for males and females

Number of Classes	Log Likelihood	AIC[a]	BIC[b]	Entropy	Identification[c]
Males					
2	-5483.21	11076.42	11329.42	0.844	100
3	-5406.01	10978.01	11359.91	0.748	100
4	-5364.29	10950.58	11461.31	0.697	40
5	-5330.08	10938.16	11577.73	0.744	10
Females					
2	-6167.54	12445.07	12701.12	0.889	100
3	-6096.07	12358.13	12744.54	0.832	100
4	-6044.00	12309.99	12826.74	0.830	40
5	-5995.88	12269.76	12916.87	0.766	40

[a]AIC=Akaike's Information Criterion.
[b]BIC=Bayesian Information Criterion.
[c]Identification represents the % of times the best-fitting solution was replicated out of 20 sets of starting values. These 20 sets of starting values were identified by following 250 sets of starting values for 20 iterations and selecting those with the best log likelihood values.

For both males and females the pattern of model fit statistics with the number of latent classes was the same. The log likelihood and AIC indicated a preference for higher numbers of classes, whilst the BIC and entropy statistics preferred a two-class model. Models were less well identified above three classes. Inspection of the five class solutions for males and females revealed a set of five classes for females that was similar to the classes observed when using combined data for males and females. The five classes for the male only model differed slightly, in that the class of late-onset smokers was replaced with a class who exhibited late-onset drinking (i.e. similar to the extra class that emerged when running a six-class model for the combined data; see previous section). This late-onset drinking class had a very low prevalence, even in the male only data, constituting only 4.1% of the sample. If the main differences in class structure by gender were that few males exhibited the late-onset smoking pattern, and that a few males did not drink until older ages, both of these differences could be adequately represented in a combined model. The few taking longer to start drinking could be accepted as noise within the larger low-risk class, whilst the tendency not to exhibit the late-onset smoking pattern could be represented by allowing class membership to vary by gender.

4.3.4 Adjustment for age

Adjusting the LCA model for the age of the respondents (within survey wave) means the latent class variable describes the response pattern for all three outcomes across the three ages as before, but with additional adjustment for the respondents' specific ages when surveyed at each measurement point. In order to include as many respondents as possible, those with missing values for age were set to the mean age for that measurement point (i.e. assuming that anyone who did not respond at later waves would have responded at the mean age if they had responded). Gender was left out of these models in order to aid convergence.

In an initial run of models with 2-6 classes (results not shown), only three of the nine age coefficients estimated (i.e. one for each item at each survey) were found to be significant: those for drinking at ages 15 and 17 and that for smoking at age 15. Older age (within survey wave) was associated with an increased likelihood of smoking and drinking at these measurement points. I therefore repeated this exercise with only these three age effects in the model. Results are presented in Table 4-5. The BIC favours four-classes while the log likelihood and AIC favour five, and the log-likelihood six. Models with more than three classes also had computational difficulties due to non-identification. Since the goal here was to investigate the effect of adjusting for age, it seemed sensible to select the five-class model to facilitate comparison.

Table 4-5: Model fit statistics for age-adjusted models

Number of Latent Classes	Log Likelihood	AIC[a]	BIC[b]	Entropy	Identification[c]
2	-11752.34	23622.68	23936.67	0.865	100
3	-11632.60	23441.19	23909.51	0.722	100
4[d]	-11523.84	23281.69	23904.35	0.758	6
5[d]	-11461.90	23215.81	23992.80	0.743	6
6[d]	-11452.42	23244.84	24149.55	0.754	5

[a]AIC=Akaike's Information Criterion.
[b]BIC=Bayesian Information Criterion.
[c]Identification represents the % of times the best-fitting solution was replicated out of 50 sets of starting values. These 50 sets of starting values were identified by following 500 sets of random starting values for 50 iterations and selecting those with the best log likelihood values.
[d]Model warnings appeared for the best fitting model here saying that the standard errors for some parameters might not be trustworthy due to non-identification.

The response probability profiles for the five-class model with age adjustment were very similar to those in the five class model without age adjustment (results not shown). However, it may be that adjusting for age does not so much affect the response probabilities as it does individual class assignment. Table 4-6 compares modally assigned class from the age adjusted models with modally assigned class in the unadjusted models. A minority of cases (n=29; 1.9%) were assigned to different classes in the age-adjusted models compared to the unadjusted ones. These 29 respondents were uncertainly assigned anyway (mean probability of membership in their assigned class was 0.478). However, the posterior probabilities of membership in each class for most respondents could be altered quite substantially without much affecting the modally assigned class. As an additional check, correlations between the posterior probabilities for each class from the age-adjusted and unadjusted models were examined and these were all 0.998 or above. These findings all suggest that little would be lost by not adjusting for age, and given the additional modelling complexity and identification problems, it made sense to proceed without this adjustment.

Table 4-6: Comparison of modal class from age-adjusted and unadjusted models

Unadjusted Class	**Age-Adjusted Class (proportions in each)**				
	Class 1	Class 2	Class 3	Class 4	Class 5
Class 1	0.992	0.000	0.000	0.000	0.008
Class 2	0.010	0.981	0.000	0.000	0.010
Class 3	0.008	0.000	0.967	0.008	0.017
Class 4	0.000	0.000	0.000	0.958	0.042
Class 5	0.000	0.000	0.001	0.009	0.990

4.3.5 Description of classes

The preceding sections described how a model with five latent classes was selected as the optimal description of the developmental profiles within the smoking, drinking and psychiatric distress data. Figure 4-3 displays the proportions at each level of smoking, drinking and psychiatric distress within each of the five latent classes. Class 1 (labelled *Low Risk*) had the healthiest pattern of responses: they had the lowest levels of psychiatric distress, which increased modestly with age; mainly low drinking, with some progressing to medium drinking by age 18; and very little smoking. Class 2 (*High Drinking*) started drinking earlier and many were drinking heavily by age 18. This group contained very few smokers but had higher distress levels than in the *Low Risk* class. Class 3 (*Early Smokers*) included many medium smokers at age 15, with the majority smoking 10-a-day or more by age 17. *Early Smokers* also had greater increases with age in distress and earlier and heavier involvement with drinking than in the *Low Risk* class. Class 4 (*Late Smokers*) had relatively high levels of distress and a similar drinking pattern to that of the *Early Smokers*, but tended to take up smoking later and to smoke less than 10-a-day. In this group the three problems appeared to develop more or less concurrently, whereas smoking tended to precede the development of drinking and distress problems among the *Early Smokers*. Finally, Class 5 (*High Distress*) had persistent and severe psychiatric symptoms across the three surveys, but were otherwise similar to the *Low Risk* class, with low levels of smoking and drinking. The estimated proportions in each class were as follows: *Low Risk* (39.8%), *High Drinking* (20.9%), *Early Smokers* (21.8%), *Late Smokers* (8.6%) and *High Distress* (8.9%).

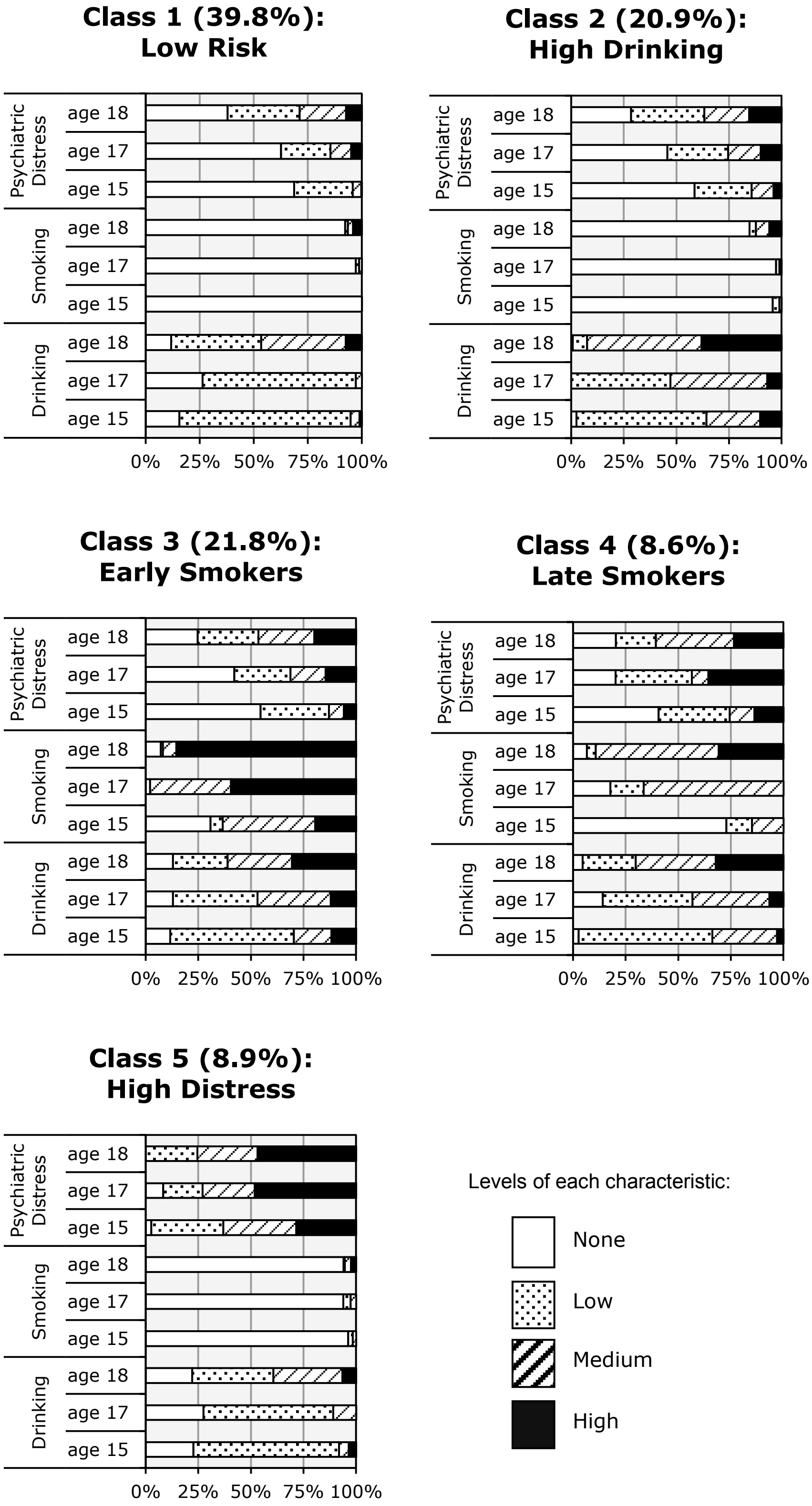


Figure 4-3: Latent class response probability profiles

4.3.6 Associations with SEP

Table 4-7 shows the ORs for membership in each class relative to the *Low Risk* class, for gender and various measures of SEP using the Vermunt 3-step method (Vermunt, 2010). All of the ORs for SEP were adjusted for gender, but were not mutually adjusted for each other. Females were more likely to be in the *High Distress* and *Late Smokers* classes and less likely to be in the *High Drinking* class than males. Four of the six indicators of a disadvantaged SEP were associated with lower odds of membership in the *High Drinking* class ($p<0.05$ for housing tenure and area deprivation; $p\leq0.1$ for occupational class and income). Associations between the other indicators of a disadvantaged SEP and being in the *High Drinking* class showed trends in the same direction, but did not reach statistical significance. There was also a gender interaction (not shown) such that females with unemployed parents were less likely to be in this group ($p<0.05$). All indicators of a disadvantaged SEP (except those for area deprivation) were associated with raised odds of being *Early Smokers*. In contrast, all indicators showed a trend towards lower odds of being *Late Smokers* for those in a disadvantaged SEP, but this only reached statistical significance for area deprivation ($p<0.05$). Finally, those from less deprived areas ($p<0.05$) and those whose parents had more education ($p<0.1$) were more likely to be in the *High Distress* group. However, most of the SEP indicators did not show significant associations with membership in this class. No other interactions between gender and SEP were observed.

Table 4-8 shows the sensitivity analysis based on modal assignment of respondents into classes. The results were similar to those using the Vermunt 3-step method in Table 4-7 except that the magnitude of associations was somewhat smaller and the confidence intervals somewhat narrower.

Table 4-7: ORs for latent class membership (Vermunt 3-step method)[a]

	Latent Class (ref: Low Risk)											
	High Drinking			**Early Smokers**			**Late Smokers**			**High Distress**		
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Females (ref: Males)	0.43	0.23-0.81	0.008	0.78	0.58-1.06	0.113	2.04	1.02-4.10	0.045	2.94	1.30-6.65	0.009
Manual Occupation (ref: Non-Manual)	0.58	0.30-1.11	0.100	1.89	1.39-2.57	<0.001	0.84	0.43-1.65	0.606	0.89	0.44-1.80	0.735
Renting/Other (ref: Owned/ Mortgage)	0.41	0.23-0.75	0.003	2.38	1.69-3.34	<0.001	0.76	0.41-1.41	0.385	0.92	0.48-1.73	0.786
Parent(s) left school by 16 (ref: stayed in school)	0.71	0.40-1.27	0.251	2.04	1.43-2.92	<0.001	0.63	0.34-1.15	0.130	0.57	0.30-1.08	0.086
Parent(s) in Part-time Employment (ref: full-time)	1.23	0.51-2.97	0.648	1.91	1.14-3.20	0.014	0.50	0.09-2.87	0.437	1.16	0.33-4.07	0.815
Parent(s) Not Employed (ref: full-time)	0.45	0.16-1.26	0.131	1.83	1.28-2.62	0.001	0.48	0.16-1.47	0.199	1.80	0.89-3.62	0.101
Middle Income Tertile (ref: Top)	0.64	0.34-1.22	0.174	1.65	1.10-2.49	0.016	0.65	0.32-1.32	0.236	0.57	0.24-1.32	0.186
Bottom Income Tertile (ref: Top)	0.50	0.24-1.05	0.066	2.42	1.62-3.61	<0.001	0.65	0.30-1.41	0.274	1.01	0.49-2.08	0.980
Middling Area Deprivation (ref: least deprived)	0.93	0.43-2.02	0.859	1.18	0.68-2.04	0.561	0.31	0.15-0.61	0.001	0.27	0.11-0.66	0.004
Most Deprived Areas (ref: least deprived)	0.29	0.10-0.80	0.017	1.51	0.88-2.59	0.137	0.19	0.08-0.43	<0.001	0.38	0.17-0.83	0.015

[a]All ORs are adjusted for gender except those for gender which are unadjusted.

Table 4-8: ORs for latent class membership (modal assignment method)[a]

	Latent Class (ref: Low Risk)											
	High Drinking			**Early Smokers**			**Late Smokers**			**High Distress**		
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Females (ref: Males)	0.68	0.51-0.92	0.012	0.83	0.63-1.10	0.193	1.50	0.99-2.28	0.055	1.99	1.30-3.05	0.002
Manual Occupation (ref: Non-Manual)	0.73	0.53-1.00	0.053	1.85	1.40-2.44	<0.001	0.98	0.64-1.49	0.915	1.04	0.69-1.58	0.834
Rented/Other (ref: Owned/ Mortgage)	0.62	0.46-0.83	0.002	2.23	1.65-3.01	<0.001	0.92	0.61-1.39	0.697	0.86	0.58-1.30	0.480
Parent(s) left school by 16 (ref: stayed in school)	0.79	0.58-1.08	0.142	1.86	1.36-2.54	<0.001	0.82	0.54-1.25	0.353	0.63	0.42-0.95	0.029
Parent(s) in Part-time Employment (ref: full-time)	1.06	0.62-1.82	0.832	1.70	1.06-2.73	0.027	0.78	0.34-1.79	0.562	0.88	0.38-2.02	0.756
Parent(s) Not Employed (ref: full-time)	0.70	0.46-1.06	0.093	1.75	1.26-2.44	0.001	0.74	0.42-1.31	0.302	1.45	0.90-2.33	0.130
Middle Income Tertile (ref: Top)	0.77	0.54-1.10	0.157	1.59	1.11-2.27	0.012	0.79	0.48-1.28	0.335	0.67	0.40-1.11	0.121
Bottom Income Tertile (ref: Top)	0.68	0.47-0.99	0.044	2.26	1.59-3.22	<0.001	0.88	0.54-1.45	0.627	1.02	0.63-1.65	0.930
Middling Area Deprivation (ref: least deprived)	0.87	0.57-1.33	0.517	1.15	0.72-1.82	0.565	0.42	0.25-0.70	0.001	0.52	0.30-0.92	0.024
Most Deprived Areas (ref: least deprived)	0.49	0.31-0.77	0.002	1.45	0.92-2.29	0.110	0.32	0.19-0.56	<0.001	0.54	0.31-0.95	0.032

[a]All ORs are adjusted for gender except those for gender which are unadjusted.

4.4 Discussion

4.4.1 Summary of findings

Distinct patterns of adolescent development in smoking, drinking and psychiatric distress were identified, supporting previous evidence of inter-relationships between smoking, drinking and psychiatric distress (Armstrong and Costello, 2002, Mathers et al., 2006, Chaiton et al., 2009). A *Low Risk* class had low levels of smoking and drinking, and low but increasing levels of psychiatric symptoms. Compared to this group, smokers had raised risks for drinking and psychiatric distress, and the majority of smokers were in the *Early Smokers* class where drinking and distress tended to develop after smoking initiation. This supports previous research showing prospective relationships between adolescent smoking and later problematic alcohol use and mental health problems (Mathers et al., 2006). On the other hand, patterns where drinking and distress developed without smoking were also relatively common.

The *Early Smokers* were the only class for which a disadvantaged SEP was associated with a higher likelihood of membership. In the *High Drinking, Late Smokers* and *High Distress* classes there was either no association with SEP or an association in the opposite direction. Adolescents in more deprived areas stood out as unlikely to be in the *Late Smokers* and *High Distress* classes. Both of these classes had high levels of distress, suggesting there may be something particular about more deprived areas (e.g. solidarity, social cohesion) which is protective in terms of distress. On the other hand this may represent a cultural bias against reporting such symptoms within more deprived areas (Stansfeld and Marmot, 1992).

4.4.2 Limitations

These findings are presented with some caveats. Drinking measurements combined quantity and frequency, which might have inadequately reflected the consumption of those who drank heavily but infrequently, though few adolescents appear to drink this way (Colder et al., 2002). Similarly, the smoking measurements may not have captured heavy smoking that occurred infrequently (i.e. less than weekly). If drop-out was associated with particular response patterns then the prevalence of these patterns may have been somewhat underestimated. With respect to SEP however, the clearest effects were in relation to the *Early Smokers* class, many of whom would have been identifiable from the representative baseline data (due to their early smoking). Thus the small differences in drop-out by SEP are unlikely to have greatly influenced the results. Also, the data refer to the specific geographic and temporal context of the West of Scotland in the late 1980s and early 1990s. Different developmental patterns and associations with SEP might be evident in other contexts where outcomes are more or less prevalent. For example, more recent female cohorts from this region have higher prevalence rates for all outcomes (Sweeting and West, 2003, West and Sweeting, 2003). Nevertheless, studies of developmental trajectories for individual outcomes in other contexts have identified broadly similar trajectories to those evident here. For example, US studies have, for the ages studied here, distinguished between early and late onset smoking (Weden and Miles, 2012), between light drinking, and increasingly heavy drinking (Colder et al., 2002), and between very high, consistently low, or moderate but increasing levels of depressive symptoms (Wickrama and Wickrama, 2010). These findings replicate most of these patterns, suggesting generalisability to other western contexts, but also indicate how these patterns co-occur, and how SEP is associated with particular combinations of trajectories.

4.4.3 SEP as a common cause

The findings were contrary to what would be expected if SEP were a simple, common cause of these outcomes. As smoking in the *Early Smokers* class tended to precede problems with drinking and distress, it may be that a disadvantaged SEP promotes early uptake of smoking only, and this then acts as a causal factor leading to later problems with drinking and psychiatric distress (Mathers et al., 2006). This could mean that preventing early smoking uptake among disadvantaged adolescents would bring additional beneficial effects on inequalities in distress and drinking. The notion of smoking as a mediator between background SEP and other adverse outcomes is discussed in more detail in Chapter 9 (section 9.3.2).

4.4.4 Opposing mechanisms

The findings in this chapter demonstrate equifinality in relation to drinking and psychiatric distress. A number of groupings had problems with drinking (*High Drinking, Late Smokers, Early Smokers*), and psychiatric distress (*High Distress, Late Smokers, Early Smokers*) but these groups were characterised by different patterns of risk in terms of socioeconomic markers. Thus, respondents with different socioeconomic backgrounds ended up with similar outcomes in terms of drinking and distress.

Inconsistent associations between drinking and SEP have previously led some to suggest that two opposing mechanisms link SEP and drinking, i.e. a lower SEP is generally associated with poorer health including heavier drinking, whilst a higher SEP indicates more resources for obtaining alcohol (Wiles et al., 2007). These opposing mechanisms could also be linked to different motivations for drinking; while some use alcohol to enhance pleasure, others use it as a mechanism for coping with stress (Colder et al., 2002, Kuntsche et al., 2006). The adverse stressors and lack of other coping resources associated with socioeconomic disadvantage could promote coping-motivated drinking, whilst those of higher SEP have more resources to enable drinking for pleasure. Since smokers often view smoking as a coping mechanism for dealing with stress (Jarvis and Wardle, 2006), smoking which begins early and is maintained at increasingly heavier levels across late adolescence, as seen in the *Early Smokers* class, may be a marker for stress-related processes within a disadvantaged SEP which then also promote coping-motivated drinking. If drinking in the *High Drinking* class represented more pleasure-motivated drinking then this might explain why this pattern was somewhat more likely for those in a more affluent SEP. Alternatively, there may be other processes of socioeconomic disadvantage that promote both early smoking and drinking, such as fewer alternative activities or lower quality parental monitoring (Hayes et al., 2004, Stock et al., 2011).

Opposing mechanisms might also explain why previous research from T07 has indicated late adolescence as a period of relative equality in psychiatric distress (West et al., 1990, Green, MJ and Benzeval, 2011). Adolescents in more affluent areas, for example, may experience anxiety-promoting pressure to do well in education (West and Sweeting, 2003), whilst adolescents in disadvantaged circumstances experience other kinds of stress or lower levels of coping resources, leading both to increased psychiatric symptoms and other problems such as early smoking. If adolescent distress in an affluent SEP is associated mainly with education and tends to dissipate thereafter, whilst adolescent distress in a disadvantaged SEP is prompted by stressful life conditions which persist into adulthood, this may create socioeconomic inequalities in distress which widen with age (Green, MJ and Benzeval, 2011).

4.4.5 Conclusion

Examining adolescent development in smoking, drinking and psychiatric distress suggests opposing mechanisms linking drinking and distress to SEP, contingent upon early smoking. Such opposing mechanisms could be missed in research that focuses on only one outcome at a time, as the opposition would result in weak or null associations. It is worth investigating whether similar patterns can be observed in other datasets, as this might help explain inconsistent previous findings on associations between SEP and drinking. SEP does not appear to be a common cause stimulating development of smoking, drinking and psychiatric distress in adolescence, but rather socioeconomic disadvantage appears particularly associated with early smoking, which may then lead to heavier drinking and psychiatric distress. Thus, prevention of adolescent smoking may be key to reducing inequalities in adolescent drinking and psychiatric distress. However, it is not yet clear how these patterns in adolescence mediate between socioeconomic background, and early adult outcomes.

5 SEP and drinking over the transition to adulthood

Figure 5-1 shows the focus of Chapter 5 within the conceptual framework of the thesis. Chapter 5 deals with associations between SEP and early adult drinking and how these are mediated via smoking and drinking in adolescence, and participation in tertiary education (as one aspect of transitions to adulthood). Findings are compared across the three cohorts of young people growing up in different contexts (NCDS58, BCS70 and T07) and by gender. Thus, this chapter addresses the second and third research questions defined in section 1.2, however within those broad aims it builds on the findings of Chapter 4 to focus on specific hypotheses relating to the development of drinking behaviour as explained below.

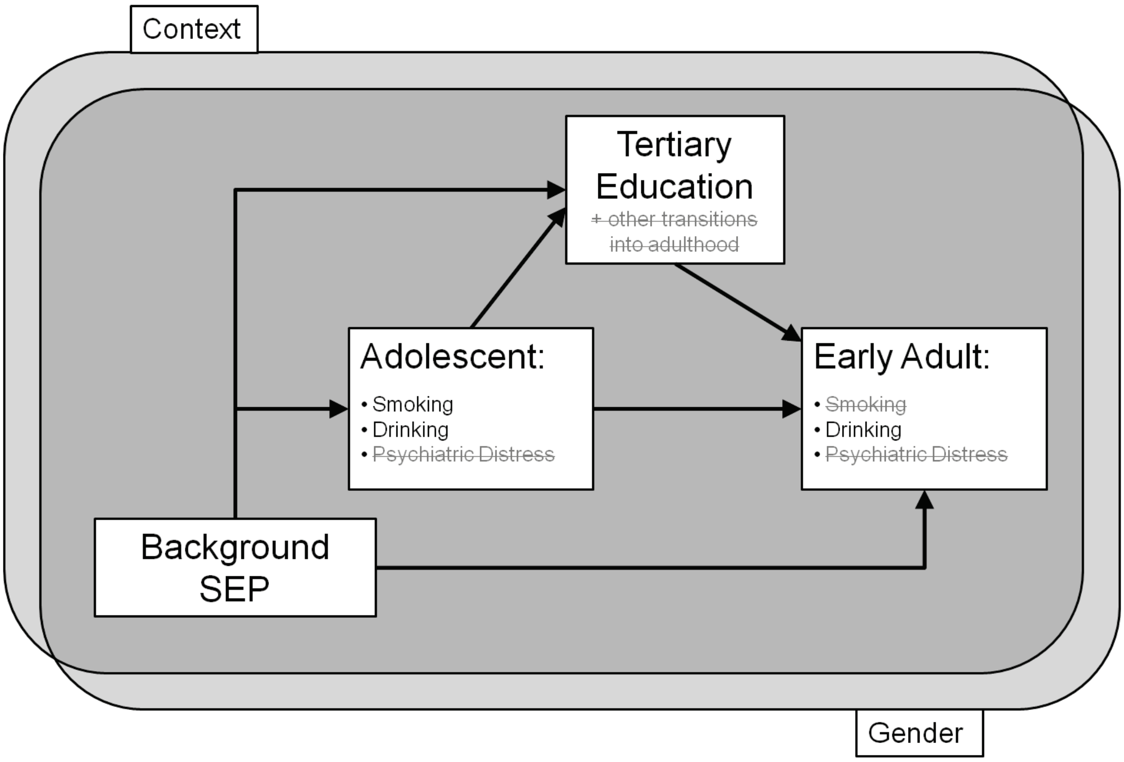


Figure 5-1: Emphasis of Chapter 5 within conceptual framework

5.1 Introduction and aims

5.1.1 Opposing mechanisms

Chapter 2 described inconsistencies in prior evidence on associations between SEP and drinking in adolescence and early adulthood with some suggesting that mechanisms associated with SEP pull in opposing directions (Hanson and Chen, 2007, Wiles et al., 2007). Hence, heavy drinking may not be stratified clearly by SEP, but the mechanisms that lead to it could be. If this can be better understood, then it may help develop more effective and targeted interventions or policies to prevent heavy drinking. If opposing mechanisms vary in strength between contexts, this might help explain the inconsistencies in prior research. This chapter therefore explores two potentially opposing mechanisms between SEP and heavy drinking in early adulthood in three different cohorts.

5.1.2 Smoking mechanism

The first mechanism explored here is smoking. Young people from a disadvantaged SEP are more likely to smoke, and to start smoking earlier (Tyas and Pederson, 1998, Gilman et al., 2003). Smoking, in turn, is often described as a ‘gateway drug’ and is associated with onset of alcohol use and alcohol problems (Mathers et al., 2006). Chapter 4 demonstrated that adolescent smokers tended to progress to heavy drinking, but a group was identified who developed heavy drinking habits without smoking. Disadvantaged adolescents tended to be in the group who smoked first, whereas the group who did not smoke before drinking heavily was populated by more advantaged adolescents. This suggests stratification of mechanisms leading to heavy drinking in adolescence, with smoking as a mechanism associated with socioeconomic disadvantage. It is not yet clear whether such a pattern extends into early adulthood, or whether it would be replicated in other contexts.

5.1.3 Tertiary education mechanism

The second mechanism examined in this chapter is tertiary education. Young people from more advantaged backgrounds are more likely to enter tertiary education (Machin and Vignoles, 2004), and students in tertiary education drink more heavily than young people of similar age outside of tertiary education (Kypri et al., 2005, Bewick et al., 2008, Carter et al., 2010). Section 2.2.3.1 explained some of the possible reasons for this related to transitional challenges and inflated norms of drinking behaviour in tertiary education

(Schulenberg and Maggs, 2002, Helmer et al., 2013). Thus, experience of tertiary education could be a mechanism promoting heavier drinking which is associated with a more advantaged socioeconomic background.

5.1.4 SEP indicators

Prior studies of drinking in adolescents and early adults have represented background SEP using a variety of indicators (e.g. parental occupational class, income, and education; Hanson and Chen, 2007, Wiles et al., 2007), but findings do not appear to vary consistently by the type of indicator used, aside from a tendency for studies using occupation and education rather than income to be more likely to report associations where disadvantaged adolescents drink more (see section 2.3.3). Section 3.2.1.6 emphasised the importance of examining multiple measures of SEP: consistent associations with SEP across different measures might be attributed to the overall construct, whilst associations that are more specific to a particular measure may have more to do with the specific characteristics emphasised by that measure.

5.1.5 Contextual variation

As described in section 3.1, NCDS58 respondents progressed from adolescence to adulthood during the period from 1974-81, whilst those in BCS70 and T07 did so in the period from 1986-1996. Examining these mechanisms (smoking and tertiary education) in different contexts may also help explain inconsistencies in prior research on SEP and drinking. Contextual heterogeneity may occur either in the associations between SEP and these mediating factors, or in associations between those factors and drinking. Variation in associations between SEP and mediating factors might be expected as contextual changes in socioeconomic distributions between cohorts mean measures of SEP may indicate greater relative disadvantage in more recent cohorts. Trends in family dynamics and labour markets may mean that young people from disadvantaged backgrounds in the more recent cohorts also experienced less familial stability and poorer employment prospects than similarly disadvantaged young people in the earlier cohort. These additional stressors might strengthen associations between socioeconomic disadvantage and smoking or drinking. On the other hand, increases in maternal employment in more recent cohorts, which have been concentrated among more advantaged families, may have differentially reduced parental monitoring, pushing the association between SEP and smoking and drinking in the opposite direction. Variations in associations between mediating mechanisms and drinking may also have occurred, for example as alcohol has become more available and smoking prevalence has declined (Roberts, 2011) or as participation in tertiary education has increased (Machin and Vignoles, 2004), but it is not clear whether changes in the prevalence of these factors would change the strength of associations between them.

5.1.6 Aim and hypotheses

The aim of this chapter is to investigate two mediating mechanisms (smoking and tertiary education) between SEP and drinking in adolescence and early adulthood. Three dimensions of parental SEP (occupational class, income and education) are examined and analyses repeated on three UK datasets representing different historical and geographical contexts. Structural equation models are used to analyse the data, as the focus is on mediating mechanisms. Specifically, it is hypothesised that:

- a disadvantaged socioeconomic background will be associated with higher odds of adolescent smoking, and adolescent smoking will be associated with heavier drinking in adolescence and early adulthood;
- an advantaged socioeconomic background will be associated with higher odds of participation in tertiary education, and participation in tertiary education will be associated with greater odds of heavy drinking in early adulthood; and
- there will be heterogeneity in the strength of these mechanisms between contexts.

Since drinking patterns are strongly linked to gender with males tending to drink more heavily (Fillmore et al., 1991, Wilsnack et al., 2009), the sensitivity of these mechanisms to gender is also explored.

5.2 Methods

5.2.1 Samples

As explained in section 3.1.1, NCDS58 and BCS70 are national UK-based cohorts respectively following people born in 1958 and 1970. Data were primarily taken from surveys in adolescence at age 16 (NCDS58: 1974; BCS70: 1986) and early adulthood at ages 23 and 26 respectively (NCDS58: 1981; BCS70: 1996), but information from earlier sweeps was also used for weighting and imputation. 18,558 respondents from NCDS58 and 18,488 from BCS70 were potentially eligible for analysis, and of these 15,672 (84.4%) from NCDS58 and 12,735 (68.9%) from BCS70 had participated in either the adolescent or early adult follow-up and constituted the analysis sample for this (and the subsequent) chapter. T07 data were primarily taken from the baseline interview in adolescence (1988; mean age=15.7 years) and a postal follow-up in early adulthood (1994; mean age=21.7 years) but data from intervening surveys were also used for imputation and for coding participation in tertiary education. The representative baseline sample of 1,515 youths constituted the analysis sample for this chapter.

5.2.2 Measures

5.2.2.1 Drinking

Self-reported indications of weekly drinking in adolescence and heavy drinking in early adulthood were available in each cohort as described in section 3.2.2.2.

5.2.2.2 Smoking

A self-reported indication of daily smoking in adolescence from each cohort (as described in section 3.2.2.1) was utilised for these analyses.

5.2.2.3 SEP and tertiary education

Measurement of parental occupational class (manual vs. non-manual), income (lowest tertile vs. higher tertiles), and education (left school by 16 vs. post-16 education) was described in section 3.2.1.7. For all three SEP variables, binary measurement was not the finest classification available. Whilst finer measurement might generally be preferred, considering the intention to compare findings from three measures across three cohorts, within a relatively complex analytical model, the binary measures were chosen in order to maintain a manageable level of parsimony.

Respondents were coded as participating in tertiary education if they had reported being in full-time education after the age of 18.

5.2.3 Analysis

5.2.3.1 Structural equation models

Figure 5-2 depicts the analysis model which was tested using structural equation modelling in Mplus 7 (Muthén and Muthén, 2012).The positive and negative signs indicate the hypothesised directions of association as smoking and tertiary education mediate between SEP and drinking (thicker lines). The model also allows for: residual effects of SEP on drinking in adolescence and early adulthood; associations between adolescent and early adult drinking; and associations between adolescent smoking and drinking and participation in tertiary education; though these relationships are not the focus, and no hypotheses are made about them (thinner lines). Models without mediation via smoking or tertiary education were also examined to assess the impact of modelling opposing mechanisms on the residual association between SEP and drinking. Modelling is confirmatory, testing whether the hypothesised associations are significantly different from the null ($p<0.05$) and in the proposed direction. Since data were categorical and models were estimated using maximum likelihood, fit statistics for the overall model were unavailable. Separate analyses were performed for each cohort and each measure of SEP and, initially, stratified by gender. However, given very few gender differences, results are mainly presented for males and females combined. Between cohort differences were assessed by examining the proportional overlap of the confidence intervals (calculated as the overlap divided by the average length of the overlapping confidence interval arms; Cumming, 2009) with overlap of less than 0.5 giving a slightly conservative approximation of standard statistical significance at the $p<0.05$ level.

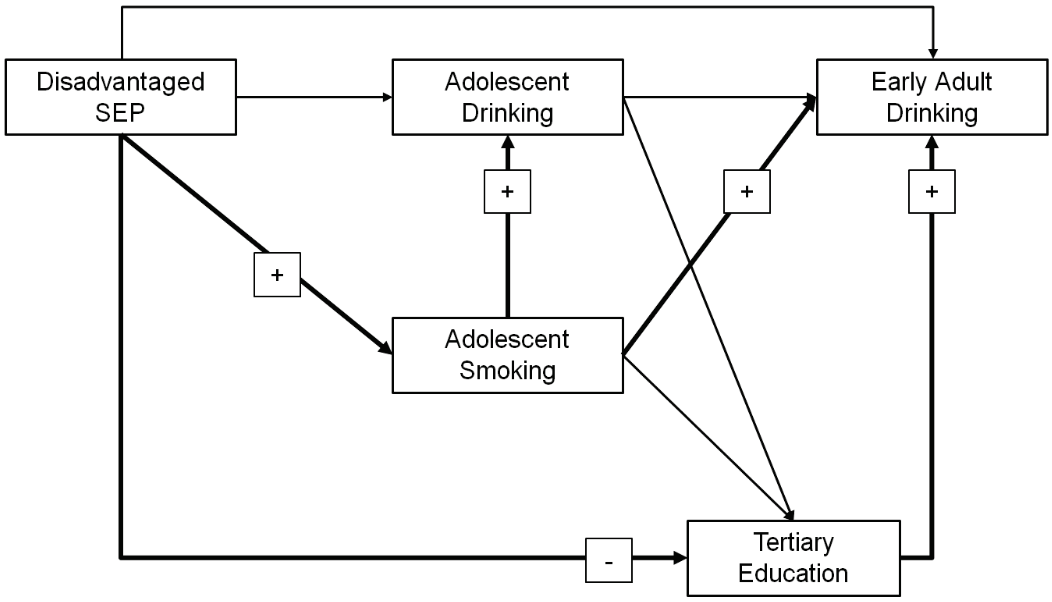


Figure 5-2: Analysis model and hypothesised direction of effects

5.2.3.2 Imputation and weighting

Many respondents had missing data. Given it was important for the samples to be representative of their location and historic period, multiple imputation (25 imputations) and inverse probability weighting were employed. These reduce bias in the estimators on the assumption that data are MAR, given the other variables in the models (see section 3.3.1.2; Clarke and Hardy, 2007). In order to strengthen this assumption, imputation and weighting models included relevant additional variables from other waves. The imputation model included a range of additional SEP indicators and variables which tend to be associated with smoking and drinking as shown in Table 5-1.

Table 5-1: Additional measures included in imputation models

	Ages at which additional included measures were taken: NCDS58	BCS70	T07
SEP indicators			
Parental occupational class	0, 7 and 11	0, 5 and 10	
Parental education		5 and 16	
Household income		10	
Housing tenure	7, 11 and 16	5 and 10	16
Parental employment status		10 and 16	16
Other variables			
Psychiatric distress	7, 11, 16 and 23	5,10, 16 and 26	16, 18 and 22
Parental absence	16	5 and 10	16
Parental smoking	16	5 and 10	16
Parental monitoring	16		
Parental drinking	7		16
Contact with psychiatrists, social work or judicial systems in childhood			16

Multiple imputation however, only accounted for missing data within the response sets of those in the analysis samples. Since the analysis samples for the NCDS58 and BCS70 differed from the original samples, inverse probability weights for these cohorts were calculated using relevant baseline variables which were identified as predictive of membership in the analysis sample (Seaman et al., 2012). Selection of variables was restricted by the availability of data within each cohort. The variables used for weighting in NCDS58 were: gender, paternal occupational class, country of birth, birth-weight (included as a rough proxy for deprivation), and maternal marital status. The variables used for weighting in BCS70 were: gender, paternal occupational class, parental education, parental employment status, maternal marital status, and birth-weight. Weighting was unnecessary for T07, since adolescent data were obtained from the representative baseline sample and all respondents were included. Weights were included in the imputation models and used to weight the analyses of the imputed data.

14,083 (75.9%) of the NCDS58 respondents and 14,809 (80.1%) of the BCS70 respondents had full data on all the baseline weighting variables. Of the rest, approximately half were missing data on a single variable (e.g. non-response to a particular baseline question), and approximately half were missing data on all of the weighting variables (e.g. immigrants who only joined after the initial survey). It was therefore necessary to decide how to treat those with missing data on weighting variables. Values were randomly assigned based on the observed distribution for each variable (e.g. 91.5% of the observations in BCS70 had employed parents, so those with missing data on parental employment status were assigned a 0.915 probability of having employed parents). This random assignment of values potentially biases towards the null in the weighting model and may underestimate the true relationships between the weighting variables and participation in the analysis sample. For those missing data on only one variable, this influence is likely to be minor relative to those with no baseline data. In order to account for these different missingness mechanisms, and that those with missing data might have different participation patterns than those with fully observed baseline data, the weighting models also included two dummy variables respectively indicating baseline respondents with some missing data, and late-entry respondents such as immigrants who had no baseline data.

Table 5-2 and Table 5-3 show ORs for membership in the analysis sample based on the weighting models in NCDS58 and BCS70 respectively. In NCDS58, respondents with fathers in occupational class grade I, and those with low birth-weight, single-mothers, or some missing data at baseline were less likely to be in the analysis sample. Respondents in NCDS58 who were female, had fathers in occupational class grades III-non-manual, and IV, or were born in Scotland were more likely to be in the analysis sample. In BCS70, females, those with fathers in higher class occupations, or parents with more education were more likely to be in the analysis sample, whilst those with fathers in lower class occupations, unemployed parents, with low birth-weight, some missing baseline data, late-entry respondents, or those whose mothers were smokers or single were less likely to be in the analysis sample.

Table 5-2: ORs for being in analysis sample from NCDS58

Weighting Variables	OR	P-Value
Female (ref: male)	1.13	0.002
Paternal Occupational Class I (ref: III-manual)	0.81	0.028
Paternal Occupational Class II (ref: III-manual)	1.10	0.137
Paternal Occupational Class III-non-manual (ref: III-manual)	1.16	0.040
Paternal Occupational Class IV (ref: III-manual)	1.21	0.005
Paternal Occupational Class V (ref: III-manual)	1.12	0.118
Born in Scotland (ref: Born in England)	1.40	<0.001
Born in Wales (ref: Born in England)	1.06	0.388
Birth-weight >2 SDs below mean (ref: within 1 SD of mean)	0.52	<0.001
Birth-weight >1 SDs below mean (ref: within 1 SD of mean)	0.80	<0.001
Birth-weight >2 SDs above mean (ref: within 1 SD of mean)	1.05	0.486
Birth-weight >2 SDs above mean (ref: within 1 SD of mean)	1.18	0.208
Mother single (ref: married or cohabiting)	0.73	0.001
Baseline respondent with missing data (ref: Baseline respondent with full data)	0.71	<0.001
Late-entry respondent (ref: Baseline respondent with full data)	1.15	0.119

Table 5-3: ORs for being in analysis sample from BCS70

Weighting Variables	OR	P-Value
Female (ref: male)	1.46	<0.001
Paternal Occupational Class I or II (ref: III-manual)	1.21	<0.001
Paternal Occupational Class III-non-manual (ref: III-manual)	1.33	<0.001
Paternal Occupational Class IV (ref: III-manual)	0.92	0.080
Paternal Occupational Class V (ref: III-manual)	0.73	<0.001
Parent(s) had post-16 education (ref: left school by 16)	1.07	0.091
Mother smoked before pregnancy (ref: did not smoke)	0.94	0.074
Parent(s) not employed (ref: employed)	0.76	<0.001
Mother single (ref: married)	0.55	<0.001
Birth-weight <2.5kg (ref: >2.5kg)	0.48	<0.001
Baseline respondent with missing data (ref: Baseline respondent with full data)	0.86	0.023
Late-entry respondent (ref: Baseline respondent with full data)	0.47	<0.001

5.3 Results

5.3.1 Descriptive statistics and missing data

Table 5-4 displays descriptive statistics and information on missing data from within each cohort. Adolescent daily smoking was lower in the more recent cohorts. Adolescent weekly drinking increased between NCDS58 and BCS70, but was particularly low in T07. Respondents in NCDS58 were most, and those from BCS70 least likely to come from manual households; respondents in NCDS58 were least likely to have had a parent in education beyond the age of 16. Participation in tertiary education was higher in the more recent cohorts and highest in the Scottish cohort. Heavy drinking in early adulthood was highest in T07 and lowest in BCS70 respondents.

Table 5-4: Descriptive statistics and missing data

(continued overleaf)

		NCDS58				BCS70				T07			
	Analysis N:	15,672				12,735				1,515			
		Observed[a]		Imputed		Observed[a]		Imputed		Observed[a]		Imputed	
		N	%[b]	N	%[c]	N	%[b]	N	%[c]	N	%[b]	N	%[d]
Gender	Male	8,032	51.3	8,102	51.7	6,279	49.3	6,635	52.1	737	48.6	737	48.6
	Female	7,640	48.7	7,570	48.3	6,456	50.7	6,100	47.9	778	51.4	778	51.4
Adolescent Measures (age 16)													
Participated in adolescence	No	1,307	8.3			2,362	18.5			0	0.0		
	Yes	14,365	91.7			10,373	81.5			1,515	100.0		
Daily smoking	No	8,752	73.1	11,394	72.7	5,269	81.1	10,150	79.7	1,273	84.5	1,281	84.6
	Yes	3,217	26.9	4,278	27.3	1,224	18.9	2,585	20.3	234	15.5	234	15.4
	Missing	3,703	23.6			6,242	49.0			8	0.5		
Weekly drinking	No	6,497	54.1	8,463	54.0	3,068	47.8	6,011	47.2	1,424	94.3	1429	94.3
	Yes	5,509	45.9	7,209	46.0	3,345	52.2	6,724	52.8	86	5.7	86	5.7
	Missing	3,666	23.4			6,322	49.6			5	0.3		
Parental Occupational Class	Non-manual	5,538	49.6	7,742	49.4	4,430	65.3	7,475	58.7	891	59.8	901	59.5
	Manual	5,633	50.4	7,930	50.6	2,350	34.7	5,260	41.3	598	40.2	614	40.5
	Missing	4,501	28.7			5,955	46.8			26	1.7		
Household Income	Mid-High	6,144	66.8	10,563	67.4	4,256	68.0	8,571	67.3	945	66.6	1,004	66.3
	Low	3,051	33.2	5,109	32.6	2,004	32.0	4,164	32.7	473	33.4	511	33.7
	Missing	6,477	41.3			6,475	50.8			97	6.4		
Parental Education	Post-16 Education	1,885	16.4	2,586	16.5	2,180	31.0	3,388	26.6	519	34.9	524	34.6
	Left School by 16	9,640	83.6	13,086	83.5	4,843	69.0	9,347	73.4	969	65.1	991	65.4
	Missing	4,147	26.5			5,712	44.9			27	1.8		
Early Adulthood Measures (ages 22-26)													
Participated in Early Adulthood	No	3,135	20.0			3,732	29.3			334	22.0		
	Yes	12,537	80.0			9,003	70.7			1,181	78.0		

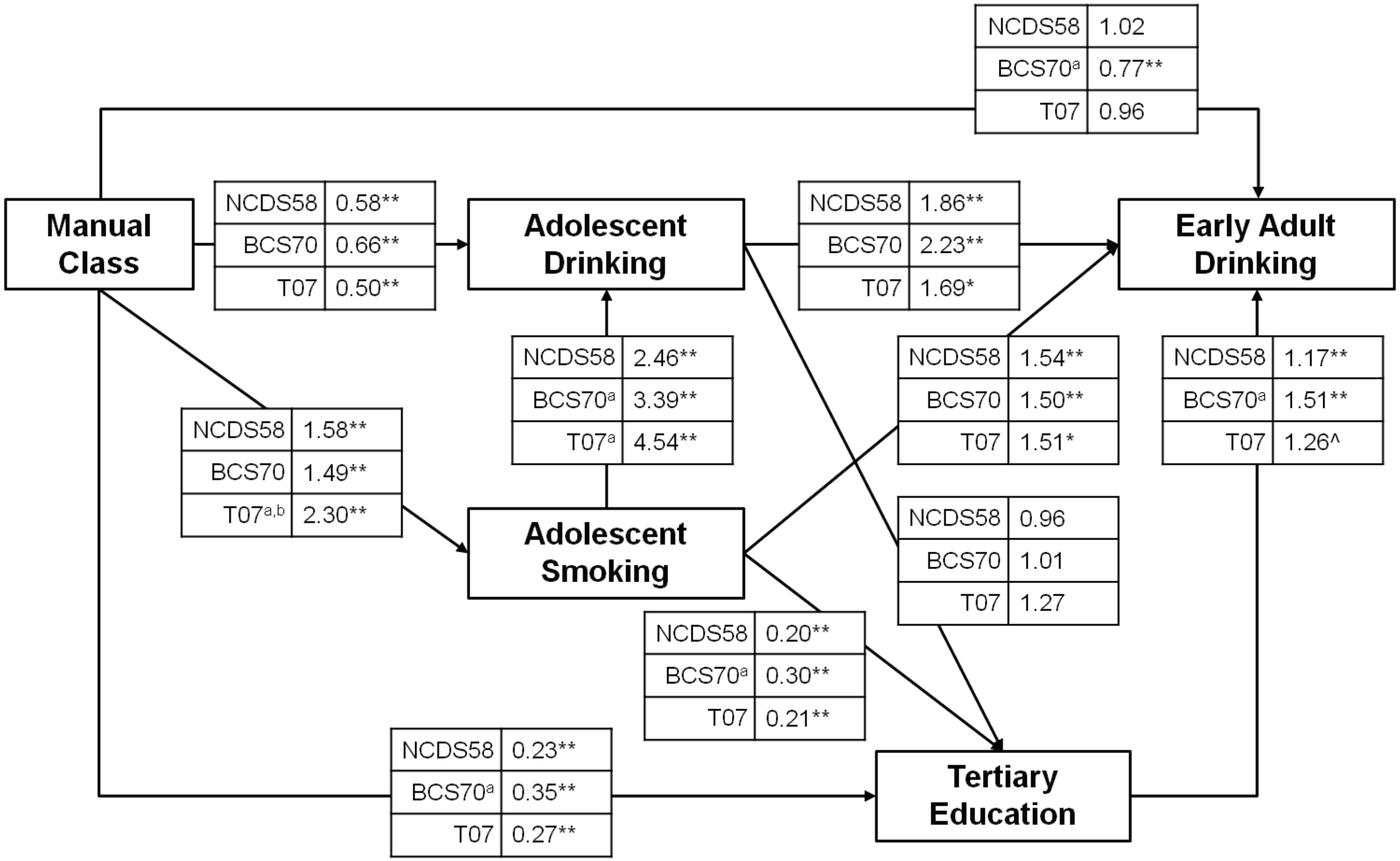
Tertiary education participation	No	9,945	79.3	12,538	80.0	6,235	70.1	9,131	71.7	885	63.7	982	64.8
	Yes	2,592	20.7	3,134	20.0	2,658	29.9	3,604	28.3	504	36.3	533	35.2
	Missing	3,135	20.0			3,842	30.2			126	8.3[e]		
Heavy drinking in early adulthood	No	7,578	70.6	11,190	71.4	6,935	78.8	9,959	78.2	714	61.4	944	62.3
	Yes	3,160	29.4	4,482	28.6	1,861	21.2	2,776	21.8	448	38.6	571	37.7
	Missing	4,934	31.5			3,939	30.9			353	23.3		
Additional Information on Missing Data													
Participated in adolescence and early adulthood	No	4,442	28.3			6,094	47.9			334	22.0		
	Yes	11,230	71.7			6,641	52.1			1,181	78.0		
Complete data on all analysis variables	No	10,557	67.4			10,659	83.7			430	28.4		
	Yes	5,115	32.6			2,076	16.3			1,085	71.6		

[a]Unweighted data.
[b]In order to facilitate comparison across cohorts, percentages are based on those with valid responses, except for missing categories where they are based on the analysis sample.
[c]Percentages are based on weighted average results across 25 imputed datasets.
[d]Percentages are based on average results across 25 imputed datasets.
[e]There are more valid responses than those participating in the early adulthood survey here because supplementary data from an intervening interview at age 18 were also used.

Despite reasonable levels of participation in adolescence and adulthood for NCDS58 and BCS70, there were fairly high levels of item-non-response, especially in BCS70 (the adolescent survey was administered in separate sections and sometimes not all sections were completed). This resulted in a relatively low proportion of the sample having data on all SEP and other analysis variables in NCDS58 (32.6%) and BCS70 (16.3%). However, SEP indicators were likely to be fairly accurately imputed from each other and from the range of other SEP indicators included in the imputation models, and the majority of the NCDS58 and BCS70 samples had data on at least two other variables besides SEP (92.6% and 83.8% respectively). Sample proportions for most characteristics remained similar after imputation.

5.3.2 Structural equation models

Figures 5-3 through 5-5 show ORs from the structural equation models respectively using parental occupational class, income and parental education as indicators of SEP. Results from each cohort are shown together within each diagram, and footnotes to the figure indicate where ORs were deemed to differ significantly between cohorts based on the proportional overlap of their confidence intervals.



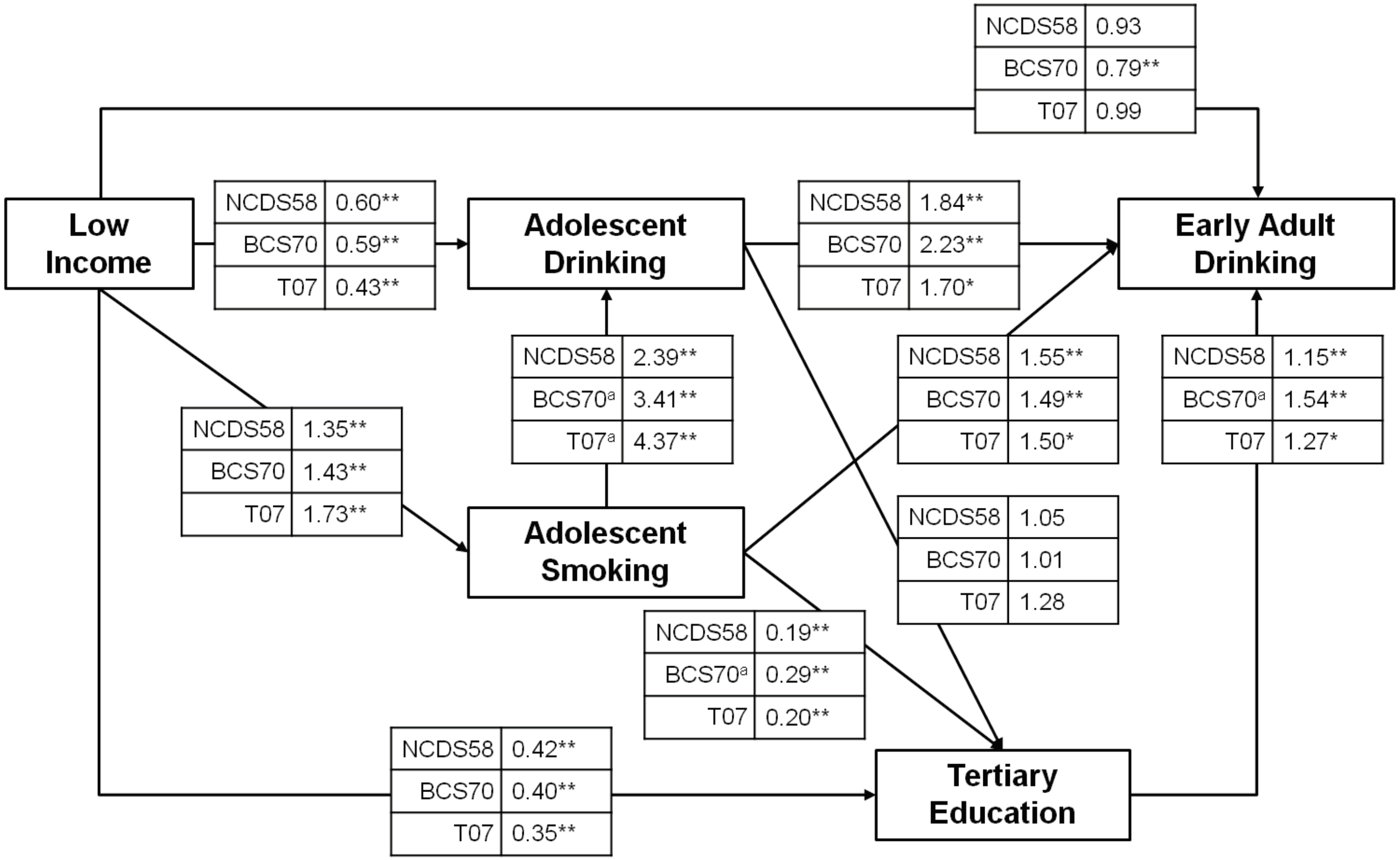
^P<0.1; *P<0.05; **P<0.01

NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study

[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.

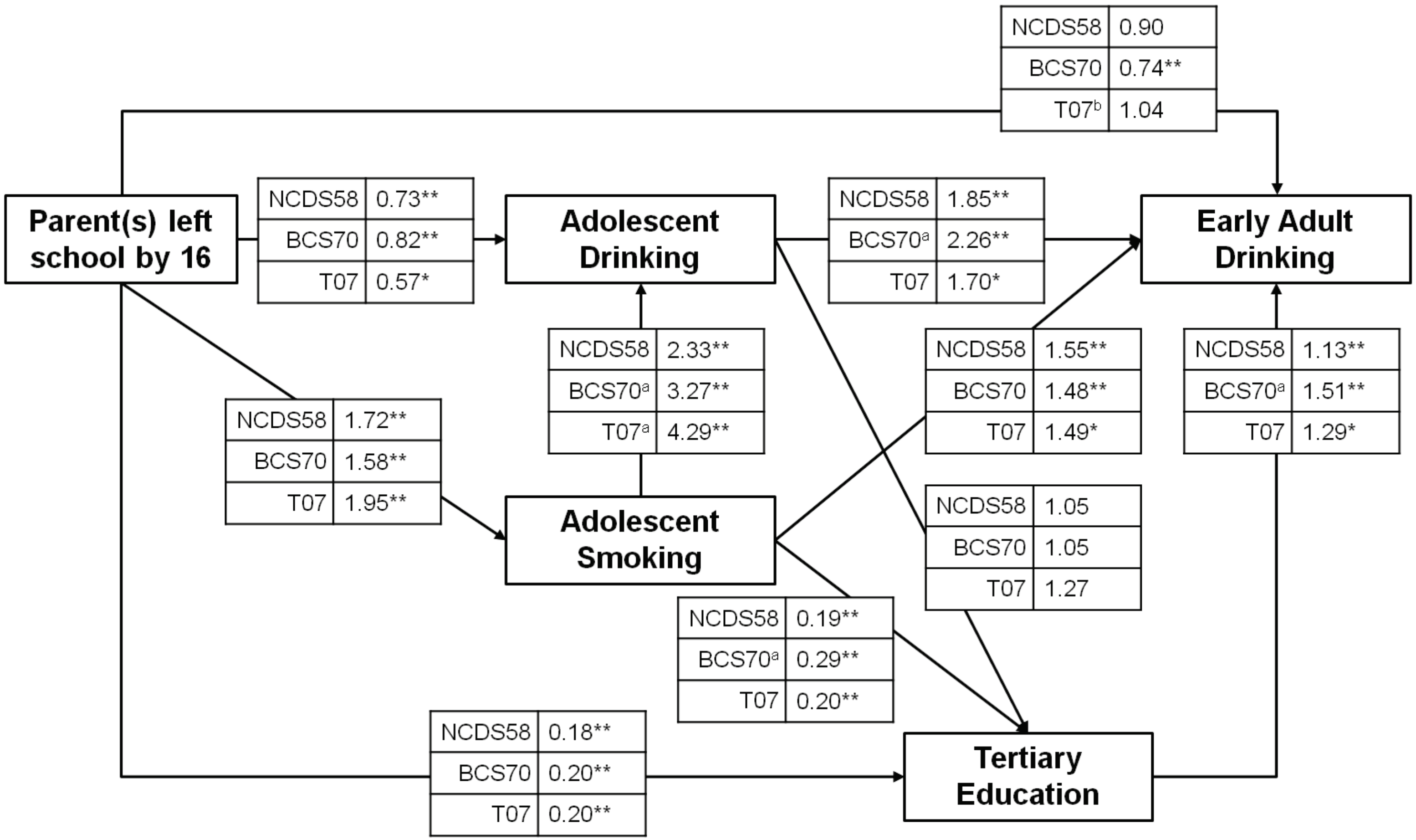
[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 5-3: ORs from model for parental occupational class



^P<0.1; *P<0.05; **P<0.01
NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study
[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.
[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 5-4: ORs from model for income



^P<0.1; *P<0.05; **P<0.01
NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study
[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.
[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 5-5: ORs from model for parental education

5.3.2.1 Smoking mechanism

Socioeconomic disadvantage was consistently associated with raised odds of adolescent smoking. The OR for manual class in T07 was stronger than that from NCDS58 and BCS70. ORs for income and parental education were similar in all cohorts.

Adolescent smoking was consistently associated with higher odds of adolescent weekly drinking. This association was stronger in BCS70 and T07 than in NCDS58. Adolescent weekly drinking was associated with heavy drinking in early adulthood (stronger in BCS70 than in NCDS58 for parental education). Adolescent smoking was independently associated with heavy drinking in early adulthood in all cohorts (no cohort differences).

5.3.2.2 Tertiary education mechanism

Socioeconomic disadvantage was associated with reduced odds of participation in tertiary education. The association was stronger in NCDS58 than BCS70 for occupational class, with no differences by cohort for parental education or income. There was also evidence of an indirect association between SEP and tertiary education via adolescent smoking, but adolescent weekly drinking was not associated with tertiary education. In all models, tertiary education was associated with heavier adult drinking, but with a borderline association for occupational class in T07 ($p<0.1$), and stronger associations in BCS70 than in NCDS58. T07 was the smallest sample and as the ORs were greater in magnitude than those observed for NCDS58, the weaker association for occupational class may be due to lack of power.

5.3.2.3 Residual association between SEP and drinking

There was a residual association between socioeconomic disadvantage and reduced odds of weekly drinking in adolescence in all cohorts and for all measures of SEP. Table 5-5 shows ORs from models that did not include the smoking or tertiary education mechanisms. These unadjusted ORs for adolescent drinking were in all cases weaker and for parental education in T07 were not significant. This suggests that the smoking mechanism tended to act in opposition to and attenuate a more general association towards weekly drinking among more advantaged adolescents.

A residual association between SEP and heavy drinking in early adulthood was only evident in BCS70, whereby disadvantaged young people in this cohort had reduced odds of heavy drinking in early adulthood. Unadjusted ORs for this association in Table 5-5 were somewhat stronger, suggesting that the tertiary education mechanism contributed to this association.

Table 5-5: ORs from models without smoking and tertiary education mechanisms

	NCDS58		BCS70		T07	
	OR	95% CI	OR	95% CI	OR	95% CI
Parental Occupational Class						
Weekly Drinking in Adolescence on...						
Manual Class	0.65	0.60-0.70	0.73	0.65-0.81	0.64	0.44-0.94
Heavy Drinking in Adulthood on...						
Manual Class	1.03	0.94-1.14	0.74	0.65-0.83	0.95	0.76-1.18
Weekly Drinking in Adolescence	1.99	1.80-2.19	2.36	2.05-2.71	1.86	1.13-3.07
Household Income						
Weekly Drinking in Adolescence on...						
Low Income	0.64	0.59-0.70	0.65	0.57-0.75	0.52	0.31-0.85
Heavy Drinking in Adulthood on...						
Low Income	0.95	0.84-1.06	0.75	0.65-0.87	0.97	0.75-1.26
Weekly Drinking in Adolescence	1.97	1.79-2.17	2.35	2.04-2.71	1.86	1.13-3.09
Parental Education						
Weekly Drinking in Adolescence on...						
Parent(s) Left School by 16	0.80	0.72-0.88	0.89	0.81-0.99	0.69	0.41-1.16
Heavy Drinking in Adulthood on...						
Parent(s) Left School by 16	0.91	0.80-1.03	0.67	0.59-0.76	0.98	0.79-1.22
Weekly Drinking in Adolescence	1.97	1.79-2.17	2.39	2.08-2.76	1.87	1.13-3.10

5.3.2.4 Gender differences

Tables 5-6 through 5-8 display ORs (and 95% confidence intervals) from gender-stratified models respectively using parental occupational class, household income, and parental education to represent SEP. ORs were very similar for males and females for most of the modelled associations. However, the association between tertiary education and heavy drinking in early adulthood was somewhat stronger for females than males in NCDS58 and BCS70, with a similar trend in T07 (albeit less clear due to the wider confidence intervals).

Table 5-6: ORs from parental occupational class model by gender

	Females OR	Females 95% CI	Males OR	Males 95% CI
NCDS58				
Adolescent Smoking on...				
Manual Class	1.60	1.39-1.85	1.56	1.39-1.75
Weekly Drinking in Adolescence on...				
Manual Class	0.60	0.54-0.67	0.56	0.50-0.63
Adolescent Smoking	2.34	2.06-2.66	2.45	2.20-2.73
Tertiary Education on...				
Manual Class	0.24	0.20-0.28	0.22	0.19-0.26
Adolescent Smoking	0.17	0.13-0.22	0.22	0.18-0.27
Weekly Drinking in Adolescence	0.90	0.77-1.05	0.98	0.84-1.13
Heavy Drinking in Adulthood on...				
Manual Class	0.93	0.78-1.09	1.02	0.89-1.15
Adolescent Smoking	1.50	1.24-1.81	1.47	1.30-1.66
Weekly Drinking in Adolescence	1.80	1.53-2.12	1.61	1.42-1.82
Tertiary Education	1.35	1.11-1.63	1.02	0.90-1.16
BCS70				
Adolescent Smoking on...				
Manual Class	1.47	1.24-1.75	1.50	1.23-1.83
Weekly Drinking in Adolescence on...				
Manual Class	0.69	0.60-0.80	0.63	0.55-0.73
Adolescent Smoking	3.59	3.00-4.29	3.33	2.70-4.10
Tertiary Education on...				
Manual Class	0.35	0.29-0.41	0.35	0.29-0.41
Adolescent Smoking	0.29	0.22-0.38	0.30	0.23-0.40
Weekly Drinking in Adolescence	1.03	0.89-1.20	0.98	0.83-1.15
Heavy Drinking in Adulthood on...				
Manual Class	0.76	0.63-0.92	0.77	0.65-0.91
Adolescent Smoking	1.81	1.35-2.42	1.60	1.30-1.98
Weekly Drinking in Adolescence	2.21	1.78-2.74	2.06	1.70-2.49
Tertiary Education	1.90	1.55-2.33	1.37	1.17-1.62
T07				
Adolescent Smoking on...				
Manual Class	2.49	1.60-3.86	2.12	1.39-3.23
Weekly Drinking in Adolescence on...				
Manual Class	0.38	0.19-0.78	0.57	0.32-1.03
Adolescent Smoking	7.19	3.16-16.35	3.56	1.83-6.94
Tertiary Education on...				
Manual Class	0.27	0.18-0.40	0.28	0.20-0.40
Adolescent Smoking	0.24	0.13-0.44	0.19	0.10-0.34
Weekly Drinking in Adolescence	1.26	0.52-3.05	1.32	0.69-2.55
Heavy Drinking in Adulthood on...				
Manual Class	1.04	0.72-1.50	0.93	0.64-1.36
Adolescent Smoking	1.74	1.08-2.80	1.51	0.95-2.39
Weekly Drinking in Adolescence	1.16	0.47-2.90	1.44	0.73-2.84
Tertiary Education	1.45	1.02-2.05	1.25	0.85-1.84

Table 5-7: ORs from income model by gender

	Females OR	95% CI	Males OR	95% CI
NCDS58				
Adolescent Smoking on...				
Low Income	1.34	1.14-1.58	1.37	1.21-1.56
Weekly Drinking in Adolescence on...				
Low Income	0.61	0.54-0.68	0.59	0.52-0.67
Adolescent Smoking	2.27	2.00-2.58	2.38	2.14-2.65
Tertiary Education on...				
Low Income	0.44	0.36-0.53	0.40	0.33-0.47
Adolescent Smoking	0.16	0.12-0.21	0.21	0.17-0.26
Weekly Drinking in Adolescence	0.99	0.86-1.15	1.07	0.94-1.23
Heavy Drinking in Adulthood on...				
Low Income	0.85	0.68-1.04	0.95	0.83-1.08
Adolescent Smoking	1.51	1.25-1.82	1.48	1.31-1.67
Weekly Drinking in Adolescence	1.79	1.52-2.11	1.60	1.41-1.81
Tertiary Education	1.34	1.11-1.63	1.01	0.89-1.14
BCS70				
Adolescent Smoking on...				
Low Income	1.42	1.18-1.70	1.43	1.17-1.75
Weekly Drinking in Adolescence on...				
Low Income	0.60	0.51-0.71	0.58	0.49-0.70
Adolescent Smoking	3.64	3.04-4.35	3.34	2.72-4.10
Tertiary Education on...				
Low Income	0.39	0.33-0.47	0.41	0.34-0.49
Adolescent Smoking	0.29	0.22-0.37	0.30	0.23-0.39
Weekly Drinking in Adolescence	1.03	0.89-1.19	0.99	0.84-1.16
Heavy Drinking in Adulthood on...				
Low Income	0.79	0.63-0.98	0.77	0.64-0.93
Adolescent Smoking	1.80	1.34-2.42	1.60	1.29-1.98
Weekly Drinking in Adolescence	2.20	1.77-2.74	2.06	1.69-2.50
Tertiary Education	1.94	1.58-2.39	1.40	1.19-1.64
T07				
Adolescent Smoking on...				
Low Income	2.15	1.41-3.27	1.39	0.93-2.08
Weekly Drinking in Adolescence on...				
Low Income	0.24	0.08-0.68	0.54	0.29-1.01
Adolescent Smoking	7.26	3.01-17.50	3.37	1.71-6.65
Tertiary Education on...				
Low Income	0.35	0.22-0.56	0.35	0.24-0.50
Adolescent Smoking	0.22	0.12-0.40	0.17	0.09-0.32
Weekly Drinking in Adolescence	1.34	0.56-3.20	1.26	0.67-2.37
Heavy Drinking in Adulthood on...				
Low Income	0.87	0.57-1.32	1.01	0.70-1.45
Adolescent Smoking	1.79	1.11-2.88	1.49	0.93-2.40
Weekly Drinking in Adolescence	1.12	0.45-2.80	1.45	0.73-2.87
Tertiary Education	1.39	0.98-1.99	1.28	0.89-1.83

Table 5-8: ORs from parental education model by gender

	Females		Males	
	OR	95% CI	OR	95% CI
NCDS58				
Adolescent Smoking on...				
Parent(s) left School by 16	1.66	1.38-1.99	1.76	1.49-2.09
Weekly Drinking in Adolescence on...				
Parent(s) left School by 16	0.70	0.60-0.81	0.74	0.65-0.85
Adolescent Smoking	2.23	1.97-2.53	2.31	2.08-2.57
Tertiary Education on...				
Parent(s) left School by 16	0.18	0.15-0.21	0.18	0.15-0.20
Adolescent Smoking	0.16	0.12-0.21	0.21	0.17-0.26
Weekly Drinking in Adolescence	0.96	0.83-1.12	1.10	0.95-1.27
Heavy Drinking in Adulthood on...				
Parent(s) left School by 16	0.77	0.61-0.96	0.91	0.87-1.13
Adolescent Smoking	1.50	1.24-1.81	1.48	1.31-1.67
Weekly Drinking in Adolescence	1.79	1.53-2.11	1.60	1.41-1.82
Tertiary Education	1.27	1.03-1.55	0.99	0.87-1.13
BCS70				
Adolescent Smoking on...				
Parent(s) left School by 16	1.57	1.30-1.90	1.58	1.36-1.84
Weekly Drinking in Adolescence on...				
Parent(s) left School by 16	0.85	0.74-0.98	0.82	0.74-0.91
Adolescent Smoking	3.48	2.90-4.18	3.27	2.80-3.82
Tertiary Education on...				
Parent(s) left School by 16	0.21	0.17-0.24	0.20	0.18-0.24
Adolescent Smoking	0.28	0.21-0.37	0.29	0.23-0.36
Weekly Drinking in Adolescence	1.07	0.91-1.26	1.05	0.91-1.20
Heavy Drinking in Adulthood on...				
Parent(s) left School by 16	0.74	0.61-0.91	0.74	0.64-0.85
Adolescent Smoking	1.79	1.33-2.40	1.48	1.23-1.78
Weekly Drinking in Adolescence	2.24	1.81-2.78	2.26	1.95-2.63
Tertiary Education	1.83	1.47-2.28	1.45	1.25-1.67
T07				
Adolescent Smoking on...				
Parent(s) left School by 16	2.05	1.20-3.49	1.86	1.23-2.81
Weekly Drinking in Adolescence on...				
Parent(s) left School by 16	0.32	0.12-0.82	0.78	0.44-1.39
Adolescent Smoking	7.22	3.00-17.41	3.32	1.66-6.61
Tertiary Education on...				
Parent(s) left School by 16	0.18	0.12-0.28	0.23	0.16-0.32
Adolescent Smoking	0.22	0.13-0.38	0.17	0.10-0.32
Weekly Drinking in Adolescence	1.07	0.50-2.32	1.41	0.75-2.65
Heavy Drinking in Adulthood on...				
Parent(s) left School by 16	1.14	0.78-1.66	1.04	0.74-1.47
Adolescent Smoking	1.74	1.09-2.78	1.49	0.93-2.40
Weekly Drinking in Adolescence	1.19	0.47-2.98	1.45	0.73-2.87
Tertiary Education	1.50	1.05-2.16	1.29	0.89-1.87

5.4 Discussion

5.4.1 Summary of findings

This chapter described investigations of mechanisms between SEP and drinking in adolescence and early adulthood in three UK cohort studies. Socioeconomic disadvantage was associated with higher odds of smoking in adolescence, and adolescent smoking was associated with heavier drinking in adolescence and early adulthood. On the other hand, disadvantaged adolescents were less likely to participate in tertiary education, which was associated with heavier drinking in early adulthood, especially for females. The findings suggest that mechanisms leading to heavier drinking are stratified by SEP, and that mechanisms associated with SEP can operate in opposing directions. These opposing mechanisms were quite consistently observed across the three studies, for three different measures of SEP, and for males and females, but there was some heterogeneity between studies in the strength of these associations.

5.4.2 Limitations

Measures used to assess drinking were less than ideal and would not have captured the full complexity of drinking patterns. Another limitation, common to comparative research, is measurement differences between the cohorts. These included differences in question wording (leading to slightly different definitions of the constructs under study), in the age at which measures took place, and in the survey methods used in early adulthood (see Table 3-1). However, there was a high level of consistency in findings across the three cohorts, despite these differences.

A particular example of a measurement difference is the age at which early adult measures were taken. Heavy drinking in early adulthood does not necessarily persist, and especially among students in tertiary education it can be age-limited with consumption recovering to more moderate levels within just a few years (Schulenberg and Maggs, 2002). The lower prevalence of heavy drinking in BCS70, where measures took place at age 26, than in NCDS58 and T07, where measurements were taken at ages 22-23, may be suggestive of this (though it is not possible to determine whether this is an age or cohort effect). However, if the heavy drinking associated with tertiary education was primarily age-limited, then the association between tertiary education and heavy drinking would be expected to be weaker rather than stronger in BCS70 when respondents were older. The stronger association suggests that tertiary education was increasingly associated with not just age-limited, but also more persistent patterns of heavy drinking. Other work on transitions to adulthood in NCDS58 and BCS70 has similarly shown associations between educational pathways and heavier drinking a few years on when the respondents were in their early thirties (Schoon et al., 2012).

5.4.3 Smoking mechanism

Associations between adolescent smoking and drinking are consistent with previous research (Mathers et al., 2006) and this chapter indicates, as hypothesised, that smoking can be a mediating mechanism between socioeconomic disadvantage and heavier drinking in adolescence and early adulthood. This may, in part, be because the physiological effects of nicotine stimulate drinking (Lê et al., 2003, Barrett et al., 2006), but the findings may also be attributable to common mechanisms leading to both tobacco and alcohol use occurring more frequently among disadvantaged youth as discussed in Chapter 4 (and in more detail in section 9.3.2).

5.4.4 Tertiary education mechanism

Associations between participation in tertiary education and heavier drinking are also commonly observed (Kypri et al., 2005, Bewick et al., 2008, Carter et al., 2010) and this chapter indicates, as hypothesised, that they may represent a mediating mechanism through which a more advantaged socioeconomic background can lead to heavier drinking in early adulthood. Students in tertiary education tend to over-estimate how much their peers drink which may inflate the perceived normality of heavy drinking in this environment (Schulenberg and Maggs, 2002, Helmer et al., 2013). Drinking might also be a response to challenges associated with transitions into tertiary education (see section 2.2.3.1; Schulenberg and Maggs, 2002).

5.4.5 Residual association between SEP and drinking

Residual associations between SEP and drinking, after accounting for the smoking and education mechanisms, indicated heavier drinking among more advantaged young people. In one instance this was not evident until the smoking mechanism had been taken into account. This provides initial support for the notion that null associations between SEP and drinking in some previous studies (Hanson and Chen, 2007, Wiles et al., 2007) may be down to opposing mechanisms cancelling each other out. It also suggests there are other mechanisms associated with socioeconomic advantage, besides tertiary education, which lead to heavier drinking, particularly in adolescence where this finding was most consistent. For example, alcohol may be more available in more advantaged homes and families (Green, G et al., 1991, Forsyth and Barnard, 2000). It may be worth exploring a wider range of mechanisms and contexts, to see if inconsistent findings on SEP and drinking can be accounted for by contextual variation in the strength of such opposing mechanisms.

5.4.6 Differences according to gender and SEP indicator

There was very little variation in the findings when stratifying by gender, suggesting that in general, despite gender differences in the prevalence of heavy drinking, the mechanisms under study here worked similarly for males and females. Indeed, while many studies show differences in prevalence (Fillmore et al., 1991), few studies show strong gender interactions in associations between predictors and drinking (Zucker, 2008). An exception here was the association between tertiary education and heavy drinking, which tended to be stronger for females than males. Perhaps, since females tend to drink less overall (Fillmore et al., 1991), the inflated drinking norms in tertiary education (see section 2.2.3.1) have a stronger relative effect for them than for males, who tend to drink more anyway.

There was also a high degree of similarity in the findings when different measures of SEP were used, suggesting that the mechanisms are related to the overall construct of SEP rather than to the specific characteristics of particular measures.

5.4.7 Contextual heterogeneity

It was hypothesised that there would be contextual variation in the strength of the smoking and education mechanisms and this hypothesis was verified. The smoking mechanism appeared stronger in the more recent cohorts, particularly the association between smoking and adolescent drinking. Increases in alcohol availability (Roberts, 2011) potentially allow more scope for nicotine to influence consumption, but if this is the explanation, a similar strengthening in the association between smoking and early adult drinking would be expected. Alternatively, as overall smoking prevalence declined between cohorts (Roberts, 2011), smoking may have become a more deviant behaviour, more strongly tied to common risk factors that also prompt more frequent adolescent drinking. Associations between parental occupational class and adolescent smoking were particularly strong in T07. One possible explanation for this is that deindustrialisation and other changes in labour market structures have tended to concentrate jobs in the southern UK, leaving northern areas like Glasgow with particularly high unemployment rates (Pemberton, 2011), so disadvantaged youths in this area may have been more stressed by poor future prospects (and thus more likely to smoke) than elsewhere in the UK.

There was little contextual variation in the association between SEP and tertiary education, though parental occupational class exhibited a stronger association in NCDS58 than in BCS70. However, tertiary education was more strongly associated with heavy drinking in BCS70 than in NCDS58. Perhaps increases in alcohol availability (Roberts, 2011) provided more scope for social norms and transitional changes associated with tertiary education to influence drinking. T07 also showed weaker evidence of such an association for occupational class. This may simply have been because T07 had less power to detect an association (especially considering that associations were evident for income and parental education). However, given its higher prevalence in T07, heavy drinking may have been more culturally accepted among all young people in Glasgow at this time than elsewhere in the UK. Further research might concentrate on elucidating particular contextual aspects which result in stronger or weaker manifestations of these mechanisms across a wider range of contexts.

5.4.8 Conclusions

This chapter examined opposing mechanisms linking background SEP to drinking in adolescence and adulthood. Smoking in adolescence was more common among disadvantaged young people, and was associated with heavier drinking in adolescence and early adulthood. Conversely, experience of tertiary education was more likely for those from more advantaged backgrounds and was associated with heavier drinking in early adulthood, especially for females. This suggests multiple mechanisms leading to heavy drinking, stratified by SEP, but operating in opposing directions. An improved understanding of these mechanisms could help make interventions to reduce alcohol consumption more sensitive to the particular pathways taken, especially in adolescence and early adulthood as the behaviour first develops. It may be worth investigating whether a similar pattern of opposing mechanisms links background SEP and psychiatric distress.

6 SEP and psychiatric distress over the transition to adulthood

Figure 6-1 shows the focus of Chapter 6 within the conceptual framework of thesis. The focus is on psychiatric distress in adolescence and early adulthood, again with consideration of smoking and tertiary education as possible mechanism, and with sensitivity to context and gender. This fits within the broader aims of research questions 2 and 3 as defined in section 1.2. The specific hypotheses addressed in relation to the development of psychiatric distress are explained below.

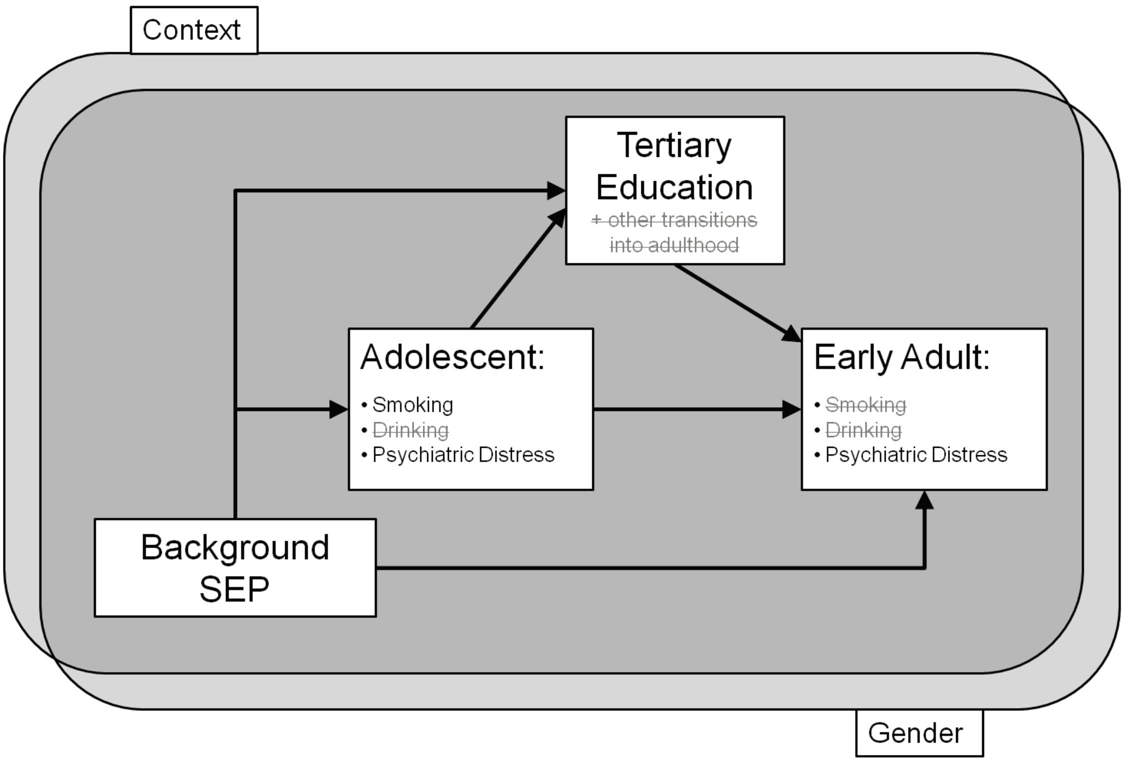


Figure 6-1: Emphasis of Chapter 6 within conceptual framework

6.1 Introduction and aims

6.1.1 Inconsistent findings on SEP and psychiatric distress

With respect to psychiatric distress, some have characterised adolescence as a period of ‘relative equality’ (West et al., 1990, Glendinning et al., 1992, Siahpush and Singh, 2000) with inequalities emerging as young people move through into later adulthood (Green, MJ and Benzeval, 2011), but others do find inequalities in psychiatric distress in adolescence. Section 2.3.4 described a meta-analysis of nine studies which found that a disadvantaged SEP was associated with a higher likelihood of psychiatric distress (Lemstra et al., 2008b).

Another systematic review showed consistent evidence of associations between socioeconomic disadvantage and poor mental health in childhood (Reiss, 2013), but evidence was weaker for adolescent ages, and for anxiety and depression rather than other mental health problems. Contextual variation in the strength of mechanisms might help explain why some studies show relative equality in youth, and others find inequalities. This chapter explores this possibility by investigating mechanisms between SEP and psychiatric distress in adolescence and early adulthood in different contexts.

6.1.2 Smoking mechanism

Chapters 4 and 5 have already demonstrated that socioeconomic disadvantage is associated with adolescent smoking. Smokers tend to experience higher levels of negative affect and those who quit smoking drop to lower levels (after an initial increase; Kassel et al., 2003). Indeed, many studies have shown prospective links between adolescent smoking and later psychiatric distress, even adjusting for SEP (see section 2.3.2; Mathers et al., 2006, Chaiton et al., 2009). This suggests a link between smoking and psychiatric distress which may be physiological, e.g. as smoking damages neurochemical pathways, or social, via stigmatisation of smoking behaviour (Kassel et al., 2003, Graham, 2012). Alternatively, smoking may not be a causal agent in itself, but a marker for life-stress mechanisms associated with socioeconomic disadvantage which prompt both smoking and distress.

Chapter 4 demonstrated that whilst adolescent smokers tended to experience higher levels of distress, other groups also experienced high levels of distress without smoking (i.e. the *High Distress* and *High Drinking* groups). Additionally, *Late Smokers* appeared to develop psychiatric symptoms more or less concurrently with their smoking behaviour, rather than smoking preceding the development of distress symptoms. This suggests equifinality in relation to psychiatric distress in adolescence, in that smoking was not the only mechanism leading to psychiatric distress. Disadvantaged adolescents tended to be in the group who smoked before developing symptoms, whereas membership in other distressed groups was either not associated with SEP or was associated with socioeconomic advantage, especially for those living in more affluent areas. Thus, the smoking mechanism appears strongly associated with socioeconomic disadvantage, whilst other non-smoking mechanisms may not be clearly patterned by SEP, or may even tend to be more frequent for more advantaged young people. It is not yet clear whether these patterns extend into early adulthood, or whether they would be replicated in other contexts.

6.1.3 Tertiary education mechanism

In contrast to Chapter 5 where there was strong prior evidence of associations between tertiary education and heavy drinking, it is less clear how tertiary education would be associated with psychiatric distress. Transitions into tertiary education may present challenges such as unfamiliar social environments and networks (Schulenberg and Maggs, 2002), and pressures related to educational success (e.g. exam-stress; Weidner et al., 1996, West and Sweeting, 2003). Section 2.2.3.2 explained how this could lead to distress where these challenges overload individual capacities or are poorly-matched to individual psychological maturity. Thus, tertiary education may potentially increase distress, whilst being associated with a more advantaged socioeconomic background. Conversely, tertiary education has potential for psychological benefit, being associated with the ‘emerging adult’ experience of increasing freedom and few responsibilities (Arnett, 2000); a time for personal development and identity exploration, including delays in the timing of other adulthood transitions (Bachman et al., 1997), reducing risk of overload. Indeed, if transitional challenges are well-matched to individual developmental capacities then tackling them successfully may lead to satisfaction and increased well-being (Schulenberg and Maggs, 2002). Thus, tertiary education could also be a mechanism for reducing or preventing distress. If the latter possibility is closer to the truth, then this may help explain why socioeconomic inequalities in distress begin to widen in adulthood (Green, MJ and Benzeval, 2011) as more advantaged young people move out of education and into satisfying adult roles.

6.1.4 SEP indicators

As in previous chapters, given the different resources emphasised by different SEP indicators (e.g. income emphasises material resources, education emphasises parental knowledge and skills and so forth) it is important to examine associations across a range of SEP indicators and see whether they exhibit a consistent pattern, or whether particular associations are unique, or more strongly presented, for particular SEP measures.

6.1.5 Contextual variation

This chapter examines contextual variation in smoking and educational mechanisms between SEP and psychiatric distress in adolescence and early adulthood. NCDS58, BCS70, and T07 are used here as in Chapter 5. Contextual heterogeneity may occur either in associations between SEP and mediating factors (smoking and tertiary education), or in the association between those mediating factors and psychiatric distress. Variation in associations between SEP and smoking might be expected because, as described in section 3.1.2, indicators of SEP may indicate greater relative disadvantage in more recent cohorts. Additionally, trends in family dynamics and labour markets (as described in section 3.1.2) may have meant that young people from disadvantaged backgrounds in the more recent cohorts had experienced less familial stability and poorer employment prospects than similarly disadvantaged young people in the earlier cohort. These additional stressors might strengthen associations between socioeconomic disadvantage and smoking or psychiatric distress. Variations in associations between smoking and psychiatric distress may also have occurred as overall smoking rates have declined (Roberts, 2011), with smoking becoming a more deviant, more stigmatised behaviour (Bell et al., 2010), leading to greater social isolation and distress. On the other hand, if associations between smoking and distress have more to do with physiological mechanisms, they might be expected to exhibit little contextual variation.

6.1.6 Aim and hypotheses

The aim of this chapter is to investigate two mediating mechanisms (smoking and tertiary education) between SEP and psychiatric distress in adolescence and early adulthood. Three indicators of parental SEP (occupational class, income and education) are examined, and analyses are repeated on three UK datasets representing different historical and geographical contexts. Structural equation models are employed, since the focus is on mediating mechanisms. Specifically, it is hypothesised that:

- a disadvantaged socioeconomic background will be associated with higher odds of adolescent smoking, and adolescent smoking will be associated with psychiatric distress in adolescence and early adulthood;
- an advantaged socioeconomic background will be associated with higher odds of participation in tertiary education, and participation in tertiary education will be associated with psychiatric distress in early adulthood (though the direction of association is unclear); and
- there will be heterogeneity in the strength of these mechanisms between contexts.

Psychiatric distress is strongly patterned by gender (West and Sweeting, 2003) and though associations with SEP are not consistently gendered (Reiss, 2013), other associations with distress are sometimes gender-dependent (Wu et al., 2010, Derdikman-Eiron et al., 2012), and so the sensitivity of the above mechanisms to gender is explored.

6.2 Methods

6.2.1 Samples

This chapter analyses NCDS58, BCS70 and T07 using the same analysis samples as defined in Chapter 5 (section 5.2.1). Thus, the analysis sample for NCDS58 included 15,672 respondents (84.4% of those eligible). For BCS70 12,735 (68.9%) respondents were included and the entire 1,515 (100.0%) respondents to T07 were included. Adolescent surveys took place at age 16 in 1974 for NDS58, 1986 for BCS70, and 1988 for T07, and surveys in early adulthood took place in 1981 (at age 23) for NCDS58, in 1996 (at age 26) for BCS70, and 1994 (at age 22) for T07.

6.2.2 Measures

6.2.2.1 Psychiatric distress

Psychiatric distress was indicated using symptom scales as described in section 3.2.2.3 (GHQ in T07 and in adolescence for BCS70; Rutter Malaise Inventory in early adulthood for NCDS58 and BCS70; neuroticism component of the Rutter Behavioural Scale for adolescent distress in NCDS58).

6.2.2.2 Smoking

Daily smoking in adolescence was defined as described in section 3.2.2.1.

6.2.2.3 SEP and tertiary education

This chapter utilised measures of background SEP as described in section 3.2.1.7, i.e. parental occupational class (manual vs. non-manual), equivalised household income (lowest tertile vs higher tertiles) and parental education (left school by 16 vs. post-16 education).

Respondents were coded as participating in tertiary education if they had reported being in full-time education after the age of 18.

6.2.3 Analysis

6.2.3.1 Structural equation models

Figure 6-2 depicts the analysis model which was tested using structural equation modelling in Mplus 7 (Muthén and Muthén, 2012). The positive signs indicate the hypothesised directions of association as smoking and tertiary education mediate between SEP and distress in adolescence and early adulthood (thicker lines). The question mark over the association between tertiary education and early adult distress indicates that the direction of this association is not yet clear. The model also allows for: residual effects of SEP on psychiatric distress in adolescence and early adulthood; associations between measures of psychiatric distress in adolescence and early adulthood; and associations between adolescent distress and adolescent smoking and participation in tertiary education (thinner lines). However, these associations are not the focus of investigation and as such no specific hypotheses are made about them. Models without mediation via smoking and tertiary education were also examined to assess the impact of these mechanisms on the residual association between SEP and psychiatric distress. Modelling is confirmatory in the sense that it tests whether the hypothesised associations are significantly different from the null ($p<0.05$) and in the proposed direction. Since data were categorical and estimated using maximum likelihood, fit statistics for the overall model were unavailable. Separate analyses were performed for each cohort and each measure of SEP and, initially, stratified by gender. However, given very few gender differences, results are mainly presented for males and females combined. Between cohort differences were assessed by examining the proportional overlap of the confidence intervals as described in section 5.2.3.1.

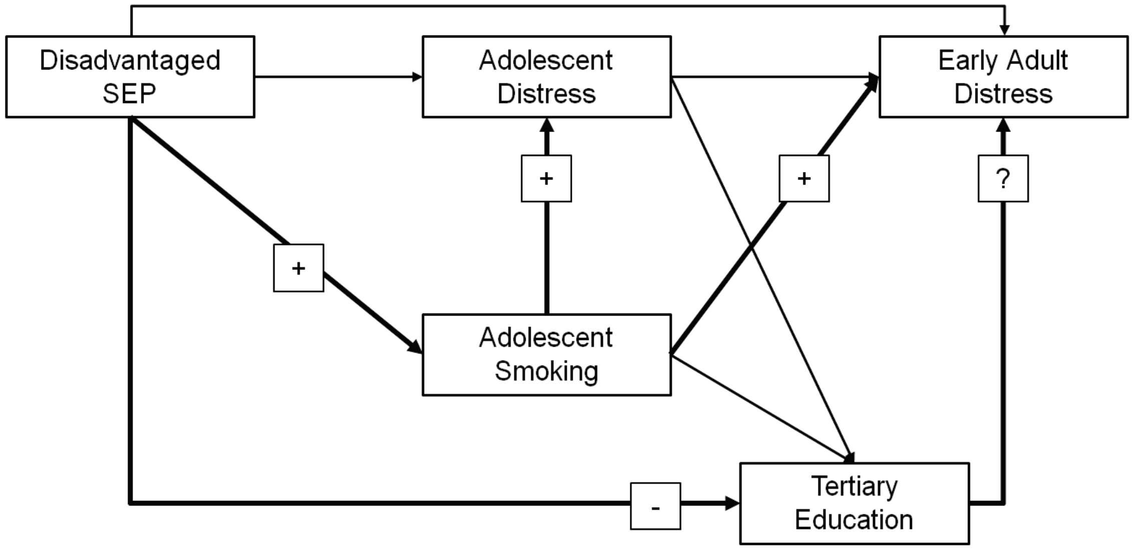


Figure 6-2: Analysis model and hypothesised direction of effects

6.2.3.2 Imputation and weighting

Many respondents within each analysis sample had some missing data either through non-participation in particular waves or non-response to particular questions. Given it was important for the samples to be representative of their location and historic period, multiple imputation and inverse probability weighting were employed as described in Chapter 5 (see section 5.2.3.2). Since the analysis samples were identical and measures of psychiatric distress in adolescence and early adulthood had been included in the imputation model in Chapter 5, these analyses used the same 25 imputed datasets and sample weights.

6.3 Results

6.3.1 Descriptive statistics and missing data

Table 6-1 displays descriptive statistics and information on missing data from within each cohort. Adolescent daily smoking was lower in the more recent cohorts. A greater proportion of adolescents were identified as distressed in BCS70 than in NCDS58, but the proportion was lowest in T07. Respondents in NCDS58 were most, and those from BCS70 least likely to come from manual households; respondents in NCDS58 were least likely to have had a parent in education beyond the age of 16. Early adult psychiatric distress was less common than in adolescence for NCDS58 and BCS70 but more common than adolescent distress in T07. However, only in T07 was the same measure applied in adolescence and early adulthood; the Rutter scale used in adulthood for NCDS58 and BCS70 may have only identified more severe cases.

Table 6-1: Descriptive statistics and missing data

(continued overleaf)

		NCDS58				BCS70				T07			
	Analysis N:				15,672				12,735				1,515
		Observed[a]		Imputed		Observed[a]		Imputed		Observed[a]		Imputed	
		N	%[b]	N	%[c]	N	%[b]	N	%[c]	N	%[b]	N	%[d]
Gender	Male	8,032	51.3	8,102	51.7	6,279	49.3	6,635	52.1	737	48.6	737	48.6
	Female	7,640	48.7	7,570	48.3	6,456	50.7	6,100	47.9	778	51.4	778	51.4
Adolescent Measures (age 16)													
Participated in adolescence	No	1,307	8.3			2,362	18.5			0	0.0		
	Yes	14,365	91.7			10,373	81.5			1,515	100.0		
Daily smoking	No	8,752	73.1	11,394	72.7	5,269	81.1	10,150	79.7	1,273	84.5	1,281	84.6
	Yes	3,217	26.9	4,278	27.3	1,224	18.9	2,585	20.3	234	15.5	234	15.4
	Missing	3,703	23.6			6,242	49.0			8	0.5		
Psychiatric Distress	No	8,048	83.3	12,867	82.1	3,070	71.7	9,233	72.5	1,146	85.2	1,286	84.9
	Yes	1,612	16.7	2,805	17.9	1,214	28.3	3,502	27.5	199	14.8	229	15.1
	Missing	6,012	38.4			8,451	66.4			170	11.2		
Parental Occupational Class	Non-manual	5,538	49.6	7,742	49.4	4,430	65.3	7,475	58.7	891	59.8	901	59.5
	Manual	5,633	50.4	7,930	50.6	2,350	34.7	5,260	41.3	598	40.2	614	40.5
	Missing	4,501	28.7			5,955	46.8			26	1.7		
Household Income	Mid-High	6,144	66.8	10,563	67.4	4,256	68.0	8,571	67.3	945	66.6	1,004	66.3
	Low	3,051	33.2	5,109	32.6	2,004	32.0	4,164	32.7	473	33.4	511	33.7
	Missing	6,477	41.3			6,475	50.8			97	6.4		
Parental Education	Post-16 Education	1,885	16.4	2,586	16.5	2,180	31.0	3,388	26.6	519	34.9	524	34.6
	Left School by 16	9,640	83.6	13,086	83.5	4,843	69.0	9,347	73.4	969	65.1	991	65.4
	Missing	4,147	26.5			5,712	44.9			27	1.8		
Early Adulthood Measures (ages 22-26)													
Participated in Early Adulthood	No	3,135	20.0			3,732	29.3			334	22.0		
	Yes	12,537	80.0			9,003	70.7			1,181	78.0		

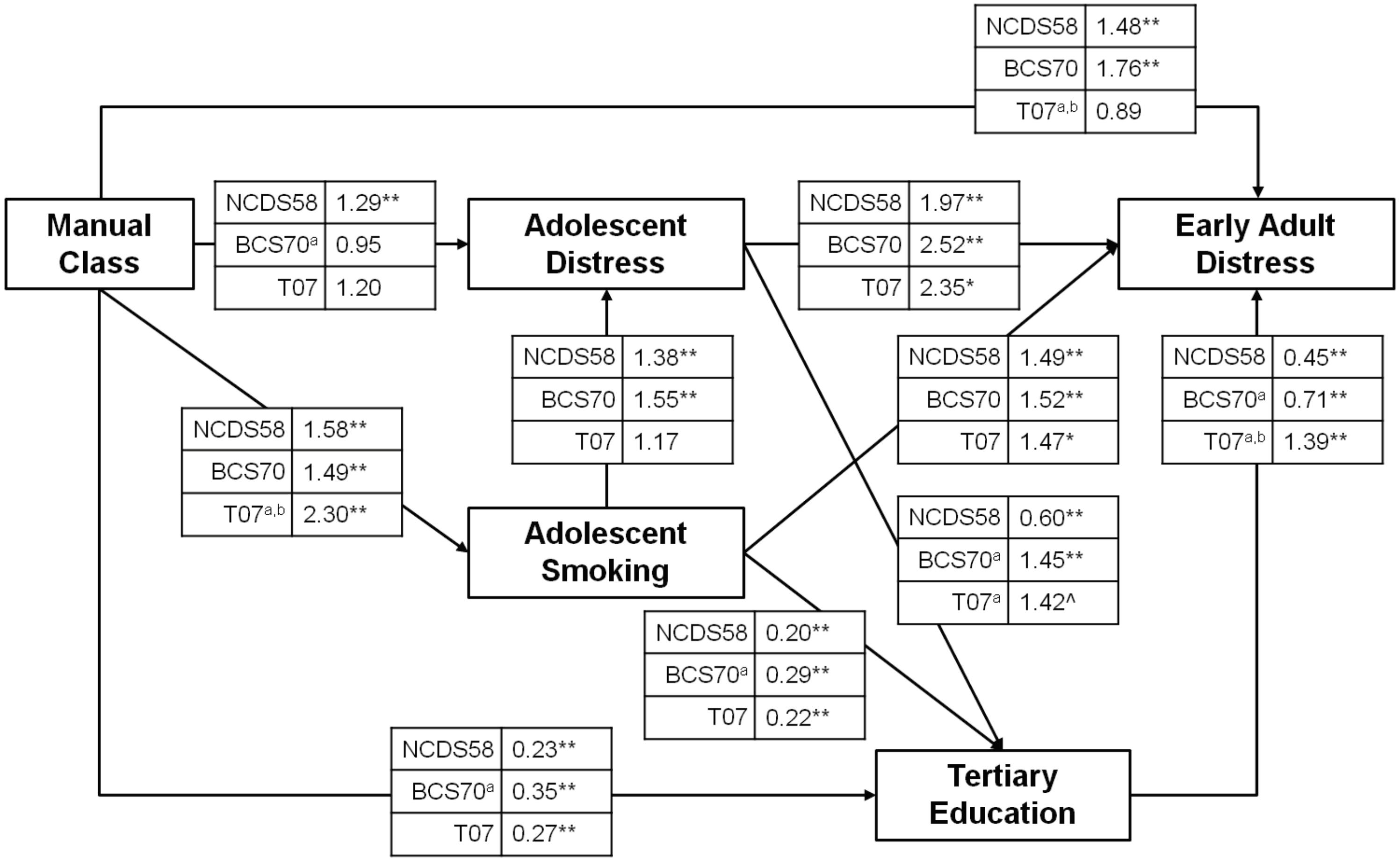
Tertiary education participation	No	9,945	79.3	12,538	80.0	6,235	70.1	9,131	71.7	885	63.7	982	64.8
	Yes	2,592	20.7	3,134	20.0	2,658	29.9	3,604	28.3	504	36.3	533	35.2
	Missing	3,135	20.0			3,842	30.2			126	8.3[e]		
Psychiatric Distress	No	11,532	92.4	14,465	92.3	7,141	86.8	10,965	86.1	753	64.7	961	63.4
	Yes	948	7.6	1,207	7.7	1,086	13.2	1,770	13.9	410	35.3	554	36.6
	Missing	3,192	20.4			4,508	35.4			352	23.2		
Additional Information on Missing Data													
Participated in adolescence and early adulthood	No	4,442	28.3			6,094	47.9			334	22.0		
	Yes	11,230	71.7			6,641	52.1			1,181	78.0		
Complete data on all analysis variables	No	9,927	63.3			11,134	87.4			475	31.4		
	Yes	5,745	36.7			1,601	12.6			1,040	68.6		

[a]Unweighted data.
[b]In order to facilitate comparison across cohorts, percentages are based on those with valid responses, except for missing categories where they are based on the analysis sample.
[c]Percentages are based on weighted average results across 25 imputed datasets.
[d]Percentages are based on average results across 25 imputed datasets.
[e]There are more valid responses than those participating in the early adulthood survey here because supplementary data from an intervening interview at age 18 were also used.

Again there were high levels of item-non-response for NCDS58 and BCS70, with low proportions having data on all SEP and other analysis variables (NCDS58: 36.7%; BCS70: 12.6%). Though again, SEP indicators were likely to be fairly accurately imputed from each other and from the range of other SEP indicators included in the imputation models, and many respondents had data on at least two of the four remaining analysis variables besides SEP (94.9% and 80.7% respectively). Sample proportions for most characteristics remained similar after imputation.

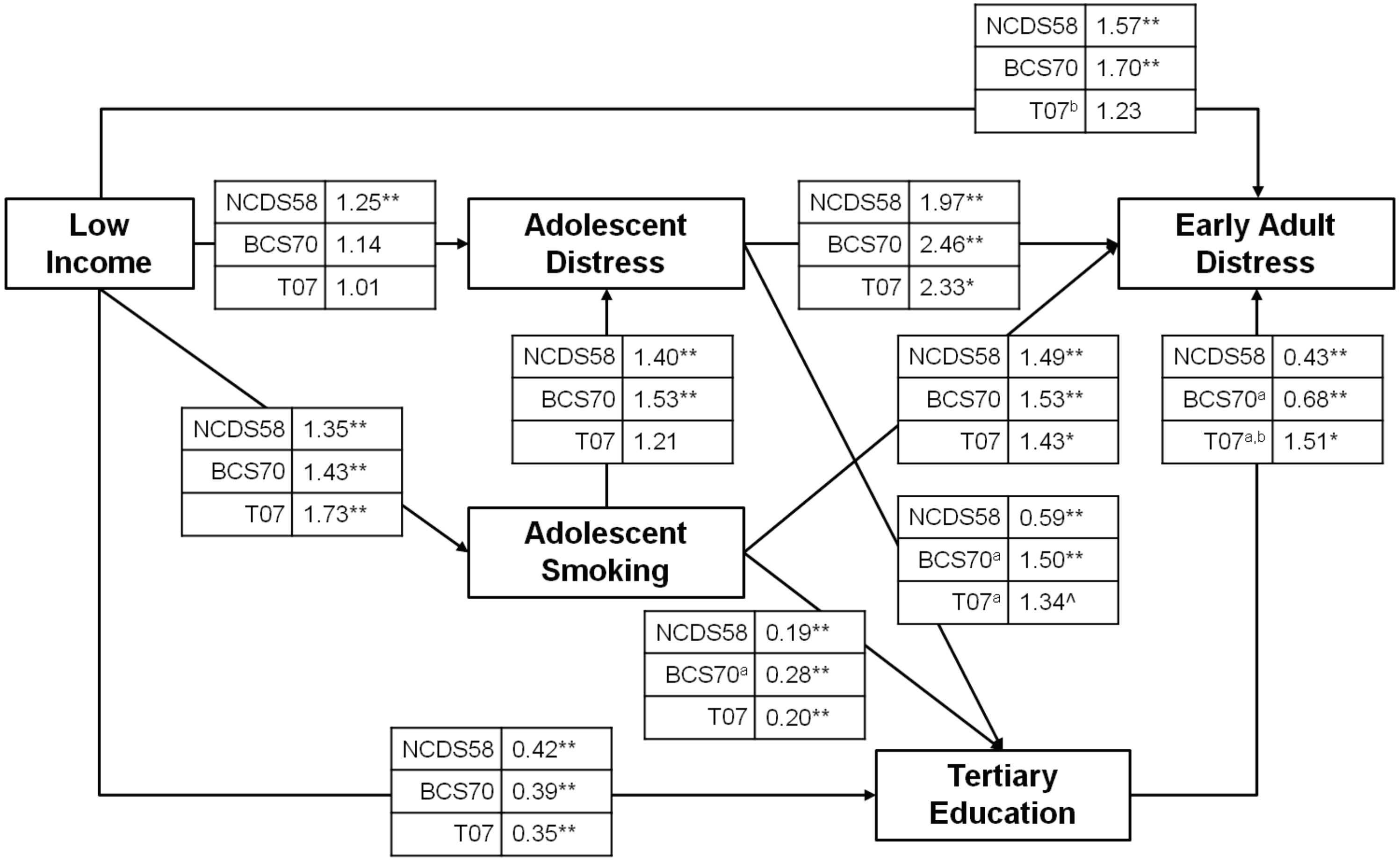
6.3.2 Structural equation models

Figures 6-3 to 6-5 show ORs from the models using parental occupational class, household income, and parental education respectively. Results from each cohort are shown together within each diagram, and footnotes to the figure indicate where ORs were deemed to differ significantly between cohorts based on the proportional overlap of their confidence intervals.



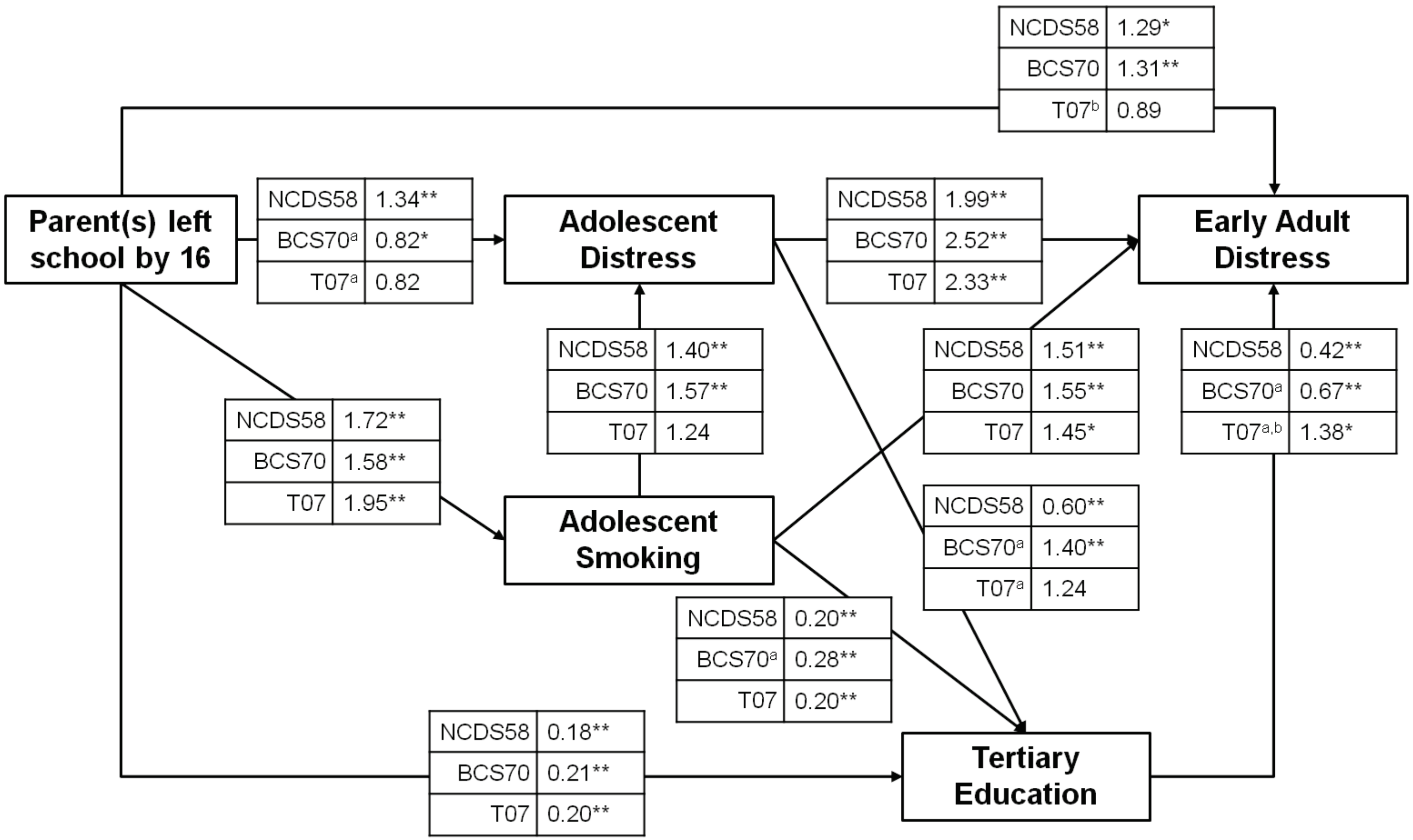
^P<0.1; *P<0.05; **P<0.01
NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study
[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.
[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 6-3: ORs from model for parental occupational class



^P<0.1; *P<0.05; **P<0.01
NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study
[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.
[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 6-4: ORs from model for income



^P<0.1; *P<0.05; **P<0.01

NCDS58=1958 National Child Development Study; BCS70= 1970 Birth Cohort Study; T07=Twenty-07 Study

[a]Proportional overlap of confidence intervals with NCDS58 is less than 0.5.

[b]Proportional overlap of confidence intervals with BCS70 is less than 0.5.

Figure 6-5: ORs from model for parental education

6.3.2.1 Smoking mechanism

As reported in section 5.3.2.1, socioeconomic disadvantage was associated with higher odds of adolescent daily smoking. This was true for all cohorts and all measures of SEP. When parental occupational class was the measure of SEP, ORs seemed stronger (based on proportional overlap of the confidence intervals) for T07 than for both NCDS58 and BCS70.

Adolescent smoking was associated with higher odds of psychiatric distress in adolescence in NCDS58 and BCS70 but not in T07. However, the confidence intervals for the OR from the T07 study overlapped with the ORs from NCDS58 and BCS70 as well as overlapping the line of unity, suggesting that there was not enough information to determine whether the OR was closer to null or closer to the significant associations found in NCDS58 and BCS70.

Adolescent distress was associated with distress in early adulthood, and there were no cohort differences apparent in this association. Even accounting for tracking of adolescent distress into adulthood, an association between adolescent daily smoking and psychiatric distress in early adulthood was found in each cohort, and these were all of similar magnitude.

6.3.2.2 Tertiary education mechanism

As reported in section 5.3.2.2, socioeconomic disadvantage was associated with reduced odds of participation in tertiary education, and for occupational class this association was weaker in BCS70 than in NCDS58. ORs for each cohort were similar in magnitude for parental education and income. Besides this direct association, socioeconomic disadvantage was also indirectly associated with reduced odds of participation in tertiary education via adolescent smoking. There was evidence of another indirect mechanism between SEP and tertiary education via adolescent distress, but this differed by cohort. In NCDS58, socioeconomic disadvantage was associated with higher odds of adolescent distress and adolescent distress was associated with reduced odds of tertiary education. In contrast, in BCS70 and T07 socioeconomic disadvantage was not directly associated with adolescent distress (except for parental education in BCS70, where distress was more likely for those with more educated parents). In BCS70 adolescent distress was associated with higher odds of participation in tertiary education. There was a similar trend in T07 but this was only borderline significant for occupational class and income ($p<0.1$), and was not significant for parental education.

Associations between participation in tertiary education and psychiatric distress in early adulthood differed by cohort. Tertiary education was associated with reduced odds of early adult distress in NCDS58 and BCS70 and the association was stronger in NCDS58 than in BCS70. In contrast, tertiary education was associated with higher odds of early adult distress in T07.

6.3.2.3 Residual associations between SEP and psychiatric distress

As noted above, in NCDS58 socioeconomic disadvantage was associated with adolescent psychiatric distress independently of the smoking mechanism, and this was true for all three measures of SEP. In contrast, in BCS70 and T07 there were almost no associations between SEP and adolescent distress. Parental education in BCS70 was an exception, with an association indicating lower odds of adolescent distress for those whose parents had less education.

For comparison, Table 6-2 shows ORs from models without the smoking or tertiary education mechanisms. In NCDS58 the ORs for associations between SEP and adolescent distress from the adjusted models were all mildly attenuated relative to the unadjusted models, suggesting that smoking contributes to associations between socioeconomic disadvantage and psychiatric distress. In BSC70 and T07 the adjusted ORs all tended slightly more towards lower odds of distress among those from a disadvantaged SEP than in the unadjusted models, but this adjustment did not change the significance level of any associations.

Taking account of adolescent smoking, adolescent distress, and tertiary education, there were greater odds of distress in early adulthood for those from a disadvantaged SEP in NCDS58 and BCS70, but not in T07. This pattern was consistent for all measures of SEP. The OR in T07 was consistently weaker than that from BCS70, but its confidence intervals overlapped with the OR from NCDS58 for income and parental education. ORs for this association were mostly attenuated in comparison to those from unadjusted models (in Table 6-2), suggesting that the smoking and tertiary education mechanisms contribute to this association.

Table 6-2: ORs from models without smoking and tertiary education mechanisms

	NCDS58		BCS70		T07	
	OR	95% CI	OR	95% CI	OR	95% CI
Parental Occupational Class						
Adolescence Distress on...						
Manual Class	1.33	1.20-1.48	0.98	0.86-1.11	1.22	0.93-1.60
Adult Distress on...						
Manual Class	1.74	1.51-2.01	1.92	1.60-2.31	0.85	0.67-1.08
Adolescent Distress	2.10	1.80-2.46	2.55	2.09-3.10	2.40	1.76-3.26
Household Income						
Adolescence Distress on...						
Low Income	1.28	1.14-1.43	1.17	0.97-1.41	1.02	0.75-1.39
Adult Distress on...						
Low Income	1.74	1.47-2.05	1.84	1.58-2.15	1.15	0.89-1.48
Adolescent Distress	2.11	1.81-2.47	2.47	2.03-3.02	2.38	1.75-3.23
Parental Education						
Adolescence Distress on...						
Parent(s) Left School by 16	1.39	1.21-1.59	0.85	0.73-0.99	0.84	0.61-1.14
Adult Distress on...						
Parent(s) Left School by 16	1.70	1.34-2.14	1.54	1.30-1.82	0.81	0.64-1.03
Adolescent Distress	2.14	1.83-2.50	2.55	2.10-3.09	2.36	1.74-3.21

6.3.2.4 Gender differences

Tables 6-3 through 6-5 display ORs (and 95% confidence intervals) from gender-stratified models respectively using parental occupational class, household income, and parental education to represent SEP. There was little difference between males and females, except perhaps in T07, but considering the wider confidence intervals due to smaller numbers in this cohort there was still little indication of substantive gender differences in associations. However, tertiary education did seem to be associated with higher odds of adult distress for males but not females in T07.

Table 6-3: ORs from parental occupational class model by gender

	Females OR	95% CI	Males OR	95% CI
NCDS58				
Adolescent Smoking on...				
Manual Class	1.60	1.39-1.85	1.56	1.39-1.75
Adolescent Distress on...				
Manual Class	1.32	1.15-1.52	1.26	1.09-1.46
Adolescent Smoking	1.52	1.32-1.75	1.34	1.15-1.55
Tertiary Education on...				
Manual Class	0.24	0.21-0.28	0.23	0.19-0.26
Adolescent Smoking	0.17	0.13-0.22	0.22	0.18-0.27
Adolescent Distress	0.60	0.49-0.74	0.62	0.49-0.77
Adult Distress on...				
Manual Class	1.46	1.24-1.73	1.62	1.22-2.15
Adolescent Smoking	1.61	1.31-1.98	1.68	1.26-2.23
Adolescent Distress	1.75	1.44-2.13	2.02	1.51-2.69
Tertiary Education	0.49	0.38-0.64	0.39	0.25-0.63
BCS70				
Adolescent Smoking on...				
Manual Class	1.47	1.24-1.75	1.50	1.23-1.83
Adolescent Distress on...				
Manual Class	0.95	0.81-1.11	0.94	0.78-1.13
Adolescent Smoking	1.53	1.28-1.82	1.53	1.19-1.96
Tertiary Education on...				
Manual Class	0.35	0.29-0.41	0.35	0.30-0.41
Adolescent Smoking	0.28	0.22-0.36	0.29	0.22-0.38
Adolescent Distress	1.51	1.24-1.84	1.43	1.15-1.79
Adult Distress on...				
Manual Class	1.77	1.46-2.15	1.74	1.31-2.31
Adolescent Smoking	1.44	1.14-1.83	1.61	1.12-2.31
Adolescent Distress	2.35	1.91-2.88	2.42	1.72-3.41
Tertiary Education	0.78	0.64-0.95	0.63	0.48-0.84
T07				
Adolescent Smoking on...				
Manual Class	2.49	1.60-3.86	2.12	1.39-3.23
Adolescent Distress on...				
Manual Class	1.26	0.86-1.86	1.07	0.66-1.73
Adolescent Smoking	1.43	0.90-2.28	0.82	0.38-1.75
Tertiary Education on...				
Manual Class	0.26	0.17-0.39	0.28	0.19-0.40
Adolescent Smoking	0.24	0.13-0.43	0.20	0.10-0.37
Adolescent Distress	1.41	0.94-2.12	1.40	0.78-2.51
Adult Distress on...				
Manual Class	0.89	0.61-1.30	0.88	0.59-1.31
Adolescent Smoking	1.34	0.82-2.18	1.65	1.01-2.70
Adolescent Distress	2.43	1.60-3.67	1.98	1.15-3.43
Tertiary Education	1.10	0.78-1.53	1.83	1.23-2.73

Table 6-4: ORs from income model by gender

	Females OR	95% CI	Males OR	95% CI
NCDS58				
Adolescent Smoking on...				
Low Income	1.34	1.14-1.58	1.37	1.21-1.56
Adolescent Distress on...				
Low Income	1.23	1.06-1.42	1.27	1.09-1.48
Adolescent Smoking	1.55	1.35-1.78	1.35	1.16-1.56
Tertiary Education on...				
Low Income	0.44	0.36-0.54	0.40	0.34-0.47
Adolescent Smoking	0.16	0.13-0.21	0.21	0.17-0.26
Adolescent Distress	0.58	0.47-0.71	0.61	0.49-0.76
Adult Distress on...				
Low Income	1.60	1.31-1.96	1.54	1.14-2.09
Adolescent Smoking	1.62	1.31-1.99	1.68	1.26-2.25
Adolescent Distress	1.76	1.45-2.13	2.00	1.50-2.67
Tertiary Education	0.47	0.36-0.62	0.36	0.24-0.58
BCS70				
Adolescent Smoking on...				
Low Income	1.42	1.18-1.70	1.43	1.17-1.75
Adolescent Distress on...				
Low Income	1.15	0.93-1.43	1.11	0.90-1.38
Adolescent Smoking	1.51	1.26-1.80	1.50	1.17-1.93
Tertiary Education on...				
Low Income	0.38	0.32-0.45	0.40	0.33-0.49
Adolescent Smoking	0.28	0.21-0.36	0.29	0.22-0.38
Adolescent Distress	1.56	1.27-1.92	1.47	1.17-1.86
Adult Distress on...				
Low Income	1.64	1.36-1.97	1.79	1.43-2.24
Adolescent Smoking	1.45	1.15-1.84	1.61	1.12-2.32
Adolescent Distress	2.29	1.86-2.81	2.37	1.67-3.35
Tertiary Education	0.75	0.61-0.91	0.62	0.47-0.82
T07				
Adolescent Smoking on...				
Low Income	2.15	1.41-3.27	1.39	0.93-2.08
Adolescent Distress on...				
Low Income	1.05	0.67-1.65	0.95	0.58-1.58
Adolescent Smoking	1.49	0.95-2.35	0.83	0.40-1.74
Tertiary Education on...				
Low Income	0.35	0.22-0.55	0.34	0.24-0.50
Adolescent Smoking	0.22	0.12-0.40	0.18	0.09-0.34
Adolescent Distress	1.33	0.91-1.96	1.35	0.78-2.34
Adult Distress on...				
Low Income	1.33	0.92-1.91	1.16	0.79-1.70
Adolescent Smoking	1.28	0.79-2.05	1.63	1.00-2.65
Adolescent Distress	2.40	1.58-3.64	1.98	1.15-3.41
Tertiary Education	1.20	0.87-1.67	1.96	1.33-2.90

Table 6-5: ORs from parental education model by gender

	Females		Males	
	OR	95% CI	OR	95% CI
NCDS58				
Adolescent Smoking on...				
Parent(s) Left School by 16	1.66	1.38-1.99	1.76	1.49-2.09
Adolescent Distress on...				
Parent(s) Left School by 16	1.41	1.17-1.70	1.28	1.04-1.58
Adolescent Smoking	1.54	1.34-1.77	1.35	1.17-1.56
Tertiary Education on...				
Parent(s) Left School by 16	0.18	0.15-0.21	0.18	0.15-0.20
Adolescent Smoking	0.16	0.12-0.21	0.21	0.17-0.27
Adolescent Distress	0.60	0.49-0.74	0.61	0.48-0.76
Adult Distress on...				
Parent(s) Left School by 16	1.30	1.00-1.69	1.42	0.88-2.29
Adolescent Smoking	1.63	1.33-2.01	1.71	1.28-2.27
Adolescent Distress	1.77	1.46-2.14	2.04	1.53-2.73
Tertiary Education	0.47	0.36-0.61	0.37	0.23-0.59
BCS70				
Adolescent Smoking on...				
Parent(s) Left School by 16	1.57	1.30-1.90	1.59	1.28-1.96
Adolescent Distress on...				
Parent(s) Left School by 16	0.81	0.67-0.98	0.82	0.66-1.01
Adolescent Smoking	1.55	1.30-1.85	1.54	1.20-1.98
Tertiary Education on...				
Parent(s) Left School by 16	0.21	0.17-0.25	0.21	0.17-0.25
Adolescent Smoking	0.28	0.21-0.36	0.29	0.22-0.38
Adolescent Distress	1.46	1.19-1.79	1.39	1.10-1.75
Adult Distress on...				
Parent(s) Left School by 16	1.27	1.03-1.55	1.37	1.02-1.84
Adolescent Smoking	1.47	1.16-1.86	1.64	1.14-2.34
Adolescent Distress	2.34	1.91-2.87	2.41	1.72-3.39
Tertiary Education	0.73	0.60-0.89	0.61	0.46-0.82
T07				
Adolescent Smoking on...				
Parent(s) Left School by 16	2.05	1.20-3.49	1.86	1.23-2.81
Adolescent Distress on...				
Parent(s) Left School by 16	0.75	0.53-1.08	0.90	0.50-1.62
Adolescent Smoking	1.57	1.00-2.47	0.84	0.39-1.78
Tertiary Education on...				
Parent(s) Left School by 16	0.18	0.12-0.28	0.23	0.16-0.31
Adolescent Smoking	0.22	0.13-0.37	0.18	0.10-0.35
Adolescent Distress	1.15	0.75-1.76	1.34	0.78-2.32
Adult Distress on...				
Parent(s) Left School by 16	0.97	0.69-1.36	0.79	0.52-1.19
Adolescent Smoking	1.32	0.81-2.14	1.64	1.00-2.68
Adolescent Distress	2.40	1.60-3.61	1.98	1.14-3.42
Tertiary Education	1.12	0.79-1.58	1.75	1.14-2.67

6.4 Discussion

6.4.1 Summary of findings

This chapter described investigations of mechanisms between SEP and psychiatric distress in adolescence and early adulthood in three UK cohort studies. Socioeconomic disadvantage was associated with higher odds of smoking in adolescence, and adolescent smoking was associated with greater chances of psychiatric distress in adolescence and early adulthood. Socioeconomic disadvantage was associated with less chance of participation in tertiary education, but associations between tertiary education and early adult distress differed by cohort: education was associated with higher odds of distress in T07, but lower odds in BCS70 and NCDS58.

6.4.2 Limitations

Similar to the investigation reported in Chapter 5 (see section 5.4.2) the findings of this chapter are limited by measurement differences between the cohorts. These included differences in question wording or in the scales used to measure psychiatric distress, in the age at which measures took place, and in the survey methods used in early adulthood (postal surveys for BCS70 and T07, interviews for NCDS58). Thus, some of the cohort differences may be attributable to differences in measurement rather than context. For example, the association between tertiary education and early adult distress was markedly different in T07, than in BCS70 and NCDS58. T07 utilised a different scale and took measures at an earlier age than the other cohorts. The earlier age, perhaps meant it was capturing some residual educational anxiety, or anxieties related to seeking or starting employment, whereas similar anxieties in the other cohorts could have receded as graduates moved on and settled into new jobs. This would be consistent with prior work in T07 indicating that socioeconomic inequalities emerge in adulthood (Green, MJ and Benzeval, 2011); in early adulthood these educational anxieties could produce similar levels of distress as those present in more disadvantaged socioeconomic strata. The GHQ is also known to identify more cases than the malaise inventory (Sacker and Wiggins, 2002), implying it might be identifying less severe cases. If tertiary education is associated with a lower likelihood of severe distress but a greater likelihood of mild distress, then this might explain the cohort differences observed here.

Also, in the residual association between SEP and psychiatric distress in adolescence, NCDS58 differed from BCS70 and T07, showing greater odds of distress for those in a disadvantaged SEP. However, the measure used to assess adolescent distress in NCDS58 was actually developed as a scale for assessing neuroticism, rather than psychiatric distress *per se*. Despite considerable conceptual overlap between neuroticism and symptoms of anxiety and depression, it may still have been measuring something slightly different. If there were stronger socioeconomic inequalities in what this scale was measuring than in what the GHQ was measuring (though I have no particular theoretical reason for expecting this to be so), then this could account for the difference in findings, rather than it being a feature of the historical context. Perhaps more importantly, the neuroticism scale was also teacher-rated rather than filled in by the respondents, and so may have been subject to perceptual biases from the teachers. Teachers may have been aware to some degree of the SEP of the children they were assessing, and could have attributed greater problems and distress to those they perceived as in greater disadvantage. This would result in an artefactually magnified inequality in NCDS58 that might not be apparent in BCS70 and T07. Nevertheless, the teacher-rated neuroticism scale in NCDS58 did exhibit similar associations to the malaise inventory administered in adulthood as were observed for the adolescent administered GHQ in BCS70.

6.4.3 Smoking mechanism

There was fairly consistent evidence of a smoking mechanism between socioeconomic disadvantage and psychiatric distress. There was an exception for adolescent distress in T07, but this was difficult to interpret considering wide confidence intervals around the estimate. T07 was consistent with NCDS58 and BCS70 in showing an association between adolescent smoking and early adult psychiatric distress.

Smoking may be causally related to distress because nicotine use has physiological effects which lead to anxiety and depression symptoms (Chaiton et al., 2009) or because smokers are stigmatised or seen as deviant (Graham, 2012). These explanations are not mutually exclusive and both could play a role. However, if social stigma is a large part of the explanation for this association, then stronger associations with distress would have been expected in the more recent cohorts, as stigmatisation of smoking has risen over time, but this was not the pattern observed. Associations were fairly consistent in magnitude between contexts, as might be expected if the explanation were physiological. Alternatively, the link between smoking and distress may be associative rather than causal, much as was suggested for drinking in section 5.4.3 (and discussed in more detail in section 9.3.2).

6.4.4 Tertiary education mechanism

It was hypothesised that tertiary education would be associated with differences in distress in early adulthood, but that these differences might be in either direction. Transitions into tertiary education were conceived of as presenting challenges in terms of unfamiliar social environments and pressures to succeed, as well as opportunities for psychological benefit in terms of developmental freedom, and delaying other adulthood transitions until one is more mature and capable of dealing with them (Bachman et al., 1997, Arnett, 2000, Schulenberg and Maggs, 2002, West and Sweeting, 2003). The balance of the results seems to point towards psychological benefit, with associations in this direction in both NCDS58 and BCS70. However, contrasting findings in T07 indicate potential for psychiatric detriment in some contexts. Indeed, it may be that tertiary education presents both challenges and benefits, with the net effect varying from context to context.

6.4.5 Residual associations with SEP

Residual associations with SEP, after accounting for the smoking mechanism, represent mechanisms not associated with smoking. In this regard, the two larger cohorts, NCDS58 and BCS70, both pointed towards greater odds of distress in early adulthood for those from a disadvantaged SEP. In adolescence however, NCDS58 showed greater odds of distress for those from a disadvantaged SEP, whilst BCS70 showed either no strong relationship or lower odds of distress for those whose parents had less education. None of these associations were significant in T07, though again this finding is more ambiguous as the confidence intervals were wider.

These findings suggest that there are mechanisms leading to distress that are inconsistently associated with socioeconomic disadvantage, but not associated with adolescent smoking, particularly in early adulthood. If the smoking mechanism is assumed to represent the effect of stressors associated with socioeconomic disadvantage then it is not immediately clear what other mechanisms might account for this, unless SEP stratifies stressors or coping resources that are not associated with adolescent smoking. Perhaps the tendency for those from disadvantaged backgrounds to move into unfavourable adult socioeconomic circumstances is at least partially independent of adolescent smoking, and stresses associated with adult SEP begin to show as inequalities in distress in early adulthood, though this would not explain why disadvantaged adolescents in NCDS58 were more likely to be distressed.

The tendency for those with more educated parents in BCS70 to be more likely to experience distress in adolescence suggests there may also be mechanisms which work in the opposite direction (i.e. mechanisms which promote distress but are more common for those from more affluent circumstances). An obvious one here might be pressure from well-educated parents for their children to do well in education, with this pressure stimulating anxiety (West and Sweeting, 2003). Such pressures might be expected to recede as young people move into early adulthood, which is consistent with the reversal of association seen between adolescence and early adulthood in BCS70.

6.4.6 Heterogeneity

As mentioned in section 6.4.4, there was marked heterogeneity between cohorts in the association between tertiary education and early adult psychiatric distress. Perhaps the benefits of education (in terms of psychiatric distress), are most marked where labour markets are favourable. The investment of time and resources in education would seem worthwhile, satisfying even, if one can progress from there into a good job. However, where unemployment rates are high, as they were in the later cohorts, especially T07 (Ashton and Bynner, 2011, Pemberton, 2011), prospects of moving directly into a good, secure job may be less sure and the investment in education may seem less worthwhile, producing feelings of frustration and disappointment. This could explain why the tendency for less distress associated with tertiary education was weaker in BCS70, and might contribute to explaining why the association was in the opposite direction in T07.

Residual associations between SEP and distress varied between contexts in adolescence and early adulthood. This suggests that mechanisms leading to distress independently of smoking are relatively variable, sometimes favouring those of higher SEP, sometimes those of lower SEP, and sometimes neither.

Besides the particular finding for parental education in BCS70 mentioned above, there was considerable homogeneity in the findings by SEP indicator, suggesting that the findings are attributable to the general construct of SEP rather than the unique characteristics of each measure. There was also little heterogeneity in the findings between males and females, suggesting that whilst distress is more prevalent among females (West and Sweeting, 2003), the processes associating SEP and distress work similarly for males and females. Nevertheless, the association in T07 between tertiary education and risk of distress did appear to be concentrated among males rather than females. If this association was indeed related to employment concerns as suggested above, these may have been more salient for males than females, due to their connection with the hegemonic, traditional bread-winner role.

6.4.7 Conclusions

The aim of this chapter was to examine smoking and tertiary education as mechanisms linking background SEP to psychiatric distress in adolescence and adulthood in three different cohorts. Smoking in adolescence was more common among disadvantaged young people, and was associated with greater odds of psychiatric distress in adolescence and early adulthood. This indicates a potentially important role for adolescent smoking in tackling inequalities in psychiatric distress in adolescence and early adulthood. On the other hand, whilst socioeconomic disadvantage was associated with less chance of participation in tertiary education, tertiary education was associated with either greater or lower levels of psychiatric distress, depending on the context. This and the previous chapter have focused on tertiary education, without considering the pattern of transitions into adult roles followed by those not remaining in education. It remains unclear whether such transition patterns are important for outcomes in early adulthood.

7 Causal effects of early transitions to adulthood

Figure 7-1 displays the emphasis of Chapter 7 within the conceptual framework set forth at the outset of the thesis. Chapter 7 considers the timing of a broader range of adulthood transitions (beyond participation in tertiary education) and focuses on whether links between these and early adult smoking, drinking and psychiatric distress are likely to be causal or merely associative, resulting from differences in background characteristics (research question 2ii). If adulthood transitions have causal effects then interventions affecting the timing of these transitions may be of use in reducing inequalities in early adult outcomes, but if associations have more to do with background characteristics then interventions affecting transition timing may not help. Figure 7-1 highlights the emphasis of the chapter, but the greyed out sections need to be considered as part of this overall aim. Sensitivity of findings to context and gender is investigated as in other chapters.

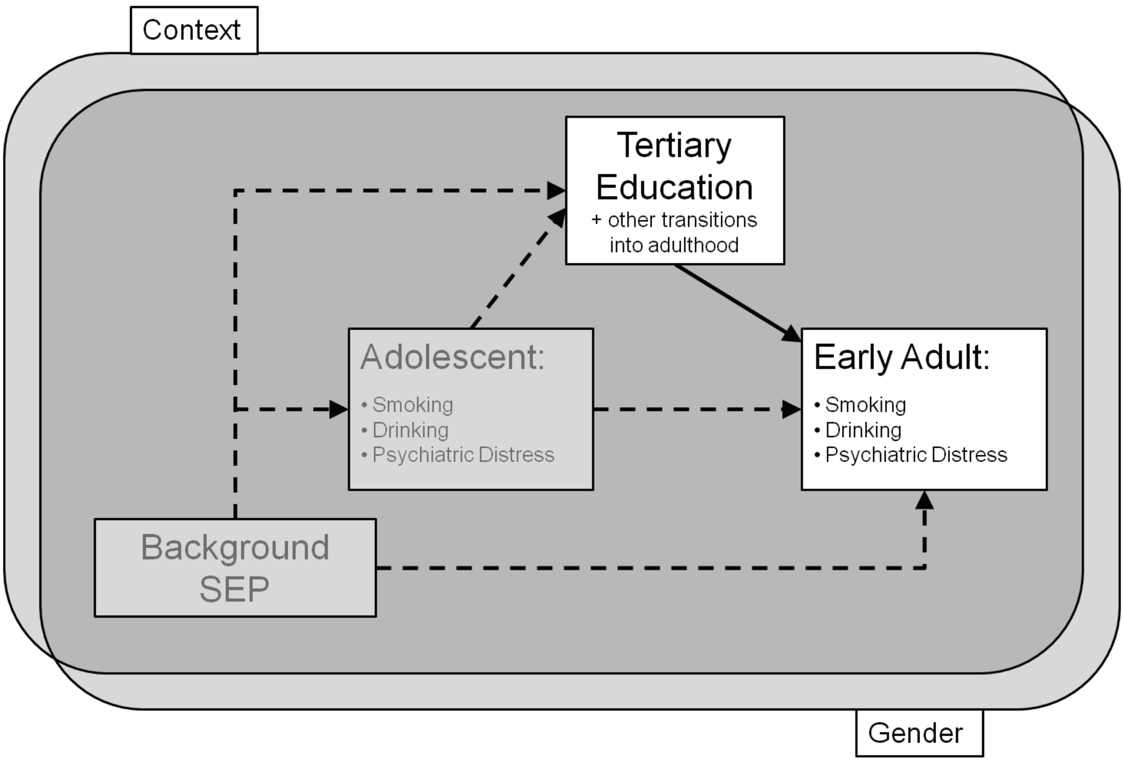


Figure 7-1: Emphasis of Chapter 7 within conceptual framework

7.1 Introduction and aims

7.1.1 Early transitions and unfavourable contexts

In section 2.1.2.3 it was explained that young people from disadvantaged backgrounds tend to make key transitions to adulthood such as leaving education, entering employment, starting cohabiting relationships, having children and leaving the parental home, at earlier ages than more advantaged young people (Sacker and Cable, 2010, Wickrama et al., 2010), with earlier educational exit particularly leading to earlier timing of other transitions (Chassin et al., 1992, Bachman et al., 1997, Schulenberg and Maggs, 2002). Section 2.2.3 described how early transitions to adulthood might have a range of influences on early adult smoking, drinking and psychiatric distress including: a mix of both positive and negative socialisation processes; potential for stress where transitional challenges overload individual capacities; and potential for psychological benefit as transitions open up opportunities to fulfil valued roles. The balance between positive and negative outcomes of entering adult roles early may be dependent on the features and timing of the roles adopted (Burton, 2007), and the individual psychological maturity of the young person (Benson and Elder, 2011, Benson et al., 2012). Thus, it is unclear what direction of association might be expected between early entry to adult roles and early adult substance use and psychiatric distress. The association may also depend on the context however; if conditions have shifted over time to favour delayed transitions (Côté and Bynner, 2008), it might be hypothesised that early transitions would have more adverse consequences (e.g. in terms of distress, coping behaviours and so forth) in more recent cohorts, where those leaving education early have poorer prospects than those leaving early in previous cohorts.

7.1.2 Selection

Section 2.2.3.3 also noted that associations between transition timing and early adult outcomes such as smoking, drinking and psychiatric distress may have more to do with who makes early transitions than with the actual effect of early transitions. There may be background characteristics which influence both the likelihood of early transition timing, and the likelihood of adverse outcomes in early adulthood, creating selection biases in observational associations. A disadvantaged socioeconomic background, and adolescent smoking and drinking, for example, are all associated with earlier transitions (Bachman et al., 1997, Sacker and Cable, 2010, Wickrama et al., 2010) and previous chapters have examined links between some of these factors and early adult drinking and distress. Thus, it is worth investigating whether early transitions to adulthood might have any causal effect on substance use and psychiatric distress. If so, they may constitute another mechanism whereby a disadvantaged SEP leads to poorer outcomes, and one that might be amenable to policy intervention.

Figure 7-2 summarises hypothesised relationships between various background factors, transition classes, and early adult outcomes. The background factors under consideration for the propensity weighting model of transitional class membership are positioned on a continuum from more distal to more proximal, and it is acknowledged that more distal factors may have effects both directly and indirectly via their associations with more proximal factors (Schulenberg and Maggs, 2002).

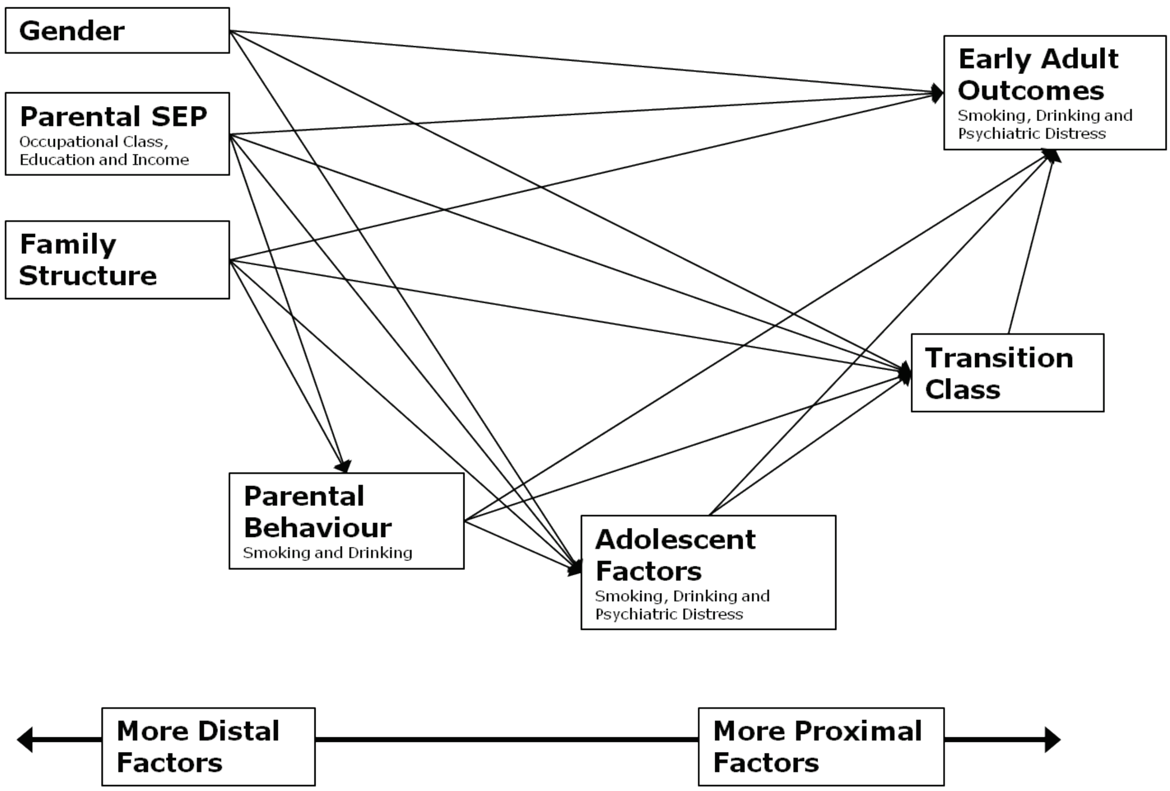


Figure 7-2: Hypothesised structure of associations

The factors considered most distal are: gender, which is viewed as a proxy for biological sex and as generally constant over the lifecourse; parental SEP, measured using parental occupational class, education and income and viewed as representing the social and economic resources of the household in which the young person grew up and therefore as antecedent to the other factors; and family structure, distinguishing between couple and single parents, which, whilst it may be closely associated with SEP is also viewed as representing the family processes, conflicts and resources of parental time that a young person grew up with, and thus, again, as antecedent to the more proximal factors.

Parental behaviours (i.e. smoking and drinking) are positioned next, and are viewed as decendents of parental SEP and family structure (but not the young person's own gender), reasoning that these behaviours may have been strongly determined by the parents' social, economic and family resources but were likely to have been long established as habits prior to the advent of the young person's own adolescence. Since parental behaviours are positioned as decedents of parental SEP, they have not been included in earlier chapters which were focused on associations between parental SEP and later outcomes, as they could represent mediators of that association. They are included here though, as the primary goal is not to estimate associations with parental SEP, but to investigate the association between transitions and early adult smoking, drinking and psychiatric distress. These associations could be confounded by parental behaviours.

Adolescent measures of the early adult outcomes are placed next, reasoning that these may have been heavily influenced by the preceding parental factors or by gender, but may also exhibit strong continuity into adulthood, and/or be important for selection into different transition patterns.

Finally, the transitional class is placed as most proximal to the early adult outcomes, reasoning simply on temporality in that it occurs after the other factors and before the outcomes. This ordering was considered to be most reasonable, but it is possible that others would order these factors differently or put arrows in different directions (e.g. one might think parental drinking could be antecedent to parental SEP or family structure). This diagram clarifies the structure of associations assumed for this analysis.

7.1.3 Aims and hypotheses

The aim of this chapter, based on further analysis of NCDS58, BCS70 and T07 is to address the following questions:

- What are the main patterns of early adulthood transitions within these three cohorts?

- How are background characteristics (background SEP, family structure, parental smoking and drinking, and adolescent smoking, drinking and psychiatric distress) associated with patterns of transitions into adult roles within these three cohorts?
- Do early transitions into adult roles have any causal effect on early adult smoking, drinking and psychiatric distress, relative to delayed transitions?
- Do causal effects differ by cohort?

Hypotheses in relation to these questions are as follows: 1) there will be patterns of both early and delayed transitions, remaining in education will be a key characteristic differentiating the two, and early transition patterns will have become less common in more recent cohorts; 2) a disadvantaged SEP will be associated with early transition patterns both directly and indirectly via other factors such as adolescent smoking; 3) early (relative to delayed) transitions will have a causal effect on early adult substance use and psychiatric distress; and 4) early transitions will be causally associated with greater risk of substance use and psychiatric distress in more recent cohorts.

7.2 Methods

7.2.1 Samples

The 1958 National Child Development Study (NCDS58), the 1970 British Cohort Study (BCS70), and the youth cohort of the West of Scotland Twenty-07 Study (T07) have already been introduced in detail (see section 3.1). In this case the analysis samples are constituted from those with data on the timing of at least one of their adulthood transitions (n=12,537, n=12,254 and n=1,429 respectively for NCDS58, BCS70 and T07). Adolescent surveys took place at age 16 in 1974 for NDS58, 1986 for BCS70, and 1988 for T07, and surveys in early adulthood took place in 1981 (at age 23) for NCDS58, in 1996 (at age 26) for BCS70, and 1994 (at age 22) for T07.

7.2.2 Measures

7.2.2.1 Transition timing

Data were obtained from each study on the ages at which respondents had made key transitions to adulthood (leaving full-time education, entering employment, entering a cohabiting relationship, having their first child, or leaving home). If dates were missing the month but not the year, the month of June was assumed as a mid-point rather than discarding the available data. Since adult outcomes were observed between ages 22-26 across the three studies, the interest here is on transitions occurring before the age of 22 (i.e. preceding the outcomes). All the transition variables were therefore censored at age 22. Questions on transition timing also tended to describe what happened beyond the age of 16 so data below this age were also censored. Data on transition timing were categorised in accordance with the timing of major educational exit points: age 16 or before; ages 17-18; ages 19-21; or not by age 22. In all cohorts, few respondents made early transitions into cohabitation and having children, so the first two age categories were combined into one category for entering a cohabiting relationship, and the variable for first child was collapsed into a binary indicator of whether or not they had had their first child before age 22. This categorisation is somewhat arbitrary, but finer categorisations in preliminary models yielded similar patterns; these categories were adopted in order to aid model convergence and interpretation. More specific details on how the timing of each transition was calculated within each study are provided below.

7.2.2.2 Leaving full-time education

NCDS58 data contained derived variables indicating economic activity status (employed, full-time education, or out of labour force) on a monthly basis between the ages of 16 and 23. T07 respondents were asked for information on monthly economic activity from age 16 onwards. In these cohorts, periods with missing data on economic activity that lasted two months or less and had the same status recorded both before and after the missing data were set to that adjacent status. In BCS70, respondents were asked to report retrospectively on economic activity since the age of 16, during interviews at ages 30 and 34 (though if they were interviewed at both ages the second of these interviews only asked for their history back to age 30; Hancock et al., 2011a). Some efforts have been made by the producers of the BCS70 data to harmonise these data (Hancock et al., 2011a) and the resulting activity histories have very few gaps (only nine respondents had a gap of one month, and only three had longer gaps of 4-6 months). In order to avoid categorising short periods away from education, e.g. term breaks, as leaving full-time education, and following others working with these cohorts (Sacker and Cable, 2010), respondents were only classed as leaving if they were recorded as outside education for at least five continuous months. Where a period outside education lasted at least five months, the beginning of that period was used to calculate the age of leaving full-time education.

7.2.2.3 Entering employment

In all cohorts, the economic activity histories were used to define age of entry to employment. In order to avoid categorising short term work, such as summer jobs between school terms, as entrance to employment, and following others working with NCDS58 and BCS70 (Sacker and Cable, 2010), a period of employment was required to last at least five months to be counted as entry to employment. Multiple consecutive periods of employment had their lengths combined to see if the five month threshold had been reached. Where a period of employment lasted five months or more, the start of that period was used to calculate age of entry to employment.

7.2.2.4 Entering a cohabiting relationship

In NCDS58, respondents were asked at age 23 for start and end dates of all cohabiting relationships lasting six months or more. The start date of the first of these was used to calculate the age of cohabitation entry. Cohabiting relationships lasting less than six months were not recorded.

BCS70 respondents were asked retrospectively during interviews at ages 30 and 34 for details of all cohabiting relationships lasting one month or more and again some data cleaning has been carried out to harmonise data from separate interviews (Hancock et al., 2011b). For consistency with NCDS58, the start date of the first that lasted six months or more was used to calculate the age of entering a cohabiting relationship. Adjacent, consecutive cohabitations with different partners were combined to see if the six month threshold had been reached.

Full cohabitation histories were not obtained in T07 until the final wave when respondents were aged approximately 35 years. Prior interviews only obtained information on current partnerships. Since there may have been unreported partnerships between interviews, the data were treated as missing unless they had provided retrospective histories during the interview at age 35. Start and end dates of cohabiting relationships were provided in years so a six-month threshold comparable to that used for NCDS58 and BCS70 could not be implemented. However, examining all the reported cohabitations in T07, only 20 cases (out of 840 who had reported a cohabiting relationship) had reported a cohabitation lasting less than one year. These relationships may have lasted more or less than six months, but the group is small enough that including them or not would probably have little impact overall. The start date of the first reported cohabiting relationship, regardless of its length, was therefore used to calculate the age of cohabitation entry in T07.

7.2.2.5 First child

In NCDS58, respondents reported at age 23 whether they had ever had children, and if so, the first child's month and year of birth. BCS70 respondents reported retrospectively at age 29 about all conceptions (where they or their partner had become pregnant), and the end date of the first pregnancy resulting in a live birth was obtained. These data were used to calculate the age that the respondents first had a child.

Respondents in T07 were asked at each interview about the ages of all their children who lived with them and at ages 30 and 35 for the ages of any children not living with them. Comparison with the age of the respondent at the time of reporting enabled calculation of the respondent's age when each child was born, and the youngest of these was taken as the age that the respondent first had a child.

7.2.2.6 Leaving home

At age 23, NCDS58 respondents were asked if they had ever moved away from their parents (or other care-providers) and if so, the date of this move was requested. This date was used to calculate age of leaving home.

BCS70 respondents were asked at age 29 for a history of move-in/move-out dates for all addresses they had lived in since age 16, and for their tenure at each address, including a code for 'living in parental home'. The move-in date for the first address where the tenure was not 'living in parental home' was used to calculate the age of leaving home.

When they were interviewed at age 18, respondents in T07 were asked for a history of address changes since their previous interview at age 16. If a move away from parents was recorded within this interview, then this date was used to calculate the age of leaving home. The postal questionnaire at age 22 asked respondents if they had left home in the past year, or in the past three years. Ages of leaving home were calculated from these data using the mid-point of the period within which they had said they had left home.

7.2.2.7 Early adult outcomes

Early adult measures of smoking, drinking and psychiatric distress were described in section 3.2.2.

7.2.2.8 Background factors

Section 3.2.1.7 described measures of parental occupation (manual vs. non-manual), income (lowest tertile vs. higher tertiles) and education (left school by 16 vs. post-16 education) and these were utilised again here.

At age 16 in NCDS58, the parental interview asked about the respondents' relationship to the person acting as their mother and the person acting as their father, including a code for the respondent having no regular father/mother figure. If either figure was absent they were coded as a single-parent family, otherwise as a two-parent family. In BCS70 at age 16, respondents reported which parental figures they were living with. Responses of 'Mother alone' or 'Father alone' were coded as single parent families. All others were coded as two-parent families. For T07, this measure was derived from questions to parents about marital status and cohabitation, during the baseline interviews. Those who were single and not cohabiting were coded as single parent families and all others as two-parent families.

Available measures of parental drinking differed considerably between the three cohorts. In NCDS58 the only indication of parental drinking available was an assessment by the health visitor performing the interview at age 7 of whether or not the family was having difficulties with alcoholism. In BCS70, both the respondents and their parents reported on parental drinking levels at age 16. Respondent reports of either their mother or their father drinking alcohol on 'most days' (as opposed to never, occasionally or some days), or parental reports of either of them drinking alcohol with a frequency of '3 or 4 times a week' or higher, were coded as heavy parental drinking. In the baseline interviews for T07, parents reported how much alcohol they had consumed over the past week. Either parent consuming more than the recommended weekly guidelines (14 units for women and 21 units for men; Royal College of Physicians et al., 1995) was coded as heavy parental drinking.

Parents of respondents in all cohorts reported their smoking status when respondents were aged 16, and respondents in BCS70 also reported on their parents' smoking status. Any indication (by parental or adolescent report) of either parent smoking was coded as parental smoking.

Measures of smoking, drinking and psychiatric distress in adolescence were described in section 3.2.2.

7.2.3 Analyses

7.2.3.1 Latent class analysis

The first stage of the analysis was to classify people into groups based on the timing of their entry into the five adult roles. Latent class analysis (Collins and Lanza, 2010) was employed for this purpose (see section 3.3.2.3 for details). For the sake of parsimony and to facilitate cross-cohort comparison, solutions with the same number of classes in each cohort were preferred *a priori*. Initial models were constructed with the data from each cohort separately and then with all data combined. For each model, 2000 sets of random starting values were followed for 25 iterations and then the 100 best-fitting sets were followed, either to convergence or for 1,000 iterations. In each case, a two-class model was taken as the starting point (on the premise that early transitions cannot be compared to delayed transitions if they are all grouped together in a single class) and further classes were added until models either failed to converge, had difficulties replicating solutions, or were clearly fitting less well with additional classes.

Models were then compared allowing response probabilities to vary by cohort and by gender. Gender comparisons were made within each cohort as well as for all cohorts combined. In addition to a statistical chi-square test for differences, the various model solutions were inspected to see if differences were meaningful. If there were statistically significant differences, but these had little impact on how the classes should be interpreted, then a more parsimonious model with a fixed latent class structure was still preferred (Collins and Lanza, 2010).

7.2.3.2 Propensity weighting

Having established a classification of how transitions to adulthood were timed using latent class analysis, the next stage of the analysis was to investigate whether transition classes were related to early adult outcomes (smoking, drinking and psychiatric distress). Since respondents were not randomly allocated to the different transition classes, but differed in terms of various background factors which might also affect their adult outcomes, selection biases could confound any observed association between transition class and early adult outcomes (Austin, 2011). There are various techniques to adjust for this using propensity scores (see section 3.3.2.5), and they tend to perform equally well (Austin, 2011). A propensity weighting approach was selected for use here on the pragmatic basis of it being easy to implement. It was also explained in section 3.3.2.5 that there are different ways of framing a counter-factual question, which give estimates of different causal effects (Austin, 2011, Lanza et al., 2013). This chapter focuses on the average causal effect among the treated (or exposed). The object was to compare those following patterns of early transitions against those who delayed transitions to remain in education. This is equivalent to asking what smoking, drinking and psychiatric distress outcomes would have been experienced in early adulthood among a group making early transitions, if they had made those early transitions (which they did) compared to if they had delayed those transitions to remain in education (which they did not).

The average causal effect among the treated was selected, acknowledging that early transitions may have different implications for the young people who make them, than they would among young people who do not make early transitions. In terms of interpretation, the focus of the question is on whether policies and interventions that encourage those who do make early transitions to remain in education would have beneficial or negative effects on their early adult outcomes, rather than on whether preventing those who do remain in education from doing so would have beneficial or negative effects on their early adult outcomes. This decision is based on the *a priori* stance that tertiary education is a good thing, associated with multiple benefits throughout the lifecourse, and so the general aim would be to increase rather than decrease the number of people accessing it.

The following further stages of analysis were carried out with a view to estimating and interpreting the causal effects of early transition classes: multiple imputation, path analysis of background factors and transitions, calculation of propensity scores and weights, checking overlap of propensity score distributions between conditions, checking whether background factors were balanced between conditions after propensity weighting, and estimating the causal effects. Each stage is explained in turn below.

7.2.3.3 Multiple imputation

Missing data on background factors can be especially problematic for propensity weighting. As in other circumstances, estimation of the model determining propensity scores and weights may be biased without the missing data, but a full set of covariates is also needed to calculate an individual's propensity score from that model. In order to overcome this, an adapted version of a procedure described elsewhere (Lanza et al., 2013) was applied. An imputation model was utilised to provide multiple complete data-sets (n=5). The propensity model was then estimated, and weights were calculated within each imputed data-set, before combining weighted estimates of the causal effects using Rubin's rules (Schafer, 1997). The choice of five imputed datasets was a pragmatic one, considering the additional processing (e.g. calculating propensity scores, checking balance) needed within each imputation. The imputation model was an unconstrained model (Asparouhov and Muthén, 2010b) including all the background factors, the early adult outcomes, and variables indicating the probability of being in each early transition class (estimated individually for each respondent from the latent class model based on their observed responses).

7.2.3.4 Structural equation model of background factors and transitions

Once the imputation step was completed, the imputed data were used in a structural equation model relating the background factors to transitional classes (as in Figure 7-1, without the early adult outcomes). There are a number of reasons that this step is important. First, it validates the set of background factors included and demonstrates whether they are indeed relevant for predicting who ends up in which transitional class. Second, it offers a sense of which background factors are most important in terms of selection into transitional classes and what the pathways are between more distal and more proximal factors. If there is a causal effect of early transitions for those who take them, then this step helps demonstrate who that causal effect is operating on. Third, it is important for assessing differences in the estimates of causal effects between contexts. Such differences may be due to changes in the causal influence of early transitions between contexts, but could also be due to changes in the selection processes determining who makes early transitions (thereby changing the nature of the population who experience the exposure). This step should make clear how stable selection processes were across the different contexts. In order to avoid over-complicating the models, only interactions between gender and other variables were included. Modal class assignment was utilised for transitional class rather than adding further complications to adjust for uncertainty in class assignments. This may result in some underestimation of the associations (Vermunt, 2010), so the results could be considered to be somewhat conservative.

7.2.3.5 Calculation of propensity scores and weights

Propensity scores for each transitional class and weights for specific comparisons were computed within each imputed data-set. Propensity scores were derived from a multinomial logistic regression of the transition class variable on all of the background factors. Thus, in constrast to other chapters, propensity models included all three measures of parental SEP, as each could have independent confounding influences on the associations between transitional class membership and early adult outcomes. Since a variety of gender interactions were observed in the modelling stage (see results in section 7.3.5 below), which were not consistent across cohorts, the propensity models included interactions between gender and all other variables. This maintains consistency in model formulation across the three cohorts. At this stage, accuracy in the propensity score estimates is more important than model parsimony (Oakes and Johnson, 2006, Austin, 2011), so it was thought appropriate to err on the side of including all potential gender interactions, even if not quite significant, rather than leaving them out. The parameter estimates from the multinomial regression models were then used to calculate, for each respondent, their probability of (or propensity for) being in each class, given their background characteristics.

With respect to calculating the propensity weights, most previous applications have tended only to consider a binary comparison (Oakes and Johnson, 2006, Austin, 2011). In such circumstances, to obtain the average causal effect among the treated, those in the exposure condition are assigned a weight of 1, whilst weights for those not exposed are calculated using the following formula (where P is the propensity score for the exposure; Lanza et al., 2013):

Weight=P/(1-P)

This divides the probability of being exposed by the probability of not being exposed. In the binary case, the two probabilities are interdependent. Hence the probability of not being exposed can be obtained by subtracting P from 1. With more categories however, the probabilities for being in any two of those conditions are not necessarily interdependent. If, for instance, the aim is to compare a particular early transition class with a delayed transition class, the propensity scores for being in those two classes will not be interdependent; they could both be low (i.e. a person might be likely to be in another class, besides the two being compared). Drawing analogy from the binary case though, the relevant weights might be computed using the following novel procedure. Those in the exposure condition would be assigned a weight of 1 as above, those not in the exposure condition or the comparison condition would be assigned a weight of 0 (and thus excluded), and weights for those in the comparison condition would be computed using the following formula (where Pe is the probability of being in the exposure group and Pc is the probability of being in the comparison group):

Weight=Pe/Pc

Using this approach, a person in the comparison condition would have a low weight if they were likely to be in the comparison group and unlikely to be in the exposure group. If they were likely to be in the exposure group and unlikely to be in the comparison group they would be assigned a high weight. Those who were more or less equally likely to be in either group would be assigned a medium weight. Since this procedure only produces weights for comparing one condition with another, a separate set of weights was calculated for each early transition class for comparison with those who remained in education.

7.2.3.6 Overlap of propensity score distributions between conditions

The aim of this step was to check that sufficient data were present to allow for the desired inferences (Oakes and Johnson, 2006, Austin, 2011). This was assessed by comparing the distribution of propensity scores in the exposure and comparison groups. The propensity score represents the probability of being in the exposure group. If there is a total lack of overlap in the distributions of this propensity score between the exposed and comparison group, then this indicates that the two groups are so very different in terms of the background factors that there is little sense in attempting to estimate the effect of the exposure. That is, the exposure is so strongly linked to the background factors that it is not possible to disentangle whether it is the exposure itself or the background factors which account for the differences in outcomes. If there is a good deal of overlap between the two distributions however, then respondents in the exposure group can be compared to those who were in the comparison group but, based on their background factors, had a high probability of being in the exposure group. Only under these conditions is it sensible to try to make causal inferences about the effects of the exposure.

Overlap of the distributions was assessed by calculating the mean propensity score for each respondent across all imputations and then putting these into a histogram which compares those in the exposed and the comparison group. No overlap and full overlap would both give clear answers, but for cases of partial overlap, considering that the method is relatively new, there are unfortunately no clear guidelines or thresholds for what would constitute sufficient overlap. Nevertheless, inferences can be made with a high degree of confidence in the results where there is a high degree of partial overlap, and confidence in the results would be lower where the degree of partial overlap is lower.

7.2.3.7 Achieving balance using weights

The object of the weighting is to achieve balance between the conditions on the background factors, and thereby mimic a randomised experiment. The aim of this step was to check whether the weights were performing as desired in achieving this balance (particularly since a novel weighting procedure was in use). The standard approach to assessing whether such balance has been achieved (including for binary categorical variables) is to examine the standardised mean differences on each background factor between the comparison and the exposure group after weights have been applied (Austin, 2011, Lanza et al., 2013). Weighted differences were calculated within each of the five imputations and differences of less than 0.2 were accepted as indicating that sufficient balance had been achieved (Lanza et al., 2013).

7.2.3.8 Estimating the causal effects

The final step was to estimate the causal effect of transition class membership on early adult smoking, drinking and psychiatric distress. This was done using a logistic regression of the outcome on a variable indicating whether a person was in the exposure or the comparison group (excluding those in other groups). This was carried out both with and without the propensity weights, in order to ascertain how much of the overall association could be accounted for by selection biases on the background factors.

7.3 Results

7.3.1 Missing data and descriptive statistics

Table 7-1: Availability of transition data in three cohort studies

	NCDS58		BCS70		T07	
	N	%	N	%	N	%
Number of transitions with valid data						
1 transition	0	0.0	61	0.5	51	3.6
2 transitions	2	0.0	402	3.3	95	6.6
3 transitions	6	0.0	634	5.2	249	17.4
4 transitions	390	3.1	1,026	8.4	325	22.7
5 transitions	12,139	96.8	10,131	82.7	709	49.6
Total[a]	12,537	67.6	12,254	66.3	1,429	94.3
Number with valid data on specific transitions						
Education	12,537	100.0	12,206	99.6	1,310	91.7
Employment	12,334	98.4	12,076	98.5	1,208	84.5
Cohabitation	12,493	99.6	11,451	93.4	917	64.2
First child	12,535	100.0	11,200	91.4	1,137	79.6
Leaving home	12,378	98.7	10,593	86.4	1,261	88.2

[a]Percentages on this row use the total sample N as denominator. All other percentages in this table use the values in this row as denominator.

Table 7-1 shows the number of respondents included from each cohort, and the proportions with valid transition data. In BCS70 and especially in NCDS58, the vast majority of those with any valid transition data had data for all five transitions. In T07, only about half of the sample had valid data for all five transitions, though most had data on at least three transitions. However, T07 did have valid data on at least one transition for a greater proportion of the total sample than in the two larger cohorts. Looking at the proportions with valid data on specific transitions, no single transition stands out as more poorly observed in NCDS58, whereas in BCS70 leaving home was least well observed, followed by first child and cohabitation. In T07, cohabitation was least well observed, which was probably due to it being ascertained retrospectively at age 35 after a portion of the sample had dropped out of the study (see section 7.2.2.4 for details). Where there were higher levels of missing data on particular transitions, the differentiation between latent classes on these items may be less strong as values were less certain. However, if the missing data can be largely predicted from the observed data on the other transitions, then this will not have made much difference to the model estimates.

Table 7-2: Proportions with missing data on background factors

	NCDS58		BCS70		T07	
	N	%	N	%	N	%
Number of background factors with valid data						
1 factor	381	3.0	3,210	26.2	0	0.0
2 factors	994	7.9	154	1.3	0	0.0
3 factors	113	0.9	871	7.1	1	0.1
4 factors	498	4.0	1,060	8.7	4	0.3
5 factors	1,261	10.1	640	5.2	10	0.7
6 factors	455	3.6	1,051	8.6	2	0.1
7 factors	851	6.8	892	7.3	10	0.7
8 factors	741	5.9	1,043	8.5	40	2.8
9 factors	2,742	21.9	1,548	12.6	278	19.5
10 factors	4,501	35.9	1,780	14.5	1084	75.9
Missing data proportions for specific background factors						
Gender	0	0.0	0	0.0	0	0.0
Parental Occupational Class	3,494	27.9	6,328	51.7	20	1.4
Parental Education	3,247	25.9	6,144	50.2	22	1.5
Household Income	5,071	40.4	6,981	57.0	85	5.9
Family Structure	3,129	25.0	7,534	61.5	34	2.4
Parental Smoking	3,181	25.4	3,922	32.0	107	7.5
Parental Drinking	3,030	24.2	4,107	33.5	116	8.1
Adolescent Smoking	3,029	24.2	6,626	54.1	6	0.4
Adolescent Drinking	3,004	24.0	6,686	54.6	3	0.2
Adolescent Distress	2,877	22.9	7,965	65.0	84	5.9
Denominator	12,537	-	12,249[a]	-	1,429	-

[a]Since gender was included in the latent class models, 5 cases from BCS70 whose gender was unknown could not be included and attributed to a transitional class and so were excluded from further analyses.

Table 7-2 indicates for the analysis sample in each cohort, the proportion of missing data on each of the background factors. In NCDS58 there was a rate of around one quarter with missing data for most background factors, with a particularly high rate (40%) for income. In BCS70 most factors had missing rates upwards of 50% with particularly high rates, around 60%, for income, family structure and adolescent distress, whilst parental behaviours were more fully observed with only around 33% missing. Missing data rates were much lower in T07 where 75.9% had full data on all background factors. Only income, parental behaviours and adolescent distress had missing rates higher than 5% in T07.

Table 7-3 shows descriptive statistics for the timing of each transition in each study. BCS70 and T07 respondents tended to remain in education longer than NCDS58 respondents, though leaving at age 16 or before was the modal outcome in all cohorts. BCS70 respondents were more likely than those NCDS58 and T07 to be in education at age 22, and those in T07 were more likely than in the other cohorts to leave education at ages 19-21. Proportions entering employment at different ages matched quite closely with those for leaving full-time education. The main exception was that in BCS70 and especially in T07 the proportion of respondents entering employment at age 16 or before was smaller than that which had left education by then. This suggests that respondents in these cohorts were finding it more difficult to move directly into employment after leaving education. NCDS58 respondents tended to enter cohabiting relationships and have their first children a little sooner than those in BCS70 and T07. There was also a trend towards leaving home later in the two more recent cohorts, which was most pronounced for T07.

Table 7-3: Descriptive statistics for transition timing in each cohort

Transition and cohort	**Age of Transition** N (%)			
Leaving full-time education	*16 or earlier*	*17-18*	*19-21*	*Not by 22*
NCDS58	7,886 (62.9)	2,851 (22.7)	1,137 (9.1)	663 (5.3)
BCS70	6,335 (51.9)	3,063 (25.1)	1,360 (11.1)	1,448 (11.9)
T07	726 (55.4)	331 (25.3)	189 (14.4)	64 (4.9)
Entering Employment	*16 or earlier*	*17-18*	*19-21*	*Not by 22*
NCDS58	7,414 (60.1)	2,745 (22.3)	1,224 (9.9)	951 (7.7)
BCS70	4,749 (39.3)	3,787 (31.4)	1,602 (13.3)	1,938 (16.0)
T07	323 (26.7)	553 (45.8)	212 (17.5)	120 (9.9)
Entering Cohabitation		*18 or earlier*	*19-21*	*Not by 22*
NCDS58		1,433 (11.5)	3,827 (30.6)	7,233 (57.9)
BCS70		1,080 (9.4)	2,727 (23.8)	7,644 (66.8)
T07		87 (9.5)	199 (21.7)	631(68.8)
First Child			*21 or earlier*	*Not by 22*
NCDS58			2,118 (16.9)	10,417 (83.1)
BCS70			1,421 (12.7)	9,779 (87.3)
T07			143 (12.6)	994 (87.4)
Leaving Home	*16 or earlier*	*17-18*	*19-21*	*Not by 22*
NCDS58	794 (6.4)	3,193 (25.8)	4,045 (32.7)	4,346 (35.1)
BCS70	311 (2.9)	2,060 (19.4)	3,090 (29.2)	5,132 (48.4)
T07	31 (2.5)	96 (7.6)	351 (27.8)	783 (62.1)

Table 7-4 shows descriptive statistics for the background factors within the analysis sample from each cohort. As would be expected, between NCDS58 and the two later cohorts there was a shift from parental manual to non-manual work, and a tendency for parents to have spent longer in education in the more recent cohorts. Family structure was similarly distributed in NCDS58 and BCS70, though there was a higher proportion of single parent families in T07. Parents were equally likely to be smokers in NCDS58 and T07, but parental smoking rates were lower in BCS70. Questions on parental drinking differed considerably between the cohorts, so it probably does not make sense to directly compare rates for this variable. Adolescent smoking was less prevalent in BCS70 and T07 than in

NCDS58. Weekly adolescent drinking increased in prevalence between NCDS58 and BCS70, but very low rates were observed for T07. Psychiatric distress in adolescence was most common in BCS70 whilst rates were similar for T07 and NCDS58, although based on different instruments.

Table 7-4: Descriptive statistics for background factors in each cohort

	NCDS58		BCS70		T07	
	N	%	N	%	N	%
Gender						
Male	6,267	50.0	6,041	49.3	687	48.1
Female	6,270	50.0	6,208	50.7	742	51.9
Parental Occupational class						
Non-Manual	4,595	50.8	3,907	66.0	853	60.5
Manual	4,448	49.2	2,014	34.0	556	39.5
Parental Education						
Post-16 education	1,534	16.5	1,900	31.1	495	35.2
Left at 16 or before	7,756	83.5	4,205	68.9	912	64.8
Household Income						
Top and middle tertile	5,110	68.4	3,683	69.9	907	67.5
Bottom tertile	2,356	31.6	1,585	30.1	437	32.5
Family Structure						
Single Parent	750	8.0	464	9.8	188	13.5
Couple Parents	8,658	92.0	4,251	90.2	1,207	86.5
Parental Smoking						
Non-smokers	2,633	28.1	3,537	42.5	381	28.8
Smoking parent(s)	6,723	71.9	4,790	57.5	941	71.2
Parental Drinking						
None to moderate	9,412	99.0	5,550	68.2	1,090	83.0
Heavy	95	1.0	2,592	31.8	223	17.0
Adolescent Smoking						
Less than daily	7,028	73.9	4,583	81.5	1,208	84.9
Daily	2,480	26.1	1,040	18.5	215	15.1
Adolescent Drinking						
Less than weekly	5,130	53.8	2,630	47.3	1,346	94.4
Regular (weekly)	4,403	46.2	2,933	52.7	80	5.6
Adolescent Distress						
No or few symptoms	8,048	83.3	3,070	71.7	1,146	85.2
Symptomatic	1,612	16.7	1,214	28.3	199	14.8

7.3.2 Establishing optimal number of classes

Table 7-5 displays model statistics from models with different numbers of latent classes in each cohort and for combined data from all three cohorts. In NCDS58 and BCS70 and for all the data combined, the fit statistics (log-likelihood, AIC, BIC) all continued to improve with additional classes, whereas for T07 (the smallest sample) the BIC favoured a five-class solution, whilst the AIC favoured seven classes, and the log-likelihood continued to improve with additional classes. Models with more than eight classes were not attempted, since those with eight were either producing small classes representing less than 5% of the population (NCDS58 & BCS70) or model fit appeared to be declining (T07). For the combined data, models did not even converge at eight classes. Since the fit statistics failed to provide a clear answer as to the best solution for NCDS58 and BCS70 and the BIC favoured five classes in T07, the five class solutions were all inspected. The latent classes in BCS70 and T07 had a very similar structure with a similar interpretation for each class. The latent classes in NCDS58 were also similar, but one class in this cohort appeared to be an amalgamation of two classes which were present in BCS70 and T07, whilst there was another distinct pattern which had not emerged clearly within the five class solutions for BCS70 and T07. The six-class solutions were therefore also inspected and the latent classes were found to be very similar in interpretation across the three cohorts (i.e. the amalgamated class in NCDS58 was split in two, and the class which had been unique to NCDS58 also emerged in BCS70 and T07). Solutions with seven latent classes were rejected because of further declines in model fit for T07 and because this would further reduce group sizes, potentially leading to problems with small numbers for the causal modelling.

Table 7-5: Model statistics for models with different numbers of classes

Number of Classes		Log-likelihood	AIC	BIC	Entropy	Number of successful replications
NCDS58						
	2	-50583.78	101217.57	101403.48	1.000	100
	3	-46954.15	93984.30	94266.88	0.975	100
	4	-44318.67	88739.35	89118.61	0.979	100
	5	-42809.06	85746.09	86222.02	0.966	78
	6	-41874.85	83903.70	84476.30	0.970	94
	7	-41238.94	82657.89	83327.17	0.968	83
	8	-41056.91	82319.82	83085.77	0.970	73
BCS70						
	2	-50530.30	101110.60	101295.94	0.996	100
	3	-47146.24	94368.47	94650.19	0.940	100
	4	-45544.76	91191.52	91569.61	0.933	6
	5	-44084.31	88296.63	88771.10	0.941	14
	6	-43550.52	87255.03	87581.18	0.919	9
	7	-43136.47	86452.94	87120.16	0.891	14
	8	-43006.81	86219.61	86983.21	0.897	22
T07						
	2	-4832.32	9714.65	9846.27	0.911	100
	3	-4627.95	9331.90	9531.96	0.778	97
	4	-4519.51	9141.01	9409.51	0.818	97
	5	-4420.68	8969.37	9306.31	0.837	25
	6	-4377.68	8909.36	9314.74	0.756	92
	7	-4356.28	8892.55	9366.38	0.765	77
	8	-4347.56	8901.12	9443.38	0.755	1
All						
	2	-107842.67	215735.33	215939.69	0.994	100
	3	-101519.01	203114.01	203424.63	0.953	100
	4	-96296.32	192694.64	193111.53	0.943	100
	5	-93759.20	187646.41	188169.56	0.949	100
	6	-91762.83	183679.66	184309.08	0.935	34
	7	-90721.68	181623.36	182359.05	0.930	59
	8		No models converged within 1,000 iterations			0

7.3.3 Measurement equivalence by gender and cohort

Table 7-6 displays the chi-square tests for measurement invariance by cohort and by gender. The chi-square tests compared a ‘free’ model where latent class response probability parameters were allowed to vary by cohort or gender, with a ‘constrained’ model that kept parameters equal. The prevalence of each latent class was allowed to vary by cohort or gender in both models. The chi-square test for classes varying by cohort was significant, but given the sensitivity of this test, the free and constrained models were inspected. The differences between the cohorts appeared to be meaningful as well as statistically significant (see description of the latent classes in section 7.3.4 below for details). Chi-square tests for differences by gender were significant for NCDS58 and BCS70, though inspection of the models revealed that the differences were not as marked as those by cohort. T07 respondents did not differ significantly by gender. The best-fitting solutions from both free and gender-constrained models of data from all cohorts were not replicated and may have been local maxima. The most prominent gender difference was in BCS70 where one of the six classes was not well replicated for males. However, since this class came out with a low prevalence for males in a constrained model, and since the class replacing it in the free model seemed quite similar in interpretation to one of the other five classes, the constrained model was thought to adequately describe the data with considerably greater parsimony. Other gender differences were viewed as relatively minor compared to the advantages of retaining the more parsimonious set of constrained models. Thus, the gender-constrained model within each cohort was used to produce posterior probabilities for assigning respondents to classes.

Table 7-6: Chi-square tests for measurement invariance

	-2*Log-Likelihood	Degrees of Freedom	P-Value
Allowing classes to vary by cohort			
Free	179606.066	231	
Constrained	182680.886	87	
Difference	-3074.820	144	<0.001
Allowing classes to vary by gender: NCDS58			
Free	82158.422	154	
Constrained	82718.916	82	
Difference	-560.494	72	<0.001
Allowing classes to vary by gender: BCS70			
Free	86051.012	154	
Constrained	86437.638	82	
Difference	-386.626	72	<0.001
Allowing classes to vary by gender: T07			
Free	8636.706	154	
Constrained	8722.272	82	
Difference	-85.566	72	0.131

7.3.4 Description of classes

It was hypothesised that there would be patterns of both early and delayed transitions, that remaining in education would be a key characteristic differentiating the two, and that early transition patterns would have become less common in more recent cohorts.

Table 7-7 shows the response probabilities and prevalence for each latent class in each cohort. The first latent class, *Early Work then Delay*, comprised those who had left school at age 16 or earlier and entered employment around the same time, though entry to employment tended to take a little longer in BCS70, and longer still in T07, where only about half the members of this class entered employment while they were 16. After an early transition from school to work, this group tended to remain at home, without having children or beginning to cohabit. For males, this was by far the largest group in all cohorts with a prevalence of 40-43%. Prevalence was not so high for females but this was still one of the larger groups including an estimated 20% of NCDS58 and BCS70 samples and 28% from T07.

The next class, labelled *Early Adults*, made all five transitions at early ages, though again BCS70 and T07 respondents took a little longer to enter employment than those in NCDS58. Compared to NCDS58, those from this group in BCS70 took a little longer to leave home and start cohabiting and were slightly less likely to have had their first child by age 22. Respondents from this group in T07 were similar to those in BCS70 but took even longer to leave home and start cohabiting. This was one of the smallest groups for males with an estimated prevalence of 5-8%, whilst for females this group accounted for 16-17% in NCDS58 and T07 and 12% in BCS70.

The third class, *Inbetweeners*, tended to leave school and enter employment between 17 and 18 years of age. Transitions into cohabitation, having children, and leaving home were most likely to have not happened by age 22 in this group. In NCDS58 and BCS70 however, cohabiting transitions were more likely to have occurred early in this group than in the *Early Work then Delay* group. Leaving home exhibited patterning by cohort, with earlier transitions in NCDS58 and later transitions in T07. This was one of the more prevalent groups, representing 19-28% of the males and females in each cohort. Females were more likely to be in this group than males in the NCDS58 and BCS70 cohorts, but there was little gender difference in T07.

The fourth class was labelled *Early Work then Family* as they tended to leave home and start cohabiting between the ages of 19-21 after early transitions out of school and into work. They were also more likely than any other group besides the *Early Adults* to have had children by age 22. In NCDS58, the transitions from school to work for this group seemed to primarily happen at age 16. A similar pattern was seen in BCS70, but some respondents took a little longer to enter employment. In T07 the school to work transitions in this group tended to happen a little later (ages 17-18), though there was still a substantial minority who left school at 16 and did not enter employment until ages 17-18 or later. The *Early Work then Family* pattern was most prevalent in NCDS58 (20% for males and 23% for females), with a substantial decrease in prevalence among the more recent cohorts, especially for males, dropping as low as 6% for T07 males.

A fifth group, labelled *Education* tended not to have begun cohabiting or child-bearing by age 22, and did not make transitions from education to employment until ages 19-21. In NCDS58 slightly more than half of the respondents in this group had left home by ages 17-18. Respondents from this group in BCS70 were more evenly balanced across age categories for leaving home. In T07 most respondents in this group had not left home by age 22. This group was most prevalent in T07 at 13% for males and 16% for females, and was more prevalent in BCS70 (11%) than in NCDS58 (9%).

The sixth class, labelled *Extended Education*, exhibited a very similar pattern of transitions to those in the *Education* class except that most had not yet transitioned from education into employment by age 22. The patterning of leaving home by cohort was similar, with those in T07 least likely to have left home by age 22. The *Extended Education* pattern was most common in BCS70 (13% for males and 12% for females) and less so in T07 (8%) and NCDS58 (6%).

As hypothesised, patterns of both early (*Early Work then Delay, Early Adults, Inbetweeners, and Early Work then Family*) and delayed transitions (*Education, Extended Education*) were identified, with the timing of educational exit clearly delineated between these groups, though early transition groups were differentiated amongst themselves on the timing of other transitions too. Overall, in line with the hypothesis, combining across the *Education* and *Extended Education* patterns, respondents in NCDS58 were less likely to delay transitions to remain in education than those in the more recent cohorts. Between the two more recent cohorts, those from T07 tended more towards the *Education* pattern and those from BCS70 towards the *Extended Education* pattern. Since these last two classes both represented a pattern of delaying transitions to remain in education, they were combined for subsequent analysis into one group labelled *Tertiary Education*, which was used as the reference group against which to compare the other early transition groups. Preliminary analyses suggested similar associations with background factors for these two groups, and combining them resulted in a larger comparison group, helping to avoid difficulties with small numbers.

Table 7-7: Description and prevalence of transitional classes in each cohort

	Estimated Prevalence		Response Probabilities[a]																	
			Age left full-time education				Age entered employment				Age of first cohabitation			Age of first child		Age left home			
	Males	Females	16 or less	17-18	19-21	Not by 22	16 or less	17-18	19-21	Not by 22	18 or less	19-21	Not by 22	21 or less	Not by 22	16 or less	17-18	19-21	Not by 22
Class 1: Early Work then Delay																			
NCDS58	42%	20%	**1.00**	0.00	0.00	0.00	**0.96**	0.02	0.00	0.01	0.00	0.01	**0.99**	0.02	**0.98**	0.07	0.08	0.10	**0.76**
BCS70	40%	20%	**1.00**	0.00	0.00	0.00	**0.76**	0.17	0.05	0.03	0.02	0.03	**0.95**	0.04	**0.96**	0.03	0.05	0.08	**0.84**
T07	43%	28%	**1.00**	0.00	0.00	0.00	**0.54**	**0.45**	0.02	0.00	0.03	0.19	**0.79**	0.04	**0.96**	0.01	0.02	0.17	**0.79**
Class 2: Early Adults																			
NCDS58	5%	17%	**0.96**	0.04	0.00	0.00	**0.86**	0.06	0.02	0.06	**0.94**	0.03	0.03	**0.75**	0.25	0.21	**0.71**	0.07	0.02
BCS70	4%	12%	**0.90**	0.09	0.00	0.01	**0.64**	0.17	0.05	0.13	**0.82**	0.11	0.07	**0.63**	0.37	0.13	**0.64**	0.15	0.08
T07	8%	16%	**1.00**	0.00	0.00	0.00	**0.70**	0.18	0.01	0.10	**0.53**	0.38	0.08	**0.64**	0.36	0.14	0.26	**0.41**	0.18
Class 3: Inbetweener																			
NCDS58	19%	25%	0.01	**0.99**	0.00	0.00	0.00	**0.94**	0.05	0.01	0.03	0.29	**0.67**	0.06	**0.94**	0.02	0.25	0.35	0.39
BCS70	20%	28%	0.00	**1.00**	0.00	0.00	0.00	**0.94**	0.04	0.02	0.05	0.24	**0.71**	0.07	**0.93**	0.01	0.16	0.31	**0.52**
T07	23%	21%	0.14	**0.86**	0.00	0.00	0.00	**0.95**	0.05	0.00	0.01	0.11	**0.89**	0.00	**1.00**	0.00	0.06	0.18	**0.76**
Class 4: Early Work then Family																			
NCDS58	20%	23%	**1.00**	0.00	0.00	0.00	**0.98**	0.02	0.00	0.00	0.00	**0.97**	0.02	0.30	**0.70**	0.07	0.09	**0.82**	0.02
BCS70	13%	17%	**1.00**	0.00	0.00	0.00	**0.80**	0.15	0.03	0.02	0.02	**0.83**	0.14	0.27	**0.73**	0.03	0.06	**0.81**	0.10
T07	6%	12%	0.37	**0.63**	0.00	0.00	0.00	**0.84**	0.11	0.05	0.24	**0.76**	0.00	0.34	**0.66**	0.01	0.13	**0.75**	0.10
Class 5: Education																			
NCDS58	9%	9%	0.01	0.00	**0.99**	0.00	0.00	0.00	**0.94**	0.06	0.02	0.22	**0.76**	0.02	**0.98**	0.01	**0.52**	0.24	0.22
BCS70	11%	11%	0.00	0.00	**1.00**	0.00	0.00	0.00	**0.89**	0.11	0.02	0.19	**0.79**	0.04	**0.96**	0.01	0.35	0.24	**0.40**
T07	13%	16%	0.05	0.03	**0.92**	0.00	0.00	0.00	**1.00**	0.00	0.02	0.12	**0.86**	0.03	**0.97**	0.02	0.09	0.30	**0.59**
Class 6: Extended Education																			
NCDS58	6%	6%	0.00	0.05	0.03	**0.92**	0.00	0.00	0.00	**1.00**	0.01	0.11	**0.88**	0.01	**0.99**	0.00	**0.60**	0.25	0.15
BCS70	13%	12%	0.01	0.03	0.00	**0.96**	0.00	0.00	0.00	**1.00**	0.02	0.12	**0.87**	0.01	**0.99**	0.01	0.39	0.29	0.31
T07	8%	8%	0.13	0.07	0.17	**0.62**	0.00	0.00	0.00	**1.00**	0.03	0.04	**0.93**	0.00	**1.00**	0.00	0.01	0.27	**0.72**

[a]Response Probabilities of 0.4 or above are displayed in bold to aid interpretation.

7.3.5 Structural model of paths into transitional classes

It was hypothesised that a disadvantaged SEP would be associated with early transition patterns both directly and indirectly via other factors associated therewith such as adolescent smoking. Tables A-2 and A-3 in the Appendix detail associations between distal and more proximal background factors. The most consistent pattern across cohorts was that a disadvantaged SEP was associated with higher odds of parental smoking, and this was in turn associated with adolescent smoking.

Table 7-8 shows direct associations between all of the background factors and membership in each of the early transition classes relative to membership in the *Tertiary Education* group (i.e. in one of the two classes who had delayed transitions to remain in education).

In all cohorts, females were less likely than males to be in the *Early Work then Delay* group. There was also evidence in each cohort that socioeconomic disadvantage was associated with higher odds of membership in the *Early Work then Delay* group, with independent associations for each measure of SEP, though in BCS70 associations with parental education were somewhat less strong for females than males. Family structure was not associated with membership in the *Early Work then Delay* group in any cohort. Young people whose parents smoked were more likely to be in the *Early Work then Delay* group in NCDS58 and BCS70. In BCS70 and T07, there were interactions between gender and parental drinking such that females with parents who drank more heavily/frequently were more likely to be in the *Early Work then Delay* group, whilst in BCS70 membership in this group was less likely for males with parents who drank more frequently. Daily smoking in adolescence was associated with membership in the *Early Work then Delay* group in all cohorts. Only in BCS70, however, was regular drinking in adolescence associated with membership in the *Early Work then Delay* group. Adolescent distress was associated with a higher chance of membership in the *Early Work then Delay* group in NCDS58 and a lower chance of membership in this group in BCS70. In T07, distressed males had lower odds whilst distressed females had higher odds of membership in the *Early Work then Delay* group.

Females were more likely than males to be in the *Early Adult* group in NCDS58 and BCS70. Socioeconomic disadvantage was associated with higher odds of membership in the *Early Adult* group in all cohorts and for all measures of SEP independently. Respondents with single parents were more likely to be in the *Early Adult* group in

NCDS58, and there were was a similar borderline association in T07, but not in BCS70. In NCDS58 and BCS70, but not T07, parental smoking was associated with membership in the *Early Adult* group. For females, parental drinking was associated with lower odds in BCS70 and higher odds in T07 of membership in the *Early Adult* group, but there were no such associations for males. Adolescent smoking exhibited particularly strong associations with membership in the *Early Adult* group in all cohorts and this association was especially strong for females in BCS70. Adolescent drinking was associated with more chance of being in the *Early Adult* group in NCDS58 and BCS70. Adolescent distress was associated with higher odds of being in the *Early Adult* group in NCDS58, but not in BCS70, and in T07, distressed males were less likely to be in this group, whilst there was a strong tendency for distressed females to populate this class.

With respect to the *Inbetweener* group, females were less likely than males to be in this group in T07, but not in NCDS58 or BCS70. Females from a manual rather than a non-manual class household were more likely to be in the *Inbetweener* group in NCDS58 and BCS70. Young people whose parents had less education were also more likely to be in the *Inbetweener* group in all cohorts, and this was especially true of females in NCDS58. Low income was associated with membership in the *Inbetweener* group in NCDS58 and T07. Family structure was not associated with membership of this group in any of the cohorts. Both parental and adolescent smoking were associated with higher chances of membership in this group in NCDS58 and BCS70. Frequent parental drinking was associated with lower odds of membership in the *Inbetweener* group in BCS70 only. There was some evidence of a relationship between regular drinking in adolescence and membership in the *Inbetweener* group in all cohorts, though it was only a borderline association in BCS70, and was only for females in T07. Adolescent distress was associated with higher chances of being in the *Inbetweener* group in NDS58 but not BCS70, and in T07, distressed males were less likely to be in this group.

The *Early Work then Family* group was more likely to be populated by females than males in NCDS58 and T07. All markers of socioeconomic disadvantage were associated with a greater likelihood of being in the *Early Work then Family* group, though associations were particularly strong for parental education. In BCS70, the association with parental occupational class was particularly strong for females, but only borderline significant for males. In NCDS58, the association with low income was somewhat more concentrated among males than females. Family structure showed only a borderline association in T07, where respondents with single parents tended to be more likely to be in the *Early Work* *then Family* group. Parental smoking was associated with a greater likelihood of being in the *Early Work then Family* group in NCDS58 and BCS70, but not T07. Parental drinking was associated with higher odds in NCDS58, but lower odds in BCS70, of membership in the *Early Work then Family* group. Adolescents who smoked or drank regularly were more likely to be in the *Early Work then Family* group in all cohorts (except for adolescent drinking in T07). Adolescents experiencing psychiatric distress were more likely to be in the *Early Work then Family* group in NCDS58, but less likely to be in this group in BCS70.

Overall, processes of selection into transitional classes on the basis of these background characteristics appeared complex with variation across cohorts and between genders. Nevertheless, as hypothesised, there were some consistent patterns indicating that socioeconomic disadvantage, however measured, tended to be associated with earlier transitions, both directly and also indirectly via adolescent smoking.

Table 7-8: Associations between background factors and transitional class

(continued overleaf)

	NCDS58			BCS70			T07		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Early Work then Delay (ref: Tertiary education)									
Female	0.44	0.33-0.61	<0.001	0.49	0.36-0.67	<0.001	0.39	0.27-0.57	<0.001
Manual Class	2.58	2.06-3.22	<0.001	1.70	1.32-2.19	<0.001	1.84	1.25-2.70	0.002
Female*Manual Class	1.11	0.79-1.56	0.547	1.15	0.84-1.56	0.380			
Left School by 16	4.64	3.59-5.99	<0.001	4.69	3.88-5.67	<0.001	3.57	2.54-5.02	<0.001
Female*Left School by 16	1.20	0.84-1.72	0.310	0.77	0.57-1.04	0.087			
Lowest income tertile	1.96	1.47-2.61	<0.001	1.22	0.98-1.51	0.072	1.74	1.16-2.63	0.008
Female*Lowest income tertile	0.76	0.52-1.13	0.173						
Single Parent	1.05	0.76-1.46	0.760	0.86	0.59-1.23	0.406	1.33	0.77-2.31	0.311
Parental Smoking	1.94	1.65-2.29	<0.001	1.49	1.26-1.76	<0.001	1.17	0.83-1.65	0.382
Parental Drinking	2.32	0.81-6.66	0.119	0.69	0.54-0.87	0.002	0.84	0.44-1.59	0.596
Female*Parental Drinking				1.40	1.08-1.81	0.010	2.52	1.06-5.99	0.037
Adolescent Smoking	4.72	3.54-6.30	<0.001	2.05	1.61-2.59	<0.001	3.33	1.85-6.01	<0.001
Female*Adolescent Smoking				1.35	0.84-2.16	0.210			
Adolescent Drinking	1.09	0.94-1.26	0.263	1.29	1.09-1.54	0.003	1.38	0.59-3.24	0.460
Female*Adolescent Drinking							1.36	0.26-7.02	0.717
Adolescent Distress	1.82	1.46-2.28	<0.001	0.78	0.66-0.93	0.004	0.43	0.23-0.80	0.007
Female*Adolescent Distress							2.07	0.88-4.90	0.097
Early Adult (ref: Tertiary education)									
Female	3.97	2.15-7.35	<0.001	2.20	1.38-3.51	0.001	1.36	0.78-2.39	0.275
Manual Class	4.69	3.01-7.32	<0.001	2.15	1.22-3.78	0.008	2.54	1.53-4.23	<0.001
Female*Manual Class	1.05	0.63-1.75	0.854	1.03	0.64-1.66	0.910			
Left School by 16	4.74	2.56-8.80	<0.001	2.88	1.74-4.76	<0.001	3.13	1.80-5.45	<0.001
Female*Left School by 16	1.16	0.60-2.24	0.656	1.36	0.78-2.36	0.279			
Lowest income tertile	2.13	1.50-3.02	<0.001	2.02	1.32-3.11	0.001	3.76	2.24-6.32	<0.001
Female*Lowest income tertile	0.95	0.60-1.50	0.825						
Single Parent	1.43	1.03-1.99	0.034	0.98	0.51-1.88	0.945	1.76	0.91-3.41	0.095
Parental Smoking	3.25	2.67-3.96	<0.001	1.97	1.60-2.44	<0.001	1.56	0.87-2.79	0.133
Parental Drinking	2.27	0.72-7.15	0.162	1.13	0.75-1.70	0.556	0.52	0.15-1.79	0.301
Female*Parental Drinking				0.69	0.46-1.05	0.085	4.78	1.22-18.75	0.025
Adolescent Smoking	9.97	7.69-12.94	<0.001	3.16	2.02-4.95	<0.001	6.25	3.19-12.27	<0.001
Female*Adolescent Smoking				1.68	1.07-2.63	0.024			

Adolescent Drinking	1.57	1.33-1.85	<0.001	1.62	1.29-2.05	<0.001	2.18	0.59-8.06	0.244
Female*Adolescent Drinking							1.79	0.25-12.63	0.558
Adolescent Distress	2.32	1.76-3.06	<0.001	1.17	0.85-1.61	0.344	0.12	0.02-0.87	0.036
Female*Adolescent Distress							10.31	1.28-82.80	0.028
Inbetweener (ref: Tertiary education)									
Female	0.99	0.78-1.26	0.950	1.12	0.87-1.44	0.918	0.55	0.37-0.84	0.006
Manual Class	1.07	0.83-1.38	0.602	0.92	0.72-1.18	0.521	1.19	0.76-1.88	0.446
Female*Manual Class	1.48	1.06-2.07	0.022	1.47	1.09-1.97	0.012			
Left School by 16	1.46	1.16-1.83	0.001	2.58	2.12-3.15	<0.001	2.36	1.59-3.50	<0.001
Female*Left School by 16	1.43	1.07-1.90	0.014	0.93	0.69-1.25	0.620			
Lowest income tertile	1.36	1.05-1.77	0.020	0.89	0.70-1.13	0.334	1.84	1.14-2.95	0.012
Female*Lowest income tertile	0.76	0.53-1.08	0.127						
Single Parent	1.14	0.82-1.57	0.439	0.98	0.72-1.34	0.910	1.26	0.68-2.34	0.451
Parental Smoking	1.52	1.29-1.78	<0.001	1.17	1.01-1.35	0.037	1.14	0.77-1.71	0.512
Parental Drinking	2.21	0.72-6.81	0.166	0.79	0.66-0.94	0.009	0.69	0.31-1.50	0.345
Female*Parental Drinking				1.24	0.95-1.61	0.109	1.18	0.40-3.45	0.769
Adolescent Smoking	2.07	1.64-2.61	<0.001	1.54	1.14-2.09	0.005	1.40	0.68-2.88	0.366
Female*Adolescent Smoking				1.17	0.69-1.96	0.561			
Adolescent Drinking	1.26	1.09-1.47	0.002	1.14	0.98-1.32	0.082	0.78	0.26-2.35	0.657
Female*Adolescent Drinking							7.15	1.26-40.59	0.026
Adolescent Distress	1.38	1.12-1.71	0.003	0.91	0.73-1.12	0.360	0.55	0.27-1.12	0.100
Female*Adolescent Distress							1.66	0.63-4.36	0.304
Early Work then Family (ref: Tertiary education)									
Female	1.65	1.10-2.47	0.016	1.37	0.85-2.21	0.197	2.13	1.21-3.75	0.009
Manual Class	3.22	2.51-4.13	<0.001	1.37	0.99-1.90	0.058	1.74	1.06-2.83	0.027
Female*Manual Class	0.97	0.70-1.33	0.836	1.53	1.03-2.27	0.033			
Left School by 16	7.18	5.18-9.94	<0.001	6.18	4.16-9.18	<0.001	3.02	1.86-4.90	<0.001
Female*Left School by 16	1.02	0.66-1.57	0.931	0.69	0.39-1.23	0.211			
Lowest income tertile	2.20	1.65-2.93	<0.001	1.36	1.01-1.81	0.041	1.97	1.17-3.33	0.011
Female*Lowest income tertile	0.68	0.45-1.04	0.075						
Single Parent	0.94	0.67-1.31	0.698	0.68	0.36-1.28	0.227	1.92	0.96-3.83	0.066
Parental Smoking	2.46	2.08-2.91	<0.001	1.71	1.40-2.10	<0.001	0.93	0.57-1.52	0.776
Parental Drinking	3.60	1.21-10.65	0.021	0.76	0.60-0.98	0.031	1.60	0.59-4.37	0.357
Female*Parental Drinking				1.09	0.78-1.52	0.610	0.87	0.23-3.29	0.841
Adolescent Smoking	6.69	5.33-8.39	<0.001	2.95	1.68-5.17	<0.001	2.86	1.35-6.04	0.006
Female*Adolescent Smoking				1.19	0.64-2.23	0.579			
Adolescent Drinking	1.36	1.19-1.56	<0.001	1.86	1.39-2.47	<0.001	1.81	0.47-6.94	0.387
Female*Adolescent Drinking							0.37	0.03-5.44	0.470
Adolescent Distress	1.76	1.39-2.24	<0.001	0.79	0.66-0.95	0.012	0.27	0.06-1.17	0.080
Female*Adolescent Distress							3.62	0.71-18.37	0.137

7.3.6 Propensity weighting analyses

7.3.6.1 Assessing overlap

Before undertaking the propensity weighted analyses it was important to check that there was sufficient overlap between the propensity scores of the exposure and comparison groups. A separate comparison was made between each early transition group and the *Tertiary Education* group. Figures 7-3 to 7-5 show, for each cohort, a histogram of the mean propensity scores for membership in each early transition group across all imputed data-sets, comparing score distributions for those in the early transition and comparison group (i.e. *Tertiary Education*). The figures show considerable overlap in propensity scores between each of the transition groups and those in the *Tertiary Education* group in each cohort. In each cohort however, the *Early Adult* group stands out as having least overlap in propensity scores with the *Tertiary Education* group, suggesting there are relatively few people in the *Tertiary Education* group who are comparable in terms of background factors to those most likely to be in *Early Adult* group. This means that for this transition group, the propensity weighted analyses may be tending to compare those in the *Tertiary Education* group with less characteristic members of the *Early Adult* group, which needs to be taken into consideration when interpreting the results.

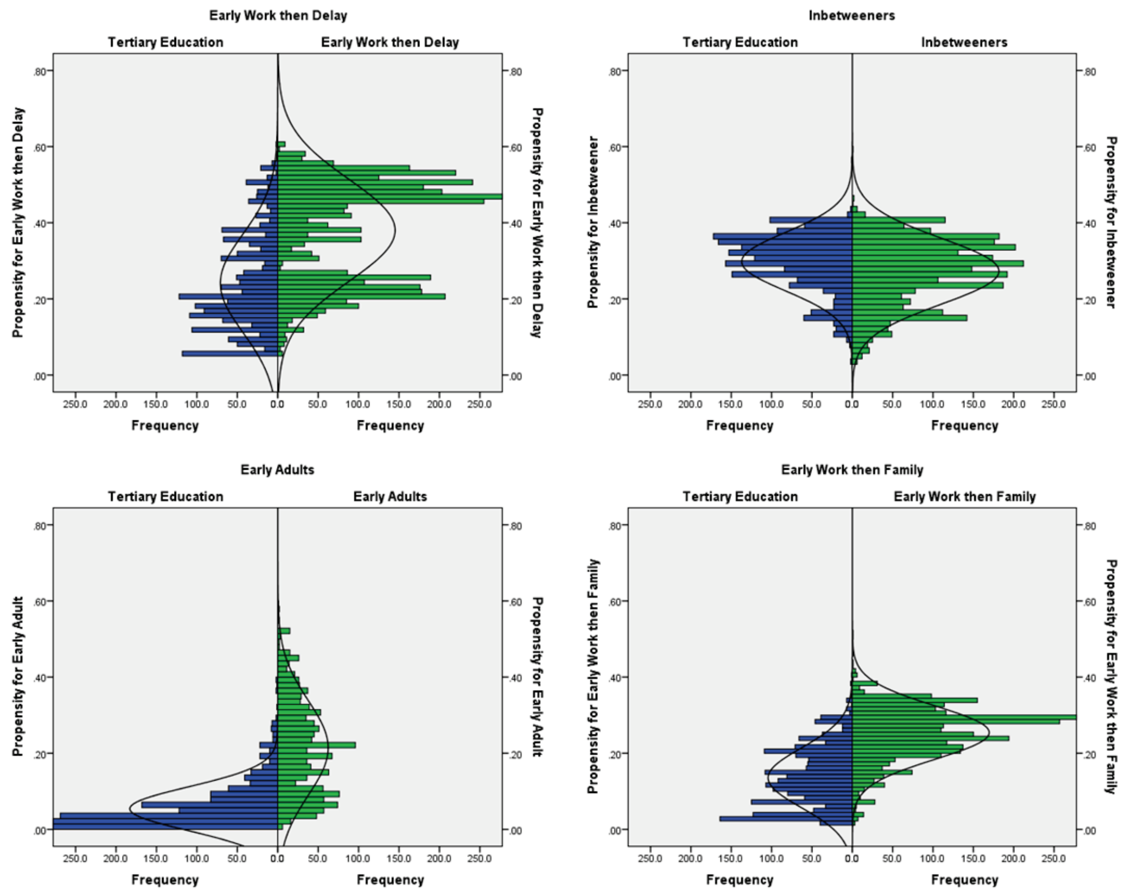


Figure 7-3: Overlap of propensity scores in NCDS58

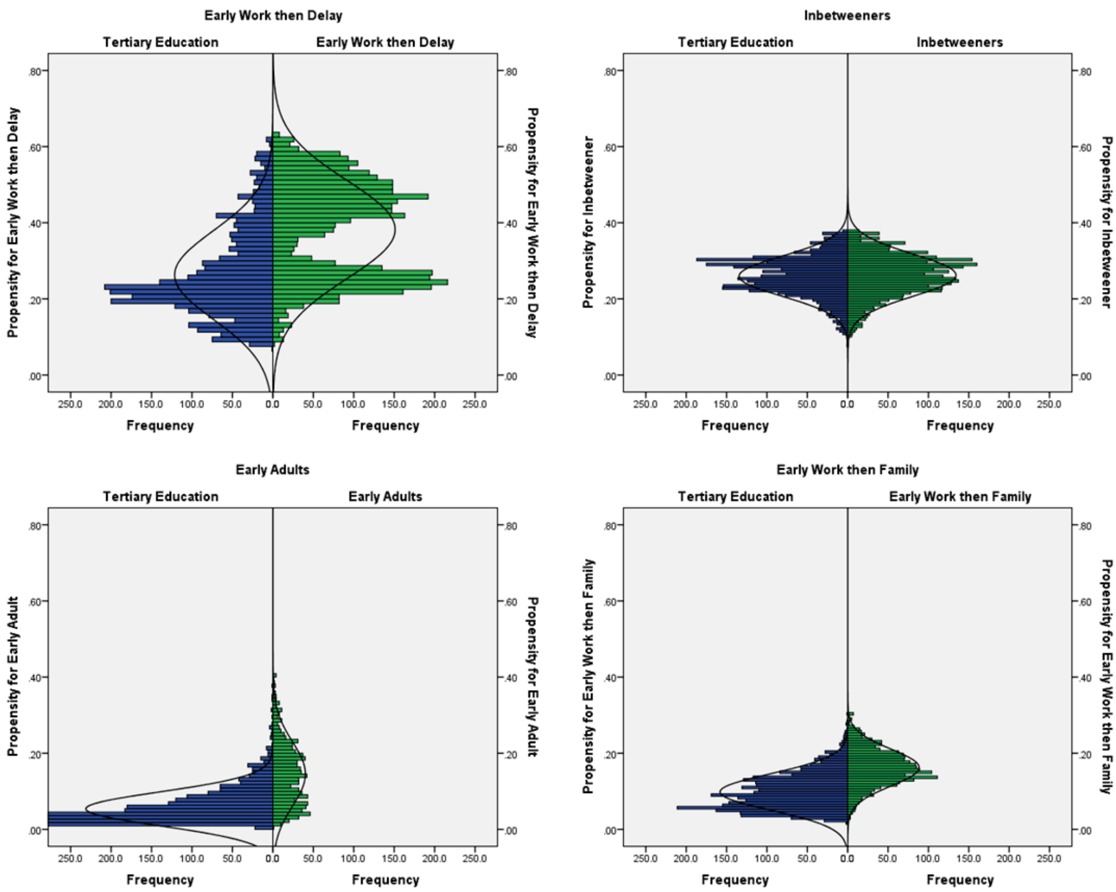


Figure 7-4: Overlap of propensity scores in BCS70

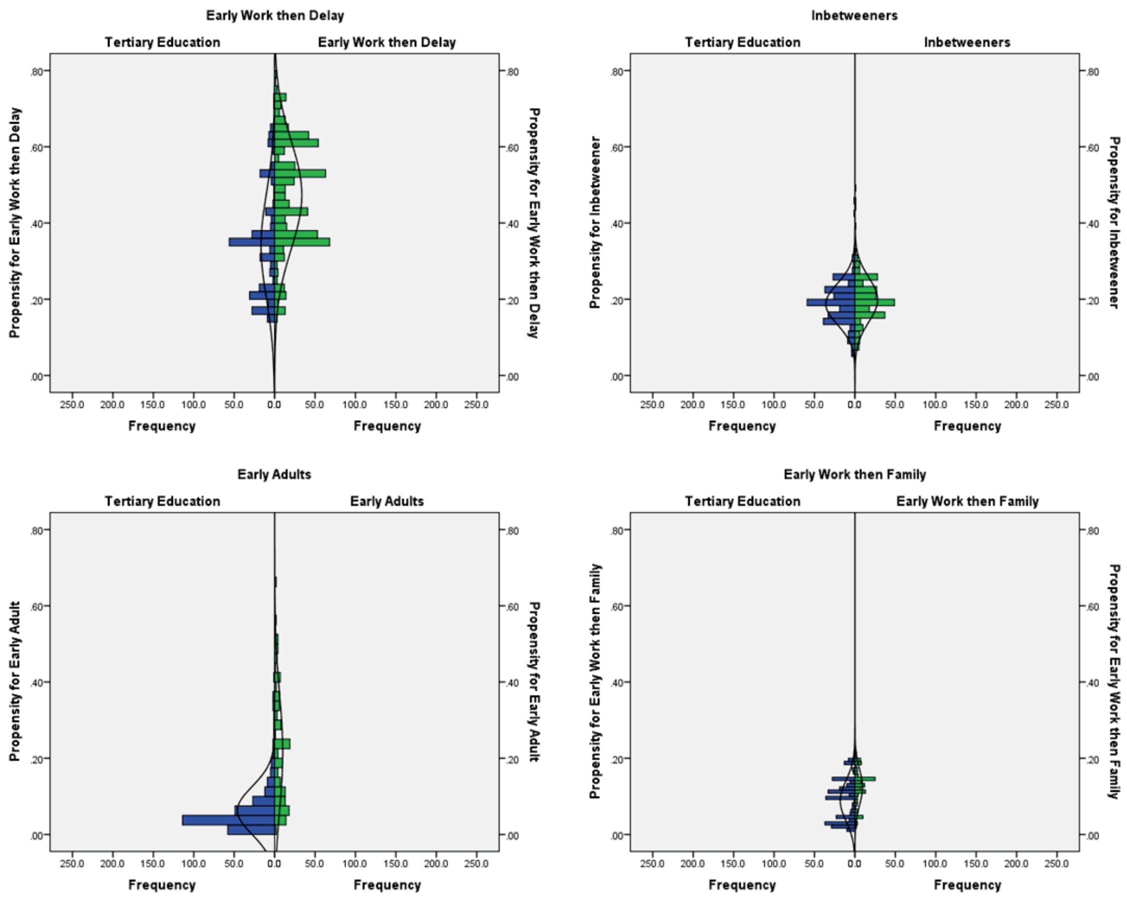


Figure 7-5: Overlap of propensity scores in T07

7.3.6.2 Achieving balance

Next, I checked whether the weighting achieved balance on the background factors by examining standardised mean differences between each of the early transition groups and the *Tertiary Education* groups within each imputed dataset for each background factor. Figure 7-6 shows differences before and after propensity weighting for gender as an example of the overall pattern. Figures A-1 to A-9 in the Appendix show results for the other background factors. Weighting reduced the differences between the early transition groups and the *Tertiary Education* group for all background factors to fall within the pre-defined acceptable range (-0.2 to 0.2). Occasionally, one or more of the imputations for the *Early Adult* group fell just outside of this range, perhaps because this group had least overlap with the *Tertiary Education* group. Even with that caveat however, it is clear that the propensity weighting in all cases largely accounted for selection biases on the basis of these background factors.

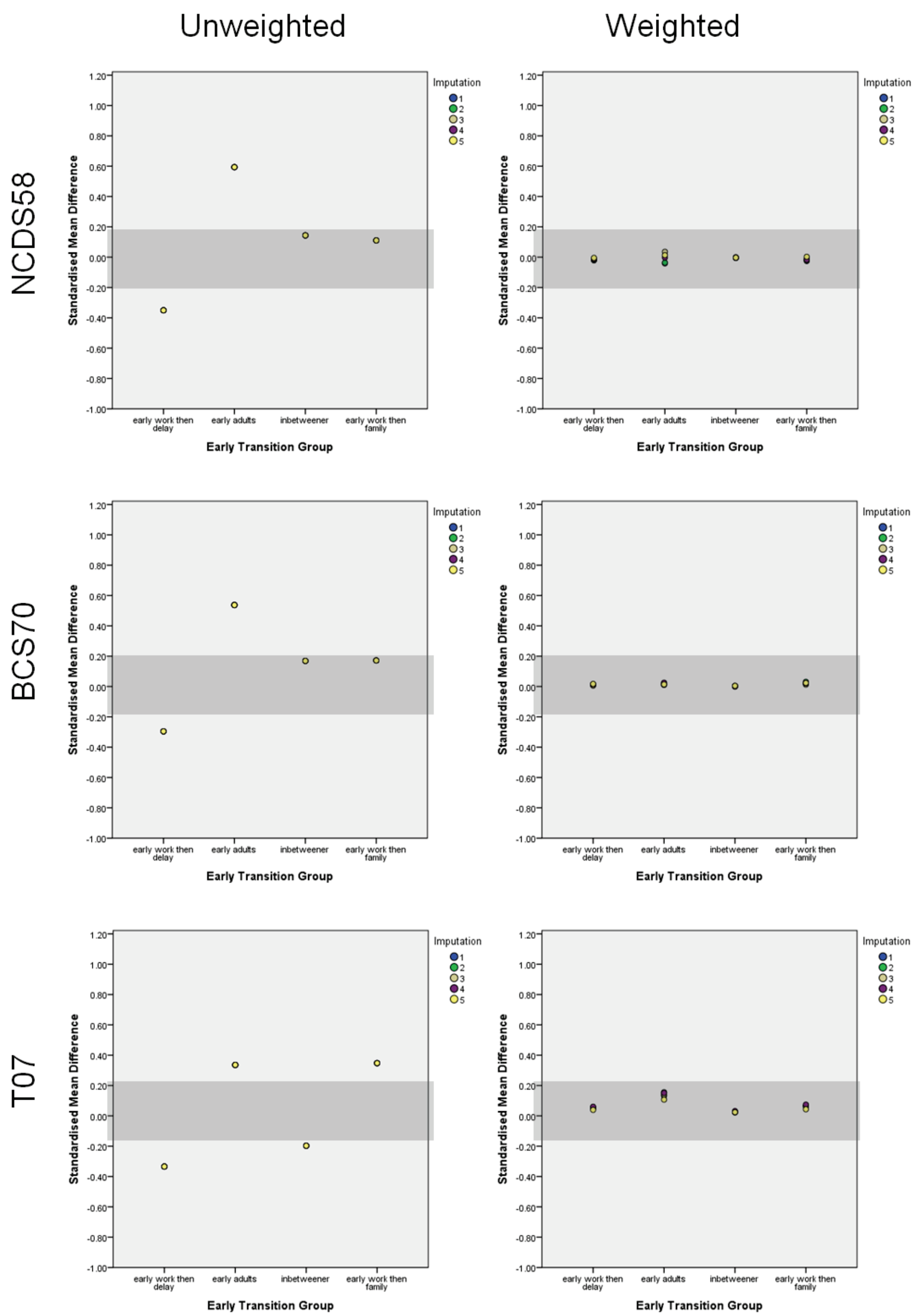


Figure 7-6: Standardised mean differences in gender

7.3.6.3 Causal effects

The aim of this analysis was to evaluate whether associations between transition class membership and early adult smoking, drinking and psychiatric distress were causal, or attributable to the background characteristics of those making early transitions. It was hypothesised that early relative to delayed transitions would have a causal effect on early adult smoking, drinking and psychiatric distress, and that early transitions would be causally associated with greater risk of smoking, drinking and psychiatric distress in more recent cohorts. Associations were examined both before and after the application of the propensity weights (the weighted ORs taking account of selection biases).

Table 7-9 shows the estimates of associations between early relative to delayed transitions and smoking in early adulthood for each cohort. Before applying the weights, each of the early transition groups was associated with higher odds of smoking in early adulthood than for those in *Tertiary Education*. ORs were particularly high for *Early Adults*, and lowest for *Inbetweeners* (there was a non-significant trend towards lower odds of smoking for *Inbetweeners* in T07).

Table 7-9: ORs for early adult smoking

	Pre-Weighting			Post-Weighting			
	OR	95% CI	P-value	OR	95% CI	P-value	% difference
Early Work then Delay (ref: Tertiary education)							
NCDS58	2.66	2.35-3.03	<0.001	1.97	1.42-2.73	<0.001	-42
BCS70	1.91	1.69-2.16	<0.001	1.39	1.15-1.67	0.001	-58
T07	1.76	1.26-2.45	0.001	0.96	0.51-1.80	0.903	-105
Early Adult (ref: Tertiary education)							
NCDS58	4.70	3.95-5.59	<0.001	2.64	2.73-4.59	0.001	-56
BCS70	3.19	2.61-3.91	<0.001	1.61	1.12-2.32	0.010	-72
T07	4.67	3.00-7.29	<0.001	2.14	0.78-5.88	0.140	-69
Inbetweener (ref: Tertiary education)							
NCDS58	1.60	1.41-1.82	<0.001	1.38	1.19-1.60	<0.001	-37
BCS70	1.28	1.11-1.47	0.001	1.12	0.92-1.37	0.248	-55
T07	0.91	0.61-1.35	0.646	0.79	0.50-1.25	0.312	+138
Early Work then Family (ref: Tertiary education)							
NCDS58	2.92	2.55-3.34	<0.001	1.93	1.35-2.76	<0.001	-51
BCS70	2.10	1.79-2.48	<0.001	1.30	0.96-1.76	0.085	-73
T07	1.81	1.15-2.83	0.010	1.34	0.68-2.62	0.393	-58

Applying the propensity weights to adjust for selection biases accounted for substantial portions of these associations. In NCDS58 most of the ORs for early adult smoking were reduced by around half, but all were still significant, suggesting causal effects of early transitions in this cohort. In BCS70 and T07, the OR reductions after weighting were greater (with the exception of that for *Inbetweeners* in T07 which got a little stronger but did not reach significance). This suggests that selection biases accounted for a greater portion of the associations in more recent cohorts. In T07, none of the associations remained significant after weighting, whilst in BCS70 there was a residual association for the *Early Work then Delay* and *Early Adult* groups, and a borderline association for the *Early Work then Family* group, whilst the association for *Inbetweeners* was no longer significant. Overall, early transitions were associated with higher odds of smoking in early adulthood, especially for *Early Adults*. This was largely to do with the background characteristics of those in early transition groups, but potentially causal contributions of early transitions to early adult smoking were present for NCDS58 and for the *Early Adult* and *Early Work then Delay* groups in BCS70. This partially supports the hypothesis about a causal effect of early transitions, but is contrary to the hypothesis of stronger causal effects in the more recent cohorts, since effects were stronger in NCDS58 than in BCS70 and T07.

Table 7-10: ORs for early adult heavy drinking

	Pre-Weighting			**Post-Weighting**			
	OR	95% CI	P-value	OR	95% CI	P-value	% difference
Early Work then Delay (ref: Tertiary education)							
NCDS58	1.52	1.32-1.74	<0.001	1.38	1.05-1.82	0.021	-26
BCS70	0.95	0.84-1.07	0.369	0.92	0.73-1.17	0.502	+45
T07	1.42	1.02-2.00	0.041	1.62	0.88-2.97	0.121	+45
Early Adult (ref: Tertiary education)							
NCDS58	0.56	0.47-0.67	<0.001	0.89	0.58-1.37	0.590	-75
BCS70	0.42	0.33-0.55	<0.001	0.52	0.33-0.80	0.003	-16
T07	0.66	0.41-1.06	0.083	1.75	0.72-4.27	0.216	-319
Inbetweener (ref: Tertiary education)							
NCDS58	0.88	0.76-1.02	0.093	0.90	0.76-1.07	0.241	-20
BCS70	0.73	0.63-0.83	<0.001	0.81	0.67-0.98	0.033	-32
T07	1.19	0.83-1.70	0.345	1.23	0.80-1.88	0.340	+22
Early Work then Family (ref: Tertiary education)							
NCDS58	0.72	0.63-0.83	<0.001	0.81	0.60-1.08	0.154	-30
BCS70	0.53	0.44-0.64	<0.001	0.56	0.40-0.78	0.001	-7
T07	0.76	0.48-1.20	0.244	1.47	0.81-2.67	0.203	-299

Table 7-10 shows weighted and unweighted ORs for heavy drinking in early adulthood. Being in the *Early Work then Delay* rather than the *Tertiary Education* group was associated with raised odds of heavy drinking in NCDS58 and T07 but not in BCS70. When propensity weights were applied, the association in NCDS58 was reduced by 26%, but not eliminated, whereas in T07 the association got both stronger and less certain, becoming non-significant. Membership of the *Early Adult* rather than the *Tertiary Education* group was associated with lower odds of heavy drinking in early adulthood (though this was only a borderline association in T07). In BCS70 this was potentially causal, remaining significant though modestly reduced after weighting, whereas in NCDS58 and T07, adjusting for background factors via weighting resulted in a null association. *Inbetweeners* had lower odds of heavy drinking relative to those in *Tertiary Education* in BCS70, and there was a similar borderline association in NCDS58, but not T07. Both were modestly reduced after weighting but that for BCS70 remained significant. Those in the *Early Work then Family* group were less likely to drink heavily in early adulthood than those in the *Tertiary Education* group in NCDS58 and BCS70, but not in T07. This association was not significant after weighting for selection biases in NCDS58, whereas the weighting made little difference to the association in BCS70 and it remained significant. Overall for heavy drinking, early transitions were either less harmful or more protective in BCS70 than in NCDS58, and whilst protective effects were mainly to do with selection in NCDS58, they appeared causal in BCS70. T07 showed few associations and those that were observed appeared due to selection. Again, the results are partially supportive of a causal effect for early transitions, this time showing a protective effect, but effects were increasingly protective in the more recent BCS70 cohort compared to NCDS58, rather than increasingly risky as hypothesised.

Table 7-11: ORs for early adult psychiatric distress

	Pre-Weighting			Post-Weighting			
	OR	95% CI	P-value	OR	95% CI	P-value	% difference
Early Work then Delay (ref: Tertiary education)							
NCDS58	2.35	1.75-3.16	<0.001	1.51	0.54-4.26	0.434	-62
BCS70	1.41	1.20-1.65	<0.001	1.18	0.90-1.56	0.226	-55
T07	0.83	0.58-1.19	0.314	1.12	0.57-2.20	0.748	-169
Early Adult (ref: Tertiary education)							
NCDS58	6.75	4.99-9.13	0.018	2.16	0.59-7.89	0.244	-80
BCS70	2.62	2.12-3.23	<0.001	1.35	0.92-1.98	0.127	-78
T07	1.34	0.84-2.14	0.215	1.92	0.60-6.19	0.272	+170
Inbetweener (ref: Tertiary education)							
NCDS58	1.62	1.18-2.22	0.003	1.20	0.81-1.78	0.359	-67
BCS70	1.16	0.97-1.38	0.099	1.00	0.81-1.22	0.966	-103
T07	0.55	0.38-0.80	0.002	0.58	0.37-0.91	0.019	-6
Early Work then Family (ref: Tertiary education)							
NCDS58	3.22	2.39-4.32	<0.001	1.55	0.61-3.90	0.356	-75
BCS70	1.62	1.30-2.02	<0.001	1.11	0.80-1.55	0.518	-82
T07	0.99	0.62-1.56	0.952	1.24	0.66-2.32	0.504	-1816

Table 7-11 displays ORs for psychiatric distress in early adulthood both before and after propensity weighting. In NCDS58 and BCS70, all of the early transitions groups had higher odds of psychiatric distress than those in *Tertiary Education*, with particularly large ORs for *Early Adults* (and there was only a borderline association for *Inbetweeners* in

BCS70). However, all of these associations were eliminated after propensity weighting was used to adjust for selection into transition groups. In T07, *Inbetweeners* exhibited less distress than those in *Tertiary Education*, and this association was only marginally attenuated by propensity weighting. Aside from this exception in T07, the findings do not support the hypothesis of a causal effect of early transitions on psychiatric distress in early adulthood, nor that of stronger effects in the more the recent cohorts.

7.4 Discussion

7.4.1 Summary of findings

This chapter has detailed an investigation of early transitions to adulthood as a possible causal mechanism between disadvantaged SEP and smoking, drinking and psychiatric distress in early adulthood. Five broad groupings relating to the timing of adulthood transitions were identified. The *Early work then Delay, Early Adult, and Early Work then Family* groups all made an early transition from school to work at age 16 and then differed in the timing of other transitions. *Inbetweeners* stayed in school longer, but did not stay as long as those in the *Tertiary Education* group, who remained in education, tending to delay any other transitions. *Tertiary Education* patterns were more frequent in more recent cohorts, and early transition patterns were more likely for those from disadvantaged socioeconomic backgrounds, and those who smoked in adolescence. Early transitions tended to be associated with higher levels of smoking and psychiatric distress in early adulthood but with lower levels of drinking than in the *Tertiary Education* group. These associations were mainly explained by the background characteristics of those who made early transitions, but some potentially causal effects were identified, with differences between cohorts. All early transition patterns had potentially causal associations with smoking in NCDS58, but only the *Early Work then Delay*, and *Early Adult* groups were more likely to be smokers in BCS70 (none in T07). The *Early Adult, Inbetweener*, and *Early Work then Family* groups all appeared causally associated with lighter drinking in BCS70, whilst being in the *Early Work the Delay* group appeared causally associated with heavier drinking in NCDS58. *Inbetweeners* in T07 appeared to have lower levels of psychiatric distress than those in *Tertiary Education* but no other differences in distress remained in any of the cohorts after propensity adjustment.

7.4.2 Limitations

7.4.2.1 Focus on timing of transitions

This study focused on the timing of first transitions into adult roles, without addressing the success with which transitions were negotiated or the maintenance of roles beyond those first transitions. Some, for example, may enter into stable partnerships or employment, whilst others follow chaotic pathways, transitioning in and out of different partnerships and jobs (Furlong et al., 2003). Indeed, those who have led disadvantaged, difficult lives, who are most likely to make early transitions, may be least likely to negotiate transitions successfully (Bachman et al., 1997), and early timing itself may be associated with a lack of the maturity needed to manage the transition successfully (Chassin et al., 1992).

As an example of the issue of timing vs. success, a previous study of the NCDS58 and BCS70 cohorts examined patterns of educational attainment, economic activity, housing, relationships, and parenthood using their current status at age 26 and also identified five distinct patterns: work orientation without children, traditional families, highly educated without children, slow starters and fragile families (Schoon et al., 2012). Given the different measures used, the five groups in this thesis do not necessarily match up well with the five groups in this other study. Neither classification system is necessarily better or worse than the other, they have different foci: the study by Schoon et al. (2012) focuses on successful attainment of various states in early adulthood, whilst the present thesis focuses on the timing of achieving those states, especially early on in life. Both aspects may be worthy of further exploration and study. Future work might consider developing a classification that incorporates the timing, quality and maintenance of adulthood transitions. However, some of the other findings of Schoon et al. (2012) were consistent with those here, e.g. the 'highly educated without children' group were most likely to drink frequently at age 33.

7.4.2.2 Residual confounding

The final models of early adult smoking, drinking and psychiatric distress were also limited in terms of causal inference in that there is still the possibility of residual confounding from other factors not included in the propensity weighting models. However, those factors thought to be most theoretically relevant were included, and this should have accounted for the most important or strongest selection biases. A further limitation is that whilst any gender interactions in the selection processes predicting who was in each transition class were fully accounted for, the models did not allow for gender interactions in the actual causal effects of early transitions (e.g. a stronger causal effect of being an *Early Adult* for females than for males). Such gender differences might in some cases be expected; for example, the socialisation effects of having children might be expected to be stronger for females than males, given the health risks to the child of substance use during pregnancy, and pregnancy has been shown previously to have a strong influence in reducing substance use (Bachman et al., 1997). As a check, gender interactions in the unadjusted associations were examined (results not shown) and for the most part there were none, though some associations between early transitions and drinking were stronger for females than males in BCS70.

7.4.2.3 Limited overlap for Early Adults

Another limitation is that there was relatively little overlap in propensity scores between *Early Adults* and those in the *Tertiary Education* group. This means that limited information was available for causal inference, as the *Tertiary Education* group contained few respondents similar to those most likely to be *Early Adults* (especially in T07 which had the smallest overall sample). Thus, less confidence can be placed in the findings for this group; different findings might have been observed had the *Tertiary Education* group contained more of the type of respondents who were likely to be *Early Adults.* This might be worth exploring in more recent cohorts; if access to tertiary education has continued to expand then there may be greater overlap between these groups in a more recent cohort. It may also be worth considering the nearest alternative to the *Early Adult* group (i.e. the alternative transition pattern which was most likely given their modal background characteristics). Comparison with this group, rather than the *Tertiary Education* group, could answer questions as to the likely effects of policies that encourage more staggered timing of transitions than in the *Early Adult* group.

7.4.3 Context and transitions to adulthood

It was hypothesised that both early and delayed transition patterns would be identified, and that delayed patterns would be more frequent in more recent cohorts. Findings concur with other work indicating a shift towards delayed transitions (Arnett, 2000, Côté and Bynner, 2008). As hypothesised, the timing of educational exit clearly delineated between early and delayed transition groups in all cohorts, but those making early transitions could also be further divided into groups based on the timing of other transitions such as cohabitation, having children and leaving home. The findings additionally demonstrate that, in the UK, it appears to have been mainly the *Early Adult* and *Early Work then Family* patterns that declined in prevalence between the 1980s and 1990s, as participation in the *Tertiary Education* group increased. For *Early Adults* however, this pattern was not mirrored everywhere in the UK; in the T07 cohort the prevalence of this pattern was similar to or even higher than it had been nationally twelve years earlier.

7.4.4 Patterning of transition classes

The findings confirm the hypothesis that socioeconomic disadvantage would be associated with earlier transitions, in line with prior research (Sacker and Cable, 2010, Wickrama et al., 2010), and this was not limited to any specific transition pattern, but was true of any pattern besides remaining in education. This highlights access to tertiary education as a key mechanism for structuring the lifecourse (Leisering, 2003). Adolescent smokers were both more likely to be in a disadvantaged SEP and more likely to be in early transition groups, consistent with suggestions in Chapters 4 to 6 that adolescent smoking may be a mechanism mediating between socioeconomic disadvantage and a number of other risks.

7.4.5 Causal effects of early adulthood transitions

The findings in relation to early adult outcomes were similar to those from an analysis of young women in the US ‘Add Health’ study (Amato and Kane, 2011) which examined changes in self-assessed health, depression, self-esteem, heavy drinking and illegal activity across the transition to adulthood. Most differences between groups with different transition patterns were already present prior to the transitions being made. Those following an educational trajectory had good health and self-esteem and low levels of depression, whilst the reverse was true for those on a single-mother trajectory. Some changes in heavy drinking patterns were attributable to the transition pathway. Those on an educational trajectory increased their heavy drinking significantly more than others, whilst those following a marriage and parenthood pathway, decreased their levels of heavy drinking. This chapter shows similar trends, but within the UK, and for both males and females. Most of the early transition groups were associated with less heavy drinking than in the *Tertiary Education* group, but for the *Early Work then Delay* group, where family transitions were conspicuously absent, there was no such protective effect, indeed in NCDS58, those in this group actually drank more than in those in *Tertiary Education*. This suggests that tertiary education can have an unhealthy influence on drinking levels in early adulthood (perhaps to do with the social norms and challenges of tertiary education; discussed further in section 9.3.3), and that moving into family roles can have a positive effect (i.e. role socialisation). There was an important difference between NCDS58 and BCS70 in the protective effect of early transitions on drinking. In NCDS58 it seemed mostly accounted for by background factors, whereas in BCS70 there appeared to be clear potential for a causal effect. It appears as though heavier drinking became more strongly associated with tertiary education in the more recent of these cohorts.

Generally though, even when there were potentially causal effects, associations were considerably attenuated with adjustment for selection biases, providing at most partial support for the hypothesised causal effects, and relatively strong support for selection theories (Chassin et al., 1992). This was particularly strongly supported for psychiatric distress in early adulthood, where almost none of the associations remained significant after adjustment. Since there were strong associations between distress and early transitions prior to adjustment, the factors which are important for selection into early transition groups (such as a disadvantaged socioeconomic background or adolescent smoking) are likely to be important influences on psychiatric distress in early adulthood (as demonstrated in Chapter 6).

The findings in relation to psychiatric distress contrast with those from an earlier study of transition timing and psychiatric distress at ages 30-33 in NCDS58 and BCS70 (Sacker and Cable, 2010). This previous study treated transitions individually as independent variables, rather than taking the person-centred approach used here, and found that earlier child-bearing, school-leaving and leaving home were independently associated with psychiatric distress after adjustment for a range of background variables. The difference in findings could be attributable to using regression rather than propensity techniques, to treatment of transitions individually rather than holistically, to the age at which adult distress was measured, or to differences in the background factors included (e.g. the other study did not include adolescent smoking). If the difference in findings is due to the age at measurement of psychiatric distress then this may indicate a time-lag in the effect of early transitions on adult distress, with the measures used here occurring too early to capture the effect.

An exception to the overall pattern for psychiatric distress was that in T07 *Inbetweeners* had lower odds of early adult distress, than similar respondents in tertiary education. After adjustment for selection, other early transition patterns did not differ from those in tertiary education, suggesting that *Inbetweeners* were faring best of all the groups in terms of mental health in T07. In Chapter 6 tertiary education was associated with higher odds of early adult distress in this cohort, and this association was in the opposite direction to those for NCDS58 and BCS70. This chapter showed a marked difference between T07 and the two UK cohorts in the timing of leaving home for those in tertiary education, with those from in and around Glasgow tending to remain at home longer whilst studying. It is possible that this limits some of the psychological benefits of delayed transitions, as remaining at home may mean that parental controls and monitoring are more persistent, limiting the freedoms and explorative nature of the emerging adult experience. Transitional challenges associated with moving into tertiary education could be more likely to result in distress if agency for negotiating these challenges is more restricted. If on the other hand those making early transitions experienced overload, or were stressed by the poor and precarious employments prospects for school-leavers in Glasgow at the time, then this might explain why the *Inbetweeners,* who stayed in school a little longer (potentially becoming a little more competitive on the labour market), but did not remain to face the challenges associated with tertiary education, had the best mental health.

In relation to smoking, the associations were particularly strong for the *Early Adult* group, even after weighting. This is consistent with the idea of role overload (Schulenberg and Maggs, 2002). If many transitions are made in a relatively short space of time, then it is more likely that individual capacities would be overloaded, and smoking may be relied upon as a coping behaviour. The smallest associations were for the *Inbetweener* group, and since the other early transition groups all tended to move from school to work at age 16, whilst the *Inbetweeners* waited longer, this lends credence to the notion that engagement with adult working environments may increase the likelihood of smoking behaviour. This may be through increased exposure to the behaviour from other working adults (Burton, 2007), or because smoking represents a form of social exchange with co-workers (Pavis et al., 1998). Additionally, whilst early family transitions appeared protective for drinking, they were, if anything, a risk for smoking. Nicotine is more addictive than alcohol (Chassin et al., 1992), and drinking more strongly tied to sociability (Pearson et al., 2006), so the socialisation effects of more responsible, family roles might be expected to be weaker for smoking than for drinking, which would be consistent with the findings here. The causal effects of early transitions on smoking in early adulthood were weaker in BCS70 than in NCDS58, which perhaps indicates a weakening in the social structuring of smoking behaviour according to lifecourse transitions, i.e. smoking may have become more about individual agency than the social structure of one's lifecourse trajectory.

It was hypothesised that early transitions would be more strongly associated with adverse outcomes in early adulthood in the more recent cohorts, where contextual conditions are thought to favour transitional delay. However, there was no evidence to support this hypothesis. It is possible that the ages used here to depict early adulthood were too early to see the outcomes of a context unfavourable towards early transitions. A previous investigation of transition timing and psychiatric distress at ages 30-33 in NCDS58 and BCS70 also found no strengthening of associations between the two cohorts (Sacker and Cable, 2010). Effects may be more evident in later life as disadvantages follow from early transitions and accumulate over time to impact on health.

7.4.6 Conclusion

Whilst early transitions may have causal effects on smoking, drinking and psychiatric distress in some circumstances, a large portion of associations between early transitions and smoking, drinking and psychiatric distress in early adulthood were accounted for by the background characteristics of those making early transitions, such as background SEP and adolescent smoking. Thus, early transitions may be symptomatic of disadvantaged lives which lead to adverse outcomes, rather than an actual cause of those outcomes. Indeed they may even be protective, as there was a trend for tertiary education to promote heavier drinking which was stronger in a more recent cohort. There was also no evidence for the hypothesis that early transitions would be more strongly associated with adverse outcomes in early adulthood in a more recent context where conditions favour delayed transitions.

8 SEP and early adolescent smoking development

Figure 8-1 shows how Chapter 8 aims to combine the first and third research questions from section 1.2 to examine the role of socioeconomic disadvantage in early adolescent smoking development, and looking at how this has changed in recent history from 1994 to 2008 (i.e. as the context changes over time). The role of gender and how this has changed over time is also considered.

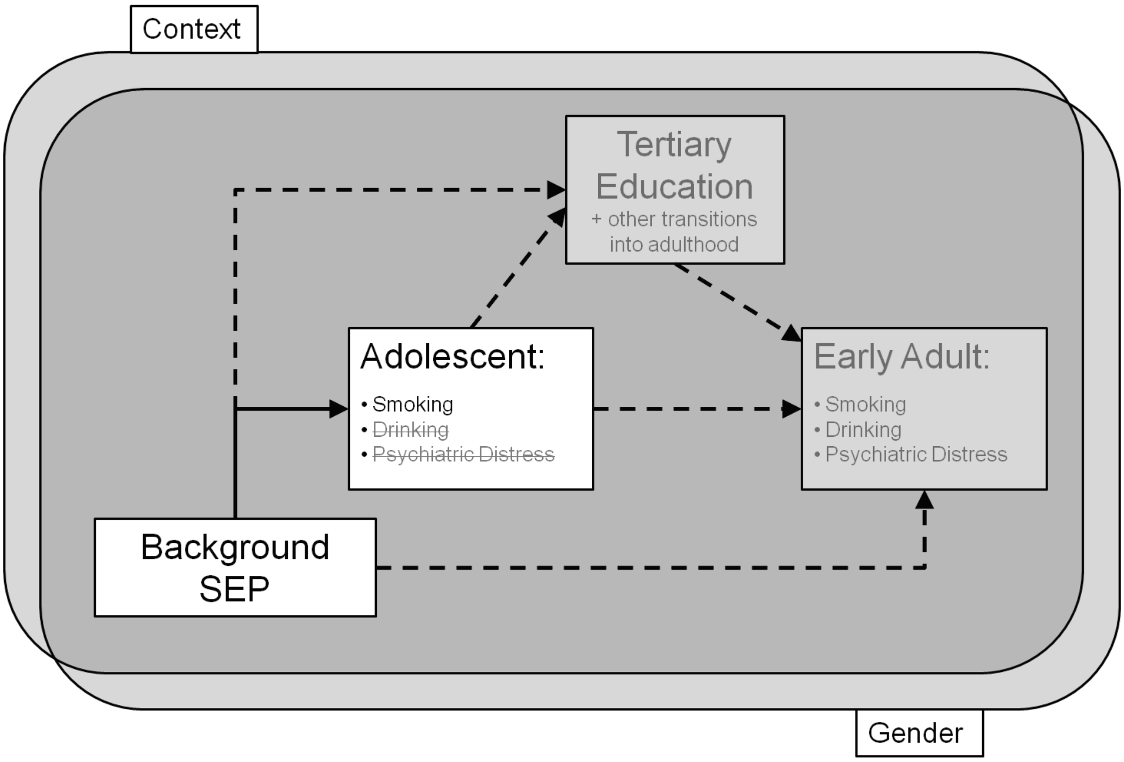


Figure 8-1: Emphasis of Chapter 8 within conceptual framework

8.1 Introduction and aims

8.1.1 SEP and smoking

Section 1.1.1 emphasised the public health importance of smoking as a risk factor for various chronic illnesses and mortality. Historically, smoking was not concentrated among the disadvantaged, but this has changed since the 1960s as the serious health consequences of this behaviour have become more recognised (Link and Phelan, 1995, Maralani, 2013). Whilst overall smoking prevalence has been decreasing since the mid-1960s (Thun et al., 2012), this happened more quickly for those in a more affluent SEP, resulting in smoking being more prevalent for those in a disadvantaged SEP (Giovino et al., 1995, Jarvis and

Wardle, 2006, Main et al., 2008, Bell et al., 2010, Maralani, 2013). Considering the associated health risks and this socioeconomic patterning it is no surprise that smoking is often found to make large contributions to socioeconomic inequalities in adult health (Gruer et al., 2009, Whitley et al., 2014). It has been suggested that those with more social and economic resources have, by dint of those resources, greater capacity for behaviour change where a behaviour is deemed to be harmful (Link and Phelan, 1995). The stresses associated with socioeconomic disadvantage are also thought to make it more difficult to quit (Chassin et al., 1996, Jarvis and Wardle, 2006) and adult smokers in socioeconomic disadvantage are less likely to benefit from individually targeted interventions such as smoking cessation services (Main et al., 2008, Thomas et al., 2008). However, recent US data have emphasised that socioeconomic inequalities in adult smoking levels have been increasingly accounted for by inequalities in adolescent take-up (Maralani, 2013) where the role of SEP is less well understood.

Smoking behaviour begins most often in adolescence: adult initiation is relatively rare. Earlier onset in adolescence is associated with heavier subsequent smoking and a reduced likelihood of quitting in adulthood (Murray et al., 1983, Kandel and Logan, 1984, Fisher et al., 1993, Chassin et al., 1996, Patton et al., 1998, Tyas and Pederson, 1998, Chassin et al., 2000, Gilman et al., 2003). Chapters 4 to 7 have emphasised that adolescent smoking, especially when it begins at early ages, is associated with patterns of subsequent heavier drinking and poorer mental health in adolescence and early adulthood. Chapters 4 to 7 have also emphasised associations between socioeconomic disadvantage and adolescent smoking. It is therefore important to better understand the role of SEP in adolescent smoking development.

8.1.2 SEP and smoking development

The development of smoking behaviour during adolescence is complex and varied. Many adolescents try or experiment with smoking and then quit without proceeding on to daily smoking (Patton et al., 1998, Maggi et al., 2007) and the rate at which adolescents progress from non-smoking to a daily habit can range from very quick to taking a number of years (Wellman et al., 2004, Maggi et al., 2007). Once smoking behaviour develops into a daily pattern though, quitting appears to become more difficult and relapse rates are relatively high (Patton et al., 1998). As discussed in section 2.1.3.2, smoking development is often conceptualised as progression through a series of stages (Flay, 1993, Mayhew et al., 2000) such as those depicted in Figure 8-2. At each stage, the probability of advancing to the next stage is less than certain (Flay, 1993). Initiation represents a transition from never having smoked to having tried it once or twice. Experimentation represents progression from trying smoking once or twice to occasional, but less than daily, use. Escalation represents a transition from occasional smoking to regular, daily use. Quitting represents an alternative transition from occasional use to non-smoking without progression to a daily habit. Although further transitions are possible after quitting or progressing to daily smoking (e.g. relapse and escalation after quitting or quitting after daily smoking) this chapter focuses on risks associated with reaching the critical stage of daily smoking.

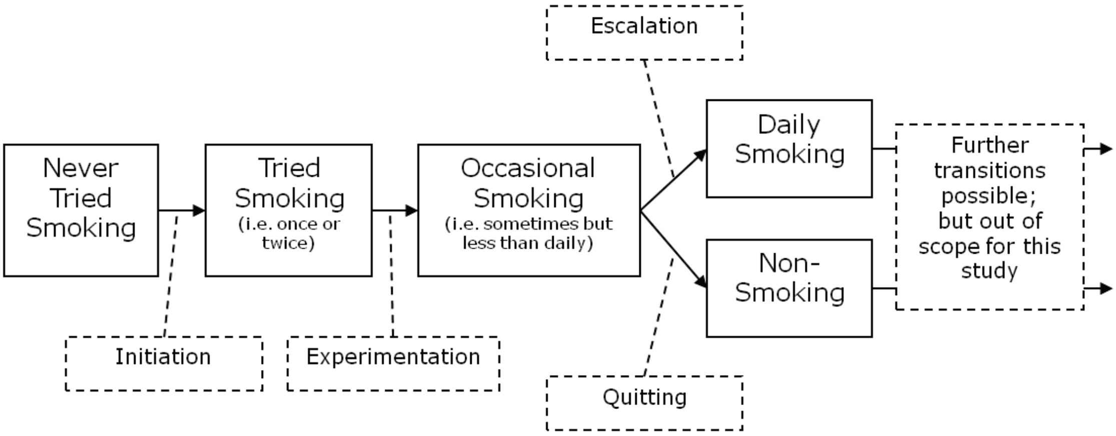


Figure 8-2: Smoking stages for early adolescents aged 11-15 years

Chapters 4 to 7 concur with other research where those from disadvantaged households have often been found to be more likely to smoke (Tyas and Pederson, 1998, Gilman et al., 2003, Schepis and Rao, 2005), and to take up smoking earlier (Dishion et al., 1999, West, 2009a, Tjora et al., 2011), with the most consistent evidence of inequalities in smoking in early rather than late adolescence (Hanson and Chen, 2007). Still, the point is often made that factors relevant to smoking may not be equally important at all smoking transitions, e.g. those factors that predict initiation may not necessarily be strongly associated with escalation or experimentation (Fisher et al., 1993, Flay, 1993, Kim et al., 2009), though most factors found to be relevant to smoking have been found to be relevant to multiple smoking transitions (Maggi et al., 2007). A disadvantaged SEP has been associated with increased likelihood of having ever tried smoking (Gilman et al., 2003, Wardle et al., 2003),with occasional smoking (Lowry et al., 1996, Dishion et al., 1999) and with daily smoking (Green, G et al., 1991, Gilman et al., 2003). However, findings in relation to later transitions can often be confounded by not adjusting for differences in earlier stage transitions, e.g. examining associations with daily smoking without accounting for differential occasional smoking, or differential initiation (Kim et al., 2009). Studies which have done this are rarer and have produced less consistent findings. For example, one study that examined progression to daily smoking among a sample of occasional smokers found no association between an indicator of low household income and the transition to daily smoking (Kim et al., 2009), whilst a retrospective study examining progression to daily use among those who had ever tried smoking found strong associations with SEP (Gilman et al., 2003). Others have also emphasised the importance of examining multiple measures of SEP, as different measures may capture different mechanisms (Gilman et al., 2003). An improved understanding of how the socioeconomic patterning of early adolescent smoking development is spread across different smoking stages could help identify key intervention points for reducing inequalities in smoking and its sequelae.

8.1.3 Contextualising smoking development

A full understanding of smoking development also needs to consider the geographical and historical context in which development occurs (Elder, 1998). Beyond the continuing temporal trends discussed in section 3.2.2, recent UK history has seen some dramatic contextual changes relevant to smoking, many of which represent deliberate policy attempts to reduce tobacco use across the population (ASH, 2013). Cigarette prices in real terms have been increasing steadily since 1990, with a large part of these increases having been in the tax element of the price (Reed, 2010). From 1991 all cigarette packets have carried mandatory warnings such as “Smoking kills”, and advertising on television has been banned (ASH, 2013). In 1992, it became illegal to sell single cigarettes and warning notices stating the illegality of selling tobacco to minors became required at all points of sale, including vending machines (ASH, 2013). In 1998, the UK Government published the white paper ‘Smoking Kills’ and increased funding of mass-media campaigns against smoking (Stationery Office, 1998). National health services across the UK launched Stop Smoking Services in 2000, and made nicotine replacement therapy available on prescription from 2001. In 2003, EU regulations began to require one of a number of specific health warnings to cover at least 30% of a cigarette packet’s front surface (Official Journal of the European Communities, 2001) and further bans on advertising were implemented (ASH, 2013). A ban on smoking in public places came into effect in Scotland from March 2006 (Stationery Office, 2005), and in England and Wales from July 2007 (Stationery Office, 2006). 2007 also saw the legal age for the purchase of tobacco in the UK rise from 16 to 18 years (ASH, 2013).

Such changes have taken place within a broader context of attempts to 'denormalize' tobacco use, which may have contributed to increasing stigmatisation of smoking (Bell et al., 2010, Graham, 2012). Indeed, data suggest declining acceptance of smoking and increasing awareness of the health risks of second-hand smoke exposure. For example, the percentage of non-smokers who say they would mind someone smoking near them went up from 56% in 1997 to 62% in 2008/09, and the percentages of people thinking that second-hand smoke increases the risk of various diseases increased between 1996 and 2008/09 (e.g. lung cancer: 83% to 89%; bronchitis: 84% to 87%; heart disease: 68% to 76%; Lader, 2009).

One might expect such contextual changes to reduce smoking prevalence overall, but it is unclear whether or how they would impact on early adolescent smoking development. Younger adolescents tend to be less likely to obtain cigarettes commercially (Ogilvie et al., 2005) so policies affecting cigarette purchase may be less relevant for them. Indeed, older (17-18 years) adolescents tend to be more sensitive to price increases than younger adolescents (13-16 years; Thomas et al., 2008).

It is also unclear how such contextual changes in tobacco control would affect the role of SEP in adolescent smoking development. A review of evidence from many countries on how such population level controls influence the socioeconomic patterning of smoking in both adolescence and adulthood concluded that restrictions on where people could smoke either disproportionately impacted adults of a higher SEP or had equal effects across social strata (Thomas et al., 2008) but very few studies were found on how adolescent smoking development would be affected. Price increases, on the other hand, tended to disproportionately affect disadvantaged adults, and of all the measures examined were deemed most likely to reduce inequalities in smoking, but again there was little evidence on how price increases influenced socioeconomic patterning in adolescent smoking. Evidence on how other population level controls such as restrictions on advertising, sales to minors or requiring health warnings had influenced the socioeconomic patterning of smoking in adults or adolescents was also scarce. Thus it is an open question whether or how the socioeconomic patterning of adolescent smoking development would be impacted within an environment where multiple population level tobacco control policies are being implemented (Hill et al., 2013). A further point with regards to context, is that the findings in Chapters 4 to 7 were based on historic cohorts, and whilst they highlighted some of the sequelae of adolescent smoking, it is important in establishing the relevance of those findings to see whether the documented associations between socioeconomic disadvantage and adolescent smoking have been maintained over time.

8.1.4 Gender

An additional issue is that of gender. Male and female adolescents may have different reasons for smoking and gender differences are often observed, having been reported in either direction (Tyas and Pederson, 1998). Historically, in western contexts, males have had higher smoking rates, but this has changed over time as female smoking rates have caught up, or in many instances overtaken, those for males (Tyas and Pederson, 1998, Sweeting and West, 2003). Explanations for these temporal trends include female targeted advertising, increasing concern over weight control, or cultural shifts in the gender balance of adolescent leisure activities that are associated with smoking (Tyas and Pederson, 1998, Sweeting and West, 2003). Developmental studies have also reported gender differences. An Australian study for example found that gender differences, with higher smoking prevalence among females, widened as age increased through adolescence, and attributed this partly to females smoking more consistently once they had begun (Patton et al., 1998). A Canadian study noted that female adolescents were more likely than males to maintain or increase their smoking during adolescence (Pederson and Lefcoe, 1986). Similar to SEP though, it remains unclear how gender differences in smoking are spread over different developmental transitions, or how transition-specific inequalities may have changed over time. These questions are important, considering that smoking plays a significant role in explaining gender differences in mortality (McCartney et al., 2011), much as it does for SEP. Additionally, gender is important because it can interact with SEP; for example, a review found that some studies showed an association between SEP and adolescent smoking for females only, whilst no studies showed the opposite, though few had gender-stratified results (Hanson and Chen, 2007).

8.1.5 Aims and hypotheses

This chapter therefore investigates the relative importance of a young person's SEP and gender at different stages of smoking development and examines whether early adolescent smoking development or the importance of SEP have changed over time within a context of increasing tobacco control (with data covering a period from 1994 to 2008). Specifically, it is hypothesised, with regard to each of the smoking transitions (i.e. initiation, experimentation, escalation and quitting):

- the risk of smoking transitions in early adolescence will have decreased over time;
- socioeconomic disadvantage will be associated with increased risk of smoking transitions in early adolescence;
- and the association between SEP and risk of smoking transitions in early adolescence will have changed over time.

As explained in section 8.1.4, associations between gender and the risk of each smoking transition are also assessed, along with any temporal trends in associations with gender.

8.2 Methods

8.2.1 Sample

Data are from the youth sample of the British Household Panel Survey (BHPS). BHPS was an annual survey of households in the UK. A representative sample of 5,538 households was taken in 1991 (the response rate was 74%) and all those aged 16 or over in responding households constituted the original sample. Original sample members and any of their children who had turned 16 were followed up annually even if they had moved into other households. If original sample members entered new households then the members of the new household were also eligible for interview until they or the original sample member left that new household. All children aged 11-15 living within surveyed households were eligible for interview as part of the youth sample from 1994 through to 2008 when BHPS was merged into the larger UK Household Longitudinal Survey. In the first wave of the youth sample, 89% of eligible children were interviewed (n=773). Additions were then made to this sample as children within surveyed households turned 11, or as adult sample members moved into new households where there were children aged 11-15. Booster samples of Scottish and Welsh households were added in 2000 and from Northern Ireland in 2004. Young people exited the sample when they reached age 16 or their household dropped out, so no respondent was included in the youth sample for more than five years. 5,122 adolescents were interviewed at least once between 1994 and 2008. Representativeness of the BHPS sample has been described in detail elsewhere (Buck et al., 2006), but individuals of disadvantaged SEP were somewhat less likely to be retained, meaning their children may be under-represented at later dates. Normally, weighting might be used to adjust analyses for differential drop-out, but the dynamic nature of the sample, with youths dropping in and out according to age and whether their household participated, means that sample weighting would be prohibitively complex.

Since respondents potentially entered and/or left the sample at any age between 11 and 15, they were not all observed at every age. Retrospective information was therefore used, where possible, to complete their smoking histories (see below in section 8.2.2.1). Thus the dataset represents a mix of prospective and retrospective data. Table 8-1 compares the age at which respondents first provided smoking data with the age at which they last provided smoking data. A majority of respondents first provided data at age 11, and most of these also provided data at age 15, though approximately 300-400 were censored at each year of age before age 15. There was also a sizeable group entering the sample with each year of age, and most of these were also observed at age 15. Thus, the dataset can be viewed as primarily prospective.

Table 8-1: Age at first observation cross-tabulated against age at last observation

	Age at last observation					
Age at first observation	11	12	13	14	15	**Total**
11	396	324	375	375	1827	3297
12	0	80	31	66	387	564
13	0	0	48	49	329	426
14	0	0	0	71	385	456
15	0	0	0	0	375	375
Total	396	404	454	561	3303	5118[a]

[a]4 respondents are missing from this table because they never answered the question on whether they had ever smoked.

8.2.2 Measures

8.2.2.1 Smoking histories

At each survey, respondents were asked whether they had ever tried smoking, and if so when they first tried it. They were also asked regarding their current smoking status (response categories were: I have never smoked; I have smoked only once or twice; I used to smoke but I don’t now; I sometimes smoke but I don’t smoke every week; and I smoke regularly, once a week or more) and how many cigarettes they had smoked within the last 7 days. These data were used to create year-by-year histories for each respondent, detailing which developmental stage of smoking they were at for each year of age between the ages of 11 and 15 (inclusive). They were coded at each year as either never-smokers, having tried smoking once or twice, occasional smokers, daily smokers (i.e. seven or more cigarettes within the last week) or ex-smokers. Since respondents were asked at each wave when they had first tried smoking, the available information was occasionally in conflict. In such cases, the earliest data available were preferred (e.g. a respondent who at age 12 reported having tried smoking at age 11 but then in a later survey said they had first tried at age 13 or had never tried smoking would have been coded as trying at age 11). Where prospective data did not provide a complete history of smoking development from ages 11 to 15, retrospective data were used as available (e.g. a respondent might first have been observed at age 14 but have answered retrospectively that they first tried smoking at age 12).

It should be acknowledged that others have conceptualised additional stages, including contemplation (i.e. a stage of thinking about smoking prior to initiation) and nicotine dependence (subsequent to regular use; Flay, 1993, Mayhew et al., 2000). However the timing of progression through these stages was not as easily identifiable within the BHPS data and so the simplified model presented in Figure 8-2 has been used. In any case, the conceptualised stages are intended as a heuristic for understanding development rather than as a complete, concrete description; it is recognised that young people might not rigidly follow this pattern (Fisher et al., 1993). A young person may, for example, go straight from trying to daily smoking without first passing through a stage of occasional smoking. It is analytically convenient to code such a person as simply passing through the occasional stage very quickly. Respondents who skipped stages were therefore coded as making the intervening transitions within the same year. If a person went from having never tried smoking in one year to saying that they used to smoke but gave up in the next annual survey then it was assumed that they had reached the stage of occasional but not daily smoking (which is likely to be mostly true at these young ages; West et al., 1999). For simplicity, a small number (n=41) who said that they had tried smoking before the age of 11 were coded as having tried smoking at age 11.

It is also acknowledged that respondents who reached the stage of daily smoking at early ages might subsequently have given up smoking before age 15, and those quitting early could have subsequently relapsed and even progressed to a daily habit before age 15. The outcome referred to here as quitting represents giving up smoking before a daily habit was established. This is viewed as a significant outcome, because those who give up without establishing a daily habit of smoking are less likely to relapse than those who quit after escalating to daily smoking (Wellman et al., 2004). Unfortunately though, data on the length of time since quitting were not available, so it was not possible to establish a one-month or six-month threshold for maintained cessation (Sutton, 2005). Further transitions after reaching either the stage of daily smoking or quitting were not considered as the numbers were getting relatively small within the defined age range of 11-15 years. Since reaching the point of daily use seems to be a key threshold in terms of the ease of giving up smoking (Patton et al., 1998), the focus here is on progressing to the point of regular, daily use by the age of 15, as compared to other patterns.

8.2.2.2 Recoding of smoking histories for discrete time event history analysis

Three new variables were created to represent the timing of smoking transitions for discrete time event history analysis. The first two variables were binary and represented the transitions of initiation and experimentation. The third variable was multinomial and represented the transitions of escalation or quitting as alternative outcomes. Time was split up into discrete blocks of one year and a value for each variable was expected for each respondent for each year from the point at which they were at risk for a transition up until the respondent experienced that transition or was otherwise censored (e.g. by dropping out of the sample). For clarification, Table 8-2 presents some examples of how respondents with different response sets would have been coded.

Table 8-2: Illustrative coding examples for smoking histories

Person-Age	Initiation[a]	Experimentation[a]	Escalation or Quitting[b]	Smoking Status from Survey Data
1-11	0	-	-	Never Smoked
1-12	0	-	-	Never Smoked
1-13	1	0	-	Tried Once or Twice
1-14	-	1	0	Smokes occasionally (<daily)
1-15	-	-	0	Smokes occasionally (<daily)
2-11	0	-	-	Never Smoked
2-12	0	-	-	Never Smoked
2-13	0	-	-	Never Smoked
2-14	1	1	0	Smokes occasionally (<daily)
2-15	-	-	1	Smokes daily
3-11	1	1	0	Smokes Occasionally (<daily)
3-12	-	-	0	Smokes Occasionally (<daily)
3-13	-	-	2	Used to smoke but given up
3-14	-	-	-	n/a
3-15	-	-	-	n/a
4-11	0	-	-	Never Smoked
4-12	0	-	-	Never Smoked
4-13	1	1	2	Used to smoke but given up
4-14	-	-	-	n/a
4-15	-	-	-	n/a
5-11	0	-	-	Never Smoked
5-12	0	-	-	Never Smoked
5-13	0	-	-	Never Smoked
5-14	-	-	-	Dropped Out
5-15	-	-	-	Dropped Out

[a]0=not made transition yet; 1=made transition. [b]0=not made transition yet; 1=escalation; 2=quit.

8.2.2.3 Measures of SEP

Various measures of SEP were employed, based on household or parental characteristics as reported by adult members of the household. These are viewed as representing the SEP of the households in which the adolescents were being raised and are thus considered as conceptually antecedent to the outcomes. Available parental variables included occupational class, education and employment status. Parental occupational class was coded based on mothers' and fathers' current or most recent jobs according to the UK registrar general's occupational class schema (Office of Population Censuses and Surveys, 1980) and split into three categories (I and II; III; or IV and V). Parental education was coded into three categories based on highest qualification (degree or postgraduate qualifications; other qualifications; or no qualifications). Parental employment status was represented by a binary variable indicating whether or not the parent was in any paid work. Women on maternity leave and others on temporary absences from work were classified as employed. For each of these parental variables, data on status had been sought from both parents where two parents were present. In such cases the higher status was used (as explained in section 3.1.1.4). Variables representing household income and housing tenure were also available. Equivalised, inflation-adjusted household income was coded into tertiles based on the distribution within each year of the survey. Calculation of tertiles used the distribution within each survey year rather than across the whole period because, despite inflation adjustment, there was real growth in household incomes over the study period and thus the distribution over the whole of the study period would have been biased towards more favourable positions for those surveyed more recently, and might have therefore been conflated with the period variable. A binary variable was used to distinguish between owned or mortgaged accommodation and rented or other accommodation.

Although time-varying information was available for the SEP variables, data from the first survey in which a respondent was observed were treated as time-invariant characteristics. This more parsimonious, time-invariant coding of the SEP variables was employed to reduce model complexity and help achieve convergence (both for the imputation model and the analysis models). Although there was some mobility between SEP categories over the five years of analysis, this was a minority experience. There was very little mobility for parental education, housing tenure and parental employment status within the maximum of five years that each respondent was observed for (pecrentages remaining in the same category at all observations were 96%, 95% and 91% respectively). There was greater variability for parental occupational class and income tertile (79% and 61% respectively remained unchanged throughout). This may represent a combination of changes in parental jobs and income, and changes between parental figures with different jobs or incomes (e.g. household income may change as a couple breaks up and a breadwinner father leaves, or occupational status could shift as a mother re-partners with someone in a different occupation to their previous partner). For income, since the tertile assignments were based on the distribution within each year, changes in status might also represent slower or faster growth in income than the average. A shift from middle to bottom tertile, for example, could represent maintenance of the same income whilst other families' incomes increased. Assuming a relationship between SEP and smoking development, it is expected that these SEP variables would exhibit the weakest associations, as those who move up between socioeconomic categories will tend to have occupied the highest positions within their starting categories (and therefore will have also had the least propensity for smoking), whilst those who move down between socioeconomic categories will tend to have occupied the lowest positions within their starting category (and therefore will have had the greatest propensity for smoking).

8.2.2.4 Context

Given multi-faceted tobacco control changes within the UK, many occurring simultaneously or within short periods of time, and that these may have had interactive effects, isolating the effects of particular tobacco control policies may be difficult (Chapman, 1993, Hill et al., 2013). Since little is yet known about influences of contextual tobacco control on early adolescent smoking development or inequalities therein, a relatively simple approach was adopted. This was based on time period, measured as the year in which each interview took place (reference value: 2001), with more recent years viewed as representing increases in contextual tobacco control. Allowing non-linear effects of period recognises that contextual effects may not be uniform across the study (e.g. as policies accumulate interactively, or as some are more effective than others).

8.2.2.5 Other variables

Gender was coded 0 (males) and 1 (females). Age was measured in years (reference value: age 11), and separated for later transition stages into age at prior transition (reference value: 11) and years since prior transition (reference value: 0). Dummy variables for country (reference category: England) were also included, since booster samples from Scotland, Wales and Northern Ireland were included at different times, and may have biased the period effects.

8.2.3 Analysis

8.2.3.1 Discrete time event history models

Event history analysis with time coded in years was used to investigate associations between covariates and odds of transitions between smoking stages. Units of years were the finest metric of time available, meaning that many respondents were coded as making transitions within the same years as other respondents. Discrete time models were therefore deemed more appropriate than continuous time models (see section 3.3.2.4). Three separate analyses were performed examining: initiation, considering all respondents at risk from the age of 11; experimentation, including respondents only from the year in which they initiated smoking; and escalation or quitting, treated as alternative outcomes (with remaining an occasional smoker as the reference category), including respondents only from the year in which they became an occasional smoker. Respondents were only considered at risk for experimentation, escalation or quitting after they had made the previous transition in order to avoid conflating predictors for the different transition stages (e.g. by contrasting those who progress to daily smoking with both occasional and non-smokers; Kim et al., 2009).

For each analysis, a model of transition risk based on the variables which were not indicators of SEP was constructed first. All models included gender, country, and period. The model of initiation included age, whilst those for experimentation and for escalation and quitting included a variable representing the age at which the prior transition had been made and another variable indicating the number of years since that transition (i.e. the number of years at risk). The sum of these two variables would be equivalent to age and therefore absolute age was not included in these models as it would have provided no additional information. Separating age out into these two variables allows for different associations between age and transition risk after a transition has occurred. All two-way interactions were tested for and retained if they were significant at the $p<0.05$ level. Additionally, a quadratic term for period was included if it significantly improved model fit ($p<0.05$), to allow for a non-linear trend. A quadratic term for age was not included as there were fewer available time points and it seemed from the initial descriptive data that a linear term would be sufficient. Next, each indicator of SEP was added to the model separately, and potential two-way interactions with the foregoing variables were examined. As explained in section 3.2.1.6, associations with each SEP indicator were tested independently rather than with mutual adjustment. A consistent pattern of associations across multiple measures of SEP was viewed as reflecting an association with the overall construct, whilst conflicting results from different measures were viewed as reflecting the unique characteristics of particular SEP measures. Results are presented as ORs and predicted probabilities. Both refer to risk of a smoking transition occurring within a given year among those at risk, i.e. those who had not already made that transition but had made any necessary prior transitions. Predicted probabilities were calculated using reference values except as otherwise specified.

8.2.3.2 Multiple imputation

Considering there were missing data on both smoking histories and parental SEP, analyses were performed using multiple imputation in Mplus 7 (see section 3.3.1.2; Muthén and Muthén, 2012). Twenty imputations were produced on an unrestricted two-level variance-covariance model of all the analysis variables. Person-years (n=25,610 with 32.7% having some missing data) were nested within individuals (n=5,122). Age, period, and a quadratic term for period were included on the lower level. Gender and all of the SEP indicators were included at the person level. Variables indicating whether mother or father figures had ever been reported as absent from the household between the ages of 11 and 15 and whether mothers or fathers had ever reported smoking within that time period were also included at the person level. These additional variables are common correlates of adolescent smoking behaviour, and father absence and maternal smoking were both associated with a higher likelihood of drop out ($p<0.05$; defining drop-out as any missing information on the smoking history variables at any age). Including them in the imputation model therefore makes the MAR assumption more plausible (see section 3.3.1.2; Clarke and Hardy, 2007).

Since the imputation model did not allow for unordered multinomial variables, smoking transitions were represented within the imputation model as four rather than three variables. These respectively represented having tried smoking, occasional smoking, daily smoking and having quit smoking (each a binary indicator), and were modelled at both the person and person-year level. A value was imputed for each variable for each respondent at each year between the ages of 11 and 15. This means, for example, that an 11-year old in 2008 had values imputed up to 2012, and a 15-year old in 1994 had values imputed back to 1990. This helps overcome bias in the period effects due to non-random missingness towards the beginning and end of the study period. SEP variables with multiple categories were treated as ordered categorical variables in the imputation model and results from the imputed data may therefore underestimate any non-linear associations between SEP and smoking transition risk.

It was not possible to include all potential interactions in the imputation model, as such a model would not converge. However, leaving interactions out of the imputation model entirely may have biased against finding interactions in the subsequent analyses. This was particularly undesirable, since interactions between period and SEP and between period and gender were part of the focus of study. A few key interactions were therefore included in the imputation model: gender*period, parental occupational class*period, parental education*period and income*period. Additional terms for interactions between period and parental employment status or housing tenure were not included as they caused convergence problems, but considering likely correlations between SEP variables, the three SEP*period interactions already included were considered sufficient.

After imputation, the variables for daily smoking and quitting were combined into a multinomial variable. In cases where a respondent had been imputed as becoming a daily smoker and quitting within the same year, which was possible because these states were imputed as separate variables, they were randomly assigned to either the daily smoking, or the having quit condition. All smoking transition variables were right-censored such that person-years occurring after a transition were removed. The variables for experimentation and for escalation and quitting were left-censored, such that person-years occurring before the previous transition were removed, even if, for example, respondents had been imputed as smoking occasionally prior to initiation. Such inconsistencies were possible within the imputation model and the frequency of these inconsistencies is reported later (section 8.3.1). Since the numbers imputed as making particular transitions as well as the times at which transitions were made varied across the imputed datasets, the imputed datasets were varied in size both in terms of people and person-years. Analyses were performed on the imputed datasets and the results were combined using Rubin’s rules (Schafer, 1997).

8.2.3.3 Complete cases analysis

Sensitivity analyses were performed on those person-years for which complete data were available back to age 11 (13,809 person-years from 4,059 individuals) using SPSS version 19 (IBM Corp., 2010). To be included here, a valid smoking history required the young person’s smoking status to be known at each year, up to the point at which they either experienced a transition or dropped out of the study sample. For example, if a young person was observed twice as a never-smoker at ages 11 and 12 and then observed next as a daily smoker at age 15, it would only be clear when they had first tried smoking if they had answered that question retrospectively at age 15, and it would not be possible to determine when they had transitioned to becoming an occasional or a daily smoker. Respondents with such ambiguous histories were only included up to the point at which their history became ambiguous. Respondents who dropped out and did not return were included up to the point at which they dropped out. The majority of those with ambiguous histories were respondents who entered the sample after the age of 11, but were already occasional or daily smokers. For such cases, the timing of initiation could be established if they had answered the question on when they had first tried smoking, but if this was in an earlier year then it would not have been clear when they first progressed to occasional or to daily smoking.

Overall there was reasonable consistency between the results from the complete cases analysis and the multiply-imputed data. Where differences were evident, the imputed data would probably tend to offer the more accurate picture. If the variables in the imputation model were sufficient to predict differences in smoking transition rates between those who were missing or censored early and those who were fully observed, then results from the imputed data would be more valid. The inclusion of auxiliary variables in the imputation model strengthens this assumption and therefore the validity of the imputed results. However, the imputation model included few interactions and SEP variables were treated as ordered categorical variables. This means that the imputed analyses, whilst generally more valid, may be less likely to find some interactions (i.e. besides those included between period and gender, and period and SEP) and less likely to pick up non-linear associations with SEP than the complete cases analysis.

8.2.3.4 Relative contribution of transition stages to inequalities at age 15

Additional calculations gauged the relative importance of inequalities at different transition stages in terms of progression to daily smoking by age 15. Predicted yearly transition probabilities (from the models on the imputed data) for ages 11 to 15 were used to calculate expected proportions of daily smokers by age 15 in two groups (parents with a degree or higher vs. parents with no qualifications). Calculations were repeated after manipulating specific transition probabilities in the disadvantaged group to equal those in the advantaged group. This shows effects of particular transitions on the expected difference between the groups in the proportion of daily smokers by age 15. Calculations were performed separately for males and females and for two time periods ten years apart (1995-1999 and 2005-2009) to see if results were consistent.

8.3 Results

8.3.1 Descriptive statistics

Table 8-3 provides descriptive statistics for the observed data and each of the analysis samples. Little difference in the proportional composition of the sample was introduced by either restricting the analysis to complete cases or in using the imputation model, though the imputed data were more similar to the full sample than the complete cases sample. The main exception to this was for the proportions making smoking transitions; here the complete cases sample tended to be closer to the observed data. The imputed data showed slightly higher rates of smoking transitions, suggesting that smokers may have been more likely to drop out, leaving their transitions unreported. The imputed data contained five person-years for every respondent, whereas many cases in the observed and complete cases samples were censored, containing fewer than five person-years. Therefore, if respondents who were likely to have made a smoking transition had dropped out prior to making that transition, then they would have been included within the observed and complete cases samples as if they were respondents who never made a transition. Thus, the transition rates in the observed and complete cases samples are likely to be under-estimates; rates in the imputed data are likely to be closer to the true rates within the sampled population. Despite this, the distribution of ages at which transitions were made in the imputed sample was very similar to that in the complete cases and observed samples, with perhaps a slight tendency towards older transitions. This is consistent with the explanation given above for higher smoking transition rates in the imputed data.

Table 8-3: Descriptive statistics from observed and analysis samples

(continued overleaf)

		Observed Sample[a] (N=5,122)		Complete Cases (N=4,059)		Imputed Analysis[b] (N=5,122)	
		N	%	N	%	N	%
Gender	Male	2,613	51.0	2,097	51.7	2,613	51.0
	Female	2,509	49.0	1,962	48.3	2,509	49.0
Year (at age 11)	1990-94	848	16.6	679	16.7	848	16.6
	1995-99	1,475	28.8	1,088	26.8	1,475	28.8
	2000-04	1,735	33.9	1,401	34.5	1,735	33.9
	2005-08	1,064	20.8	891	22.0	1,064	20.8
Country	England	2,889	56.4	2,432	59.9	2,889	56.4
	Scotland	884	17.3	664	16.4	884	17.3
	Wales	849	16.6	623	15.3	849	16.6
	Northern Ireland	500	9.8	340	8.4	500	9.8
Parental Occupational class	I & II	2,237	44.5	1,855	45.7	2,252	44.0
	III	2,007	40.0	1,589	39.1	2,042	39.9
	IV & V	778	15.5	615	15.2	828	16.2
	Missing	100					
Parental Education	Degree or Higher	827	16.3	694	17.1	830	16.2
	Other Qualifications	3,656	72.0	2,979	73.4	3,688	72.0
	No Qualifications	592	11.7	386	9.5	604	11.8
	Missing	47					
Household Income	Top Tertile	1,323	29.3	1,229	30.3	1,504	29.4
	Middle Tertile	1,525	33.8	1,382	34.0	1,711	33.4
	Bottom Tertile	1,661	36.8	1,448	35.7	1,907	37.2
	Missing	613					
Housing Tenure	Owned/Mortgaged	3,520	69.0	2,823	69.5	3,534	69.0
	Rented/Other	1,583	31.0	1,236	30.5	1,588	31.0
	Missing	19					
Parental Employment	Employed	4,139	81.4	3,392	83.6	4,154	81.1
	Not employed	948	18.6	667	16.4	968	18.9
	Missing	35					
Initiation	Yes	1,958	42.0	1,734	42.7	2,882	56.3
	Did not initiate	2,703	58.0	2,325	57.3	2,240	43.7
	Missing	461					
Age of Initiation	11 years	394	20.1	344	19.8	524	18.2
	12 years	372	19.0	342	19.7	515	17.9
	13 years	442	22.6	396	22.8	616	21.4
	14 years	434	22.2	372	21.5	660	22.9
	15 years	316	16.1	280	16.1	567	19.7
	Did not initiate	2,703		2,325		2,240	
	Missing	461					
Experimentation	Yes	878	48.8	783	49.1	1,529	53.1
	Tried only	920	51.2	812	50.9	1,353	46.9
	Did not initiate	2,703		2,325		2,240	
	Missing	621		139			
Age of Experimentation	11 years	74	8.4	57	7.3	113	7.4
	12 years	102	11.6	96	12.3	184	12.0
	13 years	179	20.4	166	21.2	313	20.5
	14 years	268	30.5	241	30.8	450	29.4
	15 years	255	29.0	223	28.5	469	30.7
	Tried only	920		812		1,353	
	Did not initiate	2,703		2,325		2,240	
	Missing	621		139			

Escalation & Quitting	Escalation	299	34.1	272	34.8	558	36.5
	Quitting	398	45.4	350	44.8	655	42.8
	Occasional only	180	20.5	160	20.5	316	20.7
	Tried only	920		812		1,353	
	Did not initiate	2,703		2,325		2,240	
	Missing	622		140			
Age of Escalation	11 years	7	2.3	5	1.8	7	1.2
	12 years	21	7.0	18	6.6	38	6.7
	13 years	47	15.7	45	16.5	86	15.5
	14 years	101	33.8	88	32.4	190	34.1
	15 years	123	41.1	116	42.6	237	42.5
	Quitting	398		350		655	
	Occasional only	180		160		316	
	Tried only	920		812		1,353	
	Did not initiate	2,703		2,325		2,240	
	Missing	621		140			
Age of Quitting	11 years	43	10.8	34	9.7	56	8.5
	12 years	66	16.6	61	17.4	100	15.2
	13 years	82	20.6	75	21.4	144	22.0
	14 years	96	24.1	86	24.6	169	25.8
	15 years	111	27.9	94	26.9	186	28.5
	Escalation	299		272		558	
	Occasional only	180		160		316	
	Tried only	920		812		1,353	
	Did not initiate	2,703		2,325		2,240	
	Missing	621		140			

[a]Percentages are based on those with valid data for comparative purposes.
[b]Percentages are based on average results across 20 imputed data-sets.

Table 8-4: Imputation details

	Mean Value	Standard Deviation	Minimum	Maximum
Initiation				
N (person-years)	20,042	30.9	19,980	20,100
N (individuals)	5,122	0.0	5,122	5,122
N (tried smoking)	2,882	19.7	2,849	2,926
Experimentation				
N (person-years)	6,362	44.4	6,273	6,450
N (Individuals)	2,882	19.7	2,849	2,926
N (reached occasional smoking)	1,529	10.8	1,510	1,547
Escalation & Quitting				
N (person-years)	2,122	22.4	2,086	2,174
N (individuals)	1,529	10.8	1,510	1,547
N (reached daily smoking)	558	11.8	541	592
N (quit smoking)	655	12.0	632	673
Imputation discrepancies				
N (person-years imputed as both daily smoker and having quit)	94	11.8	70	117
N (person-years imputed as occasional prior to initiation)	24	7.1	10	35
N (person-years imputed as daily/quit prior to experimentation)	68	9.5	48	80

Table 8-4 displays details of variability in the number of person-years for analysis and the number of smoking transitions occurring across the imputed datasets. On average across the imputed datasets, 2,882 respondents were imputed to have tried smoking before the age of 15, a little over half of these progressed to occasional smoking, and the majority of those then either quit smoking or proceeded to a daily habit. A little over a third of the occasional smokers progressed to daily smoking by age 15, and even more quit (42.8%).

Data imputation occasionally produced nonsensical responses. Cases where a person was imputed to be a daily smoker and to have quit smoking within the same year occurred rarely and never amounted to more than 0.5% of the total possible 25,620 person-years within each imputed dataset, or on average less than 5% of the 2,122 person-years included in the analyses of escalation and quitting. Cases where a person was imputed as smoking occasionally before they had tried smoking amounted on average to approximately 1.6% of the cases who reached the stage of occasional smoking. Cases where a person was imputed as quitting or becoming a daily smoker prior to reaching occasional smoking amounted on average to approximately 5.6% of the cases who ever made such a transition (i.e. to daily smoking or quitting). Since these are small proportions relative to the rest of the data, the effects of the arbitrary fixes applied to these cases are assumed to be negligible. The proportions progressing through the smoking transitions in the complete cases sample are described in the Appendix (Figure A-10).

Finally, Figure 8-3 displays rates of ever smoking and current daily smoking among 15-year olds in the observed sample (i.e. not imputed data) by parental education, together with dates of relevant contextual changes. Smoking prevalence among 15-year olds, whilst fairly stochastic, shows an overall pattern of decline as tobacco control measures accumulate over the study period. Inequalities appear to be present throughout.

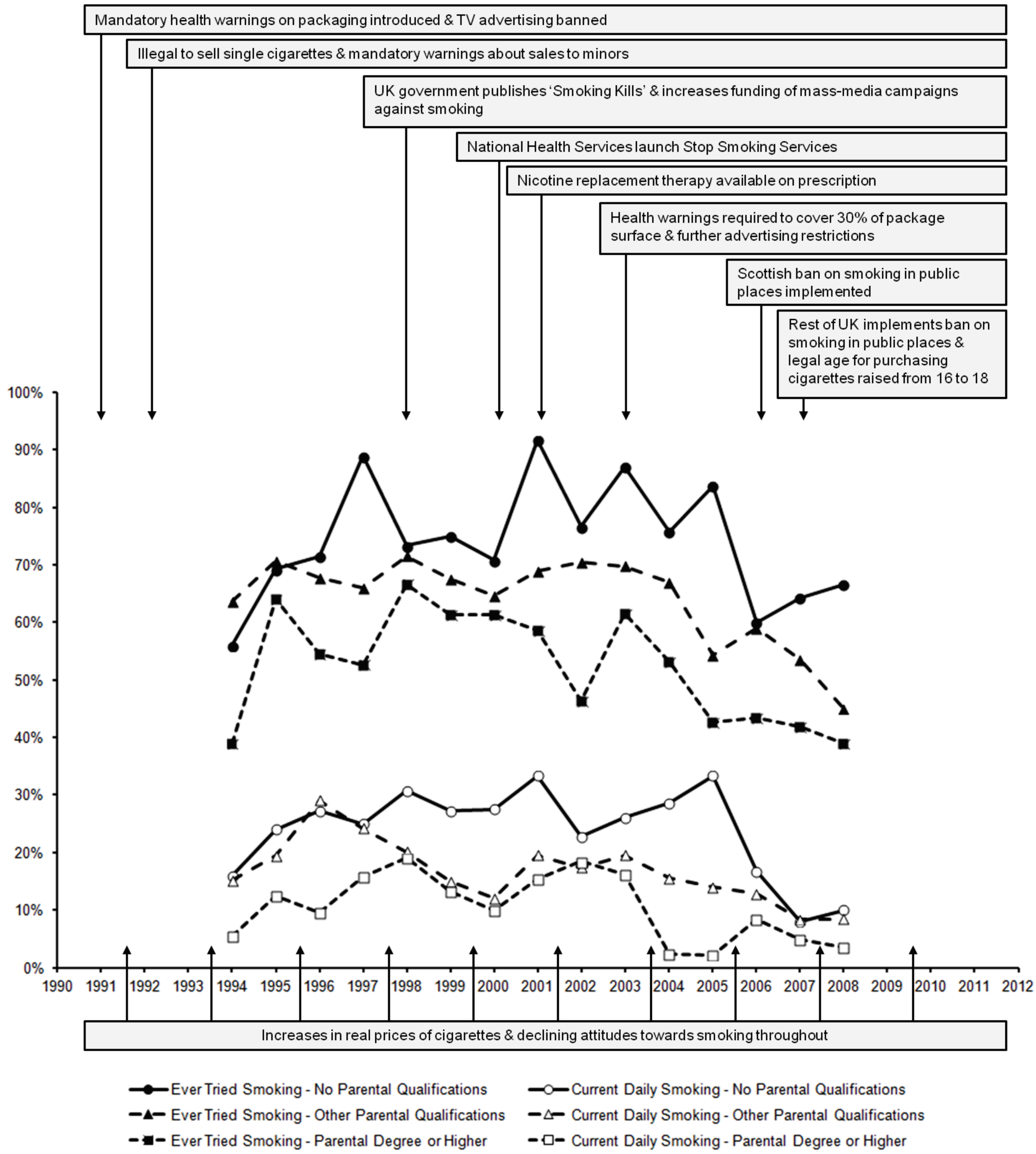


Figure 8-3: Smoking prevalence by parental education among 15-year olds (1994-2008) and contextual changes (1990-2012)

8.3.2 Event history models

Since results from different measures of SEP, and using complete cases, were mostly consistent, the section focuses on results using parental education (the most stable measure of SEP; see section 8.2.2.3) in the imputed data. Differences in the findings based on other measures of SEP, or using complete cases, are mentioned in the text (full statistical details in the Appendix). Table 8-5 shows ORs and 95% confidence intervals for each transition from models using parental education. These models were used to calculate the predicted probabilities shown in Figures 8-4 to 8-6 (which are presented to aid interpretation of Table 8-5), as well as the values in Table 8-6.

Table 8-5: ORs for smoking transitions (parental education)[a]

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		20,042		6,362		2,122		2,122
N (Persons)		5,122		2,882		1,529		1,529
N (Events)		2,882		1,529		558		655
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Female (ref: Male)	0.94	0.79-1.10	1.44	1.27-1.64	0.84	0.65-1.09	1.07	0.84-1.36
Age[b]	1.34	1.21-1.48						
Age at Prior Transition[c]			1.08	1.02-1.15	1.29	1.15-1.45	0.85	0.77-0.94
Years Since Prior Transition[d]			1.34	1.24-1.44	1.35	1.09-1.66	0.57	0.44-0.73
Wales (ref: England)	0.95	0.79-1.10	0.80	0.67-0.97	0.89	0.62-1.28	0.96	0.69-1.35
Scotland (ref: England)	1.00	0.89-1.13	0.82	0.69-0.97	0.86	0.59-1.24	1.32	0.95-1.82
Northern Ireland (ref: England)	0.80	0.66-0.96	0.82	0.61-1.10	0.89	0.50-1.59	1.20	0.72-2.01
Period[e]	0.66	0.56-0.78	0.78	0.72-0.85	1.08	0.90-1.28	1.09	0.92-1.29
Period*Period	0.81	0.74-0.88	0.92	0.85-0.99	0.81	0.70-0.93	0.88	0.77-1.01
Other Qualifications (ref: Degree or Higher)	1.76	1.38-2.25	1.03	0.84-1.25	1.63	1.10-2.41	1.37	0.95-1.99
No Qualifications (ref: Degree or Higher)	3.82	2.84-5.14	1.23	0.96-1.58	2.19	1.32-3.63	1.29	0.82-2.03
Age*Female	1.14	1.06-1.22						
Age*Period	1.04	1.00-1.08						
Age*Period*Period	1.05	1.01-1.08						
Female*Period	1.01	0.92-1.11						
Female*Period*Period	0.91	0.84-0.99						
Other Qualifications*Age	0.92	0.83-1.02						
No Qualifications*Age	0.77	0.68-0.87						
Other Qualifications*Period	1.04	0.90-1.19						
No Qualifications*Period	1.24	1.03-1.49						
Years Since Prior Transition*Period					0.74	0.59-0.93	0.94	0.72-1.23

[a]Data presented are average values across 20 imputed data-sets.
[b]ORs associated with one-year increase in age from reference value of 11 years.
[c]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[d]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[e]ORs associated with five-year increase from the reference value of 2001.

In order to aid interpretation of the ORs in Table 8-5, Figure 8-4 shows predicted transition probabilities by year, gender and either age (for initiation) or years since prior transition. Predicted probabilities are only shown for 0, 1 and 2 years since the prior transition. This was because very few person-years were included where the respondent has gone 3 or 4 years since the prior transition. This was particularly true for escalation and quitting, where only a handful of cases got that far. As all the smoking histories were censored at age 15, a respondent would have needed to have made the previous transition at 11 or 12 and then not progressed onwards in order to make it to 3 or 4 years since that transition. This happened rarely within the data.

Figures 8-4a and 8-4b display initiation probabilities for males and females respectively. All two-way interactions between age, gender and period were significant ($p<0.05$) for initiation. Risk of initiation rose with age throughout the study, but more for females than males. The trend was of gradually increasing risk through the 1990s (except for older males) followed by decreasing risk during the 2000s, with greater decreases among older than younger adolescents. Figures 8-4c and 8-4d show male and female probabilities for experimentation, with greater risks for females than males, and risks declining steadily from the late 1990s onwards (no interactions). Risk of escalating from occasional to daily smoking is shown in Figures 8-4e and 8-4f. Here there was an interaction between period and years since previous transition ($p<0.05$). In the 1990s, respondents who had spent a year or two as occasional smokers had higher risks of escalation than those in their first year of occasional smoking, but this difference declined over time, disappearing by the end of the study period. Immediate risk of escalation within the first year of occasional smoking increased during the 1990s before declining in the 2000s. Finally, Figures 8-4g and 8-4h show that chances of quitting after becoming an occasional smoker increased during the 1990s, with a down-turn towards the end of the study period (no interactions).

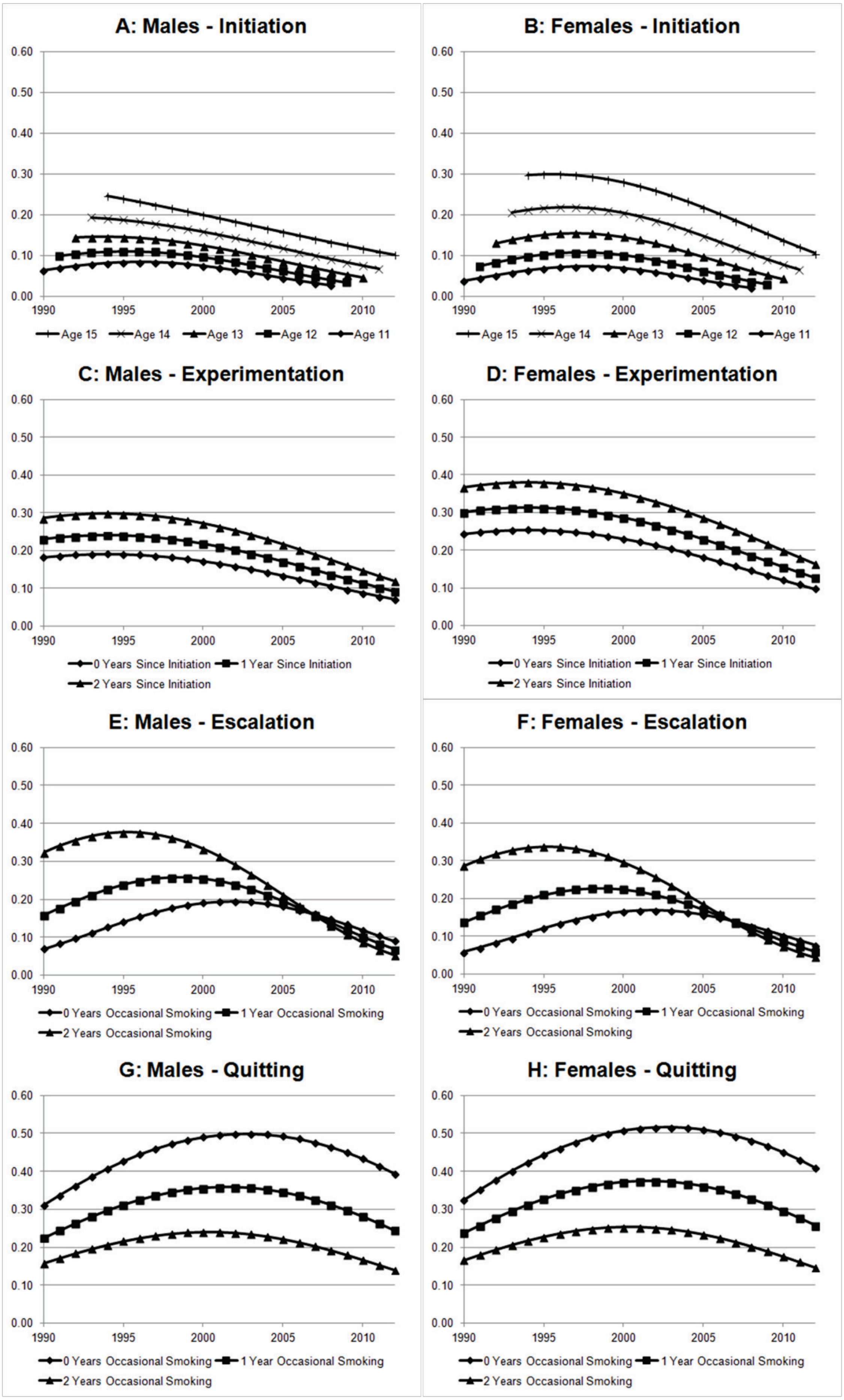


Figure 8-4: Smoking transitions probabilities by year

Figure 8-5 shows probabilities for each transition by parental education and period (since there were no interactions between parental education and gender, Figure 8-5 shows probabilities for males only). For initiation, parental education interacted with age and period ($p<0.05$; occupational class differed here from other SEP measures interacting with age but not period, see Table A-3). Figure 8-5a shows the interaction with period. Adolescents whose parents had fewer qualifications had greater risks of initiation than those with degree-level parents; these inequalities widened during the 1990s before converging as risk declined more generally during the 2000s (this convergence was in absolute terms; in relative terms inequalities continued to widen during the 2000s). Risk of experimentation is shown in Figure 8-5b and there was little difference by parental education. However, occupational class and tenure showed an association with risk of experimentation, and the effect for occupational class was non-linear; respondents with parents in class III and in rented accommodation had the highest risk (see Tables A-3 and A-5). Risk of escalation from occasional to daily smoking (Figure 8-5c) was patterned by parental education with ORs of 2.19 (95% CI: 1.32-3.63) and 1.63 (1.10-2.41) respectively for those whose parents had no or other qualifications compared to those whose parents had a degree or postgraduate education. There were no significant associations between parental education and the odds of quitting as opposed to remaining an occasional smoker (Figure 8-5d).

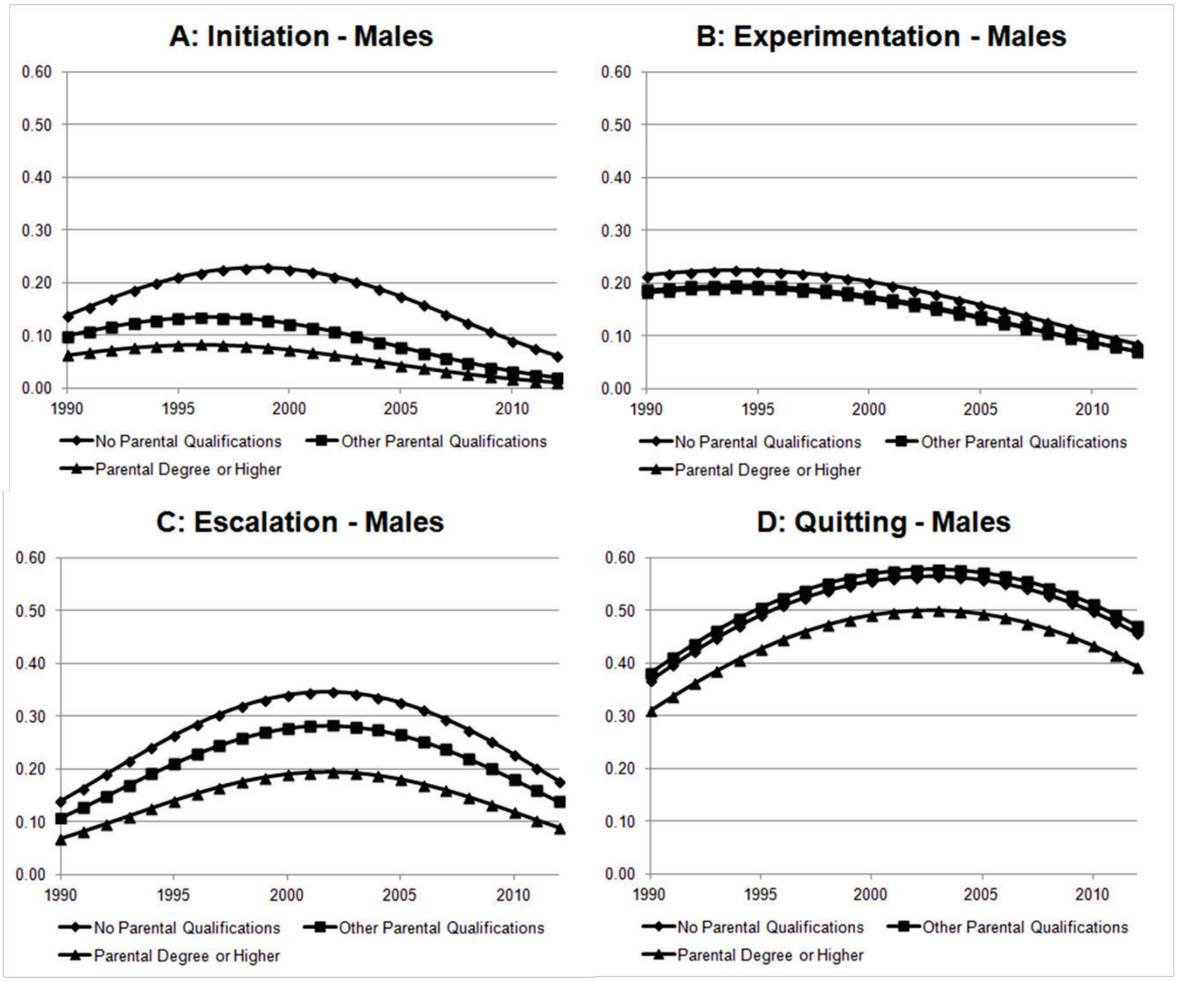


Figure 8-5: Smoking transition probabilities by parental education and year

Inequalities in initiation additionally narrowed with age with an OR of 3.82 (95% CI: 2.84-5.14) at age 11 reducing to 1.34 (0.99-1.82) by age 15, comparing those whose parents had no qualifications to those whose parents had a degree or postgraduate education (age 15 OR not shown in Table 8-5 but calculated from model coefficients). This interaction is shown in Figure 8-6. Respondents with more educated parents had a low probability of initiation at age 11 but this probability rose sharply with age, whereas in contrast the probability of initiation for those whose parents had no qualifications was already relatively high at age 11 and increased less sharply with age.

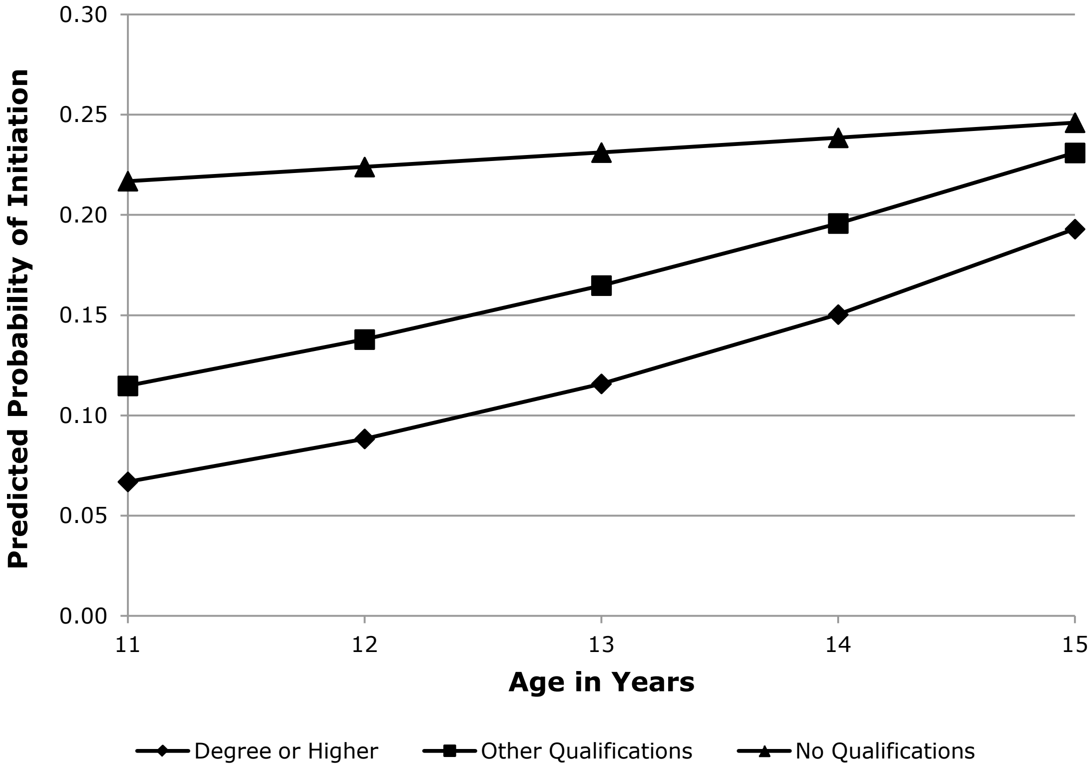


Figure 8-6: Probability of initiation by age and parental education

Tables A-3 to A-6 in the Appendix show ORs from models with different measures of SEP, with most findings consistent. Tables A-7 to A-11 show the sensitivity analyses using person-years with complete data. These were broadly supportive of the patterns shown here, but for most measures of SEP, socioeconomic disadvantage was additionally associated with higher risks of experimentation and higher chances of quitting. Also, some interactions were evident in the complete-cases but not the imputed analysis, between: years since prior transition and parental education for experimentation; country and parental occupational class, household income and parental employment for initiation (with different countries having stronger inequalities depending on the measure); parental occupational class and period for experimentation, escalation and quitting; and income and gender for experimentation. These interactions did not present any clear or consistent patterns across SEP measures.

8.3.3 Relative contribution of transition stages to inequalities at age 15

Table 8-6 shows how expected inequalities in proportions reaching daily smoking by age 15 would reduce if inequalities in initiation and escalation were removed. Greatest reductions were achieved by removing inequalities in initiation rates, especially in more recent years when prevalence was lower (83-84% reductions in 2005-2009 compared to 72-76% in 1995-1999). However, since inequalities in initiation and escalation act synergistically, substantial reductions in daily smoking could be achieved by removing either (estimated reductions for removing inequalities in escalation were all over 50%). Removing inequalities at specific ages had most impact between ages 11 and 13 for initiation, but at ages 14 and 15 for escalation (e.g. for males in 2005-2009 there was an 11% reduction for removing inequalities in initiation at age 11 only, compared to a 4% reduction at age 15, whilst comparable figures for escalation were 1% at age 11 and 21% at age 15).

Table 8-6: Relative importance of different transitions

		Percentage reduction of expected inequality[a] in number of daily smokers by age 15			
		1995-1999		2005-2009	
		Males	Females	Males	Females
Removing Inequalities in Initiation at…	All Ages (11-15)[b]	75.7	71.8	83.9	82.5
	Age 11 only	7.5	4.4	11.3	8.0
	Age 12 only	11.6	9.3	13.9	12.0
	Age 13 only	12.4	12.3	13.6	13.7
	Age 14 only	8.8	9.3	9.8	10.7
	Age 15 only	3.3	3.2	4.1	4.4
Removing Inequalities in Escalation at…	All Ages (11-15)[b]	50.7	55.7	50.7	53.3
	Age 11 only	1.1	1.1	1.4	1.4
	Age 12 only	3.7	4.0	4.1	4.3
	Age 13 only	7.6	8.7	8.1	8.8
	Age 14 only	12.4	14.4	13.3	14.5
	Age 15 only	21.3	22.8	20.9	21.6

[a]Contrasting those whose parents have no qualifications with those whose parents have a degree or higher.
[b]Contributions for removing inequalities at specific ages do not sum to the contributions from all ages as effects are multiplicative; transitions in one year affect numbers at risk in subsequent years.

8.4 Discussion

8.4.1 Summary of findings

Broadly, the rates of initiation, experimentation, and escalation decreased over time, whilst the rate of quitting increased slightly, albeit some of these changes were concentrated in particular groups. A disadvantaged SEP appeared to be associated with higher rates of initiation, particularly at younger ages, and with higher rates of progression to daily smoking once occasional smoking had begun. However, there was less evidence that it was associated with quitting or the transition from trying to occasional smoking. Females had higher initiation rates than males at all but the youngest ages and were more likely than males to progress from trying to occasional smoking. The associations with SEP changed little over time, though inequalities in initiation widened and then narrowed again over the study period.

8.4.2 Limitations

8.4.2.1 Sample representativeness

This dataset is one of the best UK resources for investigating temporal trends in smoking development, but attrition of more disadvantaged households in the BHPS (Buck et al., 2006) may mean the sample became less representative of disadvantaged adolescents over time. Given associations between SEP and smoking, this could mean smoking transition rates in disadvantaged groups were under-estimated in later years. Multiple imputation will have partially addressed differential attrition when adolescents dropped out after being observed (to the extent that their unobserved smoking behaviour was predictable by model variables), but will not have compensated for those never observed because their household dropped out before they reached the appropriate age. This caveat aside, the study describes trends in the UK context as tobacco control measures have proliferated and the findings may be generalisable to other western contexts at a similarly advanced stage in the tobacco epidemic (Thun et al., 2012).

8.4.2.2 Smoking data

Smoking status was only recorded annually, which may not capture the full variability and complexity of transitions in smoking development within adolescence (Wellman et al., 2004). Though regression from daily to occasional use within adolescence is rare, some of those recorded here as quitting may have been unsuccessful in maintaining cessation and might have returned to smoking or progressed to a daily habit (Wellman et al., 2004). Such patterns are outside of the scope of this chapter, but have implications for the interpretation of the results. If there are high relapse rates even from occasional smoking then associations with quitting as shown here may show more about which occasional smokers attempt quitting than which adolescent smokers successfully quit. If quit attempts are prompted by recognition of increasing dependence (Wellman et al., 2004) then quitting as conceptualised in this chapter may in some cases indicate a stronger relationship to smoking than in the reference category of continued occasional use. However, those who quit after only a sporadic or occasional habit do tend to have more success in remaining abstinent than those who attempt quitting after a daily habit has developed (Wellman et al., 2004). Similarly, some of those who developed a daily habit may have later quit smoking, but the focus was on the development of a daily habit as the chance of quitting later reduces once this habit is developed (Patton et al., 1998, Chassin et al., 2000).

The smoking data are self-reported and may be inaccurate, though self reports have been shown to match reasonably well with serum cotinine levels, a biological marker of cigarette use (Wagenknecht et al., 1992, Vartiainen et al., 2002). Bio-assays are not sufficiently sensitive to differentiate between occasional and non-smokers though, and self-reports are probably the best information available for studying the development of adolescent smoking (Wellman et al., 2004).

8.4.2.3 Time invariant SEP

A further limitation was the operationalisation of parental SEP as a time-invariant characteristic. This was a pragmatic simplification, considered necessary to aid model convergence, but it does ignore the dynamic nature of SEP and that some young people may have experienced substantial shifts in their circumstances during the period for which they were observed. As noted in section 8.2.2.3, occupational class and income were the least stable measures, which may be why they show the weakest associations with smoking transitions.

8.4.2.4 Complete cases vs. multiple imputation

Whilst findings from both the complete cases and imputed analysis were broadly similar, there were various differences. For example, the relationships between SEP and the rates of experimentation and quitting were stronger in the complete cases analysis than in the imputed analysis, and the complete cases analysis picked up many more interactions than the imputed analysis. In theory, the imputed analysis should be more valid as it took advantage of some additional auxiliary variables to strengthen the assumption that missingness or drop-out was random given the observed data. However, it might be argued that an imputed analysis is only as good as the imputation model used to impute the data, and the imputation model included few interactions and treated SEP variables with multiple categories as ordered. The interactions observed in the complete cases analysis only did not seem to have any strong or reliable pattern across SEP measures and therefore might be considered less trustworthy or more to do with the specific characteristics of particular measures than to do with the overall concept of SEP. The treatment of SEP variables as ordered within the imputation model might have biased the imputed analysis against finding non-linear relationships between SEP and smoking transitions, but since these were not very common in the complete cases analysis, it might be assumed that little has been lost thereby.

8.4.3 Smoking development

Consistent with other research on smoking development, the findings here show that many youths try or experiment with smoking without proceeding to a daily habit (Wellman et al., 2004, Maggi et al., 2007) and that smoking development in adolescence is highly variable, with transitions between stages occurring at very different rates for different individuals. We found that roughly half of those who initiated smoking progressed to occasional smoking, and that roughly a third of those had then progressed to daily smoking by the age of 15. This highlights the usefulness of a stages framework such as the one used here. If, for example, almost all of those who smoked occasionally proceeded quickly on to a daily habit then it might be less meaningful to think of a stage of occasional smoking. However, each of the stages considered here appears to provide a meaningful division among those who pass the previous transition. Most previous research has tended to either focus on the transitions of initiation or escalation (i.e. progressing to daily smoking), but the fact that only about half of those observed here as trying smoking progressed on to occasional smoking suggests that it may also be important to study this experimentation transition in more depth.

Other studies have indicated that adolescents are more likely to smoke and to smoke more heavily as they get older (Murray et al., 1983, Kandel and Logan, 1984, Chassin et al., 1996, Patton et al., 1998). Increasing levels of smoking among older adolescents could be the results of simply following through age differences in one transition (e.g. the rate of initiation increases with age, and this increases the number at risk for subsequent transitions), or accumulation from a constant risk such that each year those who have already become smokers may be joined by a similar proportion of non-smokers initiating. A previous study found that the risk of escalation among occasional smokers increased with age (Kim et al., 2009). These findings go a little further and indicate that each of the transitions studied was associated with age. This means that progression through the whole developmental process up towards a daily smoking habit was quicker for those who entered it later. Conversely it means that those who initiated earliest took the longest to progress to daily smoking. The chance of quitting before developing a daily habit was also higher for those who started earlier. Thus, where initiation occurs earlier, the window of opportunity for preventing subsequent transitions may be somewhat wider than where smoking begins later and there may be more of a tendency towards experimental dabbling without progression to daily smoking. Since adult smokers who initiate at the earliest ages tend to also be those who smoke most heavily and with least chance of quitting (Patton et al., 1998, Chassin et al., 2000), it is clearly important to identify those early initiators who escalate to daily smoking and find a way to prevent this escalation.

8.4.4 Contextualising smoking development

As detailed in section 8.1.3, significant changes relevant to smoking occurred in the UK context between 1990 and 2012, including several specific policies aimed at curbing tobacco use. A relatively simplistic approach was taken of equating years with increasing tobacco control, which does not enable isolation of effects for specific policies, but does give an idea of what happens when a range of such tobacco control policies are implemented cumulatively over time. More formal efforts to score tobacco control policy implementation over time in England indicate a non-linear increase in tobacco control scores from 2002-2010, with scores particularly high after the implementation of smoking bans in 2007 (Sims et al., 2014). This corresponds well with the non-linear period effects observed here; declines in smoking risk were sharpest towards the end of the study period.

Whilst some of these political changes may have been relevant to early adolescents (restrictions on advertising, mandatory warnings about selling to minors or banning the sale of single cigarettes), others such as price increases, or bans on smoking in public places may have been more relevant to older adolescents or adults, as older smokers are more likely to purchase cigarettes themselves (Ogilvie et al., 2005), and to have smoked in the places (e.g. bars, clubs etc) where smoking was no longer allowed. Though prior data on how such policies might have influenced early adolescent uptake are sparse, teenage smokers have been found to be less affected by a cigarette tax increase than adult smokers in terms of prompting quitting or cutting down, especially among low-income teenagers (who tended to cut down or smoke cheaper cigarettes rather than quit; Biener et al., 1998). Nevertheless, despite their potential for irrelevance to early adolescents, the contextual changes occurring in the UK appear to have had a health-promoting influence on rates of smoking transitions in early adolescence. Rates of initiation, experimentation and escalation were found to have decreased over time, though more strongly among the older than the younger adolescents studied for initiation, and the trend for escalation was concentrated among those who had been occasional smokers for longer (and thus would have been older). There were also increases over time in the rate of quitting. These patterns are broadly encouraging and suggest that even where population level changes are not directly relevant to early adolescent smoking, they may affect early adolescent uptake, perhaps by making smoking less normative within adolescents' social environments.

It is notable however, that the strongest associations between time period and the risk for initiation and escalation were among older adolescents for whom some of the policy changes would have been more relevant. The weaker effects for younger adolescents perhaps indicate that current policies are not fully addressing the processes through which younger adolescents tend to acquire cigarettes, e.g. via social contact with other, older smokers (Ogilvie et al., 2005). Weaker effects of period for the youngest adolescents are suggestive that the changes were less relevant for them and more targeted policies may be needed.

Unfortunately however, with multiple changes happening across the observation period, and often concurrently, the specific effects of individual policies cannot be statistically determined from these data. The observed patterns represent the net effects of all relevant contextual changes (and probably include some unknown factors that have not been discussed here). Although it seems plausible that the various population level control policies mentioned earlier would be key drivers of change, the overall decreases in smoking transition rates may be the result of contributions from various factors, not necessarily, but possibly, including these policy changes. It may also be that some policies have reduced transition rates whilst others have had no effect. For example, in the paragraph above, the contextual changes were interpreted as having a positive influence on early adolescent smoking transitions, despite some of the changes potentially not being very relevant to early adolescents. An alternative interpretation might be that only those policies which were relevant to early adolescents (e.g. restrictions on advertising etc) were having an effect, whilst other policies had no influence on them. This would still result in a net positive effect. More likely still is that the various tobacco control policies had interactive effects (Chapman, 1993). More research is needed to identify the specific and interactive effects of particular policies on early adolescent smoking development.

8.4.5 SEP and smoking development

Inequalities by SEP in early adolescent uptake were most evident for initiation and for progression to daily smoking. There was relatively little evidence of inequalities in progression to occasional smoking after initiation, or in rates of quitting prior to establishing a daily habit. Inequalities in initiation were strongest at the earliest ages, and widened in the late 1990s before narrowing again in the 2000s. Inequalities in escalation were relatively independent of age or time period. Initiation and escalation may therefore be key transitions for interventions to reduce inequalities in smoking.

These findings are consistent with most investigations of initiation (Gilman et al., 2003, Wardle et al., 2003) and fit with systematic review findings that the evidence for inequalities in smoking levels is stronger in early rather than late adolescence (Hanson and Chen, 2007). However, the results here go further by demonstrating that inequalities in initiation specifically are stronger at younger ages, even within early adolescence. The inequalities observed for initiation mean that the in-flow of adolescents into occasional smoking contains a disproportionate number of disadvantaged adolescents, as advancement from initiation to occasional smoking was not strongly patterned by SEP (and if anything was more likely for disadvantaged adolescents). Even accounting for this disproportionate in-flow into occasional smoking, escalation to daily smoking was found to be more likely for disadvantaged adolescents. This is consistent with evidence of higher rates of daily smoking among adolescents of a disadvantaged SEP (Green, G et al., 1991). With respect to studies that have accounted for inequalities in prior transitions, a study of escalation among a sample of occasional smokers found no association between escalation and an indicator of low income (Kim et al., 2009), which is contrary to the findings here, but this study only used one relatively limited measure of SEP (i.e. receipt of free school meals, or other financial assistance). In contrast, another study of progression to daily smoking among a sample of initiators did find associations with multiple measures of SEP (Gilman et al., 2003), which is closer to the findings observed here. Both of these previous studies had relatively small sample sizes compared to this study. If a disadvantaged SEP is associated with higher rates of early adolescent escalation to daily smoking then this is again a key point of intervention for prevention efforts that aim to reduce inequalities in smoking, since the chances of quitting reduce substantially after daily smoking has begun (Patton et al., 1998, Chassin et al., 2000).

These results highlight the importance of initiation and escalation in the early adolescent development of inequalities in smoking and it may be valuable to use these findings when considering targeting of individual level interventions to prevent smoking transitions. However, it is worth noting that such individual level interventions have tended not to be successful in reducing inequalities in smoking, at least among adults (Jarvis and Wardle, 2006, Main et al., 2008, Thomas et al., 2008). It tends to be the most advantaged who benefit most from such approaches, so the effect on inequalities is often minimal, or even increases inequalities. Some suggest approaches using proportionate universalism, where the intensity of interventions is adjusted to help those most in need (Benach et al., 2013). If such individual level interventions were applied, the findings indicate that they may be most effective in reducing smoking inequalities in mid-adolescence if they were targeted at prevention of initiation among adolescents, especially at ages 11-13. Efforts to prevent escalation may also have benefit but should be targeted slightly older at ages 14-15. However, these target points identified for intervention might also be considered useful for targeting population level tobacco control policies. Hence the importance of considering whether the associations with SEP have changed over time as population level tobacco control policies have been introduced (see below, section 8.4.7).

Although SEP appears to be an important correlate of both initiation and escalation, the mechanisms responsible for these associations may be different. Indeed, one of the reasons that some have advocated using multiple measures of SEP in such investigations is that differences in the strength of association for different SEP variables may prove informative as to the mechanisms involved (Gilman et al., 2003, Laaksonen et al., 2005). One study found the strongest associations with initiation were for household income, whilst escalation to daily smoking was most strongly associated with parental education (Gilman et al., 2003). They concluded from this that material disadvantages were important for initiation, whereas the richness of the environment for social and cognitive development might have been an important mechanism in the process of escalation (reasoning that more educated parents would provide a richer environment). The present study found that the strongest associations with both initiation and escalation were with parental education, where those whose parent(s) had no qualifications had considerably higher odds of making these transitions. This might be interpreted as further support for the idea that the richness of the social and cognitive environment is an important mechanism for early adolescent smoking uptake. It should be noted however that those whose parents had no qualifications were the smallest group among all the disadvantaged groups studied here, and therefore the strong associations with membership in this category might simply be because this group represented the most disadvantaged respondents in terms of SEP generally, whilst the lowest status categories on other measures may have included some slightly more affluent respondents, diluting the associations with smoking.

There may be both cultural and structural explanations for inequalities in smoking development by SEP. Cultural explanations invoke the idea that there are differences across social strata in the types of behaviour or lifestyles that are considered normal and acceptable, and thus differences in the behaviours and lifestyles that young people tend to see modelled by the people around them (DHSS, 1980). This would include, for example, explanations in terms of parental or peer smoking, where young people of a disadvantaged SEP are observed to be more likely to have parents or friends who smoke (Green, G et al., 1991, Flay, 1993, West et al., 1999). Seeing parents or peers smoke is presumed to have an influence on a young person, increasing their own propensity for taking up smoking. In terms of smoking development, such social learning processes might be expected to be most strongly related to initiation, with behavioural modelling prompting initial curiosity or intention to try; perceptions of others performing the behaviour might have most salience when a person does not yet have any personal experience with the behaviour. This does not explain however, why the parents or peers of disadvantaged adolescents are more likely to smoke (Furlong and Cartmel, 1997). Social learning related to parental smoking may have reinforced an initial difference between social strata across generations, but does not account for that initial difference. If other processes associated with socioeconomic disadvantage prompt smoking then parental or peer smoking might also be attributable to these processes (Green, G et al., 1990, Green, G et al., 1991) and statistical adjustment for parental or peer smoking might mask those processes (Tjora et al., 2011).

Structural explanations on the other hand suggest that inequalities arise from the stratification of resources and stressors (DHSS, 1980, Macintyre, 1997, Thoits, 1999, Lynch and Kaplan, 2000). Those in a disadvantaged SEP will tend to experience more adversities and difficulties and will have fewer social and economic resources for coping with those stressors. The combination of more prevalent stressors and fewer coping resources could prompt higher levels of smoking (Schepis and Rao, 2005). Smoking is commonly described by adult smokers as a coping mechanism (Jarvis and Wardle, 2006), and adolescents as young as 15-16 years also describe smoking as a coping response to stress (Mates, 1992, Tyas and Pederson, 1998). This might be particularly important for explaining inequalities in escalation. Once a young person has some experience of smoking, more frequent or chronic stressful experiences could lead to more frequent use of smoking as a coping behaviour, particularly in the absence of alternative coping resources. It is more difficult to see why a young person would resort to initiation of smoking as a coping response without any prior personal experience of it unless perhaps they had seen others using cigarettes to manage stress. There is evidence, however, associating stress with both the initiation and maintenance of smoking behaviour (Tyas and Pederson, 1998), so it may still be an important mechanism for early stage smoking transitions. As intimated above, structural and cultural explanations could be complementary. If a structural disadvantage in terms of stress or coping resources led to inequalities in escalation, then this could lead to some initial stratification of the behaviour, but this might then be accentuated by cultural processes as smokers begin to accumulate in disadvantaged social strata.

It is curious to note that there was relatively weak evidence in the present study for stratification by SEP of experimentation or of quitting. With regards to experimentation, others have noted that adverse physiological reactions to initial smoking attempts, such as nausea or choking, can be important factors in determining progression to experimentation (Fisher et al., 1993, Flay, 1993). It is hard to see how such physiological reactions would be stratified by SEP, and perhaps these reactions are so salient for the progression from trying to occasional smoking that SEP is of only marginal importance. The findings here on quitting contrast with findings from adults where those of a disadvantaged SEP find quitting more difficult (Chassin et al., 1996, Jarvis and Wardle, 2006). This may be due to different mechanisms affecting quitting in adulthood compared to early adolescence, but it is also worth noting that the quitting outcome here could be a mix of those who have genuinely achieved cessation, and those trying to quit in the face of increasing feelings of dependence (Wellman et al., 2004). If the genuine quitters are concentrated among the more advantaged strata and the more dependent smokers are concentrated among the more disadvantaged strata then the net result might be a finding of no association between SEP and the quitting outcome used here.

8.4.6 Gender and smoking development

Rates of experimentation were higher among females than males and initiation rates rose more quickly with age among females than among males, so that females tended to be more at risk. These findings contrast with those from an Australian study where smoking rates rose with age more quickly for females than for males, but the differences were concentrated in cessation rates, with males being more likely to quit, rather than in the initial stages of smoking as observed here (Patton et al., 1998). This difference could be due to the Australian study being conducted on a slightly older sample (baseline age 14-15 years), which would suggest that the smoking transitions for which gender is important change with age. Alternatively it could be due to the different context, with the importance of gender varying across different social contexts. A Canadian study of adolescent smoking trajectories was more consistent with these findings, indicating that females were more likely than males to experience a pattern of development with high rates of initiation between ages 11 and 13 (Maggi et al., 2007). A less recent US study showed male adolescents taking up smoking earlier than females (Kandel and Logan, 1984). These discrepant findings may again have to do with the importance of gender varying between contexts, which is discussed with respect to the temporal context in the next section.

The findings here showed little evidence of gender differences in escalation or quitting, which suggests that gender is less important in the later stages of smoking development. Perhaps gender lessens in importance as smoking becomes more about habit, dependence, and coping responses and less about behavioural norms, identity or culture. Other evidence has shown gender differences at later stages though, for example, with male adolescents less likely to escalate from occasional to daily smoking (Kim et al., 2009), so this conclusion should be treated with some caution.

8.4.7 Change in associations over time

Socioeconomic inequalities in early adolescent smoking were fairly consistently present over the time period studied; there was little change in the inequalities for escalation, and those for initiation widened during the 1990s before narrowing again in the 2000s. Again, it is difficult to discern the effects of particular policy changes on inequalities in adolescent smoking, but it may be that changes happening in the 1990s (e.g. restrictions on sales to minors, advertising restrictions etc) resulted in a widening of socioeconomic inequalities in initiation, whilst changes in the 2000s (e.g. specific, large health warnings, bans on smoking in public places) resulted in a narrowing of these inequalities (at least in absolute terms, which is probably more relevant as the proportion of smokers in advantaged circumstances gets very low).

Regarding the widening of inequalities in the 1990s it might have been expected that this would happen as the new policies reduced smoking more among young people of an advantaged SEP than among those of a disadvantaged SEP. However, here the inequalities widened as the probability of initiation rose among disadvantaged adolescents during the 1990s, while remaining relatively flat for more advantaged children. This either suggests that the policies introduced in the early 1990s actually encouraged smoking among the most disadvantaged young people, or perhaps that there was a temporal trend of increasing initiation rates that was curbed for more advantaged young people by the new policies introduced. Overall, inequalities in early adolescent smoking initiation and escalation have persisted despite the introduction of increasingly restrictive population level controls, suggesting that an effective population level control for reducing these inequalities remains elusive.

With respect to the increasing stigmatisation of smoking, it has been suggested that stigma may be disproportionately felt across social strata, with greater feelings of stigmatisation attached to the behaviour among the more affluent where smoking is least normative (Bell et al., 2010). Perhaps widening inequalities during the 1990s represent differential changes in attitudes towards smoking in different socioeconomic groups, with the narrowing in the 2000s occurring as attitudes towards smoking among disadvantaged groups caught up with those among more affluent groups. However, evidence on whether the stigmatisation of smoking has been stratified has been equivocal (Graham, 2012), and mostly refers to adults rather than young people, who may view the behaviour differently.

It is interesting that there was little evidence of change over time in socioeconomic inequalities for the escalation transition. If culture is the more dominant mechanism in the production of socioeconomic inequalities for initiation as suggested above, whilst inequalities in escalation have more to do with processes of stress and insufficient coping resources then this might explain why inequalities in initiation are more subject to contextual influence than those for escalation which remain relatively constant.

These findings also demonstrate that gender differences in initiation rates changed over time. The pattern of female initiation rates rising more quickly with age than male initiation rates became more pronounced in the 1990s before narrowing again in the 2000s. A previous review concluded that more recent data from western contexts showed either no gender differences or higher rates for females, whereas older data had shown more smoking among males (Tyas and Pederson, 1998). Since that review was published in 1998, the most recent data included would have been from the 1990s and thus their finding is consistent with the results here where higher risks for females were becoming more pronounced through the 1990s. The present study additionally indicates that higher risks for females receded somewhat in the 2000s. Explanations for an increasing likelihood of smoking among females have included targeted advertising, concerns over weight control, or cultural shifts in the gender balance of leisure activities associated with smoking, such as hanging out in the street without adult supervision (Tyas and Pederson, 1998, Sweeting and West, 2003). Assuming these explanations are correct, a receding gender difference might indicate that females were being less specifically targeted by cigarette advertisers, that female concerns over weight control were receding, or, perhaps more plausibly, that another cultural shift in the gender balance of leisure activities has occurred, with females shifting away from those activities most associated with smoking.

8.4.8 Conclusion

Overall, after investigating the development of smoking behaviours in young adolescents in the UK, it appears that rates of transitions into smoking behaviour have slowed over time, but socioeconomic inequalities in uptake remain important. SEP seems most closely associated with initial trying and with escalation from occasional smoking into a daily habit. Inequalities in initiation are strongest at early ages, and initiation at ages 11-13 is a particularly important period for the generation of inequalities in daily smoking by age 15, as is escalation from occasional to daily smoking at ages 14-15.

9 Discussion

Chapter 9 presents a brief summary of the findings from previous chapters, and identifies some of the broader limitations of the research conducted. This is followed by discussion of the theoretical and policy implications of the research, before identifying some possible future research directions.

9.1 Summary of findings

This thesis has described an investigation into socioeconomic inequalities in the development of smoking, drinking and psychiatric distress over the transition from adolescence into early adulthood, using the conceptual framework displayed in Figure 9-1.

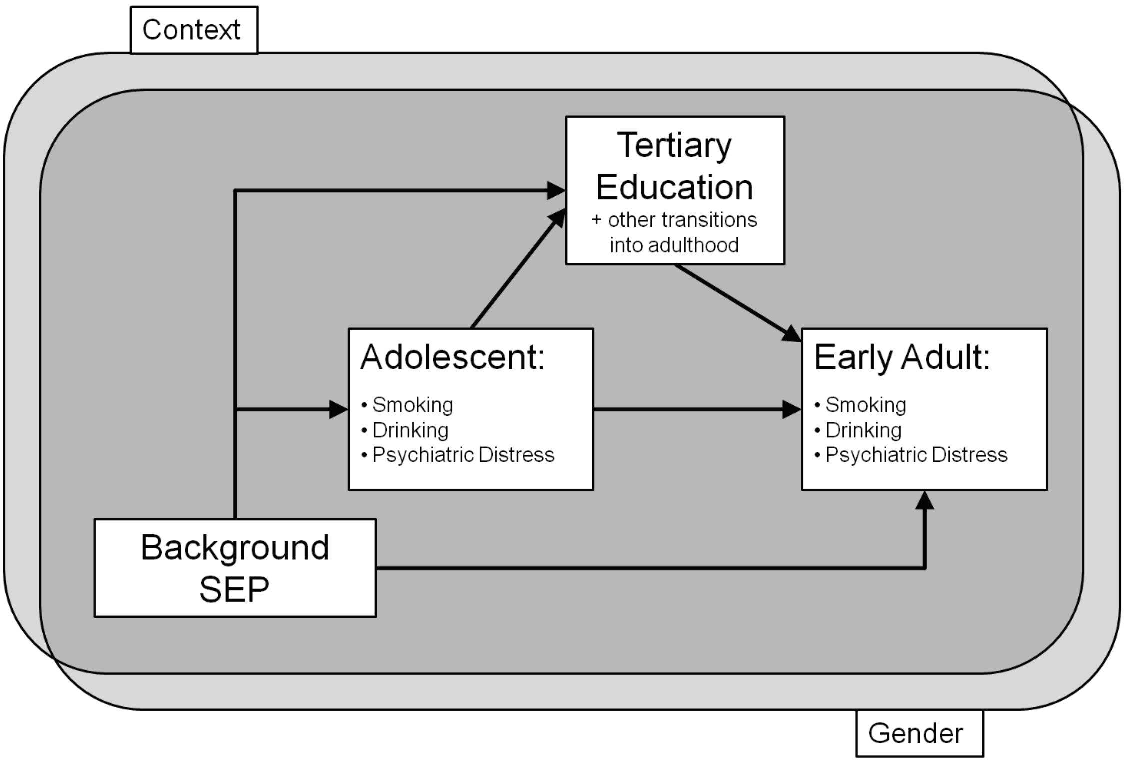


Figure 9-1: Conceptual framework

The aims of the thesis were expressed in the following research questions:

1) What is the role of SEP in adolescent development of smoking, drinking and psychiatric distress?

2) What is the role of SEP in the development of smoking, drinking and psychiatric distress from adolescence to early adulthood?
    i) How is this mediated via adolescent development of smoking, drinking and psychiatric distress?
    ii) How is this mediated via transitions to adulthood?
3) How do these developmental mechanisms vary between different geographic and temporal contexts?

Figure 9-2 summarises the findings of the thesis in relation to these research questions. The thesis examined a range of pathways and mechanisms from background SEP to early adult smoking, drinking and psychiatric distress, via adolescent smoking, drinking and psychiatric distress, and via adulthood transitions, especially participation in tertiary education. The thesis primarily focused on comparisons of three cohorts representing different geographic and temporal contexts. Solid lines show where a particular variable was consistently associated with increased odds of another outcome, and dashed lines show where a variable was consistently associated with reduced odds of an outcome. Dotted-dashed lines show where there was inconsistent evidence of an association across the three cohorts, either in terms of the presence or direction of the association.

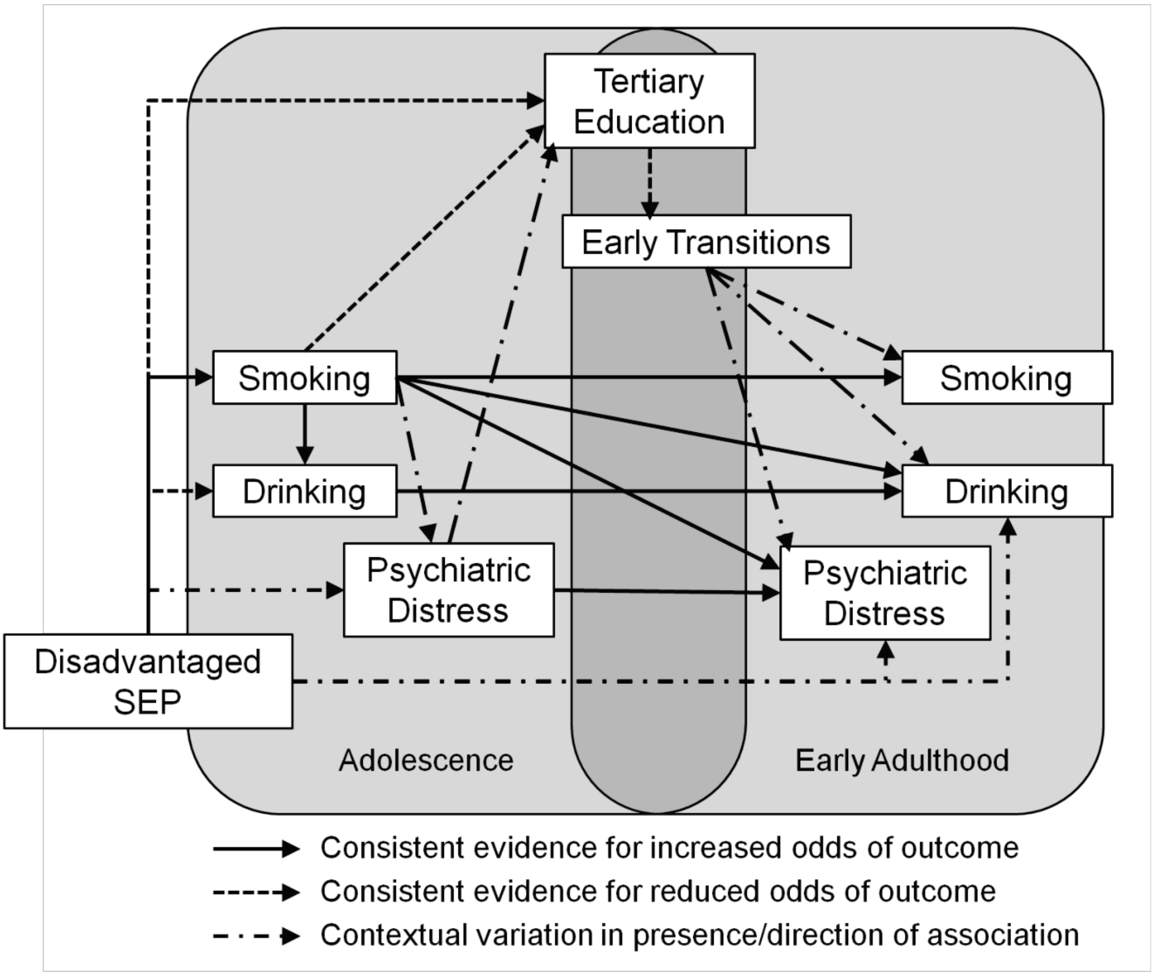


Figure 9-2: Summary of thesis findings

The findings have not described a situation where background SEP is a simple, common cause of smoking, drinking and psychiatric distress, but rather a more complex scenario where SEP stratifies access to mechanisms which sometimes operate in opposing directions, and are often context-dependent.

One of the most important mechanisms appeared to be via adolescent smoking. In Chapters 4 through 7 a disadvantaged socioeconomic background was consistently associated with adolescent smoking in all cohorts, and in Chapter 8 this association was found to persist in the UK despite more recent increases in tobacco control. Chapters 4 through 6 also presented consistent evidence that adolescent smoking was associated with higher chances of adolescent drinking and early adult drinking and psychiatric distress. Associations between adolescent and early adult smoking were not directly examined within this thesis, but prior research would suggest a strong association (Chassin et al., 1996, Patton et al., 1998, Chassin et al., 2000, Gilman et al., 2003). Chapters 5 to 7 also indicated that adolescent smoking was consistently associated with less chance of participation in tertiary education. Thus, there was strong evidence, from multiple cohorts that adolescent smoking represented an associative link between disadvantaged socioeconomic backgrounds and various adverse outcomes.

More complex, context-dependent mechanisms were evident via transitions to adulthood. Socioeconomic disadvantage was consistently associated with lower odds of participation in tertiary education, and remaining in education was associated with lower chances of early transitions such as entry into employment, cohabitation or parenthood. However, causal analysis in Chapter 7, demonstrated that associations between early transitions and early adult smoking, drinking and psychiatric distress were largely explained by background characteristics, with those that were not differing between cohorts and between those with different early transition patterns. Residual associations between socioeconomic disadvantage and psychiatric distress in adolescence or early adulthood, or early adult drinking, also depended on the context, as did the role of adolescent psychiatric distress in terms of selection into tertiary education. In some instances though, primarily for drinking in BCS70, but also for psychiatric distress in T07, there was evidence that remaining in education could have resulted in worse health outcomes in early adulthood.

The role of background SEP in these models tended to be consistent across different measures of SEP, suggesting that the findings have more to do with the overall construct of SEP than with the specific characteristics of particular measures. The sensitivity of the findings to gender was also considered throughout, but the overall pattern was that these mechanisms were similar for both males and females.

9.2 Limitations

9.2.1 Generalisation

Much of this thesis has been based on comparison of three historical cohorts set within the UK. The NCDS58 was used to examine transitions from adolescence to adulthood happening between the mid-1970s and early 1980s. BCS70 and T07 were used to examine similar transitions spanning the late 1980s and early-to-mid 1990s. NCDS58 and BCS70 covered the UK generally, whilst T07 focused on the specific context of the area in and around Glasgow. Considering the emphasis placed here on the importance of context for development, it is not clear whether the findings from these historically and geographically constrained data would be generalisable to current or future contexts, or to other geographical areas. However, they are more likely to be generalisable where contextual features are similar. For example, contexts with high levels of unemployment and poor prospects for school leavers might be expected to show similar patterns to those observed in BCS70 and T07. Additionally, in terms of geography, the discussion sections of previous chapters (e.g. see sections 4.4.2 or 7.4.5) have noted consistencies between the findings of this thesis and findings from other geographical contexts, such as the US. Thus, a fair degree of generalisability, at least to other, similar, western contexts, might be expected.

In respect of historical time, Chapter 8 showed inequalities in adolescent take-up of smoking which persisted into relatively recent settings, up to 2008 (or beyond with imputed data). If the sequelae of adolescent smoking, as identified in the analyses of the three cohort studies, have remained the same, then the findings relating to smoking as a mechanism between socioeconomic disadvantage and adverse outcomes remain very relevant. The sequelae of adolescent smoking may have changed over time, for example, continuing increasing trends in alcohol consumption (Maggs et al., 2008, Roberts, 2011), and participation in tertiary education (Côté and Bynner, 2008) have resulted in both becoming more common, which may have changed the meaning of smoking as a predictor. However, associations between smoking and these outcomes were consistent in NCDS58 and the two later cohorts, despite upward trends in prevalence of drinking and tertiary education.

9.2.2 Comparing secondary datasets

There are some limitations associated with comparison of secondary data-sets. Ideally, measurement would be identical, so differences in findings could be unambiguously attributed to differences in context. However, differences between studies in how particular constructs were measured, when they were measured (in terms of age), and the mode and location of survey administration (i.e. in-person interview, school survey, home survey; see section 3.1.1) might also account for some of the differences. Section 5.4.2, for example, discussed differences in the age at which the early adult measures of drinking were taken (i.e. a few years older in BCS70), and how this might affect interpretation of the apparently stronger effect of participating in tertiary education for BCS70 than in the other cohorts. Section 6.4.2 also discussed how the stronger residual association between socioeconomic disadvantage and adolescent distress in NCDS58 compared to BCS70 and T07, after accounting for the smoking mechanism, may have been attributable to the different measure of distress used in NCDS58, or to the fact that it relied on teacher-ratings rather than self-report of symptoms.

Comparisons with T07 have been perhaps especially problematic, as this study was not designed for comparability with NCDS58 and BCS70. T07 differs particularly from NCDS58 and BCS70 in terms of sample size, and the relatively small sample for T07 has meant that it has been unclear at times whether differences in findings were due to the Glasgow context or to lower statistical power from a smaller sample (e.g. see sections 6.3.2.1 and 7.3.6.3).

The goal of comparability across data-sets sometimes meant not using the best measures available in each dataset. The Registrar General's occupational class measure, for example, is somewhat out-dated and took mortality rates into account in its initial construction (Liberatos and Link, 1988, Galobardes et al., 2006b), so may be somewhat tautologically related to health, but it was the only occupational class measure available within all three datasets at the time the work was conducted.

9.2.3 Pragmatic decisions

Aside from the limitations of the actual data available, pragmatic decisions were made in some instances to code variables more simply than was possible with the available data.

Measures of psychiatric distress, for example, allowed for either continuous or categorical coding. Aetiological studies might generally prefer continuous coding as this includes more variation. However, a problem with continuous coding is that these measures often have distributions which are heavily skewed towards 0, and a scale-point difference at the lower end of the distribution probably means more in terms of distress than a scale-point difference at the higher end of the distribution. This could have been overcome to some degree by transforming the scores (e.g. using log-transformed scores), but expressing results in terms of between-group differences in transformed scores may have impeded interpretability. Categorical coding had the additional advantage of consistency with the smoking and drinking measures, which were also coded categorically.

Another example is in the treatment of SEP. Multiple measures of SEP were examined in separate models to assess whether findings were consistent. As explained in section

3.2.1.6, consistent findings from multiple measures were interpreted as relating to the overall construct of SEP, i.e. representing characteristics which were shared across these measures. It might have been possible to get a better measure of overall SEP by aggregating in some way across multiple indicators, but this would have ignored potential heterogeneity in associations between SEP indicators. Discussing associations with observed characteristics such as a particular level of education, or class of occupation, is also more interpretable than discussing associations with a unit-change in an SEP index or score, where it is hard to determine what exactly the unit-change represents. Nevertheless, actual experiences may not be as clearly delineated as the particular categories used; there will be heterogeneity of experience within categories of any particular measure (Platt, 2011). Considering the aim of assessing whether findings were consistent across SEP measures, some indicators of SEP were coded more simply than was necessary in order to maintain a degree of comparability across indicators, and to avoid problems with model convergence.

In common with many others, interactions between SEP measures were not investigated. Neglecting interaction effects assumes that the effect of any one measure is constant, irrespective of levels on other measures, which may not be true (Bergman and Andersson, 2010, Lanza et al., 2011). However, full statistical exploration of interactions between a range of correlated variables is difficult to interpret (Lanza et al., 2011), and is often numerically unfeasible (Adler et al., 2012). Indeed, it may be that the overall pattern across various measures of SEP is more important than any one individual measure, but investigation of this may have been a layer of complexity too far for the current analyses.

It was also necessary to limit the scope of the investigation, to keep it manageable. This meant that some interesting mechanisms relating to SEP and smoking, drinking and psychiatric distress remain unexplored herein. The role of parental behaviours for example, has only been touched on lightly (mainly in Chapter 7), and the analyses have not addressed ethnicity, which can be difficult to disentangle from SEP (Bartley, 2004). Smoking, drinking and psychiatric distress can also be associated with illicit drug use, or externalising symptoms (Armstrong and Costello, 2002, Mathers et al., 2006, Cerda et al., 2008), and the role of these factors has not been explored here. Additionally, whilst the cohort studies employed herein followed respondents further into adulthood, the thesis did not explore ongoing trajectories of smoking, drinking and psychiatric distress, beyond the cut-offs used (i.e. early adulthood for NCDS58, BCS70 and T07, and age 15 for the BHPS).

9.2.4 Missing data

All of the included studies (NCDS58, BCS70, T07 and BHPS) had some degree of drop-out and non-response, and these issues were particularly problematic for BCS70, where adolescent fieldwork was interrupted by teachers' strikes (Goodman and Butler, 1987). Appropriate modelling techniques such as maximum likelihood estimation, inverse probability weighting, and multiple imputation were used to deal with these, but these techniques rest on a couple of critical assumptions.

The first assumption is that missing data are MAR (missing-at-random; see section 3.3.1.2). Since the data are missing, this assumption cannot be tested and may be incorrect, the data may be MNAR, which would mean that model estimation could be biased (Clarke and Hardy, 2007). If, for example, it was the most disadvantaged young people who were most likely to have dropped out, and these had the worst outcomes in early adulthood (worse than could be predicted based on their observed information), then the models may have under-estimated the degree of the socioeconomic inequalities. However, inclusion of auxiliary variables in the weighting and imputation models does mean the MAR assumption is more plausible. The additional information contained in these auxiliary variables should provide more information about the missing values and mean that they could be predicted with greater accuracy, leaving less room for further non-random variation in these values.

The second assumption is that weighting and imputation models have been correctly specified and are not themselves actually introducing bias. For example, the imputation model used in Chapter 8 for the BHPS youth sample, included few interactions besides those which were central to the research questions within that chapter, and did not allow for non-linear relationships between SEP and other variables. The more distant these simplifying assumptions are from the complex reality of the data, the less accurate the imputed data and model estimates based thereon will be. This issue is particularly important where large portions of the data are being imputed (as for BCS70), as any bias in the imputation model would be amplified.

Chapter 8 included a comparison between an imputed analysis and a complete case analysis. This sensitivity test generally produced similar findings, suggesting they were relatively robust. However, when findings from such sensitivity tests differ, it is difficult to know what is correct: different findings may have been because the complete cases analysis was biased or because the imputation model was biased. Accepting the imputed findings over the complete cases findings relies on the assumption that the imputation model is well-specified.

9.3 Implications for theory

9.3.1 SEP as a common cause

As mentioned above, the simple proposition that smoking, drinking and psychiatric distress cluster because each is independently related to socioeconomic disadvantage does not appear to be supported. Instead the findings support a combination of interdependent mechanisms between smoking, drinking and psychiatric distress, and mechanisms related to SEP. Smoking was unambiguously associated with socioeconomic disadvantage, and smoking was in turn associated with drinking and psychiatric distress. Direct associations, not mediated by smoking, between socioeconomic background and drinking or psychiatric distress were more complex and context-dependent. Particularly for drinking (though there was some evidence of this for distress too), there were mechanisms leading to adverse outcomes, such as via participation in tertiary education, which were more commonly experienced by more advantaged respondents. This demonstrates equifinality (see section 2.1.3.1), in that there appeared to be different routes leading to similar outcomes. However, the findings go beyond this simple idea, showing socioeconomic stratification of different, even opposing, mechanisms leading to the same outcome. Thus, despite inconsistent evidence of associations between SEP and drinking (see section 2.3.3), SEP still appeared important as a fundamental factor stratifying mechanisms leading to that outcome. The consistency of findings in relation to SEP across multiple SEP indicators, each emphasising different characteristics or resources, is also consistent with notions of SEP as a fundamental factor stratifying experience of a multitude of mechanisms.

9.3.2 Smoking as a 'gateway'

Tobacco has previously been described as a 'gateway drug' that provides an introduction to the culture of substance use, and also tends to lead on to mental health problems (Bachman et al., 1997, Mathers et al., 2006). Taking this analogy, it is worth considering that a gateway usually operates as means of entry from one place to another; it is a portal between a point of departure and a destination. Whilst the destinations that smoking can act as a gateway *to* have been emphasised previously (e.g. drinking or psychiatric distress), Chapters 4 through 6 emphasised that smoking acts as a gateway *from* socioeconomic disadvantage, as a point of departure, to these destinations. Chapter 7 also demonstrated that smokers were more likely to leave education early, placing themselves on less favourable trajectories for their own adult SEP. Thus, aside from the risks for chronic disease and mortality in later life, smoking can represent a gateway mechanism between a disadvantaged socioeconomic background and a number of more immediate adverse consequences, including drinking problems, psychiatric distress and a less favourable socioeconomic trajectory into adulthood. Chapter 8 demonstrated that inequalities in adolescent smoking take-up were still present in recent history, so the issue of smoking as a gateway between socioeconomic disadvantage and adverse outcomes is still very relevant.

It remains unclear however, whether the role of smoking as a gateway is causal or associative, whether it is an active process leading to the adverse destinations set forth above, or simply a passive milestone on a path already determined by one's socioeconomic background, or other mechanisms associated therewith. Causal explanations posit that smoking has either physiological or social effects which make drinking, distress or leaving education more likely. Nicotine exposure can damage neurochemical pathways such as monoamine transmission, which may increase risk for depression (Chaiton et al., 2009), and can increase self-administration of alcohol (Barrett et al., 2006). Physiological mechanisms leading to early educational exit are unlikely however, especially since nicotine can have acute effects enhancing performance and attention (Kassel et al., 2003). An alternative mechanism relates to the fact that smoking behaviour may be viewed as deviant or otherwise stigmatised (Bell et al., 2010, Graham, 2012), causing smokers to be perceived negatively. This could lead to social isolation and depression and could result in less favourable treatment by teachers or other educational gate-keepers. It could also simultaneously reinforce social connections with other, perhaps more mature, substance users who may provide introduction to use of other substances such as alcohol (Bachman et al., 1997).

The alternative, associative explanation is that socioeconomic disadvantage is associated with mechanisms that make multiple outcomes more likely, including smoking. Mechanisms associated with socioeconomic disadvantage which may lead to greater chances of developing smoking and heavy drinking behaviours, might include increased exposure via parents and peers who smoke and drink heavily (Green, G et al., 1991, West et al., 1999), lack of alternative activities (Stock et al., 2011), or lower quality parental monitoring (Hayes et al., 2004). Further, socioeconomic disadvantage may set individuals on an adverse life-trajectory with consequences including heavier drinking, psychiatric distress and early school-leaving; smoking simply being the first of these adverse consequences to emerge. Social stigmatisation of smoking for example, may be tied into wider social stigmatisation of socioeconomic disadvantage (Graham, 2012), and it may be the stigma of socioeconomic disadvantage, rather than of smoking *per se*, which leads to other adverse consequences. Socioeconomic disadvantage may represent a mix of negative experiences such as family disruptions (Amato, 1996), material deprivation (Townsend, 1987), or social prejudice and discrimination. Such a toxic mix of experiences could surely be stressful and potentially lead to psychiatric distress, to coping-motivated use of substances such as tobacco or alcohol, as well as to low educational motivation and poor educational performance. Indeed, smokers identify alleviation of stress as one of their main reasons for smoking (Jarvis and Wardle, 2006), suggesting that stress prompts smoking at least. If it is ineffective in dealing with those stresses or difficulties, distress could also follow. Associative explanations do not exclude the potential causal mechanisms described above; all could be contributing to the observed associations. To the extent that there are mechanisms common to both smoking and drinking, it is important to understand what these are and which are most important. Interventions which address common mechanisms (e.g. by negating the adverse effects of stressors, providing alternative coping resources or leisure activities, or altering perceived behavioural norms) may be effective in tackling multiple adverse outcomes among young people from a disadvantaged SEP.

From an epidemiological perspective (see section 2.1.1), many of the above explanations could be thought of as pathway models, whereby a young person's early socioeconomic background increases their risk of experiencing particular exposures (such as smoking), which then increase their risk of experiencing other adverse outcomes. Chapter 8 gave some indication of a sensitive period for associations between SEP and smoking, with inequalities in initiation concentrated at the earliest ages. Chapter 4 also showed that where smoking developed in late adolescence it was not strongly associated with SEP. This is important to recognise since smoking habits are more persistent when they start at earlier ages (Fisher et al., 1993, Tyas and Pederson, 1998, Chassin et al., 2000, Gilman et al., 2003), so these inequalities in take-up could also lead to inequalities in maintenance of the behaviour (Due et al., 2011).

9.3.3 Tertiary education and drinking

Chapter 5 demonstrated a consistent association between participation in tertiary education and heavier drinking in early adulthood. The findings from BCS70 in Chapter 7 suggest that this association may be at least partly causal: young people from that cohort who did not remain in education tended to drink less heavily than their similar counter-parts in tertiary education. Education is generally positive for health (Mirowsky and Ross, 1998), but these findings suggest some potential for harm. It is probably not the actual education, but experiences associated with it that account for this. Theoretical ideas as to why tertiary education would be associated with drinking might be broadly split into ideas about social norms, and ideas about the nature and structure of the tertiary education experience.

With regards to social norms, drinking is a collective, social experience, and it has been suggested that populations change their drinking habits collectively (Skog, 1985). That is, increases or decreases in the drinking habits of light drinkers are mirrored to some degree by changes in the habits of heavy drinkers (and vice versa). Some data show such patterns to be especially strong among young people (Norström and Svensson, 2014). Importantly, this theory acknowledges that individual drinking behaviour is affected by the drinking behaviour of others not just when they are physically present, but by individual, internal perceptions of how others behave (Skog, 1985). Thus, if these perceptions of normal drinking behaviour among one's peers are falsely inflated, as they appear to be in tertiary education (Schulenberg and Maggs, 2002, Helmer et al., 2013), then the distribution of consumption within that population is likely to shift upwards, resulting in heavier drinking.

Regarding the nature and structure of the tertiary education experience, section 2.2.3 explained that transitions into tertiary education can be challenging, involving transitions into new social networks, often away from the more comfortable and familiar networks of home and school, during a period of life when young people are striving to develop both their self-identity and relationships with others. Drinking may be a response to these challenges, either as a coping mechanism when transitional challenges overload individual capacities, or functionally in terms of achieving valued social goals (Schulenberg and Maggs, 2002), e.g. alcohol may be especially valued as a social lubricant for cementing new relationships, or as a marker of identity as an independent adult.

Section 2.1.2 explained the importance of contextualising lifecourse processes, and Chapters 5 and 7 both indicated stronger associations between tertiary education and drinking in BCS70 than in NCDS58, with associations for T07 positioned between the other studies. This contextual variation is probably more consistent with social norm explanations, as the structure of tertiary education as a transition into a new environment and new social networks did not change dramatically between the 1980s and 1990s when these cohorts would have been making this transition, but social norms around drinking practices in tertiary education may well have. On the other hand, Chapter 7 indicated that T07 respondents who remained in education were much more likely to have remained at home whilst doing so than in the two UK-wide cohorts. This may represent a significant difference in the nature and structure of the experience: it being characterised by higher levels of parental monitoring, and easier maintenance of social networks and home responsibilities than in NCDS58 and BCS70 where the trend was towards leaving home, perhaps resulting in less of a transition. This may explain why associations between drinking and tertiary education were weaker in this cohort. Ultimately, social norm and structural explanations of this association are not mutually exclusive, and both may contribute.

9.4 Implications for policy and practice

This section reviews possible implications of the research findings for policy and practice. It begins with more ‘upstream’ policies, as these are deemed most likely to be effective, before considering more ‘downstream’ applications.

9.4.1 SEP as a common cause

This thesis has emphasised the importance of socioeconomic inequalities in the development of smoking, drinking and psychiatric distress. Even where drinking outcomes were not clearly patterned by SEP, the mechanisms leading to those outcomes were associated with SEP. Section 1.1.1 noted that inequalities in smoking, drinking and psychiatric distress could make strong contributions to adult health inequalities. Attempts at reducing health inequalities have seen little success however, tending to focus on individual behaviour, with little sensitivity to the long-term influence of the social and economic environments that cause poor health behaviours to persist in certain groups (Katikireddi et al., 2013b). For example, Chapter 8 showed that during a period of increasing tobacco control, there had been little change in socioeconomic inequalities for adolescents escalating from occasional to daily smoking. This may be because smoking is utilised by disadvantaged adolescents as a coping behaviour for dealing with lives characterised by many stressors and few resources. If so, then there may not be any one specific mechanism whereby an intervention would have an effective impact on these inequalities. Greater benefit might be found in more ‘upstream’, redistributive policies that weaken links between SEP and social and economic resources rather than intervening on specific ‘downstream’ resources or mechanisms. That is, policies might aim for more equal socioeconomic distributions first, before trying to address inequalities in health or health behaviours between socioeconomic groups.

A common approach in this vein is to focus on education (Katikireddi et al., 2013b), reasoning that expanding access to education for disadvantaged young people may present them with greater equality of opportunity. However, trends of increasing access to tertiary education have been more concentrated among those who started off more advantaged (Machin and Vignoles, 2004), and educational expansion can result in ‘education inflation’, where the level of qualifications required for particular occupations rises over time (Côté and Bynner, 2008, Furlong, 2013), potentially leaving young people frustrated by the lack of pay-off from the additional investment of effort and resources required to stay longer in education. This thesis has particularly noted a potential harm of expanding access to tertiary education: when those who were unlikely to participate in tertiary education did so, there was evidence that this could increase their likelihood of drinking heavily. Thus, while it may be worthwhile pursuing a more progressive expansion of access (i.e. concentrated among those from disadvantaged backgrounds), this might need to be coupled with efforts to mitigate influences on drinking behaviour.

A focus on education also prioritises equality of opportunity over equality in the socioeconomic distribution that derives from those opportunities. Weakening the link between socioeconomic background and educational success does not necessarily weaken the link between educational success and health outcomes. Policies aiming for a more equitable distribution of social and economic resources might be better suited to this goal.

9.4.2 Tobacco and alcohol policies

It has been suggested that policies affecting populations are likely to be more effective at reducing inequalities than interventions targeted at individual behaviours, but that research is still needed to identify the most effective policies (Katikireddi et al., 2013b). The findings of this thesis have some implications for such questions.

Findings from Chapters 5 to 7 emphasised adverse outcomes associated with smoking in terms of drinking, psychiatric distress and educational careers. This indicates that tobacco control policies could have additional benefits, beyond the more obvious goal of reducing smoking prevalence. For example, a recent US study showed that stronger state-level cigarette taxes and smoke-free air policies were associated with lower per capita alcohol consumption (Krauss et al., 2014). This effect was concentrated in consumption of beer and spirits rather than wine, implying stronger benefits for those who are more disadvantaged (if stereotypes about more advantaged people preferring wine still hold true; Rimm et al., 1996).

Knowledge of socioeconomic patterning in tobacco or alcohol consumption can be used for commercial gain by the relevant industries. Tobacco industry documents, for example, reveal conscious targeted marketing aimed at those who were disadvantaged or mentally ill (Barbeau et al., 2004, Apollonio and Malone, 2005), potentially exacerbating existing inequalities. Policies and regulations might be used to protect those most vulnerable. For example, Chapter 8 noted that smoking initiation rates for the youngest adolescents had changed relatively little between 1994 and 2008, and inequalities in initiation were strongest at these young ages. Tobacco industries deliberately target young adolescents as consumers in order to refresh their market (Moodie et al., 2012). Policies that restrict such targeting could therefore have value in reducing uptake and inequalities. There is evidence, for example, that policies requiring plain, standardized packaging could reduce appeal to this age group (Hammond et al., 2009, Germain et al., 2010, Moodie et al., 2012).

Another population level policy currently under debate in the UK is minimum unit pricing of alcohol, which has been accepted in Scotland, but delayed by legal challenges (Katikireddi et al., 2013a). Econometric modeling of the likely impacts of various potential alcohol policies was very influential in debates over this policy, indicating reductions in harm and consumption, particularly among heavier drinkers, but was to some extent undermined by concerns over how well the modeling captured ‘real life’ alcohol markets (Katikireddi et al., 2013a). Improved understanding of the mechanisms leading to heavy drinking could help refine such models. For example, a disadvantaged young person who has taken to drinking heavily as a coping mechanism for dealing with a very difficult life, having first established a pattern of coping through substance use as an adolescent smoker, might value the behaviour very differently than a young person in tertiary education who has begun drinking heavily to make friends and conform to what they perceive as normal behaviour within a new social network. Different values attached to drinking behaviour could mean differences in price elasticity (i.e. the degree to which consumption changes when price changes) between socioeconomic strata, even when accounting for drinking level. More refined models of these different mechanisms might help reduce concerns over validity.

9.4.3 Health education

Although it has tended to be of limited effectiveness, health education, or the promotion of health messages, often forms a central component of public health strategies against health-harming behaviours such as smoking and drinking. Such health messages have the broad goal of changing behaviour (or at least causing people to maintain healthy behaviour when they might not otherwise have done so). Social marketing approaches emphasise consideration of how the behaviour is valued by the intended consumer of the health message, the barriers that must be overcome for behaviour change to occur, the settings in which the target behaviour is enacted, and the methods used to communicate the health message (Neiger et al., 2003). Indeed, lack of success from individual level interventions, may be partly due to inadequate consideration of the long-term influence of social and economic environments (Katikireddi et al., 2013b). The findings of this thesis have potential implications in this regard, as well as at the broader policy level.

With respect to heavy drinking in early adulthood for example, whilst the desired outcome of not drinking heavily would be the same irrespective of SEP, the stratified mechanisms leading to heavy drinking may mean that values and enactments of the behaviour differ by SEP. Health messages may be more effective if they can be sensitive to the different values placed upon the behaviour, and the different ‘costs’ that giving up the behaviour may represent to those individuals. The health message might need to include ways to allay these costs (e.g. by pointing to alternative coping strategies or by striving to change social norms). If smoking is used as a coping mechanism, then messages which focus only on smoking cessation could result in substitution of drinking as coping mechanism. There may be value in messages tackling both problems in combination rather than independently.

Additionally, heavy drinkers in tertiary education are likely to perform this behaviour in different settings to those who drink heavily outside of tertiary education (e.g. they might attend different types of bars or clubs; Hollands, 2002, Holt and Griffin, 2005), which might mean different methods would be more appropriate for conveying messages to these groups. Heavy drinking in early adulthood also followed on in some degree from heavier drinking practices in adolescence, and the results in Chapter 5 indicated that mechanisms in adolescence were stratified by SEP too. Disadvantaged youths may tend to learn drinking practices with peers away from home and their parents, whilst more advantaged youths tend more towards learning at home with their parents (Green, G et al., 1991, Forsyth and Barnard, 2000). These home-based opportunities may explain the more frequent drinking observed among the more advantaged adolescents in Chapter 5. This too could have implications for promotion methods where the goal is to reduce adolescent drinking: methods relying on parents to transmit a message may be more effective for more advantaged youths, whilst peer support interventions might have more potential for tackling drinking among disadvantaged youths.

Chapter 8 has some clear implications for audience segmentation in relation to early adolescent smoking. Predictions from statistical models suggested that inequalities in initiation contributed most to inequalities in mid-adolescent daily smoking, especially at ages 11-13. Inequalities in escalation from occasional to daily smoking were powerful contributors too, especially at later ages (e.g. 14-15). Health messages focusing on preventing initiation therefore might be most effective at tackling inequalities in smoking if they were targeted at very young adolescents, aged 11-13. This could mean starting in primary school. Messages focusing on cessation after some experimental or occasional smoking, or on prevention of daily smoking, might be most effective at tackling inequalities in smoking if targeted slightly later, at ages 14-15. However, tackling inequalities in initiation at early ages should be the highest priority for resources.

With respect to health education, it is also interesting to note the contrast between the socioeconomic patterning of smoking and drinking. Heavy drinking was much less clearly associated with socioeconomic disadvantage than smoking, as there were opposing mechanisms in operation for drinking. With smoking there is a good public understanding of the health risk, indeed, most smokers understand that the habit is bad for them and have a desire to quit, irrespective of SEP (Jarvis and Wardle, 2006). This has not always been the case. Inequalities in smoking have risen sharply since the 1960s as public understanding of the health risks has increased (Link and Phelan, 1995). This may be because, once smoking was widely understood to be unhealthy, those who were more advantaged had more resources to either avoid or cease the behaviour. The lack of clear inequalities favouring the more advantaged in terms of drinking may indicate that health messages around drinking have been less effective. Reports of health benefits for moderate alcohol use compared to abstention may have clouded health risk messages, despite controversy over health benefits which may not be real, but actually due to selection effects (Fekjær, 2013, Ng Fat et al., 2013). Even if moderate consumption is healthier than abstention, poor understanding of the alcohol units in which recommendations for moderate consumption are made (Royal College of Physicians et al., 1995, Dawson and Room, 2000), may mean that many consume alcohol in excess of guidelines whilst aiming for moderate consumption. Confusion over the point at which alcohol consumption becomes unhealthy contrasts with smoking, where any smoking is recognised as unhealthy. It may be that more advantaged individuals would be more successful in avoiding or ceasing heavy drinking behaviours if the health risks and thresholds were more clearly understood, as they are for smoking.

9.4.4 Health resources and services

Since smoking is linked to later problems with psychiatric distress and heavy drinking, there may be an argument for combining certain health resources and services. If there is a causal link between smoking and later psychiatric distress, for example, it may be desirable to pool budgets, in some degree, for smoking cessation and for prevention and treatment of psychiatric distress. Resources might thereby be focused more effectively towards interventions that benefit both outcomes. On the other hand, if links between smoking and later psychiatric distress are predominantly associative rather than causal, due to common mechanisms of socioeconomic disadvantage, then intervening to reduce smoking may not have any impact on psychiatric distress, and it may be more appropriate to focus resources on tackling the wider, structural disadvantages that lead to both adverse outcomes, as noted earlier. Either way, when young people seek help from smoking cessation services, there may be an opportunity to intervene with prevention materials for heavy drinking or psychiatric distress, or to screen patients for these issues, potentially hastening identification and treatment.

Given the findings on drinking in tertiary education, institutions of tertiary education may want to consider how they might ameliorate norms of heavy drinking among students, help students manage transitions, and offer support for those who develop heavy drinking habits. For decision-makers outside of tertiary education however, it may be sensible to prioritise resources on the smoking mechanism, which will tend to benefit those who are disadvantaged, rather than on the tertiary education mechanism where benefits will tend to accrue to those who are already advantaged. Though the education mechanism may become more of a priority, if other policies successfully widen access to tertiary education among disadvantaged young people.

9.5 Future research directions

9.5.1 Causal influence of smoking

One issue arising from this thesis is that adolescent smoking is linked to later psychiatric distress, heavier drinking, and earlier exit from education. As noted in section 9.3.2 though, it is remains unclear whether these links are associative or causal. One extension of this research could be to use the propensity weighting techniques from Chapter 7 but with adolescent smoking as the exposure, rather than early transitions to adulthood. Drinking, psychiatric distress and participation in tertiary education might all be valid outcomes for consideration in such an analysis. This could help determine whether smoking is likely to have a causal effect on these outcomes, or whether associations can be explained by the background characteristics of those adolescents who smoke. However, it would be desirable to include a broader range of background factors in such an analysis, particularly if variables were available indicating some of the mechanisms which may be associated with socioeconomic disadvantage and these other outcomes, such as adverse life-events or stressors.

9.5.2 Measuring SEP

Section 9.2.3 mentioned that a more complete investigation of SEP measurement would have been too complex for the current investigation. This nevertheless represents a potentially valuable field of inquiry, particularly with a view towards capturing both socioeconomic homogeneity and heterogeneity between measures. For example, one could explore whether latent SEP is best represented as a continuous dimension (or dimensions) or as a categorical latent class variable representing particular clusters of disadvantaged (or advantaged) characteristics. Ideally, it would be desirable to test whether different dimensions of SEP had different associations with outcomes, or whether individual SEP measures had any association with outcomes over and above associations with a general, aggregated measure of SEP, as such findings could inform about mechanisms. In order to keep the rest of the analysis simple, such an investigation might start by examining associations between SEP and adolescent smoking, one of the key associations identified in this thesis, and exploring whether particular aspects of SEP are more or less important for this association.

9.5.3 Multinomial propensity weighting and latent class analysis

Previous applications of propensity weighting have tended to consider exposures as binary, and weight on the probability of being exposed versus not-exposed (Oakes and Johnson, 2006, Austin, 2011). Chapter 7 considered a situation where an exposure variable was multinomial. This means that the probability of being in a particular exposure group and of being in a chosen control group were not entirely co-dependent (i.e. an individual with a particular set of background characteristics might have had a low probability for being in either group). A novel modification of the normal propensity weighting procedure was applied here, allowing for multinomial exposure conditions, and seemed to be successful in achieving a balance of background characteristics across exposure and control groups. Further research might test this procedure out with simulated data in order to see how reliably it performs.

Additionally, the propensity weighting analysis in Chapter 7 employed modal assignment of latent class membership for the exposure variable. Despite high entropy values for the latent class variable (in the region of 0.8-0.9), this procedure did not account for uncertainty in latent class membership. Chapter 4 included a comparison of a modal assignment method (which does not account for uncertainty) and a newer 3-step method (which does account for uncertainty), in terms of assessing associations with covariates. The newer 3-step method showed larger effect sizes but wider confidence intervals than the modal assignment method. Another avenue for methodological research would be to explore whether or how this uncertainty can be taken account of in a propensity analysis of latent classes.

9.5.4 Opposing mechanisms leading to drinking

Chapters 4 and 5 demonstrated equifinality in relation to drinking, i.e. that there were different mechanisms leading to the same outcome, and additionally that mechanisms were stratified in opposing directions by SEP. The smoking mechanism was stratified, with smokers more likely to come from more disadvantaged backgrounds, and the tertiary education mechanism was stratified, with tertiary education participants more likely to come from more advantaged backgrounds. The residual associations between SEP and drinking, especially in adolescence, indicated that there may be other mechanisms which promote heavier drinking and which are associated with a more advantaged socioeconomic position. Further research might more fully explore the stratification of mechanisms relating to drinking, and as the particular mechanisms become clearer, this might inform better interventions.

A relevant concept is an oft-made distinction between drinking that is motivated by enhancement of pleasure, i.e. as a social, celebratory activity, and drinking that is motivated by coping, where alcohol is sought out for the alleviation of stress or negative feelings (Pavis et al., 1998, Colder et al., 2002, Kuntsche et al., 2006, Zucker, 2008). A plausible hypothesis is that more advantaged young people would be better resourced to pursue drinking motivated by pleasure-enhancement, whereas disadvantaged youths would tend towards coping-motivated drinking by dint of their more difficult, stressful lives. Data on adolescent SEP and drinking motivations might be used to explicitly test this hypothesis.

9.5.5 E-cigarettes

The increasing popularity of electronic cigarettes (e-cigarettes) represents an important new area for research, though the emergent nature of the phenomenon means that things can change very rapidly in this field. E-cigarettes are battery-powered devices, with early models looking much like cigarettes (ASH Scotland, 2014). They produce a vapour which can be inhaled, directly delivering nicotine to the body without combustion of tobacco. Many view them as a good thing, with potential to vastly reduce the health burden of smoking, whilst others are worried that they represent an opportunity for the tobacco industry to re-normalise smoking and that young people who might not otherwise have tried cigarettes will use them and develop a nicotine addiction, but then revert to regular cigarettes (ASH Scotland, 2014, Chapman, 2014, Dutra and Glantz, 2014, Fairchild et al., 2014). Those who had tried e-cigarettes, tended to be among the heaviest smokers in a US cross-sectional study (Dutra and Glantz, 2014), but this may be because heavy smokers have most to gain from any health benefit of replacement, rather than because e-cigarettes lead to increased tobacco use. Longitudinal data from population studies which would allow development to be studied in detail are not available yet.

Important questions that will need answering if these devices continue to become popular among young people, and as longitudinal data on their use becomes available, might include: whether the socioeconomic patterning of e-cigarette use and initiation is similar to that for regular cigarettes; whether e-cigarette use does tend to develop into tobacco use; and whether the current decreasing trends in tobacco use and take-up (as demonstrated in Chapter 8) will slow or reverse as e-cigarettes potentially re-normalise smoking behaviour.

E-cigarettes also represent an opportunity to examine causal mechanisms connecting smoking to alcohol use and psychiatric distress. E-cigarettes deliver a dose of nicotine (mainly, some models are nicotine-free), much as regular cigarettes do, but as mentioned above, the socioeconomic patterning of e-cigarette use may differ from that for regular cigarettes. Additionally, if e-cigarettes continue to be hailed as a healthy alternative, then e-cigarette users may be far less stigmatised than users of regular cigarettes. Thus, whilst the physiological agent of nicotine is constant, the socioeconomic patterning of e-cigarette use and the social effects of e-cigarette use may be very different from those for regular cigarettes. If the findings of this thesis regarding associations between smoking and heavier drinking (Chapter 5) and smoking and psychiatric distress (Chapter 6) are due to a causal effect of nicotine, one would expect to see similar associations for e-cigarette use. Whereas if these links are merely associative and due to the background characteristics of smokers or the social effects of smoking then similar associations might not be observed for e-cigarettes.

9.6 Conclusion

In summary then, this thesis has identified strong associations between socioeconomic disadvantage and adolescent smoking, and this is still true despite recent increases in tobacco control in the UK. Smoking appears to be an important mechanism, or marker for other mechanisms, linking socioeconomic disadvantage to further adverse consequences including heavier drinking, psychiatric distress, and early school-leaving. Aside from smoking mechanisms, there are also other routes into heavy drinking and psychiatric distress. For psychiatric distress, these still seem to be mainly associated with socioeconomic disadvantage, especially in early adulthood, whereas for drinking there are mechanisms associated with socioeconomic advantage. Participation in tertiary education appears to be an important example of such a mechanism, linking socioeconomic advantage to heavier drinking. Early transitions to adulthood on the other hand, did not appear to represent a key causal mechanism between socioeconomic disadvantage and adverse outcomes in early adulthood, as most differences were accounted for by background characteristics.

10 Appendices

Appendix to Chapter 7

Table A-1 shows associations among parental health behaviours and background SEP and family structure. Table A-2 shows associations between adolescent smoking, drinking and psychiatric ditress and more distal factors (background SEP, family structure and parental health behaviours)

Table A-1: Associations between parental factors

	NCDS58			BCS70			T07		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Parental Smoking									
Manual Class	1.09	1.07-1.11	<0.001	1.06	1.02-1.09	0.001	1.11	1.05-1.16	<0.001
Left School by 16	1.13	1.10-1.16	<0.001	1.09	1.05-1.13	<0.001	1.14	1.08-1.20	<0.001
Lowest income tertile	1.00	0.97-1.02	0.847	1.08	1.04-1.11	<0.001	1.07	1.02-1.12	0.007
Single Parent	0.86	0.82-0.90	<0.001	1.07	0.99-1.14	0.083	1.30	1.26-1.34	<0.001
Parental Drinking									
Manual Class	1.01	1.00-1.01	0.012	0.92	0.88-0.96	<0.001	1.04	0.99-1.09	0.088
Left School by 16	1.00	1.00-1.01	0.449	0.90	0.87-0.93	<0.001	1.04	1.00-1.09	0.062
Lowest income tertile	1.01	1.00-1.01	0.003	0.92	0.90-0.95	<0.001	1.00	0.95-1.04	0.835
Single Parent	1.03	1.01-1.04	0.001	1.02	0.98-1.05	0.296	0.88	0.84-0.93	<0.001

Table A-2: Associations between adolescent and other background factors

	NCDS58			BCS70			T07		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Adolescent Smoking									
Female	0.98	0.94-1.02	0.242	1.01	0.98-1.03	0.550	1.00	0.96-1.03	0.799
Manual Class	1.05	1.03-1.07	<0.001	1.01	0.98-1.05	0.466	1.09	1.04-1.14	<0.001
Left School by 16	1.06	1.01-1.10	0.011	1.02	0.99-1.05	0.294	1.02	0.97-1.06	0.471
Female*Left School by 16	0.96	0.92-1.01	0.094						
Lowest income tertile	1.03	0.99-1.08	0.153	1.04	0.99-1.08	0.099	1.03	0.98-1.08	0.303
Single Parent	1.10	1.05-1.15	<0.001	1.02	0.97-1.07	0.536	1.07	1.00-1.15	0.055
Female*Single Parent				1.06	0.99-1.13	0.085			
Parental Smoking	1.11	1.09-1.13	<0.001	1.07	1.04-1.11	<0.001	1.06	1.01-1.10	0.006
Parental Drinking	1.13	1.02-1.26	0.017	1.03	1.01-1.06	0.003	1.03	0.97-1.09	0.311
Adolescent Drinking									
Female	0.95	0.90-0.99	0.021	0.96	0.93-1.00	0.043	0.96	0.93-0.98	<0.001
Manual Class	0.90	0.88-0.92	<0.001	0.94	0.88-0.99	0.036	0.99	0.96-1.01	0.309
Left School by 16	1.02	0.98-1.06	0.342	1.00	0.96-1.04	0.985	0.99	0.96-1.02	0.471
Female*Left School by 16	0.93	0.89-0.98	0.010						
Lowest income tertile	0.92	0.90-0.94	<0.001	0.90	0.85-0.95	<0.001	0.97	0.95-0.99	0.016
Single Parent	1.05	1.01-1.10	0.014	1.07	1.03-1.11	0.001	1.02	0.99-1.06	0.217
Parental Smoking	1.00	0.98-1.03	0.885	1.00	0.97-1.02	0.779	1.00	0.97-1.03	0.881
Parental Drinking	0.88	0.80-0.97	0.008	1.10	1.07-1.13	<0.001	1.06	1.01-1.11	0.026
Adolescent Distress									
Female	1.04	1.03-1.06	<0.001	1.15	1.08-1.23	<0.001	1.07	1.03-1.11	0.001
Manual Class	1.01	0.99-1.04	0.298	0.99	0.94-1.04	0.647	1.03	0.99-1.07	0.189
Female*Manual Class				0.95	0.89-1.00	0.068			
Left School by 16	1.03	1.01-1.05	0.013	0.99	0.96-1.02	0.527	0.95	0.91-0.99	0.021
Female*Left School by 16				0.91	0.86-0.97	0.003			
Lowest income tertile	0.99	0.97-1.01	0.186	1.01	0.95-1.07	0.851	1.00	0.95-1.04	0.874
Female*Lowest income tertile				1.13	1.04-1.23	0.004			
Single Parent	1.07	1.04-1.10	<0.001	1.02	0.96-1.07	0.574	1.02	0.95-1.10	0.541
Female*Single Parent				1.08	0.99-1.18	0.069	1.12	1.00-1.26	0.062
Parental Smoking	1.02	0.99-1.04	0.146	0.99	0.96-1.02	0.456	0.99	0.94-1.03	0.530
Parental Drinking	1.01	0.91-1.13	0.801	1.02	0.99-1.05	0.152	1.03	0.97-1.08	0.332

Figures A-1 to A-9 show how differences in background factors (parental occupational class, parental education, household income, family structure, parental smoking, parental drinking, adolescent smoking, adolescent drinking and adolescent distress) between transitional classes were balanced out after propensity weighting.

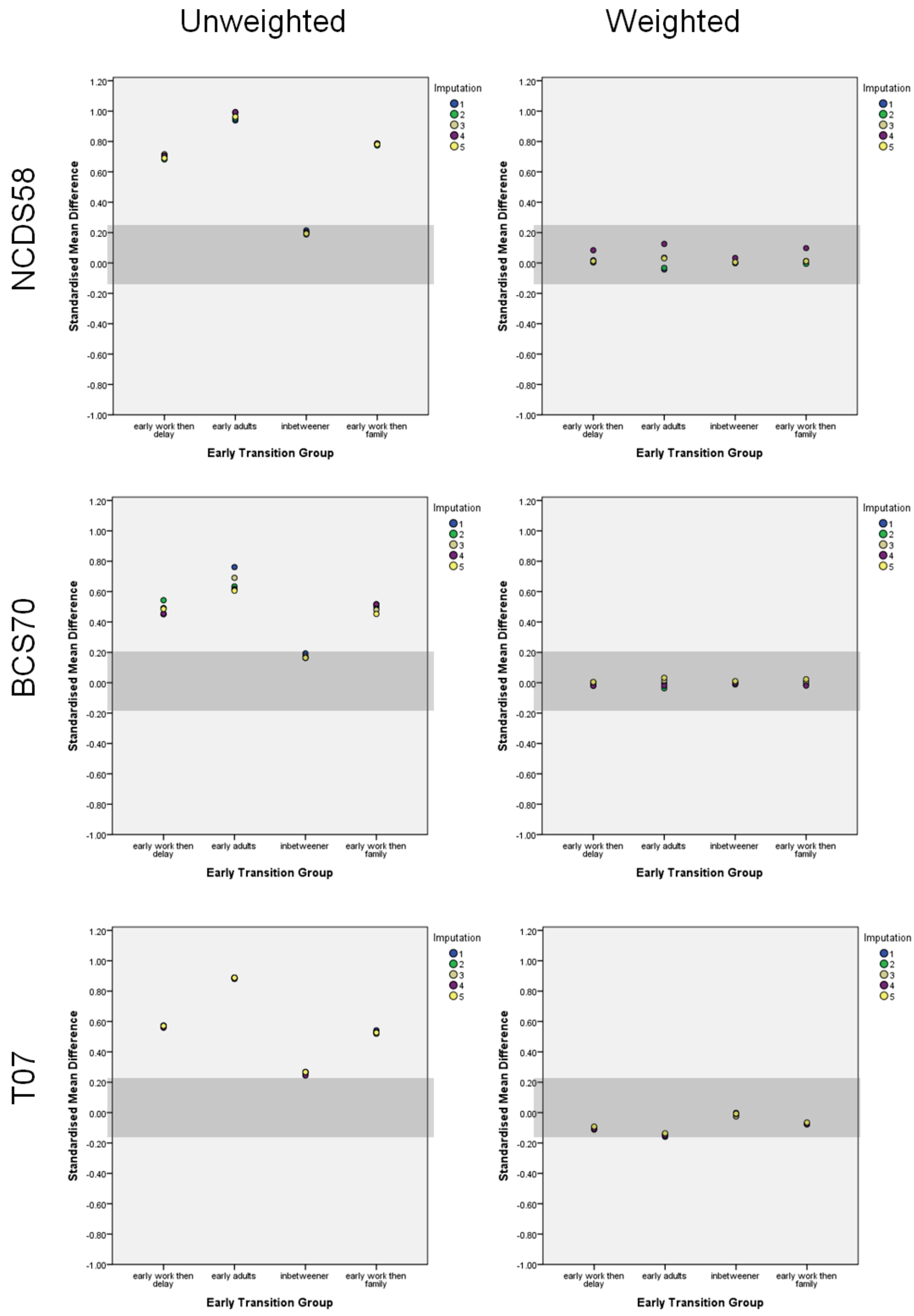


Figure A-1: Standardised mean differences in parental occupational class

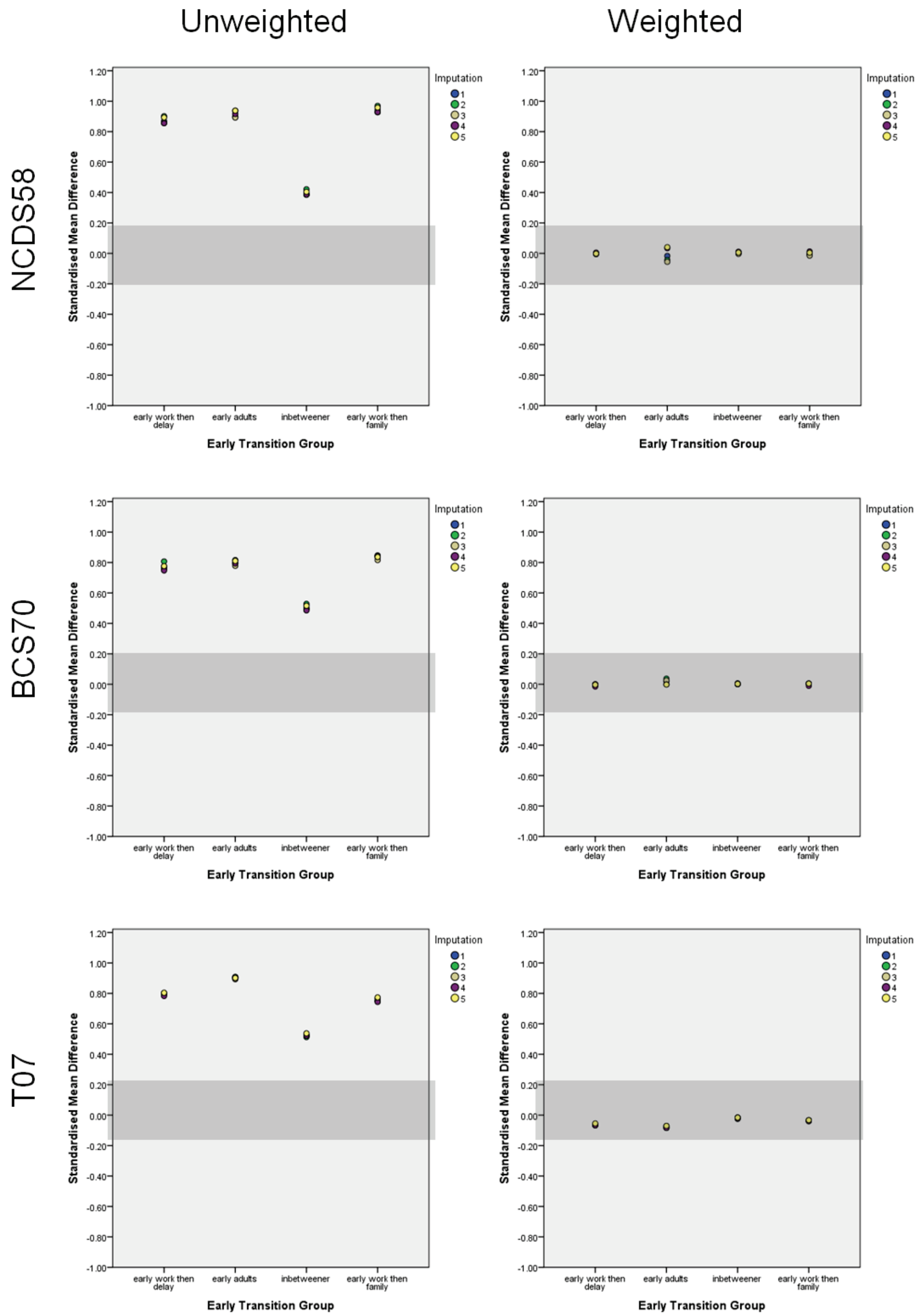


Figure A-2: Standardised mean differences in parental education

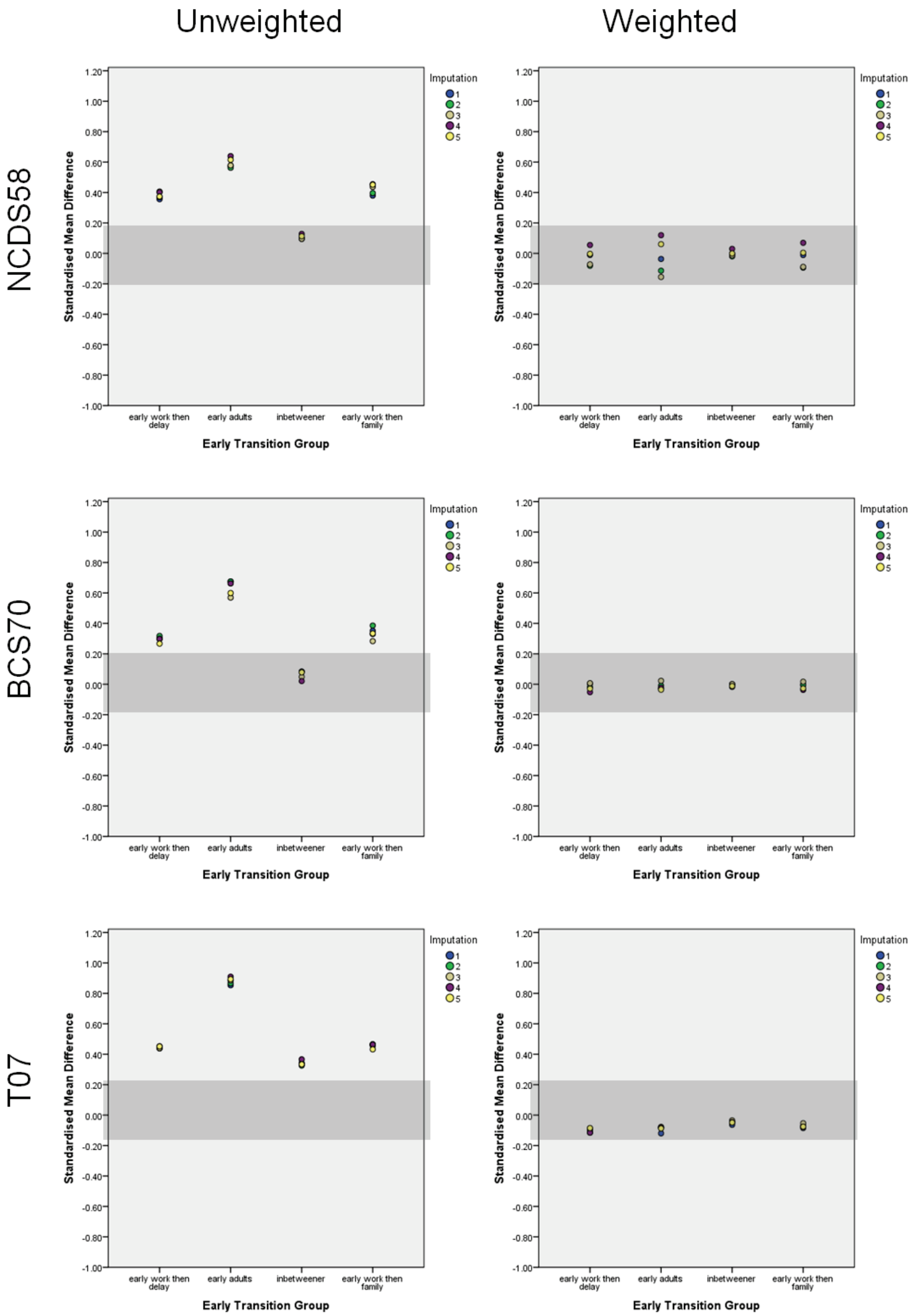


Figure A-3: Standardised mean differences in low income

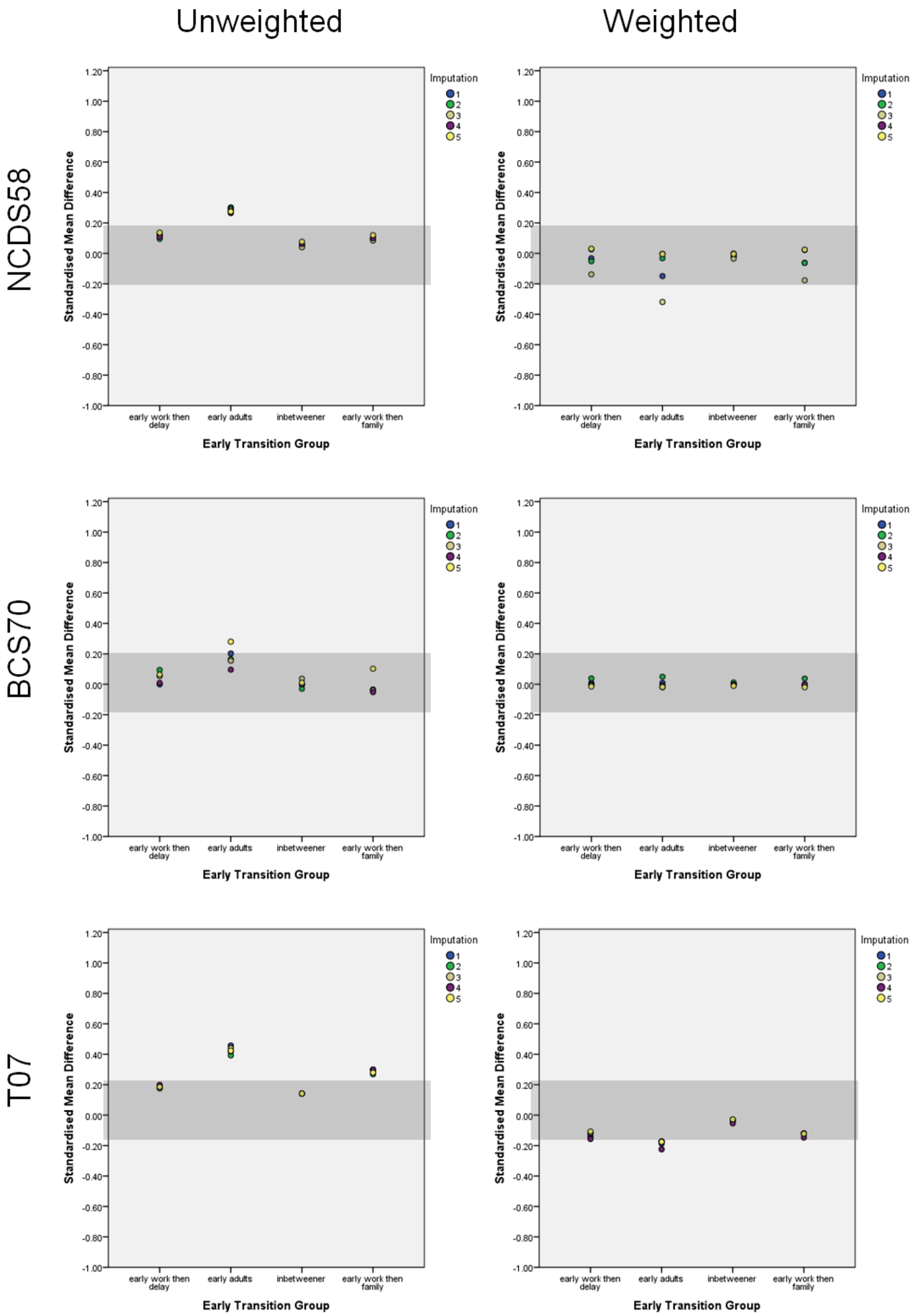


Figure A-4: Standardised mean differences in family structure

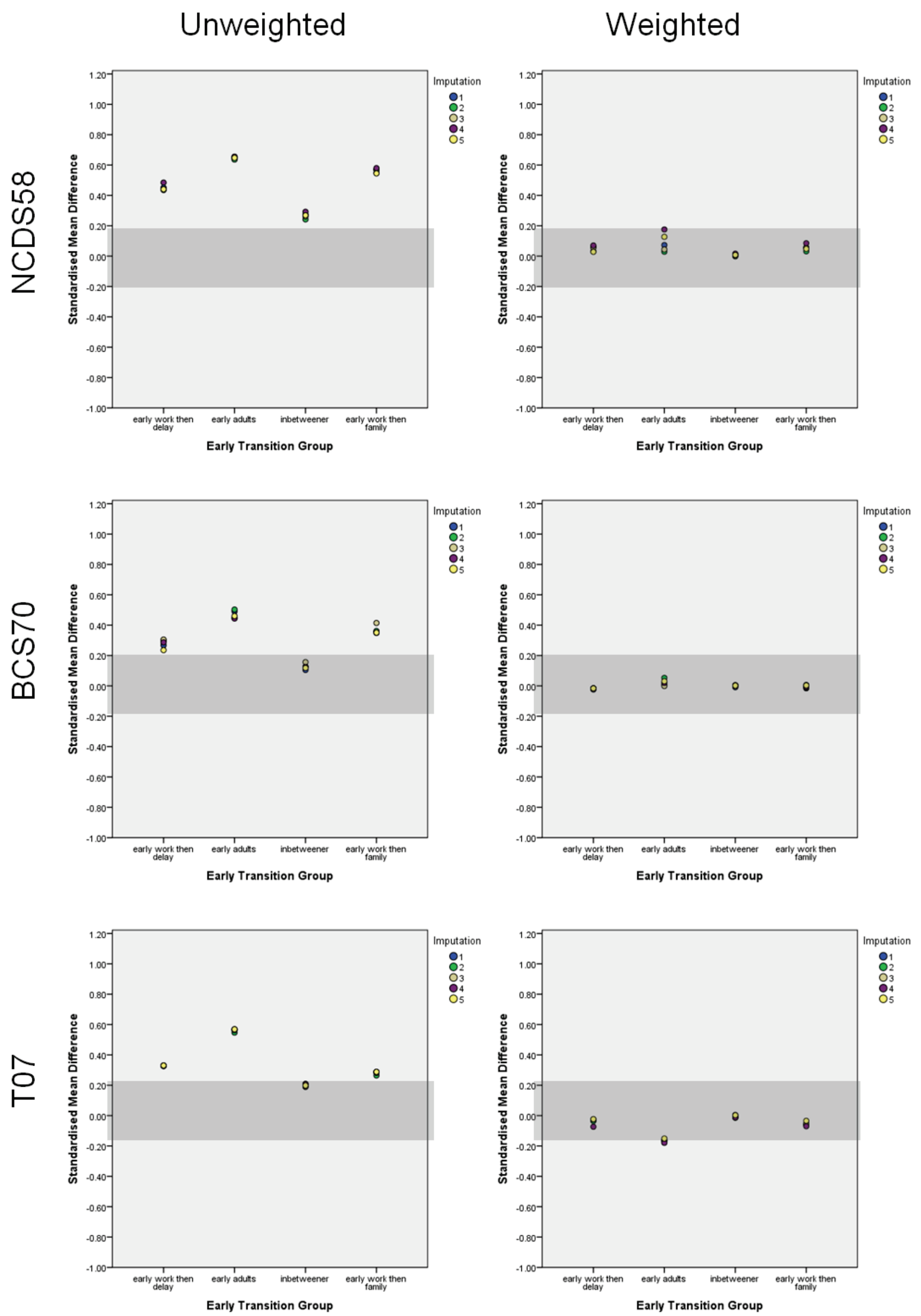


Figure A-5: Standardised mean differences in parental smoking

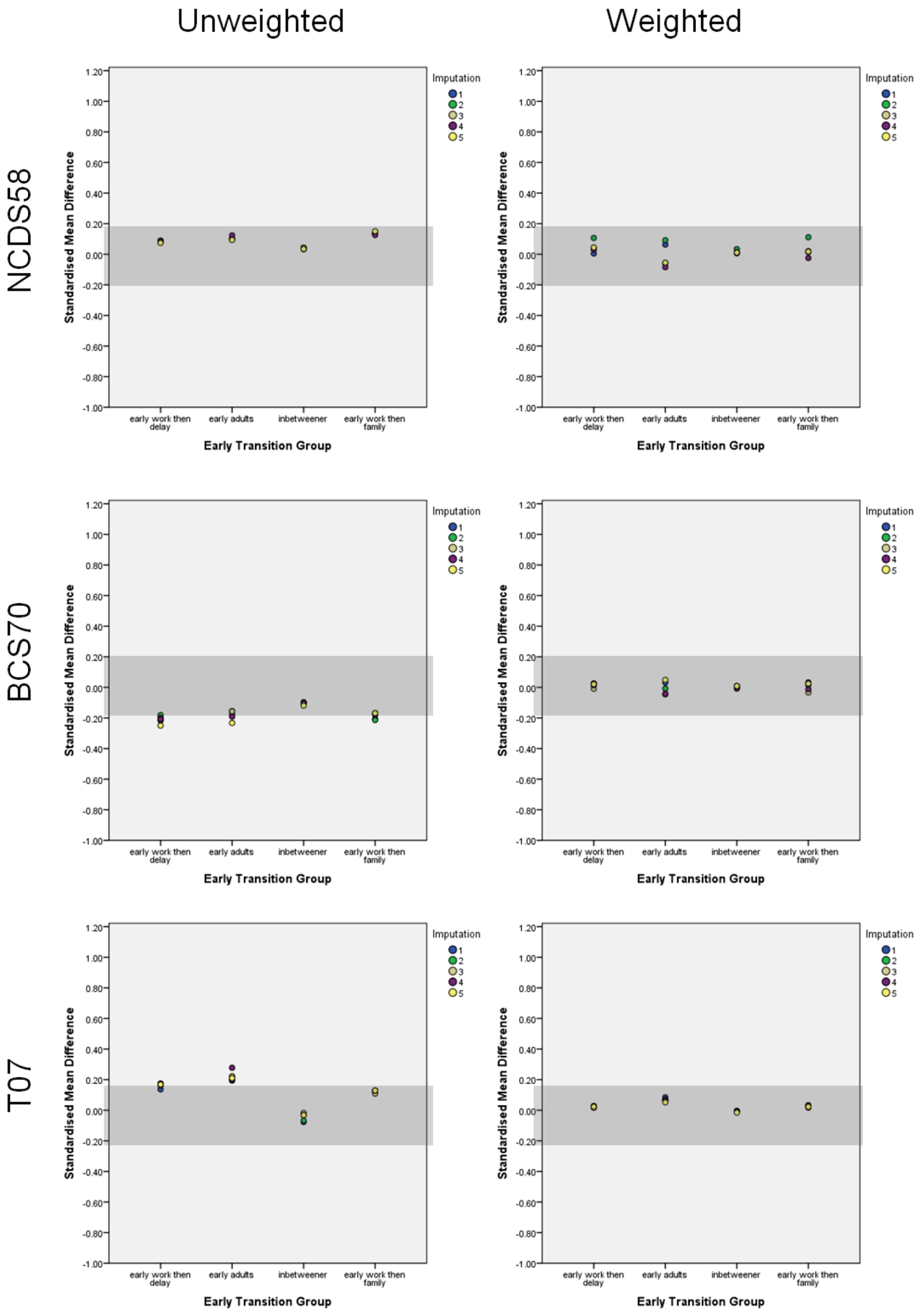


Figure A-6: Standardised mean differences in parental drinking

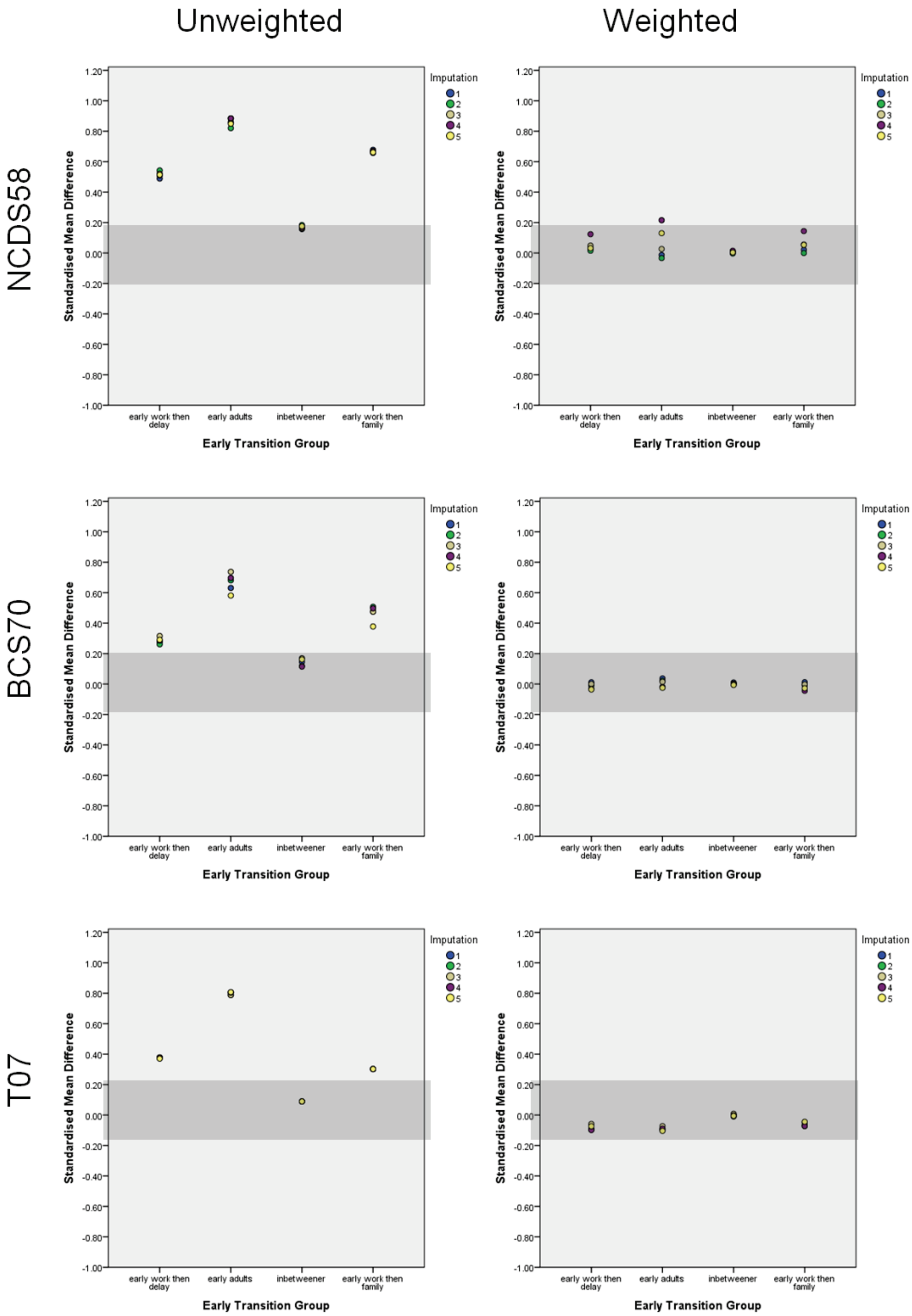


Figure A-7: Standardised mean differences in adolescent smoking

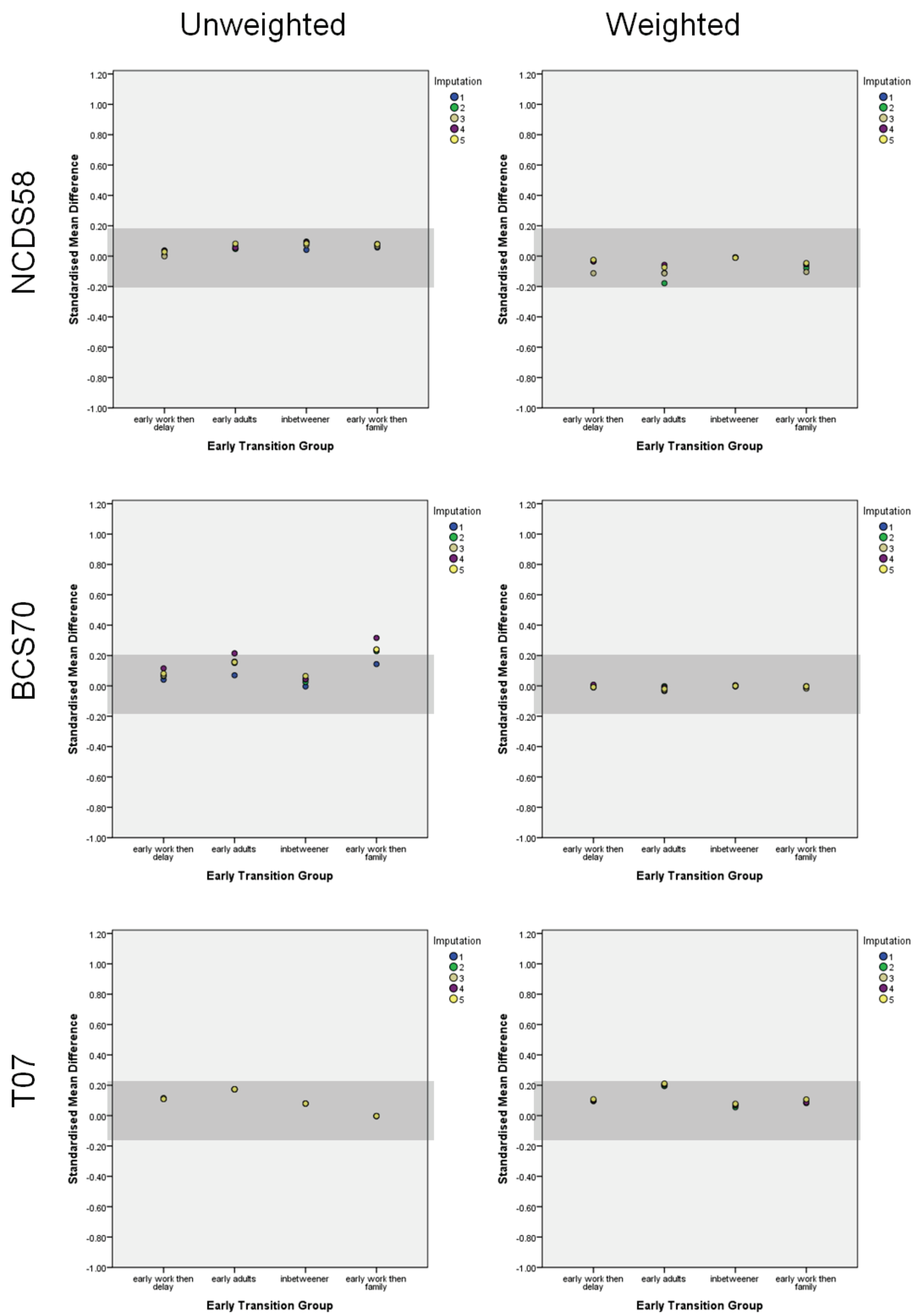


Figure A-8: Standardised mean differences in adolescent drinking

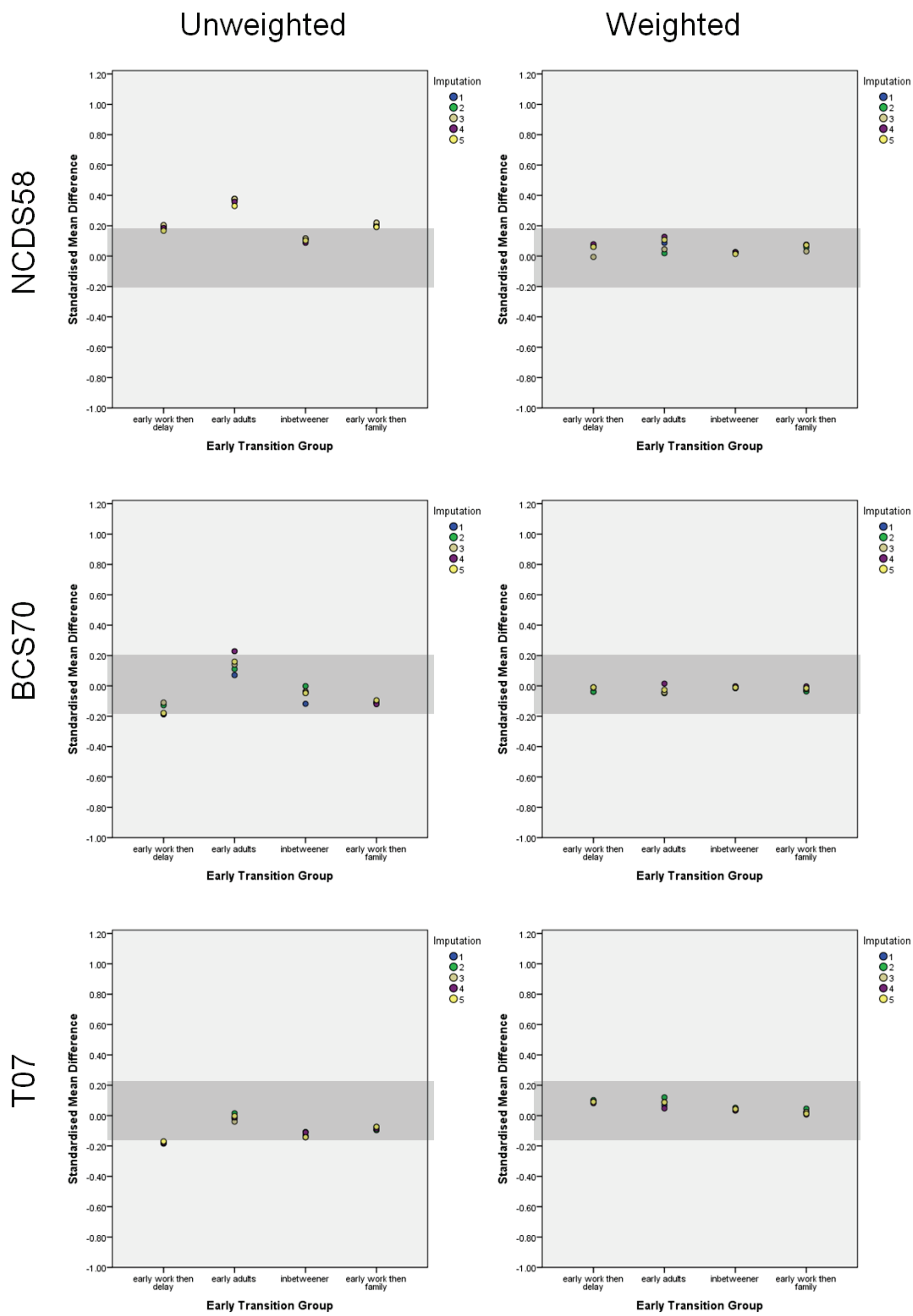


Figure A-9: Standardised mean differences in adolescent distress

Appendix to Chapter 8

Figure A-10 describes the flow of respondents for inclusion in the complete cases analyses. 4,432 (86.5%) of the 5,122 respondents had valid data on all the SEP variables, and 4,661 (91.0% of the total) had valid smoking histories. 4,059 (79.2%) had valid SEP data and smoking histories and were included in the complete cases analysis of initiation. Of these 1,734 (42.7%) actually reported trying smoking at some point within the observation period. However, only 1,595 were included in the analysis of experimentation as the timing of experimentation could not be established for 139 (8.0%) of those who ever tried smoking. 783 (49.1%) of the 1,595 who tried smoking also proceeded to experimentation. For the analyses of escalation and quitting one further case was lost because of ambiguous data, leaving an analysis sample of 782. Of the 782 occasional smokers, 272 (34.8%) progressed to daily smoking, and 350 (44.8%) quit smoking before reaching 16 years of age or dropping out.

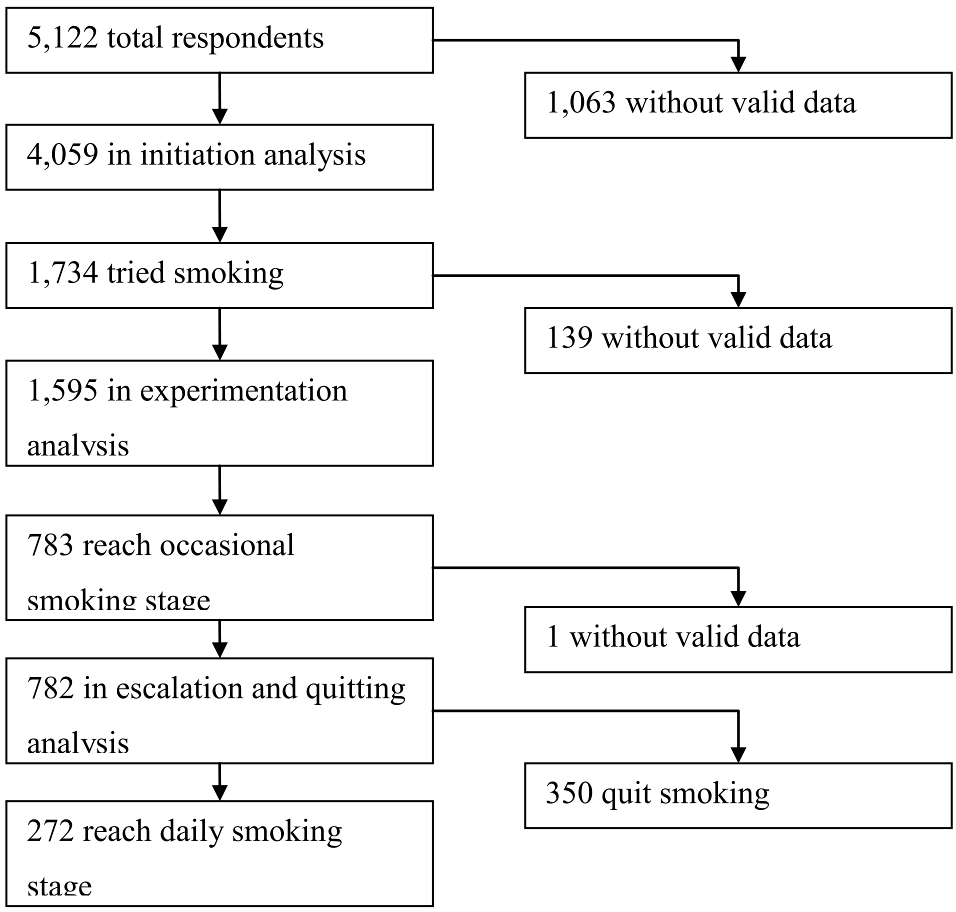


Figure A-10: Flowchart of inclusion in complete cases analyses

Tables A-3 through A-6 report ORs and 95% CIs for models of smoking transitions respectively utilising parental occupational class, household income, housing tenure and parental employment status as measures of SEP.

Tables A-7 through A-11 show the sensitivity analyses using person-years with complete data. SEP is respectively represented as parental education, parental occupational class, household income, housing tenure and parental employment status.

Table A-3: ORs for smoking transitions (parental occupational class)[a]

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		20,042		6,362		2,122		2,122
N (Persons)		5,122		2,882		1,529		1,529
N (Events)		2,882		1,529		558		655
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Female (ref: Male)	0.96	0.81-1.13	1.45	1.27-1.64	0.86	0.67-1.11	1.09	0.86-1.38
Age[b]	1.29	1.20-1.38						
Age at Prior Transition[c]			1.08	1.02-1.15	1.28	1.14-1.44	0.85	0.77-0.94
Years Since Prior Transition[d]			1.34	1.24-1.44	1.34	1.09-1.65	0.57	0.44-0.73
Wales (ref: England)	1.03	0.86-1.23	0.82	0.68-0.98	0.93	0.64-1.33	0.98	0.70-1.37
Scotland (ref: England)	0.91	0.75-1.10	0.82	0.68-0.97	0.88	0.60-1.27	1.31	0.95-1.80
Northern Ireland (ref: England)	0.60	0.43-0.82	0.84	0.61-1.13	0.96	0.54-1.70	1.19	0.72-1.99
Period[e]	0.67	0.60-0.75	0.78	0.72-0.84	1.05	0.88-1.26	1.08	0.91-1.29
Period*Period	0.81	0.75-0.89	0.92	0.86-0.99	0.81	0.70-0.93	0.89	0.78-1.01
Class III (ref: Class I & II)	1.44	1.20-1.73	1.16	1.00-1.34	1.18	0.89-1.57	1.19	0.90-1.56
Class IV & V (ref: Class I & II)	2.03	1.61-2.57	1.06	0.89-1.26	1.45	1.03-2.05	1.09	0.76-1.55
Age*Female	1.13	1.06-1.21						
Age*Period	1.04	1.00-1.08						
Age*Period*Period	1.04	1.01-1.08						
Female*Period	1.02	0.92-1.12						
Female*Period*Period	0.91	0.84-0.99						
Class III*Age	0.93	0.87-0.99						
Class IV & V*Age	0.87	0.79-0.95						
Class III*Wales	0.96	0.73-1.25						
Class IV & V*Wales	0.86	0.63-1.18						
Class III*Scotland	1.21	0.92-1.58						
Class IV & V*Scotland	1.20	0.83-1.74						
Class III*Northern Ireland	1.78	1.18-2.69						
Class IV & V*Northern Ireland	1.55	0.97-2.49						
Years Since Prior Transition*Period					0.74	0.58-0.93	0.94	0.72-1.23

[a]Data presented are average values across 20 imputed data-sets.
[b]ORs associated with one-year increase in age from reference value of 11 years.
[c]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[d]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[e]ORs associated with five-year increase from the reference value of 2001.

Table A-4: ORs for smoking transitions (income)[a]

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		20,042		6,362		2,122		2,122
N (Persons)		5,122		2,882		1,529		1,529
N (Events)		2,882		1,529		558		655
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Female (ref: Male)	0.96	0.81-1.14	1.44	1.27-1.64	0.86	0.67-1.11	1.08	0.86-1.37
Age[b]	1.31	1.21-1.42						
Age at Prior Transition[c]			1.08	1.02-1.15	1.28	1.13-1.44	0.85	0.76-0.94
Years Since Prior Transition[d]			1.34	1.25-1.44	1.36	1.11-1.67	0.57	0.44-0.73
Wales (ref: England)	0.97	0.81-1.14	0.81	0.68-0.98	0.91	0.63-1.31	0.97	0.69-1.36
Scotland (ref: England)	0.97	0.86-1.10	0.82	0.69-0.98	0.84	0.58-1.23	1.31	0.95-1.80
Northern Ireland (ref: England)	1.00	0.89-1.13	0.84	0.63-1.13	0.93	0.53-1.66	1.20	0.72-2.00
Period[e]	0.61	0.53-0.70	0.77	0.72-0.84	1.04	0.87-1.24	1.08	0.91-1.28
Period*Period	0.81	0.74-0.88	0.92	0.85-0.99	0.81	0.70-0.93	0.88	0.77-1.01
Middle tertile (ref: Top tertile)	1.50	1.21-1.86	1.15	0.97-1.36	1.38	0.98-1.95	1.16	0.84-1.59
Bottom tertile (ref: Top tertile)	1.78	1.45-2.18	1.14	0.97-1.34	1.71	1.22-2.41	1.15	0.83-1.59
Age*Female	1.13	1.06-1.21						
Age*Period	1.05	1.01-1.09						
Age*Period*Period	1.05	1.01-1.08						
Female*Period	1.01	0.92-1.11						
Female*Period*Period	0.91	0.84-0.99						
Middle tertile*Age	0.92	0.84-1.01						
Bottom tertile*Age	0.89	0.82-0.97						
Middle tertile*Period	1.10	0.97-1.24						
Bottom tertile*Period	1.17	1.04-1.31						
Years Since Prior Transition*Period					0.73	0.58-0.92	0.94	0.71-1.22

[a]Data presented are average values across 20 imputed data-sets.
[b]ORs associated with one-year increase in age from reference value of 11 years.
[c]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[d]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[e]ORs associated with five-year increase from the reference value of 2001.

Table A-5: ORs for smoking transitions (housing tenure)[a]

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		20,042		6,362		2,122		2,122
N (Persons)		5,122		2,882		1,529		1,529
N (Events)		2,882		1,529		558		655
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Female (ref: Male)	0.97	0.82-1.14	1.45	1.27-1.64	0.87	0.68-1.12	1.09	0.86-1.38
Age[b]	1.30	1.22-1.39						
Age at Prior Transition[c]			1.09	1.02-1.16	1.30	1.15-1.46	0.86	0.77-0.95
Years Since Prior Transition[d]			1.34	1.25-1.44	1.37	1.11-1.68	0.57	0.44-0.73
Wales (ref: England)	0.99	0.88-1.12	0.82	0.69-0.99	0.95	0.65-1.37	0.98	0.70-1.37
Scotland (ref: England)	0.98	0.87-1.10	0.81	0.68-0.97	0.83	0.57-1.20	1.28	0.93-1.78
Northern Ireland (ref: England)	0.85	0.71-1.02	0.85	0.63-1.14	0.99	0.55-1.77	1.21	0.72-2.02
Period[e]	0.63	0.56-0.71	0.77	0.71-0.84	1.03	0.86-1.23	1.07	0.90-1.28
Period*Period	0.82	0.75-0.89	0.92	0.86-0.99	0.81	0.71-0.94	0.89	0.78-1.01
Rented Housing (ref: Owned/Mortgage)	2.17	1.86-2.54	1.17	1.02-1.34	1.60	1.24-2.08	1.24	0.97-1.60
Age*Female	1.13	1.06-1.21						
Age*Period	1.04	1.01-1.08						
Age*Period*Period	1.04	1.01-1.08						
Female*Period	1.02	0.93-1.12						
Female*Period*Period	0.91	0.84-0.99						
Rented Housing*Age	0.84	0.78-0.90						
Rented Housing*Period	1.17	1.05-1.29						
Years Since Prior Transition*Period					0.73	0.58-0.93	0.93	0.72-1.22

[a]Data presented are average values across 20 imputed data-sets.
[b]ORs associated with one-year increase in age from reference value of 11 years.
[c]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[d]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[e]ORs associated with five-year increase from the reference value of 2001.

Table A-6: ORs for smoking transitions (parental employment status)[a]

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		20,042		6,362		2,122		2,122
N (Persons)		5,122		2,882		1,529		1,529
N (Events)		2,882		1,529		558		655
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Female (ref: Male)	0.96	0.81-1.13	1.44	1.27-1.64	0.85	0.66-1.10	1.08	0.85-1.37
Age[b]	1.30	1.22-1.39						
Age at Prior Transition[c]			1.08	1.02-1.15	1.31	1.16-1.48	0.85	0.76-0.94
Years Since Prior Transition[d]			1.34	1.24-1.44	1.36	1.11-1.67	0.56	0.44-0.72
Wales (ref: England)	1.00	0.88-1.13	0.81	0.68-0.98	0.90	0.62-1.31	0.98	0.70-1.36
Scotland (ref: England)	0.96	0.84-1.09	0.82	0.69-0.98	0.83	0.57-1.20	1.32	0.96-1.83
Northern Ireland (ref: England)	0.70	0.55-0.88	0.83	0.62-1.12	0.83	0.46-1.49	1.23	0.74-2.06
Period[e]	0.65	0.58-0.73	0.78	0.72-0.84	1.05	0.88-1.26	1.08	0.91-1.28
Period*Period	0.82	0.75-0.89	0.92	0.85-0.99	0.81	0.70-0.93	0.88	0.77-1.01
Not Employed (ref: Employed)	1.79	1.45-2.21	1.09	0.94-1.27	1.90	1.40-2.57	0.96	0.71-1.31
Age*Female	1.14	1.06-1.21						
Age*Period	1.04	1.01-1.08						
Age*Period*Period	1.04	1.01-1.08						
Female*Period	1.01	0.92-1.11						
Female*Period*Period	0.91	0.84-0.99						
Not Employed*Age	0.84	0.77-0.91						
Not Employed*Period	1.19	1.04-1.37						
Not Employed*Wales	0.94	0.69-1.28						
Not Employed*Scotland	1.21	0.91-1.61						
Not Employed*Northern Ireland	1.56	1.08-2.25						
Years Since Prior Transition*Period					0.73	0.58-0.93	0.94	0.72-1.23

[a]Data presented are average values across 20 imputed data-sets.
[b]ORs associated with one-year increase in age from reference value of 11 years.

[c]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[d]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[e]ORs associated with five-year increase from the reference value of 2001.

Table A-7: ORs for complete case analysis (parental education)

(continued overleaf)

		Initiation		Experimentation		Escalation		Quitting
N (Person-Years)		13,809		3,218		1,011		1,011
N (Persons)		4,059		1,595		782		782
N (Events)		1,734		783		272		350
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Female (ref: Male)	0.77	0.65-0.91	1.22	0.98-1.51	0.76	0.55-1.05	1.19	0.88-1.62
Age[a]	1.32	1.18-1.48						
Age at Prior Transition[b]			1.06	0.96-1.16	1.33	1.14-1.56	0.81	0.71-0.92
Years Since Prior Transition[c]			1.11	0.87-1.43	0.89	0.61-1.29	0.28	0.17-0.44
Wales (ref: England)	0.40	0.29-0.56	0.67	0.52-0.88	0.67	0.39-1.14	0.95	0.58-1.55
Scotland (ref: England)	0.78	0.59-1.03	0.81	0.64-1.03	0.69	0.41-1.16	1.28	0.83-1.99
Northern Ireland (ref: England)	##	##	0.46	0.25-0.86	0.11	0.01-0.99	1.19	0.39-3.61
Period[d]	0.71	0.60-0.83	0.81	0.67-0.98	1.29	1.01-1.65	1.14	0.91-1.44
Period*Period	0.86	0.80-0.92	0.68	0.55-0.83	1.04	0.76-1.41	1.00	0.75-1.32
Other Qualifications (ref: Degree or Higher)	1.88	1.41-2.50	1.07	0.77-1.47	1.77	1.10-2.84	1.74	1.11-2.74
No Qualifications (ref: Degree or Higher)	3.87	2.67-5.60	1.53	1.01-2.33	4.25	2.18-8.27	2.74	1.44-5.22
Age*Female	1.24	1.15-1.33						
Age*Wales	1.27	1.13-1.43						
Age*Scotland	1.02	0.92-1.14						
Age*Northern Ireland	0.93	0.76-1.13						
Period*Wales	0.92	0.75-1.14						
Period*Scotland	1.19	0.99-1.43						
Period*Northern Ireland	#	#						
Period*Period*Wales	1.25	1.02-1.52						

Period*Period*Scotland	1.05	0.87-1.25						
Period*Period*Northern Ireland	##	##						
Other Qualifications*Age	0.87	0.78-0.98						
No Qualifications*Age	0.75	0.65-0.88						
Other Qualifications*Period	1.05	0.88-1.24						
No Qualifications*Period	1.28	1.02-1.60						
Age at Prior Transition*Period			1.06	0.98-1.16				
Age at Prior Transition*Period*Period			1.17	1.06-1.29				
Years Since Prior Transition*Period					0.51	0.34-0.77	0.88	0.57-1.34
Years Since Prior Transition*Period*Period					1.43	0.80-2.54	2.30	1.31-4.04
Years Since Prior Transition*Female			1.30	1.10-1.53				
Years Since Prior Transition*Other Qualifications			0.95	0.74-1.22				
Years Since Prior Transition*No Qualifications			0.66	0.47-0.93				

#=extremely large values; ##=extremely low values
[a]ORs associated with one-year increase in age from reference value of 11 years.
[b]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[c]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[d]ORs associated with five-year increase from the reference value of 2001.

Table A-8: ORs for complete case analysis (parental occupational class)

(continued overleaf)

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		13,809		3,218		1,011		1,011
N (Persons)		4,059		1,595		782		782
N (Events)		1,734		783		272		350
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Female (ref: Male)	0.78	0.66-0.93	1.47	1.10-1.99	0.79	0.57-1.09	1.20	0.88-1.63
Age[a]	1.25	1.16-1.35						
Age at Prior Transition[b]			1.06	0.96-1.16	1.36	1.16-1.58	0.82	0.72-0.93
Years Since Prior Transition[c]			1.01	0.90-1.15	0.93	0.64-1.36	0.29	0.18-0.46
Wales (ref: England)	0.45	0.31-0.66	0.67	0.51-0.88	0.68	0.40-1.16	0.98	0.60-1.61
Scotland (ref: England)	0.69	0.48-0.97	0.80	0.63-1.02	0.71	0.43-1.19	1.28	0.82-1.99
Northern Ireland (ref: England)	##	##	0.46	0.24-0.85	0.16	0.02-1.44	1.50	0.49-4.59
Period[d]	0.73	0.68-0.80	0.73	0.57-0.93	1.47	1.02-2.11	1.21	0.88-1.68
Period*Period	0.86	0.80-0.93	0.68	0.55-0.84	1.27	0.78-2.46	1.48	0.98-2.26
Class III (ref: Class I & II)	1.53	1.24-1.88	1.42	1.09-1.86	1.70	1.03-2.80	2.20	1.37-3.53
Class IV & V (ref: Class I & II)	2.19	1.69-2.84	1.23	0.87-1.75	2.87	1.42-5.78	1.54	0.75-3.14
Age*Female	1.23	1.14-1.33						
Age*Wales	1.25	1.11-1.41						
Age*Scotland	1.02	0.92-1.14						
Age*Northern Ireland	0.97	0.79-1.19						
Period*Wales	0.94	0.76-1.15						
Period*Scotland	1.20	1.00-1.45						
Period*Northern Ireland	#	#						
Period*Period*Wales	1.24	1.01-1.51						
Period*Period*Scotland	1.03	0.86-1.24						
Period*Period*Northern Ireland	##	##						
Class III*Age	0.89	0.82-0.97						
Class IV & V*Age	0.84	0.75-0.93						
Class III*Wales	0.93	0.66-1.32						
Class IV & V*Wales	0.83	0.54-1.28						
Class III*Scotland	1.30	0.94-1.78						
Class IV & V*Scotland	1.31	0.83-2.06						
Class III*Northern Ireland	2.89	1.44-5.81						
Class IV & V*Northern Ireland	2.01	0.93-4.36						

Age at Prior Transition*Period	1.07	0.98-1.16				
Age at Prior Transition*Period*Period	1.17	1.06-1.30				
Years Since Prior Transition*Period			0.52	0.35-0.79	0.88	0.58-1.36
Years Since Prior Transition*Period*Period			1.38	0.78-2.46	2.25	1.28-3.96
Years Since Prior Transition*Female	1.31	1.11-1.54				
Class III*Period	1.29	1.02-1.62	0.86	0.54-1.38	0.84	0.55-1.29
Class IV & V*Period	0.96	0.71-1.30	0.51	0.28-0.93	0.84	0.48-1.46
Class III*Period*Period			0.75	0.40-1.41	0.49	0.28-0.87
Class IV & V*Period*Period			0.59	0.26-1.34	0.67	0.31-1.45

#=extremely large values; ##=extremely low values
[a]ORs associated with one-year increase in age from reference value of 11 years.
[b]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[c]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[d]ORs associated with five-year increase from the reference value of 2001.

Table A-9: ORs for complete case analysis (income)

(continued overleaf)

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		13,809		3,218		1,011		1,011
N (Persons)		4,059		1,595		782		782
N (Events)		1,734		783		272		350
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Female (ref: Male)	0.78	0.65-0.92	1.61	1.14-2.29	0.81	0.58-1.11	1.22	0.90-1.66
Age[a]	1.23	1.13-1.34						
Age at Prior Transition[b]			1.06	0.97-1.17	1.31	1.13-1.53	0.79	0.70-0.91
Years Since Prior Transition[c]			1.02	0.90-1.15	0.93	0.63-1.36	0.28	0.17-0.44
Wales (ref: England)	0.52	0.34-0.78	0.66	0.51-0.86	0.71	0.41-1.20	0.98	0.60-1.60
Scotland (ref: England)	0.64	0.44-0.93	0.81	0.64-1.03	0.70	0.42-1.17	1.32	0.85-2.05
Northern Ireland (ref: England)	##	##	0.45	0.24-0.84	0.16	0.02-1.35	1.60	0.52-4.89
Period[d]	0.73	0.67-0.79	0.81	0.66-0.98	1.45	0.92-2.29	1.68	1.12-2.51
Period*Period	0.86	0.80-0.93	0.68	0.55-0.84	1.12	0.82-1.52	1.03	0.78-1.37
Middle Tertile (ref: Top Tertile)	1.45	1.14-1.84	1.60	1.16-2.19	1.39	0.91-2.12	1.15	0.79-1.69
Lowest Tertile (ref: Top Tertile)	1.67	1.32-2.12	1.24	0.90-1.69	2.19	1.44-3.33	1.21	0.82-1.80
Age*Female	1.23	1.15-1.33						
Age*Wales	1.26	1.12-1.42						
Age*Scotland	1.03	0.93-1.15						
Age*Northern Ireland	0.92	0.75-1.13						
Period*Wales	0.93	0.76-1.15						
Period*Scotland	1.19	0.99-1.43						
Period*Northern Ireland	#	#						
Period*Period*Wales	1.25	1.02-1.52						
Period*Period*Scotland	1.02	0.85-1.22						
Period*Period*Northern Ireland	##	##						
Middle Tertile*Age	0.93	0.84-1.02						
Lowest Tertile*Age	0.91	0.83-1.00						
Middle Tertile*Wales	0.85	0.58-1.25						
Lowest Tertile*Wales	0.67	0.45-0.98						
Middle Tertile*Scotland	1.16	0.79-1.71						
Lowest Tertile*Scotland	1.47	1.03-2.11						
Middle Tertile*Northern Ireland	1.24	0.47-3.29						
Lowest Tertile*Northern Ireland	2.05	0.83-5.06						

Age at Prior Transition*Period	1.06	0.98-1.16				
Age at Prior Transition*Period*Period	1.17	1.06-1.29				
Years Since Prior Transition*Period			0.51	0.34-0.76	0.89	0.58-1.36
Years Since Prior Transition*Period*Period			1.38	0.77-2.45	2.35	1.33-4.15
Years Since Prior Transition*Female	1.29	1.10-1.52				
Middle Tertile*Female	0.57	0.37-0.88				
Lowest Tertile*Female	0.81	0.53-1.23				
Middle Tertile*Period			0.95	0.55-1.66	0.59	0.36-0.97
Lowest Tertile*Period			0.59	0.34-1.04	0.51	0.30-0.86

#=extremely large values; ##=extremely low values
[a]ORs associated with one-year increase in age from reference value of 11 years.
[b]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[c]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[d]ORs associated with five-year increase from the reference value of 2001.

Table A-10: ORs for complete case analysis (housing tenure)

	Initiation		Experimentation		Escalation		Quitting	
N (Person-Years)		13,809		3,218		1,011		1,011
N (Persons)		4,059		1,595		782		782
N (Events)		1,734		783		272		350
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Female (ref: Male)	0.78	0.66-0.93	1.23	0.99-1.52	0.81	0.59-1.12	1.24	0.91-1.68
Age[a]	1.22	1.14-1.30						
Age at Prior Transition[b]			1.06	0.97-1.17	1.34	1.15-1.56	0.82	0.72-0.93
Years Since Prior Transition[c]			1.02	0.91-1.16	0.94	0.64-1.37	0.29	0.18-0.47
Wales (ref: England)	0.43	0.31-0.60	0.67	0.51-0.88	0.72	0.42-1.23	1.00	0.61-1.64
Scotland (ref: England)	0.76	0.58-1.01	0.80	0.63-1.02	0.66	0.39-1.10	1.22	0.78-1.90
Northern Ireland (ref: England)	##	##	0.46	0.25-0.85	0.14	0.02-1.26	1.34	0.44-4.06
Period[d]	0.73	0.68-0.80	0.81	0.67-0.98	1.19	0.94-1.52	1.09	0.87-1.37
Period*Period	0.87	0.81-0.93	0.68	0.55-0.84	1.13	0.83-1.54	1.06	0.80-1.40
Renting (ref: Owned/Mortgage)	1.87	1.56-2.23	1.19	1.01-1.42	2.41	1.70-3.41	1.83	1.32-2.55
Age*Female	1.23	1.14-1.33						
Age*Wales	1.25	1.11-1.41						
Age*Scotland	1.03	0.92-1.14						
Age*Northern Ireland	0.91	0.75-1.12						
Period*Wales	0.92	0.75-1.13						
Period*Scotland	1.20	1.00-1.45						
Period*Northern Ireland	#	#						
Period*Period*Wales	1.25	1.03-1.53						
Period*Period*Scotland	1.04	0.86-1.24						
Period*Period*Northern Ireland	##	##						
Renting*Age	0.88	0.81-0.95						
Age at Prior Transition*Period			1.06	0.98-1.15				
Age at Prior Transition*Period*Period			1.17	1.06-1.29				
Years Since Prior Transition*Period					0.49	0.33-0.74	0.83	0.54-1.28
Years Since Prior Transition*Period*Period					1.44	0.82-2.55	2.28	1.29-4.01
Years Since Prior Transition*Female			1.29	1.09-1.52				

#=extremely large values; ##=extremely low values

[a]ORs associated with one-year increase in age from reference value of 11 years.

[b]ORs associated with one-year increase in age at prior transition from reference value of 11 years.

[c]ORs associated with one-year increase in years since prior transition from reference value of 0 years.

[d]ORs associated with five-year increase from the reference value of 2001.

Table A-11: ORs for complete case analysis (parental employment)

(continued overleaf)

		Initiation		Experimentation		Escalation		Quitting
N (Person-Years)		13,809		3,218		1,011		1,011
N (Persons)		4,059		1,595		782		782
N (Events)		1,734		783		272		350
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Female (ref: Male)	0.77	0.65-0.92	1.22	0.98-1.51	0.78	0.56-1.07	1.22	0.90-1.65
Age[a]	1.19	1.12-1.26						
Age at Prior Transition[b]			1.05	0.96-1.16	1.34	1.15-1.56	0.81	0.71-0.92
Years Since Prior Transition[c]			1.06	0.93-1.21	0.89	0.61-1.29	0.28	0.17-0.44
Wales (ref: England)	0.43	0.31-0.60	0.67	0.52-0.88	0.68	0.40-1.15	0.98	0.60-1.59
Scotland (ref: England)	0.72	0.54-0.96	0.82	0.65-1.04	0.68	0.40-1.14	1.32	0.85-2.05
Northern Ireland (ref: England)	##	##	0.46	0.25-0.85	0.10	0.01-0.89	1.29	0.42-3.95
Period[d]	0.70	0.65-0.77	0.82	0.68-1.00	1.24	0.97-1.58	1.10	0.88-1.38
Period*Period	0.83	0.77-0.90	0.67	0.55-0.83	1.08	0.79-1.47	1.01	0.77-1.34
Not Employed (ref: Employed)	1.55	1.17-2.05	1.18	0.90-1.54	2.75	1.81-4.18	1.32	0.87-2.01
Age*Female	1.24	1.15-1.33						
Age*Wales	1.26	1.12-1.42						
Age*Scotland	1.03	0.92-1.15						
Age*Northern Ireland	0.94	0.76-1.15						
Period*Wales	0.93	0.76-1.14						
Period*Scotland	1.23	1.02-1.49						
Period*Northern Ireland	#	#						
Period*Period*Wales	1.27	1.04-1.55						
Period*Period*Scotland	1.04	0.87-1.24						
Period*Period*Northern Ireland	##	##						
Not Employed*Age	0.85	0.77-0.94						
Not Employed*Period	1.25	1.05-1.49						
Not Employed*Period*Period	1.20	1.03-1.40						
Not Employed*Wales	0.82	0.54-1.25						
Not Employed*Scotland	1.45	1.01-2.08						
Not Employed*Northern Ireland	2.35	1.26-4.38						
Age at Prior Transition*Period			1.06	0.97-1.15				
Age at Prior Transition*Period*Period			1.17	1.06-1.29				

Years Since Prior Transition*Period			0.50	0.33-0.75	0.88	0.57-1.34
Years Since Prior Transition*Period*Period			1.47	0.83-2.59	2.28	1.30-4.02
Years Since Prior Transition*Female	1.30	1.10-1.53				
Years Since Prior Transition*Not Employed	0.81	0.66-0.99				

#=extremely large values; ##=extremely low values
[a]ORs associated with one-year increase in age from reference value of 11 years.
[b]ORs associated with one-year increase in age at prior transition from reference value of 11 years.
[c]ORs associated with one-year increase in years since prior transition from reference value of 0 years.
[d]ORs associated with five-year increase from the reference value of 2001.

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