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**What is the role of income in creating health inequalities?
Evidence from cross-sectional and longitudinal studies**

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ABSTRACT

Inequalities in health have been demonstrated for over 150 years in Britain, and in recent decades have been the focus of increasing policy attention. However in order to tackle inequalities in health there needs to be a clear understanding of their underlying causes. Unfortunately, the existing literature often uses different measures of socioeconomic status (SES) interchangeably; or, pays little attention to how they are measured; is still mainly based on cross-sectional data; and, tends to ‘explain away’ associations by adjusting for numerous confounders. These characteristics are unhelpful in elucidating causal processes and hence identifying mechanisms for reducing inequalities. The set of papers presented here aimed to address these issues by focusing explicitly on the role of income in creating health inequalities in order to develop a better understanding of how policies might potentially use income as a means of reducing the health divide.

The first paper based on the General Household Survey (GHS) examined the cross-sectional association between income and health. In comparison to the ‘gold standard’ – net equivalent household income - other income measures tended to underestimate the strength of the association at the lower end of the distribution, as did imposing a linear function on it, when non-linear functions performed better statistically. The association was stronger for long-term measures of health status than for recent measures of health state. We also investigated the relative importance of different measures of SES for health, and found that income had a stronger association with all measures of health than did occupational class and education, but a similar association to measures of consumption based on tenure and car ownership.

In the second paper, I analysed GHS data to explore the health of a particularly disadvantaged group in the UK – lone parents – and the extent to which low income might be the cause of their health disadvantage. Both lone mothers and fathers, compared to couple parents, had higher risk of ill health, across a range of measures, and income and other

material resources accounted for one third to a half of this, depending on the health outcome. I also explored other possible explanations, such as health selection, other social support and length of time as a lone parent, although these analyses were limited by the data available and the cross-sectional nature of the study.

The remainder of the papers employed longitudinal data to explore more effectively the relationship between income and health by considering its association over time. The third paper was the first British paper to examine income dynamics and health. Using six years of data from the British Household Panel Survey (BHPS) we found a non-linear association between income and subsequent health, controlling for prior health. Average income, and persistent poverty, across five years were more strongly associated with subsequent overall subjective health and limiting longstanding illness, while current income was more important for recent illness and psychosocial distress (measured by the General Health Questionnaire). Decreases in income were associated with raised health risk, but increases did not lead to reduced health problems. Income volatility (i.e. the size of change irrespective of direction) was also associated with health. Controlling for prior health and measuring income before the health outcome both suggested that the association between income and health may be causal. However, it is important to understand income's role in broader causal pathways.

Paper Four employed both the BHPS and the 1958 birth cohort (National Child Development Study (NCDS)) to examine the role of income in childhood and adulthood for health. Analyses of the NCDS showed that childhood income influenced adult health only indirectly through 'health capital' and income potential (education) at age 23. However, in the BHPS, having controlled for earlier health and education and the key social roles – parenting, marriage and employment - that determine income levels, average adult income over five years was still a significant predictor of subsequent health, although childhood SES measures were not. This paper included a policy analysis to assess the effectiveness of

policies to reduce health inequalities and found not only that they would have a modest impact, but also that they could worsen inequalities for some groups in society.

The final paper examined the inter-relationships in adulthood between a key cause of income change, income and health. Using 10 years of BHPS data, we examined the extent to which financial difficulties mediated the association between employment change and health. There were complex relationships depending on gender and prior circumstances. Moving out of employment into unemployment increased psychosocial distress, while moving back from unemployment to work improved it. Men retiring from non-manual jobs experienced an improvement in their mental health, while the health of those retiring from manual jobs declined. Women leaving work for family roles experienced a decline in their mental health, while moving back to work did not significantly improve it. Financial difficulties mediated these associations, attenuating the effects by approximately 30% for men and 16% for women. This paper demonstrated the complexity of many associations between SES and health over time, and the importance of considering them within appropriate pathways.

Overall these papers were among the first to consider the association between income and health over time, and within a lifecourse setting; to investigate issues of income measurement and functional form; and, to compare the relative importance of income with other SES measures. In doing this, I considered how the associations varied by health outcome, by gender and at different life stages, and according to whether or not respondents were from manual or non-manual backgrounds or had pre-existing health conditions. Taken together the papers clearly demonstrate a non-linear relationship between income and health, with the steepest associations at the lower end of the distribution. They show that income is part of the pathway between social roles and health, but that it is not the whole explanation. All of this suggests that low income is an important cause of health inequalities and hence fiscal policies to improve the incomes of the poorest in society are a potential mechanism for reducing the health divide.

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PREFACE

I graduated in Economics in 1987 and joined the King's Fund where my research initially focused on financing the NHS¹ and resource allocation.²⁻⁸ This led to an interest in inequalities in health and, working with the late Sir Donald Acheson, I organised a Ditchley Park Seminar in 1993 and co-ordinated the subsequent edited book *Tackling inequalities in health: an agenda for action*,⁹ which won a BMA Award and received widespread press and policy attention. The purpose of the book was to move beyond evidence of inequalities and consider what can be done to tackle them, and this has been an ongoing feature of my research since then.

The two key chapters I led on examined poverty and health¹⁰ and assessed the role of the NHS in addressing health inequalities.¹¹ These two areas became the focus of the next stage of my career, initially at the King's Fund, and then at the London School of Economics and Queen Mary, University of London. In relation to the NHS, I won two Department of Health grants to examine the role of health authorities^{12,13} and health action zones¹⁴⁻¹⁸ in tackling inequalities in health. My contribution in this field was recognised by being invited to give evidence to the *Independent Inquiry into Inequalities in Health*¹⁹ as well as being asked to present findings to a cross-government policy group²⁰ and the House of Commons Health Select Committee.²¹

My second research area has focused on income and health and is the topic of the papers submitted here. As an economist I was particularly interested in the role of income *per se* for health, but also I believed that income was a key policy instrument for governments to address inequalities, so investigating its role fitted with my goal of identifying ways to tackle health inequalities. The submitted papers are all secondary analyses of public datasets conducted between 1996 and 2004. Although most of these papers were written with colleagues, as described in the co-authors' declarations (Section 7), I had the original idea

for all of these papers; I developed the conceptual approach and led on the analytical strategy and interpretation of results.

The papers fall into three groups. First, two papers, based on analyses of the General Household Survey, examined the cross-sectional association between income and health²² and the role of income in lone parents' health.²³ Secondly, two papers, drawing on work under an ESRC grant,^{24,25} based on the British Household Panel Survey (BHPS) and 1958 birth cohort (National Child Development Study), examined income over the lifecourse and health.^{26,27} Thirdly, drawing on work under a MRC grant,^{28,29} on which I managed a researcher to undertake the data analyses, I am submitting one of the papers we produced,^{30,31,32} which focused on employment change, income and health,³⁰ again using the BHPS. My essay sets the scene for the submitted papers by identifying key issues in the literature at the time of their publication, and then I describe the contribution of each paper to the field.

In autumn 2004 I moved to the MRC Social and Public Health Sciences Unit, where my research changed from being based on secondary analysis to primary data collection as the Research Project Director of the West of Scotland Twenty-07 Study.³³ More recently (in 2009) I was appointed to a Programme Leader Track post for the *Social patterning of health over the lifecourse* programme³⁴ in which I have begun to address these research themes again. While papers from this period are not yet published, I briefly highlight at the end of the essay the ways in which my research has developed since the submitted work.

LIST OF PUBLISHED PAPERS

1. Benzeval, M., Judge, K. and Shouls, S. (2001) 'Understanding the relationship between income and health: How much can be gleaned from cross-sectional data?' *Social Policy & Administration* **35**:4: 376-96. DOI: 10.1111/1467-9515.00240. Reproduced with permission from John Wiley and Sons. (License Number: 2794200331819).
2. Benzeval, M. (1998) 'The self-reported health status of lone parents' *Social Science and Medicine* **46**:10: 1337-53. DOI: 10.1016/S0277-9536(97)10083-1. Reproduced with permission from Elsevier. (License Number 2794191368975).
3. Benzeval, M. and Judge, K. (2001) 'Income and health: the time dimension' *Social Science and Medicine* **52**:9: 1371-90. DOI: 10.1016/S0277-9536(00)00244-6. Reproduced with permission from Elsevier. (License Number 2794200132913).
4. Benzeval, M., Taylor, J. and Judge, K. (2000) 'Evidence on the relationship between low income and poor health: Is the government doing enough?' *Fiscal Studies* **21**:3: 375-99. DOI: 10.1111/j.1475-5890.2000.tb00029.x. Reproduced with permission from John Wiley and Sons. (License Number 2794160007460).
5. Thomas, C., Benzeval, M. and Stansfeld, S.A. (2007) 'Psychological distress after employment transitions: the role of subjective financial position as a mediator' *Journal of Epidemiology and Community Health* **61**:1: 48-52. DOI: 10.1136/jech.2005.044206. Reproduced with permission from BMJ Publishing Group Ltd. (License Number 2794160743600).

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First, I would like to thank my co-authors on the submitted papers - Ken Judge, Sue Shouls, Stephen Stansfeld, Jayne Taylor and Claudia Thomas - for the constructive, stimulating and enjoyable process of undertaking the research and drafting these papers together. Secondly, I would like to thank Sally Macintyre, my advisor, for her support, guidance and advice in producing this PhD; Seeromanie Harding, Kate Hunt, Ken Judge and Mhairi Mackenzie for their encouragement and comments on a draft of my essay; Fiona McDonald for her careful proof-reading; and, John Gilchrist for help with the pdfs. Finally, I am grateful to my team who have put up with my distraction during this process with good humour: Ellen Glasgow, Mike Green, Mary-Kate Hannah, Tony Robertson, Kathryn Skivington and Laura Watts.

Data on citations for the submitted papers were downloaded from Google Scholar and the Web of Science on 25th July 2011. Both databases have been used to allow for the different areas of the literature that they capture; no attempt has been made to merge the citations to give a single figure for each paper.

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DEGREE OF PHD BY PUBLISHED WORK: AUTHOR'S DECLARATION

I, Michaela Jane Benzeval, declare that this is my own work and to my knowledge, has not been submitted in any form for another degree or been submitted before for any degree or examination in any other university. Information derived from the published and unpublished work of others has been acknowledged.

Signed:

Date:

Copy of signed form available in print version or on request

ABBREVIATIONS

BHPS	British Household Panel Study
BMA	British Medical Association
ESRC	Economic and Social Research Council
GHQ	General Health Questionnaire (a measure of psychological distress)
GHS	General Household Survey
HALS	Health and Lifestyle Survey
MRC	Medical Research Council
NCDS	National Child Development Study (1958 birth cohort)
NHS	National Health Service
SES	Socioeconomic status
USA	United States of America

1. INTRODUCTION

Evidence of the existence of social inequalities in health in Britain has been demonstrated for over 150 years,³⁵ but became the focus of significant academic attention after the publication of a government commissioned inquiry in England, the Black Report, in 1980.³⁶ During the period in which the papers presented here were written a further English government inquiry was held in 1997/8,³⁷ and a national policy response proposed.^{38,39} Beyond Britain, a wide range of other European countries published their own equivalents of the Black Report and developed national strategies to tackle the problem.⁴⁰

At the start of this period, partly in response to the belief that recent attention had over-emphasised the role of individual behaviours, there was a growing recognition within the academic community that socioeconomic status (SES) might be a ‘fundamental cause’ of poor health.⁴¹ This was because SES had been shown to affect multiple outcomes via multiple mechanisms; and while the specific mechanisms and outcomes varied over time and between places, the association with SES remained constant.⁴¹ However, measures of SES were often used inconsistently⁴² and interchangeably depending on the availability of indicators,⁴³ rather than recognising that each SES measure has distinct meaning in terms of the dimension of SES it captures and hence the causal process it might play in determining health.^{44,45} Moreover, attempts to explore the contribution of different factors often led to researchers controlling for multiple confounders in models in ways that explained away the association rather than elucidated it.⁴⁶

Among all of the SES measures, income is the most malleable policy instrument,⁴⁷ governments can use the tax and benefit systems to change income levels far more directly and quickly than any other SES measure. It is also the most direct measure of a household’s material resources,⁴⁸ providing ‘the raw materials for health: it buys shelter, warmth and

food,⁴⁹ (p.106). Given this, tackling poverty was a key plank of the King's Fund's agenda for action,⁹ but in my research for this book I found little direct empirical evidence about the relationship between income and health in Britain.¹⁰ Moreover, we recognised that the key causes of low income – poor education, lack of employment, lone parenthood – were themselves important determinants of health.⁵⁰ As outlined in the Preface, this led me to develop the set of papers presented here, which focus on the income and health relationship, how this fits in a lifecourse perspective, and what the policy implications of the findings might be. It is important to note that I chose not to focus these analyses on the subsequent part of the pathway – from income to health - and what mediated this association, since more proximal factors, such as behaviours and psychosocial stress, were being extensively researched in the literature at the time.⁵¹⁻⁵⁵ I felt, therefore, that elucidating the pathways between the different socioeconomic precursors to income, income and health would be a more useful line of enquiry.

The next section, therefore, examines the background to the submitted papers. This is followed by an outline of each of the papers and a brief summary of their contribution to the subsequent literature, identifying some of the questions that remain unanswered. The final section briefly highlights the ways in which my current research is continuing to address these issues.

2. THE BACKGROUND TO THE SUBMITTED PAPERS

This section has two main parts: first, it describes the existing literature on income and health at the time of the development of this set of papers and the questions that needed to be addressed. Secondly, it outlines the emergence of a lifecourse framework for health inequalities research,⁵⁶ which increasingly influenced the development of the papers.

2.1 Evidence about the association between income and health

Early evidence about the relationship between income *per se* and health came from the USA in the 1970s: analysing linked census data with mortality records Kitagawa and Hauser⁵⁷ found evidence of higher death rates among low income groups. Subsequent studies demonstrated income gradients in morbidity in Europe,⁵⁸ the USA,⁵⁹ Canada⁶⁰ and Australia.⁶¹ In one of the few longitudinal studies of income and health conducted in the 1990s, Lynch and colleagues found that the number of occasions a person experienced poverty over time was associated with increased risk of limiting activities of daily living and depression.⁶²

In Britain, where income data are not included in the census, early evidence about the association of income and health came from two surveys conducted in the 1970s and 1980s. In the Health and Lifestyle Survey (HALS), which collected data from approximately 9,000 respondents in 1984, Blaxter⁶³ found a clear association between income and a range of measures of morbidity and disability. In multivariate analyses to investigate the relative importance of income and social class, she concluded that ‘the apparently strong association of social class and health is primarily an association of income and health’ (p. 72). Using the 1976 General Household Survey (GHS) Hurst⁶⁴ found a gradient in limiting illness by income deciles, and O’Donnell and Propper⁶⁵ found a clear gradient by quintiles of equivalised income for both subjective assessments of health and limiting longstanding

illness using data from the 1985 GHS. These papers made important contributions to the evidence about income and health in Britain, but the analyses on which they were based were limited. In HALS, income data were gathered by a categorical question, which did not distinguish between net and gross income or adjust for household composition; moreover income data were missing for 20% of the sample.⁴⁸ In Hurst's analysis of GHS, he neither equivalised income nor controlled for basic demographic differences between income groups, although O'Donnell and Propper did address both of these limitations.¹⁰ More generally in the literature, income was measured in a range of ways: as wages, individual or household-based measures, gross or net, actual or equivalised. The data analyses were also almost all cross-sectional so it was not known whether the direction of causation ran from income to health or if low income was the result of health selection (i.e. poor health resulting in people either losing their jobs or downgrading them to accommodate health problems).⁶⁶

The limited evidence from Britain on income *per se* and health reflected national trends in the availability of SES measures collected in surveys and census.⁴⁴ In Britain there is a long history of employing occupation-based measures of social class to examine health inequalities, with the original classification dating back to 1911,⁶⁷ although this measure has been significantly criticised for its inadequate representation of the SES of women, older people and those out of the labour force.^{68,67} In North America and some European countries, where income is included in the census and is more commonly employed in surveys, income or education tend to be the most commonly used SES markers.

Increasingly, however, studies across countries included a range of SES indicators and researchers began to investigate the relative importance of the different SES measures for different health outcomes, all arguing that while the measures were inter-related each was likely to have its own causal effect on health.^{69-72,44} For example, occupation, as well as being a measure of social and economic standing, also indicates the level of physical hazards and psychosocial stress a person might experience in their job; education additionally might enable people to process health information and access health services more effectively and to develop problem-solving skills more generally. Income, as well as being a direct measure

of the resources available for health, is often also seen as a measure of relative social standing in the community. However, the studies that had investigated the relative importance of different SES measures for health all came to different conclusions. For example, Davey Smith and colleagues found occupational class was the best predictor of mortality in a Scottish study,⁴⁴ while Hay found income performed best in a Canadian study of self-reported health⁶⁹ and Winkleby that education was a better predictor of cardiovascular risk factors in a US study.⁷¹ Further investigation of the relative importance of different SES markers for health and what this might tell us about underlying causes of health inequalities was therefore required.

2.2 A lifecourse perspective: the pathways to health inequalities

Within social epidemiology, in the late 1990s, a concern with lifecourse influences on health was developing. The importance of lifecourse was not new, having been studied in sociology for several decades,⁷³ and the importance of childhood (and pre-birth) factors for adult health had also been previously investigated.^{74,75} However, at the end of the 20th century, the lifecourse framework was incorporated into health inequalities research in a significant way.⁷⁶⁻⁸⁰ The conceptual model underpinning lifecourse epidemiology focused on the importance of considering the temporal order of exposures and their inter-relations.⁷⁸ It emphasised the value of examining the effect of physical and social exposures on the biological, behavioural and psychosocial pathways that operate across the lifecourse (and generations) to influence health.⁷⁸ At its most simple, there are two broad models: the critical period model which suggests that there are specific periods in the lifecourse when an exposure has a long lasting effect on physiological functions and hence subsequent disease (e.g. the importance of nutrition during pregnancy for cardiovascular risk factors in middle and older ages^{81,82}). The second key model is that of accumulated risk i.e. as the number of times an exposure occurs, or its duration increases, there is cumulative damage to biological systems and psychosocial resources, and increased clustering of health-damaging behaviours (e.g. a number of studies have shown that lifetime measures of SES affect health in later

life,⁸³⁻⁸⁵ and that early social position can lead to accumulated risk which then influences later health^{51,86-88}).

The specific role of income within these social and economic processes has not been given much prominence within the lifecourse literature. Moreover, it was only in the early part of the 21st century that researchers began to think more conceptually about how different socioeconomic factors inter-related over time for health,⁸⁹⁻⁹¹ although health economists had earlier proposed the importance of considering the causes of income levels and change – such as employment and marriage – and their direct and indirect effects on health.⁴⁷

Against this background, the papers presented in this thesis focused on the role of income in creating health inequalities in order to develop a better understanding of how policies might potentially use income as a means of reducing the health divide. The contribution of each paper to the literature is described below.

3. THE SUBMITTED PAPERS

3.1 Papers based on analyses of the GHS

Benzeval, M., Judge, K. and Shouls, S. (2001) 'Understanding the relationship between income and health: How much can be gleaned from cross-sectional data?' *Social Policy & Administration* 35:4: 376-96. (Citations: Google Scholar: 39; Web of Science: 18)

Against the background of the income and health literature at the time (see Section 2.1), this paper combined two years of GHS data (1992/3 and 1993/4, N=30,195) to investigate: whether the way in which income was measured and operationalised affected any observed associations with health; and the role that health selection and a wider range of confounders, which were often included in the broader literature, might play in the income-health association. The paper also examined the relative importance of income compared to other common measures of SES. In comparison to equivalent net household income - the 'gold standard' measure of household resources⁹² - other measures (such as individual or gross family income) under-estimated the association between income and health, particularly at the lower end of the distribution. A prominent debate in the income-health literature at the time was whether the association was linear.⁹³⁻⁹⁵ Investigating the shape of the income-health association showed that non-linear functions produced better statistical models than linear ones, and ignoring this led to an underestimation of the association at low-income levels. There were stronger associations between income and measures of overall long-term health status than for measures of recent illness, which was consistent with broader literatures on the social patterning of health.^{63,96}

Using the employment status of 'unable to work due to ill health', we investigated the role of health selection in the income-health association and found that including this variable did attenuate, but not eliminate, the association. However, this was a crude way of controlling for selection effects and may have exaggerated its contribution, as it took no account of the

fact that income might have caused the poor health which prevented people from doing paid work in the first place. Investigating the impact of a wide range of other confounders often used in the literature, we found demographic, parental and marital status, occupation and education had little impact on the income-health association, but measures of consumption based on tenure and car ownership⁹⁷ and employment status did result in considerable attenuation, although the relationship remained significant for overall measures of health status. Finally, comparing the relative importance of different SES measures for health suggested that income had a stronger association with all measures of health than did occupational class and education, but a similar strength of association to measures of consumption. We argued that this might be because consumption measures were a better marker for people's long-term resources accumulated across the lifecourse.

The ensuing literature, which often drew on this paper, has continued to investigate the shape of the income-health relationship and the relative importance of income compared with other SES measures for different measures of health. In the main the literature suggests that the type of income considered has little effect on the association with health^{98,99} but that income has a curvilinear association with health. For example, using spline regression models (which allow the data to determine turning points rather than imposing a functional form), Mackenbach and colleagues¹⁰⁰ analysed data from seven European countries and found decreasing marginal benefits with increasing income for most but not all health measures in most but not all countries. More recently, Rehkopf found non-linear associations between income and mortality¹⁰¹ and a range of biomarkers.¹⁰² A number of studies have compared measures of current income with measures of wealth (long term resources) and, consistent with our findings for measures of consumption, found that longer term measures of wealth had a stronger association with some health outcomes than current income,^{103,104} although in one study this was only for those over 65.¹⁰⁵ While studies continued to investigate the relative importance of different measures of SES for health and find varying results depending on the health outcome,¹⁰⁶ gender¹⁰⁷ and national context,¹⁰⁸ the argument

that the timing of these different SES factors should be taken into account^{89,90} points to the need to consider these debates in a lifecourse framework.

Benzeval, M. (1998) 'The self-reported health status of lone parents' Social Science and Medicine 46:10: 1337-53. (Citations: Google Scholar: 96; Web of Science: 52)

This paper combined a literature review of lone parents' health with analyses of data from three years of the GHS (1992/3 to 1994/5, N=16,736). Of the 15 existing studies identified, which utilised varying definitions of lone parenthood (with 11 focusing on mothers only), all generally found higher levels of ill health, particularly psychosocial distress, among lone than couple parents. Most of these studies made no attempt to control for the large differences in basic characteristics of the two groups e.g. age; however, those that did still found significant differences in health.^{72,56,73} A few studies adjusted for a range of SES factors and found that in the main these explained the health differences between lone and couple mothers.¹⁰⁹⁻¹¹¹ My study, building on this work, modeled the differences in health between lone and couple parents (separately for mothers and fathers) in a staged approach to understand the role that other factors - in particular household resources – might play in the association. I found that there were significant differences in the health of lone and couple parents, with the biggest differences more apparent for measures of overall health status than for recent illness. Lone mothers had the poorest health, with lone fathers' health part way between them and couple parents, reflecting their middle position in terms of SES factors. In more detailed multivariate analyses for mothers only (given the limited number of lone fathers in the study), income and other material resources accounted for between one-third and half of the difference in health between lone and couple mothers. Insofar as data were available I also investigated other mediating factors – such as having other support in the household and time since becoming a lone parent – as well as considering the possibility of health selection. There were limitations to these analyses: for some subgroups of lone parents the dataset was still too small to investigate health differences effectively; using cross-sectional data did not permit assessment of the direction of association between health,

SES and lone parenthood; and, other potential mechanisms such as stress and stigma – which might affect health via underlying biological pathways¹¹² – were not measured so could not be investigated.

Subsequent research, building on this paper, has continued to demonstrate higher levels of poor health and mental distress among lone mothers,¹¹³⁻¹¹⁸ and to a lesser extent lone fathers,^{119,120} compared to couple parents. A number of studies have investigated the explanations for the generally higher health risks among lone than couple parents. To different degrees the role played by higher levels of financial difficulties seems the most important, with lower levels of social support and health selection playing a more minor role.⁸⁴⁻⁸⁶ While a number of studies have examined long-term marital and parenting histories and their effect on health, few have studied the experience of lone parenthood over time. One exception is the paper by Avison which demonstrates that women who are in continual partnerships over a 14 year period with and without children are much less likely to experience psychological distress than women who were lone mothers for part of the period.¹²¹

3.2 Papers from an ERSC grant based on analyses of the BHPS and NCDS

Benzeval, M. and Judge, K. (2001) 'Income and health: the time dimension'
Social Science and Medicine 52:9: 1371-90. (Citations: Google Scholar: 177; Web of Science: 84)

This paper combined a review of the existing literature on income and health over time with analyses of six waves of the BHPS (1991 to 1996/7) to investigate associations between health and income measured at different points in time, more ‘permanent’ measures of income and measures of income dynamics. The sixteen papers identified for the review drew on eight different longitudinal studies from four countries: USA, Canada, West Germany and Sweden. In general they found that income was significantly associated with

health, even after controlling for prior health as a way of addressing health selection. Long-term measures of income were more significant than current income. Income falls had a greater effect on health than improvements, and persistent poverty was more detrimental for health than occasional experience of poverty.

Analysing the effect of income across waves 1 to 5 of the BHPS on health outcomes at wave 6 we found similar results. Across all of the health measures, controlling for prior health, there was a non-linear association with income, which was weaker for psychological distress (as measured by the General Health Questionnaire (GHQ)) and recent illness. Five-year average income was more strongly related to subjective assessments of health and limiting longstanding illness than current income, while current income was more important for GHQ. Similarly, persistent poverty was more significant than occasional episodes for all the health measures except GHQ. An associated book chapter¹²² explored these associations among different subgroups of the population and found that persistent poverty was more strongly associated with health for men under 65 while subjective experience of financial difficulties was more important for women and those over 65.

While there were significant associations between income falls and health, increases in income were not significant, although income volatility, which was strongly correlated with the size of income change, was. This was the first paper to consider the role of volatility *per se* on health. Controlling for prior health and measures of income prior to the health outcomes still resulted in a significant association between income and health, suggesting the relationship might be causal. The relationship with income change was complex, only operating in one direction, which might be the result of time lags, or perhaps more importantly the need to take account of the reason for income changes.⁴⁷

In a systematic review published in 2011, Gunasekara and colleagues¹²³ described this paper as ‘the most thorough review of income and health using longitudinal data ... systematic reviews ... are otherwise lacking’ (p.193). In their update of our review they identified 13 subsequent, mainly econometric, studies, which examined changes in both income and health over time. These studies found a small positive association between income and health, but generally only investigated short-term changes and did not examine long-term income or longer time lags in the relationships. This led Gunasekara and colleagues to conclude that the true causal association between income and health might be smaller than previously suggested; however, the focus on short-term income ignores our and other previous suggestions that longer term measures of income are more important for health.^{62,27,103,104}

Benzeval, M., Taylor, J. and Judge, K. (2000) 'Evidence on the relationship between low income and poor health: Is the government doing enough?' Fiscal Studies 21:3: 375-99. (Citations: Google Scholar: 48; Web of Science: n/a)

This paper, and two associated book chapters,^{124,122} drew on the lifecourse literature¹²⁵ to investigate the specific role of income in childhood and adulthood for subsequent health. I developed a conceptual framework that explicitly drew out the role of income. This framework was then tested against two datasets: the NCDS to examine income in childhood for ‘income potential’, as measured by education, and ‘health capital’ (health status at age 23) as people make the transition to adulthood; and the BHPS to investigate similar concepts of income potential and health capital with subsequent adult health. In the NCDS a derived measure of permanent income²⁶ and the number of times respondents experienced financial difficulties in childhood¹²⁴ were both significant predictors of ‘income potential’ and ‘health capital’ at age 23. Controlling for income potential and health capital, childhood poverty, whichever way measured, did not have a direct effect on adult health. In the BHPS measures of income potential and health capital were the strongest predictors of adult health, followed by variables representing respondents’ social roles (parenting, marriage and employment), but average adult income was still significant, although childhood factors

were not. We concluded that in the main the impact of childhood poverty on adult health was indirect via its effect on key transition factors such as education, health capital and social roles, but that adult income still had a direct effect on health.

This paper, along with a range of other outputs during this period,^{126,127,124,128} also examined the policy context for this relationship, considering the macro economic and social policies that led to significant differences in income in Britain, and how successful government attempts to address these disparities might be. While acknowledging the wide range of economic and social policies that the New Labour Government had introduced³⁸ we suggested that these would have only a marginal impact on income and health inequalities, and could exacerbate inequalities for some subgroups of the population.

3.3 Papers from an MRC grant based on analyses of the BHPS

Thomas, C., Benzeval, M. and Stansfeld, S.A. (2007) 'Psychological distress after employment transitions: the role of subjective financial position as a mediator' Journal of Epidemiology and Community Health 61:1: 48-52.
 (Citations: Google Scholar: 10; Web of Science: 7)

The final paper presented for this PhD investigated the inter-relationships between income, the causes of income change and health. For this paper we chose to employ a subjective measure of financial circumstances rather than actual monetary income, as we felt this might better reflect the gap between people's resources and outgoings, and had been shown to be a strong predictor of mental health in other studies.^{129,130} Using 10 years of data from the BHPS (1991 to 2000), we investigated how changes in subjective financial circumstances mediated the association between annual changes in employment status and subsequent health.

For both men and women, moving from employment to unemployment increased the odds of GHQ caseness. For men, those retiring from non-manual occupations showed an improvement in their mental health while those retiring from manual roles showed a deterioration. For women leaving employment for family care was detrimental for health, while moving back into employment from family care did not significantly improve their mental health. However, returning to work after a period of unemployment was beneficial for both men and women's health. Experiencing financial difficulties was also associated with poor mental health, and this attenuated the association between employment change and health by 30% for men and 16% for women. Changes in employment seemed to be important for the onset and resolution of mental distress rather than its maintenance. In general, beneficial effects of returning to work were only seen for those with prior mental health problems while the detrimental effects of losing paid employment were only apparent for those without pre-existing health problems.

While the subsequent literature has increasingly examined the effect of long-term role occupancy for health,¹³¹⁻¹³³ insofar as this has examined mediating factors it has tended to focus on the quality of social roles, rather than their impact on income. One exception to this is a recent analysis of 16 years of BHPS data, which found that a measure of financial capability exacerbated the effect of divorce and unemployment on psychological wellbeing.¹³⁴ Moreover, the literature has paid less attention to the effect of *changes* in roles on health. The findings of differential effects of retirement for those from different occupational background was supported by other literature,¹³⁵ although subsequent studies have found that it is whether retirement is voluntary or not which is more important for subsequent health.¹³⁶⁻¹³⁸ Most studies find that having multiple roles is beneficial for women's health,^{139,131,132,140} although in the main this research has either examined roles at one point in time^{139,140} or over long periods of time^{131,132} so the impact on health of recent transitions may be masked.

3.4 Overview

In the mid-1990s, when I began this body of work, there was very limited evidence in Britain on the association between income and health, and what existed was often cross-sectional and based on inadequate measures of income. At the same time, there was a growing body of work recognising the importance of lifecourse factors for health, and the economic and poverty literature was arguing that single measures of income could not adequately reflect people's material resources at any point in time, and that the dynamics of income change also needed to be considered. This set of papers addressed these issues.

Across the papers, I concluded that: there was a non-linear association between income and health; income appeared a more important determinant of health than other SES markers, except perhaps even longer term measures of material resources; income was a significant part of the pathway between social roles and health, but such roles still had an additional effect over and above income; and, the effect of childhood income on health appeared to be mediated via education and health capital, but adult income still had an independent association with health. These associations varied by the health outcome considered, were different for men and for women, at different life stages, and according to whether or not respondents were from manual or non-manual backgrounds or had pre-existing health conditions.

There were of course limitations to all of these papers. Based on existing survey data, they were restricted to a limited set of self-reported health measures. BHPS and NCDS, in different ways, only covered short periods of the lifecourse – in different papers based on the former I used between 6 and 10 waves of data, and in NCDS information was only available until the relatively young age of 33 years. When combining waves of these datasets, attrition effects were an issue and the sample size became much smaller, making some of the sub population analyses that would have been interesting too small to contemplate. Similarly, the

techniques employed – mainly logistic regression with robust standard errors to adjust for clustering – were relatively simple and not as effective as they might have been at unravelling the complexities of the role that income may play in the pathways across the lifecourse to health. The literature has, of course, moved on since these papers were published. The next section, therefore, very briefly highlights the contribution of my current ongoing research to these debates.

4. MY RESEARCH SINCE 2004

Evidence of the importance of experiences over the lifecourse in determining health inequalities¹⁴¹⁻¹⁴⁴ has increased greatly since the publication of these papers. As the timespan covered by key cohort and longitudinal studies has grown, more complex methodological techniques have been developed.¹⁴⁵⁻¹⁴⁸ and more sophisticated markers of the possible underlying biological processes have been collected.¹⁴⁹⁻¹⁵⁴ This has enabled researchers to begin to unpick the complexities of pathways through the lifecourse that create and maintain health inequalities.¹⁵⁵⁻¹⁵⁸

Yet income still rarely features in these debates, and so I am continuing to investigate its role in a longer term lifecourse context. Based on data from the Twenty-07 Study – a three cohort study that has followed people aged originally 15, 35 and 55 in 1987/8 and at the most recent wave 35, 55 and 75,³³ we have found that poverty dynamics are more important for the development of depression than anxiety, but that different experiences of poverty are more important for each cohort.¹⁵⁹ In contrast to my previous research, we have also found a stronger effect on mental health for increases in income than income falls, which may reflect the longer time periods over which we can examine income change in the Twenty-07 Study. We are also examining the pathways between social roles, income and health. Losing a job, separating from a partner and having a first child were all significantly detrimental to mental health, while gaining a job had a positive effect on mental health, once the mediating role of income was included.¹⁶⁰ Income itself was still important for depression but not anxiety, once social precursors were considered. I plan to continue to explore these pathways in more detail across a wider range of health outcomes, at the same time considering the differing historical context of the three cohorts' lives and how this might affect these relationships.

More generally, working with my research team enables me to investigate a broader range of issues within the lifecourse framework,³⁴ building on some of the principles from the work

submitted for my thesis, for example the need to consider both long term factors and short term changes in them; the importance of investigating different pathways for different health measures, for men and women, for different life stages, and for people from different socioeconomic backgrounds. For example, we have examined when social inequalities in health emerge during early adulthood,¹⁶¹ whether social inequalities in health widen or converge as people age,¹⁶² the way in which anxiety and depression change and co-occur at different life stages,¹⁶³ and one of my PhD students is investigating movements on and off of incapacity benefit over the lifecourse, how these affect mental health, and whether this varies by SES.¹⁶⁴

In addition we are investigating the pathways - biological, psychological, behavioural and cognitive - that underlie social inequalities in health.³⁴ In relation to biological pathways, our focus at present is on whether telomere length is an effective biomarker of aging,¹⁶⁵ and the extent to which it is socially patterned.¹⁶⁶ We are also investigating whether psychosocial factors predict telomere length¹⁶⁷ and in future will examine the mediating role of telomere length between socioeconomic factors and subsequent mortality. Having examined the social patterning of sleep trajectories over 20 years,¹⁶⁸ we are now investigating the extent to which sleep mediates the association between socioeconomic factors and diabetes¹⁶⁹ and mental health.¹⁷⁰ Two students are examining behavioural trajectories over the lifecourse; one focusing on physical activity¹⁷¹ and a second on the clustering of smoking and drinking.¹⁷²

Given the three-cohort composition of the Twenty-07 Study, we are in a unique position to examine the historical context of the development of health inequalities; and this is the focus of a current studentship.¹⁷³ This research will shed light on how different macro socioeconomic environments and policies may influence the relationship between different social pathways and health.

Overall, therefore, I have designed the programme to investigate the full range of pathways that might contribute to health inequalities over the lifecourse in order to identify key factors and interventions that may help to reduce the health divide. In this way I am continuing with my aim of using my research not just to investigate health inequalities but also to explore what can be done to tackle them.

5. CONCLUSION

The submitted papers have demonstrated the significance of income for health, and explored some of the complexities of this association. However, ongoing academic debates have continued to question its specific causal contribution,^{174,123} and hence its value in policies to reduce the health divide. Nevertheless, improving income amongst those who are least well off in society was a key policy recommendation of the latest English government inquiry of how to tackle health inequalities.¹⁷⁵ While the English policy to tackle health inequalities is largely regarded as the most comprehensive and focused of all international efforts, evidence supporting specific strategies is weak.¹⁷⁶ Continued efforts to understand the role of income and its place in broader pathways to health inequalities are therefore important to policy debates.

Against this background, this set of papers made an internationally recognised novel empirical contribution to our understanding of the income and health relationship, on which others have built, and the findings have contributed to policy debates about how best to reduce inequalities in health. My current research is continuing with this focus on the role of income, as well as examining some of the other pathways that might create health inequalities, in order to better understand how we might tackle them.

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7. THE CO-AUTHORS' DECLARATION FOR THE SUBMITTED PAPERS

Copies of the signed forms are available in the print version or on request

PhD by Publication submission

Co-author declaration

- 1. The Applicant: Michaela Benzeval**

- 2. Title of submission: What is the role of income in creating health inequalities? Evidence from cross-sectional and longitudinal studies**

- 3. The Publication(s) and applicant's contribution**

Benzeval, M., Judge, K. and Taylor, J. (2000) 'Evidence on the relationship between low income and poor health: Is the government doing enough?' *Fiscal Studies* 21:3: 375-99.

Michaela Benzeval acted as lead author on this paper including shaping its overall direction, conducting the literature review and writing the first and revised drafts (in the light of comments by co-authors and referees). Michaela also prepared the data and undertook the BHPS analysis. The data preparation, analysis and drafting of the NCDS section was carried out by Jayne Taylor; Michaela met with her regularly to discuss this. More generally, all authors met periodically during the development of the paper and commented on drafts.

Benzeval, M., Judge, K. and Shouls, S. (2001) 'Understanding the relationship between income and health: How much can be gleaned from cross-sectional data?' *Social Policy & Administration* 35:4: 376-96.

Michaela Benzeval acted as lead author on this paper including shaping its overall direction, conducting the literature review and writing the first and revised drafts (in the light of comments by co-authors and referees). The data preparation and analysis were carried out by Sue Shouls under Michaela's guidance. Michaela line managed Sue, meeting with her regularly to oversee the work. More generally, all authors met periodically during the development of the paper and commented on drafts.

Benzeval, M. and Judge, K. (2001) 'Income and health: the time dimension' *Social Science and Medicine* 52:9: 1371-90.

Michaela Benzeval acted as lead author on this paper including shaping its overall direction, conducting the literature review, preparing the data and carrying out the analysis and writing the first and revised drafts (in the light of comments by co-authors and referees). The two authors met periodically during the development of the paper and KJ commented on drafts.

4 Declaration

Both Sue Shouls and Jayne Taylor have left academia and we are unable to locate them. I am therefore making this declaration on behalf of all coauthors.

I am in agreement that, with regard to the details provided in section 3 above, this is an accurate reflection of the candidate's contribution to the publications specified and being submitted here, in partial fulfilment of the degree of Doctor of Philosophy by Publication at the University of Glasgow. The publication has not, to my knowledge, been submitted before for any degree or examination in any other University.

Signed

Date

(Co-author)

PhD by Publication submission

Co-author declaration

1. The Applicant: Michaela Benzeval

2. Title of submission: What is the role of income in creating health inequalities? Evidence from cross-sectional and longitudinal studies

3. The Publication(s) and applicant's contribution

Thomas, C., Benzeval, M. and Stansfeld, S. A. (2007) 'Psychological distress after employment transitions: the role of subjective financial position as a mediator' *Journal of Epidemiology and Community Health* 61:1: 48-52.

Michaela Benzeval was joint PI on this project (with Stephen) and line managed Claudia. The original idea for this paper was Michaela's, and she provided the overall direction for the paper. Claudia prepared and analysed the data and drafted the paper under Michaela's guidance. They met regularly to discuss this work and Michaela contributed to redrafting the paper. More generally, all of the authors met during the development of the paper and commented on drafts.

4 Declaration

I am in agreement that, with regard to the details provided in section 3 above, this is an accurate reflection of the candidate's contribution to the publication specified and being submitted here, in partial fulfilment of the degree of Doctor of Philosophy by Publication at the University of Glasgow. The publication has not, to my knowledge, been submitted before for any degree or examination in any other University.

Signed

Date

(Co-author)

Signed

Date

(Co-author)

8. THE SUBMITTED PAPERS

PAPER 1

Michaela Benzeval, Ken Judge and Sue Shouls (2001)

'Understanding the relationship between income and health: How much can be gleaned from cross-sectional data?'

Social Policy & Administration 35:4: 376-96.

Understanding the Relationship between Income and Health: How Much Can be Gleaned from Cross-sectional Data?

Michaela Benzeval, Ken Judge and Sue Shouls

Abstract

The aim of this paper is to develop a better understanding of the relationship between income and health using a cross-sectional survey of the general British population. It is divided into two parts. First, it examines a number of methodological inconsistencies in the existing literature and assesses their consequences for the inferences that can be drawn about the income–health association. These issues include: the measurement of income and its functional form; health selection; and the role of confounders. Second, it explores the relative strength of the income–health association in contrast to that of other socioeconomic measures. The relationship between income and health is complex. However, having taken into account a range of methodological problems, income is still significantly associated with health. The association appears to be non-linear and is attenuated but not removed by controlling for health selection effects. The inclusion of a wide range of confounders into models of income and health reduces the association between them, but does not make it insignificant. In comparison to other socioeconomic measures, income appears to be a better discriminator of health status than education or occupation. However, tenure and car ownership seem to be at least as good if not better than current income.

Keywords

Health; UK population; Income; Education; Occupation

Introduction

It is widely believed that poverty and low income are bad for health. For example, in an answer to a parliamentary question in his first month in office, the Prime Minister stated that “there is no doubt that the published statistics show a link between income, inequality and poor health” (Hansard 1997). Similarly, the Secretary of State for Health and Minister of Public Health, in the Foreword to the Green Paper *Our Healthier Nation*, asserted

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that "poor people are ill more often and die sooner" (Cm 3852, 1998). However, when the Green Paper goes on to cite evidence in support of this assertion, there is a subtle shift in terminology: "The link between poverty and ill health is clear. In nearly every case the highest incidence of illness is experienced by the worst off social classes" (Cm 3852, 1998).

All too often in the world of politics—and even in academic circles—low income, poverty, manual occupational classes and poor educational achievement are treated as interchangeable phenomena. This is not a significant problem if the primary aim is to demonstrate the association between disadvantaged socioeconomic circumstances and health. However, if the objective is to develop an understanding of the causal nature of the relationship between socioeconomic status and health, one needs to be much clearer about how and why different variables are employed. It is only by doing this that one can begin to develop effective policy options to reduce health inequalities.

Developing a clearer understanding of the association between income and health is important because income is one of the most malleable policy instruments (Duncan 1996). For example, through policies to set state benefit or taxation levels, and legislation on minimum wages, governments can influence the income level of their citizens with immediate effect. In contrast, other efforts to tackle disadvantage, such as improving employment and education opportunities, are longer-term strategies.

The literature on the association between income and health is quite limited in Britain. A number of national surveys—for example, the National Child Development Survey (NCDS), Health and Lifestyle Survey (HALS), General Household Survey (GHS) and British Household Panel Survey (BHPS)—have included questions on both income and health, although analysis of the association between these variables has been limited. Nevertheless, evidence from these studies does support the belief that there is a relationship between income and health.

- In an analysis of the respondents to NCDS at age 23, Power and colleagues (1991) illustrated a marked relationship between income categories and self-assessed health, malaise, psychological morbidity and height.
- Using HALS, Blaxter (1990) found a clear and consistent association between income and health. Based on the results of multivariate analyses she argued that "the apparently strong association of social class and health is primarily an association of income and health". In more detailed analysis of women's health in HALS Macran and colleagues (1996) find that "income is associated positively and significantly with women's health" after controlling for a range of other socioeconomic factors.
- The GHS has mainly been used to describe rather than explain the association between income and health. An association between the two variables has been demonstrated for GHS data from the 1970s (Hurst 1985), 1980s (O'Donnell and Propper 1991) and 1990s (Benzeval 1997; Benzeval and Judge 1998). For example, in the early 1990s, people of working age whose family income is in the bottom 20 per cent of the distribution are over 3.5 times more likely to report their health as poor than those in the top fifth (Benzeval and Judge 1998). A weaker association has been demonstrated

- between income and health among older people controlling for a range of other factors (Benzeval 1997; Arber and Ginn 1993).
- Using a cross-section of the BHPS Weich and Lewis (1998) found a significant association between common mental disorder (as measured by the GHQ) and low household income, after controlling for a wide range of confounders.

More significantly, there is also a substantial international literature that confirms an association between income and health. For example, Benzeval and Webb (1995) cite evidence from eight different countries in Europe, North America and Australia. The USA, in particular, has a wealth of evidence based on income and measures of morbidity and mortality. The first major study linking information with the census for 1960 found higher mortality rates among black and white, men and women with low incomes (Kitagawa and Hauser 1973). Repeating this analysis with data from the mid-1980s Pappas and colleagues (1993) found not only that the income differential in mortality still existed but that it had widened. A large national survey in Australia found a significant association between income and a range of morbidity measures after controlling for a wide range of other factors (National Health Strategy 1992).

Against that background, this paper has two aims. First, to explore the implications of different methodological assumptions for the income and health association. In particular, there are three key issues that merit closer investigation:

- the measurement of income (including linearity);
- the role of health selection;
- the use of confounders.

The second aim is to develop a better understanding of the interrelationship between income, other measures of socioeconomic status and health. It is based on the analysis of a large cross-sectional national survey conducted in Britain in the early 1990s, which is described in the next section.

Data

The General Household Survey (GHS) is a continuous household survey, conducted by the Office of National Statistics, which contains information on approximately 16,000 households and 25,000 people every year. It is based on a stratified random sample of private households in Great Britain and has an annual response rate of between 80 and 85 per cent (Thomas *et al.* 1994; Foster 1995). The survey has been shown to be representative of the general population in Great Britain, having a similar demographic and socioeconomic profile to the 1991 Census (Bridgewood and Savage 1993). This paper focuses on adults of working age (16–64), since the association between income and health for children and older people is rather different. The analysis employs two years of GHS—1992/3 and 1993/4—which results in a sample size of 30,195.

Box 1

Health questions in the GHS

1. Over the last 12 months would you say your health has on the whole been good, fairly good, or not good?

Variable 1 Fairly good or not good health versus good 33% sample
Variable 2 Not good health versus fairly good or good health 9% sample

2. Do you have any long-standing illness, disability or infirmity? By long-standing I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time.

- a) Does this illness or disability limit your activities in any way?

Variable 3 Has long-standing illness 31.6% sample
Variable 4 Has limiting long-standing illness 17.9% sample

3. Now I'd like you to think about the 2 weeks ending yesterday. During those 2 weeks, did you have to cut down on any of the things you usually do (about the house/at work or in your free time) because of illness or injury?

Variable 5 Has recent limiting illness 12.5% sample

The health measures

The GHS contains three health questions, which are used to create five binary health variables that are shown in box 1. All of the analyses in the paper are conducted for each of the five variables.

Income in the GHS

All adult respondents to the survey are asked a series of questions about their income from all sources, including employment, state benefits, occupational pensions, investment interest and dividends, rent from properties, educational grants and any other payments or allowances. Total income for individuals, net of taxes, is then aggregated to the family level. For all families where income is not available for any individual, all members are coded as having missing income data. As a result 13 per cent of families do not have income information. Families with missing information tend to be of slightly higher socioeconomic status than the general survey population. Where possible a dummy variable for people with missing income information is included in the analysis.

Two adjustments are then made to disposable family income in order to create a measure of comparable living standards. First, the income information is deflated by the retail price index to adjust for inflation. Second, the income data are equivalized to take account of the different size and composition of families. Three different equivalent scales were investigated—McClements

(1977), OECD (Atkinson *et al.* 1995) and one derived from social security rates (Department of Social Security 1992). However, as the results did not differ substantially between them the paper only reports those based on the McClements scale, the most commonly employed measure in British research.

Other data available in the GHS

The literature includes a wide range of factors that have been used as confounders in the relationship between income and health. The most common confounders identified from other studies, which are available in GHS, include:

- age and sex;
- ethnicity;
- social roles—marital and parental status, living arrangements;
- education;
- occupation;
- economic status—employment status and reason for non-employment;
- consumption measures—tenure and car ownership.

In order to explore the association between income and health in detail while controlling for other factors, multivariate analyses are conducted. Since all of the health outcome measures are binary, i.e. take the value 0 or 1, the most appropriate statistical technique is logistic regression (Hosmer and Lemeshow 1989). The method for examining each of the issues is described below. All of the analyses are conducted for each of the five health outcome measures and the models always include age and sex.

Given the quite different approaches required to explore the two aims of this paper, the methods and results for each are set out separately in the following two sections. The final part of the paper discusses the significance of the findings for further research and policy.

Methodological Issues

The first aim of the GHS analysis is to examine the effect of employing different methods—in terms of the measurement of income, the role of health selection and the use of confounders—on the inferences that can be drawn about the relationship between income and health.

Income measurement

There are two issues in relation to the measurement of income that need to be explored: first, whether the definition of income employed in the analysis influences the size and strength of the association with health; and second, which functional form of income is most appropriate.

Income definition There is little consensus in the health inequalities literature about how best to measure income. Some studies use family income, others

individual, while others limit their analysis to wages only. Some studies adjust for taxes and benefits and the composition of families, but many do not. Often, however, income is based on a self-reported answer to a single banded question (for example in HALS) where it is impossible to know whether respondents are using a consistent definition.

Since the income and health literature is based on a variety of measures of income it is difficult to compare the results from one study to another. Are differences in the findings of studies real, or are they an artefact of the different ways in which income has been measured? Does the association between income and health remain when an appropriate measure of income is employed?

Social scientists are clear, however, that the most appropriate measure of income for comparative purposes is equivalent disposable family income (Atkinson 1992). This means income, net of direct taxes, that is derived from all sources, such as wages, investments, benefits and pensions, for all family members. This income measure must then be weighted—or equivalized—to take account of the different size and composition of families. This is because a family of two adults and two children would need more income, but not four times as much income as a single person in order to have an equivalent standard of living.

To illustrate the effect that using different definitions of income has on the association between income and health, we compare models for each health variable, using three different measures of income:

- net individual income;
- gross family income;
- equivalent net real family income adjusted for family composition using the McClements scale.

Results Table 1 shows the odds ratios for income quintiles for the three different income definitions: net individual income, gross family income and equivalent net family income, for each of the health measures. Equivalent net family income produces the best statistical model—in terms of the change in scaled deviance from a constant only model—for three of the health measures: the two versions of subjective general health and limiting long-standing illness.

In fact, there is a strong association between equivalent net family income and health for four of the health measures. For example, people in the lowest income quintile are 2.5 times more likely to have a limiting long-standing illness and 4.5 times more likely to report their health as not good than the richest fifth of the population. In contrast, the association between income and recent limiting illness is much weaker. Only the bottom two income quintiles are statistically significant and their additional health risk in comparison to the richest fifth is relatively small compared to the other health measures.

GHS respondents with missing income information tend to have odds ratios that are slightly lower than those for people in the middle income quintile, reflecting their above-average socioeconomic status.

Table 1
The effect of different definitions of income on the income–health relationship

Income quintiles	Odds ratios for income quintiles ^a														
	Long-standing illness			Limiting long-standing illness			Recent limiting illness			General health fairly or not good			General health not good		
	net ind income	gross family income	equiv family income	net ind income	gross family income	equiv family income	net ind income	gross family income	equiv family income	net ind income	gross family income	equiv family income	net ind income	gross family income	equiv family income
1 lowest	1.56	1.81	1.75	1.96	2.35	2.53	0.95ns	1.52	1.32	2.19	2.58	2.78	2.81	3.60	4.57
2	1.88	1.52	1.52	2.68	1.81	2.04	1.16(10)	1.28	1.27	2.38	2.05	2.25	3.47	2.51	3.44
3	1.65	1.21	1.29	2.20	1.31	1.50	1.17	1.09ns	1.07ns	2.08	1.53	1.80	3.06	1.68	2.09
4	1.24	1.20	1.13	1.40	1.19	1.23	0.99ns	0.97ns	1.00ns	1.45	1.27	1.35	1.56	1.47	1.79
5 highest	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
missing	1.10ns	1.04ns	1.06ns	1.37	1.24	1.32	0.92ns	1.02ns	0.98ns	1.49	1.50	1.60	1.80	1.66	2.01
χ^2	1710	1695	1683	1697	1648	1702	176	239	197	1287	1400	1475	1102	1140	1259
<i>N</i> =	29784			29721			29789			28213			28213		

^a All models contain age and sex. All odds ratios are significant at 5 per cent level unless otherwise indicated.

In comparison to equivalent net family income, net individual income appears to underestimate the relative poor health of people in the lowest part of the income distribution, across the range of health measures. This is reasonably intuitive. Many people at the bottom of the distribution will have zero individual incomes. However, this does not mean that they have no material resources because they share the income available to the rest of their family. Hence, using individual income can underestimate the income available to individuals to invest in their health and dilute the association between income and health.

Gross family income also appears to underestimate the poor health of people with the lowest incomes. Again, an intuitive explanation is apparent. When the income measure does not take into account the size and composition of families, single people will tend to be at the bottom of the income distribution because they have fewer pounds in their pockets than families with multiple earners or benefit recipients. However, when family composition is taken into account single people are shown to be comparatively more affluent than families on the same income who have more people to maintain. Again the association is diluted at the bottom of the distribution by not taking this into account.

The remainder of the paper uses net equivalent family income.

Income functional form The second aspect of income measurement to explore is the shape of the association between income and health. The income and health relationship may take a number of forms. At its simplest, there may be a linear gradient between income and health such that for every £1 increase in income there is a unit increase in health. Alternatively, there may be a threshold effect, so that income clearly affects people's health up to a specific level, beyond which the association disappears. Finally, there may be a non-linear relationship between income and health, such that at different points of the income distribution income has a different effect on health. In this paper, therefore, alternative functions of the income variable are examined in order to assess which one best explains the relationship between income and health. Separate models were constructed for all five health measures using different functions of income, controlling for age and sex. Three income functions were tried:

- a continuous linear variable;
- non-linear transformations of the continuous income variable—specifically quadratic and cubic functions;
- dummy variables for income quintiles, with the richest quintile excluded from the analysis to act as the base category.

In order to ensure comparability between the models, people with missing income were excluded from all of the analyses in this section. The change in scaled deviance from a constant only model of each income function was compared to assess which was the best model. The probability of reporting ill health for each functional form of income is then calculated to assess the effect that the different forms might have on interpreting the relationship between income and health.

Results Table 2 shows the change in scaled deviance from the constant only model for each functional form of income for all five health variables, after adjusting for age and sex.

The results suggest that the relationship between income and health is non-linear. For each of the health measures the best statistical fit is provided by the model based on income quintiles, followed by the two non-linear functions, while the linear income model consistently has the poorest statistical fit.

Figure 1 shows the implications of employing different income functions for predicting the probability of reporting fairly or not good health. In comparison to the non-linear models, linear income understates the probability of reporting "fairly or not good" health among low-income groups and overstates it among high-income groups.

The remainder of this paper, therefore, uses income quintiles in the statistical analyses, since they appear to give the best statistical fit, are easily interpreted, and enable people with missing income to be kept in the analysis.

Health selection

Most studies tend to assume that low income causes poor health. However, it is possible that health selection may be taking place, i.e. that poor health results in people's income being reduced. There are at least two types of health selection that might occur as part of the income and health relationship. First, a person in poor health might be unable to work and hence lose or leave their job and this would result in a lower income. In these circumstances, they may describe themselves as unable to work due to ill health, being unemployed, looking after the home or retired. Second, someone with ill health might have to take a less strenuous or stressful job or work fewer hours because of their health, which might result in a lower income. Clearly this issue is a more direct problem when wages or individual income is the variable of interest. However, even with family income, lower incomes for any individual will almost certainly lead to lower incomes for the whole family. Hence, not taking account of health selection effects may overstate the causal link between income and health.

With cross-sectional data such as the GHS it is impossible to identify the time sequence of events, i.e. whether a person changed their occupation or economic status before or after their change in health. Longitudinal data are required to explore this problem effectively. However, it is possible to take account of these health selection effects in a very crude way, by excluding from the analyses all people who reported that they were economically inactive due to ill health.

There are clearly problems with this approach even at a crude level. First, it assumes that for everyone who was economically inactive due to ill health, the direction of causation ran from poor health, to job loss, to low income. It does not take into account what caused the poor health in the first instance. On the other hand, it does not take account of those people who, when they lost their job directly or indirectly as a consequence of poor health, described

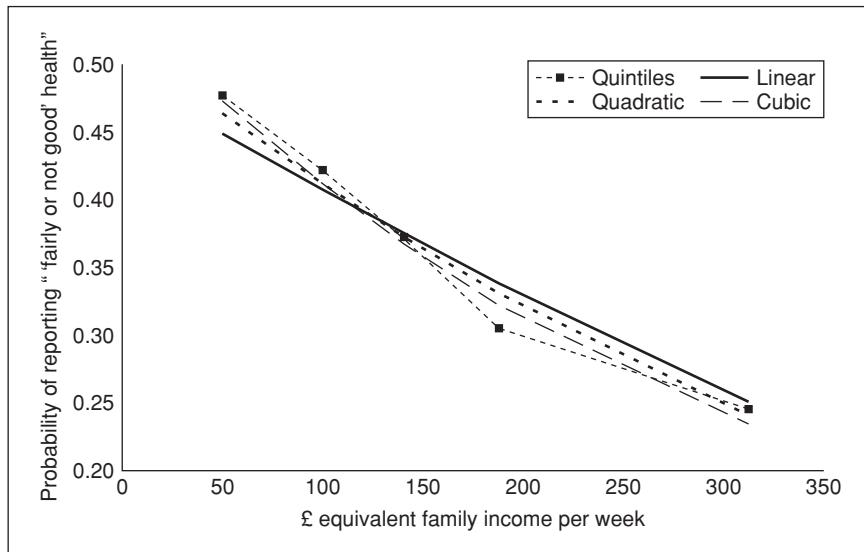
Table 2
The effect of different functional forms on the income and health relationship

Income function	Change in scaled deviance from constant only model (χ^2) ^a				
	Long-standing illness	Limiting long-standing illness	Recent limiting illness	General health fairly or not good	General health not good
linear (3 d of f)	1414	1423	161	1289	1064
quadratic (4 d of f)	1456	1490	173	1379	1118
cubic (5 d of f)	1475	1525	177	1414	1128
quintiles (6 d of f)	1495	1571	191	1441	1178
<i>N</i> =	26364	26310	26369	25144	25144

^a All models contain age and sex.

Figure 1

Probability of reporting fairly or not good health for different functional forms of income



themselves as looking after the home, retired or unemployed. Similarly, people who may have changed their job, and hence experienced a drop in income, because of illness cannot be identified. Nevertheless, it is still useful to estimate part of the effect that health selection might have on the income and health association using this approach. For each health measure, models of the association between income and health are estimated including and excluding people who are economically inactive due to ill health.

Results Table 3 shows the implication of attempting to adjust for some of the most obvious health selection effects. For each health measure the left-hand column shows the odds ratios for each income quintile for all adults. The right-hand column shows the odds ratios for all adults *excluding those who are economically inactive due to ill health*. Excluding people who are permanently unable to work due to ill health affects both the statistical fit of the models and the shape of the income–health relationship. Across all of the health measures, the scaled deviance of the restricted models is substantially lower than that of the models for all adults, and the gradients are flatter, particularly among the lower income quintiles. However, this is not surprising since people who are economically inactive due to ill health tend to be in the bottom of the income distribution. Not taking account of the possibility of health selection, therefore, may lead one to assume that a much stronger and steeper causal relationship exists between income and health than may be the case.

Table 3
The effect of health selection on the income and health relationship

Income quintiles	Odds ratio for income quintiles ^a									
	Long-standing illness		Limiting long-standing illness		Recent limiting illness		General health fairly or not good		General health not good	
	All adults	Excluding eiih ^b	All adults	Excluding eiih	All adults	Excluding eiih	All adults	Excluding eiih	All adults	Excluding eiih
1 lowest	1.8	1.4	2.5	1.9	1.3	1.1ns	2.8	2.3	4.6	3.3
2	1.5	1.3	2.0	1.5	1.3	1.1ns	2.3	1.9	3.4	2.5
3	1.3	1.2	1.5	1.3	1.1ns	1.0ns	1.8	1.7	2.1	1.7
4	1.1	1.1ns	1.2	1.1(10)	1.0ns	1.0ns	1.3	1.3	1.8	1.6
5 highest	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
missing	1.1ns	1.0ns	1.3	1.2	1.0ns	1.0ns	1.6	1.5	2.0	1.8
χ^2 (7 d of f)	1683	1074	1702	916	197	112	1475	999	1259	667
<i>N</i> =	29784	28357	29721	28302	29789	28364	28213	26915	28213	26915

^a All models contain age and sex, all odds ratios are significant at 5 per cent level unless indicated otherwise.

^b Economically inactive due to ill health.

However, it is important to emphasize that even when these potential health selection effects are removed, there is still a strong association between income and health for all of the health measures, except recent limiting illness. For example, people in the bottom fifth of the income distribution are 1.9 times more likely to have a limiting long-standing illness and 3.3 times more likely to report their health as not good than the richest fifth.

Respondents who are economically inactive due to ill health have been excluded from the remainder of the analyses in an attempt to adjust for the worst of the health selection effects.

Confounders

A wide range of other variables are often included in statistical models that aim to explore the relationship between income and health. The rationale for the inclusion of these other factors is not always clear and the implications of multi-collinearity between other variables and income on their coefficients are rarely considered. Moreover, the effect on the association between income and health is difficult to assess systematically since different studies use different combinations of variables. Unfortunately, this means that the policy inferences that can be drawn from the literature are ambiguous. A weak association between income and health may simply mean that the model has not been specified correctly or that the variables are poorly measured. The final methodological issue to consider, therefore, is the impact that different kinds of confounders have on the income and health relationship. To do this, multivariate models of each health measure are developed by adding each set of confounders in stages, as set out below.

- Stage 1 Income quintiles plus age and sex
- Stage 2 Stage 1 + ethnicity
- Stage 3 Stage 2 + social roles—parental and marital status
- Stage 4 Stage 3 + education and occupation
- Stage 5 Stage 4 + economic status
- Stage 6 Stage 5 + housing tenure and car ownership

Results Table 4 shows the effect on the odds ratios for income quintiles of including each group of confounders into models of health in a cumulative fashion, as shown above.

The table does not present the full results for each model but focuses on changes in the odds ratios for the income quintiles at each successive stage in the modelling process for three of the health measures.

The first thing to note is that the pattern of association between income and health remains broadly consistent for all health measures at stages 2 and 3. This suggests that controlling for ethnicity and social roles has little effect on the income–health relationship. From stage 4 onwards, however, the association between income and health begins to flatten as education and occupation—and more significantly economic status and measures of consumption—are added to the models. Nonetheless, for all of the health measures except recent illness, after adjusting for a broad range of socioeconomic

Table 4

The effect of different confounders on the income and health relationship

Income quintiles	Odds ratios for income quintiles at each stage of modelling ^a					
	1	2	3	4	5	6
Long-standing illness						
1 lowest	1.43	1.44	1.47	1.41	1.19	1.11 (10)
2	1.27	1.28	1.37	1.30	1.20	1.16
3	1.18	1.18	1.22	1.19	1.15	1.14
4	1.07ns	1.07ns	1.10 (10)	1.07ns	1.06ns	1.06ns
5 highest	1.00	1.00	1.00	1.00	1.00	1.00
missing	1.02ns	1.03ns	1.05ns	1.02ns	0.99ns	0.98ns
χ^2	982 (7)	14 (3)	72 (2)	10 (2)	136 (4)	32 (3)
Limiting long-standing illness						
1 lowest	1.89	1.90	1.88	1.72	1.25	1.16
2	1.51	1.51	1.54	1.41	1.24	1.20
3	1.26	1.26	1.28	1.20	1.13 (10)	1.12 (10)
4	1.12 (10)	1.12 (10)	1.13 (10)	1.07ns	1.06ns	1.06ns
5 highest	1.00	1.00	1.00	1.00	1.00	1.00
missing	1.22	1.22	1.24	1.17	1.09ns	1.08ns
χ^2	843 (7)	3 (1)	21 (2)	29 (2)	168 (4)	36 (3)
Recent limiting illness						
1 lowest	1.07ns	1.08ns	1.05ns	1.14 (10)	1.08ns	1.00ns
2	1.08ns	1.09ns	1.10ns	1.19	1.17	1.13 (10)
3	0.96ns	0.96ns	0.97ns	1.04ns	1.04ns	1.02ns
4	0.95ns	0.95ns	0.97ns	1.01ns	1.01ns	1.01ns
5 highest	1.00	1.00	1.00	1.00	1.00	1.00
missing	0.99ns	1.00ns	1.00ns	1.07ns	1.06ns	1.05ns
χ^2	90 (7)	2 (1)	41 (2)	21 (2)	22 (4)	12 (2)
General health fairly or not good						
1 lowest	2.34	2.29	2.23	1.81	1.53	1.29
2	1.94	1.92	1.94	1.59	1.50	1.37
3	1.68	1.68	1.70	1.45	1.42	1.36
4	1.29	1.29	1.30	1.17	1.16	1.15
5 highest	1.00	1.00	1.00	1.00	1.00	1.00
missing	1.55	1.54	1.54	1.37	1.33	1.30
χ^2	975 (7)	25 (4)	56 (2)	213 (4)	111 (4)	125 (4)
General health not good						
1 lowest	3.29	3.20	3.19	2.65	1.77	1.46
2	2.50	2.46	2.48	2.10	1.81	1.63
3	1.77	1.68	1.70	1.50	1.41	1.34
4	1.64	1.64	1.65	1.52	1.51	1.49
5 highest	1.00	1.00	1.00	1.00	1.00	1.00
missing	1.86	1.82	1.85	1.67	1.53	1.48
χ^2	646 (7)	23 (3)	3 (1)	53 (3)	168 (5)	46 (3)

^a All models contain age and sex, the sample excludes all those people who were economically inactive due to ill health. All odds ratios are significant at 5 per cent level unless otherwise indicated.

and demographic characteristics, people in the lower income quintiles are still significantly more likely to have poorer health than the richest fifth.

Summary

The results presented in this paper show that there is a strong bivariate association between income and self-reported health. The association remains when an appropriate measure of income is employed and health selection is controlled for, albeit in a crude manner. The relationship between income and health appears to be non-linear. Changes in health appear to be much steeper in the bottom part of the income distribution and there is a much weaker association at high levels of income. This is consistent with the findings from a number of other studies that have investigated the shape of the relationship between income and health (Backlund *et al.* 1996; Mirowsky and Hu 1996; Der *et al.* 2000).

In multivariate analyses the association between income and health becomes weaker, although it generally remains significant, when other measures of socioeconomic status are introduced. Measures of economic status and consumption, in particular, weaken the association between income and health. The next section of the paper, therefore, explores the interrelationship between income, other measures of socioeconomic status and health in more detail.

The Relative Importance of Income

Building on the descriptive analysis outlined above, the second aim of this paper is to develop an understanding of the relative importance of income and other measures of socioeconomic status for health. We compare the association between income and health, with education—measured by age of leaving full-time education and qualifications—occupation and measures of consumption. To do this we compare the statistical properties of models of the association between income and health stratified for a second socioeconomic measure, with those of models of different socioeconomic measures stratified by income. This allows the odds ratios of ill health to vary between strata, allowing comparisons to be made of their significance within each stratum. Davey Smith and colleagues (1998) argue that a good discriminator of socioeconomic inequalities in health will remain strong and significant within each stratum of other socioeconomic measures. However, our analysis is rather more complicated than that of Davey Smith and colleagues because they assume that the socioeconomic measures are linear and only compare two variables. Hence they compare a single beta coefficient for each variable within the different strata of the second. However, we believe that the relationship between socioeconomic measures and health could be non-linear. Hence we divide each socioeconomic variable into four hierarchical categories, and compare the odds ratios for each category within each stratum. Any case that had missing information on any of the variables was excluded from all of the analyses. This reduces the sample for this part of the paper to 21,997.

Results

Table 5 illustrates the results with the specific odds ratios from the model for the subjective reporting of health being only fairly or not good. The top section—above the rule—shows the two-way comparison between education, as measured by age left full-time education, and income.

The left-hand side of the table shows the odds ratios for income quartiles in four different strata based on age left full-time education. The right-hand side shows the odds ratios for the four different categories of education within each income quartile stratum. In each case the reference category is the most affluent group, and they are not listed in the table. For example the first row shows that in each education stratum people in the bottom 25 per cent of the income distribution were nearly twice as likely to report fairly or not good health as those in the top quarter. In contrast people who left full-time education under 16 are 1.24 times more likely to report fairly or not good health than those who left after 19 if they are in the third income quartile and approximately 1.7 times more likely if in the top or bottom income stratum.

In general, in each two-way comparison (of models of income stratified for a second socioeconomic variable and models of the second variable stratified for income), income appears to be a stronger discriminator (in terms of the size of the change in scaled deviance, the gradient across the socioeconomic categories and the number of significant odds ratios) than both measures of education, and occupational class. However, the variable based on tenure and car ownership appears to be at least as good a discriminator as current family income. What is also apparent from this table is that those people with multiple measures of disadvantage have particularly poor health.

Overall, therefore, income does appear to have a strong association with health and to be a relatively better discriminator than other traditional measures of socioeconomic status such as occupation and education. As with the other analyses above, models for the other health variables except recent acute illness follow the same pattern, and so are not presented here.

Discussion

A number of studies have tried to assess the relative importance of income, occupation and education for mortality (Rogot *et al.* 1992; Sorlie *et al.* 1995) and morbidity (Leigh and Fries 1991; Hay 1988; Winkleby *et al.* 1992; Dahl 1994; Stronks 1997). Each comes to a different conclusion.

In an analysis of Norwegian data, Dahl (1994) concludes that “occupation status stands as the most powerful and consistent predictor of ill health among employed individuals”. Winkleby and colleagues (1992) in a study of the employed population found that “after adjusting for age and the time of the survey education was the only measure of socioeconomic status that was significantly associated with the risk factors”. In contrast, Hay (1988) found that in an analysis of male earners “of the three socioeconomic measures, income was consistently the best correlate of health status”. Finally, Stronks (1997) in a study of the whole population of working age found that an income proxy resulted in the biggest change in deviance for both chronic

Table 5

The relative importance of different measures of socioeconomic status for subjective assessment of health as fairly good or not good

Odds ratios for income quartiles within other SES strata**+					Odds ratios for other measures SES within income quartile strata**+					
income quartile	Age left full-time education				Age left ft ed	Income quartile stratum				
	under 16	16	17-18	19+		bottom 25%	2	3	top 25%	25%
bottom 25%	1.95	2.17	1.93	1.95	under 16	1.64	1.36	1.24	1.70	
2	1.52	1.65	1.41	1.65	16	1.29	1.25	0.96	1.21	
3	1.29	1.23	1.22	1.54	17-18	1.15	1.05	0.96	1.19	
Change in χ^2	86	101	37	56	Change in χ^2	27	13	12	36	
income quartile	Educational qualifications				quals	Income quartile stratum				
	none	GCSE	A level	degree		bottom 25%	2	3	top 25%	25%
bottom 25%	2.08	2.10	1.28	1.82	none	1.79	1.55	1.45	1.63	
2	1.58	1.63	1.24	1.56	GCSE	1.33	1.27	1.17	1.18	
3	1.24	1.33	1.07	1.37	A level	0.90	1.09	1.05	1.27	
Change in χ^2	85	112	5	38	Change in χ^2	53	24	19	26	
income quartile	Occupational class				class	Income quartile stratum				
	I&II	IIIIn-m	IIIm	IV&V		bottom 25%	2	3	top 25%	25%
bottom 25%	2.06	2.08	1.99	1.92	I&II	1.51	1.61	1.80	1.51	
2	1.54	1.87	1.50	1.42	IIIInm	1.16	1.47	1.36	1.11	
3	1.31	1.38	1.30	1.12	IIIm	1.07	1.13	1.32	1.09	
Change in χ^2	59	56	91	39	Change in χ^2	29	36	36	13	
income quartile	Tenure and car access				class	Income quartile stratum				
	LA rent no car	LA rent car	owner no car	owner car		bottom 25%	2	3	top 25%	25%
bottom 25%	4.71	1.87	1.63	1.53	LA rent no car	2.35	2.00	1.68	0.84	
2	3.66	1.64	1.45	1.43	LA rent car	1.77	1.66	1.50	1.45	
3	2.61	1.32	1.28	1.28	owner no car	1.25	1.17	1.17	1.19	
Change in χ^2	25	44	45	33	Change in χ^2	88	64	28	16	

* All models contain age and sex, the sample excludes all those people who were economically inactive due to ill health or had missing information on any of the socioeconomic measures.

+ All odds ratios are significant at the 10 per cent level except those indicated in italics.

condition and perceived general health for men and perceived general health for women. However, Stronks went on to add employment status to her models and found that this substantially reduced the coefficients on the income measures, concluding that

the relatively strong association between income and health, relative to that between education/occupation and health, is largely due to the concentration of those with a long-term work disability in the lower income levels.

Stronks therefore reanalysed her data to exclude those who had a long-term work disability and found the association of income with health to be similar to that with education or occupation.

Since all of these studies are based on different population groups with different health outcomes and different measures of the socioeconomic variables of interest, it is difficult to draw any general conclusions from their results. Moreover, as Dahl (1994) points out, all of the different measures of socioeconomic status are highly correlated. For example, in this analysis of the GHS, the Pearson's correlation coefficients between income, and education ($r = 0.31$) and occupation ($r = 0.34$) are significant at the 99 per cent level. Similarly, people who are economically inactive, for whatever reason, are over five times as likely to be in the bottom 20 per cent of the income distribution as those in employment. In addition, all of the variables are likely to be subject to measurement error. These two problems taken together mean that the coefficients estimated by logistic regression are likely to be biased, imprecise and unstable (Koutsoyiannis 1977). Caution must be employed, therefore, in making any statement about the relative importance of one measure of socioeconomic status over another.

However, from a theoretical perspective, it is important to be clear that education, occupation, economic status and income are all hypothesized to have overlapping and distinct effects on people's health as well as being markers of people's socioeconomic status (Sorlie *et al.* 1995; Dahl 1994). For example, education might be thought to have a direct effect on people's health by enabling them to process health information and by encouraging a cultural identity and peer group membership that promote the adoption of a more healthy lifestyle. However, education will also affect health indirectly because it is the key determinant of people's access to a well-paid job, influencing their occupation and employment status and hence their income. Occupation will directly affect people's health through their working conditions but also indirectly because it is a key determinant of their income. An individual's economic status is a good proxy for their current access to resources, since having a job is the best route out of poverty (Benzeval and Webb 1995). In addition, there is evidence to suggest that the social role of being employed may be beneficial to one's health, because it improves people's self-esteem and widens social contacts.

The stronger and more robust association between consumption measures—tenure and car ownership—and health may be because they are better markers for long-term material resources than current income. Economic theories of the life cycle suggest that people will smooth their expenditure

as their income fluctuates by making use of borrowing and savings (Blundell and Preston 1995). The strength of the association between tenure and car access and health, therefore, is consistent with the broader literature on health inequalities which emphasizes the importance of the cumulative impact of socioeconomic circumstances across the life course for health (Power *et al.* 1999).

Conclusion

The analysis of income and health presented in this paper has explored two key issues. First, given the confusion in the literature about different methodological issues, it assesses their implications for the income and health association. We report that even when these are taken into account, there appears to be a strong association between income and health. Second, the paper examines the interrelationships between income, other socioeconomic measures and health. Having controlled for these in as sophisticated a way as possible with cross-sectional data, we still identify a significant association for income and health.

What these results imply is that improving current income levels, particularly among those at the bottom of the distribution, should improve health. However, the analysis also begins to illustrate the complexity of the relationship between income and health. In particular, the way that health selection, economic status and consumption measures reduce the significance of income for health implies that a more sophisticated conceptual framework of the relationship is required. Such a model ought to satisfy a number of requirements. For example, it would: take into account the timing of events; explore some of the determinants of current income levels (economic status and education); and adopt a life-course perspective (suggested by the significance of consumption factors). However, the development of such a model can only be undertaken with longitudinal data. No matter how carefully one conducts the analysis of cross-sectional data, such as that made available from the GHS, there are limitations on the policy-related inferences that can be made. Any serious attempt in the future to identify the underlying nature of the relationship between poverty and health must adopt a life-course perspective.

A start has been made in exploring the relationship between income and health over the life course using panel data, mainly in the USA. For example, Duncan (1996) concludes that

family income is a powerful (perhaps the most powerful) component of SES in its linkage with health . . . income volatility also matters, although its role is less important than that of income level. The results on income level are consistent with but do not prove that *ceteris paribus* increases in the short-run income of low-income families would improve health status.

In a more detailed systematic review of "replication" studies, Duncan and Brooks-Gunn (1997) begin to try and unravel the effects of income, parental education and family structure on a range of outcomes in childhood. They conclude that persistent poverty in early childhood is particularly damaging for educational ability and achievement, and hence is likely to affect the

chances of success in the labour market in adulthood. What is now needed is the replication and further development of analyses based on longitudinal data so as to develop a broader theoretical framework that encompasses both childhood and adulthood determinants of health and income.

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PAPER 2

Michaela Benzeval (1998)

'The self-reported health status of lone parents'

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THE SELF-REPORTED HEALTH STATUS OF LONE PARENTS

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Abstract—A number of studies have shown that lone parents have poorer health status than the general population. However, what is missing from the existing literature is any systematic assessment of the contribution that lone parents' relatively poor socioeconomic circumstances make to their relative health disadvantage. This paper aims to fill this gap. It employs a large national dataset based on three consecutive years of the *British General Household Survey* (1992/1993 to 1994/1995) to assess the relative health status of lone parents in comparison to couple parents, and to evaluate the importance of different explanations for their health differences. The results confirm that lone parents, particularly lone mothers, have poor health status relative to parents living as couples. The observed health differences mirror variations in socioeconomic circumstances. However, even when a wide range of demographic and socioeconomic circumstances are included in multivariate models, lone mothers still have significantly poorer health than couple mothers for four out of five health variables. The paper concludes by discussing alternative explanations for the health differences between lone and couple parents — such as the absence of an intimate/confiding relationship, the stress and stigma associated with becoming a lone parent and health selection — and by highlighting future options for policy and research in this area. © 1998 Elsevier Science Ltd. All rights reserved

Key words—lone parents, self-reported health, social relationships, one-parent families, socioeconomic circumstances

INTRODUCTION

Over 1.7 million parents and 3 million children, representing over one quarter of all families with dependent children, live in one-parent families in Britain (Ford and Millar, 1997). People enter lone parenthood for a variety of reasons, through divorce and separation, widowhood or having a child alone, and this diversity of past experience can have a considerable effect on their circumstances as lone parents (Popay and Jones, 1990). Nevertheless, the majority of lone parents are mothers, living on low incomes, unable to work because of the lack of affordable childcare or employed in low-pay, low-status occupations (Bradshaw and Millar, 1991; McKay and Marsh, 1994; Ford *et al.*, 1995). Given their circumstances, it is hardly surprising that a number of studies have found that lone parents have poorer health than the general population.

From a policy perspective, however, it is important to ascertain whether the poor health experience of lone parents is primarily a result of them being disadvantaged or whether there is something distinctly health damaging about being a lone parent *per se*. If the former is true, then policies that address general problems of poverty — poor employment and educational opportunities and lack of childcare — should improve the health of lone parents as well as that of other families living in poverty. If, on the other hand, there are particular features of lone parenthood that affect people's

health, then specific policy initiatives will need to be designed to improve their health status.

The central aim of this paper is to assess the contribution that the poor socioeconomic circumstances of lone parents make to their relative health disadvantage. In doing so, however, it is important to bear in mind, and explore where possible, other potential explanations for their relative health position. These include:

- the lack of a confiding/intimate relationship, which provide people with social and emotional support which is health promoting;
- health selection into lone parenthood, i.e. poor health leads to marital breakdown or reduced chance of marrying rather than vice versa;
- the stress associated with becoming a lone parent, which could have short or long term health consequences;
- the stigma associated with being a lone parent in Britain today, which could be health damaging.

It is important not to treat these explanations for lone parents' relative health disadvantage as mutually exclusive. Instead they should be seen as interactive and cumulative. For example, women living in disadvantaged socioeconomic circumstances are more likely to be socially isolated and lack support than their more affluent counterparts (Blaxter, 1990; Oakley and Rajan, 1991). Hence, it is likely that a combination of such factors

accumulated over time will interact to explain the particularly poor health of this group.

The aim of this paper therefore is to assess and explain the relative health status of lone parents in Britain. It has two main parts. First, it reviews the existing literature that addresses this issue. Secondly, using new evidence from a large national dataset, it compares the health of lone and couple parents, and attempts to explain the reasons for their health differences. Before doing this, however, it is important to set the paper in context by briefly highlighting the broader international literature within which the relationship between lone parenthood and health status should be considered.

Background

The first studies to suggest that marital status and parenthood might be associated with health were conducted over one hundred years ago. First, Farr (1859) analysed age-specific deaths in France in 1853 by marital status and found that "marriage is a healthy state. The single individual is more likely to be wrecked on his voyage than the lives joined together in matrimony" (quoted in Macintyre, 1992, p. 453). Secondly, Durkheim (1951) in an analysis of suicide rates in France in 1897 found that both marriage and parenthood reduced the risk of suicide and argued that this was because such roles provided individuals with meaning and purpose to their lives as well as a sense of obligation and constraint.

Since these studies were published, a vast literature has developed highlighting this kind of associations across the world. Initially interest lay in demonstrating and attempting to understand the association between marital status and a wide range of health measures. Married people have been shown to live longer, have less ill health, better psychosocial health, adopt healthier lifestyles and use health services less often than non-married people; with single, never-married people appearing to have better health than those previously married. (For reviews of the literature see, for example, Morgan, 1980; Macintyre, 1992; Wyke and Ford, 1992). Explanations for these associations can be broadly divided into two: health selection and social causation (Wyke and Ford, 1992). The former suggests that unhealthy people are less likely to get married, more likely to suffer a marital breakdown and less likely to remarry than healthy people. The social causation arguments have a number of dimensions including that married people experience a health advantage because they have better access to material resources and social support; are less likely to indulge in unhealthy or risky behaviours; and, are protected from stress by their social role. Moreover, previously married people are likely to have suffered considerable stress during the marital breakdown which may have short and/or long term adverse consequences for their health. However, very little

of this literature distinguishes between those people who have children and those who do not or, if it does, it often focuses on the role of children for married people because of the small numbers of lone parents and difficulties in identifying them in surveys (Kobrin and Hendershott, 1977; Weatherall *et al.*, 1994).

Against this background a second strand of literature has developed looking at the effect of multiple social roles — marriage, parenthood and employment — on health, particularly for women. Again explanations are divided between health selection — i.e. people are less likely to marry, have children or work if they are unhealthy — and social causation. In terms of the latter, the literature presents two opposing views about the consequences for health of multiple roles (Hibbard and Pope, 1993). First, that given limited time and energy, multiple roles may create role conflict or role overload as people try to juggle various responsibilities resulting in stress and poor health. Alternatively, it is argued that each role provides people with social support, resources, self-esteem, social ties and obligations that enhance health in a cumulative way.

Most of the empirical evidence in this field comes from the United States and suggests that those people without any role have the poorest health prospects while those with multiple roles are the healthiest. For example, in a study in Detroit Verbrugge (1983) found that for men and women marriage, parenthood and employment all have an independent positive effect on health, although employment seemed to have a stronger effect than the other social roles. There were no interaction effects so that there appeared to be no evidence of role overload or role accumulation over and above the individual beneficial effects of each role. However, Verbrugge (1983) and others (see, for example, Bartley *et al.*, 1992; Hibbard and Pope, 1993) have argued that role occupancy is a very crude way of measuring the impact of social roles on health and one needs to investigate the burden, demands, and satisfaction of the roles more directly.

Many of these studies only focus on the main effects of marital, parental and employment roles on health. However, a number begin to note the excess health risks of lone parents.

In an analysis of social roles and health using the *Health Interview Survey* in the U.S.A., Nathanson (1980) found that divorced, separated and widowed women with children who were not in formal employment had lower levels of good health and more days of restricted activity than their married counterparts.

Aneshensel *et al.* (1981) in a study in Los Angeles found that lone mothers had the highest rates of depression of all women after controlling for age, income and education.

Table 1. The British literature

Authors	Data source, sample size and composition	Type of comparison	Health measures	Other variables considered	Results
(1) Hunt <i>et al.</i> (1973)	survey of 3323 parents in 5 towns: Dorset, Dundee, Halifax, Haringey and Glamorgan	lone parents vs couple parents	mental distress; subjective health	none	in all areas the proportion of lone parents with good health was lower than that of parents in couple families; lone mothers had particularly high levels of mental distress in comparison to married mothers, while lone fathers had similar rates to married fathers
(2) Kruck and Wolkind (1976)	173 attendees at an antenatal clinic followed until child was 42 months. Tower Hamlets, 1974/1975	women not married or cohabiting at time of conception vs couple mothers	problems in pregnancy; psychiatric well-being	none	lone mothers had a slightly higher rate of psychiatric problems than couple mothers (not significant) when their child was aged 42 months, but not before
(3) Moss and Plewis (1977)	survey of 180 mothers with child under 5 in 3 areas of inner London, 1974/1975	unmarried mothers vs married mothers	mental distress	none	72% of unmarried mothers against 46% of married mothers had severe or moderate distress (statistically significant); twice as many (18%) lone mothers as married mothers had severe distress
(4) Middleton (1995)	1991 Census population living in households with dependent children	lone parents, no other adults vs all adults in other households with dependent children	limiting long-term illness	none	7% of lone parents had a limiting long-term illness compared with 6% of adults in other households with dependent children
(5) Barker <i>et al.</i> (1997)	11 040 mothers in the Avon Longitudinal Study of Pregnancy and Childhood, surveyed 8 months post partum, 1992	lone mothers vs couple mothers	self-reported health problems and GP consultations for 16 common symptoms	none	lone mothers were significantly more likely to report depression and anxiety than couple mothers; however, lone mothers were significantly less likely to report coughs and colds or haemorrhoids than couple mothers and there were no significant differences for headache or headaches and migraines
(6) Bolden (1980)	medical records of 72 parents from GP practice in Exeter, 1977	lone parent for at least 1 yr vs married parents	contact with GP	age, sex	lone parents had approx. 2 times the consultation rate of married parents (statistically significant); lone parents were more likely to consult for respiratory illness, contraception and gynaecological problems than married parents; there were no differences in psychiatric consultations
(7) Burnell and Wadsworth (1981); Osborn (1984)	3488 mothers in the Child Health Education Study, 5 yr follow up, 1975	lone mothers when child aged 5 or at birth vs couple mothers	malaise score	employment; length of time as lone parent	lone mothers had a higher risk of malaise (39%) than couple mothers (23%) (statistically significant); the highest rates (46%) were among mothers unsupported at birth who continued to be lone mothers until the child was five
(8) Arber <i>et al.</i> (1985)	13 500 women aged 20–59 in the GHS, 1975 and 1976	divorced, separated or widowed mothers vs other women	No. of days of restricted activity	employment	lone mothers had 161% the illness rate of all women; illness rates were especially high for lone mothers in full (178%) and part (172%) time employment
(9) Blaxter (1990)	2600 women aged 18–45 in the HALS, 1985–1986	lone mothers vs married women with and without children	illness score; malaise score	age	lone mothers aged 18–29 had 30% higher illness rates and 38% higher malaise scores than married women; for those aged 30–45 lone mothers had 5% higher illness, 46% higher malaise

(10) Popay and Jones (1990, 8105 parents with child under 16 in the GHS, 1980, 1981 and 1982)	lone parents vs couple parents	long-standing illness; limiting long-standing illness; recent illness; subjective health	employment; tenure; state benefits; living arrangements	lone mothers and fathers aged over 35 were more likely to report poor health than couple parents; the health pattern varied by marital status and gender; for all socioeconomic groups, lone parents had worse health than couple parents, women had poorer health than men; there was a stronger socioeconomic gradient in health for lone than couple mothers; lone parents had better health if they were employed; lone fathers had better health if they lived with others, for lone mothers the results were mixed
(11) Reeves <i>et al.</i> (1994)	2085 mothers with child under 16 in the Trent regional health and lifestyle survey, 1992	lone mothers, no other adults vs couple mothers	subjective health; happiness	employment; tenure
(12) Brown and Morgan (1997)	404 mothers with children under 18, Islington, London, early 1980s	lone mothers vs couple mothers with partners in manual occupations	Onset and experience of chronic depression (Present State Examination)	employment; financial hardship; life events
(13) Beatson-Hird <i>et al.</i> (1989)	6440 mothers in the GHS, 1983 and 1984	lone mothers vs married mothers	longstanding illness; recent illness	age; education; employment; tenure; No. of children
(14) Macran <i>et al.</i> (1994)	3746 women aged 18–59 in the HALS 1985–1986	lone mothers vs other women	subjective health	age; permanent sickness; employment; occupation; equivalent income; living arrangements
(15) Macran <i>et al.</i> (1996)	2535 women aged 18–59 with complete information in the HALS, 1985–1986	lone mothers vs other women	disability; fitness; illness score; malaise score; subjective health	age; employment; equivalent occupation; equivalent income

In a study of domestic roles and health Clark *et al.* (1987) found that "there are clearly negative effects or burdens of children on single women, but at the same time these same children when they are the responsibility of single (divorced) men have a protective effect" (p. 506).

Kotler and Wingard (1989) in an analysis of the *Alameda County Study* found that lone mothers were twice as likely to die as couple mothers in 18 years of follow-up after controlling for a wide range of factors, although the differences were not statistically significant.

In a study in Finland, Martikainen (1995) found that lone mothers were 1.35 times more likely to die than married mothers in the five years after the 1980 census. Mortality rates were similar for different kinds of lone mothers, but higher among those with two or more children, especially for deaths from accidents and violence.

Finally, a study in Norway by Elstad (1996) found that lone mothers had significantly higher rates of longstanding illness than married mothers in the 1970s, although in the 1980s the difference was only significant for non-working mothers.

In addition to the multiple role literature, a number of other studies have also shown poor health outcomes among lone parents, particularly mothers. Perhaps the first paper to do so was based on the *Alameda County Study* and published in 1969. Using the cross-sectional data from the baseline interviews Berkman (1969) found that lone mothers had higher rates of ill health than married mothers, with separated and divorced mothers having significantly poorer health. The study also showed that lone mothers were much more likely to live in poverty areas, have low income and be welfare recipients. However, after controlling for these factors there was still significant difference in lone and married mothers' health. In addition, lone mothers were much more likely to suffer from stress and have less resources, both in terms of internal strength and social support, to cope. A study in New Haven (Weissman *et al.*, 1987) also found that lone mothers had excess mental health problems compared to couple mothers, although they suggested that much of this difference could be accounted for by differential poverty rates. Similarly, Walters (1993), in a study of women's health in Hamilton City, Canada, found that lone mothers were much more likely to report stress, anxiety and depression than other women.

Lone-parent families in Britain are particularly disadvantaged in comparison to those in other countries. For example, in a comparison of the circumstances of lone parents in 20 countries Bradshaw *et al.* (1996) found that British lone parents were the most likely to experience relative poverty and had some of the lowest employment rates of all. Given that the aim of this paper is to assess the contribution that lone parents' socioeco-

nomic circumstances make to their relative health disadvantage, it is important to examine how studies of lone parent's health in Britain have taken this factor into account. The next section, therefore, looks in detail at British evidence about the relative health status of lone parents, paying particular attention to the other factors that such studies consider.

LITERATURE REVIEW

Since 1970, fifteen separate investigations have examined the relative health status of lone parents in Britain. In general, they all found some evidence of poorer self-reported health among lone parents, but their characteristics differ on a number of dimensions that are worth exploring.

Table 1 lists some key features of each study. In the first column the authors of the study are identified. In a couple of cases, the same or different authors have published the same analyses and/or results; these are examined here as a single contribution. Column 2 of the table shows the data source, size and composition of the sample on which each study is based. Column 3 indicates the comparisons that have been made. Column 4 shows the health measures analysed and column 5 what other factors have been considered in the analysis. Finally, column 6 describes the results with respect to lone parents.

Most of the studies focus on the comparative health status of lone mothers, in addition, four include information on lone fathers' health. One of the first things to note about the literature is that, as Table 1 shows, the studies often have different definitions of lone parents themselves and different comparator groups. For example, Bolden (1980) specifies that parents must have been alone for at least one year, to try to exclude the health-damaging effects of the stress associated with becoming a lone parent. While Reeves *et al.* (1994) and Middleton (1995) limit their definition of lone parents to those who live alone with their dependent children, with no other adults in the household. Most of the studies use couple parents (or mothers) for their comparison groups, although several studies focus on all women (Arber *et al.*, 1985; Macran *et al.*, 1994, 1996). Such differences in definition must be borne in mind when comparing the results in terms of lone parents' relative health status.

For convenience, the literature has been split into three groups according to the type of analysis employed to explain the health disadvantage experienced by lone parents:

- basic comparisons: simply compare the health of lone parents to other groups in the population, usually couple parents — studies 1–5;
- simple analyses: compare the health of lone parents to others, taking into account variations in one or two other factors, usually age, employment

status or tenure, but not in a multivariate way — studies 6–12;

- multivariate models: compare the health of lone parents with others, simultaneously taking into account a wide range of other factors — studies 13–15.

Basic comparisons

The first five studies listed in Table 1 simply make straightforward comparisons between the rate of ill health among lone and couple parent groups. They range from a study of 173 mothers in 1974/1975 (Kruk and Wolkind, 1976) to an analysis of the 1991 Census for Great Britain (Middleton, 1995). Most of the basic studies focus on the psychosocial health of parents, and find that lone parents are more likely to have poor mental health or high levels of distress than couple parents. For example, the first study by Hunt *et al.* (1973), based on a survey of five towns conducted in the 1970s, found that more lone parents reported poor health than parents in couple families, and that lone mothers, in particular, had very high levels of mental distress. The most recent study which falls into this category by Barker *et al.* (1997) also finds significantly higher levels of depression and anxiety among lone mothers than couple mothers, but finds that lone mothers report significantly lower levels of coughs and colds and haemorrhoids. However, since none of these studies even take into account the quite distinctive age distributions of the two parent groups, it is hard to assess whether such differences in health are anything other than a reflection of their different demographic compositions.

Simple analyses

The majority of British studies identified (Refs 6–12 in Table 1) are based on simple analyses, i.e. they compare the health of lone parents with other groups in the population and take account of one or two possible confounding factors, but not in a multivariate way. There is again a considerable difference in the scale of the studies undertaken, ranging from 72 parents in a GP practice in Exeter (Bolden, 1980) to 13 500 women in an analysis of the *General Household Survey* (GHS) (Arber *et al.*, 1985).

The studies cover a range of self-reported health measures, such as limiting longstanding illness, recent limiting illness, physical illness symptoms, depression, malaise and subjective assessments of general health. The one exception is Bolden (1980) who based her analysis on medical records from GP consultations. Finally, as Table 1 shows, the studies take into account a number of other factors in comparing the health of lone parents with other groups. The simplest of these adjusts for differences in the age structures of the two groups. For example, using the *Health and Lifestyle Survey* (HALS)

Blaxter (1990) calculates age standardised ratios of reporting poor health and demonstrates that in the 18–29 age group lone mothers have 30% more physical symptoms and 37% more psychosocial malaise than married women, with and without children.

The other studies in this category begin to take account of differences in the socioeconomic circumstances of the two groups, and in particular their employment status. For example, Popay and Jones (1990, 1991) compare the health of lone parents in three years of the GHS in 1980–1982 with parents in couple families. They find that lone mothers aged over 35 are at least 2.5 times more likely to report their health as not good than mothers in couple families. For lone fathers the ratio was two. Lone mothers report worse health than those in couple families across a range of socioeconomic groups, based on tenure and receipt of means-tested benefits. The pattern was similar for lone fathers, but not as consistent. However, because the study does not control statistically for differences in age and socioeconomic factors when examining health differences between lone and couple parents, it is difficult to unravel their relative importance.

The most recent study in this group by Brown and Morgan (1997) not only looks at differences in lone and couple parents' employment and financial circumstances but also focuses on their experience of humiliation/entrapping life events and difficulties, such as separation, put downs and delinquent behaviour from close ties. Brown and Morgan conclude that it is the more frequent experience of these events among lone mothers that explain their higher level of onset of depression compared to couple mothers.

Multivariate analyses

The final set of three studies, Refs 13–15 in Table 1, use multivariate analysis to assess whether or not lone parents have poor health when other differences between them and the comparator group are taken into account. These studies are all based on the secondary analysis of two large datasets: the GHS and the HALS.

Beatson-Hird *et al.* (1989) use the GHS to examine the relative health experience of lone mothers. Using data from 1983 and 1984 they produce logistic regression models for longstanding illness and recent limiting ill health, for all mothers. They find that lone mothers are more likely to report higher rates of illness, on both health measures, than mothers in couple families. However, when they control for other factors — including age, employment status, tenure, education and number of children — only separated and divorced mothers are significantly more likely to report a recent illness than other mothers. There are no significant differences for longstanding illness.

Macran and colleagues have published two papers examining women's health using HALS. In both studies women's health is modelled against a wide range of factors including a dummy variable for lone-parent status. The papers differ in terms of the health status measures investigated and the statistical methods employed. In the first paper, Macran *et al.* (1994) use logistic regression to model the probability of women's subjective assessment of their health being not good. Controlling for a range of socioeconomic factors, they find that lone mothers are significantly more likely to report not good health than other women. In the second paper, Macran *et al.* (1996) use linear regression to model a number of different health measures, including the subjective assessment of health variable used in the first paper. These results suggest that, although lone mothers are significantly more likely to report psychosocial malaise than other women, they are significantly less likely to be disabled and there are no significant differences for illness symptoms or subjective health assessment. However, as the authors themselves note linear regression is "not entirely suitable" (p. 1208) for the categorical dependent variables used in the study. As a result, these findings should be treated with considerable caution.

Overview

Over the last 25 years a range of different studies have found that lone parents' health appears to be worse than that of other parents and/or other adults. However, as Table 1 shows, the studies differ in relation to their scale, location, definition of lone parents and/or comparator group and the other factors that they take into account. As a result, it is difficult to generalise from their findings. Moreover, none of the studies combine a sufficient sample size with a wide range of confounders, clear conceptual model and appropriate statistical techniques, to assess with confidence the contribution that poor socioeconomic circumstances make to the disadvantaged health status of lone parents.

This paper aims to overcome these weaknesses and uses the most widely accepted definitions of lone parenthood and appropriate conceptual models and statistical techniques in order to investigate the relative health status of lone parents in a robust way. More specifically, the empirical part of this paper has two objectives. First, to assess the latest evidence about the relative health status of lone parents in comparison with other parents, using a large national dataset from the 1990s. Secondly, to consider what factors might account for their health variance, and, in particular, whether such differences can be explained by lone parents' relatively disadvantaged socioeconomic position.

DATA AND METHODS

The aim of this paper is to assess the relative health status of lone parents in a more systematic way than is often the case in the literature. To do this, both bivariate and multivariate analyses of the GHS have been employed, all of which are described below. The GHS is a cross-sectional household survey, conducted by the Office of National Statistics, which contains information on approximately 16 000 households and 25 000 people every year. It is based on a stratified random sample of private households in Great Britain and has an annual response rate of between 80 and 85% (Bennett *et al.*, 1996). The survey has been shown to be representative of the general population in Great Britain, having a similar demographic and socioeconomic profile to the 1991 Census (Bridgewood and Savage, 1993). All adults in each household are asked a range of questions about their personal and household characteristics, their social and economic circumstances and their health and health care utilisation.

The dataset used in this paper combines three years of the GHS, 1992/1993, 1993/1994, 1994/1995, and is limited to parents with dependent children — i.e. children aged under 16 or between 16 and 18 and in full-time education — of whom there are 16 736. The basic cornerstone of the analysis is the distinction between two different types of parents: those married or cohabiting and living with a partner (labelled as couple parents); and, those who may or may not live with other adults but who do not have partner present in the household (lone parents). However, there is one minor complication. There are some parents who are married or cohabiting but their partners are absent from the household, often for work purposes. In this paper, such parents are separately identified, but for many of the analyses they are excluded because their numbers are so small. A few of the parents with absent partners gave the reason for absence as separation, in these cases the parents were reclassified as lone parents.

Some of the analyses separate lone mothers according to their marital status. It is not appropriate to do this for lone fathers because of their small numbers. In addition, for lone mothers who have previously been married it is possible to calculate the length of time since the end of their marriage or death of their spouse. This information is also used in some of the analyses.

Table 2 shows the breakdown of the sample by type of parent and gender. 12% of all parents are lone parents; 93% of whom are mothers. Over half of lone parents, both mothers and fathers, are separated or divorced. Nearly 40% of lone mothers are single, never married, while widowers are the second largest group of lone fathers.

Table 2. Parents in the GHS, Great Britain, 1992/1993–1994/1995

Type of parent	Mothers	Fathers	Total
Couple	7336	7314	14 650
Absent partners	41	3	44
Lone	1885	157	2042
single	716	18	734
widowed	86	31	117
divorced	654	67	721
separated	429	41	470
Total	9262	7474	16 736

The health measures

Health is a multidimensional concept (Blaxter, 1990) and the three health questions in GHS, which are set out in Table 3, are clearly inadequate as descriptions of the variety of dimensions of health that individuals experience. However, they do cover measures of both health status — in terms of long standing illness — and current health state — in terms of recent limiting illness and subjective assessments of health (Bartley *et al.*, 1992). As such they are able to shed some, albeit limited, light on the nature of parents' health experience.

The questions can be used to create five binary health variables. The first variable indicates whether or not people have a longstanding illness, which is true for 26% of parents in this sample. Commonly, both parts of the longstanding illness question are combined into a single binary variable that distinguishes between people with a limiting longstanding illness and those without. In this study 14% of parents report that they have a limiting longstanding illness. The variable about recent limiting illness is also dichotomised with nearly 12% of parents reporting that they had to reduce their activity in the last fortnight due to ill health.

The subjective general health question, with three categories, can be split into two binary variables: not good health versus fairly good or good health, and good health versus fairly good and not good health. Overall, 70% of parents report that their health is good; 22% that their health is fairly good and only 8% that their health is not good.

Determinants of health

In order to assess what might explain the relative health status of lone parents, a wide range of determinants of health need to be taken into account

Table 3. Health questions in the GHS

- (1) Over the last 12 months would you say your health has on the whole been good, fairly good, or not good?
- (2) Do you have any long-standing illness, disability or infirmity? By long-standing I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time.
(a) Does this illness or disability limit your activities in any way?
- (3) Now I'd like you to think about the 2 weeks ending yesterday. During those 2 weeks, did you have to cut down on any of the things you usually do (about the house/at work or in your free time) because of illness or injury?

covering their demographic characteristics, socioeconomic factors and social relationships (Benzeval *et al.*, 1992). The GHS has a reasonable set of variables covering the first two of these groups of variables but very little on the last.

Demographic factors

It is commonly acknowledged that an individual's age, gender and ethnic status will have an effect on their health. Given that there are considerable differences in the age and ethnic composition of parents in lone and couple families, such confounding factors should be taken into account when comparing their relative health status.

Socioeconomic markers

GHS contains a wide range of variables covering people's socioeconomic circumstances. However, since the purpose of this paper is to assess how much of the health difference between lone and couple parents might be explained by differences in their socioeconomic factors, it is only those variables that might be thought of as mediators in this relationship are included in the models. Specifically, parent's employment status and measures of household resources. In the GHS, information is provided on people's access to a car, housing tenure, ownership of a wide range of consumer durables, such as refrigerators, dishwashers, televisions and hi-fi equipment, and income. The most appropriate measure of income for comparative purposes is real equivalent disposable family income, which takes into account all income for all family members, net of direct taxes and adjusted for price inflation and household size and composition. Details of how this measure was constructed can be found elsewhere (Benzeval *et al.*, 1997).

It is important to emphasise here that the household measures of resources described above refer to the broad family group that live together and not just the lone parent and their children. Hence if a lone parent lives with his or her parents the level of income and household resources of the whole family group are assumed to be beneficial to the lone parents' health. Although we cannot tell how the resources are shared within such extended families, it seems more appropriate to assume that lone parents do derive some material benefits from living with others rather than assuming that they do not.

The GHS does not contain very much information on people's social relationships. It says nothing about whether lone parents have a supportive relationship with an adult other than a partner. However, it does indicate whether or not lone parents live with other adults. Anson (1989) has suggested that marriage is supportive of health because of the social ties and regulations provided by living with another adult. If this is true, then lone parents who live with other adults should have

better health than those who live alone with their dependent children. Since many of the material resource benefits from living with others should be captured by the household resource variables described above, including a variable which distinguishes between those lone parents who live with other adults (who are not their non-dependent children) and those who live alone, should test Anson's hypothesis.

Methods

Given the different health experience and determinants of ill health among men and women (Popay and Jones, 1990), all of the analyses in this paper are conducted separately for each gender. However, given the relatively small number of lone fathers in the sample, it is not possible to conduct all of the analyses on fathers and the results are less reliable. For this reason much more emphasis is placed on the analysis and explanation of lone mothers' health status.

Three different sets of analyses are employed in this paper. First, indirect age and sex standardised illness ratios (SIRs) are calculated for each parent group to assess whether there is a significant health difference between lone and couple parents, and between different types (in terms of marital status) of lone mothers. The standard population chosen is all parents aged 16–64. Age and sex specific rates of ill health from the standard population are applied to the number of people in each age and sex group in the different parent categories to estimate the number of ill people expected if the parent group has the same age and sex distribution of illness as the standard population. The actual number of parents experiencing illness is then expressed as a ratio of the expected number. Ratios *greater* than 100 imply the parent group is *less* healthy than all parents and ratios *less* than 100 that the group is *more* healthy. Confidence intervals are also calculated at 95% to assess whether or not the differences are statistically significant.

Secondly, in order to assess whether differences in the demographic and socioeconomic profiles of the two groups can explain their relative health status, multivariate models are calculated for mothers and fathers for each of the health measures. The most appropriate statistical technique for this part of the analysis is logistic regression, as the health outcome measures are binary, i.e. take the value zero or one (Hosmer and Lemeshow, 1989). Separate models are calculated for the five different health measures in three stages. First, a dummy variable representing lone parents is entered into the models to establish the baseline difference in health status between parents in lone- and two-parent families. Secondly, demographic factors are added to ascertain whether variations in health status between parent groups are simply the result of different age and ethnic profiles. Finally, all of the

socioeconomic variables are added to the models to examine the effect of adjusting for these factors on the relative health status of different types of parents.

At each stage forward and backward stepwise logistic regression is used to assess which of the variables in the group is the most important. Final models are chosen on the basis of statistical significance, *a priori* reasoning, and parsimony. A variable is included in the model if its Wald statistic is significant at the 90% level and the change in scaled deviance associated with its inclusion is also significant when compared to the χ^2 distribution.

These models are repeated for mothers replacing the single variable identifying lone mothers with a series of dichotomous variables based on their marital status to assess whether there are significant health differences between lone mother groups after controlling for other factors.

The aim of the final piece of analysis in this paper is to assess whether living with other adults is beneficial for lone parents' health, after controlling for their demographic and socioeconomic characteristics. Two dummy variables are added to the final models described above to distinguish between those lone parents who live with others and those who live alone, with the base category being couple parents. This analysis is carried out for lone mothers only because of the small numbers of lone fathers.

It is important to be clear at this stage about the conceptual framework for the determinants of health that underlies this analysis and to distinguish between confounding and mediating factors (Macintyre, 1997). With the exception of the demographic factors, all of the other variables that will be used in the statistical models should be thought of as mediating or intervening factors between lone parenthood and health i.e. they are proxies for some of the mechanisms that might explain the poor health status of lone parents, they are not confounders. The aim of this paper is not to "explain away" (Macintyre, 1997) the association between lone parenthood and health but to develop an understanding of the contribution that socioeconomic circumstances make to this relationship. Central to the experience of being a lone parent in Britain today is to be poor, to be isolated and stigmatised by society, all factors that are likely to damage health. From a policy perspective it is *all* of the excess ill health of lone parents that needs to be tackled. The purpose of the statistical analysis is to assess how much of that might be done by addressing lone parents' socioeconomic circumstances and for how much policy makers need to look to other aspects of lone parents' lives.

Table 4. The relative health status of lone parents

Health measure	Age and sex standardised ratio of reporting poor health (all parents = 100)			
	mothers ^a		fathers ^a	
	lone	couple	lone	couple
Fairly good or not good health	127.7 ^b	89.7	128.4 ^b	92.1
Not good health	151.1 ^b	83.8	107.5	89.8
Longstanding illness	126.7 ^b	92.3	117.3	98.5
Limiting longstanding illness	137.2 ^b	90.0	129.6	88.9
Recent limiting illness	121.4 ^b	98.4	102.5	99.0
N=	1885	7336	157	7314

^aParents with absent partners are excluded from the analysis.

^bDifference between lone and couple parents is significant at 95% level.

RESULTS

The relative health status of lone parents

Table 4 shows the SIRs for couple and lone parents, mothers and fathers, for all five health measures. In each instance lone parents experience poorer health than couple parents after taking into account differences in their age distributions. The health difference appears to be larger for mothers than fathers, and to vary according to the type of health measure, with the biggest difference being for subjective assessment of health for mothers and limiting longstanding illness for fathers, and the smallest for recent limiting illness. For each health measure the difference between lone and couple mothers is statistically significant at the 95% level, while for fathers the only significant difference is for subjective assessment of health as fairly or not good, although the lack of significance could be a result of the small number of lone fathers. There are no significant differences between lone mothers and lone fathers.

Table 5 shows the SIRs for mothers, separating lone mothers by their marital status. Across the range of health measures included in the GHS, divorced lone mothers have the worst health, closely followed by single and separated mothers. All of these three marital groups have significantly poorer health than couple mothers. However, there are no significant differences between the different groups of lone mothers.

The health of those mothers who were previously married was also assessed by the length of time

since the breakdown of their marriage. The length of time since their separation or the death of their husband could be identified for 905 lone mothers only, and even for this group the confidence which one can place on this measure is questionable (see below). Lone mothers are divided into those whose marriage had ended less than two years, those between two and five years and those "alone" for more than five years. The association between length of time since the end of the marriage and health is inconsistent across the health measures and there are no significant differences. Standardising for age differences, for subjective assessments of health rates of ill health are U-shaped being highest following the end of the marriage and after 5 years alone, for limiting recent and longstanding illness health declines with the length of time since separation/death of a spouse, while for longstanding illness rates of ill health are constant for the first five years and then increase (results not shown).

The socioeconomic circumstances of parents

Lone and couple parents, mothers and fathers all have quite distinctive demographic and socioeconomic profiles that might help to explain the relative differences in their health status.

Table 6 shows the demographic and socioeconomic circumstances of couple and lone parents. In terms of age, lone mothers are, on average, younger than other parents and lone fathers are the oldest group. The ethnic profile of lone parents is considerably different from couple parents. Lone

Table 5. Self-reported health by lone parent's marital status

Lone mother's marital status	Age standardised illness ratio (all mothers = 100)				
	subjective assessment of health not good	subjective assessment of health fairly or not good	longstanding illness	limiting longstanding illness	recent limiting illness
Single ^a	158.2	134.1	123.7	122.3	126.8
Widowed	117.2	124.4	109.2	94.0	130.4
Divorced ^a	158.5	132.5	138.1	143.3	141.2
Separated ^a	153.9	120.4	124.0	126.7	148.6
Absent partner	81.8	110.1	122.6	102.4	156.0
Married/cohabiting	83.8	89.4	92.1	92.0	90.0

^aSignificantly different from couple mothers at 95% for all health measures.

Table 6. Personal characteristics of lone and couple parents^a GHS 92/93–94/95

	Percentage of parents with each characteristic			
	lone fathers	couple fathers	lone mothers	couple mothers
Under 35	17.8	33.0	59.4	43.8
Over 45	33.1	23.8	10.7	14.5
African and Caribbean	4.5	1.4	5.4	1.2
Indian, Pakistan and Bangladeshi	2.5	4.9	1.6	4.7
Work full-time	51.3	82.7	16.2	22.1
Work part-time	8.3	3.0	22.9	41.7
Unemployed	14.7	9.2	7.2	3.9
Look after home	21.8	0.7	47.8	29.9
N=	157	7314	1885	7336

^aParents with absent partners are excluded from this table.

parents are more likely to describe themselves as African or Caribbean, but less likely to be of Indian, Pakistan or Bangladeshi origin.

In terms of economic status, lone parents also have quite a different profile from couple parents. Lone parents are less likely to be in employment, and much more likely to be unemployed or to look after the home. For example, nearly one half of lone mothers and a fifth of lone fathers look after the home, in comparison to a third of couple mothers and almost no couple fathers.

Table 7 compares the household circumstances of families headed by lone mothers, lone fathers and couples. In every instance, families headed by lone mothers are the most disadvantaged, couple families the most advantaged, with lone fathers half way between the two. For example, Table 7 shows lone mothers are at least three times more likely to be in the bottom fifth of the income distribution, receive income support, or live in social housing as couple families; and about one and a half times more likely than families headed by lone fathers.

Among lone mothers, single mothers are the youngest and the most economically disadvantaged, while widows are the oldest and the most affluent (results not shown).

It is clear that lone parents, especially, lone mothers, face considerably more disadvantages than couple parents. The next stage of the analysis uses multivariate techniques to assess how much of the relative health difference is accounted for by such factors.

Multivariate results

Before discussing the results as they relate to lone parents, it is worth highlighting some of the key findings for all parents across the range of health measures in the GHS. In general, the probability of reporting poor health increases with age, is higher among those with disadvantaged socioeconomic circumstances and among minority ethnic groups. For example, controlling for a wide range of other factors the models show that: mothers aged 55 and over are twice as likely to have a limiting longstanding illness as younger mothers; mothers living in local authority housing are 1.7 times more likely to report their health as only fairly or not good than those in owner occupied or privately rented homes; and, fathers without access to a car are 1.5 times more likely to report their health as not good than those with a car.

Table 8 shows the odds ratios for lone mothers at each of the three stages of the analysis described earlier for each of the health variables. The odds ratio describes how much more likely a lone mother is to have poor health than a couple mother, controlling for any other factors in the model. All of the odds ratios are significant at the 95% level unless indicated otherwise.

Column 1 shows the crude health difference between lone and couple mothers. This ranges from lone mothers being 87% more likely to report their health as not good to 42% more likely to have a limiting longstanding illness than couple mothers. Column 2 shows the health gap between lone and

Table 7. Family characteristics of lone and couple families, GHS 92/93–94/95

	Percentage of families ^a with each characteristic		
	lone fathers	lone mothers	couple parents
Family income in bottom 20% of income distribution	41.7	65.4	19.2
Receiving income support	38.8	64.5	8.9
Rent from local authority	42.7	57.9	17.6
Less than 5 household durables	25.6	29.9	8.7
One dependent child only	62.8	51.9	37.1
All children under 5 yr	8.3	26.5	22.8
All dependent children over 16 yr	11.5	5.2	6.4
Other adults in household	9.6	12.5	n/a
N=	157	1885	7314

^aParents with absent partners are excluded from this table.

Table 8. Multivariate models of mothers' health

Health measure	Odds ratios for lone mothers ^a		
	lone mother only	plus demographic factors	plus socioeconomic variables
Fairly good or not good health	1.77	1.73	1.25
Not good health	1.87	2.01	1.20(ns)
longstanding illness	1.49	1.60	1.31
Limiting longstanding illness	1.42	1.50	1.09(ns)
Recent limiting illness	1.59	1.66	1.34

^aBase category includes parents with absent partners.

couple mothers when differences in their age and ethnic distribution are taken into consideration. As can be seen, differences in such factors between the two groups of mothers have little effect on the relative health status of lone mothers. In fact in most cases, the relative health status of lone mothers actually deteriorates when demographic factors are taken into account, reflecting their younger age structure.

Finally, column 3 shows the relative health difference of lone mothers, after all of the socioeconomic variables available have been taken into account. Controlling for differences in tenure, access to cars and consumer durables, employment status, and equivalent income substantially reduces the health gap between lone and couple mothers. There is no longer a significant difference in the likelihood of reporting a limiting longstanding illness and the gap for the subjective assessment of health as not good is only significant at the 90% level. For all five health measures the difference is reduced to a half or a third of its original size. However, for four of the health measures, lone mothers are still significantly more likely to report poor health than couple mothers.

Table 9 shows the equivalent set of odds ratios for lone fathers. It is important to bear in mind that the small number of lone fathers make identifying significant associations very difficult, and the results therefore must be treated with caution. Generally, the pattern is similar to that of lone mothers, although there is no health difference in terms of recent limiting illness between lone and couple fathers. The only significant differences are that lone fathers are 68% more likely to report that their health is only fairly or not good and 35% more likely to say they have a longstanding illness (only at 90% level) than couple fathers. Controlling for differences in the age and ethnic composition of

the two groups has little effect on their relative health status. However, controlling for variations in their socioeconomic circumstances substantially reduces the excess health disadvantage of lone fathers. At this stage, all of the differences are statistically insignificant and, at the most, only one-third of their original size.

The multivariate models for mothers have also been produced replacing the simple dichotomous variable for lone motherhood with a series of dummy variables that distinguish between the different marital states of lone mothers. A very similar pattern emerges to that described above (results not shown). All of the different types of lone mothers have poorer health than couple mothers. Including demographic and socioeconomic variables reduces the health difference between the different groups of lone mothers and couple mothers. Divorced mothers have significantly more illness than couple mothers for four health measures and single and separated mothers for two measures. There are no significant differences in health between the different types of lone mothers.

Living alone

The final analysis tries to assess whether living with other adults is beneficial for lone mothers' health. Unfortunately, the number of lone fathers was too small for this analysis. Table 10 shows the odds ratios for lone mothers who live with and without other adults in comparison to couple parents for all five health measures, after controlling for demographic and socioeconomic factors. The picture is complex. Lone mothers living with and without other adults are more likely to have poor health than couple mothers for all of the health measures, except for lone mothers living with others who are less likely to report recent limiting illness than couple mothers. However, the difference

Table 9. Multivariate models of fathers' health

Health measure	Odds ratios for lone fathers ^a		
	lone father only	plus demographic factors	plus socioeconomic variables
Fairly good or not good health	1.68	1.63	1.23(ns)
Not good health	1.24(ns)	1.16(ns)	1.03(ns)
Longstanding illness	1.35(ns)	1.29(ns)	1.11(ns)
Limiting longstanding illness	1.35(ns)	1.26(ns)	0.93(ns)
Recent limiting illness	0.99(ns)	1.00(ns)	0.98(ns)

^aBase category includes parents with absent partners.

Table 10. Living alone and lone mothers' health

Health measure	Odds ratios controlling for demographic and socioeconomic factors (couple mothers ^a = 1) (Lone mothers)	
	living alone	living with others
Fairly good or not good health	1.26 ^b	1.21(ns)
Not good health	1.21(90)	1.11(ns)
Longstanding illness	1.33 ^b	1.14(ns)
Limiting longstanding illness	1.09(ns)	1.11(ns)
Recent limiting illness	1.52 ^{b,c}	0.74(ns)

^aBase category includes parents with absent partners.

^bLone mothers have significantly different health to couple mothers at 95% level.

^cLone mothers living alone have significantly different health to those living with other adults at 95% level.

in health with couple mothers is only significant for lone mothers living alone with their children (for four out of five of the health measures). Lone mothers who live alone are more likely to report poor health than those who live with others, although the difference is only significant for recent limiting illness. For limiting longstanding illness, lone mothers who live alone with their children have slightly better health than other lone mothers, however, the difference between them is not significant.

DISCUSSION

The analyses presented here clearly show that lone parents, particularly lone mothers, have poor relative health status compared to parents living as couples. Their health differences mirror the variations in their socioeconomic circumstances, with lone mothers being the most disadvantaged, couple parents the most advantaged and lone fathers half way between the two groups. It is not surprising, therefore, that in the multivariate analyses much of the health difference between the parent groups is accounted for by differences in their socioeconomic circumstances. However, even when a wide range of demographic and socioeconomic circumstances are included in the multivariate models, lone mothers still have significantly poorer health than couple mothers for four out of five health variables. There are no significant differences for lone fathers, although this could be a result of the small numbers in the sample.

Trying to explore the health of the different groups of lone mothers in more detail, the results presented here suggest that divorced lone mothers, followed closely by single and separated mothers appear to have the poorest health, although the differences between them are not significant. There is some evidence that rates of ill health increase with the length of time since separation, but differences are not significant and the measurement of this factor is problematic as discussed below. In terms of the benefits of having a confiding/intimate relationship, the results show some evidence that living alone is health damaging for lone mothers, but it is not conclusive.

The significance of these results for policy needs to be assessed in the light of two sets of issues: first, the strengths and weakness of the dataset and analysis itself; and, secondly, in relation to the other potential explanations for the poor health status of lone parents.

Strengths and weakness of the data analysis

This paper is based on the secondary analysis of a large cross-sectional dataset, which has both strengths and weaknesses. The large number of respondents and the wide range of socioeconomic factors contained in the survey facilitate the examination of specific subgroups of the population and their circumstances relative to the general population. Although even with a dataset as large as this, the numbers in specific subgroups — such as lone fathers or lone mothers grouped by their marital status — were too small for confident analysis. However, where numbers allow, such analyses enable the researcher to report associations which are generalisable to the wider population. The use of multivariate models provides an understanding of the relative importance of different factors that might explain the health difference between lone and couple parents. However, the interpretation of such results needs to be done with care so that the significant public policy problem of the poor health of lone mothers is not considered unimportant because it can be “explained away” by other factors.

The use of secondary datasets is a cheap and relatively quick way of shedding light on important policy issues. However, given that they cover a wide range of topics, surveys such as the GHS often cannot go into the ideal level of detail on the topic of interest to a specific researcher. In this case there is a particular problem because the distinction between different types of lone parents is blurred by lack of information on past cohabitation. Hence the survey combines all parents who have never been married with those who are now lone parents after a period of cohabitation. Other evidence has shown that while 35% of lone mothers are classified as single, only 18% have never lived with a partner (Ford and Millar, 1997). Since the characteristics and circumstances of such parents are likely to be

quite different, the inability to distinguish between them makes it difficult to explore the diversity of experiences of lone parents in detail.

This issue is again a problem when one tries to investigate the implications for health of the length of time someone has been a lone parent. The GHS only asks people about their last marriage not about periods of cohabitation, hence one is forced to assume that the respondent has not cohabited since the breakdown of their marriage. For a considerable proportion of lone parents this is almost certainly not the case. For example, 10% of previously married lone parents have children who were not conceived during their last legal marriage. Many others may have cohabited without having further children and hence such relationships are invisible in the analysis. For these reasons, this study has not placed too much emphasis on the results for lone parents by their marital status or the length of time since their marital breakdown.

Alternative explanations

The GHS contains a reasonable selection of variables that measure people's socioeconomic circumstances. However, the ability to assess the importance of other potential explanations for the health difference between lone and couple parents is limited by the nature of the dataset or available information. As highlighted in the introduction, the other possible explanations for the health divide between parent groups which need to be considered include:

- the lack of a confiding/intimate relationship;
- health selection into lone parenthood;
- the stress associated with their route into lone parenthood;
- the stigma associated with being a lone parent in Britain today.

In terms of social relationships, the GHS has particularly poor information. Although some studies have suggested that living with others may provide an individual with social ties and support similar to that of marriage (Anson, 1989), the physical presence of another person in the household says very little about the quality of the relationship and hence whether it is beneficial or harmful to health. A number of studies of women's health have suggested that it is not so much being married that is beneficial for health but having a supportive confidante (Brown and Harris, 1978). For example, Brown and Morgan (1997) found that the rate of depression among lone mothers was similar to that of other mothers who had poor quality marriages. Moreover, some lone parents, particularly mothers, may have caring responsibilities towards the other adults in the households as well as their children, which could make living with others "a burden and/or a source of support" (Popay and Jones, 1990, p. 508). Further evidence is required therefore about the nature and quality of social relationships

of different parent groups in order to assess if this could help to explain their health divide.

The association between lone parenthood and poor health could be the result of health selection, i.e. it is not that being a lone parent causes poor health, but that poor health increases the risk of becoming a lone parent. The selection effect may operate in two ways (Riessman and Gerstel, 1985). First, ill people may be less likely to marry or more likely to have their marriages break up than healthy people. Secondly, healthy lone parents may be more likely to find a new partner and remarry/marry than those who are less healthy.

Some analysts have argued that measures of health status — such as the long term illness question — can be used as independent variables in analyses such as these to identify health selection effects while the health state measures, such as recent illness or subjective assessments of health, are the dependent variables (Bartley *et al.*, 1992). Doing so with this analysis does change the results. Not surprisingly, limiting longstanding illness is an extremely significant predictor of the health state variables. Although lone parent status is still significant in models of health state with just limiting longstanding illness as the other explanatory factor, when socioeconomic variables are also controlled for lone parenthood ceases to be a significant determinant of health state. However, including such a variable as a measure of health selection assumes that the limiting longstanding illness not only occurred before the individual became a lone parent but that it was a cause of it. While this possibility cannot be ruled out neither should it be assumed. Hence it would be much more appropriate to try to deal with the possibility of health selection effects through longitudinal data where the time sequence of events may be made clearer.

Becoming a lone parent, through divorce, separation, widowhood, or having a baby alone, is a stressful experience and this may have temporary or lasting effects on lone parents' health. For example, Popay and Jones (1990) suggest that widowhood results in a sudden and dramatic change in roles, particularly for men, while separation causes social, emotional and material turmoil, all of which may have a detrimental effect on health. The results presented here suggest that divorced lone mothers, followed closely by single and separated mothers appear to have the poorest health, although the differences between them are not significant. However, simply using this typology of lone parents is an inadequate way to capture the effect of stress during the transition into lone parenthood. For example, it combines people who have been widowed or separated for a few weeks with those who have been alone for a substantial part of their time as parents.

One would expect the initial period after becoming a lone parent to be particularly stressful due to

the breakdown of a relationship or death of a partner. It is hard to assess whether such effects would have a permanent effect on health or if only temporary how long they would last. As the length of time an individual remains a lone parent grows one might hypothesise two opposing implications for health. On the one hand individuals may become accustomed and adjust to their new social status and material circumstances, develop alternative support mechanisms and recover from the stress associated with the transition. Alternatively, as time goes by the accumulation of the stress of bringing up a child alone with reduced material and social resources may take its toll on health. Moreover, there is some evidence to suggest that there is likely to be a health selection effect in term of establishing new partnerships; with people in poor health less likely to do so.

The limited information on length of time since the end of a marriage in the GHS suggests that health worsens with the length of time someone has been a lone parent. However, the poor quality of the information on non-marital partnerships and the lack of detail about the nature of the marital breakdown or the quality of the support available to the lone parent after that, mean that little can be made of the results.

It might also be the case that becoming a lone parent may improve some people's health chances. Lone parenthood should not be seen as a totally negative experience. For many people lone parenthood is an escape from a different set of problems, which may have been equally, or more, harmful to their health. For example, 20% of lone parents give violence as a major factor in the breakdown of their relationship (Bradshaw and Millar, 1991). Moreover, many women feel better off after a marital breakdown, even if they have fewer resources, because they have more control over their finances and their lives (Graham, 1987). Many lone parents argue that they are "happy alone" because lone parenthood gives them independence, self-esteem, pride and confidence (Shaw, 1991).

The final explanation that has been put forward to account for lone parents' relatively poor health status is that it is a consequence of the stigma associated with lone parenthood in Britain today. Many lone parents are clearly distressed by attitudes they face in their everyday lives. For example, Kempson (1996) reports one young single mother as saying "I don't go out. They look at you like you're a slag... cos I was so young like... 15 when I had her" (p. 56). A second single mother living in a rural area reported "there's not a lot of young mums around here, not as young as me anyway, and they mostly have blokes. People look at you funny" (p. 56).

There is a growing body of evidence — based on psychoneuroimmunology — that supports the notion that factors such as these may have health

consequences (Evans *et al.*, 1994). This work is beginning to identify the biological pathways between what people think and feel through chemical changes in their brain to changes in their immune and endocrine system to some of the main causes of disease in society today, including atherosclerosis and many tumours.

It is important to emphasise, once again, that these explanations should not be seen as mutually exclusive. It is likely to be the cumulative experience of a combination of them that explains the health difference between lone and couple parents. This study has shown that differences in the socioeconomic circumstances of lone parents do make a substantial contribution to their poor health status. While this does not mean that other explanations are unimportant, it does help to identify some ways of improving lone parent's health.

WAY FORWARD

The secondary analysis of large quantitative cross-sectional datasets is a relatively cheap way of providing a clear picture of broad associations between lone parents, their socioeconomic circumstances and their health. The size of the sample and the strength of the associations between socioeconomic circumstances and health enable a clear policy message to be delivered. If policy makers wish to reduce the excess health disadvantage of lone parents they must tackle their socioeconomic problems. Policies to tackle social and economic disadvantage in general, therefore, would improve the relative health status of lone parents. Such strategies would need to cover a range of measures to promote employment opportunities for those who want or are able to work — through better child-care, improved training and education and concerted efforts to reduce unemployment — and to improve the living conditions for those who continue to rely on benefits (Benzeval and Webb, 1995).

However, the poor socioeconomic circumstances of lone parents do not explain all of the health difference between them and couple parents. Other explanations need to be explored and the interactions between them need to be considered. To do this other kinds of information are required both to develop a much more detailed picture of the circumstances of lone parents' lives and how these affect their health, and to unravel the dynamic relationships between lone parenthood, socioeconomic characteristics and health. To go forward on both of these fronts requires much more qualitative information about lone parents' experiences and longitudinal data. The former will enable people to describe their transition to lone parenthood and the experience of being a lone parent over time and how they feel it affects their health and lives. Longitudinal data will not be able to achieve the

richness of such research but will enable the broad associations between lone parenthood, socioeconomic circumstances and health to be assessed over time. This will give researchers insight into the direction of causation, and allow the health experience of lone parents to be assessed before, during and after the transition to lone parenthood.

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PAPER 3

Michaela Benzeval and Ken Judge (2001)

'Income and health: the time dimension'

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Income and health: the time dimension

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Abstract

It is widely recognised that poverty is associated with poor health even in advanced industrial societies. But most existing studies of the relationship between the availability of financial resources and health status fail to distinguish between the transient and permanent impact of poverty on health. Many studies also fail to address the possibility of reverse causation; poor health causes low income. This paper aims to address these issues by moving beyond the static perspective provided by cross-sectional analyses and focusing on the dynamic nature of people's experiences of income and health. The specific objective is to investigate the relationship between income and health for adult participants in the British Household Panel Survey from 1991 to 1996/97. The paper pays particular attention to: the problem of health selection; the role of long-term income; and, the effect of income dynamics on health. The results confirm the general findings from the small number of longitudinal studies available in the international literature: long-term income is more important for health than current income; income levels are more significant than income change; persistent poverty is more harmful for health than occasional episodes; and, income reductions appear to have a greater effect on health than income increases. After controlling for initial health status the association between income and health is attenuated but not eliminated. This suggests that there is a causal relationship between low income and poor health. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Income; Health; Panel study; Britain; Income dynamics; Health selection

Introduction

It is a truism that poverty is bad for health. However, the precise links between various definitions and perceptions of financial circumstances and different measures of health status are not clearly understood. Moreover, much of the evidence about the association between income and health is based on cross-sectional data where the direction of causation cannot be known with any certainty. In addition, recent research findings make it increasingly clear that poverty is a dynamic not a static concept. Although some people face long periods of sustained financial hardship, a large number of others

move in and out of poverty in various ways and for differing periods of time. Yet,

... time seldom features in debates about poverty. ... without taking time into account it is impossible fully to appreciate the nature and experience of poverty or truly understand the level of suffering involved. Equally, it is impossible to develop policies that successfully tackle the multiple causes of the problem or offer lasting solutions (Walker & Ashworth, 1994, p. 1).

Such concerns are even more relevant to the debate about the relationship between poverty and health, as Walker and Ashworth argue:

... a brief spell of poverty is not the same as a lifetime spent with resources outstripped by need and. ... neither is [it] the same as repeated bouts of

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poverty separated by time that may allow for some financial and emotional repair. [For example,] ... during spells of poverty psychological well-being may well reflect a complex interplay between factors that change with time: frustrated expectations and stress caused by the need to budget on an exceptionally low income for long periods, contrasting with growing expertise in what may be relatively stable financial circumstances (1994, pp. 139; 38–39).

Time, therefore, is a vital ingredient in any analysis of income or poverty and health. Three key aspects of the association over time are important.

- First, establishing the temporal order of events will increase confidence about the direction of causation in a way that is not possible with data measured at one point in time.
- Secondly, there is a growing recognition of the importance of examining people's current health in light of their life-course experience (Kuh & Ben-Shlomo, 1997). This issue may be particularly important for the association between income and health because income measured at one point in time may be a poor marker for an individual's access to material resources across their lifetime (Blundell & Preston, 1995).
- Finally, as highlighted above the contrasting experiences of poverty dynamics may have different consequences for health, which need to be explored.

The purpose of this paper, therefore, is to investigate the relationship between income and health over time for adults with respect to these three issues. Children have not been included in the analysis because the relationship in childhood is likely to be different to that in adulthood, being based on parents' income rather than the individual's own. However, a number of studies have been conducted on the consequences of income dynamics for child outcomes, including health (see, for example, Duncan, Brooks-Gunn & Klebanov, 1994; Miller & Korenman, 1994; Duncan & Brooks-Gunning, 1997).

The paper begins by briefly summarising the findings from existing studies that take account of a time dimension in the relationship between income and health. It then goes on to present findings from analyses of the British Household Panel Survey (BHPS).

Literature review

We cannot claim to have conducted a comprehensive and systematic review of studies that investigate the relationship between income and health over time. However, we have tried to identify what appear to be significant English-language studies that might provide a

scholarly context for this investigation. Sixteen studies are included in this review if they:

- focus on adult health outcomes;
- include monetary measures of income for more than one point in time;
- contain a measure of income that precedes the health outcomes.

The studies identified are based on eight different longitudinal datasets from four countries: the USA, Canada, West Germany and Sweden. Table 1 summarises the main characteristics and results of the studies. The authors and details of the survey, including the time period covered, are given in columns 1 and 2 respectively. Column 3 specifies the size and defining characteristics of the population studied. Column 4 lists the health outcomes investigated and column 5 identifies the way in which both income levels and income change have been measured. Column 6 highlights any other confounding variables that have been included in the multivariate analyses. Column 7 explains both the statistical technique and modelling employed in the studies. Finally, column 8 describes the result of the study with respect to the income variables only.

The surveys used for analyses of the relationship between income and health over time cover a very diverse set of populations, from a small group of women living in Berkeley in the 1930s followed until 1970 to 500,000 men registered in the Canadian Pension Plan. Most of the studies focus on specific sub-groups, in particular, men, older people, labour force participants and couples. The length of studies ranges from cross-sectional surveys with historical information on income, to a survey of families at two points in time forty years apart, to one with twenty-four consecutive years of data.

Approximately half of the study outcome measures are mortality rates. Nearly all of the remaining studies have a measure of psychosocial wellbeing, as well as variables based on subjective assessments of general health, lists of physical symptoms and activities of daily living.

Time has been incorporated into the income measures in a wide range of ways, which can be roughly grouped as: income level; income change; and, poverty experience. Ten studies include a measure of income level, with six of these being based on long-term income. Two studies include both long-term and current income, one of which also explores individual's income level measured at a number of different points in time. Ten studies include some measure of income change. Such studies are reasonably distributed between two measures — loss only and any change. Seven studies include measures of both income level and income change. Six studies have a measure of poverty experience, one of which attempts to assess the stability of the occurrence as well as its duration.

Table 1
Income and health: the time dimension

Authors	Location	Sample	Outcome measure	Income measure	Confounders	Method	Results
Elder and Liker (1982)	Berkeley Guidance Study 1930–70	81 women born in 1890–1910	Psychosocial health at age 60–80	Dummy variable: husband's income loss between 1929 and 1933 greater than 30%	Psychosocial health in 1930 Hollingshead index of SES in 1929	LISREL model to assess effects of income loss in two stratas: middle and working class	For middle class women, income loss in 1930s had a significant and positive effect on their health in 1970. For working class women the effect on health was negative but not significant.
Elder, Liker and Jaworski (1984)	Berkeley Guidance Study 1928–1945	211 families: parents born 1890–1910; children born 1928/30	Average score on 7 point scale of emotional stability 1933–35 1936–38 1939–45	Income loss- % difference between family income in 1929 & lowest income 1933 to 1934–35	Initial emotional stability score 1930 Marital support SES	LISREL	For all men the effect of income loss is weak (only significant in 1st time period), initial health and marital support are much more important. 'However, heavy income loss entailed very substantial health costs for initially unstable men, but not for unstable women' p. 191. For initially stable women, there was a significant improvement in their health as a result of heavy income loss.
Hirdes et al. (1986)	Ontario LS Aging, 1959–78	2000 men in labour force aged 45 in 1959, only 52% left in sample in 1978	1. Cross-sections subjective general health and subjective assessment of health change in last year 2. Panel (a) good health in 1969 if good in 1959 (b) good health in 1973 if good in 1969	1. Cross-sections 3 category variable individual income level; subjective assessment of income change over last year 2. Panel (a) 59 individual income level change; real individual income 59–69 (b) ratio of 73/69 real individual income.	None	1. Cross-sections logistic regression both outcome variables, against income level, subj. income change and interaction 2. Panel (a) logistic regression remain in good health in relation to 59 income level & 59–69 income level (b) logistic regression remain in good health against ratio of 73 to 69 real income.	1. Cross-sections Both income level and income change significant, interaction not significant. 2. Panel (a) prob remain in good health 59/69 related to 59 income level and income change (b) income ratio significant predictor of remaining in good health 73/69 ⁶ loss of income was strongly associated with a perceived loss of health and a weaker relationship was observed between an increased income and better health' p. 201

(continued on next page)

Table 1 (continued)

Authors	Location	Sample	Outcome measure	Income measure	Confounders	Method	Results
Hirdes and Forbes (1989)	Ontario LS Ageing, 1959–78	2000 men in labour force aged 45 in 1959, only 52% left in sample in 1978	Mortality by 1978	1969 individual income level — categorical (low, medium, high) individual income category change 59–69	Education Smoking Subjective assessment of health, 1969	Logistic regression for people with good or excellent health in 1959	1969 income level significant (if exclude current health) but not income change.
Kaplan and Haan (1989)	Alameda County Study, 1965–1983	7000 people aged over 50 in 1965; 120,000 person years of follow-up	9 yr mortality (1974–83)	<ul style="list-style-type: none"> ● Income fall of \$10,000 1965–74 ● Income level 1965 	Age Sex Baseline health	Cox proportional hazards	<ul style="list-style-type: none"> ● Income fall was significantly associated with mortality after controlling for baseline health and income. ● Income level was not significant. <p>'dynamics of socioeconomic position are more strongly related to risk of death in older persons than are single point estimates of socioeconomic position' p. 42</p>
Tåhlin (1989)	Swedish Level of Living Survey, 1981, linked to tax records for income 1978–81	2588 wage earners aged 25–64 who work for more than 18 hrs	factor analysis of list of illnesses to create: cardiovascular disease; mental health capacity	<ul style="list-style-type: none"> ● Net adj. current family income ● Relative income (social) — difference in income from average for reference group ● Income change from aver income previous 3 yr 	<i>Economic</i> Cash margin Vacations <i>Exogenous</i> Age Sex Education <i>Endogenous</i> Working condition Wage level	LISREL structural equation models 1. Net adj. income 2. Social income and income change Aim to assess whether income level or relative income more important	<ul style="list-style-type: none"> ● Net family income and social income both significant for mental health and CHD; ● Income change only significant for CHD ● Models with social & income change fit better than income level <p>'influence of economic resources on the state of health ... predominantly seems to be connected with relative income' p. 126</p>

Zick and Smith (1991)	Panel Study of Income Dynamics (PSID) 1968–84, USA	2000 household & wives (all those who die plus quarter of rest appropriate sample converted into person year file)	Mortality btwn 71 and 84	Dummy variable: ever poor between $t-3$ and $t-1$ (family income need ratio < 1)	<i>Time invariant</i> Race Education <i>Time varying</i> Age, age ² Employment status $t-2$ Marital status $t-2$ Marital change $t-2, t-1$	Discrete time event history methods: Logistic regression models die in year t or not, separately for men and women	'One or more spells of poverty between $t-3$ and $t-1$ significantly increases the hazard of dying for both sexes. However, the effects are somewhat stronger for women than for men' p. 332
Mullis (1992)	National Longitudinal Study (NLS) Mature males 1966–81 USA	Men aged 55–69 in 1976	Psychological wellbeing (happiness with (six dimensions of life))	<ul style="list-style-type: none"> ● Family income 1976 ● Earnings 1976 ● Net worth 1976 ● Economic wellbeing (7 yr average income + net worth/ poverty income) 	Age Marital status Family size Education Locus of control Area unemployment rate	ANOVA OLS	Multivariate analysis all income measures are significantly associated with happiness, strongest predictor is economic wellbeing '...suggests that psychological wellbeing is more a function of the level of income patterns rather than the level of current income' p. 132
Smith and Zick (1994)	PSID 1968–87 USA	1302 couples who married (1st time) in 68/69, husband between 35 and 64	Mortality	<ul style="list-style-type: none"> ● Household poverty — income /need ratio < 1.5 — in 68 or 69 ● Household poverty — income /need ratio < 1.5 — in 68 and 69 	Age Disabled Race Partner's characteristics Poor area Smoking Children Divorce Education Risk avoidance	Paired proportional hazards (Cox's)	Both poverty variables increase risk of mortality. Poor in both years bigger effect.
Wolfson et al. (1993)	Canadian Pension Plan begun 1969–88	500,000 men aged 65 after Sept 1979	Survival probabilities until death between ages 65 and 74	Average annual earnings from 1966 until aged 65 (13+yr)	Marital status and age at retirement (by stratification)	Weibull survival regression model Separate models run by marital status and by each age at retirement, excluding people who have ever received disability benefit	'an extra dollar of income is beneficial for longevity at all incomes, but it offers decreasing 'protective effect' at higher incomes than at lower incomes' p.S175

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Table 1 (continued)

Authors	Location	Sample	Outcome measure	Income measure	Confounding	Method	Results
Menchik (1993)	NLS older men 1966–83 USA	Approx 5000 men	Mortality: failure to survive 17 yr	<ul style="list-style-type: none"> ● Permanent income level — net household worth 1966 — average discounted individual earnings since 1966 ● Transitory income — Number of years adj. Family income below poverty threshold as ratio no years of data 	Age Parent's education No parents alive Region Marital status	Stepped logistic regression all respondents. Separate models for those with initial health good and not poor.	Wealth, permanent income and transitory income are all significant after controlling other factors. Similar coefficients when sample split by initial health status, although permanent income slightly smaller coefficient and on margins of significance. 'the greater the number of spells of poverty, given permanent income, the higher the death rate' p. 436
Lundberg and Fritzell (1994)	Survey of Swedish Living Standards 1991, linked to tax returns 1980 and 1990	6000 people aged 35–64 in 1991 excluding housewives and the self-employed	Two binary variables based on list of physical and psychosocial symptoms in 1991	<ul style="list-style-type: none"> ● Initial individual income level in 1980 in quintiles ● Income change <i>Categorical variable</i> (fall, stable, increase) of mobility within income distribution <ul style="list-style-type: none"> ○ <i>Relative change</i> Income based on difference in decile 	Age Prior health status	Separate logistic regression models for men and women in four stages 1. Age and income change 2. 1 plus prior health 3. 1 plus initial income 4. All variables	For men's psychosocial illness income change variables significant and not affected by confounders (slightly stronger when control initial income). For physical health income change is only significant after controlling initial income. For women income change was not significant for psychosocial but was for physical health when initial income controlled for. For both sexes and both health measures strong association between initial income and health outcome. 'These analyses point to income changes, both absolute and

				position to self in past ○ <i>Absolute change</i> Income based on change in real income of at least half median change		relative, as clearly related to physical as well as mental health' p. 55
Duncan (1996)	PSID 1968–1992 USA	Men aged 40+	Mortality	<ul style="list-style-type: none"> ● Average family income category over 5 yr ● No of times income fell by 50% from one yr to next in previous 5 yr 	Age Race Household size Decade	Logistic regression with Taylor-series approximation to adjust for individual and area clustering. Data split into 14 10-yr time periods income data are used for 1 st five years, mortality for last five years
Lynch et al. (1997)	Alameda County Study 1965–1994 USA	1081–1124 respondents with complete information 1965, 1974, 1983, 1994	Physical functioning (ADLS) Psychological functioning (depression, cynical hostility, optimism) Cognitive functioning social isolation	<ul style="list-style-type: none"> ● No of times family income below 200% federal poverty line (max. 3) 	Age Sex Disability in 65, 74, 83 Smoking Alcohol Exercise BMI	Logistic regression Separate analyses for (a) people with no disability in 1965, (b) people in good health in 1965, (c) people in good health whose income source is not wages
McDonough et al. (1997)	PSID 1968–1989 USA	People aged 45+	Mortality	<ul style="list-style-type: none"> ● Income_{t-1} ● Income_{t-5} ● Average family income category over 5 yr 	Age Sex Race Household size _{t-4} Education Work disability	Logistic regression with SUDAN sampling error estimates for sampling and between period within person

(continued on next page)

Table 1 (continued)

Authors	Location	Sample	Outcome measure	Income measure	Confounders	Method	Results
Thiede and Traub (1997)	German Socio-Economic Panel 1984–92	8489 people aged 16+ in 1992	Physical functioning (ADLS) Impairment Emotional functioning (optimism) Social functioning (loneliness) Satisfaction with health	● Income stability (persistency of poverty or affluence) ● Year on year income loss of 50% interacted with income level ● Change in equivalent family income 92–94	None	variability Data split into 14 10 yr time periods income data are used for 1st five years, mortality for last five years	mortality. Income loss had a persistent effect on mortality when income level was controlled. Controlling for initial disability and education attenuated the association but did not make it insignificant. 'Findings point to pronounced mortality disadvantage for those at low end of income hierarchy, income stability beginning to matter at mid-income levels' p. 1481 'Income changes certainly induce influences on health variable assessed by functional status, whereas health status has little explanatory value as a determinant of income change' p. 876

The most commonly employed confounders are demographic factors and prior health status. The latter is often employed as a method of controlling for the possibility of reverse causation or health selection. Other confounders include education, employment, family characteristics, living arrangements and behaviours.

The studies reviewed here employ a number of ways of controlling for health selection. First, virtually all of the studies highlight the value of using measures of income that precede the health outcomes. Secondly, many of the studies control for initial health status to take account of selection effects. Finally, a number of other studies only include in their analysis people who were in good health at the start of the survey, or stratify the sample by initial health status to identify possible selection effects.

All of the studies that include measures of income level find that it is significantly related to health outcomes. Using the various methods to control for health selection outlined above, all of the studies conclude that health selection is not a serious issue and the main direction of causation runs from income to health. There is some suggestion from the results that long-term income may be more significant for health than short-run income, although one study finds little difference. In relation to income change, people whose income falls over time, in comparison to those whose income remains stable or increases, have poorer health outcomes. Income loss appears to have a much stronger effect on health than increases in income. In the majority of studies that contain both income level and income change variables, the former appears to be more significant. Finally, persistent poverty appears to be most damaging for health. Those people who are persistently poor, in comparison to those who experience poverty only occasionally or not at all, have the worst health outcomes.

Data analysis

The data analysis presented in this paper has two main aims. First, to investigate the effect on the association between income and health of including a time dimension. Much of the evidence about the relationship between income and health is based on cross-sectional analyses (Benzeval, Judge & Shouls, 2001). Although such studies show a strong negative correlation between increasing income and poor health, it is impossible to know in which direction the causation runs, i.e. does low income result in poor health, or poor health reduce an individual's earning ability and hence their income? Moreover, income measured at one point in time may be a poor reflection of the material resources available to the individual. The first part of

the data analysis section, therefore, investigates the effect of including initial health and income over time on the cross-sectional association between income and health.

The second aim of the data analysis is to explore whether the broad pattern of findings, outlined above, about the relationship between income dynamics and health hold true for a British dataset in the 1990s. In particular, three key questions are considered:

- Is long-term income more important for health than income measured at one point in time?
- Are persistent episodes of poverty more harmful than occasional ones?
- What is the effect of income change on health after controlling for income level?

This section begins by briefly describing the dataset. It assesses its representativeness and provides some information on the measures of health and income employed in the analysis. Next, it outlines the methods adopted to investigate the research questions identified above. Finally, it summarises the results of the multivariate models of income and health over time.

BHPS dataset

The BHPS was begun in 1991 and this paper is based on information for the first six waves of the survey (1991–96/7). The initial sample was designed as a nationally representative sample of the population of Great Britain living in private households and covered approximately 5000 households and 10,000 adults. The sample was based on a two-stage stratified clustered design. In the first stage, 250 postcode sectors were selected from an implicitly stratified listing of the small user Postcode Address File. The postcode sectors were stratified by region and socio-demographic data from the 1981 Census, and specific sectors were chosen on the basis of a probability selection proportionate to the size of the postcode sector. In the second stage, delivery points — addresses — were sampled from the postcode sectors using an analogous systematic procedure. Up to three households were selected to participate in the sample (using random probability sampling if more than three households were resident at the address). All adults in the household are interviewed. For a fuller description of the sampling strategy see the BHPS user manual (Taylor, 1998).

Strenuous efforts have been made to follow up all of the initial members of the panel over time. In addition, new people who join panel households, for example new partners, babies, lodgers, are also included in the study. However, for most research purposes, including this paper, it is only the individuals who respond to all waves who are of interest. Sample attrition is therefore a

considerable concern for the study. The survey has achieved year-on-year response rates of approximately 95 per cent. However, by Wave 6 only 72 per cent of those who gave full interviews in the first wave were included in the follow up. This paper is further complicated by the need to have complete income information for all adult respondents in each household to calculate a family income variable. With this selection criterion, only 5281 initial adult respondents had complete information for themselves and their household for each year.

The initial 1991 sample was under-represented in comparison to the Census in terms of households in rented tenures, with more than six people and without access to a car. Young adults and children were slightly over-represented and older people under. Post stratification weights successfully adjust for these problems. (Taylor, 1994). Attrition since the first wave has tended to occur among specific groups of the population, including those living in inner city conurbations, less affluent households, younger people particularly men, members of ethnic minority groups and the highly mobile. Longitudinal weights have been calculated based on the previous characteristics of those lost to the survey to correct for these biases (Taylor, 1994, 1998), and are employed in this paper.

Health questions

The BHPS contains four sets of health questions that cover a range of different dimensions of health, including measures of both physical and mental health problems, psychological wellbeing (GHQ), limiting illness and subjective assessments of general health. For the purpose of this analysis, each health question has been used to create a binary dependent variable, as shown in Box 1.

Box 1
Health measures in the BHPS

Variable	Explanation	Sample prevalence in wave 6 %
Limiting illness	Whether or not respondent has illness which limits his daily activities	18.3
Health problems	Respondents are asked whether they have any illnesses from list of various health problems — a binary variable is created by splitting the distribution at the average number of health problems (1.27)	34.4
Psychological well-being	The GHQ is scored by the caseness method and a binary variable is created by splitting the distribution at those with score of 3 or more. (Weich and Lewis, 1998a,b)	26.5
General Health Questionnaire (12 item)		
Subjective assessment of health	Five-category question about overall assessment of health as excellent, good, fair, poor or very poor. Binary variable created by comparing those with fair, poor and very poor health with excellent or good health	32.3

In Wave 6 approximately one-third of the sample experience a higher than average number of health problems. A similar proportion assess their general health as being only fair, poor or very poor. Just over one-quarter of respondents have a GHQ score of 3 or more. Eighteen per cent of people report an illness that limits their daily activities.

The extent of change in health across the six years varies with the outcome considered. For example, just over two-thirds of respondents do not have a limiting illness throughout the six years, while the same is true for only just over 40 per cent of respondents for poor subjective assessments of health and high GHQ scores. Despite this, only a small proportion of respondents is in poor health for every year of the survey. Again, this varies with the health outcome considered. Almost double the proportion of respondents are continually in poor health based on the experience of health problems than for the measure of limiting illness, and very few respondents have poor psychological health for all six years.

Measuring income and poverty dynamics

The BHPS collects income information from all sources — employment, benefits, pensions, investment and savings, maintenance payments — for all adults in the household. Unfortunately, the BHPS does not collect sufficient information on taxation to facilitate the calculation of an accurate measure of net income from the public dataset (Webb, 1995). It only asks employees about their net income for their main occupation. It does not collect information on the tax paid for second jobs nor for people who are self-employed or pensioners. In addition, information is not collected on local taxation. However, Jarvis and Jenkins (1995) have used tax and benefit simulation models to estimate net family income more accurately than one is

able to do using the basic public dataset. Their measure of net family income has been deposited at the Data Archive and is used in this analysis (Jarvis & Jenkins, 1998).

Two adjustments have been made to this measure of net family income in order to create an indicator of comparable living standards for the respondents. First, given that the survey information was collected over six years, the income data are deflated by the retail price index to adjust for inflation (January 1996 = 100). Secondly, the income data are equivalised — using the McClements scale — to take account of differences in the size and composition of families.

In conducting these analyses we have been acutely conscious of the relatively short length of the panel and we have therefore wanted to maximise our use of the available data. However, in investigating the association between income levels and health, we felt it was inappropriate to link income and health in the same year. We have therefore employed income measures that precede our health outcomes. For example, we investigate the association between average income from waves 1 to 5 and health in wave 6. This helps to ensure that the association is not the result of health selection. However, the same problem does not apply when looking at changes in income over the time. For our measures of income change therefore we felt that we could exploit all six years of the data.

Following on from this, we used the measure of real net equivalent family income to create three types of income dynamics variables: income levels, poverty experience, and income change, as described below.

First, annual income data are calculated for each year of the survey. In addition, five-year (waves 1–5) average income has been calculated. From these measures variables are derived that identify in which quintile (fifth) of the income distribution people are located, in each specified time period.

The second set of income measures assesses people's experience of poverty over the first five years of the survey. Three distinct variables are employed. Two of these simply measure the duration of individual's poverty experience in terms of:

- the number of years that the respondent's family income has been less than half of the average for each specific year.
- the number of years that the respondent's family income has been in the bottom fifth of the income distribution.

The final measure attempts to combine information on poverty duration with some consideration of the stability of the experience, following the concept devised by McDonough, Duncan, Williams and House (1997). The variable devised for this analysis has five categories:

- 3 or more years in the bottom two income quintiles and no years in the top two income quintiles;
- 1–2 yr in the bottom two income quintiles and no years in the top two quintiles;
- income in the middle quintile or a mixture of poor and affluent years (i.e. the residual category);
- 1–2 yr in the top two income quintiles and no years in the bottom two-fifths of the income distribution;
- 3 or more years in the top two income quintiles and no years in bottom two quintiles.

The final set of variables derived from net family income assesses the extent of income change over the six years of the survey. A variety of measures from the literature were tested, but as a reasonably consistent pattern emerged only three are presented here.

- The simple monetary difference between income in Wave 6 and in Wave 1.
- Following Elder and Liker (1982) we constructed dummy variables which identified those people with large increases and decreases in income (> 30 per cent) across the six years, with the reference category being those who do not experience such large changes in their income.
- Income volatility measured by the standard deviation of each respondent's family income across the six years of the survey.

Analysis of the BHPS suggests that there is quite considerable income dynamics over the six-year period. For example, in any specific year approximately 16.5 per cent of the sample experience poverty (defined as having less than half of average income). However, over the course of the six years of the survey, 37 per cent have experienced at least one year of poverty, while only 3 per cent are poor for all six years. Thus while persistent poverty affects only a small minority of the population, a large proportion experience poverty during a relative short period of time.

Methods

In order to explore the association between income and health in detail while controlling for other factors, multivariate analysis is employed. Since all of the health outcome measures are binary, i.e. take the value 0 or 1, the most appropriate statistical technique is logistic regression (Hosmer & Lemeshow, 1989). The analysis has been conducted in STATA in order to adjust for the multistage sampling design of the BHPS. Survey estimation techniques are employed that take into account the clustering and stratification of the sample selection methods and the longitudinal probability selection and attrition weightings. This methodology also takes account of the non-independence of

individual observations as a result of the analysis containing more than one adult from each household. These methods ensure that the point estimates are unbiased and that the standard errors are not inflated (Stata Press, 1997). Individual independent variables are considered statistically significant if their *t*-statistic is significant at the 10 per cent level. The overall significance of the model and groups of explanatory factors are assessed using the adjusted Wald *F*-statistic, which takes account of the sample design, and can be compared to the *F*-distribution with k , $N - k$ degrees of freedom (where k is the number of independent variables and N the number of observations).

Relatively simple models of the association between income and health have been constructed for this paper, which only control for age and sex. We recognise that the literature reviewed above also includes a wide range of other confounders. However, many of these 'confounders' are actually joint determinants of income and health, such as education and employment. Simply adding a range of such variables to models of income and health is likely to obscure rather than clarify the relationship (Benzeval, Judge & Shouls, 2001). It is obviously important to explore these complex inter-relations, but this need to be done in detail within an appropriate theoretical framework (Benzeval, Taylor & Judge, 2000). In this paper, however, we wish to undertake a careful exploration of the direct relationship between income and health, and hence have only controlled for relatively straightforward confounders such as age and sex.

Introducing a time dimension to the relationship between income and health. The starting point for this part of the analysis is the traditional cross-sectional association between income and health, controlling for age and sex. Prior health status and income over time have then been added to these models to assess their effect on the cross-sectional association. At each stage the Wald *F*-statistic and odds ratios for current income are compared to develop a better understanding of the effect of past income and health on the current association.

Replicating international findings. Based on the literature reviewed in the first part of this paper, we identified three key questions to investigate using the BHPS data.

- *Is long-term income more important than income measured at one point in time?* Models are developed for each health outcome with income measured at four points in time — current year (t), previous year ($t-1$), initial year ($t-6$) and the average over the first five years — controlling for age, sex and initial health status. The relative importance for contemporary health of each income measure is assessed by comparing the joint significance of each set of quintiles and the pattern of the odds ratios.

- *Are persistent periods of poverty more harmful for health than occasional ones?* The effect of poverty duration on health is investigated by adding the three measures of poverty experience described above to models containing age, sex, and initial health. The joint significance of the odds ratios for the poverty variables is assessed using the Wald *F*-statistic.
- *What is the effect of income change on health after controlling for income level?* Finally, the analysis assesses the effect of income change on health over and above an individual's income level. It begins with a base model containing age, sex and initial health and initial income and then the three measures of income change described above are added. The significance and direction of the association of each of the measures of income change is assessed and the Wald *F*-statistics associated with initial income and income change are compared to see which appears more important.

Results

Multivariate models: introducing a time dimension to the cross-sectional relationship

Table 2 shows the effect on the cross-sectional association between income and health of adding first prior health status and then income over time, for each of the four outcome measures. Column 1 shows the odds ratio for current income quintiles, having controlled for age and sex. An odds ratio indicates how much more likely a person in each of the income categories is to report poor health than someone in the reference category — in this case the top income quintile. For example, people in the bottom twenty per cent of the income distribution are about 2.4 times as likely to report poor subjective health or a limiting illness and 1.5 times as likely to report a high GHQ score or above average health problems as those in the top fifth. The association between income and health seems to be steepest and most significant for subjective health assessments and limiting illness.

Given the emphasis in the literature on the existence of a stepwise gradient between socioeconomic status and health (Macintyre, 1997), it is worth noting here the non-linear association we find between income and health. Although all of the other income quintiles have poorer health than the richest fifth, there is a particularly big increase in the odds of reporting poor health among the those in the bottom 40 per cent of the income distribution. This suggests that there is not a smooth linear relationship between income and health, but a non-linear one, which is steepest among low-income groups. This finding is consistent with a number of other

Table 2
The effect of a time dimension on the association between current income and health

Current income quintile (wave 6)	Odds ratios for poor health ^a				Health problems				Limiting illness		
	Subjective health		GHQ		Current income	Plus initial health	Plus 5 year average income	Current income	Plus initial health	Plus 5 year average income	Current income
	Current income	Plus initial health	Current income	Plus initial health							
1 (poorest)	2.39	1.94	0.94 ns	1.46	1.21	1.24 ns	1.50	1.40	1.25 ns	2.37	2.03
2	2.31	1.85	0.99 ns	1.49	1.28	1.29	1.39	1.20 ns	1.10 ns	2.52	2.10
3	1.60	1.39	0.96 ns	1.22	1.08 ns	1.08 ns	1.49	1.45	1.51	1.91	1.64
4	1.29	1.21	0.98 ns	0.93 ns	0.87 ns	0.85 ns	1.03 ns	0.98 ns	1.04 ns	1.38	1.23 ns
5 (highest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial health	—	5.09	5.00	—	3.19	3.20	—	7.97	7.95	—	10.49
F statistic for current income	26.4	12.2	0.1	6.6	3.5	2.4	5.5	4.6	3.8	12.3	7.2
p value	0.0000	0.0000	0.98	0.0001	0.0093	0.0515	0.0003	0.0016	0.0058	0.0000	0.4730

^a Model includes age and sex. All odds ratios are significant at the 10 per cent level unless indicated.

studies (Backlund, Sorlie & Johnson, 1996; Mirowsky & Hu, 1996; Benzeval et al., 2001; Der et al., 2000).

Column 2 shows the effect of adding initial health status to the models. The odds ratios for initial health are large and significant, ranging from approximately 3.2 for GHQ to 10.5 for limiting illness. Adding initial health results in a substantial increase in the overall significance of the models for all of the health measures. At the same time, the odds ratios for current income are reduced — on average by 14 per cent — but, in general, remain statistically significant. This suggests that while health selection effects account for a small part of the cross-sectional association between income and health, the main direction of causation runs from income to health.

Column 3 shows the effect on the cross-sectional association between current income and health of adding five-year average income to the models, controlling for age, sex, and initial health. For subjective assessments of general health and limiting illness, average income is statistically significant and its inclusion in the models makes current income insignificant. For health problems, both measures of income are significant, while for GHQ only current income is significant. However, it is important to remember that current and average income are closely related and are likely to be determined by the same factors, which makes it difficult to assess their independence in the same model.

Replicating the international findings

The second set of analyses explores the relevance of the findings from the international literature for Britain in the 1990s.

First, Table 3 compares the relative importance of income measured at four different points in time — current year, previous year, initial year and the five-year average. The results in column 1 are identical to those in column 2 of Table 2 and are reproduced here to facilitate comparison between the income measures.

For subjective assessments of health and limiting illness, the steepest and most significant association is with five-year average income. This suggests that cross-sectional studies, which do not include a time dimension, may under-estimate the relationship between income and health. For both health measures, no matter when income is measured, people at the bottom of the distribution are 2–2.5 times as likely to report poor health as those in the top 20 per cent. For GHQ, current income is the only significant variable, while for health problems there is little difference in the association with health between the income variables measured at different points in time.

The second finding from the literature explored here is the effect of poverty experience on health. Table 4 shows that having controlled for age, sex and initial health,

Table 3
Income over time and health

Odds ratios for poor health ^a																
Income quintile	Subjective health				GHQ				Health problems				Limiting illness			
	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 yr aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 year aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 yr aver income	Current income (t)	Income in previous year (t-1)	Initial income (t-6)	5 yr aver income
1 (poor)	1.94	2.10	2.25	2.54	1.21	1.11 ns	1.02 ns	1.20 ns	1.40	1.31	1.29	1.31	2.03	2.14	2.19	2.53
2	1.85	1.63	1.71	2.34	1.28	1.15 ns	1.00 ns	1.21	1.20 ns	1.15 ns	1.05 ns	1.37	2.10	1.58	2.02	1.94
3	1.39	1.32	1.47	1.44	1.08 ns	0.99 ns	0.92 ns	1.08 ns	1.45	1.17 ns	1.03 ns	1.00 ns	1.64	1.49	1.70	1.45
4	1.21	1.04 ns	1.04 ns	1.27	0.87 ns	0.89 ns	0.82	1.06 ns	0.98 ns	0.86 ns	0.81	0.97 ns	1.23 ns	1.12 ns	1.78 ns	1.10 ns
5 (high)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<i>F</i> -statistic for income quintiles (4,172)	12.2	15.3	19.2	28.9	3.5	1.3	1.5	0.8	4.6	3.8	3.4	3.9	12.3	8.3	8.9	13.2
<i>p</i> value	0.0000	0.0000	0.0000	0.0000	0.0093	0.2648	0.2014	0.5058	0.0003	0.0055	0.0104	0.0047	0.0000	0.0000	0.0000	0.0000

^aModel includes age, sex and initial health. All odds ratios are significant at the 10 per cent level unless indicated.

Table 4
Poverty duration and health

Odds ratios for poor health ^a									
Number of years spent in poverty	Subjective health		GHQ		Health problems		Limiting illness		Bottom fifth of income distribution
	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution	Less than half of average income	Bottom fifth of income distribution	
4 or 5	1.80	1.78	1.01 ns	0.99 ns	1.29	1.40	1.66	1.73	
2 or 3	1.78	1.72	1.07 ns	1.24 ns	1.20 ns	1.08 ns	1.72	1.83	
1	1.23	1.50	1.07 ns	1.02 ns	1.18 ns	1.26	1.30	1.44	
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
<i>F</i> statistics for poverty variables (3,173)	15.1	17.6	0.2	1.7	1.7	2.9	8.8	10.6	
<i>p</i> value	0.0000	0.0000	0.8768	0.1689	0.1618	0.0363	0.0000	0.0000	

^aModel includes age, sex and initial health. All odds ratios are significant at the 10 per cent level unless indicated.

Table 5
Poverty stability and health^a

Poverty stability	Odds ratios for poor health*			
	Subjective health	GHQ	Health problems	Limiting illness
> 3 yr poor, none affluent	2.21	0.98 ns	1.28	2.50
1–3 yrs poor, none affluent	2.58	1.35	1.17 ns	1.72
Middle income	1.43	0.99 ns	1.11 ns	1.55
1–3 yr rich, none poor	1.07 ns	0.91 ns	0.80 ns	1.36 ns
> 3 yr rich, none poor	1.00	1.00	1.00	1.00
F statistic for poverty stability (4,172)	21.8	2.2	2.1	11.3
p value	0.0000	0.0737	0.0828	0.0000

^a Model includes age, sex and initial health. All odds ratios are significant at the 10 per cent level unless indicated.

poverty duration between waves 1 and 5 is significantly associated with health, for all of the health outcome measures except GHQ. The results show that people who experience persistent poverty have the worst health. There is a steady reduction in the risk of ill health as the duration of poverty decreases. The poverty measure based on the number of years people spend in the bottom 20 per cent of the distribution appears to be more strongly associated with health than the one based on the experience of having less than half of average income.

We also created a measure of poverty stability, as described above, which is significantly associated with all health outcomes, as shown in Table 5. As with the measures of poverty duration and income levels, there is a stronger association between poverty stability and subjective assessments of health and limiting illness than for the other health outcomes.

Finally, we explored the relationship between income change and health. Table 6 shows Wald F-statistic for initial income and the income change measures in models that also contain age, sex, and initial health. Having controlled for these factors there is a significant negative association between the linear measure of income change and poor health, for subjective assessments of health and limiting illness. This suggests that the greater the increase in income over the six years the less likely an individual is to report poor health controlling for their starting health and income level. However, with the exception of GHQ, where none of the income measures are significant, initial income appears to be much more strongly associated with health than income change.

In addition for the subjective assessment of health and limiting illness models, there also appears to be a negative association between the measure of income volatility and the probability of reporting poor health. This implies that the greater the amount of income change across the six years, the less likely an individual is to assess their health as poor. Although strictly speaking this measure of volatility is independent of the

direction of change, there is a strong positive correlation between the standard deviation and large increases in income, which may explain this association. Nevertheless this is an interesting finding and requires further exploration when more years of data become available.

The continuous measure of income change described above assumes a linear relationship with health. However, since there is no a priori reason for such an assumption, we also tested a number of non-linear measures. The results are illustrated in Table 6 for a measure that identifies those respondents who had large increases or decreases in their income over the six year period (> 30 per cent). Again the initial income variables appear more significant than those measuring income change. However, large falls in income are significantly associated with reporting poor health, but there is not a significant association between large increases in income and improvements in health. This result is consistent with the international literature, but clearly requires further investigation.

Discussion

The analysis of the BHPS supports the general findings in the international literature on income dynamics and health. Namely, that:

- average income appears more significant for health than current income;
- persistent poverty has a greater health risk than occasional episodes of poverty;
- income level and income change are both significantly associated with health although income level appears more important;
- falls in income appear more important for health than increases.

However, these results are much stronger for two of the health outcomes — subjective assessments of health

Table 6
Income change and health^a

Income variables	F statistics for income variables							
	Subjective health		GHQ		Health problems		Limiting illness	
	F-stat	p value	F-stat	p value	F-stat	p value	F-stat	p value
Monetary difference (w6-w1)	6.6	0.0113	2.66	0.1048	1.27	0.2614	4.6	0.0341
Initial income	21.1	0.0000	1.7	0.1542	3.5	0.0085	9.7	0.0000
Volatility (standard deviation)	3.26	0.0728	1.75	0.1882	0.63	0.4293	2.9	0.0925
Initial income	17.5	0.0000	1.55	0.1905	3.47	0.0093	7.71	0.0000
Odds ratios for categorical income change (w ₁ to w ₆)								
Dummy variables for large changes in income								
30 % increase	1.07 ns		0.98 ns		1.02 ns		1.04 ns	
30% decrease	1.39		1.32		1.22 ns		1.59	
Stable income (base)	1.00		1.00		1.00		1.00	
F-statistic (p value)	5.24 (0.0062)		3.35 (0.0373)		1.07 (0.3468)		4.62 (0.0111)	
Initial income f-statistic (p value)	19.4 (0.0000)		1.63 (0.1689)		3.24 (0.0136)		9.54 (0.0000)	

^a Model includes age, sex, initial health and initial income. All odds ratios are significant at the 10 per cent level unless indicated.

and limiting illness — than for the others — GHQ and health problems. In addition, the BHPS analysis shows the strong association between initial health status and final health outcomes.

The strength of the association between income and limiting illness and subjective assessments of health is not surprising and reflects the results of a number of British studies of the cross-sectional association between income and health (Blaxter, 1990; Power, Manor & Fox, 1990; Benzeval, Judge, Johnson & Taylor, 2000; Ecob & Davey Smith, 1999; Der et al., 2000). However, the results for GHQ and health problems are more unexpected. This may be a result of the way that the underlying questions, which produce count data, have been dichotomised here, and further work is required to investigate this. However, the weaker association with these health measures may also be consistent with other studies in the literature.

In general, although measures of psychosocial health appear to be related to access to material and social resources (Power et al. 1990; Weich & Lewis, 1998a; Ecob & Davey Smith, 1999), this has not been a consistent finding, particularly in relation to minor psychiatric disorders (Stansfeld & Marmot, 1992). For example, Weich and Lewis (1998b), using GHQ-12 in the BHPS, found that financial strain and unemployment are associated with the maintenance but not onset of episodes of common mental disorder and even for this the longitudinal association is much weaker than the cross-sectional one. Stansfeld and Marmot (1992) suggest that the weaker socioeconomic association with minor psychiatric disorders might be a result of differential reporting. As part of the Whitehall Study of civil servant's health, they compared results from the GHQ-30 with clinical assessment of respondents. They found that individuals in lower employment grades consistently under-report psychiatric disorders with the GHQ relative to those in higher grades.

The health problems variable is based on a list of physical and mental health symptoms. It includes some items that the literature suggests should be associated with socioeconomic status (e.g. breathing problems), and others that are not (e.g. migraines). Overall, this variable is more highly associated with old age than the other measures. For example, 63 per cent of people aged over 75 years experience above average health problems, while only 44 per cent report their subjective health as poor; 36 per cent have a limiting illness and 28 per cent have a high GHQ score. A range of other studies have shown that while there is a significant association between income and health at older ages, it is much weaker than that for people under retirement age (Benzeval, Judge, et al., 2000; McDonough et al., 1997; Ecob & Davey Smith, 1999). A number of suggestions have been put forward to explain this phenomena. These include:

- the healthy survivor effect, i.e. the poorest and unhealthiest members of the population will die prematurely so that only healthier people reach old age;
- recent measures of income may less accurately reflect access to material resources in old age than at other periods of life, because this will be dependent on a lifetime of accumulation of wealth and assets.

Such explanations may explain the weaker association between income and reporting health problems. However, further work is required to explore the relationship between income and these two health measures in more detail for particular sub-groups of the population.

More generally, the results described above shed further light on the three key aspects of the relationship between income and health over time highlighted in the introduction:

- the direction of causation — health selection effects;
- the role of life course in determining health inequalities;
- income dynamics.

Health selection

Given the various approaches described in the literature for controlling for health status, two were adopted in this paper. First, the analysis is based on income measures that precede the health outcomes of interest. Secondly, initial health status is included in all of the models. While this is the single most powerful predictor of final health outcomes, a persistent association between income and health remains. In addition, the inclusion of initial health in the models only reduces the odds ratios on the income variables by approximately 14 per cent. This implies that health selection only accounts for a small part of the association between income and health. This is consistent with findings from studies in the literature which employ this technique (e.g. Lundberg & Fritzell, 1994; McDonough et al., 1997). Moreover, as McDonough and colleagues (1997) point out adopting this approach to control for health selection may over adjust for the problem because it takes no account of the role of low income in determining initial health status. Taking all of these factors into account, therefore, these results provide convincing evidence that income and health are causally related.

These findings are consistent with the literature, where all of the studies conclude that the main direction of causation runs from income to health. This is true across the whole range of methods of controlling for health selection. For example, Elder and Liker (1982) conclude that 'the long-term framework of this study [40 years] and the particular change variable, based on loss of the

husband's income, help to clarify the causal direction of influences that link Depression hardship to women's health in old age' (p. 249). Menchik (1993), having stratified by initial health state, reports 'that even *within* health classes, mortality risks are lower for more affluent men; therefore, the economic status/mortality link appears to be causal' (p. 434). Similarly Lynch, Kaplan and Shema (1997) who only examine people in good health at the start of the survey, conclude that their findings show 'very little evidence that reverse causation could explain the overall magnitude and pattern of the findings' (p. 1894).

Moreover, three of the studies investigate health selection directly by examining the effect of changes in health on changes in income. They all conclude that health selection is not a serious problem (Hirdes, Brown, Forbes, Vigoda & Crawford, 1986; Wolfson, Rowe & Gentleman, 1993; Thiede & Traub, 1997). For example, Hirdes and colleagues (1986) show that while income changes over time are significant predictors of subsequent perceived health, initial perceived health is not a significant predictor of income changes. While Thiede and Traub (1997) conclude that 'income changes certainly induce influences on health variables associated with functional status, whereas health status has little explanatory value as a determinant of income changes' (p. 876).

A life-course perspective

The significance of initial health status and the greater importance of average income, at least for some of the health measures, reinforces the role of factors across the life course as determinants of health inequalities. For example, the significance of initial health could be seen a marker for individuals' cumulative socioeconomic life experiences up to that point, rather than an indication that health selection plays a role in the association between income and health. Five-year average income may be a much better marker for an individual's lifetime access to material resources, both past and future, than income measured at one point in time.

Elsewhere we have developed a conceptual framework for investigating the relationship between income and health in the BHPS within a lifecourse perspective. This shows the significance of measures of income potential (using education as a marker) and health capital at the start of the survey, as well as recent income, for final health (Benzeval, Taylor, et al., 2000). However, a panel dataset of six years only allows a small portion of an individual's life course to be investigated. So we have linked this work with analyses of the National Child Development Survey which have shown the independent significance of income both in childhood and in adulthood for adult health (Benzeval, Taylor, et al., 2000). Moreover, this work highlights the importance of

considering the role of childhood income in jointly determining adult income and health. One important implication is that the complex and inter-related development of health and income require further investigation to enable clear policies to be developed.

Income dynamics

Income change, over and above income levels, plays a significant, if minor role, in determining adult health. What is surprising is that this association seems to be driven by falls in income harming health, rather than short-term rises in income promoting health. Although this finding is consistent with the international literature, it is important to consider a number of caveats when thinking about the implications of these results. First, Jenkins (1999) has questioned the quality of some of the income data in the BHPS. In particular, he points to a significant number of implausible benefit increases that cannot be explained by changes in the respondent's circumstances. The quality of the data therefore must urge caution in interpreting the results.

Secondly, the analysis is based on relatively short-run changes in income. Individuals may be able to maintain their living standards by drawing on savings or building up debts in periods of low income. As income increases they may pay off debts or build up reserves of savings rather than change their immediate standards of living. Moreover, this analysis has not taken into account the possibility of time lags between income change and consequent changes in health. The differential results for income increases and falls may be explicable by the operation of different kinds of time lags. Further work is required with longer runs of panel data to explore the effect of income dynamics on health in more detail.

In addition, one needs to consider the reason for the change in income and its timing (Duncan, 1996). For example, a predictable income change because of the birth of a child or retirement may be less harmful for health than a sudden and unpredictable loss of income associated with separation or unemployment, which in themselves may also be health damaging. Income instability or intense spells of poverty may be particularly damaging for children during their development; in adulthood they may be especially harmful for psychosocial health. Further work is required which explores both the quality of the income data in the BHPS and the nature and cause of the income change in more detail.

Conclusion

Evidence from a recent British panel study supports the general findings in the literature that long-run income and persistent poverty are key determinants of health, and that short-term falls in income can have a

detrimental effect on health. These findings suggest that two sets of policies need to be considered.

First, policies need to focus on reducing the risk of persistent poverty. In the long run, strategies to promote education and create work opportunities for people may be the most appropriate response. However, governments must not neglect the needs of those adults currently experiencing poverty for whom the education route is too late, and the task of finding well-paid work difficult or problematic. For such people benefit levels need to provide an adequate standard of living.

Secondly, however, policies need to be devised that protect people from sudden drops in their income and/or ameliorate the health damaging effects that such events might have. Strategies in this area need to address the effects on income and health of transition from employment into unemployment or retirement, divorce and separation and becoming a parent. For all of these transitions the relationships between social change, income and health is likely to be very different for men and women, and this gender dimension needs to be explored further.

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PAPER 4

Michaela Benzeval, Jayne Taylor and Ken Judge (2000)

'Evidence on the relationship between low income and poor health: Is the government doing enough?'

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Evidence on the Relationship between Low Income and Poor Health: Is the Government Doing Enough?

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Abstract

The government's report, *Opportunity for All: Tackling Poverty and Social Exclusion* (Department of Social Security, 1999), identified poor health as one of the major problems associated with low income. However, much of the available evidence on the relationship between income and health is of little help in forming policies to reduce health inequalities, as it has tended to be based on cross-section surveys and is therefore unable to shed much light on causal effects. Here, we make use of two British longitudinal datasets to examine the longer-term influences of income on health within a life-course perspective. We then use the results of our analysis to provide a brief critical assessment of the likely success of the government's anti-poverty strategy in reducing health inequalities. A more detailed assessment of government policy in this respect can be found in Benzeval et al. (forthcoming).

JEL classification: I1, I3.

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I. INTRODUCTION

While it is widely recognised that poverty, or low income, is associated with poor health, even in rich societies, the nature of the relationship between income and health status is not clearly understood. A degree of confusion is often created by the use of occupational class as a proxy for income and by the failure to take account of the fact that poor health can lead to low income as well as vice versa. There is also growing support for the idea that poverty should be viewed as a dynamic concept, not a static one. From this perspective, cross-section studies of income and health, which abound in the literature, are not particularly helpful. For example, Ellwood (1998) argues that it is vital to understand the dynamics of people's experiences in order to design effective policies:

... dynamic analysis gets us closer to treating causes, where static analysis often leads us towards treating symptoms. ... If, for example, we ask who are the poor today ... The obvious static solution ... is to give the poor more money. If instead, we ask what leads people into poverty, we are drawn to events and structures, and our focus shifts to looking for ways to ensure people escape poverty.

Ellwood, 1998, p. 49

Following the logic of this perspective, there is a growing literature on poverty and income dynamics that looks not so much at *who* is poor but *why* they are. At the same time, social policies in both Britain and the US are beginning to focus on changing people's life-course trajectories, by emphasising the role of education and promoting work opportunities as a means of tackling poverty (Ellwood, 1998; Blair, 1999; Department of Health, 1999b). The purpose of this article is to extend this approach to the debate about health inequalities. First, we briefly review the evidence on the relationship between income and health over the life course. In Section III, we present results of an analysis of income and health over time based on data from two British datasets. Section IV briefly assesses the extent to which government policy is addressing some of the key causes of health inequalities and considers how successful its strategy might be in the light of the evidence we find.

II. BACKGROUND

A recent review of the literature has identified a range of studies that examine the relationship between adult health and income over time (Benzeval and Judge, forthcoming). These studies employ a range of different ways of measuring income over time, which can be roughly grouped into three categories:

- income levels over a number of years;
- income change over time;
- duration of poverty experience.

All of the studies identified that include measures of income *levels* over time find a significant correlation with health outcomes. One study that incorporates both long-term and current income finds that the former has a much more powerful impact on health than the latter (Mullis, 1992). However, McDonough et al. (1997) find little difference in the association between mortality and income measured at different points in time.

Most of the studies that include measures of income *change* also find significant results. Income loss appears to have a much stronger effect on health than increases in income (Hirdes et al., 1986). In general, people whose income falls over time have poorer health outcomes than those whose income remains stable or increases (Duncan, 1996). In the majority of studies that contain both income level and income change variables, the former appears to be more significant.

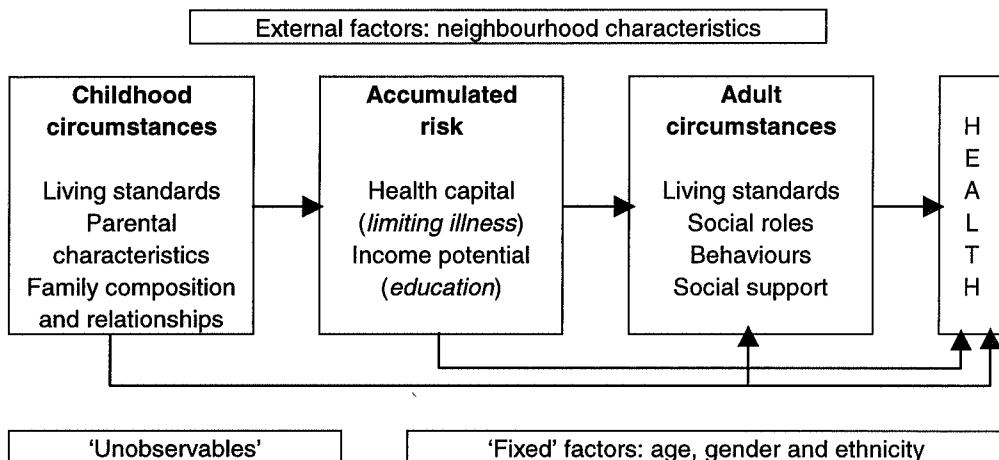
Finally, and of particular interest to us here, a number of studies focus specifically on measures of very low income, or *poverty*. They find that persistent poverty appears to be most damaging for health. Those people who are persistently poor have worse health outcomes than those who experience poverty only occasionally or not at all (Smith and Zick, 1994; Menchik, 1993).

While all of these studies do contain a longitudinal element — and most take into account the dynamic nature of income, the possibility of health selection and a range of other confounders — only one of them considers the role of life-course influences (Elder and Liker, 1982). Moreover, none of the studies deals with the issue of indirect selection, i.e. the fact that income and health might be jointly determined by the same prior experiences or characteristics. In order to explore these relationships, one needs to look to an individual's circumstances in childhood as well as their adult-life experiences, and this breadth of information is rarely available in a single survey.

A range of studies have demonstrated the significance of childhood factors for adult health (Peck and Vagero, 1989; Kaplan and Salonen, 1990; Power, Manor and Fox, 1990; Lundberg, 1993; Power and Matthews, 1997; Kuh et al., 1997). In particular, Lundberg (1993) found that economic hardship in childhood resulted in significantly higher risk of ill health in adulthood. Two broad mechanisms or pathways have been put forward to explain such associations (Lundberg, 1993; Kuh et al., 1997):

- the *biological pathway*: disadvantaged socio-economic circumstances during gestation, infancy and childhood result in 'biological' changes in the child, including poor health, that later lead to ill health in adulthood;
- the *social pathway*: disadvantaged socio-economic circumstances in childhood lead to poor educational and other learning experiences that result in poor socio-economic circumstances in adulthood and consequent ill health.

FIGURE 1
Income and Health: A Life-Course Perspective



Through these two pathways, individuals enter adulthood with an accumulated risk profile in various domains of their lives that will affect their future socio-economic circumstances and health (Kuh et al., 1997). Here, we are concerned with two key dimensions that we define as 'income potential' and 'health capital'. Income potential is the accumulation of abilities, skills and educational experiences in childhood that are important determinants of adult employability and income capacity. Education is seen as the key mediator in this association (Kuh et al., 1997), being strongly influenced by family circumstances in childhood and a central determinant of an individual's income in adulthood. Health capital is the accumulation of health resources, both physical and psychosocial, 'inherited and acquired during the early stages of life which determine current health and future health potential' (Kuh et al., 1997, p. 173). We can think of income potential and accumulated health resources as key components of an individual's general human capital development. Figure 1 illustrates the role that these resources play in determining adult health within a life-course perspective.

In childhood, we are particularly interested in the effect of parental financial resources (or living standards) on the development of children's health capital and income potential. Other characteristics of the parents — for example, their education and health — reflect their personal resources which are also likely to be important. In addition, family composition and relationships, in particular whether or not parents stay together, have all been shown to be significant for child development.

The process of transition from childhood to adulthood, via the accumulation of risk profiles with respect to health and income potential, is described above. We focus on the role of health status and educational qualifications on moving into adulthood as key determinants of later adult health and living standards. Finally, in adult life an individual's living standards and health are determined partly by their life-course experience up to that point and partly by the social roles — in terms of marital status, employment and parenthood — that they assume.¹

Underlying all of these various interrelationships, an individual has certain characteristics that are generally unchangeable by the individual, such as age, gender and ethnicity, which may also affect their health and socio-economic status throughout their life. Whilst age, unlike gender and ethnicity, is not 'fixed' in the true sense of the word, we group all of these factors together in our empirical analysis and refer to them collectively as 'fixed factors'. In addition, an individual may have 'unobservable' characteristics that are genetic or inherited at birth which may influence a range of outcomes. If these effects are not taken into account, then the observed association between income and health might not reflect the true relationship. However, it is generally very difficult to find appropriate measures to act as proxies for such characteristics, as discussed below in relation to our two datasets. Finally, resources in the broader community and neighbourhood characteristics will also have an influence on the childhood and adulthood relationships identified in Figure 1.

Using this framework, the next section presents an analysis of the link between income and health over the life course, using data from two British longitudinal surveys.

III. EMPIRICAL ANALYSIS

The purpose of the empirical analysis that follows is to examine the role of income within the framework outlined above, in order to identify the mechanisms that link income and health over the life course. The results, we hope, will provide important evidence on which to base an assessment of how far current government policy is likely to reduce income-related inequalities in health.

We address three important questions:

1. What role does childhood poverty play in shaping educational outcomes and the acquisition of health capital?
2. How important are educational attainment and health capital accumulated in childhood for later health?

¹We do not consider the role of individual behaviour nor social support mechanisms in this study, although we recognise that they are both important influences within this framework.

3. What is the role of recent poverty experience in determining adult health, after having taken account of accumulated risk?

1. Data

There is no single British dataset that covers the breadth of information or length of life course necessary to address these issues. We have therefore adopted a modified approach which reflects the characteristics of the datasets that can be used. First, the National Child Development Study (NCDS) is employed to investigate the role of financial circumstances in childhood as a determinant of health capital and educational outcomes. The NCDS is a birth cohort study which has collected data at five points in time, with the latest available information being when the respondents were 33 years old. The second dataset used in this paper is the British Household Panel Survey (BHPS), which collects information from the same sample of adults on an annual basis. The sample employed here contains data from six consecutive years of the survey. Both the NCDS and the BHPS are used to investigate the contribution that health capital and education make to predicting adult health outcomes. Finally, the BHPS is employed to explore the associations between recent income and health in adulthood, having controlled for the accumulated risks over the life course.

We describe each dataset in more detail below and assess their relative strengths and weaknesses with respect to our conceptual framework. Before doing that, however, it is important to emphasise that we have adopted a consistent approach across both datasets to measuring the key variables of interest in this paper: low income, income potential, health capital and health outcomes.

- Low income is defined as having family income of less than 60 per cent of the median for each sample.² In the NCDS this is based on a measure of 'permanent' income in childhood, as described below, while in the BHPS it is based on average income over the six years of the survey. In each case, we have created a binary variable to compare those with low income and those without.³
- Income potential is measured by an individual's highest educational qualification, based on information collected when respondents were aged 23 in the NCDS and on information available in the first wave of the BHPS (because information is not available for all respondents in their early

²This is one of the British government's official poverty measures. Employing an alternative measure of poverty — family income below half the mean — generates very similar results to those presented in this paper.

³We have focused in this study specifically on the impact of low income or poverty on health, but we found the results to be qualitatively the same when using a linear income term instead of a poverty dummy in the analysis.

twenties as it is in the NCDS). We distinguish between those with no qualifications and those with some.

- We have chosen to employ a measure of limiting illness as our proxy for health capital. Limiting long-term illness is generally regarded as a measure of long-term health status (Bartley, Popay and Plewis, 1992; Benzeval, 1998) and as such is the most appropriate proxy available in both datasets for health capital. Again, for the NCDS this is based on information collected when respondents were 23 years old and in the BHPS it is based on information from the first year of the survey.
- The health outcome measures are based on responses to very similar questions in both surveys, where respondents are asked to assess their general health. In each dataset, a dichotomous variable has been created which contrasts those respondents who report their health as fair or poor against those who say their health is excellent or good.

The NCDS

The NCDS contains information on a cohort of individuals born during one week in March 1958. Information is available on family circumstances and individual characteristics at birth and when respondents were 7, 11, 16, 23 and 33. For the purpose of the current analysis, individuals are included if they have valid information in all relevant waves of the survey, which gives a sample size of around 7,200 for predicting education and accumulated health capital and 5,700 for our model of adult health. Full details of the survey can be found in Ferri (1993). The characteristics of the final samples selected for analysis are quite similar to those of the full sample at wave 4 of the survey (when respondents were 23 years old), but there is some evidence of health-related attrition and attrition bias against children from more deprived backgrounds more generally. For example, a slightly smaller percentage of NCDS respondents in the final sample for the health capital and education models reported a limiting long-standing illness than the full NCDS4 sample (3.9 per cent compared with 4.6 per cent). Similarly, members of this group are less likely to have no qualifications (12.3 per cent compared with 15.7 per cent).

Our approach to measuring health, health capital and income potential in the NCDS is described above. The fixed factors we have employed include gender, birth weight and illnesses experienced by NCDS respondents in the weeks after their birth. More controversially, following, for example, Blundell et al. (1997), we have also included early indicators of the child's ability, in terms of the results of reading and numerical tests at age 7, to act as proxies for unobservable characteristics. However, we believe that there is considerable evidence to show that age 7 ability scores are strongly determined by social factors in childhood (Duncan and Brooks-Gunn, 1997). Given the problems of interpreting these

variables, we have included them separately in the analysis, so that either interpretation is possible.

Information on parental characteristics was collected throughout childhood, and we have selected for the current analysis indicators of mother's and father's education and employment, parental chronic illness and teacher's reporting of parents' interest in their child's education. The group of variables selected to reflect family support relate to the composition of the family within which the child was raised (in terms of the number of brothers and sisters they have and whether or not the child ever lived with only one parent) and the amount of time that parents say they spend with their child. Finally, the NCDS variables selected to represent external influences include the type of secondary school attended by the child (as a proxy for teacher and peer-group influence), neighbourhood characteristics (in terms of local housing conditions) and region.

The main problem with the NCDS is the lack of reliable information on living standards in childhood. We only have a single observation on family income in childhood, collected at wave 3 of the survey when the child was 16 years old. Reported parental income may, therefore, contain irrelevant transitory components that can be smoothed by saving behaviour. Also, since parents of NCDS respondents are observed at different ages, reported income will include age effects. Low income at one point in time may not imply low permanent (or lifetime) family resources, which we might think are the most important for a child's development. We therefore use information on parental characteristics and local labour market conditions to predict permanent parental income, or average living standards in childhood. The appendix provides details of our estimation strategy. Based on this prediction of family income in childhood, 3 per cent of NCDS4 respondents were in 'poverty' in childhood (i.e. permanent parental or family income was below 60 per cent of the median).

The BHPS

The BHPS was begun in 1991 and this paper is based on information for the first six waves of the survey (1991–96/97). The initial sample was designed as a nationally representative sample of the population of Great Britain living in private households and covered approximately 5,000 households and 10,000 adults. For a fuller description of the sampling strategy, see Taylor (1998).

Strenuous efforts have been made to follow up all of the initial members of the panel over time. However, by wave 6 only 72 per cent of those who gave full interviews in the first wave were included in the follow-up. The final sample used in the current study is restricted to those with complete income information for all adults in each household, in order to be able to calculate a total family income variable. In addition, we have limited the analysis to those respondents of working age who are not in full-time education. Finally, we have excluded those respondents who reported themselves unable to work due to ill health as a

way of reducing the potential for the causation to run from health to income rather than vice versa. However, in interpreting the results, it must be borne in mind that this will generate potential sample selection problems, which may lead to an underestimation of the true relationship between income and health (Benzeval and Judge, forthcoming; McDonough et al., 1997).

The initial 1991 sample was slightly under-represented in comparison with the Census with respect to families living in disadvantaged circumstances. Attrition since then has exacerbated this bias. However, longitudinal weights have been calculated based on the previous characteristics of those lost to the survey to correct for these biases (Taylor, 1994 and 1998) and are employed in this paper. As a result, our final sample has very similar characteristics to those who responded in the first wave. For example, 22.0 per cent of all wave 1 respondents had no qualifications compared to 19.7 per cent of our final sample; and 9.0 per cent had a limiting illness compared to 8.8 per cent before excluding those unable to work due to ill health and 5.8 per cent after they are excluded.

We use the BHPS to explore the adult relationships outlined in our conceptual framework. The measures employed to act as proxies for income potential and health capital, and also health outcomes, are described above. Fixed factors in the BHPS include measures of age, gender and ethnicity. Unfortunately, there are no appropriate measures in the BHPS to act as proxies for 'unobservable' factors. This needs to be borne in mind when interpreting the results presented below, as failure to control for potential 'unobservable' effects will lead to inconsistency in the parameters of interest.⁴ Neither does the BHPS contain direct information about an individual's experience of poverty in childhood. However, it does contain information on whether the respondent lived in a lone-parent family under the age of 16 and on their parents' social class when they were 14. Both of these variables can be used to assess the role of disadvantaged childhood circumstances in general on adult health but not the explicit role of income poverty. For this reason, we rely most heavily on the NCDS for this part of our analysis.

In adulthood, we employ two sets of variables. First, as highlighted above, our measure of low income is defined as equivalent family income averaged over six years being less than 60 per cent of the median for the sample (16 per cent of the final sample). The measure of family income employed is based on the income of all members of the household from all sources net of direct taxes, and was derived by Jarvis and Jenkins (1998). It has been adjusted to take account of inflation and equivalised to adjust for household size and composition. Second, we examine an individual's social roles — employment, marital status and parenthood — and changes in them over the course of the six years of the

⁴For the purpose of the current study, we have endeavoured as far as possible to apply a common approach to the analysis of the two datasets at our disposal. Therefore we have not exploited fully here the panel element of the BHPS to model individual-specific effects explicitly.

survey. Finally, as a proxy for area effects, we have included dummies for the region in which the individual lived at the start of the survey.

2. Modelling Approach

Using multivariate analysis techniques, we explore the complex associations between income and health using both datasets, controlling for the wide range of other factors identified in our conceptual framework above. In the analysis of both the NCDS and the BHPS, we have selected outcome measures that take the value 0 or 1 according to whether or not an individual reports fair or poor general health, has no formal qualifications or has a limiting illness. The specific statistical method employed is logistic regression analysis, which estimates the odds ratio for reporting bad health (or having no qualifications or a limiting illness) associated with each of the explanatory variables included in the models. Odds ratios describe how many times greater the relative odds of poor health, etc. are for someone with a particular characteristic compared with someone without that characteristic, other things being equal. The statistical significance of individual variables or characteristics is assessed by the p-value of the z-statistic associated with the relevant odds ratio.

The statistical significance of groups of variables is assessed by way of the p-value, which is calculated by comparing the change in scaled deviance ($2 \times \log$ likelihood ratio) associated with their inclusion in the model with the chi-squared (χ^2) distribution. The 'size' of the contribution of different sets of variables is estimated by comparing their contribution to the pseudo R^2 calculated for the full model.

3. Results

Question 1: What role does childhood poverty play in shaping educational outcomes and the acquisition of health capital?

This question is addressed using information from the NCDS. Separate models are developed for our two dependent variables: having no educational qualifications and reporting a limiting longstanding illness at age 23. Base models are constructed that include 'fixed factors' — namely, gender, ethnicity, birth weight and illness at birth.⁵ Childhood 'poverty' is then added to these models. Next, we include all the other childhood factors, neighbourhood resources and external influences. Finally, we add age 7 maths and reading scores to the models.

Table 1 reveals that children from 'poor' families are at greater risk of having poor health and poor educational outcomes as they move into adulthood. In the

⁵All NCDS respondents are, of course, the same age.

TABLE 1
The Effect of Childhood Income on Educational Attainment and the Development of Health Capital: NCDS

	<i>Odds ratios (p-values in parentheses)</i>					
	No qualifications at age 23 (12% of sample)			Limiting illness at age 23 (4% of sample)		
	(1) <i>Childhood 'poverty' and fixed factors only</i>	(2) <i>Plus other childhood factors^b</i>	(3) <i>Plus age 7 ability scores</i>	(4) <i>Childhood 'poverty' and fixed factors only</i>	(5) <i>Plus other childhood factors^b</i>	(6) <i>Plus age 7 ability scores</i>
Childhood 'poverty' ^a	3.68 (0.000)	1.59 (0.006)	1.52 (0.015)	1.74 (0.033)	1.53 (0.156)	1.48 (0.193)
Pseudo R ²	0.021	0.194	0.236	0.004	0.043	0.053
No. of observations				7,153		

^aDefined as predicted family income below 60 per cent of the median.

^bDoes not include age 7 ability scores.

simplest model, presented in column 1, the odds of having no qualifications by age 23 are almost four times the odds for children from better-off families. The odds ratio on childhood poverty in our simplest 'health capital' model (column 4) is 1.74.

The odds ratios for childhood poverty are reduced when other childhood circumstances are added to the education model in particular, although coming from a poor family remains a statistically significant predictor of having no qualifications. The group of variables producing this effect includes parents' education and family composition, both of which are strong determinants of family income and also have an independent impact on educational outcomes (see, for example, Blundell et al., 1997). For example, well-educated parents may 'develop social and personal skills in their offspring (such as motivation and self direction, manners of speech and peer identification)' (Kuh et al., 1997, p. 172). Parental marital breakdown has also been shown to have a strong detrimental impact on children's development (Duncan and Brooks-Gunn, 1997; Hobcraft, 1998; Hobcraft and Kiernan, 1999). The inclusion of age 7 ability scores also slightly reduces the odds ratio on childhood poverty in our education model (from 1.59 to 1.52), but the interpretation of this finding is less straightforward. Maths and reading test scores have been included in our models in an attempt to control for unobservable effects. However, indicators of early ability such as these are just as easily interpreted as mediators between early life conditions and a wide range of outcomes in later life, and hence may be acting as proxies for social factors in these models.

In the full model for limiting illness (column 6), our measure of childhood poverty is no longer a significant predictor of poor health once we control for other childhood factors. This does not necessarily imply, however, that low income in childhood has no independent effect on the development of health capital. For example, our predicted income measure might not be an adequate proxy for living standards in childhood,⁶ and other variables included in the model might be picking up true 'income effects'.

Question 2: How important are educational attainment and health capital accumulated in childhood for later health?

This question can be addressed using both datasets. Tables 2 and 3 show the odds ratios for the individual variables of interest and the calculated χ^2 statistic for groups of variables, along with the associated p-values, so that the statistical significance of each set of variables in our model can be assessed. The final column illustrates how the estimated pseudo R^2 is reduced when each set of variables is excluded from the full model (the percentage reduction is shown in parentheses), providing some indication of the relative size of the impact of the reported variables on adult health.

Table 2, based on data from the NCDS, suggests that education and health capital (limiting illness at age 23) are highly significantly related to adult health, as demonstrated by the very small p-value associated with the calculated odds ratios. The largest effect is generated by limiting illness at age 23. Once we include education and health capital, along with all other childhood factors, we find that coming from a poor family does not demonstrate a significant independent association with the probability of poor adult health. Indeed, inclusion of childhood poverty in our model has no effect at all on the calculated pseudo R^2 . However, in attempting to answer question 1, we found a strong association between low income in childhood and the probability of having no qualifications by age 23 (Table 1). This implies an indirect effect of childhood poverty on adult health, via education. Furthermore, if our chosen measure of childhood poverty is an imperfect one, as discussed above, then our results might underestimate the true relationship.

Table 3 examines the relative importance of health capital and education in models of adult health using the BHPS alongside other adult factors, including poverty, and some basic proxies for disadvantage in childhood. As with the analysis of the NCDS, it shows the crucial role that our measures of health capital and education play in determining adult health — together they account for over 40 per cent of the pseudo R^2 . Social roles (employment, parental and marital status) account for the next largest reduction in the full model pseudo R^2 ,

⁶The appendix provides a brief discussion of the assumptions required for validity of our approach.

Low Income and Poor Health

TABLE 2
The Role of Health Capital and Education in Determining Adult Health: NCDS

Dependent variable = 'fair'/'poor' self-assessed health at age 33 (12% of sample)

<i>Single variables</i>	<i>Odds ratio</i>	<i>p-value</i>	<i>Reduction in pseudo R² if excluded from model</i>
Childhood 'poverty' ^a	1.04	0.841	0.000 (0%)
Limiting illness at age 23	4.38	0.000	0.019 (27%)
No qualifications at age 23	1.71	0.000	0.005 (7%)
<i>Groups of variables</i>	χ^2	<i>p-value</i>	<i>Reduction in pseudo R² if excluded from model</i>
Age 7 ability scores	15.61	0.076	0.004 (6%)
Other childhood factors ^b	120.52	0.000	0.026 (37%)
Pseudo R ²		0.070	
Number of observations		5,729	

^aDefined as predicted family income below 60 per cent of the median.

^bDoes not include age 7 ability scores.

TABLE 3
The Role of Health Capital and Education in Determining Adult Health: BHPS

Dependent variable = 'fair'/'poor' self-assessed health in wave 5 (19% of sample)

<i>Single variables</i>	<i>Odds ratio</i>	<i>p-value</i>	<i>Reduction in pseudo R² if excluded from model</i>
Adult 'poverty' ^a	1.76	0.000	0.004 (7%)
Limiting illness in wave 1	3.99	0.000	0.021 (35%)
No qualifications in wave 1	1.59	0.000	0.005 (8%)
<i>Groups of variables</i>	χ^2	<i>p-value</i>	<i>Reduction in pseudo R² if excluded from model</i>
Social roles	18.1	0.152	0.007 (12%)
Childhood circumstances	7.7	0.102	0.002 (3%)
Pseudo R ²		0.059	
Number of observations		3,055	

^aDefined as total equivalised family income below 60 per cent of the median.

although as a group their χ^2 value suggests that they are not statistically significant. However, the individual variables for unemployment have large odds ratios and are highly significant. Having controlled for these factors, poverty in *adulthood* is still significantly associated with adult health. This contrasts to the results shown in Table 2 for the NCDS, where no independent effect of

childhood poverty in the full model is implied. This may be a result of the more accurate measurement of income in the BHPS than in the NCDS, or because the income measures in the BHPS are more proximate in time to the health outcomes than those in the NCDS. Alternatively, as highlighted above, it may be that the key poverty effects from childhood are picked up indirectly by the individual's educational outcomes, while adult poverty remains significant over and above this.

Finally, again in contrast to the NCDS, we do not find that childhood factors more generally make a significant contribution to adult health in the BHPS models. There may be a number of reasons for this disparity. First, in general, the childhood variables are almost certainly measured more effectively in the NCDS than in the BHPS. Second, the BHPS models contain other adult variables, which the NCDS models do not. It may be that if adult socio-economic factors were included in the NCDS models, the significance of the childhood factors would be reduced. Finally, the disparity may be a result of the nature of the samples involved, with the NCDS analysis modelling health outcomes for relatively young adults (aged 33), for whom childhood factors may still be very significant, while the BHPS results are based on a sample of adults of all working ages.

Question 3: What is the role of recent poverty experience in determining adult health, after having taken account of accumulated risk?

Table 4 shows the relationship between recent experience of poverty and adult health in more detail. The models of subjective health assessments are developed in four stages. First, a dummy variable for having low average income (i.e. less than 60 per cent of the median) is added to a base model, which also contains the fixed factors gender, age and ethnicity and proxies for area effects, i.e. regional

TABLE 4
The Role of Recent Poverty in Adult Health: BHPS

Dependent variable = 'fair'/'poor' self-assessed health in wave 5 (19% of sample)

	<i>Income variables only</i>	<i>Plus social roles</i>	<i>Plus education and health capital</i>	<i>Odds ratios (p-values in parentheses)</i> <i>Plus childhood circumstances^a</i>
Adult 'poverty' ^b	2.19 (0.000)	2.07 (0.000)	1.78 (0.000)	1.76 (0.000)
Pseudo R ²	0.026	0.034	0.059	0.059
No. of observations		3,055		

^aFull model is identical to the model on which the results presented in Table 3 are based.

^bDefined as total equivalised family income below 60 per cent of the median.

Note: All models contain age, gender, ethnicity and regional dummies.

dummies. Second, adult social roles are included. Third, measures of educational outcomes and health capital are added. Finally, childhood circumstances are included. This most general model is the same as the one described in Table 3, but set out rather differently here to explore the relationship between income and health more closely. Table 4 shows the odds ratios for the poverty duration dummies and the p-value of the associated z-statistics at each stage. With only fixed factors in the model, individuals who experience low income across the six years of the survey are more than twice as likely to report their health as only fair or poor. The odds ratios for adult poverty are reduced slightly as other factors from across the life course are added to the models, but they remain statistically significant. This shows the importance of considering the current living standards of adults, as well as childhood factors, if health inequalities are to be reduced.

4. Summary

As the foregoing analysis and discussion have illustrated, it is extremely difficult to untangle the complex interrelationships that exist between poverty and health over the life course. Measurement error and selection problems pose real challenges for researchers in this field, and despite our efforts to overcome these difficulties it is inevitable that some bias may consequently be introduced into our results. However, this paper does represent a valuable contribution to the health inequalities debate, attempting as it does to overcome some of the shortcomings in the available data. It brings together for the first time evidence from two British longitudinal surveys — the BHPS and the NCDS — in order to paint a comprehensive picture of the relationship between income and health over the entire course of an individual's life. Five key findings are worth highlighting:

1. Childhood poverty is strongly related to educational attainment.
2. Other childhood circumstances, in particular parental education and family composition, are also significant predictors of both education and accumulated health capital.
3. Educational attainment and health capital are strongly associated with adult health outcomes.
4. Even after controlling for this accumulated 'human capital' effect, recent poverty experience is also a strong predictor of health.
5. In the NCDS, childhood circumstances still demonstrate a significant association with adult health outcomes.

The next section examines the implications of these findings for policy and discusses the extent to which they are addressed by the government's strategy for reducing social exclusion.

IV. POLICY ANALYSIS

Results of the empirical analysis have shown the enduring importance of childhood poverty for educational attainment and the additional health-damaging consequences of low income in adulthood. The results suggest that practical policies to reduce poverty, especially for families with children, should be an essential ingredient in any concerted effort to tackle health inequalities. However, as the results show, the statistical importance of the poverty variables is reduced when other measures, such as education, unemployment and parents' circumstances, are introduced into the models. This suggests that other policy developments are also required — for example, to promote educational opportunities, provide support for parents, reduce the harmful consequences of marital breakdown and promote employment opportunities.

It is important to be aware that many of these contributory factors are significant causes of poverty itself. For example, using the BHPS, Jenkins (1999) demonstrates that the two most significant causes of entry into poverty are a reduction in the employment income of the head of the household and demographic changes (for example, the break-up of a relationship or a child leaving home). The most significant change associated with escaping from poverty is an increase in income from employment.

New Labour's Response

Saving Lives, the government's White Paper on health, has as one of its two aims to improve the health of the worst-off in society and to narrow the health gap (Department of Health, 1999a). The preceding Green Paper acknowledged the social causes of ill health and inequalities and noted that 'tackling inequalities generally, is the best means of tackling health inequalities in particular' (Department of Health, 1998, p. 12). The most recent articulation of the government's strategy — *Reducing Health Inequalities: An Agenda for Action* — sets out what it describes as 'the most comprehensive programme of work to tackle health inequalities ever undertaken in this country' (Department of Health, 1999b, p. 4). The policies and interventions described fall into three broad categories:

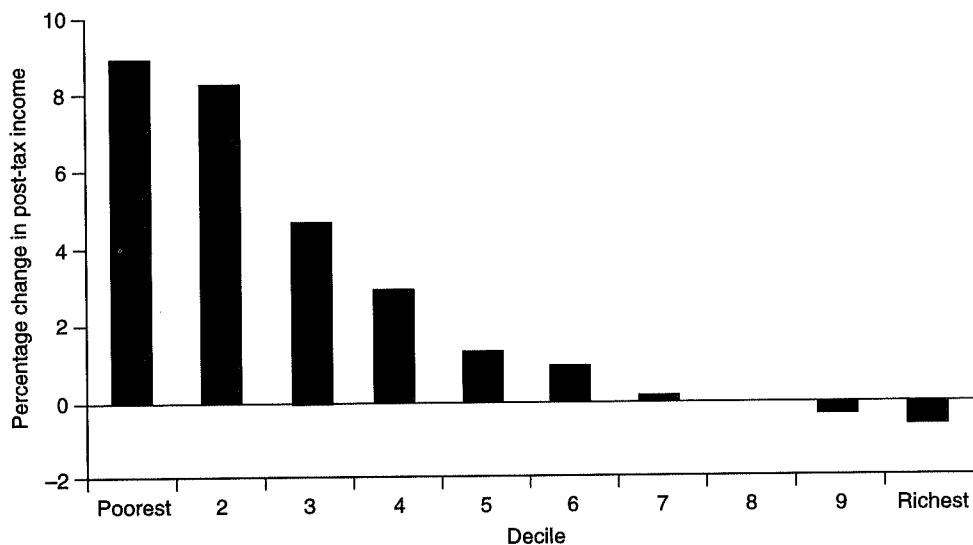
- tackling poverty through employment, education and social security strategies;
- improving the environment — for example, in relation to housing, transport, crime and neighbourhoods; and
- promoting the public health agenda within the NHS, particularly at the local level.

Given the focus of this paper, it is the first of these three areas of New Labour's strategy that we wish to examine in more detail here, although this does not

mean that we do not recognise the importance of the other two broad strands of policy.

New Labour's policies to reduce poverty and improve living standards suggest a good understanding of the life-course influences identified above. New initiatives 'intend[ed] to tackle the *causes* of poverty and social exclusion not just alleviate the *symptoms*' (Department of Health, 1999b, p. 5, italics original). The strategy focuses on improving employment opportunities, making work pay, improving skills through education and training and, finally, providing financial security for those who cannot work (Benzeval et al., forthcoming). Through all of these elements, the government's anti-poverty strategy has two distinct themes. First, it emphasises the central role of formal work as the best route out of poverty. Second, it prioritises families with children. Our analysis suggests that both of these are important elements of any strategy to reduce health inequalities. However, detailed analysis suggests that efforts to promote employment have only had marginal effects and are unlikely to make a major impact on the levels of unemployment in Britain in the future (Bell, Blundell and Van Reenen, 1999; Gregg, Johnson and Reed, 1999), although, in relation to poverty, the national minimum wage has increased incomes of those in the lowest-paid jobs (Low Pay Commission, 2000), while successive Budgets have redistributed income towards those in disadvantaged circumstances. A summary

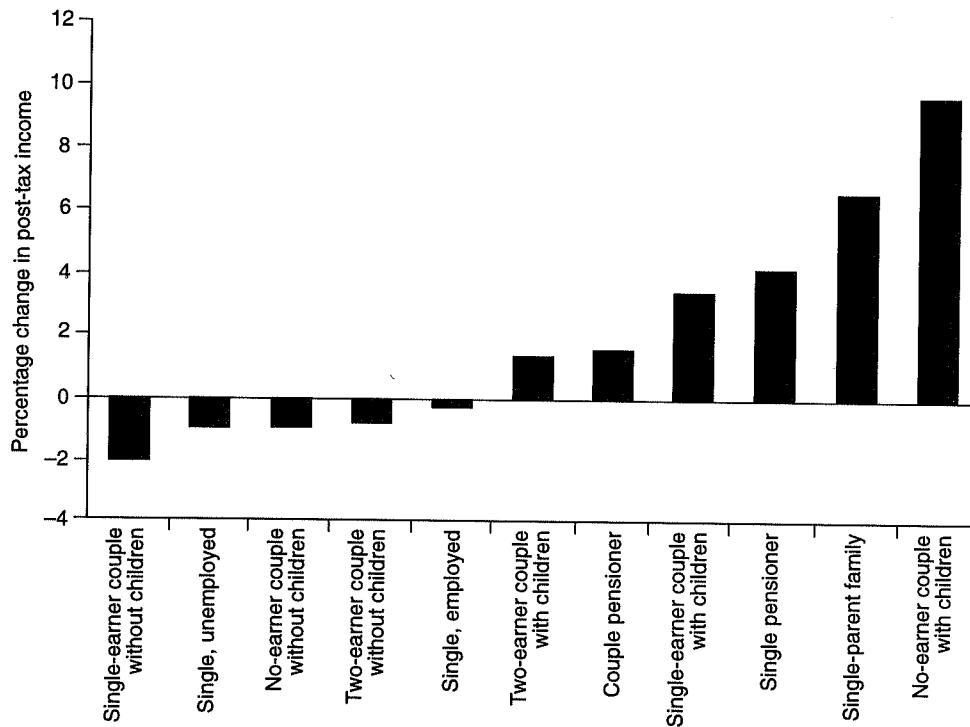
FIGURE 2
**Distributional Impact of Major Fiscal Reforms Announced Since July 1997,
 by Decile**



Source: Institute for Fiscal Studies (2000), based on results from the IFS tax and benefit model (TAXBEN).

FIGURE 3

**Distributional Impact of Major Fiscal Reforms Announced Since July 1997,
by Family Type**



Source: Institute for Fiscal Studies (2000), based on results from the IFS tax and benefit model (TAXBEN).

of the distributional effects of the main tax and benefit changes introduced by New Labour is shown in Figures 2 and 3 (the impact of the minimum wage is not included). As can be seen, across its first four Budgets, New Labour has increased the average income of the poorest groups and redistributed money towards families with children.

The government itself estimates that, by the end of this Parliament, it will have lifted 700,000 children out of poverty, but that it will take 20 years to eradicate child poverty altogether (Blair, 1999). In a detailed assessment of these policy changes, Piachaud (1999) confirms that the government should achieve its target for the end of the first term and that, more generally, the numbers of people experiencing poverty should be reduced from 14 million to 12 million. This in itself would be a significant achievement. 'Yet to achieve the goal [to eradicate child poverty in 20 years] would require an acceleration on progress in

the future' (Piachaud, 1999, p. 157). Piachaud argues that to achieve this goal two things are required:

- (a) much more redistribution through social security benefits and tax credits;
- (b) much greater effort to tackle the long-term causes of poverty — low pay and unemployment. This will require an increase in public expenditure or a restructuring of expenditure so that policies to tackle poverty are given much more priority.

The government must be congratulated for setting itself the goal of reducing poverty and social exclusion. Moreover, it has made policy changes that have already had an impact on the numbers living in poverty. Over the longer term, such efforts should also begin to reduce health inequalities. But this is only a start, and much more substantive efforts are required if it is to achieve its long-term goals.

V. CONCLUSION

Family income plays an important role in children's educational attainment. Educational qualifications, in turn, display a significant correlation with both living standards and health in adult life, and these effects are reinforced by the detrimental effect of low income in adulthood on an individual's health. The government acknowledges the need to tackle these 'root causes' of ill health as well as develop a stronger public health focus into the health service. Government policies to tackle social exclusion and poverty emphasise the importance of creating opportunities for employment and education as well as reforming the tax and benefit systems in favour of low-income groups. It is too early to assess how successful these policies will be in reducing either poverty or health inequalities. However, evidence suggests that they might only have a marginal effect on the targeted groups. Moreover, the government has chosen some of the easier strategies to move people out of poverty. As time progresses, it will become increasingly difficult to maintain the momentum without substantial increases in benefit levels. Furthermore, current policies may run the risk of excluding other groups in the population who are also at increased risk of ill health (for example, single people or couples without children on low incomes). On the other hand, it must reasonably be expected that significantly reducing the health divide will take at least a generation. We welcome the fact that health inequalities are being treated as a serious issue and that some attempt is being made to address their causes. The challenge for the future will be to find ways of sustaining and reinforcing these efforts over the longer term.

APPENDIX

There are a number of reasons why parental income information available in survey data might be inadequate for our purposes. For example, in the NCDS we only have information on parental income at one wave of the survey — when the respondent was 16 years old — and this may contain irrelevant transitory components that can be smoothed by the parents' saving behaviour. In addition, since parents are observed at different ages, reported income will include age effects. Therefore low income at one point in time may not imply low lifetime resources. Whether parents' lifetime resources or current resources matter for their children's welfare depends on the ability of households to transfer resources across time periods. If, as we assume here, parents engage in consumption 'smoothing', then their lifetime, or *permanent*, resources are most relevant.⁷ On the basis of this assumption (and partly because of data restrictions), we use the single observation we possess on household income to construct a measure of parental permanent resources and use this as a proxy for childhood living standards. A particularly attractive feature of our approach, which develops the method employed by Dearden, Machin and Reed (1997), is that it purges observed income from measurement error and is therefore likely to provide more precise estimates than if we use actual income.

Family income in the NCDS is reported in banded form separately for father's earnings, mother's earnings and 'other' sources of family income. The banded nature of this income information requires the use of grouped dependent variable techniques. Using ordinary least squares (OLS) will tend to generate inconsistent estimates in this case, because the dependent variable in our family income equation will tend to be left, right or interval censored (Stewart, 1983). The lower band limits of father's and mother's earnings and 'other' family income are added together, and the same is done with the upper limits; a total family income equation is estimated.⁸ Results are presented in Table A.1. The explanatory variables are

- mother's and father's years of education (calculated by subtracting five from age at leaving full-time education);
- father's occupational class dummies (the reference group is skilled manual);
- dummy variables for whether or not mother worked during child's upbringing;
- dummy variables for whether or not a mother or father figure was ever absent during childhood;

⁷Flavin (1981), for example, provides a formal description of the permanent income hypothesis.

⁸Predicted income is transformed back to levels for estimation of the poverty measure used in the main analysis.

TABLE A.1
'Permanent' Family Income Equation

	<i>Coefficient</i>	<i>p-value</i>
Father's years of education	0.028	0.000
Father's education missing	0.226	0.000
Mother's years of education	0.024	0.000
Mother's education missing	0.306	0.000
<i>Father's occupation^a</i>		
Professional	0.216	0.000
Intermediate	0.114	0.000
Skilled non-manual	-0.010	0.459
Semi-skilled non-manual	-0.112	0.001
Semi-skilled manual	-0.066	0.000
Unskilled manual	-0.072	0.000
Mother worked part-time before child at school	-0.003	0.760
Mother worked full-time before child at school	0.056	0.000
Mother worked part-time while child at school	-0.005	0.645
Mother worked full-time while child at school	-0.009	0.592
Mother working in wave 2 (child aged 11)	0.019	0.048
Mother working in wave 3 (child aged 16)	0.234	0.000
<i>Local labour market conditions</i>		
Proportion economically inactive	-0.007	0.000
Proportion in manufacturing jobs	0.002	0.000
Proportion in agricultural jobs	-0.006	0.000
Proportion in professional jobs	0.004	0.000
Ever no father figure	-0.010	0.591
Ever no mother figure	-0.091	0.113
Father's age	-0.055	0.000
Father's age squared	-0.060	0.000
Mother's age	-0.072	0.000
Mother's age squared	-0.022	0.008
Constant	4.815	0.000
<i>N</i>	6,784	
Pseudo R ²	0.151	

^aBase group is skilled manual.

- characteristics of the local labour market: proportion in professional jobs, proportion in manufacturing jobs, proportion in agriculture and local unemployment rate;
- mother's and father's ages (and age squared).

Fathers with missing occupational class information at NCDS3 are excluded from the analysis. Information on mother's and father's ages is only available in the birth survey, thus potentially restricting the sample on which family income is predicted to NCDS respondents with natural parents at wave 3. However, the sample is expanded by imputing the age of non-natural parents — conditional on there being one natural parent in the household — using information on the mean difference in reported mother's and father's ages at birth. This procedure assumes implicitly that the characteristics of the non-natural parent are similar to those of the natural parent they have replaced.

The following variables are assumed to have a *permanent* effect on family income levels: parental education, father's occupational class, mother's employment, absence of either parent at any point in childhood and local labour market conditions. We then use the estimated coefficients on these 'permanent' characteristics to predict average family income in childhood, holding constant parents' ages (the transitory, time-varying component of family income determination). It is this prediction of permanent income that we assume drives the family's average living standards relevant to the child's development.

The validity of this approach is necessarily based on a number of important assumptions (Meghir and Taylor (1999) provide a formalisation of the underlying model). For example, all unobservable components of the income-generating process are assumed to be transitory in nature. We also assume that the transitory components are uncorrelated with permanent status. Importantly, our approach also assumes that liquidity constraints are not prevalent. We do not regard this latter assumption as an important shortcoming for two reasons. First, earlier research (Blundell, Browning and Meghir, 1994) has shown that liquidity constraints are not an important feature in explaining consumption growth. Second, healthcare in the UK is free at the point of delivery. Hence expenditures for health that are incurred are unlikely to be large discrete amounts that require financing. The effects of wealth on health are more likely to reflect overall standard of living and nutrition, etc., where one might expect that liquidity constraints are less important.

A final important assumption is that father's occupational class, local labour market conditions and mother's employment when the child is 16 years old only affect the development of a child's earnings and health potential through their impact on family income in childhood, *once parents' education and other childhood circumstances are taken into account*. In other words, these variables

only enter the income equation, not the education or health models.⁹ Importantly, the child's accumulated health capital and education, and also adult health, are allowed to vary with mother's employment during earlier childhood.

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⁹Including these variables in the health and education equations in the main analysis reduces the estimated poverty effect.

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PAPER 5

**Claudia Thomas, Michaela Benzeval
and Stephen Stansfeld (2007)**

**'Psychological distress after employment transitions: the role of
subjective financial position as a mediator'**

***Journal of Epidemiology and Community Health* 61:1:48-52.**

RESEARCH REPORT

Psychological distress after employment transitions: the role of subjective financial position as a mediator

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Objective: To explore the extent to which the mental health effects of transitions into unemployment, or other forms of non-employment, and vice versa, are mediated by financial changes.

Methods: Longitudinal analysis of the British Household Panel Survey from 1991 to 2000. There were 89 264 person-years of observation from 14 686 individuals aged ≥ 16 years. Main outcome measure was psychological distress measured by the 12-item General Health Questionnaire.

Results: Transitions to unemployment were associated with increased risk of psychological distress for men (adjusted odds ratio (OR) 3.15 (95% confidence interval (CI) 2.50 to 3.98)) and for women (OR 2.60 (95% CI 1.97 to 3.43)). Women who left work to look after the family were also more likely to experience psychological distress (OR 1.72 (95% CI 1.45 to 2.05)). A reduced risk of psychological distress was seen for transitions from unemployment to paid employment for men (OR 0.52 (95% CI 0.41 to 0.68)) and for women (OR 0.68 (95% CI 0.69 to 1.40)). Financial difficulty partially mediated these relationships: men who became unemployed and were worse off financially were more likely to experience psychological distress (OR 4.19 (95% CI 3.20 to 5.50)) than men who were not (OR 1.48 (95% CI 0.95 to 2.33)). Conversely, the beneficial health effect for people who left unemployment and became employed was confined to those who were better off financially (OR 0.34 (0.25 to 0.48) for men).

Conclusions: Changes in employment status have both direct and indirect effects, through changes in financial circumstances, on subsequent psychological distress. The results support the view that the direction of causation runs from employment transitions to financial difficulties and psychological distress.

All in income seem to be more detrimental to health than increases are beneficial.¹ However, the reasons for drops in income need to be considered—for example, a sudden unexpected fall due to unemployment may be more detrimental than a predictable change when retiring from paid employment.^{1,2} It is therefore important to examine the causes of changes in financial circumstances, and the effect of changes in income, on health, so that their relative contribution can be assessed. Changes in employment status are themselves associated with health; unemployment has been linked to psychological distress in several studies.^{3–6} However, the relationship with other forms of non-employment is less clear. Although retirement may be beneficial to mental health,^{5,7} women who stay at home to care for the family may experience considerable psychological distress.^{5,8}

A decline in monetary income at a specific point in time may not adequately reflect the actual resources available to provide the necessities for good health. For example, people may be able to reduce expenditure, delay payments or draw on savings to maintain their standard of living in the case of income loss. Psychological distress is likely to be more associated with the gap between a family's expenditure and resources rather than its income as such. Such a financial gap may be more adequately measured by perceived financial difficulties than income. Using data from the British Household Panel Survey (BHPS), Wildman⁹ showed that subjective financial status was a stronger determinant of mental health than were objective measures of household income.

Given this, we examined the extent to which the mental health effects of employment change can be explained by perceived changes in financial circumstances using the BHPS. Three hypotheses were tested: (1) employment transitions are independently associated with psychological distress after controlling for health, social and economic circumstances

before the transition; (2) changes in subjective financial circumstances mediate the effect of employment transitions on psychological distress; and (3) the direction of causation runs from employment transitions to financial changes and to psychological distress.

PARTICIPANTS AND METHODS

Study population

The BHPS, which started in 1990, is a longitudinal general population survey of a nationally representative sample of 5000 private households, resulting in a sample of about 10 000 people in Great Britain.⁹ All original household members have been followed up over time and anyone joining such a household is added to the survey, helping to maintain its representativeness.⁴ From the first 10 years of follow-up, 89 264 person-years of observation from 14 686 individuals aged ≥ 16 years were available for analysis. To examine annual changes in employment status, we included individuals who contributed at least two consecutive years to the study and whose complete data were available for the analyses. This provided 86 932 observations, which we have termed transitions, although many of them relate to those who remain in employment (or non-employment).

Measures

The outcome used in this study was psychological distress, measured by the 12-item General Health Questionnaire (GHQ-12). Individuals with a GHQ-12 score of ≥ 3 , which is the average for the sample, were classified as cases of psychological distress; this approach recommended by Goldberg *et al*¹⁰ is commonly used.

Abbreviations: BHPS, British Household Panel Survey; GHQ-12, 12-item General Health Questionnaire

Employment transitions were measured as year-to-year changes in employment status ($t-1$ to t); changes within a year were not considered here. Transitions were constructed in two directions: (1) from paid employment (fulltime or part-time) to various categories of non-employment (unemployed, retired, maternity leave or family care); and (2) from each non-employment category into paid employment. Given the small numbers of transitions to and from maternity leave, we merged this category with family care, which included women looking after children or other adults.⁵ Although different mechanisms may underpin the way these transitions affect health, previous work shows that these two groups of transitions have similar effects on psychosocial distress.⁵

To explore the role of financial resources as a key mediator of the health effects of employment transitions, year-to-year changes in subjective financial circumstances were obtained from the answer to the question "Would you say that you yourself are better off or worse off financially than you were a year ago?" The responses were coded as (1) about the same, (2) better off and (3) worse off. The variable was recoded and used in two ways depending on the specific analysis. For analysis of transitions into non-employment, the variable was coded 0, not worse off (same or better off) or 1, worse off; for transitions from non-employment, it was coded 0, not better off (same or worse off) or 1, better off.

Data on a range of confounders were considered in the analysis. These consisted of the following:

1. Fixed or unmodifiable factors: age, sex.

2. Precursors measured at $t-1$: psychological distress, long-term limiting illness, marital status (never married; married or cohabiting; separated, divorced or widowed), parenthood status (parent or guardian of a dependent child aged ≤ 16 years living in the same household), carer status (spend >20 h/week looking after a sick, elderly or handicapped person), Registrar General's social class (manual, non-manual).

3. Accumulated factors up to $t-1$: home ownership, level of education, proportion of survey spent in fulltime employment.

Statistical analysis

Random-effects logistic regression models were used in this analysis to account for the repeated measures nature of the data. STATA V.8 was used for all analyses. The main focus of the analysis was to explore (1) the direct effects of employment transitions on psychological distress; and (2) the indirect effects of employment transitions on psychological distress mediated

by changes in financial circumstances. The analysis also took into consideration other factors that might confound or modify the association between employment transitions and health. Four sets of models were fitted.

- First, main effect models were fitted separately for men and for women to estimate the direct association between employment transitions and psychological distress. To avoid collinearity and over-adjustment of models, parsimonious models were selected by examining the effect of each potential confounder on the employment transition model associations. Confounders were removed from the model only if they did not alter the exposure association and if they were not independently associated with the outcome (likelihood ratio (LR) test, $p \geq 0.05$). Thus, not all confounders identified earlier were retained in the final models.
- In the second set of models, effect modification by precursor variables was investigated by fitting interaction terms to the models and tested using the LR statistic ($p \leq 0.05$).
- Third, the role of financial circumstances as a mediator of the effect of employment transitions on psychological distress was examined by assessing whether the addition of financial circumstances to the model reduced the association between employment transitions and psychological distress.
- In the fourth set of models, the interaction between the transitions and subjective financial circumstances was examined.

The variance inflation factor was used to test for multicollinearity of model variables; no significant effects were found.

Health status before the transitions was adjusted for in all models to control for health selection. The possibility of health selection was also explored by undertaking a sensitivity analysis, repeating the analysis excluding those who reported the presence of limiting illness ($t-1$).

RESULTS

Relationship between employment transitions and psychological distress

Table 1 describes the prevalence of perceived changes in financial difficulties by each employment transition and psychological distress after each of the employment transition types and subsequent changes in perceived financial circum-

Table 1 Percentage prevalence of psychological distress after employment transitions

Transition type	Number of transitions	Experiencing financial difficulties/improvements (%)			Experiencing psychological distress (%)		
		Percentage worse off financially	Overall	Not worse off financially	Worse off financially	Overall	Not better off financially
Transition from employment to*							
Unemployment	1390	71.3	43.4	28.6	49.4		
Retirement	798	53.1	20.7	17.6	23.3		
Family care†	1187	47.5	36.7	29.9	44.3		
Stayed employed	47370	23.1	23.2	19.3	36.2		
Transition to employment from*							
Unemployment	1346	62.3	25.6	35.4	19.6		
Family care†	399	25.3	23.1	22.5	24.7		
Stayed non-employed	31136	15.1	29.6	30.0	27.5		

*A total of 51 534 transitions from employment to non-employment occurred; 789 transitions were into categories that were not a focus of this study: fulltime student ($n = 407$), long-term illness ($n = 285$), government training ($n = 42$), something else ($n = 55$). A total of 35 398 transitions were from non-employment to employment; 2517 transitions were from categories that were not a focus of this study: fulltime students ($n = 1076$), retirement ($n = 212$), long-term illness ($n = 105$), government training ($n = 123$), something else ($n = 127$).

†Family care applies only to women and includes maternity leave or staying at home to look after the family.

Table 2 Relationship between employment transitions and psychological distress*

	Men		Women	
	OR	95% CI	OR	95% CI
Transition from employment to†				
Unemployment	3.15	2.50 to 3.98	2.60	1.97 to 3.43
Retirement	0.95	0.64 to 1.63	1.15	0.83 to 1.60
Family care	—	—	1.72	1.45 to 2.05
Transition to employment from†				
Unemployment	0.52	0.41 to 0.68	0.68	0.51 to 0.92
Family care	—	—	0.98	0.69 to 1.40

*Models are adjusted for current age (time, t), psychological distress, limiting illness, marital status, caring status, home ownership and manual occupational class (all measured at time, t-1).

†Reference categories are "stay employed" for models of transitions from employment to non-employment, and "stay non-employed" for models of transitions from non-employment to employment.

stances. Individuals moving in or out of unemployment were much more likely to perceive a change in their financial difficulties than other employment transitions. Interestingly, those returning to work after a period of maternity or family care were less likely to report an improvement in their financial circumstances than those returning from unemployment.

Overall, there was a higher prevalence of distress for transitions from employment to unemployment (43.4%) and to family care (36.7%) than that among people who stayed employed (23.2%). For each of these transitions, we also found a higher prevalence of distress for people who were worse off financially than those who were not, as well as for those who remained in employment. For transitions in the opposite direction, there was a lower prevalence of distress for people who returned to paid work from unemployment (25.6%) or from family care (23.1%) than for those who stayed in non-employment (29.6%). This was strongly related to a perceived improvement in financial circumstances after leaving unemployment (19.6%) but not after leaving family care (24.7%).

Table 2 summarises the main effects associations for employment transitions and psychological distress. Controlling for relevant confounders, a transition from paid employment to unemployment was significantly associated with an increased likelihood of psychological distress both for men (adjusted odds ratio (OR 3.15)) and for women (OR 2.60). We found a significant interaction for the transition and prior psychological distress, suggesting that this effect was limited to people without prior psychological distress (OR 3.50 (95% confidence interval (CI) 2.67 to 4.59 for men; OR 2.97 (95% CI 2.07 to 4.28) for women). Women who left paid employment for maternity leave or family care were nearly twice as likely to experience psychological distress as those who stayed at work; an effect that was also limited to women without prior distress (OR 1.80 (95% CI 1.47 to 2.22)). A significant interaction was also found for social class and retirement. Men who retired from manual occupational classes were nearly three times as likely to experience distress (OR 2.69 (95% CI 1.21 to 5.97)), and men from non-manual classes were almost half as likely to be distressed (OR 0.59 (95% CI 0.33 to 1.06)), as those still working.

Both men and women who returned to work from unemployment were less likely to experience distress (OR 0.52 and 0.68, respectively) than those who remained in non-employment (table 2). However, interaction testing found that the beneficial effects of transitions from unemployment to employment were limited to those with distress while unemployed (OR 0.40 (95% CI 0.25 to 0.64) for men; OR 0.62 (95% CI 0.35 to 1.10) for women). The beneficial effect of transitions from family care to paid employment on mental health was also limited to women who experienced

psychological distress before the transition (OR 0.48 (95% CI 0.24 to 0.96)).

Perceived financial difficulties as a mediator

Experiencing a change in perceived financial difficulties was significantly associated with psychological distress for both men (OR 2.32 (95% CI 2.12 to 2.54)) and for women (OR 2.06 (95% CI 1.92 to 2.21)). When this factor was added to the main effects models (table 2), the ORs for transitions from employment to unemployment were diminished by about 30% for both men and women, and for transitions to family care (for women) by 19%. The addition of perceived financial difficulties to the models reduced the OR for transitions from unemployment to employment by 30% for men and by 16% for women, with a loss of significance. For transitions from family care to employment, perceptions of financial difficulties had no effect on the association. These results suggest that changes in subjective financial circumstances partially mediated the associations between employment transitions and psychological distress.

To examine this mediating effect further, an analysis using a single variable that combined the transition and perceived financial difficulties data was undertaken (table 3). People who became unemployed or women who began family care and considered themselves to be financially worse off, compared with their status the year before the employment transition, were more likely to experience psychological distress than those who underwent these transitions but did not experience financial difficulty. This relationship was stronger for men from manual than those from non-manual social classes ($p<0.001$, LR test for interaction). The association with psychological distress was greater for those from manual classes who become unemployed or retired and were worse off financially (OR 4.86 (95% CI 3.48 to 6.79) for unemployment; OR 4.01 (95% CI 2.65 to 6.07) for retirement) than those from non-manual classes (OR 3.10 (95% CI 2.01 to 4.79) for unemployment; OR 1.82 (95% CI 1.10 to 3.01) for retirement). An association with psychological distress was also found for those from manual classes despite reporting that they were the same or better off after becoming unemployed (OR 1.92 (95% CI 1.13 to 3.25)), an effect that was not seen for men from non-manual classes. The lower half of table 3 shows that the beneficial effect on mental health related to returning to paid work from unemployment was closely linked to perceived improvements in financial position both for men (OR 0.34) and for women (OR 0.43). However, this was not the case for women entering employment after a period of family care. The beneficial effect of gaining employment and being better off financially was greater for men from manual (OR 0.29 (95% CI

Table 3 Employment transitions, income change and psychological distress*

	Men		Women	
	OR	95% CI	OR	95% CI
Transition from employment to†				
Unemployment				
Not worse off financially	1.48	0.95 to 2.33	0.58	0.34 to 1.00
Worse off financially	4.19	3.20 to 5.50	4.89	3.48 to 6.88
Retirement				
Not worse off financially	0.79	0.42 to 1.46	1.35	0.83 to 2.18
Worse off financially	1.14	0.67 to 1.93	1.11	0.71 to 1.72
Family care				
Not worse off financially	–	–	1.27	1.00 to 1.63
Worse off financially	–	–	2.28	1.80 to 2.91
Transition to employment from†				
Unemployment				
Not better off financially	1.03	0.71 to 1.51	1.15	0.76 to 1.75
Better off financially	0.34	0.25 to 0.48	0.43	0.28 to 0.65
Family care				
Not better off financially	–	–	0.94	0.63 to 1.41
Better off financially	–	–	1.13	0.56 to 2.26

*Models are adjusted for current age (time t) psychological distress, limiting illness, marital status, caring status, home ownership and manual occupational class (all measured at time, t-1).

†Reference categories are "stay employed" for models of transitions from employment to non-employment, and "stay non-employed" for models of transitions from non-employment to employment.

0.19 to 0.45)) than from non-manual (OR 0.45 (95% CI 0.28 to 0.72); p<0.001, LR test) backgrounds.

Health selection

In all models, we controlled for prior health status (psychological distress and long-term limiting illness at t-1). Further, a slightly higher prevalence of psychological distress after employment transitions was found for the full sample compared with a healthy sample that excluded those with prior limiting illness (56 563 person-years; 10 866 people). In particular, for transitions from paid employment to retirement for men, the prevalence was 14.6% compared with 10% for the healthy sample. This suggests that there is some evidence for selection out of employment into retirement due to poor health. More generally, however, after regression analysis of the healthy sample, we found that the effect estimates for employment transitions were similar to those obtained from the full analysis, indicating that the influence of health selection was adequately controlled for in the models.

DISCUSSION

The findings from a 10-year general population survey have shown that transitions from paid employment to unemployment are associated with an increased likelihood of psychological distress after adjusting for a range of prior social circumstances and health selection; a finding that is consistent with that from other studies.³⁻⁵ Evidence that the results represented the onset or resolution of psychological distress, rather than the maintenance of episodes, was supported by the observation that the negative effects of transitions to non-employment were limited to those without distress before the transition, and the beneficial effects of employment were seen only for those who were distressed before becoming employed. Although there was some indication of health selection into non-employment in the BHPS, we provide evidence for an effect of employment transitions on mental health that was independent of prior health status. Our results also show that changes in subjective financial circumstances mediated the relationship between employment change and health.

It is important that men and women are considered separately in analyses because they have different patterns of employment, with women spending considerable periods in

fulltime non-employment roles.¹¹ Previous research indicates that the health experiences of women are related to their combinations of work and family roles.¹² In this analysis, women who left work to stay at home and look after the family were more likely to experience psychological distress than women who stayed in paid employment. This group included women on maternity leave, those looking after children and those with other caring responsibilities. Other analyses have shown that women who care for both children and adults have the highest scores on the GHQ.⁵ This suggests that caring may be an important cause of psychological distress and this has also been found in other studies.¹³⁻¹⁵ This may also explain why women returning to work after a period of family care do not see an improvement in their health in the same way as those returning after being unemployed because of the effects of role overload.

Another important non-employment transition is into retirement. For men, the mental health effect of retirement transitions was more strongly related to occupational class than to financial situation. An increased risk of psychological distress was seen for those from manual occupational classes, and a reduced association for men from non-manual occupations, a finding that is consistent with findings from the Whitehall II Study,¹⁶ but has not been widely demonstrated in the general population. We also found that the effects of transitions into unemployment accompanied by financial difficulties (and vice versa) varied by social class in men but not in women. Further research is needed to fully understand the inter-relationships between social class, employment transitions and mental health.

Although differences by sex exist, transitions to unemployment have similar detrimental effects on the psychological health of both men and women. However, the effect for men seems stronger than that for women. This is in keeping with the findings of Artazcoz *et al's*,¹⁷ who suggested that unemployment has a greater effect on men's health because of their role as "primary providers for the family", whereas women are protected by their nurturing roles.

For transitions to paid employment, both men and women were less likely to experience psychological distress if they found paid work after a period of unemployment than those who remained non-employed, and improvements in perceived

What is already known

- Changes in both financial circumstances and employment-unemployment transitions affect mental health. However, less is known about the effect of transitions into and out of other forms of non-employment.
- An individual's perceived financial situation may be more strongly related to mental health than measures of monetary income because it could more adequately capture the gap between expenditure and resources.
- Mediation of the effect of the full range of employment transitions on mental health by financial circumstances has not yet been investigated.

What this paper adds

- Changes in subjective financial circumstances are an important mediating factor in the longitudinal association between employment transitions and mental health.
- This seems to be more important for transitions to and from unemployment than for other types of employment change.

financial circumstances were important mediators. However, other factors such as social status, self esteem, physical and mental activity and using one's skills may also have a role in mediating health effects of employment transitions.¹⁷

Strengths and limitations

Our study has several limitations. Using subjective financial difficulty, we assessed the role of financial resources as a mediator of the health effects of employment transitions. An association with psychological distress was previously shown for this measure in two consecutive years of the BHPS.¹⁸ However, whether this association is causal or the consequence of negative affectivity is not clear. This is a genuine concern but there are reasons to believe it may be causal. Subjective financial circumstances have been shown to be a strong predictor of health,⁶ and may capture the adequacy of financial resources in relation to need more succinctly, and completely, than actual household income at one point in time.

The potential for bias due to missing data must also be considered. In the BHPS, psychological distress, unemployment, being younger, single, not having any children and being in fulltime education are most strongly associated with observation gaps and loss to follow-up.¹⁹ As unemployment and prior psychological distress were associated with current distress, the results represented here are therefore most likely to underestimate the effects of employment transitions on psychological distress.

Our study has several key strengths. Data from longitudinal surveys allow the temporal order of exposures, confounders, intermediate factors and the outcome under consideration to be established, which help reach stronger causal conclusions.²⁰ In our study, the health outcome was always measured after the transition had occurred and health indicators that were measured before the transition were included in statistical models to control for health selection into or out of employment. This is important because the effect of an employment transition may be dependent on the social circumstances immediately before the transition and on the accumulation of experiences during the life course.

CONCLUSIONS

Both unemployment and financial hardship have been previously shown to be associated with poor mental health. Transitions into unemployment or family care were more likely to result in psychological distress if accompanied by increased financial hardship. Improvements in financial resources as a result of becoming employed seemed to be responsible for the resolution of psychological distress.

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