Conceptualisation, design and development of a primary school based child healthy weight intervention

by

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ABSTRACT

INTRODUCTION: In common with much of the developed world, Scotland has a severe and well established problem with overweight and obesity in childhood with recent figures demonstrating that 31% of Scottish children aged 2-15 years old were overweight including obese in 2014. This problem is more pronounced in socioeconomically disadvantaged groups and in older children across all economic groups (Scottish Health Survey, 2014). Children who are overweight or obese are at increased risk of a number of adverse health outcomes in the short term and throughout their life course (Lobstein and Jackson-Leach, 2006). The Scottish Government tasked all Scottish Health Boards with developing and delivering child healthy weight interventions to clinically overweight or obese children in an attempt to address this health problem. It is therefore imperative to deliver high quality, affordable, appropriately targeted interventions which can make a sustained impact on children's lifestyles, setting them up for life as healthy weight adults. This research aimed to inform the design, readiness for application and Health Board suitability of an effective primary school-based curricular child healthy weight intervention. METHODS: the process involved in conceptualising a child healthy weight intervention, developing the intervention, planning for implementation and subsequent evaluation was guided by the PRECEDE-PROCEED Model (Green and Kreuter, 2005) and the Intervention Mapping protocol (Lloyd et al. 2011). RESULTS: The outputs from each stage of the development process were used to formulate a child healthy weight intervention conceptual model then develop plans for delivery and evaluation. DISCUSSION: The Fit for School conceptual model developed through this process has the potential to theoretically modify energy balance related behaviours associated with unhealthy weight gain in childhood. It also has the potential to be delivered at a Health Board scale within current organisational restrictions.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

PREFACE

This thesis outlines the process of conceptualisation, design, development and subsequent planning for delivery and evaluation of a primary school-based child healthy weight intervention. The intervention that was developed through this process went on to be delivered at a Health Board scale, but this thesis focuses on its development rather than reporting on the results of the evaluation or effectiveness of this intervention, which is reported elsewhere. This intervention formed part of the NHS Lanarkshire Child Healthy Weight Programme, which is managed by the author. The role of the author in relation to this thesis is, therefore, that of a practitioner researcher.

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Jonathan Cavana

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AUTHOR'S DECLARATION

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

Signature 

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LIST OF ABBREVIATIONS

HE	Healthy Eating
PA	Physical Activity
TV	Television
SSB	Sugar Sweetened Beverage
SB	Sedentary Behaviour
BMI	Body Mass Index
BMI-SDS	Body Mass Index-Standard Deviation Score
EBRB	Energy Balance Related Behaviours
SG	Scottish Government
HEAT	Health Efficiency Access and Treatment
H3	Health Efficiency Access and Treatment 3
SIGN	Scottish Intercollegiate Guidance Network
NICE	National Institute of Clinical Excellence
SHeS	Scottish Health Survey
NHS	National Health Service
NHSL	National Health Service Lanarkshire
SIMD	Scottish Index of Multiple Deprivations
CHW	Child Healthy Weight
CHWP	Child Healthy Weight Programme
CWM	Child Weight Management
NCD	Non-Communicable Disease
SCT	Social Cognitive Theory
SEM	Social Ecological Model
MI	Motivational Interviewing
BCT	Behaviour Change Techniques
UK	United Kingdom
PPM	PRECEDE-PROCEED Model
IM	Intervention Mapping
QOL	Quality of Life
FDG	Focussed Discussion Groups
CfE	Curriculum for Excellence
EO	Experiences and Outcomes
CAF	Curriculum Alignment Framework
AifL	Assessment is for Learning
PO	Performance Objective
HWB	Health and Wellbeing
HBC	Health Behaviour Change
QA	Quality Assurance
FFS	Fit for School

CHAPTER 1: INTRODUCTION

1. Introduction to child obesity

Preventing Overweight and Obesity in Scotland: A Route Map Towards Healthy Weight (Gruer, 2010) which was produced by the Scottish Government (SG) highlighted that in common with most of the developed world, Scotland is experiencing an obesity epidemic. Child obesity is a worldwide health problem and prevalence rates increased by an estimated 47.1% between 1980 and 2013 (Ng et al. 2014). Normalisation of overweight and obesity has resulted in a higher average weight status within the population and a distorted perception of a healthy body shape and, therefore, conceals the percentage of people in Scotland who are overweight or obese (National Health Services (NHS) National Services Scotland, 2011). Obesity increases the likelihood of various diseases, including type II diabetes, heart disease, disruptive sleep apnoea, osteoarthritis and certain types of cancer (Haslam and James, 2005).

Maintaining a healthy weight status requires a long-term balance between energy intake and energy expenditure, which are influenced by a range of energy balance related behaviours (EBRB). However, the Scottish Intercollegiate Guidance Network (SIGN) 115 Guidelines (Hering et al. 2010) describe the obesogenic process as the consequence of complex adaptive physiological systems acting as a result of multifactorial external environmental and societal influences and internal biological and psychological systems. Obesity, therefore, occurs as the result of inadequate behavioural and biological responses to an environment, often termed as obesogenic, which promotes an energy surplus that over time leads to excess energy being stored by the body in the form of adipose tissue resulting in unhealthy weight gain (Hering et al. 2010).

1.1 Child obesity prevalence and trends in Scotland

One of the most commonly used methods of determining body composition and subsequently estimating levels of body fat is Body Mass Index (BMI) (Cole et al. 1998). Although other measures of adiposity change, including waist circumference and skinfolds (Gorely et al. 2009) are also used to evaluate

interventions. Weight status can be defined using clinical or epidemiological categories in BMI distribution (BMI centiles) but within this thesis epidemiological categories will be used when discussing overweight and obesity prevalence. The BMI centile definition of a healthy weight status is a BMI ≥2nd - <85th centile, at risk of overweight is defined as a BMI ≥85th – 94.9th centile and at risk of obesity is defined as a BMI ≥95th centile.

The 2014 Scottish Health Survey (SHeS) reported the proportion of Scottish children at risk of obesity (BMI ≥95th centile) between 2 to 15 years of age increased from 14.3% in 1998 to 16.6% in 2008 but the rate of increase has stabilised and fluctuated between 16% and 17% every year since. The trends in prevalence for boys at risk of obesity demonstrated an increase from 14.5% to 19.7% between 1998 and 2012 but since then has dropped to 16% in 2014 (SHeS, 2014). Whereas the proportion of girls at risk of obesity demonstrated greater fluctuations and showed an overall decrease from 14.2% in 1998 to 13.7% in 2012 but peaked at 15.9% in the interim. However, the prevalence in girls has risen sharply to 15% in 2013 and 18% in 2014 (SHeS, 2014).

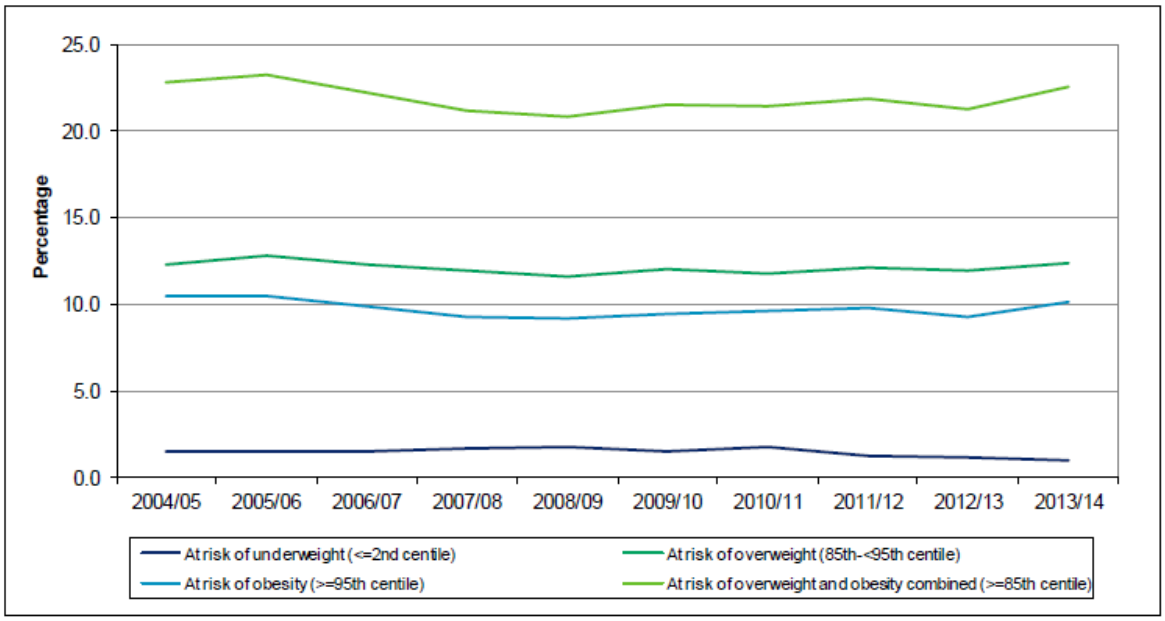
It was further reported that the proportion of 2 to 15 year old boys and girls at risk of overweight and obesity combined (BMI ≥85th centile) rose from 29.1% in 1998 to 32.8% in 2008. In the intervening years the prevalence has remained broadly similar with a figure of 31% reported in 2014 (SHeS, 2014). Boys demonstrated a rise in risk of overweight and obesity from 29.0% in 1998 to 37.5% in 2008. Notable reductions were reported in 2009 and 2010 with prevalence figures of 31.3% and 32.9% which rebounded to 36.2% in 2011 before declining to 33.6% in 2012 then 31% and 28% in 2013 and 2014 respectively. Prevalence levels for risk of overweight including obesity for girls dropped from 29.1% in 1998 to 27.4% in 2012 ranging from 27.8% to 30.2% in the intervening years but recently increased to 34% in 2014 (SHeS, 2014).

1.1.1 Childhood overweight prevalence at different age groups in Scotland

The Child Health Surveillance Programme identified that the prevalence of overweight including obesity in Primary 1 children has remained consistent over

the last ten years of published data. Over the period from 2004/05 to 2013/14 the prevalence of children identified as at risk of overweight including obesity increased from approximately 21% to 23%. A downward trend in the proportion of children at risk of overweight including obesity from 23.3% to 20.9% was reported from 2005/06 to 2008/09, but the prevalence subsequently increased again to 22.6% in 2013/14, see Figure 1-1 (Information Services Division, NHS National Services Scotland 2015).

Fig 1-1: Percentage of children in Primary 1 at risk of: underweight, overweight and obesity, by school year (epidemiological categories), All participating NHS Boards/Scotland



Source: Information Services Division, NHS National Services Scotland 2015

The SHeS (2012) reported that around one in six 2-15 year old children were at risk of obesity but the proportion at risk of obesity was not homogenous across this age range and prevalence increased with age, from 12.1% of those aged 2-6 to 22.5% of those aged 12-15. The SHeS (2012) further reported that around three in ten children were at risk of overweight, including obesity, but again this increased with age from 26% of 2-6 year olds to 31% of 7-11 year olds. There was an increased likelihood of boys being overweight or obese across all age groups between 2-15 years old with this disparity particularly manifest between 2-6

years old, with 32.7% of boys classified within this age range, compared with 22.3% of girls.

It was also reported in the SHeS (2012) that approximately two-thirds of reviewed children were categorised as being within a healthy range with a significantly greater proportion of girls than boys from 2-15 years old within this category. As with the categories of at risk of obesity and at risk of overweight including obesity, the proportion of children within a healthy weight range demonstrated variations with age. The 12-15 year old age group was where both boys and girls were least likely to be within a healthy weight range with 59.5% of boys and 60.9% of girls within this category.

1.1.2 Predicted future trends in childhood overweight and obesity in Scotland

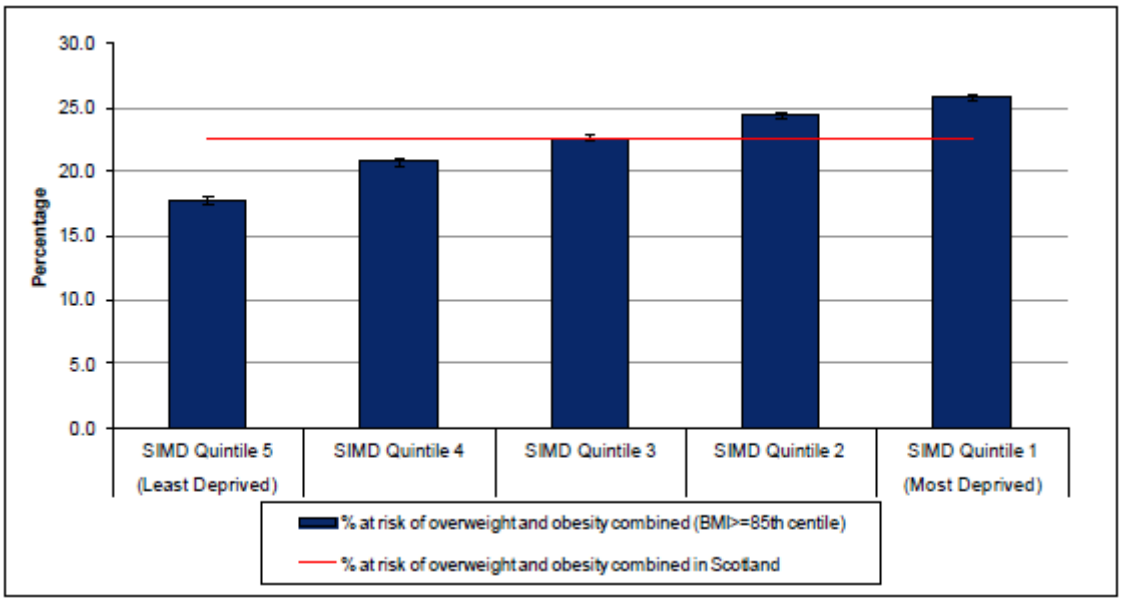
Childhood overweight and obesity for Scottish children have shown an increasing trend in recent years. Each year the reported percentages of children classified as overweight, including obese and severely obese, has increased by an average of 1.3 percentage points (NHS National Services Scotland, 2011). The Foresight Committee within the Government Office for Science predicted that in the United Kingdom (UK) by 2050 over 60% of children will be overweight including obese with 25% of all children classified as obese (Butland et al. 2007). It should be noted that childhood obesity has a strong correlation with adult obesity and, therefore, a large proportion children who are obese will remain so throughout their lives (Nader et al. 2006).

1.1.3 Comparative health: socioeconomic differences in childhood overweight and obesity in Scotland

The prevalence of overweight and obesity in Primary 1 children increases with deprivation. The Information Services Division of NHS National Services Scotland (ISD Scotland, CHSP School 2014) reported on health conditions by socioeconomic status. Figure 1-2 demonstrates that in the least deprived areas of Scotland, as defined by the Scottish Index of Multiple Deprivation (SIMD) (SIMD

quintile 5), 81.1% of children were classified as within a healthy weight range while in the most deprived areas (SIMD quintile 1) this was 73.2%. A positive correlation exists for P1 children between deprivation and the prevalence of the risk of overweight including obesity. The 2013/14 Child Health Surveillance Programme reported that 17.8% of children in the least deprived areas (SIMD quintile 5) were classified as at risk of overweight including obesity compared to 25.9% in the most deprived areas (SIMD quintile 1).

Fig 1-2: Percentage of children in Primary 1 in Scotland at risk of overweight and obesity combined, by Scottish Index of Multiple Deprivation (SIMD) 2012 Quintile, school year 2013/14 (epidemiological categories)



Source: Information Services Division, NHS National Services Scotland 2015

It should be noted that in recent years there has been a decline in the rates of child obesity from higher socioeconomic groups, whereas there was an increase among economically disadvantaged groups (ISD Scotland, CHSP School 2014). This may indicate that stability in the recent overall rates of childhood overweight and obesity in Scotland could be concealing widening obesity-related inequalities across the socioeconomic gradient.

1.2 Drivers of unhealthy weight gain in childhood

The range of factors influencing the maintenance of energy balance and subsequently a healthy weight status are wide-ranging and multifaceted, and research in this area of health spans the sociological, medical, biological, environmental and economic disciplines. The following review of research highlights basic associations of influences on childhood obesity rather than a detailed exploration of the association between the influencing factors with the outcome or the identification of causal mechanisms.

1.2.1 Obesity System Map

The UK Government's Foresight, Tackling Obesities: Future Choices – Project Report (Butland et al. 2007) identified complex interactions between societal and biological factors that have uncovered an innate human susceptibility to weight gain. The Foresight report (Butland et al. 2007) included an obesity system map with a psychobiologic core acting as a system engine and driving energy balance. The obesity system map, visualised as a dynamic causal loop model, included more than 100 interconnected variables that at multiple levels directly or indirectly affect energy balance. The connections between these influencing variables were weighted causal linkages showing the strength of the impact of this weight gain on energy intake or expenditure and the variables were clustered into seven principal themes. These themes were biology, physical activity (PA) environment, individual PA, societal influences, individual psychology, food environment and food consumption.

The obesity system map is therefore a representation of the sum of all the relevant factors and their interdependencies that influence weight status for individuals or groups. The purpose of the obesity system map was to understand the complex interactions driving obesity and can be used as a tool for policy makers and programme managers to generate effective responses to addressing obesity. This tool can be applied directly to the development process for approaches to address unhealthy weight gain in childhood.

1.2.2 Child behaviours related to child obesity

EBRB are those behaviours that influence energy expenditure (i.e. PA) and energy consumption (i.e. dietary habits) and thereby determine body weight. However, other factors explored within this review influence weight status by either directly or indirectly influencing these EBRB.

Low levels of habitual PA are related to excessive weight gain in childhood (Livingstone, 2001) and PA levels of pre-schoolers was found to be a predictor of weight gain throughout the primary school age range. In addition, low levels of PA were found to have a stronger influence on weight gain in children who were already overweight or obese when compared to healthy weight children with low PA levels. Children within a healthy weight range with low PA levels did not demonstrate increased adiposity as they aged, while children who were already above a healthy weight range gained more weight in association with low levels of PA (Livingstone, 2001). The causal mechanisms underlying these findings are unclear, but it would indicate that low PA levels appear to be more strongly correlated with future risk of unhealthy weight gain in children who are already overweight or obese at a young age.

Sedentary lifestyles often assessed through measures of screen-based activities such as computer use and television viewing (TV) have been identified by numerous studies as correlates of unhealthy weight gain in childhood. TV viewing time was found to be directly associated with low levels of PA and low levels of time spent outdoors (Gable and Lutz, 2000). High levels of TV viewing were also related to increased exposure to advertising for unhealthy food and drinks and EBRB associated with weight gain included consumption of snack foods and lack of engagement with extra-curricular activities (Gable and Lutz, 2000).

Consumption of foods and drinks high in fat and/or sugar, fruit and vegetable consumption and consuming too great a quantity of food are key aspects of excessive energy intake in childhood associated with childhood overweight and obesity. The development of dietary habits begins early in life and is persistent throughout childhood (Vik et al. 2013) with food preferences associated with availability and accessibility. The quality and quantity of foods consumed have

also been found to be related to food sources (e.g. home cooked or ready meals), the portion sizes provided, whether families eat together and TV viewing during meals (Vik et al. 2013).

Short sleep duration is recognised as a significant risk factor in the development of obesity in childhood; however, questions still remain on the underlying causal mechanisms. It was reported by Gozal et al. (2012) that insufficient sleep affects the regulation of homeostatic and hormonal systems related to growth, maturation and bioenergetics. Inadequate sleep has been associated with increased energy intake but should be recognised as an independent element of an obesogenic lifestyle and it is considered by Gozal et al. (2012) that sleep patterns should be considered alongside dietary and PA patterns in weight management interventions. Börnhorst et al. (2012) identified an inverse relationship between sleep duration and BMI and hypothesised that Insulin may explain part of this association, particularly at higher BMI scores. Furthermore, short sleep duration was associated with overweight and obesity in preadolescent children with one hour less sleep per night at ten years old associated with an increased risk of overweight and obesity at thirteen years old (Börnhorst et al. 2012).

Braithwaite et al. (2013) hypothesised that screen time (ST) (comprising TV viewing and computer or mobile phone use) contributed to unhealthy weight gain in childhood and identified a positive association between BMI and the amount of time spent using screen based devices in both adolescents and children. In addition, there was an indication of a dose-response effect. Furthermore, ST was associated with reduced overall health-related quality of life (QOL) in overweight and obese adolescents (Goldfield et al. 2015). Potential causal mechanisms underlying this association have been proposed including displacement of PA and reduction in basal metabolic rate resulting in resting energy expenditure compared to non-screen based activities while watching TV. Also, exposure to advertising of less healthy foods and drinks and subsequent consumption of foods and drinks high in sugar and fat, increased calorie intake while watching TV and disrupted sleep patterns or shortened sleep duration were also proposed as causal mechanisms (Maher et al. 2012).

1.3 Health consequences of childhood obesity

Healthcare costs were found to be higher in obese than non-obese children as a result of increased clinic visits, hospitalisations, duration of hospitalisations, and number of prescribed medications (Hering et al. 2009). Children who are overweight or obese are at increased risk of a number of adverse health outcomes in the short term and throughout their life course. Childhood obesity was found to directly cause several morbidities including non-communicable diseases (NCD) such as gastrointestinal and orthopaedic complications, sleep apnoea and early onset of cardiovascular disease and type-2 diabetes alongside comorbidities associated with the latter two NCD (Lobstein and Jackson-Leach, 2006). It was further reported that childhood obesity has a tendency to persist into adult life, and adults who developed obesity in childhood demonstrate a greater risk of developing obesity-related NCD, including some cancers, type 2 diabetes, hypertension and cardiovascular disease than individuals who developed obesity in adulthood (Nathan and Moran, 2008). Health problems previously confined to adulthood are now increasingly being observed in children and adolescents, a trend attributed, by some, almost entirely to paediatric obesity (Ebbeling et al. 2002). Critically, it has been suggested that, for some obesity-related comorbidities, childhood obesity has an irreversible impact on adult health (Kelsey et al. 2014). This view, however, is not shared by all as Juonala et al. (2011) purport that moving into a healthy weight range in adulthood can ameliorate some of the risks of morbidity and mortality.

Childhood obesity has also been linked with a range of psychological and social problems including anxiety, depression, low self-esteem, isolation and some risk-taking behaviours in adolescence (Luttikhuis et al. 2009). Furthermore, childhood obesity has been linked to stigmatisation, lack of socialisation and cognitive impairment (Miller et al. 2014). Obesity at 11 years of age was found by Booth et al. (2014) to be associated with poorer academic attainment for females up to at least 16 years old, and that a causal relationship may exist between obesity and subsequent academic attainment. This concurred with Caird et al. (2011) who reported a weak negative association between obesity and educational attainment in children and young people. The relationship

between obesity and academic outcomes may be important to young people, their families, teachers and wider society especially when the relationship between academic attainment and employment status in youth is considered (Booth et al. 2014). The impact of obesity on academic outcomes may encourage Local Authority Education Department stakeholders to engage with curricular interventions that both treat and prevent paediatric obesity.

The obesogenic environment can also negatively impact on children who are not above a healthy weight range. Definitions of childhood overweight and obesity categorise weight status but do not take account of children who have a trajectory of weight gain, that while still placing them within a healthy BMI range for their age, puts them on a path towards an unhealthy weight status in the future (Sun et al. 2012). The social, emotional and health consequences of childhood overweight and obesity are also on a continuum and can affect a child's QOL before BMI-for-age cut-offs are breached (Lobstein and Jackson-Leach, 2006). Furthermore, the position of fat distribution in the body also has implications for health. BMI is a simple and commonly used method to identify children who are overweight or obese, but it cannot accurately identify children with visceral abdominal adiposity which increases the risk of future health complications (Lobstein and Jackson-Leach, 2006).

1.4 Scottish Government policy to address child overweight and obesity

To differentiate between the proposed intervention that is the focus of this thesis and existing interventions identified through the development process, the proposed intervention will be referred to as the Child Healthy Weight (CHW) intervention and elements associated with the Scottish Government HEAT target will be referred to using the CHW abbreviation. Existing real world interventions and empirical research in this area will be referred to as Child Weight Management (CWM) interventions. Aspects of approaches to weight management in childhood, for example, behavioural change approaches or theoretical intervention concepts, will also be referred to using the CWM abbreviation.

While highlighting that childhood overweight and obesity is a particular challenge the 2008 HEAT (Health Improvement, Efficiency, Access & Treatment) 3 Child Healthy Weight (CHW) Target (Scottish Government, 2008) reiterated the SG health and wellbeing vision to address health inequalities and focus interventions on the early years to break the link between behaviours in early life and subsequent adult disease. This established the target population (aged 5-15 years old with a BMI >91st centile) and required interventions to combine dietary and PA components, involve the family alongside children and be grounded in evidence-based behavioural change theory to support long-term sustainable modifications in EBRB.

In 2010 the SG produced the Preventing Overweight and Obesity in Scotland: A Route Map Towards Healthy Weight (Gruer, 2010) which outlined the aim of the SG that a majority of people in Scotland should be within a healthy weight range throughout adult life, thereby avoiding the consequences of overweight and obesity. This document echoed much of what was contained in the Foresight Report and emphasised that the responsibility for the issue of overweight and obesity was a cross-sector, cross-portfolio task. This partnership approach would ensure that the landscape would move away from being one which promotes weight gain to one that sees healthy choices in eating, PA and the environment as the norm. The Obesity Route Map sits in the wider context of

the SG National Performance Framework and reducing childhood obesity levels will support several national outcomes and directly address a National Indicator aimed specifically at childhood overweight and obesity.

The SIGN Guideline 115, Management of Obesity a national clinical guideline (Hering et al. 2010), provides evidence-based guidance on the prevention and treatment of obesity for children, young people and adults. It advocates a number of approaches including combining a reduction in calorie intake with an increase in PA levels and reduction in sedentary behaviour. Revised H3 Guidance was published by the SG in 2011 (Scottish Government, 2011) alongside a new HEAT Target H3 Child Healthy Weight 2011-14 which provided greater specificity on intervention content and contextualised CHW interventions within an integrated systems approach to addressing childhood overweight and obesity. One significant difference in the eligibility criteria for interventions was a reduction of the minimum age of participants from 5 years old to 2 years old in line with an early intervention and prevention approach in early years.

2. Health behaviour change methods within child weight management

Whether explicitly stated within intervention methodologies or not, most evidence-informed, theoretically driven school-based Child Weight Management (CWM) interventions that aim to modify EBRB associated with unhealthy weight gain in childhood draw from established concepts of behavioural change within public health programmes. Multiple reviews have stressed the importance of basing child obesity interventions on established, evidence based theories of behaviour change (Nixon et al. 2012). Different theoretical perspectives can be used for intervention design, identifying target behaviours to change or understanding the process of behavioural change. Examples of theoretical perspectives of behaviour change, commonly employed by NHS Health Board level interventions, and cited as an essential requirement of H3 eligible interventions will be explored within this section of the review.

There are a number of health promotion theories and models that underpin healthy lifestyle interventions. This thesis focuses on concepts of behaviour change, which in this context are essentially ways to change children's behaviours that relate to weight management. Since definitions vary and can cause some confusion, this thesis draws from definitions of theories, models, and techniques as described by Glanz et al. (2005). Theories are an integrated set of proposals that explain a phenomenon and are introduced after a systematic set of uniformities have been identified for behaviour. Theories are systematically organised principles that provide a basis for explaining certain events, for example, the Theory of Planned Behaviour (Ajzen, 1991). Models are a subclass of a theory and provide a plan for investigating and or addressing a phenomenon. They attempt to represent but not to explain the processes underlying learning and act as a vehicle for applying theories, for example, the Social-Ecological Model (SEM) (Bronfenbrenner, 1979). Behavioural approaches are practical application strategies that consist of a set of techniques that can be used to change behaviours and within child weight management Motivational Interviewing (MI) is commonly used. Techniques for behaviour change are specific tools that can be considered the smallest building blocks within

behaviour change methods and include goal setting, rewards and problem solving.

A commonly used behavioural change theory within CWM is Social Cognitive Theory (SCT) (Bandura, 1986) that theorised the process of behaviour change is based on an interaction between that behaviour with personal and environmental factors (Bandura, 1986). Some of the key personal factors within SCT for behavioural change are self-control, reinforcements, emotional coping and observational learning, acquisition of skills, self-efficacy and the motivation to act because of outcome expectancies (Perry et al. 1990). Some key environmental factors associated with behaviour change are modelling, positive reinforcement from parents, teachers and peers, and availability of resources, e.g. provision of water instead of sugary drinks, (Nixon et al. 2012). As young children are influenced primarily by parents in their dietary habits and activity patterns, Baranowski et al. (2003) suggest that focusing on specific environmental variables (e.g. parental role modelling or increased availability of healthy food choices) offer promising intervention targets with younger children. SCT within an educational context posits that, in part, learning is the result of observing significant others and experiences of replicating behaviours. Modelling of that behaviour is dependent on whether there is positive or negative reinforcement for their behaviour and the outcome of the behaviour (Perry et al. 1990).

There are several ways in which SCT can be incorporated into CWM, for example, self-efficacy can be developed through the provision of resources and support which raise the confidence levels of individuals (e.g. provision of healthy snack options and support to select them). This should be done through a series of small steps in order to promote successful outcomes (Perry et al. 1990). In addition, Bandura (1986) stated that even when individuals possess sufficient self-efficacy this may not result in changes to behaviours if incentives to do so are insufficient. This seems to suggest that it may initially be necessary to provide incentives and rewards for individuals to display desired behaviours or to combine incentives with self-efficacy development in an approach that focuses on internal and external motivation. According to SCT, environmental factors

that might aid CWM could involve the provision of assistance and fostering social support networks (Perry et al. 1990). It is also important to recognise that, conversely, certain environmental constraints have the potential to deter behaviour change.

Bergh et al. (2012) used SCT within the HEIA study on a school-based multicomponent CWM intervention that demonstrated increased PA levels and reductions in BMI scores. SCT was also used in the school setting by Gorely (2009) within GreatFun2Run which demonstrated increases in moderate to vigorous PA and reductions in the BMI score of participants. Improvements in both fruit and vegetable consumption were demonstrated by Rosário et al. (2012) in an intervention using SCT in a school intervention and Kipping (2014) also used SCT in this setting within Active for Life Year 5 (AFLY5), which showed reductions in SSB consumption and ST in participating children.

Behaviour change models attempt to represent but not explain behavioural processes, unlike behavioural theories that can be used to explain phenomenon. Behavioural models can be used to provide a vehicle through which theories can be applied in order to address a phenomenon. The SEM is concerned with interconnected external influences and broadly focused in terms of understanding the development of behaviours and the influencing factors which must be addressed in order to modify behaviours. The SEM was devised by Bronfenbrenner (1979) and defines the levels of influence on individual choices or behaviours which are usually represented as a series of concentric circles with the most proximal influences at the centre and the most distal influences on the outside. This model can include four or five levels as they can either separate or combine the community and policy levels. The SEM was later used by Stokols (1992) specifically to address social ecology in relation to health-related behaviours. In this context, Stokols (1992) reported that the SEM makes four assumptions. One, the group and individual health are determined by complex interactions of the physical and social environment as well as personal characteristics such as genetic inheritance, psychological nature, and behavioural patterns. Two, the complex nature of environmental influences, physical and social, must be considered. Three, participants should be analysed

as individuals and groups and supported on multiple levels. Four, multiple environmental levels exist in which local environments are embedded in more complex environments and reciprocal influences occur between people and environment. A co-operative environment where participants share common goals may facilitate positive physical and emotional well-being (Stokols, 1992).

The SEM supports health interventions that require strategies that address multiple individual, social and physical behavioural determinants simultaneously and was used by Li et al. (2014) within a school based PA programme that reported significantly decreased BMI, skinfold thickness and fasting glucose, and increased levels of moderate to vigorous PA. Simon et al. (2014) reported on ICAPS, an intervention which used a Socio-Ecological approach to promote PA and limit sedentary behaviours (SB) in adolescence. The results of ICAPS, demonstrate that a school-based obesity prevention intervention, based on a comprehensive Social-Ecological approach to both promote PA and limit SB, prevents excessive weight gain with positive results maintained up to 2.5 years post intervention (Simon et al. 2014). Furthermore Naylor et al (2006) developed a conceptual primary school PA intervention, Action Schools! *BC,* with the SEM to provide environments that supported healthy choices and behavioural change at school and individual levels. Naylor et al. (2006) noted that increasing levels of PA in children requires a complex approach and demands intervention across multiple levels and settings. The results of these interventions suggest that the SEM is appropriate for use within CWM to address behavioural determinants at various levels of influence.

Behavioural approaches, such as MI can be applied directly within CWM and used to change behaviours within strategies devised using behavioural models. MI was developed initially in response to treating alcoholism by Miller (1983) and the basic approach was further developed by Miller and Rollnick (1991) into a coherent theory and a clinical procedure. This is both, a set of techniques and a style of behavioural counselling which is directive, client-centred and designed to understand and elicit behaviour change. MI is a method of helping individuals identify and resolve problem behaviours and is commonly used by the NHS within adult services including dietetics and smoking cessation. However, MI is now

becoming more commonplace within child focussed interventions and can be particularly useful for individuals who are ambivalent about changing behaviours. MI is designed to be persuasive and supportive with the ambition of increasing intrinsic motivation so that the impetus to modify behaviours comes from within rather than being externally imposed (Miller and Rollnick, 1991).

Within a systematic review, Rubak et al. (2005) reported that MI effectively helps clients change targeted behaviours and that it elicits superior results than traditional advice given in approximately 80% of the studies they reviewed. None of the studies Rubak et al. (2005) reviewed reported any harmful events or adverse effect associated with MI. This finding is of critical importance when addressing a potentially sensitive topic such as child obesity management in which children, parents and professionals may have reservations about engaging. This appropriateness was tested by Christison et al. (2014) who used a MI approach within Well-Child visits and demonstrated that it modified EBRB and subsequent weight status in children and improved the effectiveness of staff in delivering an obesity prevention programme.

Behaviour Change Techniques (BCT) are observable and replicable components of interventions designed to bring about changes in behaviour. They are the smallest components of behavioural interventions and can be described as the active ingredients underlying the proposed mechanisms of change that can be used alone or in combination within a package. The previously described theories of behaviour change postulate the underlying scientific explanations of the processes of change and link behaviour change to concepts in a systematic way (Michie et al. 2011). Theories describe how, when and why changes in behaviour occur and are therefore fundamental in designing behaviour change interventions. Theories, however, do not direct how to link these hypothesised mechanisms of change with BCT (Michie et al. 2011). Therefore, examples of CWM interventions which effectively apply combinations of BCT within a package should be sought within the literature.

3. Review of primary school based child weight management interventions: characteristics and strategies of effective approaches

3.1 Introduction to the review of primary school child weight management

It has been recognised by researchers worldwide that schools are key settings for obesity prevention initiatives. Primary school age (4-12 years old) is a critical period in which health behaviours develop and are maintained into young adulthood (Institute of Medicine of the National Academies, 2013). It is important to remain cognisant that school-based child obesity treatment and prevention interventions are not a panacea in paediatric obesity management and have demonstrated mixed results (Brown and Summerbell, 2009). However, Lavelle and colleagues (2012) reported that school-based interventions were effective in reducing BMI and Gonzalez-Suarez et al. (2009) concluded that school-based interventions were effective in the short-term for obesity prevention. It should be noted, however, that even when school-based obesity prevention interventions do not reduce BMI they can demonstrate desirable changes in knowledge, attitudes, and behaviours in children regarding PA and healthy eating (HE).

Interventions that target only obese children are defined as treatment interventions which utilise a methodology specifically designed to change the behaviours of this group. Whereas universal interventions for mixed groups, such as school classes, will combine both prevention strategies for children within a healthy weight range and treatment strategies for already overweight children (Lavelle et al. 2012). Given this important distinction between these intervention types and that the fact that the proposed intervention setting is pre-determined as primary schools; the aim of the following section is to evaluate the effects of universal, whole class, school-based interventions. These should include HE and PA components for the prevention and treatment of obesity in primary school aged children in the curricular primary school setting. A secondary aim is to identify intervention characteristics and the moderators of

the primary outcome of BMI modification that they address and which may contribute to intervention effectiveness. The third aim is the identification of intervention approaches that can be replicated within the proposed CHW intervention methodology.

Studies selected for inclusion in this review were primary school-based, universal interventions delivered within the curriculum which were designed to modify BMI through increasing levels of PA, reducing SB or dietary modification. They must have included BMI measurement in pre and post analyses to allow for the assessment of intervention impact on the BMI status of participants.

3.2 Effective universal, school-based, multicomponent child weight management interventions identified through the literature review

A review of the literature identified 20 studies on 18 interventions, listed in Appendix 1, that helped to inform which characteristics of school-based CWM interventions were most effective. Participants included boys and girls, samples sizes ranged from N= 294-2622 participants, within mixed primary school age classes. Study designs included randomised controlled trials and non-randomised controlled trials based on interventions ranging from five to thirty-six months. Interventions were considered successful if there was a reduction or maintenance of BMI or EBRB in the entire intervention group or a sub-group within intervention versus control conditions from pre to post. Behavioural moderators included PA levels, fruit intake, vegetable intake, sedentary time and SSB consumption. Intervention duration was classified as short-term (≤ 6 months), moderate-term (> 6 months and ≤ 12 months), or long-term (> 12 months). A behavioural variable, such as PA level, was classified as a potential moderator if a significant change in the variable occurred in addition to a significant change in BMI in the intervention compared to the control group.

Half of the reviewed interventions utilised a behaviour change theory with SCT (Bandura, 1986) being used in five interventions, including GreatFun2Run (Gorely et al. 2009) and AFLY5 (Kipping et al. 2014), while the remaining were not informed by any explicitly mentioned behaviour change theory. Results of both interventions which were based on behavioural change theories and those that were atheoretical were mixed in terms of improved BMI. For example, some theoretically-driven interventions were effective in modifying BMI variables e.g. WAY (Spiegel and Foulk, 2006) and some interventions not reporting a behavioural theory or model were also effective, including APPLE (Taylor et al. 2007). It may be that some reviewed interventions used strategies based on behaviour change theories but failed to report the theoretical framework. It should be noted, however, that despite the absence of, or failure to report, theoretical behaviour change underpinnings within some reviewed interventions there is a growing body of evidence in the area of obesity prevention and treatment which has demonstrated successful behavioural and health outcomes

from theory-driven interventions which applied psychological principles of behaviour change (Beckman et al. 2006). Interventions which were driven by theories of behaviour change aimed to change how individuals think and act, with regards to EBRB, rather than being traditional knowledge based obesity interventions which merely impart information. It was reported by Beckman et al. (2006) that there was strong evidence that certain components have been integrated into obesity interventions which have supported individuals to become more motivated to implement and achieve nutrition and exercise related goals. Beckman et al. (2006) reported on research evidence that supports the belief that behavioural, theory-based EBRB interventions more effectively produced changes in behaviours than knowledge-based interventions. It would therefore, seem preferable to apply theoretical behaviour change methods to the proposed CHW intervention.

School-based healthy weight interventions differed in terms of how they were delivered and often used a combination of environmental, educational, PA, and parental involvement strategies. Most initiatives, for example HEIA (Bergh et al. 2012) and CHILDREN (Angelopoulos et al. 2009), were delivered solely by teachers, although there was also a combination of teachers and internet resources, within the LA Health Project (Williamson et al. 2012), teachers alongside specialists, within Project Energise (Rush et al. 2012), and teachers alongside students within Healthy Buddies (Stock et al. 2012). Less commonly, community coordinators or university students delivered interventions. Some interventions also often included a parental component and half of the interventions that included this component successfully influenced BMI results, for example EdAl (Tarro et al. 2014) and Avall (Llargues et al. 2011), while only 1 of 6 that did not include a parent component demonstrated successful outcomes.

The primary outcome of successful interventions was BMI. When looking at BMI in the total intervention group, only 31% of reviewed studies, including Avall and CHILDREN, achieved a statistically significant improvement whereas 40% of studies which measured BMI-SDS/z-score (a statistical analysis that allows direct comparison across different age groups), including GreatFun2Run and APPLE,

achieved an improvement in this variable. However, more than half of the studies, including EdAl and WAY resulted in an improvement in BMI variables in specific sub-groupings such as older children (Healthy Buddies), girls (Rosário et al. 2012), and white girls (LA Health Project).

Secondary outcome measures of effectiveness were moderators of BMI. Twelve studies measured PA or moderate and vigorous PA (MVPA), and five of these studies including GreatFun2Run and WAY, resulted in improvements in these variables alongside improvement in BMI variables. Two studies, CHILDREN and APPLE measured SSB consumption and reported improved BMI alongside decreased SSB consumption. Nine studies measured fruit and vegetable intake, with four achieving an increase in fruit consumption (CHILDREN, Avall, WAY and APPLE) and one in vegetable consumption (WAY) alongside BMI improvement. No studies measuring SB such as CHANGE (Fairclough et al. 2013) and ALFY5 or total sedentary time, including LA Health Project, were able to decrease either, nor were they able to improve BMI variables.

Sustained effects of interventions were reviewed with one study by Fairclough et al. (2013) who reported post intervention follow-up measures. CHANGE was delivered over five months and was unable to reduce BMI or BMI z-score at post measures. However, authors reported a significantly lower BMI z-score at ten week post-intervention follow-up from pre-intervention measures.

3.3 Findings and implications of this review of effective universal, school-based, multicomponent child weight management interventions

The review of effective universal, school-based, multicomponent CWM interventions identified a number of findings which should be considered when designing new CWM interventions to ensure that they have a methodology grounded in evidence-based best practice.

1. Ways in which to improve SB and sedentary time were not identified in this review. Five of the twelve studies measuring PA or MVPA, including Avall, CHILDREN and WAY, improved these variables alongside BMI. This finding is consistent with other published reviews (Gonzalez-Suarez et al. 2009 and Lavelle et al. 2012). The study in this review that measured sedentary behaviour (Fairclough et al. 2013) and the two studies that measured total sedentary time (Kipping et al. 2014 and Williamson et al. 2012) were unable to reduce these behaviours and improve BMI variables.
2. Lowering SSB consumption may be achievable through school-based initiatives and may contribute to improving BMI. Two (Angelopoulos et al. 2009 and Taylor et al. 2007) of the four studies that measured SSB reported improvements in BMI alongside a decrease in SSB.
3. Increasing fruit consumption was easier than increasing vegetable consumption. Only one of nine studies measuring vegetable intake increased this variable alongside BMI improvement (Rosário et al. 2012). Increasing vegetable consumption appeared more difficult than increasing fruit intake which was demonstrated in five studies including APPLE.
4. Short term and long term interventions were more effective than medium term interventions. The current review suggested that school-based interventions may be more effective with moderate (> 6months and ≤ 12 months) or long-term durations, (> 12 months). Although interventions lasting more than 12 months were most often used and capable of improving BMI as demonstrated by Tarro et al. (2014), those lasting more than 6 months and up to 12 months were most successful at improving BMI as reported by 5 authors including Gorely et al. (2009) and Kain et al. (2014). Interventions lasting less than 6 months were less successful at improving BMI (Rosário et al. 2012 and Fairclough et al. 2013). Short-term interventions may have been

less effective because moderate-term programmes gave the children more time to improve BMI, whereas, within long-term interventions fidelity or active participant engagement may be more difficult to maintain as intervention duration increases.

5. A teacher led methodology was effective with several authors including Llargues et al.(2011) and Kain et al. (2014) reporting that teacher-led interventions improved BMI variables, was the most common approach and may be the most financially sustainable delivery method.
6. Parental involvement appeared to support intervention effectiveness. However, because of the disparity between levels of parental involvement across reviewed studies, it is difficult to quantify the relative importance of parental influence. While the inclusion of homework assignments and information sent home to parents may appear to be a low-intensity element of the interventions, this approach may be a sustainable aspect of long-term teacher-led initiatives.
7. An education-only methodology may not be effective in bringing about changes in BMI. While multiple combinations of environmental, educational and physical strategies demonstrated the capacity to improve child BMI strategies in numerous studies, including GreatFun2Run and HEIA, this review suggests that education-only interventions may not be sufficient to induce behaviour change (Rosário et al. 2012). In line with the principle of SCT, the findings of this review seem to suggest that if a child's environment does not support and reinforce new knowledge and attitudes from education and/or the child does not practice health-enhancing behaviours a supportive environment, the likelihood of inducing sustainable behavioural change may be low.

The findings of the literature review for this study were compared with those of systematic reviews. Universal school-based CWM interventions that included HE and PA components may be effective methods for improving moderators of BMI, such as SSB consumption, in primary school children (Brown and Summerbell, 2009 and Lavelle, 2012). Similarly, Brown and Summerbell's (2009) review suggested that school-based obesity interventions containing HE and PA components may help prevent overweight, and Lavelle (2012) also determined that school-based interventions may be effective in reducing BMI. Reduction of

SSB consumption has been reported by parents and children to be one of the easiest health behaviours to modify (Looney and Raynor, 2014). However improving fruit consumption is likely to be easier than increasing vegetable intake which is attributed to the child's perception of fruit being more palatable than vegetables (Blanchette and Brug, 2005).

Cook-Cottone et al. (2009) suggested that school-based interventions may be more effective with moderate (> 6months and ≤ 12 months) or long-term durations**,** (> 12 months) which was in line with Gonzalez-Suarez's (2009) who conducted a meta-analysis and determined that interventions lasting 1-2 years or more than 2 years were more effective than those lasting less than 6 months. Teachers play a strong role in a child's social environment and have the potential to positively influence behaviours through environmental and social interactions (Gubbels et al. 2011). Parental involvement appeared to be a positive factor in intervention effectiveness and may be due to its direct positive relationship with health behaviours in youth (Lawman and Wilson, 2012).

This thesis aims to describe the design and development of an effective universal child obesity intervention with characteristics and moderators that may support its effectiveness. The findings of this review are particularly salient to the process of developing evidence-based CWM interventions in the future. Initiatives that last between 6 - 12 months that include a parental component and involve multiple environmental, educational, and physical strategies may provide the most promising approach to modifying BMI variables. Targeting BMI moderators which are more modifiable could include increasing PA, decreasing SB, lowering SSB consumption, and increasing fruit intake. Although it is unlikely that one specific school-based intervention can be effective across different cultures and genders, the identification of consistent elements used worldwide that have demonstrated aspects of effective interventions which will support the development of an evidence-based CHW intervention.

The reviewed studies highlight the mixed effectiveness of school-based healthy weight interventions and the related characteristics and moderators that are important for effectiveness. That being said, the studies are limited in several

ways. There was a general lack of reporting of adverse events, reporting characteristics of participants or establishments lost to follow-up, measuring or reporting on intervention fidelity and reporting if participants who agreed to take part were representative of the population. Furthermore, some interventions were atheoretical while others employed methodological elements which cannot be replicated directly within the proposed CHW intervention, primarily due to duration and delivery staff requirements. However, those elements which can be replicated will be considered for incorporation into the proposed CHW intervention.

4. Requirement for the proposed child healthy weight intervention to be evidence informed and theory-driven

While developing interventions designed to impact positively on childhood obesity, identifying empirical evidence on the specific behaviours relating to a healthy diet and an active lifestyle which should be addressed is only the first step. The second step, requiring an equally rigorous scientific approach, is to ascertain appropriate and effective methods of achieving behavioural change in the target population. Lloyd et al. (2011) believe that the systematic approach provided by a planning model ensures that the behavioural change techniques are focussed directly on EBRB and their associated determinants. This organised and systematic approach acts as a framework for ongoing process analysis increasing both the likelihood that the programme operational ambitions will be realised by achieving the desired health outcome (Lloyd et al. 2011) and also that the strategic ambitions will be realised through meeting the requirements of NHS Lanarkshire (NHSL) and the SG.

Therefore, a Health Improvement planning model was used to meet these operational and strategic requirements. Numerous existing planning models could have been validly used to guide the formulation, development, implementation and evaluation of an efficacious school-based CHW intervention. A number of models that had been used effectively within childhood obesity management approaches across various settings were identified by a review of the literature including the LEAP (Barr and Daily, 2007), ANGELO (Swinburn et al. 2000) and RE-AIM (Glasgow et al. 1999) models. However, the PRECEDE-PROCEED Model (PPM) (Green and Kreuter, 2005) with the addition of the Intervention Mapping (IM) Protocol (Belansky et al. 2013) was identified as most suitable to meet the requirements of the proposed CHW intervention.

5. The PRECEDE-PROCEED Model & Intervention Mapping and the reasons for using them to address the research questions

5.1 The PRECEDE-PROCEED Model

The PRECEDE-PROCEED Model (PPM) is a Health Promotion Logic Model, which incorporates a theory of change that was developed for use in public health (Green and Kreuter, 2005). This concept of informed choices is at the core the PPM, which has a focus on the active promotion of behaviours and attitudes that support health and wellbeing and improve QOL. The PPM assumes that identification of a problem should precede a public health intervention and that it should be monitored utilising process, impact and outcome evaluations. The premise of the PPM is that it focuses on outcomes, and the process should start with the desired outcome and then identify the systems, procedures and actions necessary to bring about these outcomes (Crosby and Noar, 2011).

Planning models such as the PPM attempt to delineate a process through which complex social interventions, which act on complex social systems, will have the greatest likelihood of achieving desired outcomes (Crosby and Noar, 2011). Target group participation in an intervention does not guarantee a successful outcome as programme effectiveness is dependent on context and implementation. These additional variations in intervention outcomes can be minimised through formalised planning, delivery and evaluation frameworks such as the PPM (Crosby and Noar, 2011). Planning models such as the PPM operate at the macroscopic level and function as a framework for systematising an entire health promotion programme and in this sense PPM serves as a blueprint to direct a specific intervention. Glanz et al. (2008) purported that the purpose of the PPM is to function as a systematic structure for applying theories of behaviour change within health behaviour change (HBC) programmes and to support the planning and evaluation of these programmes. Reviews have shown interventions utilising theoretical approaches report to be more efficacious than atheoretical interventions (Glanz and Bishop, 2010 and Noar, 2008).

5.1.1 Structure of the PRECEDE-PROCEED Model

PRECEDE and PROCEED are both acronyms with PRECEDE standing for Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation. This initial stage of the PPM is used to guide the process leading up to an intervention and identifies a desired outcome for the specific target population. It then goes on to outline what has to be done to achieve that outcome and identify issues of administration and policy that need to be addressed. Each phase of PRECEDE builds up to delivering the intervention. PROCEED stands for Policy, Regulatory, and Organisational Constructs in Educational and Environmental Development. The second stage of the model outlines how to implement the intervention starts with the focusing on the changes which must take place to achieve the desired outcome and uses these to develop an intervention that will bring it about (Green and Kreuter, 2005).

PRECEDE is subdivided into four phases.

- **Phase 1**: Social Assessment. Identify the desired outcome
- **Phase 2:** Epidemiological Assessment. Identify and set priorities areas and the behavioural and environmental factors that are acting as barriers achieving that outcome
- **Phase 3:** Educational and Ecological Assessment. Identify factors which predispose, enable, and reinforce the behaviours, attitudes, and environmental factors prioritised in Phase 2
- **Phase 4:** Administrative Assessment, Policy Assessment and Intervention Orientation. Identify administrative and policy factors associated with the target setting which can influence what interventions can be implemented and how this can be done

Phases 1 and 2 identify intervention goals whereas Phases 3 and 4 are focussed on planning and design and define the structure and behavioural targets of the intervention. The four phases of PRECEDE can, therefore, be considered a formative process (Green and Kreuter, 2005).

PROCEED is the active component of the model and consists of four phases that direct the implementation and evaluation of the intervention.

PROCEED is subdivided into four phases

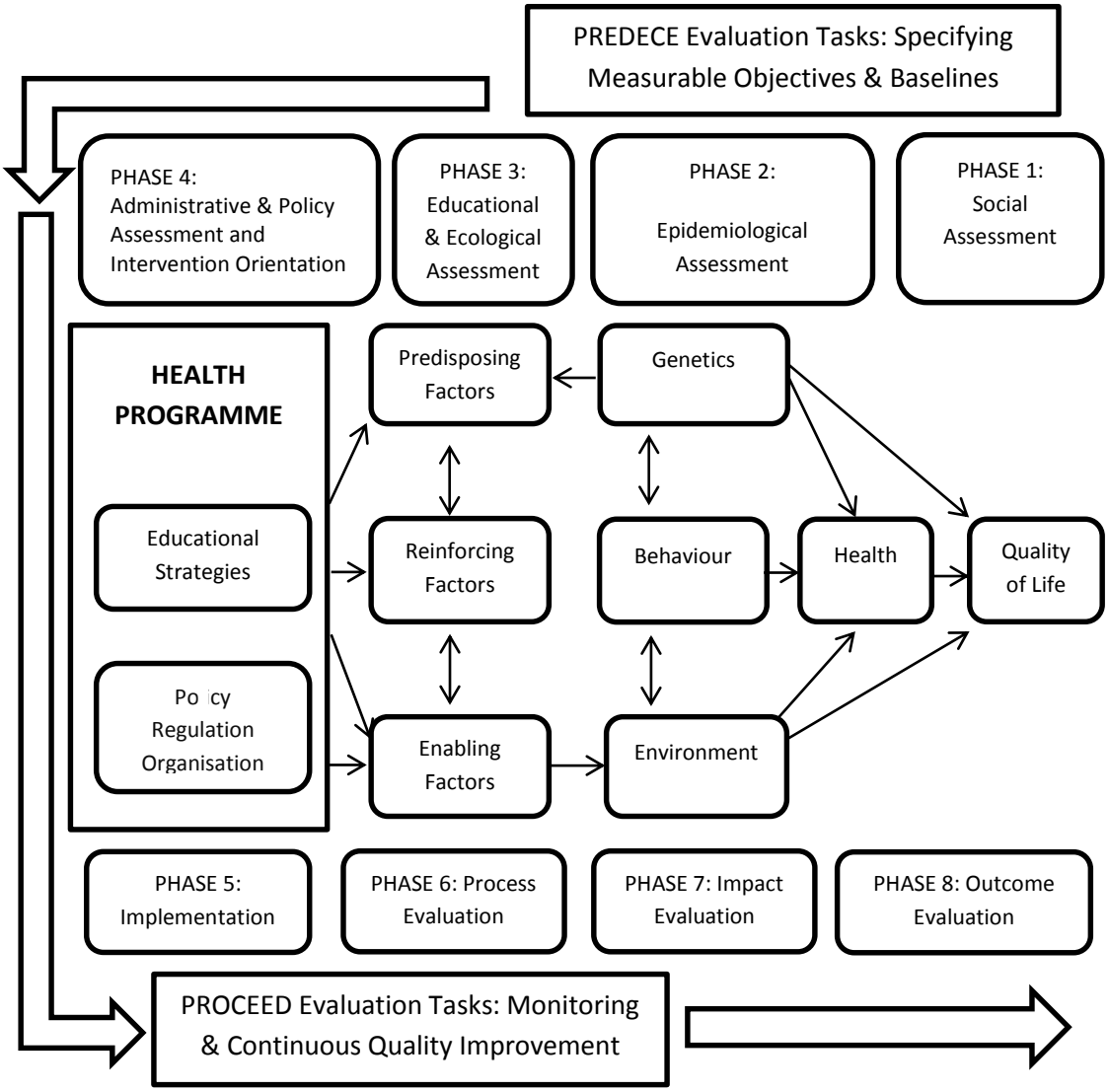
- **Phase 5:** Implementation. The design and delivery of the intervention
- **Phase 6:** Process evaluation. An analysis of whether or not the planned activities that compose the intervention are being carried out as planned
- **Phase 7:** Impact evaluation. An analysis of whether the intervention is having the desired impact on the target population
- **Phase 8:** Outcome evaluation. An analysis of whether the intervention is leading to the outcome that was envisioned in Phase 1

The phases of the PPM and the actions carried out within each phase will be outlined in more detail in the methodology and results sections of this thesis.

5.1.2 Visual representation of the PRECEDE-PROCEED Model

The diagram of the PPM (Figure 1-3), developed by Green and Kreuter (2005), shows the cyclical nature of the PPM, which commences with an analysis of the target population then the PRECEDE Phases 1-4 direct the conceptualisation, development and planning of an effective intervention. The PROCEED phases then direct the operationalisation of the intervention in Phase 5 and the subsequent process analysis of effectiveness through Phase 6. Phase 7 guides an evaluation exploring the impact of on the behavioural or environmental factors identified by Phase 2 and Phase 8 directs an outcome evaluation which examines whether the intervention has had delivered the desired outcomes identified in Phases 1 and 2. This process returns to the beginning, either having achieved the chosen outcome or if not, to commence the process again.

Fig 1-3: Visual representation of the PRECEDE-PROCEED Model



Source. L. Green and M. Kreuter. (2005). Health Promotion Planning: An Educational and Ecological Approach (4th Ed.). Mountain View, CA: Mayfield Publishers.

5.2 The Intervention Mapping Protocol – A Strategic Intervention Development Tool

Intervention Mapping (IM) addresses the potential gap between the evidence base for programme theory and that of programme delivery by outlining a protocol for the development of interventions which incorporate theoretical and evidence-based approaches. IM will be used in addition to PPM between Phases 4 and 5, as it guides the selection of theoretical foundations to underpin interventions, the application of these theoretical approaches with programme participants, and the translation of theory into physical programme resources and participant activities (Belansky et al. 2013).

IM is delineated as a series of six phases from problem identification through a systematic approach to problem mitigation by creating evidence-based and grounded meaningful operational logic models which link performance objectives (PO) to activities and outputs. The completion of all six steps provides a blueprint for operational intervention planning, design and implementation which Belansky et al. (2013) believe is required for evidence-based health promotion to be implemented and sustained in the school setting given the realities of programme application with limited resources and multiple competing pressures. Using IM as a structured, evidence-based approach is recommended by SIGN 115 (Hering et al. 2010) within intervention development as this helps to ensure the intervention is based on appropriate theories which are grounded in empirical evidence. IM provides a structure for integrating theoretical intervention and behaviour change methodologies and empirical evidence of practical approaches to develop a set of learning and behavioural change objectives for the population of interest. Furthermore, IM identifies the intrinsic personal and external environmental determinants linked to the PO thereby outlining the intervention activities which are required to achieve the PO and increasing the likelihood that the desired outcome of childhood obesity prevention and management will be achieved (Lloyd et al. 2011).

IM has been found to be a useful instrument for systematically adapting existing programmes as well as tailoring new bespoke interventions. Often health improvement practitioners are interested in adapting existing evidence-based

programmes for new populations and settings and IM can ensure this is based on a systematic approach and adequate insights about a programme. IM can help programme planners identify and retain essential programme elements and therefore, improve effectiveness, as programmes are translated to different communities and settings for which they were not developed and evaluated (Lee et al. 2008).

5.2.1 Phases of the Intervention Mapping Protocol

Each of the six steps of IM involves several tasks and completing the tasks required in each step creates an output which guides the following step. However, as illustrated in Figure 1-4, the process is also cumulative as each step builds on the work completed in previous steps. Therefore, while using IM, it is essential to remain mindful that under-developing a step can endanger the potential effectiveness of the intervention by narrowing the scope and compromising the validity of the information upon which later steps are based (Bartholomew et al. 1998).

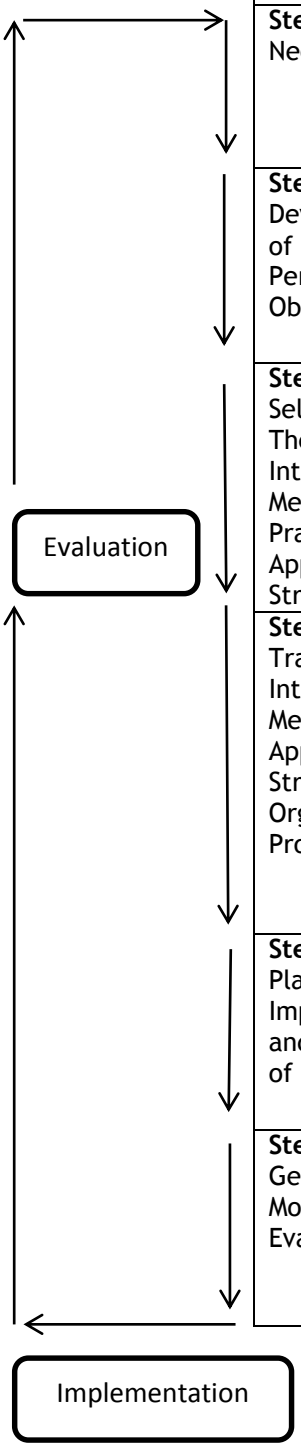
The six stages of the IM Protocol are:

1. Conduct a needs assessment
2. Develop a matrix of change for performance objectives
3. Select theory-based intervention methods and practical application strategies
4. Translate intervention methods and application strategies into an organised intervention design
5. Plan for adoption, implementation and sustainability of the intervention
6. Generate a monitoring and evaluation plan

The steps of the IM protocol and the actions carried out within each step are listed in the visual representation of the process in Figure 1-4 and will be outlined in more detail within the methodology and results sections of this thesis.

5.2.2 Visual representation of the Intervention Mapping Protocol

Fig 1-4: The Intervention Mapping Protocol Process



Products	Tasks
Step 1 Needs Assessment	• Plan needs assessment • Assess health, QOL, behaviour and environment • Assess capacity • Establish programme outcomes
Step 2 Develop a Matrix of Change for Performance Objectives	• State expected changes in behaviour and environment • Specify performance objectives • Specify determinants • Create matrices of learning & change objectives
Step 3 Selection of Theory-Based Intervention Methods and Practical Application Strategies	• Review programme ideas with interested participants • Identify theoretical methods • Choose programme methods • Select of design strategies • Ensure that strategies match change objectives
Step 4 Translate Intervention Methods and Application Strategies into Organised Programme Design	• Consult with intended participants and implementers • Create programme scope, sequence, theme and materials list • Develop design documents and protocols • Review available materials • Develop programme materials • Pre-test programme materials with target groups & implementers and oversee materials production
Step 5 Plan for Adoption, Implementation and Sustainability of the Programme	• Identify adopters and users • Specify adoption, implementations and sustainability performance objectives • Specify determinants and create matrix • Select methods and strategies • Design intervention to affect programme use
Step 6 Generate a Monitoring and Evaluation Plan	• Develop evaluation model • Develop effect and process evaluation questions • Develop indicators and measures • Specify evaluation designs • Write an evaluation plan

Source: Lloyd J J., Logan S., Greaves C J., and Wyatt K M. Evidence, theory and context - using intervention mapping to develop a school-based intervention to prevent obesity in children. International Journal of Behavioral Nutrition and Physical Activity 2011, 8:73

6. Aim and research questions

This thesis will report on the application of a modified version of the PPM and IM protocol to guide the process of systematic assessment, design and development of a theoretical curricular primary school-based CHW intervention underpinned by an evidence-informed, theory-driven model. The intervention that was developed through this process was required to meet the needs of the NHSL CHWP. However, the primary purpose of this process was to develop a CHW intervention that has the theoretical capacity to prevent or treat overweight and obesity in participating children within the NHS Lanarkshire Health Board Area.

This thesis will aim to inform the design, readiness for application and health board suitability of a primary school-based curricular child healthy weight intervention by using the PRECEDE-PROCEED Model and Intervention Mapping Protocol. The following research questions support this aim.

Research question 1
How can the intervention be conceptualised and contextualised in such a way as to engage key NHSL partner organisations sufficiently to prioritise addressing this health problem, facilitate agreements on shared outcomes and achieve the ongoing multi-agency support and engagement necessary for Health Board scale delivery?

Research question 2
How can the intervention formulation process incorporate the elements of effective methodological approaches to primary school-based child weight management that are necessary to modify EBRB in a way that has the potential to prevent or treat overweight and obesity?

Research question 3
What elements of the intervention conceptual model are required to enhance the possibility of regional acceptance from senior education management and individual schools necessary to secure the large-scale uptake needed to support NHS Lanarkshire to achieve the HEAT 3 Child Healthy Weight Target?

CHAPTER 2: METHODOLOGY

7. Methodological intervention development process

The following section will outline the process involved in formulating a conceptual model of a CHW intervention, the process of developing the intervention, planning for implementation and subsequent evaluation. The planning models identified to formulate, develop, implement and evaluate the proposed CHW intervention were the PPM (Green and Kreuter, 2005) and the IM protocol (Lloyd et al. 2011). In simple terms, the four phases of PRECEDE guide the preparation for intervention development and groundwork for programme management. IM separates PRECEDE and PROCEED and through six steps guides detailed strategic intervention design acting as a blueprint for this process. The four phases of PROCEED guide intervention implementation and evaluation of the delivery process, the impact of the intervention and the subsequent outcomes.

7.1 Participants, apparatus and procedures

Within this thesis, participants represent the individuals and organisations that were involved in the initiation, planning, design, logistical preparation and implementation of the intervention. The apparatus refers to the equipment, resources, materials, financial and partnership agreements, tools for data collection and venues required to prepare for, initiate, manage and evaluate the intervention. Procedures include reviews of literature, critical analysis of CWM interventions, questionnaire administration, interviews, expert consultation, focussed discussion group facilitation and feedback data collection.

7.1.1 The context for the intervention

The proposed intervention was part of the overall NHS Lanarkshire H3 CHWP with a specific focus on primary schools as part of a suite of differentiated CWM interventions. As such, some aspects of intervention design were already decided and these limitations had to be considered within the development

process. Therefore, the methodological approach used to design the proposed intervention had to take into account the pragmatic realities and requirements of a real world Health Board level Health Improvement intervention.

The SG H3 guidance requirements were the primary external factor influencing predetermined aspects of intervention development. NHS Boards were given licence to develop CHW interventions to meet local requirements but within certain parameters. These included a minimum duration of 6 weeks, the inclusion of HE and PA elements underpinned by appropriate behavioural change strategies, some parental involvement and the collection of a core data set. In addition, to meet SG quality assurance (QA) standards, NHS Boards were instructed to adhere to national level guidance from SIGN, including SIGN 115 (Hering et al. 2010) when developing and delivering CWM interventions. This guidance included aspects such as training requirements of delivery staff, specific intervention content or efficacious behavioural change strategies. H3 funding was allocated to all NHS Health Boards by the SG based on population size. Therefore, the overall annual NHSL CHWP budget was set in advance but the proportion of that budget allocated to the design, development and delivery of the proposed intervention was decided by the Programme Manager and thesis author.

7.1.2 Intervention leaders and managers involved

The proposed intervention was one element of the overall NHSL CHWP and as such a Strategic Steering Group was already in place to provide corporate oversight and strategic support. In addition to the existing Strategic Steering Group, it was necessary to set up separate North Lanarkshire and South Lanarkshire Local Authority area partnership management groups to support logistical and intervention implementation aspects in each area. Both partnership management groups supported the development of a single intervention which will be delivered the same way in both areas, but each Local Authority area required separate groups to support delivery planning. Furthermore, once individual school establishments had been identified it was necessary to liaise with staff from within that school to make final arrangements

prior to initiating the intervention. The membership of each of these groups is outlined in Table 2-1 below.

Table 2-1: Organisational support for the proposed CHW intervention at strategic, management and operational levels

Management Group	Group Membership
Overall NHSL CHWP Strategic Steering Group membership	• NHSL Assistant Health Improvement Manager • NHSL Senior Health Improvement Officer (CHWP Lead and thesis author) • NHSL Professional Lead for Dietetics • NHSL Paediatric Endocrinologist • NHSL Public Health Nurse • NHSL Head of Information Management • Lanarkshire voluntary sector representative • North Lanarkshire Leisure representative • South Lanarkshire Leisure & Culture representative
Local Authority area partnership planning and management groups	North Lanarkshire group • North Lanarkshire Education • North Lanarkshire Active Schools • North Lanarkshire Leisure South Lanarkshire group • South Lanarkshire Education • South Lanarkshire Active Schools • South Lanarkshire Leisure & Culture
Logistical planning for implementation of the intervention at an individual school level	• School Head Teachers • School administration staff • Class Teachers

7.2 Design and procedure

The procedures used to achieve the aim of this thesis and address the research questions are outlined within the structure of the PPM and IM stages, which guide the design of the proposed intervention through a series of work phases. This is a complex, multi-disciplinary intervention involving input from multiple individuals, groups and organisations. The author was professionally responsible for the proposed intervention and as such was directly involved in all of the work phases outlined within this thesis. This level of this involvement varied across work stages as the author was solely responsible for some work stages but directed work in partnership with other professionals within work stages that required a more collaborative approach.

7.2.1 PRECEDE: systematic assessments

PPM Phase 1: Social Assessment. This phase included the identification of the health problem to be addressed, defining the High-Level Outcome of the intervention and planning for target group participation. The identification of the health problem had already been carried out by the SG prior to the initiation of the H3 target but an additional interrogation of primary and secondary demographic data sources was carried out to further define the health problem and provide local context.

Planning for target group participation was supported through consultation meetings with key stakeholders to gain insight from relevant professionals with expertise in this area. To further support participation and effective engagement it was important to consider the intrinsic assets, including strengths and readiness to change of the target group children and their families and in this respect, this stage of intervention development used an asset-based approach (Crawford, 2005). The use of focussed discussion groups (FDG) with pupils, parents and teachers allowed the perceptions, opinions, beliefs and attitudes of the target group to be assessed and taken into account in the

intervention design. The FDG also allowed the target group to provide input into the problem of childhood obesity that should be addressed within a school setting and examined a number of areas such as duration of the intervention, parental fears and misperceptions, language used within lessons, terminology in consent forms, appropriateness of assessments, data protection and follow-up support for families if issues were identified.

PPM Phase 2: Epidemiological assessment**.** This phase guided the identification of the behaviours associated with the health problem, the behavioural and environmental influences on this issue and individual or familial characteristics related to increased risk or prevalence. Through an examination of empirical research and systematic reviews of the literature, this phase guided behavioural and environmental assessments to elucidate the factors most likely to influence the health problem. This phase then supported the selection of those factors which are modifiable and outlined how to convert them into measurable PO, which if achieved would support the High-Level Outcome (Green and Kreuter, 2005).

Phases 1 and 2 were where the long-term goals of the intervention were developed, where the ultimate desired outcome was determined, and where the issues or associated factors that will influence this outcome are identified. These behavioural lifestyle factors, supported by some environmental factors, are what the intervention was ultimately aiming to change.

PPM Phase 3: Educational and Ecological Assessment. This phase included the identification of the determinants of target behaviours which are the predisposing, reinforcing or enabling factors that must be addressed to achieve the desired behavioural and environmental changes highlighted in Phase 2. These factors were identified through a review of the literature which included both empirical research and systematic reviews. This review focussed on the antecedent and reinforcing factors of the target behaviours and associated issues, such as the relative difficulty in modifying specific behaviours, that must be considered within the change process.

Through a separate review of the literature Phase 3 also guided the identification of the most appropriate educational strategies and behavioural theories, models and techniques that should be incorporated into the intervention to address the identified behaviours and ways in which they can be incorporated into the intervention. This work was complimentary to the following selection of theory based methods in IM Step 3.

PPM Phase 4: Administrative Assessment, Policy Assessment and Intervention Orientation. The last phase of the PRECEDE stage supported the assessment of policies, administrative factors and organisational structures within the proposed intervention setting, an evaluation of existing health promotion activities in this setting and the identification of obstacles or supporting factors that will influence the development and implementation of the intervention. A critical analysis of existing interventions was carried out to analyse the rationale, design, approach, methods, and systems utilised by CWM interventions and the impact, outcomes and effectiveness of these interventions. Furthermore, an analysis of the content of intervention resource packs (n=59), listed in Appendix 2, and associated materials was carried out. In addition to this, local interventions were evaluated through direct observation of programme delivery within schools and discussions with partners.

Phase 4 also included an intervention orientation which considered the impact of internal school administrative structures and policies. Through liaison with school Head Teachers and management staff, organisational issues were explored and an assessment was made on how they would interact with the planned intervention to avoid mismatches or conflicts between the organisational setting and the planned intervention.

7.2.2 Intervention Mapping: strategic intervention development

When PPM and IM are combined, they support the formulation of a more effective intervention. A visual representation of the full IM protocol is outlined in Figure 1-4. However, there is some crossover between specific tasks in PRECEDE and Step 1 within IM. Therefore, a modified approach to using PPM and

IM together avoided the duplication of work by using some of the outputs from the PRECEDE stage within IM.

IM Step 1: Conduct a needs assessment. When carrying out the full IM protocol Step 1 is comprised of four stages which outline a problem analysis, determine intervention goals, determine PO and identify behavioural or environmental determinants associated with the health problem and link these to the PO. The initial problem analysis stage was completed in PPM Phases 1 and 2 and the identification of target EBRB and their determinants were identified in PPM Phase 3, therefore, this was not replicated in IM Step 1. However, the Intervention Goals and PO were established in this step and specific behavioural or environmental determinants were aligned with the PO. The Intervention Goals can be conceptualised as action statements specifying goals for health improvement that indicate what individuals were required to learn or what must change within their environment as a result of the intervention to achieve the High-Level Outcomes and address the specified health problem.

IM Step 2: Develop a Matrix of Change for PO. The PO were determined by the developer using the IM protocol guide to provide clear, concise statements which described the criteria for achieving the Intervention Goals and what requires to be influenced. This review of CWM resource packs rather than just empirical data provided useful contextualisation and considerations for real world application. The scope and scale of the intervention determined the number of PO under each Intervention Goal. Once PO were established, they were linked to modifiable EBRB, identified using the same data sources as the PO, which had either behavioural determinants or environmental determinants. Therefore, two types of PO were established, one set with behavioural determinants that specified what participants needed to accomplish as a result of the intervention and were defined as Learning Objectives and one set with environmental determinants that specified desired environmental changes and were defined as Change Objectives. Together Learning and Change Objectives outlined the targeted changes of the intervention. Developing a Matrix of Change acted as a guide that allowed the content and focus of the CHW intervention to be targeted specifically at those behavioural and environmental determinants which must be

addressed to achieve the desired PO and subsequently the Intervention Goals and High-Level Outcomes.

IM Step 3: Selection of Theory-Based Intervention Methods and Practical Application Strategies. This step of the IM process involved generating intervention ideas to determine real world solutions to achieve the PO and ensure the Matrix of Change is populated with suitable and applicable behavioural and environmental determinants. PPM Phase 3 already identified appropriate pedagogical strategies and behavioural approaches within existing interventions that utilised similar theoretical underpinnings and methodological approaches. Personal and environmental determinants of target EBRB had already been identified, therefore; these activities were not repeated within this step.

Application strategies allow translation of theoretical methods into strategies that enable the intervention to be effectively delivered to the target population on a sufficient scale, within time and budgetary constraints and in a way that can ensure that the intervention effectively addresses the PO. Therefore, practical intervention application strategies or delivery methods were selected from existing successful approaches reported in the literature and from a critical analysis of CWM intervention resource packs, delivery guides, reports and evaluations.

IM Step 4: Translate intervention methods and application strategies into an organised intervention design. This step comprised organising the theoretical intervention techniques, pedagogical strategies and behavioural approaches into a deliverable intervention, essentially combining them within the resource pack that delivery staff would use in schools. However, before the techniques, strategies and approaches identified in previous steps could be combined within an effective intervention; there was a requirement to develop a structure upon which they could be applied. The development of this structure was carried out through intervention design activities which included the definition of key programme themes, differentiation of topic content to be age and stage appropriate across the primary school age group, identification of key features, determination of the scope of the topics covered and the development of lesson

materials such as workbooks. Throughout this process there was a continual requirement to ensure the emerging intervention supported the Health and Wellbeing (HWB) area of a Curriculum for Excellence (CfE), a pre-requisite for eventual implementation, to avoid reworking of the intervention at a later date. Further elements of this step included a number of generic programme management activities including the establishment of quality control measures. Through this process of intervention design, the conceptual model of the CHW intervention emerged and a resource pack was constructed.

This step progressed onto gaining feedback on the draft CHW intervention resource pack from multi-agency programme planning partners by providing them with copies of the draft resource and requesting individual feedback before hosting an event with all partners to come to a consensus on a version that was ready to pilot test. Written and verbal feedback from participants and class teachers was then fed back into the development process and the concluding action was the finalisation and production of revised intervention materials, protocols and the CHW intervention delivery resource pack.

IM Step 5: Plan for adoption, implementation and sustainability of the intervention. The CHW intervention was supported by several key delivery partners and part of the implementation plan involved the formalisation of partnership agreements covering areas such as finance, communication, data collection and reporting. Staff were employed to deliver the intervention through partner organisations and as such it was necessary to agree on minimum staff qualifications and work experience to select an initial cohort of intervention staff. Overall participation numbers and geographical coverage were determined by the availability of suitable staff. Therefore, negotiating agreements with principle partner organisations on the release of staff for intervention delivery was critical. Participating schools were identified and delivery schedules timetabled at this stage.

Agreements were reached on shared outcomes with Local Authority Education Departments through formal meetings with senior management within which the benefits to all stakeholders were outlined. Contemporary approaches to curricular planning, monitoring and assessment were included at this stage to

support formal curricular integration and, therefore, the uptake of an optional NHSL devised intervention by education establishments which had no obligation to do so.

Process objectives and Key Performance Indicators were set to support intervention analysis and process evaluations and implications for projected initial financial outlays, on-going delivery and management costs, relative intervention cost-effectiveness and potential on-going financial sustainability were considered.

IM Step 6: Develop an evaluation model. As outlined previously there is some crossover when combining PPM and IM and, therefore, the IM protocol was modified to avoid duplication. The PROCEED stage of PPM provided a more detailed guide to process, impact and outcome evaluation through Phases 6-8 and, therefore, the evaluation of the intervention was carried out using these phases rather than IM Step 6.

7.2.3 PROCEED: intervention implementation and evaluation

The CHW intervention design process was guided by the PRECEDE stage of PPM and the IM protocol with the PROCEED stage of PPM, outlined through Phases 5–8 of the process, guiding the implementation and evaluation of the CHW intervention. However, activities within Phases 5-8 did have an impact on the design process. For example, the SG H3 target guidance on evaluation required Health Boards to collect a specific core data set. This ultimately influenced certain aspects of intervention design and delivery necessary to comply with these requirements.

The results of the intervention are reported elsewhere and the present thesis is primarily concerned with the conceptualisation and development of the proposed CHW intervention and will only report in detail on the stages up to the point of intervention implementation. However, as aspects of delivery and evaluation will influence the formulation process, an overview of the PPM phases beyond implementation will be provided.

PPM Phase 5: Implementation. This phase involved intervention delivery supported by the Implementation plan devised in IM Step 5 and detailed previously.

PPM Phase 6: Process Evaluation. This phase was not about intervention outputs or outcomes, but rather about a procedural analysis to assess intervention operation according to predetermined protocols and whether or not the target group received the intervention as planned. Activities within this phase included observation of intervention delivery, assessment of planning systems, collating feedback from school staff, debriefing staff, the identification of problems and developing plans for problem resolutions.

PPM Phase 7: Impact Evaluation. An analysis of the initial success of the intervention was carried out to determine if the intervention was having the anticipated impact on the overall High-Level Outcomes. This initial impact evaluation was not focussed on specific Intervention Goals and PO but rather on changes to BMI-SDS of participants throughout the course of the CHW intervention.

PPM Phase 8: Outcome Evaluation. This phase guided an analysis of the achievement of the High-Level Outcomes identified in Phase 1. Additionally, there was a requirement to assess total target group completion which, while not related to the PO, Intervention Goals or High-Level Outcomes, was a compulsory requirement associated with the HEAT 3 funding.

CHAPTER 3: RESULTS

8. Results of the intervention development process

The results section of this thesis outlines the outputs generated by the phases of PPM and stages of the IM protocol within the intervention development process and aligns them with the research aims they support. Cumulatively the outputs from the results of the research will answer the research questions and determine whether or not the research aim was achieved.

8.1 Research question 1

The purpose of research question 1 was to further explore the health problem of childhood overweight and obesity at an NHSL level to provide local level contextualisation to encourage prioritisation, engagement and mutual understanding among partner organisations. This mutual understanding would facilitate agreements on shared outcomes and ongoing multi-agency partnership support for intervention delivery at a Health Board scale. This was directly supported by the outputs from PPM Phase 1.

8.1.1 PPM Phase 1: social assessment

The first phase of PPM guided the Identification of the desired outcome and involved the initial intervention planning. The outputs from this phase included the identification of the health problem to be addressed, definition of the High-Level Outcomes of the intervention and planning for target group participation. Based on the SG directive to achieve the H3 target and the local needs assessment a number of High-Level Outcomes were established which the CHW intervention is ultimately designed to achieve.

The first output identified the health problem of childhood obesity which was defined within the H3 guidance and further explored within the literature review of this thesis. Scottish boys in the 2-15 year old age range demonstrated a

prevalence of overweight and obesity of 28% while Scottish girls of the same age demonstrated a prevalence of 34% in 2014 (SHeS, 2014). Childhood overweight and obesity for Scottish children has increased by an average of 1.3 percentage points each year (NHS National Services Scotland, 2011) and on current trends in the UK the Government Office for Science predicted that by 2050 over 60% of children will be overweight including obese with 25% of all children obese (Butland et al. 2007). Obesity increases the likelihood of various diseases, including type II diabetes, heart disease, disruptive sleep apnoea, osteoarthritis and certain types of cancer (Haslam and James, 2005). The second output of PPM Phase 1 was the production of the three High-Level Outcomes which for this intervention were that participants move towards and/or maintain a healthy weight status, participants benefit from improved social, emotional and mental health and participants have an improved QOL. The final output from PPM Phase 1 was a plan to achieve target group participation. The target group were identified as primary school aged children with a BMI ≥91st centile. The CHW intervention setting was identified as primary schools and the delivery methodology was an intervention for whole class groups delivered within the formal curriculum with a duration that would fit within a school term.

8.2 Research question 2

Research question 2 focussed on identifying ways in which to modify specific EBRB in order to address unhealthy weight gain within the target group. To achieve this it was necessary to determine behaviour change methods, theoretical intervention methodologies, modifiable EBRB and determinants of these EBRB and formulate deliverable aims and objectives. This was supported by the outputs from IM Step 1 and PPM Phases 2 and 3. An additional focus of this question was on developing a theoretically informed and evidence driven primary school-based, whole class multi-component intervention that can be delivered effectively within the overall NHSL CHWP. This was supported by the outputs from PPM Phase 4 and also IM Steps 3 and 4. Evidence from different sources was used to support research question 2, however, different selection criteria were applied to different sources of evidence in order to establish the quality of these materials. Intervention components and PO were sourced from research articles on effective interventions with a high level of methodological rigour and which used an appropriate study design. Intervention resource packs were used to identify sources of content, for example lesson plans. The quality control judgement on unpublished resource packs differed from those applied to research articles and was based on intrinsic practitioner knowledge from professional experience in this field.

8.2.1 IM Step 1: conduct a needs assessment

The outputs from this step were based on a problem analysis that explored the health issue and determined the intervention goals. However, the problem analysis in IM Step 1 mirrors the social assessment already carried out in PPM Phase 1 and, therefore, does not need to be replicated. IM Step 2 then moved on to producing intervention goals through a process that gave consideration to Governmental requirements, National guidance, input from the steering group, the local needs assessment and the literature review. This established five Intervention Goals which, within the CHW intervention, are categories of thematic EBRB that are the areas upon which the intervention is designed to focus. These five Intervention Goals relate directly to the achievement of the

High-Level Outcomes established by PPM Phase 1 and align with the target behaviours established in PPM Phase 2. The five Intervention Goals identified within IM Step 1 were Reduce Screen Time, Reduce SB, Increase Levels of PA, Improve Diet and Get an Adequate Amount of Sleep.

8.2.2 IM Step 2: develop a Matrix of Change for Performance Objectives

IM Step 2 directed the development of PO which are specific detailed ambitions that should be achieved to realise the higher level and more thematic Intervention Goals. A total of 21 PO, listed in Table 3-1, were established and each aligned to one of the five Intervention Goals. It was not the intention of the intervention to achieve all of the PO within a single ten week project block. Participant achievement of most or all of these PO would require participation in multiple projects over a number of years.

Table 3-1: CHW intervention Performance Objectives aligned to Intervention Goals

Intervention Goal	1. Reduce Screen Time
Performance Objectives	1.1 Spend less than 2 hours screen time / using digital devices (TV, computer, tablet, phone) per day outside school or homework times 1.2 Avoid watching TV during mealtimes 1.3 No screen-based activities (TV, computer, tablets, phone) before 5pm
Intervention Goal	2. Reduce Sedentary Behaviours
Performance Objectives	2.1 Reduce levels of sedentary behaviour and avoid long unbroken periods of inactivity
Intervention Goal	3. Increase Levels of Physical Activity
Performance Objectives	3.1 Carry out a minimum of 60 minutes of moderate physical activity per day 3.2 Three periods of vigorous or intense physical activity each week 3.3 Active travel where possible 3.4 Encourage active recreation e.g. swim, trampoline, cycling or dog walking 3.5 Increase levels of fitness
Intervention Goal	4. Improved Diet
Performance Objectives	4.1 Eating a high nutritional quality breakfast each day 4.2 No fast food for lunch, instead opt for healthy lunchbox or school meal options 4.3 Age appropriate portion sizes. Me sized portions 4.4 Meals based on Eatwell plate food groups and proportions 4.5 Wait 20 minutes before second helpings, allowing time for the body to feel full 4.6 A minimum of 5 portions of fruit and vegetables each day, at least 3 portions of vegetables 4.7 Limit snacks to once per day based on healthy options e.g. fruit and vegetables or wholegrain cereal products 4.8 Snack options that are less healthy, those high in fat, sugar or salt are treats once per week 4.9 Reduce or cease consumption of sugar sweetened drinks, choose water instead 4.10 Reduce consumption of high fat foods
Intervention Goal	5. Get an Adequate Amount of Sleep
Performance Objectives	5.1 Sleeping for a minimum of 10 hours per night 5.2 Set a regular, early age appropriate bedtime

Once a list of PO had been generated to establish what areas need to be addressed to achieve these Intervention Goals a further process was undertaken to identify modifiable behavioural and environmental determinants associated with each of the Intervention Goals. This identification of these determinants and subsequent alignment against all of the PO constitutes the second output from IM Step 2. Table 3-2 outlines examples of behavioural and environmental determinants that were identified for the Intervention Goal an Adequate Amount of Sleep prior to being allocated to a PO.

Table 3-2: Examples of behavioural and environmental determinants of an Adequate Amount of Sleep

Behavioural / Personal Determinants

Attitudes	Knowledge	Skills & Self-efficacy	Outcome Expectation	Perceived Social Norms
Feel positive about making changes to sleeping routines	Know the benefits of getting 10-12 hours of sleep a night	Explain to others the problems of not sleeping enough	Expect to get to bed early and have more energy	Accept that healthy children need 10-12 hours of sleep
Accept that an early bedtime is part of a healthy lifestyle	Children who get 10-12 hours of sleep have more energy throughout day	Develop skills to encourage a pre-bed routine for child	Expect an improvement in health if child is getting 10-12 hours of sleep combined with a healthy diet	Recognise that others in the group are setting an early bed time

Environmental / External Determinants

Cues	Reinforcement
Parents setting goals for bed time	Remove any screens or tablets from bedroom to encourage sleep
Praise children for going to bed early	Build up a pre bed routine to relax child

The final output in this step was dedicated to developing the Matrix of Change that identified behavioural and environmental determinants for each of the 21 PO. A sample of the Matrix, relating to PO 1.1, is included in Table 3-3.

Table 3-3: Matrix of Change for Performance Objective 1.1

Intervention Goal: Reduce Screen Time				
Performance Objective: PO 1.1Spend less than 2 hours screen time / using digital devices (TV, computer, tablet, phone) per day outside school or homework times				
Behavioural / Personal Determinants				
Attitudes	**Knowledge**	**Skills & Self-efficacy**	**Outcome Expectation**	**Perceived Social Norms**
A 1.1a Feel positive about reducing screen time	K 1.1a Know the problems with high screen time	SE 1.1a Explain the benefits of reduced screen time	OE 1.1a Expect health improvement after reducing screen time	N 1.1a Recognise that others in the group are reducing screen time.
A 1.1b Feel positive about finding an alternative		SE 1.1b Explain the benefits of the alternative activity	OE 1.1b Develops an understanding of the consequences of sedentary behaviour	
Environmental / External Determinants				
Cues			**Reinforcement**	
C 1.1a Being more active helps to reduce screen time			R 1.1a Parent praises child for watching less than 2 hours screen time	
C 1.1b Recognises alternatives to using TV as a recreation activity			R 1.1b Family choosing to exercise	

8.2.3 PPM Phase 2: epidemiological assessment

Phase 2 of the PPM process guided the selection of priority areas for the intervention to focus on to achieve the desired outcome in relation to childhood overweight and obesity. The outputs generated by this phase are the identification of the behaviours associated with childhood overweight and obesity, selection of modifiable behavioural and environmental influences of this health problem and individual characteristics related to increased prevalence.

The behaviours that will be targeted by the intervention are ST, SB, PA, Diet and Sleep. If PPM was being used in isolation, there would have been a requirement to assess behavioural and environmental influences of the target health problem and produce another output at this stage. However, as a modified approach was being used that included IM, the behavioural and environmental determinants of childhood overweight and obesity were already identified within IM Step 2 so another output based on target behaviours did not need to be produced. It was also necessary to identify characteristics associated with increased prevalence of childhood overweight or obesity. The output produced within this phase was in line with the literature review of this thesis which identified that increased prevalence of childhood overweight and obesity is associated with socioeconomic deprivation with a strong gradient evident from lower levels in the most affluent to higher levels in the most deprived. Prevalence also increases with age, certain minority ethnic groups show a higher prevalence and gender differences are evident. In addition early life influences such as maternal smoking during pregnancy, high or low birthweight, breastfeeding and excessive early weight gain also have an influence. Furthermore, familial factors such as maternal employment in excess of 20 hours per week or parental obesity are also linked with unhealthy weight gain in childhood.

The proposed CHW intervention used a universally delivered whole school class methodology and, therefore, could only target populations with increased prevalence by age or socioeconomic status based on the geographical location of the school. Moreover, some familial factors can be focussed on through parental engagement.

8.2.4 PPM Phase 3: educational and ecological assessment

At this stage of the process, the health problem had been chosen, priority areas for intervention were selected and target behaviours identified. PPM Phase 3 focussed on the production of an output that identified the determinants of target behaviours which are the predisposing, reinforcing or enabling factors that must be addressed to achieve the desired behavioural and environmental changes highlighted in Phase 2.

The predisposing factors that were identified through the review of the literature as important for the CHW intervention to address included individuals' knowledge, attitudes, beliefs, preferences, existing skills and self-efficacy. However, the incorporation of the IM protocol supports the development of a Matrix of Change, within which behavioural determinants of target behaviours are identified. These behavioural determinants are identified under the following categories knowledge, attitude, outcome expectations (approximates with beliefs), social norms (approximates with preferences), skills and self-efficacy. Therefore, specific predisposing factors were not identified within the PPM process at this stage but rather during IM Step 2.

Reinforcing factors are principally the attitudes of influential people, such as parents or guardians, peers, teachers and educational decision makers. The CHW intervention development process remained cognisant of these individuals and groups, because of their influence on the target population. Examples of reinforcing factors considered by the CHW intervention included social support, peer influence, significant others, and vicarious reinforcement. These were addressed predominantly through an intervention design that used a methodology based on the socioecological model to attempt to influence factors associated with child weight status at the individual child and peer group/familial levels of influence.

The CHW intervention addressed enabling factors by seeking to raise the priority placed on HWB within the school curriculum and engender the commitment of individual schools to address the issue of childhood overweight. The intervention itself was designed to proactively engage the target group, thereby increasing the accessibility of the service, and then offer ongoing support post intervention by promoting additional services which pupils could engage with. Also, the Matrix of Change included environmental determinants which the intervention was designed to address thereby further influencing enabling factors. By addressing these three levels of factors concurrently it was hypothesised that the likelihood that desired behavioural and environmental changes related to EBRB which the CHW intervention aimed to bring about would occur.

8.2.5 PPM Phase 4 Part 1: administrative assessment, policy assessment and intervention orientation

Green and Kreuter (2005) recommended a process of intervention matching, mapping, pooling and patching within comprehensive intervention design. This process involved the identification and analysis of a number of interventions with a similar methodological approach to the proposed CHW intervention. This process guided the development of an output that required the intervention developer to match the ecological levels of influences on EBRB to core programme components. This was carried out within IM Step 3 and is reported against the practical application strategies for the SEM.

The process included mapping similar interventions based on their theoretical constructs. In addition to a review of the empirical literature into theoretical constructs underlying effective interventions, an analysis was carried out on the resource packs, intervention manuals and delivery guides of existing CWM, HE, PA, SB and healthy lifestyle (HL) focussed interventions. The purpose was to review the theoretical constructs underlying these interventions, their theoretical intervention methods, the mechanisms of change they purported to apply and the practical methods by which they applied these mechanisms. This review was focussed primarily on school-based interventions but did include some community-based interventions, all of which were required to provide sufficient information to critically analyse the underlying theoretical constructs. These interventions are listed in Appendix 2. Data generated by this process was fed into IM Step 3 where specific theory-based methods and application strategies were selected.

This process further required the author to pool prior interventions that might have a less rigorous evidence base underpinning them, and if necessary, patch those reviewed interventions together to mitigate issues with potential gaps in evidence-based best practices. The pooling and patching elements of this process were used to identify the lesson topics, themes and activities used by same interventions identified in the previous element of this process. This element of the process ensured that the CHW intervention topics, lessons and activities were as fun and engaging as possible, were in line with existing

contemporary interventions, were sufficiently broad-based to address the targeted EBRB and all PO and there was sufficient content to provide different stage-specific projects for every year group. The criteria for selecting intervention content and activities was based on considerations such as resource implications, applicability to the class setting, applicability based on coach expertise and cultural parallels. Additional considerations, which were harder to quantify, were also applied such as the selection of activities that were fun, engaging and interesting while being appropriately sensitive to universal childhood overweight and obesity management. Moreover, some activities were required to be applicable to the family unit in the home and community setting. The data collected from this output, in the form of potential intervention content, was applied within IM Step 4, Output 2 that stratified this data into the content for thematic projects, modules, lessons and activities for each year group from P1-7.

8.2.6 IM Step 3: selection of theory-based intervention methods and practical application strategies

This step of the IM process involved generating intervention ideas to determine real world solutions to achieve the PO and ensure the Matrix of Change is populated with suitable behavioural and environmental determinants and applied appropriately. These solutions included a focus on energy balance related factors as education leverage points, identification of practical application strategies for the Matrix of Change and the development of a behavioural change construct designed specifically to achieve the aims of the CHW intervention. An example of an output that was produced at this stage was to use energy balance related factors from the Obesity System Map (Butland et al. 2007) as a focus for education topics within the CHW intervention. These were termed education leverage points.

Causal chains were identified within the Obesity System Map (Butland et al. 2007) as those which were identified as modifiable through health education and were considered education leverage points. These causal chains show links between individual factors that influence energy balance and subsequently

weight status. The identified chains cross several of the principle themes within the Obesity System Map but all commence within social psychology. As the CHW intervention is primarily a focussed health education intervention, the initial factor to be addressed in all of the identified causal chains is education. These causal chains demonstrate how focusing on specific factors relating to energy balance as topics within the intervention can have an impact on energy balance. The causal chains were divided into groups based on the factor that the intervention was designed to address and aligned these groups of causal chains with PO and an Intervention Goal. Some examples are provided of how Intervention Goals and PO can be supported by education focussed on factors related to energy balance and the causal linkage between this factor and energy balance. Individual factors related to energy balance provided a context for educational content that supported several PO.

Table 3-4 displays education leverage points to reduce screen time, increase PA and reduce SSB consumption and improve diet respectively. Factors from the Obesity System Map were identified as education leverage points which can be used to address unhealthy weight gain and the causal linkages between thematic education on these factors and behaviours that promote energy balance. Table 3-4 provides an example of how a PO is addressed through these education leverage points highlighting the overall Intervention Goal supported by this activity.

Table 3-4: Education leverage points to reduce screen time and reduce sedentary behaviours

Example of Performance Objectives linked to Education Focus	Education Focus in CHW intervention	Causal Linkages between CHW Intervention Education Focus and Achieving Energy Balance
1.1 Spend less than 2 hours screen time / using digital devices (TV, computer, tablet, phone) per day outside school or homework times	Reduced media consumption	1. Reduced negative influences on body image – reduced peer pressure – reduced negative impact on self-esteem – increased conscious control of accumulation 2. Reduced social acceptability of fatness – increased conceptualisation of obesity as a disease – increased self-esteem – increased conscious control of accumulation

A further output of this stage was to develop practical application strategies to address the behavioural and environmental determinants within the Matrix of Change. Table 3-5 outlines examples of a theoretical approach that was taken to practically apply the Matrix of Change to address both behavioural and environmental determinants within the CHW intervention. This strategy was used as a method to incorporate the five behavioural and two environmental determinants of the Matrix of Change within lesson plans. A range of theoretical intervention methods were used throughout the resource pack to provide numerous ways to address individual behavioural and environmental determinants or combinations of these. Lesson plans within the resource pack used this application strategy to incorporate theoretical intervention methods for a range of specific thematic content and topics linked to individual PO thereby supporting the achievement of the Intervention Goals.

Table 3-5: Practical application strategies to simultaneously address both a behavioural and an environmental determinant of the Performance Objectives from the Matrix of Change

Behavioural and Environmental Determinants	Theoretical Intervention Method	Definition of Method	Considerations for use within the intervention	Practical Application within the Intervention
Behavioural: Social Norms **Environmental:** Cues	Barrier identification	Plans which identify potential barriers to the implementation of desired behavioural outcomes then link situational cues with appropriate responses designed to be effective in achieving desired outcomes.	Participants have existing intention to make behavioural changes Prompting making if/then plans that link situational cues with responses that are effective in attaining goals or outcomes	Development of individual action plans in which participants describe specific goals, ways to achieve them, potential barriers and ways to identify or avoid barriers. Feedback is given during debrief sessions
Behavioural: Skills and Self-efficacy **Environmental:** Reinforcement	Self-monitoring of behaviour	Participants are encouraged to keep a record of specified healthy lifestyle related behaviours	Monitoring tools must be valid for the specific behaviour and data collected Requires to be interpreted; Monitoring tools must be appropriate to the age and stage of participants; The addition of rewards for monitoring or achieving behaviours may be beneficial but must support individual reinforcement	The importance of monitoring is explained to participants and appropriate tools to monitor behaviour are provided. The importance of self-monitoring is reiterated throughout the programme.

The Behavioural Change Construct of the CHW intervention was an output guided by IM Step 3. This involved the selection of the most appropriate behavioural change approaches, educational strategies and pedagogical approaches to

achieve the intervention objectives and combine them within the conceptual model.

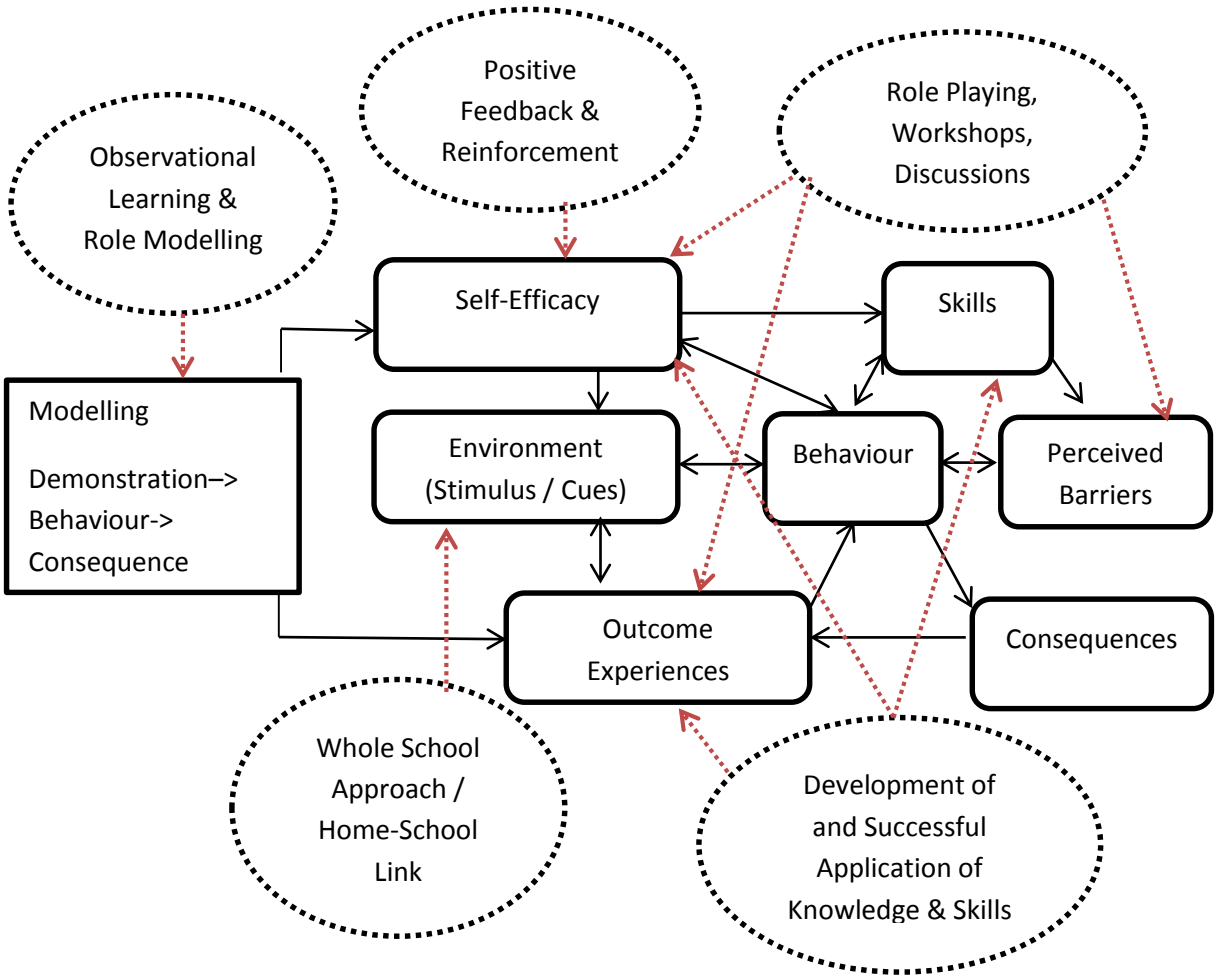
Behaviour change methods which were identified as effective for the prevention of childhood overweight and obesity provided the basis of the theoretical behavioural framework of the CHW intervention and were combined with educational strategies to achieve effective and sustainable lifestyle changes. Parental involvement was built into the intervention through the incorporation of a home-school link, to further support children in improving their behaviours. Programme learning activities provided a context for the application of the CHW intervention pedagogical and behavioural strategies. The primary ambition of the CHW intervention is to address unhealthy weight gain in childhood which can only be attained through addressing lifestyles factors associated with EBRB. Achievement of this ambition, therefore, goes beyond merely imparting knowledge or participation in practical and educational activities. It requires an intervention methodology which utilises relevant pedagogical and behavioural strategies to achieve the desired PO. To this end, the CHW intervention Behavioural Construct was developed to give the best chance of realising this ambition within the pragmatic realities of a school-based, non-expert delivered intervention. The Behavioural Construct incorporates elements from appropriate behavioural models and theories and where they operate at an individual or interpersonal level they are applied using simplified approaches and combined with suitable pedagogical strategies.

The HBC theory, model, approach and techniques that were identified as most appropriate within this context were selected and combined within the CHW intervention Behavioural Change Construct. The selected elements were the Social Cognitive Theory (Figure 3-1), the Social Ecological Model (Figure 3-2), a simplified Motivational Interviewing approach and numerous techniques including Goal Setting and Role Modelling. Practical application strategies to facilitate the incorporation of these elements of the Behavioural Change Construct were developed as part of the intervention methodology.

The practical application strategy for the SCT can be seen in Figure 3-1 which is a graphical representation of the SCT with the addition of practical approaches

taken within the CHW intervention to impact positively on elements of this theory in order to influence EBRB of participating children.

Fig 3-1: Graphical representation of the theoretical CHW intervention application strategy using the Social Cognitive Theory

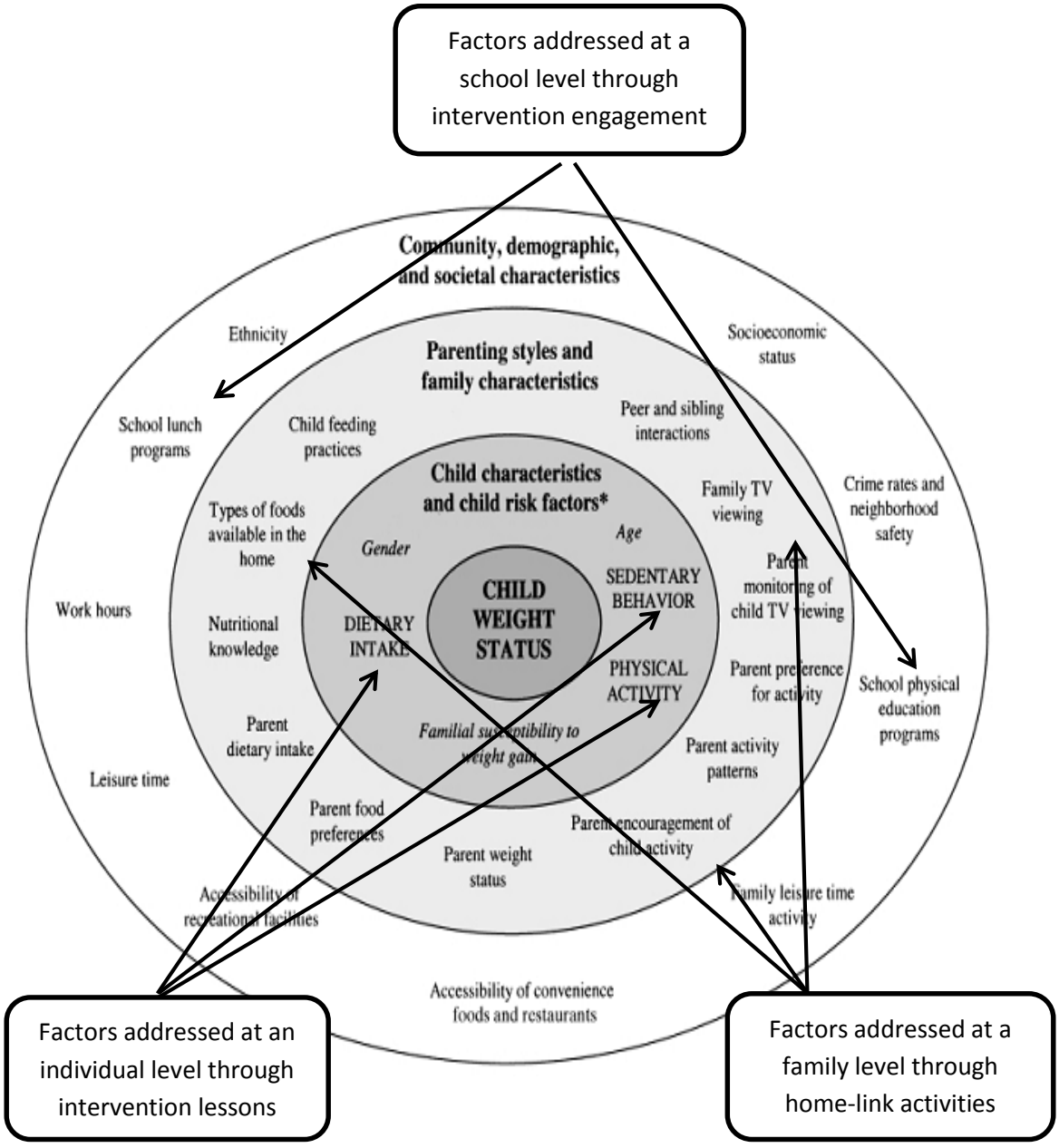


The practical implementation of the SEM was based on the diagram of the SEM produced by Davidson and Birch (2001) that highlighted predictors of childhood overweight by populating the levels of influence with examples of influencing factors at each level related directly to childhood overweight. The CHW intervention utilised a social-ecological perspective by being built on a multilevel approach to HBC involving children, parents, teachers, and community organisations and within which, environmental and behavioural factors are considered and complementary. The version of the SEM developed by Davidson and Birch (2001) was used to contextualise various aspects of the CHW

Intervention and identify specific EBRB and topics to address within a multi-level approach. Factors that influence child weight status across the levels of the SEM that are modifiable within the CHW intervention were selected from those identified by Davison et al. (2001) as predictors of childhood overweight.

Green and Kreuter (2005) recommended a process of intervention matching, mapping, pooling and patching within comprehensive intervention design using PPM. Within this process developers were encouraged to match the ecological levels to core programme components. Therefore, as outlined in figure 3-2, the proposed CHW intervention incorporated components at different levels of the SEM that focussed on key factors that influence child weight status and specific EBRB.

Fig 3-2: Graphical representation of the theoretical CHW intervention application strategy on specific factors that influence child weight status at different levels of the SEM



Source: Adapted from Davison KK, Birch LL. 2001. Socio-ecological model of predictors of childhood overweight

The intervention HBC approach was MI and several strategies were translated within the intervention, but unlike traditional MI based interventions that use face-to-face counselling, these MI strategies have been incorporated into the resource pack. The components of MI can be described as skills, processes and spirit (Miller and Rollnick, 2013) and to ground the intervention in MI the components, theoretical insights and practical techniques of MI were embedded in the resource pack to facilitate non-expert use of MI by delivery coaches.

The translation of core MI communication skills was achieved in several ways. Delivery staff may not be able to skilfully facilitate open questioning and use reflective listening. These skills were incorporated into a prescriptive resource pack through a structured approach whereby the lesson plans included multiple open questions, predicted pupil responses and potential reflective listening type feedback to these responses to add a dimension of coach understanding and skilful responses. Affirming was embedded by using an empathetic style in the feedback messages. For example, if a pupil failed to reduce the amount of SSB they consume, feedback focusses on the effort and stresses that future efforts may be more successful. Summarising topics was incorporated through plenaries to ensure pupils receive messages that summarise key topics discussed that day and homework activities summarise key weekly topics. Furthermore, informing and advising was embedded within the resources as coach information instructed them to assess information needs in order to identify what pupils want and require. If a need exists then information can be provided but not necessarily interpreted for the pupils. For example, pupils can be directed to websites but can choose for themselves what information, if any, they take from this.

MI processes were translated into the intervention through specific inclusions that were designed to engage pupils in the intervention process in several ways. Week one lessons direct the coach to describe the nature of the intervention to the pupils and at the start of each lesson pupils will receive an overview of the topics that will be covered. To facilitate focusing, pupils will be told that the intervention will concentrate on themes such as PA. Within the context of these themes, lesson plans encourage pupils to come up with their own ideas and focus. Evoking is a further MI process embedded through the use of importance

and confidence rulers in some activities to assess the relative importance of certain aspects of behaviours and the outcomes of those behaviours alongside pupil confidence towards adopting those behaviours. Evoking will be supported by the incorporation of looking forward by, for example, asking pupils to imagine that they positively change one aspect of their diet and the possible benefits of this. They will then consider how they would feel, and if this would influence their future decisions on dietary habits. Planning processes were incorporated as lesson plans direct pupils to make action plans based on SMART goals that will be evaluated in subsequent lessons. Pupils will then be encouraged to identify factors that hindered or supported them in achieving their SMART goals and adjust them over following weeks. Older pupils will create coping plans which focus on anticipating barriers to achievement of SMART goals and a plan to cope with this.

The translation of the MI spirit into the intervention was achieved in several ways. The spirit of partnership was embedded through coach instructions to ask pupils to give opinions, or to reflect on previous statements and in this manner the intervention will use pupil partnership input. Moreover, acceptance and compassion are within the spirit of MI and were embedded through the inclusion of specific messages that both fit the needs of the intervention and, remaining cognisant of the sensitivity of childhood obesity, are acceptable to pupils, teachers and parents. Furthermore, all pupil handouts, homework and lessons used an empathetic style, without using pressure or blame.

A range of twenty behavioural change techniques were identified within the literature and included modelling of behaviours, goal setting, monitoring of behaviours and feedback on behaviours. The practical application strategy for these techniques consisted of three aspects. Firstly they were integrated throughout the resource as part of the behaviour change construct and were used throughout all content and topics within classroom lessons, practical activities, homework activities, workbooks. They were also included in the delivery staff notes and recommended delivery style of staff to support the achievement of all Intervention Goals. A full list of these techniques is included in Appendix 3.

The second aspect of the application strategy was to ensure that each item from the package of behaviour change techniques was aligned with a specific application method within the intervention. For example, for the goal setting technique children were set goals to achieve that were linked to activities in the home setting if possible and for the monitoring of behaviour techniques children recorded information on EBRB in an activity log and food diary. In addition to supporting the achievement of the PO, individual techniques were mapped against all PO that were determined to be most predisposed to modification by these techniques. For example goal setting was determined to support the achievement of the following Performance Objectives PO1.1, PO1.2, O2.1, PO3.1, PO3.3, PO4.1, PO4.3, PO4.5, PO4.6, PO4.7, PO4.9, PO5.1 and PO5.2 and was therefore aligned to the objectives were possible within the resource pack.

Furthermore, the third aspect of the approach was applied through the Health Skills for Life element of the intervention which was based on a thematic approach to the application of behaviour change techniques within the resource pack. Therefore, the Health Skills for Life focus within the resource pack structure was based on applying behaviour change techniques as a theme within the ten week class group projects. As such these themes do not stick rigidly to individual techniques.

8.2.7 IM Step 4 part 1: translate intervention methods and application strategies into an organised intervention design

This step comprised organising the theoretical intervention techniques, pedagogical strategies and behavioural approaches into a deliverable intervention, essentially combining them within the resource pack that is created for delivery staff to use in schools. This section reports on the conceptual model of the CHW intervention, the structure, content and topics within the intervention, the Curricular Alignment Framework (CAF) and provides a sample lesson plan.

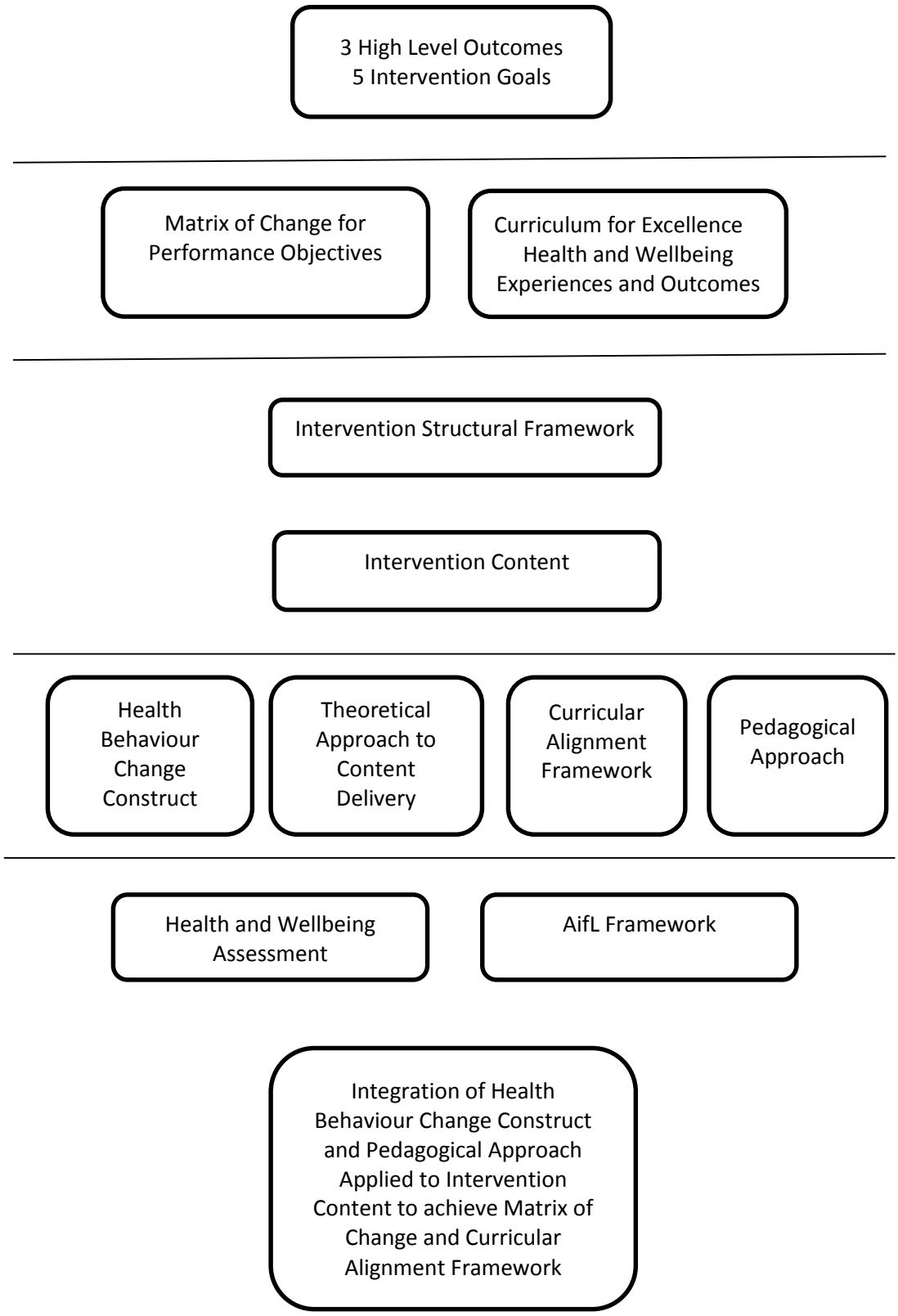
The outputs from all previous phases of PPM and stages of IM were combined within this output which produced the CHW intervention Conceptual Model. The CHW intervention Conceptual Model, described in Table 3-6 and structurally visualised in Figure 3-3, is built on the structural framework populated with intervention content and uses practical application strategies from the pedagogical approach and behavioural change construct to deliver health education lessons. The conceptual model is designed to support children to achieve the PO in order to help them to make positive choices around EBRB thereby supporting them to achieve the high level health outcomes of the intervention. The conceptual model is entirely behavioural insofar in that it is a method through which to impact on EBRB. Different lessons provided an opportunity to change the topic, content or focus to ensure a variety of knowledge, understanding and skills were supported and environmental determinants were addressed. This structure also supported a modular approach to interdisciplinary learning and thereby supported integration into the formal curriculum and the achievement of both CfE HWB and cross-curricular EO. However, any of the lesson topics, modules or projects could articulate with the conceptual model as lesson activities provide a context for learning and the application of behavioural techniques and approaches within the overall behaviour change theory and model. Varying the learning content or context does not alter the way in which the overall behaviour change construct can be applied.

Lesson topics used within the CHW intervention were identified from intrinsic practitioner knowledge, partner consultation a literature review and existing CWM interventions,. This was guided by PPM Phase 4 to identify lesson topics most able to address the specific targeted childhood obesity-related behaviours. The selected behaviours were chosen because of their potential impact on health outcomes, applicability to the school setting and susceptibility to modification.

Table 3-6: CHW Intervention Conceptual Model

Components CHW Conceptual Model
Element: Intervention Structural Framework
3 CfE level specific stages and 7 class group specific projects
Projects are built from 4 thematic modules (Healthy Eating, Active Lifestyle, Healthy Lifestyle and Home-Link) underpinned by behaviour change approaches
All modules within a stage combine to form a thematic unit
Lesson Plans are built from activities and tasks from each module
Element Theoretical Approach to Content Delivery
Projects designed for age specific delivery and show progression and development throughout the programme
Interdisciplinary, cross-curricular lessons addressing multiple influences of energy balance related behaviours
Projects delivered over 10 weeks with one 90 minute lesson per week
Thematic lesson activities each last 30-45 minutes and are selected from healthy eating, physical activity and healthy lifestyle activities
Follow up assessments can be seen as additional contact time
Parental engagement facilitated through pre intervention parental information and weekly homework linked to the curricular content
Health behaviour change techniques are incorporated throughout all modules but the the Health Skills for Life modules specifically guides this inclusion
Element: Matrix of Change for Performance Objectives
High Level Outcomes
Performance Objectives
Behavioural and Environmental Determinants
Element: Practical Application Strategies to Achieve Planned Outcomes
Behavioural Change Construct
Theoretical Approach to apply Matrix of Change
Delivery style and approach designed to support engagement
Delivered by non-expert staff
Element: Curricular Alignment Framework
Mapping the intervention against the CfE HWB & Cross Curricular E&O and 4 Capacities
Lesson Planner comprises aims, objectives, learning intentions, success criteria and AifL materials
Alignment with the ethos, approach and ambitions of CfE
Monitoring, Evaluation & Feedback through AifL for HMIE
Element: Evaluation Framework
Pre and post intervention and follow up BMI
Attendance – total number of sessions attended and percentage of all available sessions attended
Demographic information of participants
Pre and post intervention and follow up health and wellbeing assessment

Fig 3-3: Elements of the CHW Intervention Conceptual Model



A necessary output from IM Step 4 was the development of the CHW intervention structure and content based on thematic projects, modules and lessons. Table 3-7 is a visual representation of the structure of the CHW intervention which was developed through the PPM and IM process. Each of the seven thematic projects is made up of four topic specific modules and augmented by an additional Health Skills for Life behavioural focus.

Table 3-7: CHW Intervention Structure, Content and Topics

Class and project title	Topic	Module	Content summary
P1:	HE	Healthy food, healthy me!	Fruit and vegetables
Healthy habits for life	PA	Being active is fun!	Fun games
	Link	Eat well, be active	Eat, play, grow
	HL	What is healthy?	Healthy lifestyles
P2: Healthy me	HE	Enjoy healthy food and drink	Five-a-day
	PA	Get active!	60 min of physical activity per day
	Link	Grab 5	Five-a-day
	HL	Explore the balance	Healthy lifestyles and how I feel
P3:	HE	Enjoy healthy food and drink	Where does my food come from?
Get healthy stay	PA	Get active!	Ways to be active
healthy	Link	Every day is a healthy day	Ways to eat well
	HL	Explore the balance	Smart goals
P4:	HE	Enjoy healthy food and drink	Eat well plate
Food for thought	PA	Get active!	Exercise and your body
	Link	My healthy plate	Eat well plate
	HL	Explore the balance	Food and diseases
P5:	HE	Eating and drinking well!	Food in school
Energy for exercise	PA	Stay active!	Physical activity in my area
	Link	Heart healthy foods	Food at home
	HL	Getting the balance right	Healthy lifestyles and learning
P6:	HE	Eating and drinking well!	Food labels
Finding the balance	PA	Stay active!	Green activity
	Link	Chew on this	Food out of home
	HL	Getting the balance right	Benefits of being outside
P7:	HE	Eating and drinking well!	Food advertising, be media smart
Be Health literate	PA	Stay active!	Fitness
	Link	Food matters	Food and healthy lives
	HL	Getting the balance right	Lifestyles and mental wellbeing

In addition to the overall structure of the intervention IM Step 4 guided an output focussed on the development of lesson plans for every module within the intervention. Lesson plan 1 from the P1 HE Module is included in Table 3-8. The

P1 HE Module contained ten lesson plans in total which were delivered over the ten week block alongside PA and HL lessons and homework activities.

Table 3-8: P1 Healthy Eating Module Lesson Plan 1

Lesson 1 Eatwell Plate – 45minutes		
ITINERARY	**LEARNING ACTIVITY**	**TEACHING POINTS**
INTRO ACTIVITY **5 MINS**	Share Learning Intentions with the class: Explain we are going to explore the Eatwell plate. Share Success Criteria with the class	Explain fully the learning intention and the activity within the lesson
WHOLE CLASS ACTIVITY **15 MINS**	Provide children Handout 1 The Eatwell plate that shows the different types of food we need to eat – and in what proportions – to have a well-balanced and healthy diet. It is a good idea to try to get this balance right every day, but you don't need to do it at every meal. You might find it easier to get the balance right over a longer period, say a week. Eating healthily is about eating the right amount of food for your energy needs. In Britain, most adults are either overweight or obese. This means many of us are eating more than we need, and should eat and drink fewer calories in order to lose weight. However, it doesn't apply to children under the age of two because they have different nutritional needs.	Discuss the sections of the Eat-well plate with the children, highlighting what foods belong to each section.
INDIVIDUAL / SMALL GROUP ACTIVITY **15 MINS**	**<u>The Eatwell plate</u>** The children will work individually to accurately draw and colour an item(s) of food in each section of the plate. The children could be instructed to choose their favourite foods from each section or foods which they would like to taste in future.	Work in pairs to create a plate by drawing a piece of food from each section on it. Teacher can demonstrate where on the sheet.
CLOSING ACTIVITY **10 MINS**	The children will have opportunity to present their Eat-well plate to the rest of their class. The children will be able to state the foods which they have chosen and why? Plenary – Allow the class to refer back to the Learning Intentions and Success Criteria for this lesson and decide if each of these have been met.	Praise children who complete the task successfully.
OPTIONAL EXTENSION ACTIVITY	Children could create another plate which could be eaten at a different time of the day, to the first plate they created. The children should use a completely new selection of foods to complete the task	Remind children that the food groups should be in the same place as the first plate.

8.3 Research question 3

The purpose research question 3 was to determine whether an intervention could be formulated in a way that would support CfE and achieve buy in from the Local Authority Education Departments, school Head Teachers and class teachers. This was supported by the outputs from part 2 of PPM Phase 4 and part 2 of IM Step 4. This research question also focussed on the development of aspects of the intervention necessary to for it to be used as a primary driver for the achievement of the NHSL H3 target. This was supported by the outputs from IM Steps 5 and 6 and PPM Phases 5-8.

8.3.1 PPM Phase 4 Part 2: administrative assessment, policy assessment and intervention orientation

This phase guided the identification of administrative and policy factors associated with primary schools that can influence intervention implementation and delivery and therefore, must be considered in the intervention formulation stage. As such, an assessment of policies, administrative factors and organisational structures within the school setting, an overview of existing health promotion activities in this setting and the identification of obstacles or supporting factors that will influence the development and implementation of the intervention was carried out.

The initial task within PPM Phase 4 was to identify relevant primary school policies, strategies and approaches in this setting. Those identified that related to the proposed intervention were a CfE, Getting it Right for Every Child, Health Promotion Nurseries, Health Promoting Schools, the Schools (Health Promotion and Nutrition) (Scotland) Act 2007 and Hungry for Success. Throughout the development process it was essential to remain cognisant of these documents.

The next output was the identification of relevant primary school administrative factors and organisational structures that may influence the intervention delivery plan. The intervention was designed to be delivered to whole single year group classes but was flexible enough to be delivered to composite classes

made up of different year groups though stratified activities. To support overall school year planning the intervention was required to fit within a single school term, utilise standard school classrooms, sports facilities and equipment and individual lessons had a duration that allowed them to be delivered within the daily timetable between breaks, for example between morning break and lunch. It was also designed not to disrupt other normal school activities and once school participation was agreed the organisation was simple enough to be administered and co-ordinated by office staff and the class teachers within minimal additional workload for them. A further output, focussing on higher level influences was the identification of obstacles or supporting factors that can impact how the intervention is implemented. With regards to the proposed CHW intervention the primary facilitator of intervention implementation within an education setting was the roll out of a CfE (Scottish Executive, 2004) which placed HWB education at the core of the formal Scottish Curriculum. The aim of the HWB area was to ensure that learners develop the skills to make healthy choices ad establish lifelong healthy habits. However, there was the potential for a CfE to be an obstacle due to the competing educational requirements of 8 curricular areas and the time constraints that these competing priorities place on limited curricular time. It was therefore, critical to develop the intervention in a way that maximised the benefits that it provided to teachers and schools, thereby justifying its inclusion within the curriculum, rather than simply developing an effective health intervention. In addition, the NHSL Health Improvement Action Plan was used to identify additional existing health promotion activities which while not focussing on the same topic as the proposed CHW intervention may have competed for time within the curriculum, for example tobacco control or mental wellbeing promotion.

While not strictly an output, in terms of the production of a piece of work or development process, it was critical that the culmination of PPM Phase 4 Outputs 2-4 was that any aspect that could influence Local Authority Education Department endorsement and the subsequent approval and uptake of the intervention by schools had been taken into account and addressed. This was true not only for intervention design but also for additional aspects such as the terminology within parental correspondence, style of classroom delivery, methods of assessment and information governance. This was therefore, a

consideration of the factors that had the potential to influence the acceptance and subsequent uptake intervention in the round, using this to develop an overall ethos and applying this to guide all aspects of the intervention.

8.3.2 IM Step 4 Part 2: translate intervention methods and application strategies into an organised intervention design

IM Step 4 supported two research questions, with the first part of this step relating to the development of the overall structure, content and approach of the intervention and the resource pack materials that were designed to be delivered by coaches and is linked to research question 2. The second part of the step related to research question 3 and also involved designing the resource pack but these materials focussed on planning and assessment within the curriculum. While these provided some benefit to the healthy lifestyle coaches delivering the intervention they were designed to be used by teachers to understand how the intervention fitted within the curriculum and what aspects it supported, the aims and objectives of modules, the weekly learning intentions and success criteria of lessons and how learning could be assessed. This part of the intervention development process therefore focussed on supporting acceptance of the intervention by Education Department senior management, Head Teachers and class teachers.

To support integration into the curriculum, the CAF was developed as an output in this step. Every module within the CHW intervention included the information necessary to align it with CfE and Assessment is for Learning (AifL). This curricular alignment and assessment information was in addition to the lesson plans used by the delivery coaches to deliver the intervention. The AifL framework within the CHW intervention aspires to ensure that every young person achieves the maximum outcome from participation and gives a clear commitment to putting the learner at the centre of this programme. Assessment has a critical part to play in realising this outcome because it can give learners, and educators, the feedback they need to improve their learning. The CAF was developed while remaining cognisant of the pedagogical approach in contemporary Scottish education that is based on learning, teaching and development which are underpinned by a theoretical and practical base

(Learning and Teaching Scotland, 2005). Pedagogy should also take cognisance of the cultural, social and political values and principles influencing the context in which pedagogical approaches are applied. The CAF included CfE alignment and AifL materials within every module in the CHW intervention and consisted of seven elements for each module. All CAF materials were included in the intervention resource pack and examples of this from the P1 HE Module are contained within this thesis for illustrative purposes. The elements that were developed included a module overview illustrated in Table 3-9, a list of CfE Experiences and Outcomes (EO) supported by the module seen in Table 3-10 and weekly lesson learning intentions and success criteria demonstrated in Table 3-11. In addition, the areas of the 4 Capacities of a Curriculum for Excellence supported by each module were highlighted and can be seen in Appendix 4, an AifL Key Points information sheet was provided for each module, an AifL Framework was developed for each module and can be seen in Appendix 5 and a Traffic Light Assessment Grid was produced for each module and is illustrated in Appendix 6. Examples of the seven elements of the CAF for the P1 HE Module which supported the integration of the CHW intervention into the curriculum are provided.

A Module Overview was produced for every module within the intervention. The P1 HE Module Overview is outlined in table 3-9 and provides a high level summary of the focus and ambitions of this 10 week module for delivery staff, teachers and pupils.

Table 3-9: P1 Healthy Eating Module Overview

P1 Healthy Eating Module		
Module Topic	Fruit and vegetables	
Weekly Lesson Focus	1. Eat-Well Plate 2. Fruit on a healthy plate 3. Vegetables on a healthy plate 4. Design a fruit salad 5. Design a veggie pizza	6. Design a fruit kebab 7. Eat the rainbow 8. Design a smoothie 9. Design a healthy sandwich 10. Amazing fruits
Module Aim	Educate pupils about the benefits of eating fruit and vegetables as part of a balanced diet. The children will be given a wide range of exciting and interesting ways to eat fruit and vegetables which should excite them and encourage them to continue eating them.	
Module Learning Objectives	By the end of this module, the children should know; • What a healthy Eat-well plate is and foods from each of the sections which make it up. • Identify and draw accurately a selection of fruits • Identify and draw accurately a selection of vegetables. • What a fruit salad is, what is included in one and how to design their own • How to design a vegetarian pizza with their own ingredients • What a fruit kebab is and be able to design their own kebab with a repeating pattern. • That fruits and vegetables come in all colours, • How to select a vegetable or a fruit to match each of the colours of the rainbow • What a smoothie is and design their own • What a healthy sandwich is, and design their own • The names of some exotic fruits, along with their interesting features	
Module Differentiation	Differentiation will be at the discretion of the delivery coach or class teacher taking into account the class progressions through the activities within the lesson plans. In addition, flexibility is built into the lesson plans through additional activities.	

Each module included a list of the CfE EO that it supported. The CfE EO addressed by the P1 HE Module are outlined in table 3-10. This allowed the class teacher to identify which areas of the curriculum were supported by this module and which were not.

Table 3-10: Curriculum for Excellence Experiences & Outcomes supported by the P1 Healthy Eating Module

Curriculum for Excellence Experiences and Outcomes - Health and Wellbeing	
Reference	**Descriptor**
HWB 0-29a	I enjoy eating a diversity of foods in a range of social situations.
HWB 0-30a	Together we enjoy handling, tasting, talking and learning about different foods, discovering ways in which eating and drinking may help us to grow and keep healthy.
HWB 0-32a	I know that people need different kinds of food to keep them healthy.
HWB 0-33a / HWB 1-33a	I am becoming aware of how cleanliness, hygiene and safety can affect health and wellbeing and I apply this knowledge in my everyday routines such as taking care of my teeth.
HWB 0-35a	I explore and discover where foods come from as I choose, prepare and taste different foods.
HWB 0-23a	I am aware of my own and others' needs and feelings especially when taking turns and sharing resources. I recognise the need to follow rules.
Curriculum for Excellence Experiences and Outcomes – Cross Curricular Dimensions	
Reference	**Descriptor**
LIT 0-02a / ENG 0-03a	As I listen and talk in different situations, I am learning to take turns and am developing my awareness of when to talk and when to listen.
LIT 0-04a	I listen or watch for useful or interesting information and I use this to make choices or learn new things.
LIT 0-07a / LIT 0-16a / ENG 0-17a	To help me understand stories and other texts, I ask questions and link what I am learning with what I already know.
LIT 0-09a	Within real and imaginary situations, I share experiences and feelings, ideas and information in a way that communicates my message.
LIT 0-10a	As I listen and take part in conversations and discussions, I discover new words and phrases which I use to help me express my ideas, thoughts and feelings.
MTH 0-13a	I have spotted and explored patterns in my own and the wider environment and can copy and continue these and create my own patterns.

Source: Curriculum for Excellence Scotland Curriculum areas - learning and teaching

The Learning Intentions and Success Criteria were included to support delivery staff and class teachers to understand the focus of the individual lessons weekly Learning Intentions and Success Criteria were devised to clarify exactly what children should learn from the lesson and how success can be evaluated. Table 3-11 includes some of the P1 HE Module weekly lesson learning intentions and success criteria

Table 3-11: Learning Intentions and Success Criteria for P1 Healthy Eating Module (week 1 and 2 only)

Lesson 1

Learning Intentions	Success Criteria
To understand what the healthy eating plate is	• The children will be able to describe what a healthy eating plate is • Children will understand that following these rules will result in a healthy diet.
To name the parts of the healthy eating plate	• The children will be able to name all 5 sections of the Eat-well plate.
To name and draw a food from each section of the plate	• The children will be able to name foods from each section of the Eat-well plate • The class will be able to draw foods from each section of the Eat-well plate.

Lesson 2

Learning Intentions	Success Criteria
To understand what the healthy eating plate is and the place of fruit on it	• Pupils will be able to describe what a healthy eating plate is • Pupils will be able to understand that following these rules will result in a healthy diet. • The group will be aware of how fruits are included on the Eat-well plate
To identify and name a selection of fruits	• The children will be able to identify a variety of fruits • The class will be able to name a variety of fruits
Select and draw accurately a variety of fruits	• The children will be able to select a variety of fruits. • The class will be able to draw accurately a variety of fruits.

The Curriculum for Excellence has four high level ambitions termed the four capacities, which it is designed to support children to achieve. These are that children should become Successful Learners, Confident Individuals, Responsible Citizens and Effective Contributors and each of these capacities includes a list of what children should demonstrate and be able to do. The CAF highlights which

aspects of the four capacities are supported by each of the modules, Appendix 4 lists the four capacity areas and the ambitions within them and that are supported by the P1 HE Module.

Key points to incorporate an AifL approach within each model were provided for teachers. For the P1 HE Module the AifL key points included but were not limited to the learning intentions and success criteria being shared with the children at the beginning of lessons and the recommendation that children should be given regular, timely feedback throughout lessons about their work. Other key points included, children completing a homework task each week for this module to make a home-school link through their learning, the use of peer assessment in specific task and children being given the opportunity to pose questions. Also, to support class teachers to assess the success of weekly lessons they were provided with an AifL framework for the module with key points that could be assessed each week. Appendix 5, provides a sample of the AifL framework for the first four weeks of the ten weeks of the P1 HE Module. For example, the AifL framework recommends that within lesson 1 assessment should focus on no hands and thinking time when listing healthy foods and unhealthy foods, teacher feedback on children's answers, peer evaluation of drawings of foods from each group, teacher assessment of understanding of task results and a plenary to end the lesson. Finally, the inclusion of the AifL traffic light assessment grid allowed teachers to quickly allocate pupils to either red (developing), amber (consolidating) or green (secure) categories for eight areas considered important for pupils to achieve the aims and objectives of the module. For example, within the P1 HE Module, two of these areas are; 1. Can the pupil name the parts of the healthy eating plate and 2. Can the pupils list and draw accurately a selection of fruits and vegetables. This visual tool could be used to quickly provide an assessment of the overall class progress and individuals who required additional support and an example of the AifL traffic light grid from the P1 HE Module is included in Appendix 6.

8.3.3 IM Step 5: plan for adoption, implementation and sustainability of the intervention

The actions required within step 5 included the development of an intervention implementation and delivery plan which was obliged to take into account the requirements for a sustainable approach. There is some crossover between IM Step 5 and PPM Phase 4, therefore, because outputs already produced by PPM were considered sufficient to meet some of the requirements of this step only the activities required to produce outputs considered necessary and sufficiently different were carried out.

Producing a cost per case analysis and cost-benefit analysis as part of the planning process was necessary to establish whether or not the CHW intervention was sufficiently cost effective. The following cost per case analysis figures were projections based on average class sizes, the average prevalence of overweight and obesity across the whole primary school age range and assumed levels of consent form returns. The staffing requirement for each class for a full block was 24 hours per class. Using the standard hourly rate for sessional partner staff one block was calculated at £360. The average number of eligible participants per class was calculated at 25.5 pupils, based on an average class size of 30 and assuming a 90% return rate on consent forms and 5% missing an assessment. As a result, the cost per pupil, within all weight ranges, of a fully completed intervention and assessment was estimated at £14.40 (£360 ÷ 25). However, the target group was estimated using the average prevalence of overweight and obesity in Scottish primary schools of 23.1% against the assumed number of eligible participants per class of 25.5 (25.5 ÷ 23.1) to give a figure of 5.8 eligible target group children per class. As such the cost of a completed intervention for a target group child was calculated at £62.1 per head (£360 ÷ 5.8).

The 2008-11 H3 target for NHS Lanarkshire was 2236 completed target group interventions. Therefore, if the proposed intervention was used to achieve the entire target there would be a requirement to deliver it to a minimum of 391 primary school classes (2263 ÷ 5.8). The delivery costs to achieve the H3 target with this intervention would be a minimum of £140,730 (£360 x 391). Also, pupils with less than 75% attendance cannot be counted, and rural schools with smaller

class sizes are prevalent in some areas. All of these factors will require additional school class participation and increase costs. It should also be noted that these figures relate only to direct costs for staff delivery of the intervention and did not include aspects such as staff training, administration and associated project management expenditure.

When preparing to carry out the cost-benefit analysis it was established that It was not within the scope of the proposed intervention to assess any ongoing costs to NHSL of treatment or other costs related with overweight and obesity, and associated co-morbidities, of participating children. Therefore, it was not possible to produce a cost-benefit analysis for target group participation in the intervention or to identify NHSL spending reductions associated with delivery of this intervention. It was, however, possible to carry out a prospective cost-benefit analysis to predict the potential impact of the intervention on future NHSL spending.

Research on the Counterweight programme (Tigbe et al. 2013) quantified the additional healthcare costs associated with increasing levels of overweight, including obesity, and calculated that each additional unit of BMI increased healthcare spending by an average of £16 per year, largely on items such as cholesterol and high blood pressure medications, for each already overweight or obese adult. It may, therefore, be possible to infer equivalent healthcare savings for each reduced unit of BMI, from any cause including interventions, for already overweight or obese adults. These potential healthcare cost savings cannot be applied directly to current NHSL spending on childhood overweight and obesity but may provide some indication of the long term cost-benefit of the intervention to future NHSL spending on obesity related morbidity.

Intervention delivery staff identification and training programme development was an essential output in IM Step 5. Set criteria were applied to staff selection, before participation in induction training. Where possible, staff were selected for the CHW training and subsequently delivery of the intervention based, on desirable attributes related to essential working practices, knowledge and skills. Staff were required to work effectively with pupils, modify approaches to ensure

engagement, develop close working relationships with teachers and manage large amounts of data.

Prior to delivering the CHW intervention staff were required to attend CHW induction training. This training was developed by the author and tailored to the needs of the intervention. Key areas that were focussed upon within the staff training were familiarisation with the resource pack and knowledge, skills and confidence related to child weight management. Due to the nature of the methodological approach to the delivery of the intervention, selection and training of delivery staff and the limited ability for direct support and supervision by the CHWP manager it was considered essential to ensure staff were clear how to act and what to do in most reasonably conceivable situations. Therefore, coach roles and responsibilities and communication protocol documents were produced along with a document outlining in detail the information governance protocols that should be adhered to when dealing with person identifiable data.

IM Step 5 guided the production of a range of materials to facilitate the implementation of the intervention and adoption by schools at the required scale. Education Department information packs were developed and included a senior management intervention briefing document and child obesity overview and a Head Teacher background and information document. Parent or guardian formal information sheets and informed consent forms were also developed.

Project management tools were produced to ensure smooth delivery of the intervention over a sufficient period to achieve the H3 target. These tools were used by NHSL and key delivery partner organisations and included templates for scheduling and timetabling individual and multiple cohorts, a data collection log and an individual class booking form. Additionally, while not related directly to development, planning or delivery of the intervention this step included the production of SG QA information to ensure those target group children who completed the proposed CHW intervention could be counted towards the H3.

IM Step 5 guided the development of a plan for adoption, implementation and sustainability of the intervention. Part of this plan required the consideration of

the likely socioeconomic status of participating pupils based on their school catchment areas and therefore influenced school selection. NHSL has a requirement to ensure that all programmes and services reduce the HWB inequality gap, which is strongly influenced by socioeconomic status. However, the intervention will be delivered universally across Lanarkshire and aspects such as PO or behavioural strategies cannot be varied based on the likely socioeconomic status of participating pupils. This NHSL focus on HWB inequalities will, therefore, be addressed through targeted delivery of the intervention that will ensure that schools in the most deprived areas will receive equity of access or preferential access to the intervention in line with the principle of proportionate universalism (Marmot, 2010). This approach is in line with the SG requirement that a minimum of 40% of all CHWP participants are to be from the two most deprived SIMD quintiles.

8.3.4 IM Step 6: generating programme evaluation plans

This step focussed on the development of an evaluation framework as the primary output. The evaluation plan involved initially collecting demographic data on week 1 and the data that was considered important for collection was gender, date of birth and home post code. The HWB assessment was planned to include the date of assessment, height and weight, a fitness test and a food and PA diary at every assessment date. The HWB data collection was planned for weeks one and ten of the intervention to determine the immediate impact and then at six and twelve months post intervention to assess the medium and long-term impact of the intervention. Where possible, review appointment dates were planned to be arranged at six and twelve months after completion but school holidays will influence the scheduling of these appointments. Feedback can be provided after any assessment point. Furthermore, attendance was planned to be recorded weekly on a class register.

8.3.5 PPM Phase 5: implementation

When the PPM process is used without the inclusion if IM then PPM Phase 5 involves the development of the intervention resource pack. However, this was

already completed in IM Step 5 and, therefore, did not need to be repeated. Therefore, this phase focussed on the pretesting of materials with delivery coaches and class teachers to ensure they were clear, understandable, complete and appropriate for use within the requirements and limitations of the curricular school setting with feedback considered before initial delivery. In addition, formal consultation events took place with senior education management and school representatives to agree specific aspects of the intervention such as design, content, themes, approach, language and data collection. Moreover, materials from the resource pack were passed to partner organisations for more detailed review and proofreading.

8.3.6 PPM Phases 6-8 evaluation

PPM Phases 6-8 cover the process, impact and outcome evaluations that together define the evaluation of the intervention and compare intervention activities, procedures and results against an acceptable standards and key performance indicators, including achievement of the H3 target. Data derived from this work is not reported within this thesis. However, evaluation planning is a core element of the PPM and IM process which is carried out prior to intervention implementation and has an impact on aspects such as intervention design, staff training, partnership agreements, parental consent and data analysis. Therefore, aspects of this evaluation plan are reported in this section.

Phase 6 of PPM was dedicated to a future procedural analysis of intervention delivery adherence to pre-determined protocols. Planned activities included the direct observation of intervention delivery and face to face debriefing sessions with school staff and delivery staff. To support a future process evaluation materials were developed that would be used in parallel with intervention delivery. These materials focussed on teacher evaluation of content, teacher and school management evaluation of the process, teacher evaluation of the HWB assessment and a teacher evaluation of the potential for future teacher led delivery. It was anticipated that an analysis of the evaluation forms and debriefing sessions would support the identification of actual and potential problems.

If following future intervention delivery, it was established that it was not effective in supporting currently overweight or obese children to move towards a healthy weight status then it will have been ineffective in achieving its primary ambition and High-Level Objective independently of any impact on social, emotional or mental health and wellbeing or overall QOL. Therefore, the initial impact evaluation was planned to focus on changes to the BMI, which will be used to further derive BMI Centile of participants between pre and post intervention assessment as the primary method of impact evaluation. Additional data collection was planned to provide some qualitative and quantitative data related to EBRB and fitness to provide additional information related to the impact and effectiveness of the intervention. The data collection tool devised to collect data on EBRB was a food and activity diary should be completed by the child or their parent over the course of a week at the start and end of the intervention. The primary impact measure of BMI should be collected alongside fitness test data on a fitness test and BMI assessment score sheet which was produced for delivery coaches to complete.

In addition to the impact or effectiveness of the intervention in addressing BMI or EBRB of participants a primary aim of the CHW intervention was to support the achievement of the H3 Target and, therefore, it was necessary to develop tools to assess total target group completion and store data in preparation for reporting to the SG. It was identified during PPM Phase 8 that the CHWP Manager would be required to compile and analyse the data recorded in the class registers and HWB assessment sheets and then to store this electronically. As a result, templates were devised for this purpose. These templates were designed to quickly allow data to be generated on the overall performance of the intervention, within the NHSL CHWP, which would be returned to the SG in a quarterly reporting template.

PPM Phase 8 also guided an analysis of the achievement of the High Level Outcomes identified in Phase 1 and therefore, went beyond assessing the impact of the intervention to analysing the outcome of the intervention. The achievement of the High Level Outcomes was primarily evaluated by an analysis of participant BMI (BMI centile & BMI-SDS). Within the literature review childhood obesity was associated with poorer social, emotional and mental

health and QOL scores (Lobstein and Jackson-Leach, 2006). Therefore, within the initial outcome evaluation planning stage it was decided that improvements in these psychosocial variables were to be inferred from reductions in BMI scores rather than directly measured. Although not a direct psychosocial assessment this still goes beyond the requirements of the H3 guidance.

CHAPTER 4: DISCUSSION

9. Discussion of intervention development

This thesis outlined the conceptualisation, design and development of a CHW intervention and associated delivery and evaluation plans. The discussion will critically analyse theoretical aspects of the intervention developed by the PPM and IM process and assess its potential to achieve the ambitions of the NHSL CHWP. This discussion will reflect on the content, methodology and theoretical underpinnings of the intervention and also the possible operationalisation and sustainable long-term delivery in a real world setting. Finally, the implications for professional practice will be explored and recommendations will be made for future research on CHW intervention development.

During the development process the CHW intervention that was formulated was named Fit for School (FFS) by the author. When completed, FFS went on to be delivered in primary schools across Lanarkshire, however, the results of the evaluation of the impact and effectiveness of the intervention are reported elsewhere.

9.1 Critical analysis of the overall Fit for School conceptual model and its potential to prevent and treat unhealthy weight gain in childhood

9.1.1 Primary strengths of the Conceptual Model

The CAF may facilitate school engagement as it supported aspects of planning and assessment within the curriculum that made integration of the intervention into school plans an easy process and removed the time and workload requirements for individual class teachers to do this. This was considered to be a strength of the methodology as it may encourage school uptake when there will be no obligation for them to do so thereby enhancing scalability. Potential intervention scalability of FFS was an essential requirement for the development process as this will impact on both, its ability to address the issue of unhealthy

weight in childhood at a Health Board scale and also the potential to support NHSL to achieve the H3 target. If the CAF can increase demand for this intervention, then there is a requirement to put in systems to ensure that this demand can be met. It is considered by the author that a primary methodological strength of this intervention is the use of existing cohort of partner organisation staff and the ability to mobilise them to deliver the intervention at scale and the flexibility to meet regional and annual variations in demand.

If the intervention can encourage school engagement as is anticipated and partnership management systems can provide the level and flexibility of staff that this demand requires, then consideration must be given to the relative cost effectiveness of this staffing structure underpinning this approach. The proposed staffing structure only requires staff to be paid when they deliver FFS as they are sessional staff employed by partner organisations. As such, they do not represent the same ongoing cost pressure to NHSL as they would if they were employed through substantive posts. In addition, they can be mobilised based on the demand for the service for particular locations, days of the week or times of the year. Also, the cost per case and cost-benefit analyses carried out within this research indicates that this intervention can be delivered at an acceptable cost and can be delivered at a scale sufficient to achieve the H3 target within the budget allocated to this work.

The development of a complex intervention that has the potential to be delivered by non-expert staff and remain theoretically effective in addressing target EBRB and thereby unhealthy weight gain in childhood was a fundamental concern within the design process. Much of the focus of the development of this intervention was on developing an intervention which, as far as possible, within the previously outlined limitations, could be theoretically driven and evidence informed. This would support an intervention design that is as close to best practice as possible but throughout the design process the author was cognisant that the final conceptual model would utilise application strategies based on non-expert delivery. The intervention conceptual model strikes a balance between the high level of expertise that was used in the formulation process and the limited expertise required in the delivery process thereby potentially

profiting from the benefits of a best practice methodology and large-scale delivery.

The depth and detail of the development process allowed a huge amount of content to be produced that was applicable to a broad target age range. This, therefore, facilitated the development of a different age and stage specific project with a different thematic focus for every year group from P1-7. This, both increased the pool of potential participants and, therefore, the potential of the intervention to achieve the H3 target but also set up an intervention in which a child could theoretically participate every year throughout primary school, therefore, increasing the likelihood that it will support changes to EBRB. A whole class approach has two primary benefits. Firstly, as a universal intervention, it can utilise both a prevention and treatment approach to unhealthy weight gain in childhood and provide benefits to children who are within a healthy weight range and would not be the focus of a targeted community intervention but who are on a path to unhealthy weight gain. A second benefit of a whole class approach is that it avoids the difficulties of engagement and drop-out rate that have a huge negative impact on the participation numbers in traditional community or clinical interventions.

The way in which theoretical mechanisms are engaged to mediate behavioural changes within the FFS Conceptual Model is a potential strength of this approach. BMI is a commonly used measure of obesity and indicator of successful outcomes in CWM interventions but is in itself not a measure of health. However, neither body composition or health are measures of behaviours as neither weight or disease are behaviours, but are instead at the end of a chain of results which are the consequence of individual behaviours acting on a complex biological system and influenced by emotional, social, environmental and societal factors. If a CWM intervention is to be effective, it is required to act on personal and environmental behavioural determinants at the start of this process which are the earliest stage, other than prenatal, at which an intervention can act. Addressing the determinants of behaviours at multiple levels of influence (Li et al. 2014) rather than trying to simply address the behaviour directly is more likely to result in successful outcomes in terms of behaviour change and subsequently weight and health (Lloyd et al. 2011). The

conceptual model employed by FFS uses lessons and home-link activities to address modifiable behavioural and environmental determinants of specific EBRB, categorised as PO that are linked to Intervention Goals and subsequently the High-Level Outcomes. The focus of the PO and the intervention structure in which they are set may be a strength of the Conceptual Model, but this must be combined with an approach to change the EBRB that occur as a result of these behavioural determinants. Within FFS, the approach to address behaviours is based on the Behavioural Change Construct, which in itself may represent a strength of the model. This strength is demonstrated in the correlation between the children's EBRB associated with obesity such as screen time (Braithwaite et al. 2013) that were identified in the literature review as drivers of weight gain, the factors in the Obesity System Map (Butland et al. 2007) and the focus of the Intervention Goals and PO developed through the early PPM and IM process. These were reflected in the thematic multicomponent topics covered within activities, lessons, modules and projects incorporated into the FFS structure in the later stages of PPM and IM.

Synergies were identified across key elements of the Behavioural Change Construct as **t**he four cross-cutting factors identified within the enhanced SEM by McKee et al. (2000) can be related directly to the behavioural determinants outlined within the Matrix of Change and many of the constructs which form the SCT (Bandura, 1986). Table 4-1 highlights the commonalities between three of the main HBC aspects of FFS demonstrating the synergies across the construct. It is theorised that the synergies across the behavioural model that the intervention was built upon, the behavioural theory which drives the approach and the behavioural and environmental determinants of the Matrix of Change of PO which the intervention was designed to address will enhance the likelihood that the desired behavioural outcomes will be realised.

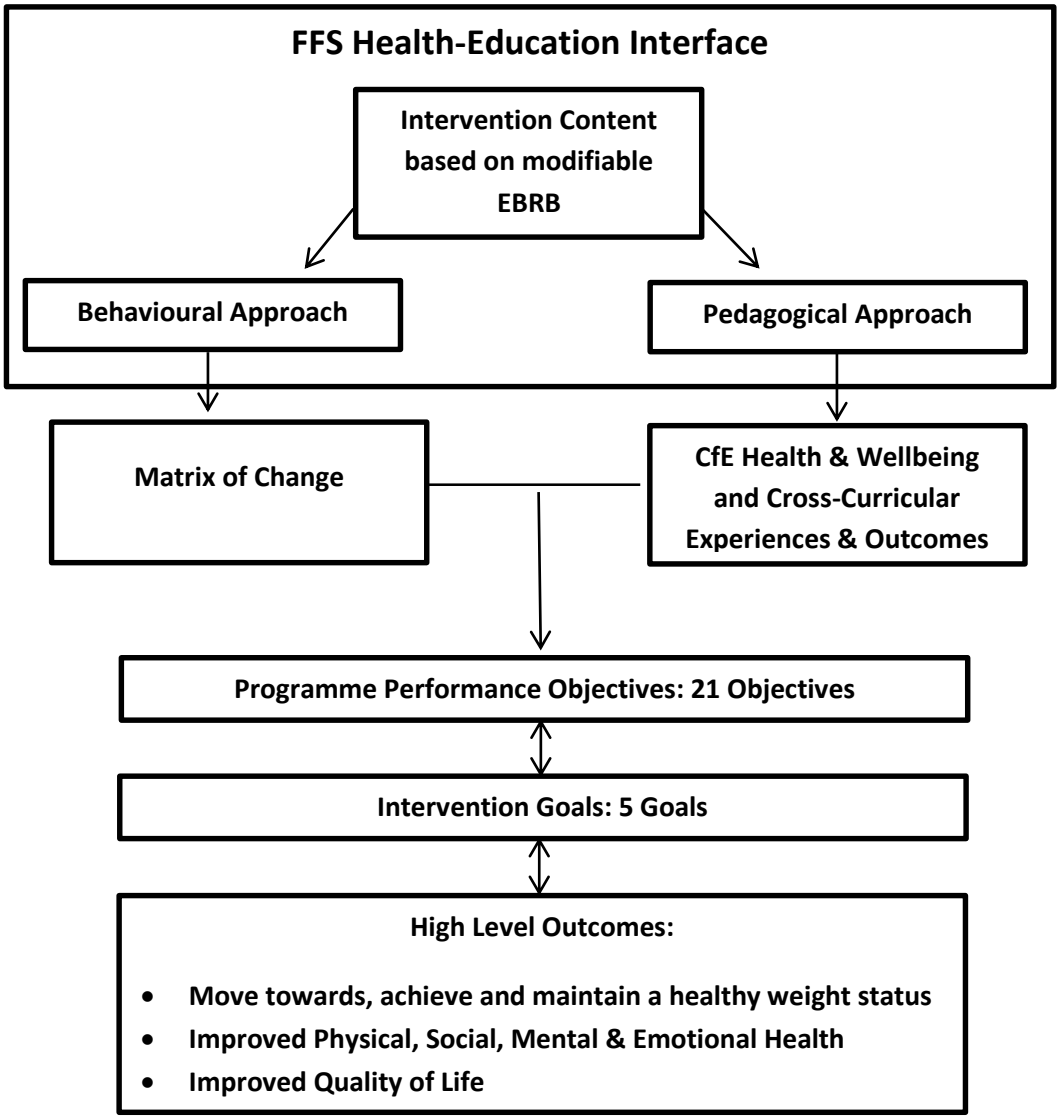
Table 4-1: Common elements between the cross cutting factors of the Social-Ecological Model, the Matrix of Change and the Social Cognitive Theory

Socio-Ecological Model: Cross Cutting Factors	Matrix of Change: Personal Determinants	Social Cognitive Theory: Constructs
Information: knowledge	Knowledge	Learning
Motivation: attitudes and beliefs	Attitudes	Barriers
Ability to Act: skills, self-efficacy and access	Skills & Self-efficacy	Skills, Efficacy, Control
Norms: perceived, sociocultural and gender	Perceived Social Norms	Modelling, Environment
	Outcome Expectation	Outcome Expectations

However, within the design process, it was decided that in addition to the efficacy of the Behaviour Change Construct, consideration must be given to the setting in which it is applied and factors associated with school engagement. This application strategy necessitated the development of a pedagogical approach to increase target group participant uptake. Consequently, the intervention was designed to simultaneously apply a combined behavioural and pedagogical approach which is considered by the author to be a primary strength of the conceptual model. This methodological approach was designed to combine the health focussed Behavioural Change Construct and the education focussed Pedagogical Approach in order to achieve both the aims of the Matrix of Change for PO and the CAF. This combined approach, seen in Figure 4-1, can only be theoretically analysed within the scope of this research but has the potential to bridge the gap between the approaches taken in the health and education sectors to achieve often shared HWB ambitions. The behavioural and environmental determinants within the Matrix of Change of PO and the parallel HWB EO, learning intentions and success criteria represent the core knowledge, understanding, skills, capabilities and environmental changes required by children and young people to increase the likelihood that they will be able to make positive choices about EBRB. It is anticipated that the theoretical Health-Education Interface employed within the intervention methodology will demonstrate greater efficacy in improving participant weight status than has

been seen in comparable interventions which often report little immediate or long-term improvements in weight status.

Fig 4-1: Multimodal Behavioural Change Construct and Pedagogical Approach



9.1.2 Critical analysis of the limitations of the Conceptual Model

An extended duration would be preferable to give participants a longer period within which to establish and maintain new behavioural patterns and the additional time this requires poses a strong case for an extended intervention to increase the possibility of long-term behaviour change. The structure and content of the intervention supports the flexibility to extend the duration.

However, this approach would have required delivering the intervention over more than one school term with gaps in the intervention during school holidays. Moreover, from an education standpoint, this would have required allocating a greater proportion of the limited time available for HWB education to the focussed, albeit holistic, FFS intervention.

Parental involvement was identified within the literature review to be an important characteristic of effective interventions. Methods of increasing parental involvement were explored within the development process, but most were considered unworkable within the proposed intervention setting and methodology. It was accepted that one of the costs of engaging with large numbers of children in a school setting is limited effective parent engagement. This restricted and passive parental involvement, while an inherent characteristic of curricular interventions, may be considered to be a methodological weakness within the current design. School wide family events focussed on demonstrating the topics that were covered within each project were explored as an optional element but not included in the initial intervention design. However, the parent engagement techniques used by FFS were more applicable for a potential future move to sustainable teacher-led delivery (Cook-Cottone et al. 2009).

9.2 Critical analysis of how effectively the PPM and IM outputs achieved the research aims

There is a requirement to consider the potential effectiveness of FFS in meeting the needs of the NHSL CHWP. This will be assessed by a reflection of the process and an analysis of the outputs against the requirements of the research aims.

The outputs from PPM and IM that related to the first research question provided a valuable contribution towards achieving the ambitions of the NHSL CHWP. NHSL has a requirement to both, address inequalities in health and also to ensure that the inequality gap is not widened by approaches to health improvement which are disproportionately taken up by individuals or groups which already demonstrate superior health outcomes. For many health outcomes, including obesity, the most affluent exhibit the lowest prevalence and conversely the most socioeconomically disadvantaged exhibit the greatest prevalence (SHeS, 2014). An approach taken by NHS Boards to prevent health promotion from widening the inequalities gap is termed proportionate universalism, in which universal services are provided with additional elements of targeted support (Marmot 2010). The identification of population sub-groups or geographic areas which are likely to have higher levels of childhood overweight and obesity can therefore be used to target FFS in an approach which uses proportionate universalism.

Additionally, the identification of areas or sub-groups which are likely to display a higher prevalence of childhood overweight and obesity and, therefore, a greater requirement for preventative or management services supported the development of Local Authority area partnership planning and management groups. Evidence of a focussed and targeted approach to addressing populations or areas of greatest need was helpful in engendering partnership agreements and facilitating an ongoing working relationship. This targeted approach was focussed on achieving maximum outcomes and, therefore, justified the time and efforts of partner organisations as, in a health and social care sense; it gave the greatest potential for a return on their investment.

The outputs relating to research question 2 appear to have the potential to perform well within the conceptual model and theoretically address EBRB in the target population. As such these outputs appear to be sufficient in scope and scale to answer research question 2. It must be noted, however, that until it is delivered at scale and impact and outcome evaluations carried out, it will not be possible to confirm the efficacy of the formulation process guided by PPM and IM or to judge the effectiveness of the intervention itself. Moreover, the assessment of the results of this research question is based on a theoretical analysis of an intervention designed for real world application. This, however, cannot be addressed within the limited scope of this research and will, therefore, require additional future research.

Research question 2 also reflected the requirement of the intervention to be, within specific restrictions, theoretically informed and evidence driven. Therefore, to answer this research question the intervention formulation process was required to produce outputs that identified common elements of content, structure, approach, delivery and design within effective curricular primary school-based whole class multi-component CWM approaches, determine which elements were replicable within the proposed intervention, determine practical application strategies and incorporate this into intervention design. The outputs from PPM Phase 4 and IM Step 3 and 4 provided sufficient information on aspects related to intervention approach, design and delivery and how these could be incorporated within the formulation process to answer this question. The extensive and thorough procedures required to develop the outputs that relate to this question supported the development of a particularly detailed intervention that met the requirements of H3 eligible interventions set out by the SG, as outlined in the H3 guidance in section 7.1.1 which described the context for the intervention. This intervention also had all necessary requirements to act as a core component of the NHSL CHWP and primary driver of the H3 target.

To effectively support research question 3, the development process involved consultation with class teachers and Head Teachers on intervention content, approach, delivery and materials. It also involved discussions that explored how overall, the intervention integrated with existing core health education. The

development of the AifL materials within the CAF was also discussed within this forum and was the subject of considerable discussion. This process required the support and input from numerous Education, NHS and partner staff, some of which had to be paid for their time, but was essential to the overall success of the intervention in terms of acceptance of an optional intervention and subsequent scalability. Discussions with senior management took place in parallel with class and Head Teacher consultations as senior staff wanted to have an input in the main aspects of intervention development, if not the fine details. However, at the end of this process the guiding principles of the intervention were accepted and the sample FFS materials which were provided to the Local Authority Education Departments for verification passed their QA processes.

This verification process also identified the requirement for the CAF that was developed alongside the Intervention Structural Framework as part of the overall Conceptual Model. This was an additional unanticipated focus on curricular integration through the development of curricular planning and assessment materials alongside anticipated elements of development. This additional facet of the Conceptual Model proved to be a valuable component of the intervention as it greatly enhanced the likelihood of large scale uptake of the intervention. However, this was not the only benefit of this process as it formed the basis of the pedagogical approach within the Conceptual Model. The parallel development process resulted in an intervention that was designed to simultaneously achieve both NHS Health Improvement outcomes and Local Authority Education Department outcomes. The Health-Education Interface used intervention content based on modifiable EBRB, which were stratified into a thematic stage appropriate structure that within the conceptual model was used to apply a duel focus. This duel focus was designed to achieve, both the Matrix of Change PO using the Behavioural Approach and also the CfE EO using the Pedagogical Approach.

Additional benefits arising from the outputs of PPM Phase 4 that addressed this research question were that the intervention was guided by local expert opinion from the initial conceptualisation stages and allowed it to be tailored specifically to the needs of local communities, rather than being produced in

isolation, increasing the likelihood that it could be deliverable within local operational restrictions.

Research question 3 also focussed on attempting to ensure that the intervention which was developed met or exceeded the minimum requirements set out in the H3 guidance and passed the NHS Health Scotland QA process. The intervention was designed to successfully fit within contemporary NHSL structures, and the predicted delivery costs indicated that it could be delivered at a sufficient scale within the financial restrictions of the H3 funding. The multi-agency partnership delivery and management mechanisms built into this intervention would indicate that it can be delivered at scale over a sufficient duration but there is some inherent risk in this assumption as the ongoing support and involvement of all partners cannot be guaranteed in the long-term. However, alternative partnership structures would be applicable to the delivery of this intervention and can mitigate potential future risk.

The Theoretical Approach to Content Delivery incorporated parental involvement but limited parental involvement is an inherent characteristic of curricular interventions which cannot practicably be overcome, but even so this aspect of design met the minimum requirements of the H3 guidance. The duration of the intervention was ten weeks, which exceeded the minimum six week duration set out in the H3 guidance, but was not within the optimum duration of six to twelve months identified by Kain et al. (2014) in the literature review. It was anticipated that a duration of ten weeks would be sufficient to begin to change behaviours, but the efficacy of this duration to elicit sustainable changes to behaviours is uncertain.

The minimum data set required to be collected for every participating individual under the H3 guidance was built into the HWB assessment as the minimum that would be collected as part of the intervention but was augmented by the addition of food and activity questionnaires and fitness testing within an extended data set. This additional data collection has the potential to provide information on behaviours and physiological changes rather than simply demographics, attendance and body composition. This may overcome the methodological weakness in simply using measures of weight status within a

short term intervention that could fail to identify changes in behaviours and lifestyles that are mediators of future weight reduction and are collected by the effective school-based interventions identified in the literature review. The FFS Conceptual Model was cognisant of the relevant guidance and recommendations and as such met this essential requirement as evidenced by the acceptance of the intervention by NHS Health Scotland as eligible for inclusion as a H3 intervention following submission of the QA template.

The considered opinion of the author is that PPM and IM process produced outputs that can answer the research questions. The FFS and associated materials that were produced and the enquiry, consultations and partnerships that were developed as the culmination of this process has the potential to meet fully, and realistically exceed, the ambitions of the NHSL CHWP.

9.3 Lessons learned and usefulness of the process

9.3.1 Usefulness of the PPM and IM process

Much of the benefit of using the PPM and IM approach comes from the application of empirical evidence and theoretical underpinnings within the major components and concepts of the intervention. PPM is a strong theoretical model that can guide the development of comprehensive multicomponent CWM interventions with the best chance of being successful in school settings. PPM guides the identification and inclusion of the multiple factors that influence health and wellbeing and assists with the development of interventions that address factors that are both important and modifiable (Phillips et al. 2012). A key characteristic of PPM is the determination of desired outcomes at the inception of the planning process which ensures these outcomes are focussed on throughout the intervention development process.

The needs assessment within intervention formulation can be skewed by the focus, priorities or bias of the developer but by using PPM, partners and intended participants are actively involved in a process of identifying need and prioritising actions. As such, interventions developed using PPM are inclusive and developed with, rather than for the end recipients (Phillips et al. 2012). This model requires intervention developers to assess and potentially change existing practices and approaches in service delivery. This diagnostic method encourages the identification and consideration of the behavioural and environmental factors that may impact on a health problem and, therefore, must be considered by a proposed intervention. It also enhances the efficacy of interventions by focusing efforts on factors that are not only important but also susceptible to the change (Phillips et al. 2012). The development process starts with the desired outcomes and ensures the developer remains cognisant of this throughout. The detailed approach within PPM also minimises the potential for unanticipated consequences, and when addressing a health problem as potentially sensitive for both families and partner organisations as childhood obesity, this is a critical concern.

PPM is a process, not a set plan to follow, and takes account of indigenous practitioner knowledge and context, skipping steps where necessary. It is however very detailed which while forcing intervention developers to consider all aspects of intervention design, content, theoretical approach, delivery and setting can result in an extremely time-consuming process. That said, within the current context it was more important to produce an efficacious intervention than to complete the process quickly, therefore, as a result of these factors it can be concluded that the PPM was effective in developing a theoretical CHW intervention.

The application of IM resulted in an evidence-based programme informed by the requirements of children, families and education practitioners (Belansky et al. 2013). IM is typically applied to simple and unidimensional behaviours and can become difficult and unwieldy when applied to weight management interventions which are multi-dimensional (Pittson and Wallace, 2011). However, following the IM stages, although time-consuming within a multi-dimensional intervention programme, can ensure that the behaviours which the intervention is targeting and the change objectives selected to bring about changes in behaviours are appropriate and more likely to be effective.

FFS uses a similar methodological approach to those used by other effective multi-component CWM interventions which were reviewed by Upton et al. (2009). IM guided the incorporation of an enhanced data set within the HWB assessment to support an efficacious evaluation within a comprehensive evaluation plan. This will augment qualitative analysis of the views and experiences of participants, parents and partners, highlighting which aspects of the intervention were found to be most helpful and an analysis of this (Luttikhuis et al. 2009).

However, it should be noted that the modified PPM and IM process had not been used by the author prior before its use in developing FFS, therefore, it was unclear at times how far to develop or specifically how much content to produce at each step before moving onto the next step. This uncertainty did result in some superfluous work as there was an attempt to develop each step fully.

9.3.2 Benefits of this work to future NHSL interventions

A number of the outputs of this process resulted in the development of materials which can be considered assets that have applications beyond the parameters of this research. The content and structure of curricular alignment materials has now been established and knowledge of this process and the protocol for their development will be retained by the partner organisations and will support future resource development. Banks of delivery staff were identified and subsequently trained to deliver the intervention. This enhanced staff skillset will support their employers in the short term and increase their capacity to deliver future CWM or related HWB programmes in school and community settings. In addition, staff training packs were produced and this work will not need to be replicated in the future. Multi-agency partnerships were established and senior management, teacher, parent and child resources were produced which can be reworked to support similar programmes in the future. Furthermore, project management materials, for example, data collection logs, were produced which can be applied to similar programmes and services in the future.

The review of the theoretical underpinnings of effective school-based multicomponent interventions and the analysis of existing CWM resource packs has produced information on aspects such as intervention approaches, style and structure, staff selection, training and support, participant identification, recruitment and retention, assessment approaches and resource content. This information can be used in the development of future interventions, for example, in the nursery or high school settings. In addition, the Matrix of Change can be flexibly applied, not only to future interventions in school settings but also to other key settings for CWM.

Furthermore, current levels of parental understanding of unhealthy weight gain in childhood, its drivers and inevitable health consequences were established alongside the perceptions and attitudes of children, families and professionals of what is considered acceptable within approaches to CWM in this setting. This knowledge will prove extremely valuable in the formulation of future interventions to enhance target group engagement and retention.

9.4 Limitations of the research

A major limitation of this research it that the critique of the research outcomes must focus on the process of developing the intervention, a theoretical analysis of the conceptual model of the intervention itself and an assessment of the potential of this intervention to meet the needs of the NHSL CHWP. The processes of systematic assessments, intervention formulation and development of the evaluation plan which were described in this thesis are based on a rigorous application of approaches to intervention development (Green and Kreuter, 2005). However, it is essential to remain cognisant that while the development processes can be analysed and the theoretical conceptual model of the finished intervention scrutinised, this is merely an intellectual process carrying out a theoretical stress test that is not comparable to an assessment of the performance of an intervention in a real world setting. Therefore, when drawing conclusions from this research and the application of the findings for professional practice, it is critical to bear in mind that this thesis relates only to a planned intervention prior to delivery of FFS. Therefore, the following section will attempt to identify some limitations within this research and potential methodological weaknesses of FFS.

Based on H3 Target guidance and requirements, the limitations of fitting within the NHSL CHWP and the partnership management approach some aspects of the intervention design and delivery were already decided before the formulation process were carried out. As a result, not all options were available during the design and development process and this has implications for developing an intervention that takes full advantage of the PPM and IM process. For example, existing partner requirements such as geographical targeting of support services and elements that were dismissed prior to the development phase such as holiday time delivery must be considered when assessing the potential efficacy of this process.

The NHSL Board area, in common with most of Scotland demonstrates a high but stable prevalence of childhood obesity. As a result, the health problem FFS was designed to address is not unique to this area and neither is the application of

the intervention itself. The partnerships and staff selection used by the intervention were based on current NHSL and partner organisation structures which are available in most Scottish geographical Health Board areas so could, therefore, be replicated across Scotland. Beyond Scotland, the systems and structures employed by this intervention are flexible enough to be applied to existing organisational structures in different areas. However, one aspect of the Conceptual Model that is not directly applicable outside of Scotland is the CAF as this was developed specifically to align with a CfE and AifL. While the pedagogical underpinnings of curricula outside of Scotland may be directly comparable to those upon which the CAF was developed the concepts behind this element would need to be considered before they could be used by researchers in other settings. This, therefore, may have implications for the application of the CAF outside of the setting in which it was designed. A new intervention could be developed using all elements of the Conceptual Model except the CAF, but this would potentially reduce its acceptance in schools, negatively influencing scalability, and would negate any theoretical benefits of the Health-Education interface.

The planned HWB assessment methods included both validated measures such as BMI assessment (Cole et al. 1998) and non-validated measures such as food and activity diaries that were developed for this intervention. Data from the non-validated assessments would, therefore, be questionable and comparison with the results of other studies will be problematic. Planned data collection methods such as self-reporting are amongst the most practical and cost effective way of generating data from large groups provide scope for inaccuracy. These limitations were considered within the development of the evaluation plan and approaches to ameliorate these risks were identified. These potential future data collection methods identified to improve data validity included using face-to-face data collection methods instead of pupil self-completion of assessment sheets, the modification of data collection tools for different levels of cognition and pre-data collection explanations. Additional options which were also considered included linking data collection into class lessons in maths or literacy, checking pupil and teacher understanding levels on assessment tasks, teachers suggesting stage appropriate terminology and purchasing validated tools.

Moreover, beyond the validity of the measures that were included it is important to remain cognisant of potential measures that would have been beneficial to include but were not possible within the scope of this intervention. The three High Level Objectives of the intervention were to support participants to move towards, achieve and maintain a healthy weight status, to improve physical, social, mental and emotional health and to improve QOL. However, only weight status, measured through assessment of BMI status, will be assessed directly. Improvements in physical, social, mental and emotional health and overall QOL can be inferred from improved weight status (Lobstein and Jackson-Leach, 2006), increased PA levels and an improved diet but indirect assessment presents an additional methodological weakness.

In addition, the plan for the administration of HWB assessments utilised healthy lifestyle coaches who were selected based on experience in intervention delivery rather than the collection of research data, thereby risking the validity of future comparisons with other research. Training was provided to support this area of their work but the quality of the assessments they may carry out and validity of any results must still be considered. QA measures were also put in place to remove any incorrectly gathered data and included threshold cut-off points, maximum allowable differences between pre and post test results and exceptions, for example, pupils getting shorter between weeks one and ten, to remove outliers and mistakes from data sets. Moreover, despite planned geographical and socioeconomic targeting, participating schools will be self-selecting, potentially steering intervention delivery to more motivated or interested schools, and pupil participation in the HWB assessments was based on parental consent. Therefore, a future data set must be considered a convenience sample. Furthermore, no controls were put in place to account for the effect of other HWB programmes taking place in the school at the same time as FFS and, therefore, there is potential for contamination of results. However, if successful FFS will be delivered at a Health Board scale over several years and as such; potential issues around inaccuracies in data collection by individual staff and school selection will be limited by the sample size of the data set.

No control schools were included in the design of the evaluation plans as they could not provide process, impact or outcome data and participants could not be counted towards the H3 target. This deliberate omission of control schools from the evaluation plan will not directly influence the results of this thesis but could limit future research on evaluations of the effectiveness of the intervention and may be considered a methodological weakness of the evaluation plans. This limitation, may however, be addressed in the future by adding schools to a waiting list and collecting pre-intervention data at the start and end of the school term directly preceding involvement in the intervention. This would provide baseline data for these schools and control group data for the intervention as a whole.

A potential limitation of this research is that the results are the outputs of PPM and IM but there is a risk that individual outputs can be developed too far if too much time is spent on a specific phase or step or through the duplication of work which is required by both elements. Also, the level of detailed enquiry required by certain stages of the process, for example, IM Step 3 which guides the selection of theory-based intervention methods and practical application strategies, led to the identification of numerous approaches which could all conceivably been incorporated into the intervention design. This resulted in an unintended consequence of the process whereby an attempt was made to incorporate too many elements into the conceptual model. For example, attempts were made to combine a number of theories of behaviour change within the behavioural construct using a multimodal approach which appeared initially to integrate well together. However, this would have caused a level of complexity within the intervention design and delivery that would have made practical application problematic and in the opinion of the author less effectual. Consequently, it should be kept in mind when using the PPM and IM process that the systematic assessment and identification of potential practical and theoretical elements of interventions is so thorough that developers may be tempted to include more than is necessary to achieve better outcomes but inadvertently reduce intervention efficacy.

NHSL has a requirement to ensure that all programmes and services reduce the HWB inequality gap. There is a possibility that this intervention will be more

effective at addressing unhealthy weight gain in childhood, either through weight reductions or a reduced rate of weight gain, in children from a higher socioeconomic status. While the intervention can be geographically targeted to increase the likelihood that children from more disadvantaged socioeconomic backgrounds have equity of access or preferential access, in line with the principles of proportionate universalism (Marmot, 2010), the nature of the intervention itself means that beyond age specific projects for each year group it must be delivered in the same way across Lanarkshire regardless of the socioeconomic status of participants. This therefore, presents a risk in that children from more affluent families may achieve superior reductions in BMI as the financial status of these families may make it easier to implement some suggested lifestyle changes, for example, increasing levels of extra-curricular PA. If this situation occurs it could increase the chances that these children are supported to achieve the intervention High Level Outcomes and PO, thereby, increasing the inequality gap between them and peers from a lower socioeconomic status. This risk is a potential limitation of the intervention but cannot be assessed directly until a sufficient amount of data on the impact and effectiveness of the intervention is available.

9.5 Implications for professional practice

9.5.1 Critical reflection on how the results of this research align with national guidance

The main child obesity and overweight prevention recommendation in SIGN 115 (Hering et al. 2010) was that sustainable school-based interventions should be used by and across agencies and further, that active parental or family involvement should be facilitated. This however, did not describe sustainable methodologies for school-based prevention interventions, make any recommendations for which agencies should address this issue in the school setting, identify ways in which cross-agency working can be achieved or suggest effective methods of parent or family involvement. Furthermore, while SIGN 115 gave some guidelines on the components of multi-component approaches, such as increased PA and decreased TV viewing, it did not elucidate the content of the components. It also does not mention behavioural approaches for the prevention of childhood obesity, only referencing this in the treatment recommendations. In essence, SIGN 115 provided guidance on what to do to prevent childhood obesity but not on how to actualise this.

What was surprising is that the main recommendations offer so little fine grain detail on key areas of effective multi-agency approaches and parent or family involvement. This presents the risk that researchers or programme managers utilise approaches that are less than optimal. Moreover, the absence of guidance on the incorporation of behavioural components within design or delivery of child obesity prevention intervention could be considered a weakness of this guidance. In Scotland, most children are within a healthy weight range but most adults are not, so it would seem to the author to be important to use all available tools when attempting to support children within a healthy weight range to remain so.

Paediatric obesity treatment guidance within SIGN 115, not taking account of surgical or pharmacological approaches, focuses on targeted work with obese populations usually in the home, community or clinical setting as opposed to

treatment in the universal CWM approaches for whole class groups that were reviewed in chapter 1 this thesis. The SIGN 115 child obesity treatment guidelines recommended that interventions designed to manage existing childhood obesity should incorporate behaviour change components and be family based with the aim of changing the lifestyles of the whole family. Furthermore, interventions should focus on decreasing overall dietary energy intake, increasing PA levels and decrease levels of SB including time spent on screen-based activities. A specific duration is not directly recommended but interventions lasting, at least, six months are suggested

The behaviour change components that are recommended for incorporation into treatment interventions that SIGN 115 define as behavioural interventions, were described as behaviour modification techniques such as goal setting and rewards. Those techniques recommended by SIGN 115 were those outlined in the previously published NICE 43 (2006) guidance. What was surprising to the author was again the lack of detail about the content of these recommended components, how they can be applied and also a focus only on behaviour change techniques with no mention of behavioural theories, models or approaches. These recommended behaviour change techniques were incorporated into FFS at the formulation stage but SIGN 115 did not advise how this should be done. Therefore, rather than simply using these techniques within lesson plans the approach to practical application and aligned them to appropriate PO and used them as a focus for the Health Skills for Life aspect of year group projects. SIGN 115 did not reference behavioural theories, models or approaches but the literature review identified their use as efficacious so they were included as a core element of intervention design.

In light of the national SIGN 115 paediatric obesity guidance, the results of this research may provide intervention developers key points to consider for child obesity prevention as the development process formulated a Conceptual Model, which adhered to the guidelines for both prevention and treatment of childhood obesity. Furthermore, the intervention uses practical application strategies for a sustainable delivery methodology based on a multi-agency partnership management and delivery approach. The application of the Behavioural Change

Construct to a combined preventative and treatment approach also bring in an early intervention element.

The results of this research many elucidate application strategies, not immediately clear from national guidance, for programme managers who are developing new interventions and may wish to do so based on the SIGN 115 recommendations. However, these guidelines provide broad recommendations on what should be incorporated within interventions but do not provide guidance on how to develop interventions that can incorporate these elements or subsequently be practically applied. Also, those effective universal prevention and treatment CWM interventions that were identified within chapter 1 of this thesis provided little information on intervention design, delivery and management procedures.

Using PPM and IM as an evidence-based development approach for CWM interventions can bridge this knowledge gap between national guidance and intervention design or between evidence-based approaches in the literature and practical application at a local level. FFS provides an example of how national guidance and best practice from empirical research can be incorporated into a real world health promotion setting. Moreover, FFS combines the concepts and components recommended by SIGN 115 for both prevention and treatment approaches in a single, albeit complex, Conceptual Model with a methodological approach to delivery at a large scale that has the potential to remain effective. This research may, therefore, provide an example of a theoretical CHW intervention that uses a Conceptual Model, which can achieve the ambitions of both prevention and treatment approaches. This intervention can be delivered by existing partnership staffing structures and applied at a Health Board scale within contemporary organisational and financial restrictions.

9.5.2 Unexpected findings

A critical analysis of the processes carried out within this research has identified some unexpected findings. Primarily these are the apparent synergies that exist within the behavioural construct between the cross-cutting factors of the SEM,

the behavioural determinants of the Matrix of Change for PO and the SCT. This may indicate the appropriateness of the selected behaviour change theory and model for incorporation into the Behavioural Construct within a health intervention that used the IM protocol to guide the focus of the intervention on behavioural determinants and ultimately target behaviours.

The development process produced a combined behavioural and pedagogical approach, which was not envisioned before the commencement of the process, but was created to overcome a potential weakness in the levels of voluntary uptake of the intervention by schools and, therefore, address a risk to achieving the H3 target. This element that was intended to ameliorate the risk of low participation levels may have unexpected implications for professional practice in intervention design and efficacy. This cannot be tested in the current thesis, but the concept of the health-education interface which emerged from this research may have the potential to bridge the gap between the often divergent approaches taken in the health and education sectors to achieve shared HWB ambitions and enhance both health and educational outcomes for participating children.

9.5.3 Potential future research directions based on the results of this research

Future work would initially review delivery as part of a feasibility study to test the theoretical intervention within a real world application but beyond that much consideration has been given to the restrictions that were put in place, primarily by the requirements of the H3 target, which influenced the methodological approach utilised by this intervention. If a future school-based intervention was developed which was free of the constraints of the H3 requirements, then some of the limitations in the current conceptual model could be addressed and both approaches could be directly compared.

The processes by which the Conceptual Model was developed, alongside planned delivery and evaluation mechanisms, are reported in this thesis and can be followed by others who may wish to replicate this work. The health-education interface requires to be tested both in terms of practical application and in

terms of impact and effectiveness in achieving the ambitions the health and education sectors. This could represent the primary focus of future research in the area of curricular paediatric weight management and if found to be effective will have implications for collaborative cross-sector approaches to addressing this health issue. Alternatively, future research could expand on the application of the FFS Conceptual Model by modifying the aspects that were restricted by the H3 guidance and were not in line with elements of the SIGN 115 guidance. Specifically, future research could explore the acceptance and practical application of a duration longer that six months, possibly throughout the full academic year, and methodological aspects that focus on active family engagement, rather than passive parental involvement, through an enhanced home-link as a primary focus. This research may be supported, and outcomes potentially enhanced, by a financially neutral and sustainable approach based on teacher-led delivery.

Future research may be further supported by the flexibility of the Intervention Structural Framework that can be taken by researchers and applied to different age groups or settings by altering the lesson plan content. The delivery methodology can be applied to a broad range of non-expert delivery staff and that increases the scope for potential delivery in different areas. This is particularly salient as the cost per case analysis indicates that this approach should be used by practitioners who must consider financial aspects of intervention delivery when developing future interventions.

9.5.4 Contributions of this research to non-clinical child weight management interventions

Many of the identified CWM interventions either did not include or report the application of a developmental and operational logic model. Using PPM and IM within this research allowed the incorporation of theoretical behaviour change approaches, targeted at modifiable determinants of specific EBRB in a way that orientated the intervention to the delivery setting, incorporated partnership management structures and fit within the structural limitations of the host organisations. This supported the development of an intervention that had a greater likelihood of achieving its desired outcomes but also being sustainable in

the long term. This research, therefore, has the potential to address some of the methodological weaknesses in non-clinical CWM interventions that have failed to report positive outcomes or demonstrate significant long-term changes to obesity-related behaviours and subsequently weight status.

This Conceptual Model was designed to fit the primary school setting but has the flexibility to be applied in nursery or high school setting. Furthermore, this approach to the modification of lifestyle behaviours could be applied to other areas of health such as substance misuse and alcohol. Also, many effective school-based interventions are not scalable or sustainable because they rely on expert delivery staff such as weight management professionals or psychologists and many large scale interventions have limited efficacy because they rely on non-expert delivery. However, the expertise within this intervention was applied in the conceptualisation and design process which formulated an intervention that may overcome some of these limitations. It is hypothesised that the Conceptual Model of FFS allows for non-expert delivery staff to deliver an intervention which has the potential to modify EBRB at a Health Board level. Moreover, the FFS Conceptual Model will have the potential to bridge the gap between efficacy and scalability.

In the absence of guidance on combined prevention and treatment approaches within SIGN 115, FFS has the potential to fill a gap in the knowledge base on the process of developing an intervention that incorporates national prevention and treatment guidance within a combined approach in the school setting. Furthermore, the Behavioural Construct within this intervention facilitates the application of SIGN 115 treatment guidance in a setting traditionally associated with prevention.

10. Conclusion

In health improvement intervention planning, it is important to follow a protocol-based, stepwise process of development and evaluation to increase the likelihood that an intervention will reach its target audience and achieve its stated goals and objectives. This will also help to ensure it is implemented and evaluated effectively, provides co-productive opportunities for the community to address social equity issues and maximises the likelihood that the programme will become sustainable (Crosby and Noar, 2011). To meet these health improvement intervention planning ambitions, FFS was developed using a modified combination of the PPM (Green & Kreuter, 2005) and IM protocol (Bartholomew et al. 1998). Using the PPM and IM as a framework or logic model for intervention development and future management supported the efficacy of the process and the validity of subsequent results.

The school setting was identified as the ideal place to apply, at a Health Board scale and in a cost-effective way, interventions which combine overweight prevention and management activities (Story et al. 2006). The development process further involved analysis of appropriate methods of behaviour change that can underpin obesity prevention interventions, selection of educational strategies appropriate to young children (Gibson et al. 2012) and the identification of suitable delivery models to operate an intervention within schools (Nethe et al. 2012). Furthermore, the intervention was produced based on policy and sociocultural factors, local insights and reviews from key partners and critical appraisal of materials from children, parents and teachers. FFS was developed to utilise the concepts of the Social Cognitive Theory and simplified Motivational Interviewing within a Socio-Ecological Model structure to apply behaviour change techniques through a pedagogical and health promotion approach to facilitate changes to specific behaviours in the target population.

This thesis outlines the conceptualisation, design and development an evidence-driven and theoretically informed whole class school-based Child Healthy Weight intervention. This is a new approach to combined child overweight and obesity prevention and treatment within a multicomponent intervention that has the potential to modify energy balance related behaviours and address unhealthy

weight gain in across the primary school age range. The development process aimed to learn from the emerging future rather than basing future solutions entirely on evidence and guidance from the past and remain cognisant of predicted future outcomes, local contextualisation and the requirement for cross-sector exchange of ideas.

The FFS Conceptual Model developed through this research is a prototype framework that could be the basis of future school-based approaches. Aspects that may support effectiveness include a comprehensive Curricular Alignment Framework built on an intervention with a holistic multi-component approach (Fairclough et al. 2013) with an emphasis on behaviour change (Watson-Jarvis et al. 2011) that is delivered using Motivational Interviewing with pupils (Christison et al. 2014). FFS is theoretically powerful and prior to implementation appeared to have the potential to support a transformational change in the way that combined child obesity prevention and treatment approaches are developed for the school setting and sustainably delivered at scale. The FFS Conceptual Model uses a different approach that might be more effective than those used by previously published interventions that have reported mixed result and often demonstrate little significant differences to immediate or long-term changes in obesity-related behaviours. This potentially effective method of bridging the knowledge gap between empirical evidence or national guidance and practical application in real world settings can inform future intervention design and delivery in this setting and identify one potential route to address a local health problem of national significance. Moreover, at an NHS Lanarkshire level, the results of FFS will be disseminated among key stakeholders in order to support decision-making for public health policy and health promotion planning.

APPENDICES

Appendix 1

Effective universal, school-based, multicomponent child weight management interventions identified through the literature review

Intervention name	Author
Healthy Buddies	Stock et al. (2007)
Unnamed*	Kain et al. (2014)
CHANGE	Fairclough et al. (2013)
GreatFun2Run	Gorely et al. (2009)
AFLY5	Kipping et al (2014)
CHILT	Graf, 2005
CHILDREN Study	Angelopoulos et al. (2009)
Lekker fit	Jansen et al. (2011)
APPLE	Taylor et al. (2007)
HEIA (3 studies)	Grydeland et al.(2013)
Project Energize	Rush et al. (2012)
Unnamed*	Rosario et al. (2012)
EdAl	Tarro et al. (2014)
Avall	Llargues et al. (2011)
WAY	Spiegel and Foulk (2006)
LA Health Project	Williamson et al (2012)
Bright Start	Story et al. (2012)
CATCH	Coleman et al. (2005)

*Intervention not named within the journal article

Appendix 2

Reviewed CWM, Healthy Eating, Healthy Lifestyle and Physical Activity Interventions

Reviewed Interventions		
ABC for Fitness ACES Active Choices Active Movement Active8 Action Schools Be Active BC Action Schools BC Integrated Health Education Chew on This CSH Counterweight Dish it Up Daily Activity Eat Like a Champ Early Moves Early STOPP EmpowerMe4Life Fit Club FNEP Food and Farming	Food Dudes Food Route Game on Wellness Challenge GOALS Great Grub Club Great Food Journey Health Get Moving, Get Learning CrickEd Healthy Eating and Lifestyle Programme Healthy Food– A Fact of Life Healthy Kids Healthy Kids for Life Healthy Kids in the Classroom Healthy 'n Wise HEALTHY Study Healthy Weights Heart Healthy Kids I Move, We Move	Jump up and Go Jump Start LEAP Max in the Middle Mission Nutrition My Plate Media Smart Nutrition Detectives Operation Fit-Kid Pause to Play Screen Smart Snackativity SPARK Sip Smart Take Shape TravelSmart TAAG We Can Whole School Active Transport 5210 Let's Go

Appendix 3

Behaviour change techniques used within the CHW intervention

Set homework tasks	Goal setting	Feedback on monitored behaviours
Monitoring of specified behaviours	Comparison with past behaviours	Social comparison
Contract of agreed performance	Planning	Coping planning
Goal review	Prompt	Graded tasks
Instruction	Modelling of behaviours	Relapse prevention
Persuasive communication	Decision-making	Time management
Contextualised messages	Behavioural information	

Appendix 4

Elements of the four Capacities of CfE supported by the P1 Healthy

The Four Capacities	
Successful learners *with* • enthusiasm and motivation for learning • determination to reach high standards of achievement • openness to new thinking and ideas *and able to* • use literacy, communication and numeracy skills • use technology for learning • think creatively and independently • learn independently and as part of a group • make reasoned evaluations • link and apply different kinds of learning in new situations	**Confident individuals** *with* • self-respect • a sense of physical, mental and emotional wellbeing • secure values and beliefs • ambition *and able to* • relate to others and manage themselves • pursue a healthy and active lifestyle • be self-aware • develop and communicate their own beliefs and view of the world • live as independently as they can • assess risk and take informed decisions • achieve success in different areas of activity
Responsible citizens *with* • respect for others • commitment to participate responsibly in political, economic, social and cultural life *and able to* • develop knowledge and understanding of the world and Scotland's place in it • understand different beliefs and cultures • make informed choices and decisions • evaluate environmental, scientific and technological issues • develop informed, ethical views of complex issues	**Effective contributors** *with* • an enterprising attitude • resilience • self-reliance *and able to* • communicate in different ways and in different settings • work in partnership and in teams • take the initiative and lead • apply critical thinking in new contexts • create and develop • solve problems

Source: The purpose of the curriculum - what is curriculum for excellence? - learning and teaching

Areas of the Four Capacities that are supported by the P1 HE Module are underlined

Appendix 5

P1 Healthy Eating Module Assessment is for Learning Framework (lessons 1-4 only)

AifL Framework	
Lesson 1 - Assessment of this lesson: • No hands & thinking time when listing healthy foods & unhealthy foods. • Teacher feedback on children's answers • Peer evaluation of drawings of foods from each group. • Teacher assessment of understanding of task results • Plenary to end the lesson	**Lesson 2 - Assessment of this lesson:** • No hands & thinking time when listing fruits • Teacher feedback on children's knowledge of fruits • Self/Peer evaluation of their performance during the task • Teacher assessment of understanding of lesson aims • Plenary to end the lesson
Lesson 3 - Assessment of this lesson: • Teacher feedback on the children's answers • Self and peer evaluation of completion of the task • Teacher assessment of understanding of task and aims • Plenary to end the lesson	**Lesson 4 - Assessment of this lesson:** • No hands & thinking time when listing possible fruits • Teacher feedback on children's answers • Teacher assessment of understanding of the task • Plenary to end the lesson

Appendix 6

P1 Healthy Eating Module Assessment is for Learning Traffic Light Assessment Grid

Name	AifL areas for P1 HE Module							
	Can name the parts of the healthy eating plate,	Can list and draw accurately a selection of fruits and vegetables.	Can a design and accurately draw a healthy fruit salad.	Can design and accurately draw a healthy vegetarian pizza.	Can design and accurately draw a healthy fruit kebab.	Can accurately draw a fruit and vegetable rainbow.	Can design and accurately draw a healthy sandwich.	Can design and accurately draw the ingredients and the finished healthy fruit smoothie.
Pupil 1								
Pupil 2								
Pupil 3								
Pupil 4								
Pupil 5								
Pupil 30								

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