

A systematic map of the research on the relationship between Obesity and Sedentary Behaviour in young people

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the relationship between Obesity and
Sedentary Behaviour in young people**

TECHNICAL REPORT

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List of abbreviations

ANCOVA	Analysis of Co-variance
ANOVA	Analysis of Variance
BMI	Body Mass Index
DCSF	Department for Children, Schools and Families
DoH	Department of Health
FFM	Fat free mass
FM	Fat Mass
RCT	Randomized Controlled Trial
SES	Socio-economic status
TV	Television
UK	United Kingdom
US	United States of America

Abstract

What do we want to know?

The systematic map aimed to review the scope of the quantitative research literature on the relationship between obesity and sedentary behaviour in young people aged 6-16 in order to:

- Identify where there appeared to be gaps in the literature;
- Assess whether there was sufficient research to warrant an in-depth review and synthesis.

Who wants to know and why?

In January 2008, in the report 'Healthy Weight, Healthy Lives', the Government recognized obesity reduction as a national priority and set out an aim to reverse the current obesity trend. It has been argued that a better understanding of the dynamics of weight gain amongst young people is required to design effective policy solutions. Increasing levels of sedentary behaviour such as television viewing have been hypothesized as having some relation to the increase in weight being found amongst young people.

What did we find?

- 326 relevant studies were identified. The majority of studies were conducted in the United States, followed by Canada and Australia. Only 15 were undertaken in the UK. Studies covered both Primary and Secondary school age ranges and most covered both boys and girls.
- Studies used a variety of different measures of sedentary behaviour. The most frequent measure was time spent in TV, film and video viewing or a proxy for this, such as TV in the bedroom or number of TVs in the house. This was followed by computer use/playing computer games/owning a computer and playing video games. Most studies use Body Mass Index (BMI) as an indicator of obesity.

- Most studies explored the relationship between obesity and sedentary behaviour. 197 studies attempted to assess the effect of sedentary behaviour on obesity, 65 studies aimed to assess the effect of obesity on sedentary behaviour, and eight studies assessed both. In addition there were 41 intervention studies that attempted to manipulate sedentary behaviour and assess its effect on obesity.

It is our judgement that there is probably sufficient evidence to address two specific in-depth review questions:

- What are the factors/mechanisms that link sedentary behaviour to obesity in children aged 6-16?
- What is the impact of interventions that aim to reduce sedentary behaviour on reducing obesity in children aged 6-16?

Further primary research may also be needed as comparatively few of the studies identified were carried out in the UK.

What are the implications?

This systematic map of the quantitative research literature on the relationship between obesity and sedentary behaviour in young people aged 6-16 aimed to identify literature on the factors that link sedentary behaviour with obesity as well as interventions that influence obesity/sedentary behaviour. This map cannot provide answers about the relationship between obesity and sedentary behaviour but rather indicates potentially fruitful directions for future research. Implications for primary and secondary research are discussed.

How did we get these results?

A thorough search strategy was developed and all of the main social science databases were searched for relevant research. In addition, 'handsearching' of bibliographies and searches of the so-called 'grey' literature was undertaken. The initial searches identified 9,769 papers. After removing duplicate papers and applying the inclusion/exclusion criterion, 326 full text studies on the topic were identified. Limited coding was undertaken to enable limited description of studies.

CHAPTER ONE

Background

1.1 Background and rationale for the current map

Over the past two decades, there has been an increase in the prevalence rate of obesity amongst children in England (Chinn and Rona 2001, Lobstein *et al.* 2003) and other developed countries (Flodmark *et al.* 2004, Ogden *et al.* 2006). For young people and children in particular, the increase in prevalence has been at least threefold (Boone *et al.* 2007, Ogden *et al.* 2006, Stamatakis *et al.* 2005). In England between 1994 and 1998 the increase in the proportion of children overweight increased from 13 to 20 per cent (Lobstein *et al.*, 2003). It is argued that excess weight in childhood is not only linked to adult obesity but also has negative behavioural, social, economic and psychological consequences in the shorter-term (Flodmark *et al.* 2004, Reilly and McDowell. 2003a).

In January 2008, in the report 'Healthy Weight, Health Lives' (Department of Health, 2008), the Government recognized obesity reduction as a national priority. The initial focus of this program is directed towards children with the aim of reducing the number of obese children by 2020 to the level they were in the year 2000.

1.2 Research background

It has been argued that socio-cultural and environmental rather than genetic changes explain the trend toward increased weight (Spanier *et al.* 2006). Increases in energy consumption (i.e. food intake) and reduction in energy expenditure have created imbalances in energy intake and expenditure, which, for individuals over time, results in obesity (Dietz 2001, Spanier *et al.* 2006). There has been a large amount of research conducted on or about the intake side of the equation and similarly considerable attention has been paid to physical activity on the output side.

Researchers in this field have argued that sedentary behaviour is not the same as a lack of active behaviour. They have pointed out that sedentary behaviour can co-exist with active behaviour and in fact there is little correlation between the two (Biddle *et al.* 2004a, 2004b). Instead they have pointed to the need to understand sedentary behaviours and their relationship to obesity rather than activity/inactivity (Biddle 2007, Dietz and Gortmaker 1985, Spanier *et al.* 2006, Owen *et al.* 2000)

There have already been studies and reviews which have investigated some aspects of 'sedentary' behaviour. Most research has focused on TV viewing and weight gain alone. However, Biddle (2007) points out an important paradox: that while obesity figures are increasing, TV viewing habits have remained consistent over the past few years. Marshall *et al.* (2004) conducted a systematic review and meta-analysis of studies that reported on the relationship between TV viewing and computer game/video use and body fatness and physical activity. The study found a small but statistically significant relationship between TV viewing and body fatness. The findings showed that the relationship was too small to be of 'substantial clinical relevance'. However, the treatment of TV viewing as a proxy for inactivity has been questioned by other researchers (Reilly *et al.* 2003b) who point out that up to half the time spent in inactivity is spent in behaviours other than TV viewing.

Previous reviews have either been focused in their conception of sedentary behaviour e.g. as television viewing (Marshall *et al.* 2004) or have not systematically searched and synthesized the research in this area (Coon and Tucker 2002, Must and Tybor 2005).

1.3 Definitional and conceptual issues

1.3.1 Obesity

There is some debate about the point at which being overweight becomes a pathological issue. Whilst it may be argued that the issue of concern is excessive weight gain this is difficult to operationalise in a standardized fashion. One common approach in the scientific and policy-making community has been to use 'obesity' as the cut off point. This review has followed such an approach as it allows a standardized method of study identification and selection to be applied. It is recognized however that this may result in an underestimation of the scale and scope of the literature identified.

Obesity is defined as a condition where the accumulation of fat in a person's body is likely to become harmful for his/her health. The condition is a result of the accumulation of excess body fat mass when there is greater consumption of energy than expenditure over a period of time. Although measuring percentage of body fat or skin fold thickness would be ideal, it is difficult and often impractical to use in large studies (Cole *et al.* 2000). Body Mass Index (BMI), which may be less sensitive but is easier to measure, has become widely used in epidemiological research (Cole *et al.* 2000). However, it should be kept in mind that BMI is only a proxy measure of body fat and is a less useful measure at the individual level (Flodmark *et al.* 2004). Obesity in adults is defined as having a BMI of 30 kg/m² or more while overweight is having a BMI at or above 25 (NHLB 1998, WHO 1997).

In adolescents and children the criterion is less clear. In a study that conducted a survey of 26 countries, the BMI cut-off points to categorize young people as obese or overweight ranged from 85th to 97th percentile (Guillaume, 1999). This wide range is extremely problematic as even small variance in percentiles can lead to a different estimate of the prevalence of obesity. Added to this is the problem of using different indexes to measure obesity which can also lead to varied results (Guillaume, 1999). Therefore, it is important to keep in mind that although obesity in children and adolescents is measured using the same indexes, the cut-offs are not universally agreed upon and differ from country to country. For children and adolescents it is essential to keep age and gender in mind as well as pubertal status as these factors can cause variations in BMI (Flodmark *et al.* 2004).

1.3.2 Sedentary behaviour

Despite the demands in the literature to focus on sedentary behaviour as a concept in itself, there appears to have been little systematic analytical consideration of what sedentary behaviour is and/or isn't. From a biological perspective, sedentary activities are those in which energy expenditure levels are close or equivalent to the resting metabolic rate (Dietz, 1996). These activities consume very little energy. Activities which raise the basal metabolic rate increase energy consumption. The salient issue would therefore appear to be the balance between energy intake on the one side and activities which use energy on the other.

The most common practical expression of this model, reflecting a 'behavioural tradition' dominant in contemporary health promotion, categorizes people's behaviour rather than the activity itself. In this approach adults who indulge in less than 30 minutes of moderate exercise or those that expend less than 10 per cent of their daily energy through physically intense activities are said to be sedentary (Allender *et al.* 2008, Biddle *et al.* 2004a). For children and young people, one hour of moderate intensity activity daily is the primary recommendation by the US Department of Health and Human Services (1996). This approach may equate the lack of vigorous activity to inactivity and may also equate 'sedentary behaviour' with 'inactivity'. The drawback of this type of approach is that it assumes that if people are not indulging in vigorous activity, they are not indulging in any activity (Biddle *et al.* 2004a) and that all 'inactivity' makes the same energy consumption demands on the body. Further, a study by Marshall *et al.* in 2002 found that there is little relationship between physical activities and sedentary behaviour in young people and that both can co-exist.

The approach taken by some other researchers appears to be different in that it differentiates between inactivity and sedentary behaviours and considers indulging in particular activities such as television and video viewing or playing computer and video games to be sedentary activities. Therefore, an increasing number of studies record sedentary activities using time use diaries as this makes it possible to measure the duration and frequency of sedentary behaviours. It also helps identify the type of sedentary activity compared to accelerometers that only provide information on the energy expenditure. Hamar *et al.*, (2009) in a recent study of young people in Hungary, has identified TV viewing to be one of the most frequently occurring sedentary behaviours, followed by homework, sitting in motorized transport, sitting and talking and playing computer/video games. Gender differences in sedentary behaviour activities were also seen. The disadvantage to this approach would appear to be that it does not seem to take into the account the

underlying biological issue of imbalance between energy consumption and energy expenditure which is considered to be the root cause of obesity and overweight.

Therefore, it is important to consider the 'mechanism' that causally links obesity with 'sedentary' behaviour. One theory is that television watching is associated with increased consumption of food that has high energy value (Ashton 2004, Coon and Tucker 2002), perhaps due to a link with advertisements. However, others have questioned this link (Ashton 2004).

On the energy expenditure side, a displacement hypothesis has been proposed that suggests that increasing sedentary behaviour contributes to obesity by ensuring a sustained period of low energy expenditure and competing for the time that could have been utilized by physical activity (Epstein *et al.* 2005, Fox and Riddoch 1999). As explained before, this link has also been questioned by Marshall *et al.* (2002) by showing that the two can co-exist.

Others have argued that sedentary behaviour is linked to changes in metabolic rate, particularly in women (Ferraro *et al.* 1992, Klesges *et al.* 1993). However, this relationship was not replicated in other studies that aimed to examine the effect of television viewing on resting metabolic rate (Dietz *et al.* 1994).

For the purpose of this review, sedentary behaviour was considered to be a class of low energy consumption activities such as: TV viewing; computer use; talking on the phone; use of motorized transport; sitting in a classroom; doing homework; sitting doing nothing; talking with family and friends; reading; listening to music; and cognitive hobbies etc (Biddle *et al.* 2004a, Epstein *et al.* 2000, Must and Tybor, 2005).

1.4 Authors, funders, and other users of the review

The systematic review/map was completed by the EPPI-Centre. The funding for the project was from the Department of Children, Schools and Families (DCSF), UK.

1.5 Review question

The review question was as follows:

What is the relationship between sedentary behaviour and obesity in children and young people aged 6-16?

CHAPTER TWO

Methods used in the map

2.1 User involvement

The DCSF/DoH Advisory group provided input at the stage of scoping the review question and to protocol development.

2.2. Defining relevant studies: Inclusion and exclusion criteria

Detailed information about inclusion and exclusion criteria are given in Appendix 2.1.

2.3 Identification of potential studies: Search strategy

Full details of the search strategy are given in Appendices 2.2 and 2.3. The search strategy included:

- Searching bibliographic databases
- Citation searching of key source documents
- Contacting experts/key organizations
- Internet searches

2.4 Screening studies: applying inclusion and exclusion criteria

Based on the research question, a search strategy was developed. Studies were searched on the basis of the specific search terms listed in Appendix 2.2. The inclusion criteria were used to identify the studies included in this map. After an initial screening on the basis of the abstract and titles, full-texts of relevant papers were obtained. These were excluded if they met any of the exclusion criteria.

2.5 Characterizing included studies

To facilitate rapid completion of the map, a limited amount of coding was undertaken on the definition of sedentary behaviour/inactivity, study participants and their characteristics, setting of the study and some characteristics of the variables in the study. Map specific questions were developed for this review with the aim of being able to analytically describe the literature in this field. The limited time available for completion of the map meant that it was not possible at this stage to code for study methods and quality information. The keywording tool can be found in Appendix 2.4.

2.6 Identifying and describing studies: quality assurance process

The exclusion and inclusion criteria were developed and piloted by the review team. The screening for the map was conducted by one reviewer. Where it was not clear if a study met the inclusion criteria, the study was screened by an independent reviewer and differences were resolved through a discussion. Two reviewers were involved in the coding process. However, each study was coded by only one reviewer. Some papers were selected and independently coded by another reviewer to ensure consistency in coding. Where there were differences in the data extraction of the two reviewers, these were resolved through a discussion.

Moderation was also conducted at the beginning of each process (i.e. screening and coding). This was a process in which all the reviewers involved in this review discussed their screening and coding procedure. It was done to ensure that there is a uniform understanding of the criterion applied in this review.

CHAPTER THREE

Identifying and describing studies: results

3.1 Studies included from searching and screening

9769 papers were identified. Table 3.1 illustrates how the records were screened in order to identify the 326 studies that are relevant to the research question:

3.2 Characteristics of the included studies

3.2.1 Setting of the study

The 326 studies that met our inclusion criteria were conducted in 53 different countries across the world. Seven studies compared more than one country. A list of the countries where these studies were conducted or where the sample was from can be seen in Figure 3.1 (Appendix 2.5).

As shown in Figure 3.1 (Appendix 2.5), the majority of the studies were conducted in United States (n=149), followed by Canada (n=20) and Australia (n=19). Fifteen studies were conducted in the United Kingdom and Germany each.

Countries that had only one or two studies are not included in Figure 3.1. Greenland, Hungary, Iceland, Latvia, Lithuania, Macedonia, Malta, Poland, Slovenia, Ukraine, Cyprus, Costa Rica, La Reunion Island, Iran, Tonga, Yemen, Chile, Senegal, Philippines, Lebanon and Egypt had only one study each. The following countries had two studies each: Austria; India; Thailand; Turkey; Saudi Arabia; and Guatemala.

The research appears to be concentrated in High Income countries but this may reflect the focus on English language publication only. Notwithstanding this there appears to be worldwide research interest in the topic. The studies included are dominated by studies conducted in the United States. The characteristics of studies reported here will therefore be skewed towards this group.

3.2.2 Participant Details

One hundred and fifty two studies covered both Primary (ages 6-11) and Secondary (ages 11-16) school participants. In 106 studies the participants were between 6-11 year-olds and in 67 studies the sample of interest comprised of 12-16 year-olds.

One study did not report the age range or the mean age of its participants. Most studies carried out their research on a mixed sample of boys and girls (n=292). However, 28 studies used girls as their sample while five only used boys. One study did not report the gender of its participants.

3.2.3 Nature and aims of the study

The majority of the studies (n=285) explored the relationship between obesity and sedentary behaviour and were not intervention studies, i.e. they did not evaluate the impact of an intervention to reduce sedentary behaviour and study its effect on a measure of obesity. Forty one studies were intervention studies. All of these aimed to manipulate sedentary behaviour and assess its effect on obesity.

3.2.4 Measures of Sedentary Behaviour

Figure 3.2 (in Appendix 2.5) illustrates the various measures of sedentary behaviour that were used by the studies in this systematic map. A number of studies used multiple measures of sedentary behaviour. Therefore, the list of measures per study is not mutually exclusive. The most frequent measure used (267 studies) was time spent in TV, film and video viewing or a proxy for this such as TV in the bedroom or number of TVs in the house. This was followed by computer use/playing computer games/owning a computer (n=106) and playing video games (n=88).

Table 3.1: Screening summary

Summary		Details	
Total Hits	9769	Excluded on: Not published in English	15
Duplicates removed	1478	Excluded on: Not completely on topic	3343
Screened	8291	Excluded on: Not empirical research	591
Excluded on abstract	7595	Excluded on: Not primary research	143
Full reports retrieved and screened	696	Excluded on: Sample not children between ages 6-16	1335
Excluded on Full-text	348	Excluded on: Not about obesity AND sedentary behaviour	2118
Not Obtained	22	Excluded on: No measure of obesity	172
Total studies Included	326	Excluded on: No measure of sedentary behaviour	226
		Not Obtained	22
		Included Full-Texts	326

Twenty three studies measured sedentary behaviour in ways that are not listed in Figure 3.2 (Appendix 2.5). These include measures such as: shopping; eating; attending school; being baby sat; club/group membership; playing with dolls at home or at a neighbour's house; sitting or standing during some cultural event or sports event; attending religious ceremonies; non-sports-related activities; sedentary energy expenditure; activities such as slow walking; slow games; parlour; meal consumption; break etc.

3.2.5 Instruments to determine body size, weight or composition

As seen in Figure 3.3 (Appendix 2.5), a majority (n=319) of the studies use Body Mass Index (BMI) as an indicator of obesity. A number of studies measure more than one indicator of obesity. Body fat was also measured using skin fold thickness (n=48), fat mass or percent body fat (n=49), waist to hip ratio (n=10) and waist circumference (n=35). Five studies also used other measures of obesity such as body size, fat free mass, muscle mass, parents' perception of child's weight as a problem and mid arm circumference. Only one study did not clearly report how it measured obesity.

3.2.6 Direction of the relationship

Eight studies assessed both the effect of obesity on sedentary behaviour as well as the effect of sedentary behaviour on obesity. These studies either aimed to assess the effect of sedentary behaviour on obesity or compared BMI/body fat between sedentary vs. non sedentary groups. In 238 studies the independent variable was sedentary behaviour and the dependent variable was the measure of obesity. Forty one of these were intervention studies.

Sixty five studies treated obesity as the independent variable in their analysis and sedentary behaviour as the dependent variable. The aim of these 65 studies was either to measure the effect of obesity on sedentary behaviour or to compare the difference in sedentary behaviour between obese and non obese/overweight groups. In 30 studies the direction of the relationship was unclear. One study did not report the direction of the relationship.

3.2.7 Intervention studies

Forty one of the 326 studies evaluated the impact of interventions/experiments that attempted to alter sedentary behaviour and thus reduce obesity. The majority of these were carried out in the US (n=23) with only four in the UK. No study included more than one country. Figure 3.4 (Appendix 2.5) shows the setting of the intervention studies.

The list of sedentary behaviours targeted in the intervention studies can be seen in Figure 3.5 (Appendix 2.5). Almost all the interventions aimed to target TV, film and video viewing (n=35). Some also targeted computer use (n=15) and video game playing (n=12) along with TV viewing. Four studies did not specify the sedentary behaviours that they were targeting although one study mentioned that it also aimed to reduce TV viewing. Another study which is included in the category: 'other' in Figure 3.5 (Appendix 2.5) stated that it aimed to reduce the time in low level activity without specifying which type of low level activity. No intervention study aimed to alter the time spent sleeping/napping, time in motorized vehicles, time spent in homework, school or in reading.

1 Cut-off rates to determine obesity vary between different countries

Table 3.2: Potential mediating factors (moderating factors or co-variates) in the relationship between obesity and sedentary behaviour

Variables in the equation	Frequency of Studies*
Physical activity/exercise	128
Age	125
Gender	105
Other	97
Food intake and nutrition intake	85
Socio Economic Status	82
Ethnicity/cultural background	66
Unknown/not reported	64
Parental obesity	48
Parental education	45
Not Applicable- Intervention Study	41
BMI (at previous point) or birth weight	39
Neighbourhood characteristics	27
Pubertal stage	20
No. of siblings/No. of children in the family/No. of people in the household	17
Intrauterine and Prenatal factors such as maternal smoking, breast feeding etc	13
Meal frequency	12
Parental health factors	12
Unclear	10
Height (for age)/ growth	8
Other Family characteristics/Family environment/ Obesogenic environment	8
Asthma	4
Menarche history or timing	4
Mental health related factors such as depression	4
Order of birth	4
Metabolic rate/metabolic risk factors	3
Non parental care	3
Sleep disorders/sleepiness	3
Blood pressure	2
Food security	2
Risk for cardiovascular diseases	2
Parent's physical activity	1
Parent's sedentary behaviour	1

*Not mutually exclusive

3.2.8 Other variables included in the analysis

In the 285 non intervention studies the variables included in the investigation or analysis of the relationship between obesity and sedentary behaviour were identified (see Table 3.2 below). Of these 285 studies 10 studies did not clearly report if there were other variables in the equation or what these variables were. Sixty four studies did not report additional variables. These were studies that either assessed the difference between means or carried out simple correlations.

The remaining 211 studies carried out some type of analysis of variance or regression model where other variables were entered into the equation as covariates/other independent variables or control variables. Some comparison studies (n=6) also measured energy expenditure or metabolic rate during sedentary behaviour and these were included as variables in the equation.

CHAPTER FOUR

In depth review: results

4.1 Strengths and limitations of this systematic map

The systematic map aimed to review the scope of the literature on the relationship between obesity and sedentary behaviour in young people. Three hundred and twenty six studies were found. These studies had different aims and designs, some assessed the effect of an intervention that aimed to reduce obesity by decreasing sedentary behaviour or to experimentally manipulate sedentary behaviour in order to assess the mechanisms through which it affected obesity; others compared obese vs. non-obese or sedentary vs. non-sedentary groups in order to see the difference between these groups; others measured obesity and sedentary behaviour in a population and assessed whether these were related through simple statistical techniques such as correlations or more sophisticated techniques such as regression models with multiple controls.

The limited amount of time and resource available meant that:

- it was not possible to search for and include non-English language publications
- twenty two identified papers were not obtained as they were either thesis or conference papers and were unpublished and thus not obtainable within the timescale available for the review

Only a limited amount of coding was possible, thus it is not possible to comment upon the designs of the studies, the appropriateness of the design in answering the map question, the quality of the research and the possible sources of bias in the studies.

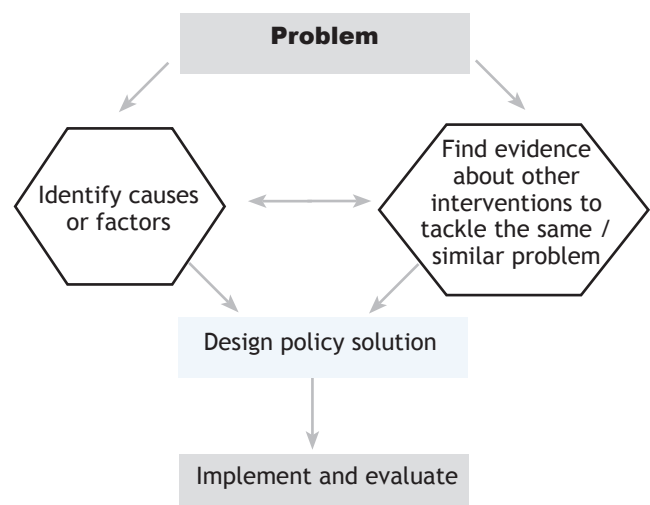
Relatively few studies (n=15) were conducted in the UK. The potential implications vis-à-vis transferability of findings will be a consideration should any in-depth review be undertaken.

4.2 Implications

4.2.1 The contribution of systematic maps

A general simplified conceptual model of the policy-making process to which a systematic review can contribute evidence is illustrated in Figure 4.1 below. In essence, this is a problem solving framework in which policy is viewed as providing a solution in the form of an intervention. The systematic review can contribute evidence to help identify the causes or factors which create or affect a particular problem and thus which will need to be addressed in the design of any policy solution; and/or it can contribute evidence about the effectiveness, design and implementation of interventions which have been developed to address the same or similar problems.

Figure 4.1: Contribution of review to policy-making as problem solving process



A systematic map does not aim to provide an answer to a specific policy question. Instead the aim is to answer a question about the scope, nature and content of empirical research that has been carried out on a particular topic. This information can be used to help focus the policy question. Subsequently a specific policy research question can be identified and an in-depth review undertaken of studies from the map that answer that particular question.

This map identifies both intervention studies and studies that aimed to identify causes and factors of obesity/sedentary behaviour and thus suggests that existing research evidence may potentially make a contribution of both types. This map cannot provide answers but rather indicates potentially fruitful directions for future research.

4.2.2 Future secondary research: In-depth review questions from this map

From a scientific perspective finding that there is little or no high quality evidence on a particular research question is a useful. It allows a response of 'no high quality research evidence' to any claim about causes and/or what to do (although this is not the same as evidence to refute a claim) and establishes the need for new/further research into a particular area. However, such an outcome may be less attractive for policy-makers who wish to make policy and or research funding decisions. One purpose of conducting this map was to assess whether there was sufficient primary research to merit conducting a full in-depth systematic review; this could be seen as an attempt to ascertain the likelihood of having a robust answer to a research question at the end of the review process.

Although 326 studies were identified as generally investigating the relationship between obesity and sedentary behaviour, based on the information obtained about these studies in the coding exercise it is difficult to make such judgements. In order to combine results in a synthesis more specific questions will need to be identified and it is not uncommon that once more specific questions are identified the number of studies addressing each specific question becomes considerably smaller. Furthermore from the information coded so far we are only able to make limited judgements about the degree of similarity between studies (studies need to be sufficiently similar for synthesis) and the study quality. A further consideration that we need to take into account is whether these studies if synthesised would provide us with a better answer than we already have. Better in this context may mean more rigorous and/or provide us with new/different/deeper understanding of these phenomena (obesity and sedentary behaviour). One consideration here is whether new systematic reviews would add any more to knowledge than existing systematic reviews. As mentioned before (in Chapter 1) there are existing systematic reviews in this topic area.

It is our judgement based on the fact that a considerable number of studies have been published since the last systematic review in this area that there is probably sufficient evidence to address more specific in-depth review questions.

What are the factors/ mechanisms that link sedentary behaviour to obesity in children aged 6-16?

What are the most effective interventions to reduce obesity through reduction of sedentary behaviour in children aged 6-16?

4.2.2.1 What are the factors/ mechanisms that link sedentary behaviour to obesity in children aged 6-16?

Marshall *et al.* (2004) conducted a systematic review that aimed to 'review the empirical evidence of associations between television viewing, video/ computer game use and (a.) body fatness, and (b.) physical activity'. The Marshall review only included TV viewing and computer/video games as a measure of sedentary behaviour whereas this map is broader in its definition of sedentary behaviour and includes time spent on the computer in activities other than games, homework, reading, sitting in motorized transport etc. Another limitation of the Marshall *et al.* review was that many of the studies identified in it used relatively unsophisticated research designs (such as simple correlations) which limit the validity of conclusions that can be drawn about the existence, strength and direction of any relationship between sedentary behaviour and obesity. The Marshall *et al.* review searches were concluded in 2002². Two hundred and twenty five of the studies identified in this systematic map were published since 2002. Furthermore it is our impression that more recent studies also have more sophisticated analysis which allow, for example, controls for other confounding variables.

Two hundred and eighty five studies in the current systematic map investigated the relationship between obesity and sedentary behaviour. Of these, 64 studies were correlational or simply compared the mean difference in weight between two or more groups displaying different levels of sedentary behaviour or the mean differences in sedentary behaviour between two or more groups displaying different levels of weight. A limitation of correlation designs and group difference studies is that they are regarded as providing weak evidence to establish causal and or directional effects. However, a synthesis of the direction of the studies without regard for the magnitude or significance can assist in resolving inconsistencies in directionality of the relationship between obesity and sedentary behaviour (Tornatzky and Klein, 1982). A pooled correlation coefficient (of the co-relational studies) can provide an indication of likelihood of both the direction and the magnitude of the relationship between two variables (Roberts *et al.*, 2004).

² this date is not reported in the study, but references show that included studies were published before 2002

Six other studies compared energy expenditure and metabolic rate while obese vs. non obese subjects were participating in sedentary behaviour. These studies could provide greater insight into one mechanism (energy expenditure) through which sedentary activity affects obesity.

The authors of the various studies in this map, in studying the relationship between obesity and sedentary behaviour, have controlled for both individual factors such as age and gender and external factors such as education and parents' weight that can influence this relationship. 'Controlling' in this sense means attempting to remove the influence of these other factors on the outcome in order to determine the independent effect of sedentary behaviour on obesity or vice versa. Different factors have been included in the statistical models depending upon the age and gender of the participants which may allow a more specific analysis to be undertaken on these questions.

Although these other variables cannot unpack the mechanisms through which obesity affects sedentary behaviour or vice versa, they may help to establish the presence or absence of a statistically significant independent relationship between sedentary behaviour and obesity. For example, it is theorized that sedentary behaviour can affect obesity through two mechanisms - increasing energy consumption (food intake/energy intake) and decreasing energy expenditure (activity and exercise). In a model that controls for the effect of these two mechanisms, increased food intake on obesity as well as the effect of activity levels on obesity and still finds a significant relationship between obesity and sedentary behavior, this would suggest that there are other mechanisms through which sedentary behavior affects obesity. However, if no significant relationship between obesity and sedentary behaviour is found when these two variables are controlled for, it may imply that sedentary behaviour affects obesity only through its impact on food intake or activity.

4.2.2.2 What are the most effective interventions to reduce obesity through reduction of sedentary behaviour in children aged 6-16?

There are a number of previous systematic reviews on the effectiveness of interventions to reduce sedentary behaviour. Summerbell *et al.* (2005) in a Cochrane review aimed to systematically review and synthesize interventions for preventing obesity in children. The review searched five databases up to 2005. The searches for this map have identified a further 22 interventions studies published since 2005. Five others were published in 2005 and could have been published after February. The scope of the Summerbell *et al.* review is broader than sedentary behaviour suggesting that cross over between that review and this map will be even less. Similar reviews aiming to synthesize all types of interventions that aim to reduce obesity were

also conducted by Campbell *et al.* (2001) and Doak *et al.* (2006). Therefore, the same issues regarding the search dates and scope also arise with these reviews.

However, the scope of a review by DeMattia *et al.* (2007) was similar to the scope of this systematic map. The DeMattia review aimed to synthesize interventions that limit sedentary behaviour in order to reduce childhood obesity. However, their searches only identified studies published on or before February 2005. This map has identified at least 23 additional intervention studies that have been published since. Other reviews such as those by Must and Tybor (2005) and Coon and Tucker (2002) have attempted to explore the relationship between sedentary behaviour and adiposity. These reviews, however, may suffer from biases as they are not systematic in their methods and therefore a systematic review based on this map may be more rigorous.

An in-depth review of current interventions in this systematic map may answer the question: 'What are the most effective obesity treatment/prevention interventions that target reducing sedentary behaviour?' The 41 intervention studies used an experimental design (a minimal indicator of quality) and appear sufficiently similar for synthesis purposes. It is also important to note that while some of these interventions investigate the sole effect of manipulating sedentary behaviour on obesity, the intervention component in other studies manipulates sedentary behaviour in conjunction with other variables such as food intake or activity that may also affect obesity. In such studies, it may not be possible to investigate the isolated effect of sedentary behaviour on obesity.

4.3 Future primary research

Notwithstanding any evidence generated by potential systematic reviews it appears likely that further primary research will be needed, particularly as comparatively few of the studies identified were carried out in the UK. Future primary research studies should be informed by the findings of any systematic reviews either by developing and further testing identified relationships and/or their application in a UK context.

Future research that aims to assess the impact of reducing sedentary behaviour on obesity measures should follow Robinson's (1999, 2000) example and use a randomized controlled trial (RCT). To assess the effect of an intervention programme a meta-analysis of well conducted RCTs is considered to be at the apex of the hierarchy of evidence (Fineout-Overholt and Johnston, 2005). Therefore, future research should focus on conducting RCTs that control for various sources of bias so that the independent impact of reducing sedentary behaviour on obesity can be assessed.

Future research could also aim to test a theoretical model of all the possible mechanisms through which sedentary behaviour impacts obesity and vice versa using prospective, longitudinal data. This research should ideally have multiple measures of both obesity and sedentary behaviour and should measure all the mechanisms through which one could affect the other.

In assessing the mechanisms through which sedentary behaviour causes obesity, sophisticated multi-level, multi-variate techniques could be used to assess the impact of sedentary behaviour on each potential mediating variable. Through testing a theoretical model like this, it would be possible to assess which mechanisms play a role in impacting obesity through their interaction with sedentary behaviour.

CHAPTER FIVE

References

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Appendix 1.1: Authorship of this report

This report was written by Naira Kalra and Dr Mark Newman of the EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

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Appendix 2.1: Inclusion and exclusion criteria

Exclusion Criteria

1. Not published in English.
2. Published before 1985.
3. Studies which have absolutely nothing to do with the topics of obesity or sedentary behaviour.
4. Not empirical research e.g. views, reviews, opinion pieces, commentaries.
5. Not primary research e.g. systematic review.
6. Sample does not consist of young people or children between ages 6-16. The average age should fall between 6-16 and/or results for aged 6-16 should be reported separately.
7. Not about obesity AND sedentary behaviour: Studies that do not mention obesity (or a synonym or a measure of obesity) AND sedentary behaviour (or a synonym for sedentary behaviour or a type of sedentary behaviour) and give no indication that they are going to investigate the relationship between the two variables in the title, abstract or keyword will be excluded on this criterion.

If the relationship between obesity or sedentary behaviour and another variable (which is not obesity or sedentary behaviour) is being investigated and obesity or sedentary behaviour is being measured as a control variable but, there is no indication that the interaction effects or the relationship between obesity and sedentary behaviour are reported, the study will be excluded.

Studies that talk about the relationship between only one aspect of this equation (except sedentary behaviour) and obesity will not be marked i.e. studies on the relationship between only physical activity and obesity, consumption and obesity, metabolic rate (not related to activity) and obesity. Studies that address the relationship between indirect factors in the relationship between energy consumption and expenditure will also be excluded, such as those on the role of playgrounds in obesity, socio-economic status and obesity, gender and obesity etc.

However, studies that do not explicitly talk about sedentary behaviour and obesity but do refer to the balance between the energy consumption and energy expenditure and its relationship with obesity would be marked at this stage. These studies should explicitly measure some form of energy intake and output. Sedentary behaviour would have a role in this equation (even if this is not explicitly stated).

8. Does not measure obesity using a standardized and accepted measure of obesity such as BMI, Ponderal Index, weight & height, skin fold thickness etc. Exclude if obesity is measured using any self or others (e.g. parents, teachers) perception of body size, weight, image, or eating patterns, consumption behaviour.

9. Does not have a measure of sedentary behaviour, inactivity or non-activity. Measures can include (but not limited to) time spent in television/videotape viewing, playing computer games, reading, sitting and listening to music, talking on the telephone, playing board games, cognitive hobbies, sitting in motorized transport etc. Excluded if only measures sport or other strenuous physical 'activity'.

Appendix 2.2: Search strategy for electronic databases

PsychInfo:

AB (child* OR preadolescen* OR young OR youth OR adolescen* OR boys OR girls OR kids OR teen* OR schoolchild*) and AB (weight OR “overweight” OR obes* OR “body mass index” OR BMI OR adiposity OR fat*) and AB (sedentar* OR television* OR TV OR computer* OR internet* OR “online” OR video* OR inactiv* OR “home work” OR homework OR napping OR transportation OR travel OR “car” OR “bus” OR sitting OR reading OR hobbies OR lying OR “desk” OR idle OR seated OR immobile OR stationary OR “screen time” OR leisure OR “media” OR telephone)

Limiters - Publication Year from: 1985-2009; Published Date from: 198501-200912; English

Search modes - Boolean/Phrase Hits (2029)

MEDLINE:

child* OR preadolescen* OR young* OR youth) or (adolescen* OR boys OR girls OR teen*) or (schoolchild* OR student* OR kids)) and KW=((weight OR body size OR overweight) or (obes* OR body mass index OR BMI) or (overnutrition OR adiposity)) and KW=((sedentar* OR television* OR TV OR computer* OR online OR screen time OR leisure OR telephone) or (internet OR social networking OR video* OR inactiv* OR home work OR homework) or (sleep NOT apnea OR napping OR travel OR sitting OR reading OR hobbies OR desk OR idle OR seated OR immobile OR stationary)

Date Range: 1985 to 2009

Add English as a limiter: 5362

CINAHL:

AB (child* OR preadolescen* OR young OR youth OR adolescen* OR boys OR girls OR kids OR teen* OR schoolchild* OR student) and AB (weight OR body size OR overweight OR obes* OR body mass index OR BMI OR overnutrition OR adiposity) and AB (sedentar* OR television* OR TV OR computer* OR video* OR online OR internet OR social networking OR inactiv* OR home work OR homework OR sleep NOT apnea OR napping OR travel OR sitting OR reading OR hobbies OR desk OR idle OR seated OR immobile OR stationary OR screen time OR leisure OR telephone)

Limiters - Published Date from: 198501-200811; Exclude MEDLINE records

Search modes - Boolean/Phrase

Hits: 263

CENTRAL:

584 hits (child* OR preadolescen* OR young OR youth OR adolescen* OR boys OR girls OR kids OR teen* OR schoolchild* OR student*):ti,ab,kw and (weight OR “body size” OR overweight OR obes* OR “body mass index” OR BMI OR adiposity):ti,ab,kw and (sedentar* OR television* OR TV OR computer* OR online OR internet OR video* OR inactiv* OR “home work” OR homework OR napping OR travel OR sitting OR reading OR hobbies OR desk OR idle OR seated OR immobile OR stationary OR “screen time” OR leisure OR telephone):ti,ab,kw, from 1985 to 2008 in Clinical Trials

BiblioMap:

The following term were used for a free text search:

1	Freetext (item record) child*	1060
2	Freetext (item record) youth	875
3	Freetext (item record) young	1420
4	Freetext (item record) adolescents	1825
7	Freetext (item record) preadolescent	12
8	Freetext (item record) girls	402
9	Freetext (item record) boys	355
10	Freetext (item record) teenagers	205
11	Freetext (item record) schoolchildren	106
12	Freetext (item record) kids	33
13	1 OR 2 OR 3 OR 4 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12	4824
14	Freetext (item record) weight	443
15	Freetext (item record) “body size”	9
16	Freetext (item record) overweight	95
17	Freetext (item record) obesity	266
18	Freetext (item record) obese	76
19	Freetext (item record) obesogenic	0
20	Freetext (item record) “body mass index”	94
21	Freetext (item record) BMI	38
22	Freetext (item record) overnutrition	2
23	Freetext (item record) adiposity	8
24	14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23	706
25	Freetext (item record) sedentary	75
26	Freetext (item record) television	97
27	Freetext (item record) TV	23
28	Freetext (item record) computer	527
29	Freetext (item record) online	40
30	Freetext (item record) internet	49
31	Freetext (item record) video	114
32	Freetext (item record) inactive	15
33	Freetext (item record) inactivity	30
34	Freetext (item record) “home work”	2
35	Freetext (item record) homework	35
36	Freetext (item record) sleep	40
37	Freetext (item record) napping	0
38	Freetext (item record) travel	23
39	Freetext (item record) sitting	2
40	Freetext (item record) reading	699
41	Freetext (item record) hobbies	5

42	Freetext (item record) desk	11
43	Freetext (item record) idle	1
44	Freetext (item record) seated	1
45	Freetext (item record) immobile	1
46	Freetext (item record) stationary	0
47	Freetext (item record) “screen time”	2
48	Freetext (item record) leisure	121
49	Freetext (item record) telephone	161
50	25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44 OR 45 OR 46 OR 47 OR 48 OR 49	1757
51	13 AND 24 AND 50	35

Social Policy and Practice:

There is no direct access to this database. It comprises of:

1. social care (to which there is free access)

<http://www.scie-socialcareonline.org.uk/>

This was searched using obesity and population terms: (freetext=”children “ or freetext=”adolescent OR young “) and freetext=”obesity OR inactivity “) or profile=”obese OR weight”) or freetext=”body mass index “) and publicationdate>=1985 and publicationdate<=2008

2. Child data: This will be searched by health promotion team

3. Ageing data

4. Compline

ASSIA

Search Query #1 KW=((child* OR preadolescen* OR young* OR youth) or (adolescen* OR boys OR girls OR teen*) or (schoolchild* OR student* OR kids)) and KW=((weight OR “body size” OR overweight) or (obes* OR “body mass index” OR BMI) or (overnutrition OR adiposity)) and KW=((sedentar* OR television* OR TV OR computer* OR online OR screen time OR leisure OR telephone) or (internet OR social networking OR video* OR inactiv* OR “home work” OR homework) or (sleep NOT apnea OR napping OR travel OR sitting OR reading OR hobbies OR desk OR idle OR seated OR immobile OR stationary))

218 Published Works results found in ASSIA: Applied Social Sciences Index and Abstracts

3294 Scholars results found in COS Scholar Universe: Social Science

Date Range: 1985 to 2009

Limited to: English Only

ERIC:

Query: (TI=(body within 3 size OR body within 3 shape OR overweight OR thin OR thinness OR skinny or body weights or obese or obesogenic or obesity or leptogenic) or AB=(body within 3 size OR body within 3 shape OR overweight OR thin OR thinness OR skinny or body weights or obese or obesogenic or obesity or leptogenic) or TI=(weight and body) or

AB=(weight and body) or DE=("body weight" or "obesity" or "body composition")) and (DE=("youth" or "disadvantaged youth" or "out of school youth" or "rural youth" or "urban youth" or "adolescents" or "early adolescents" or "mixed age grouping") or DE=("african american children" or "latchkey children" or "minority group children" or "migrant children") or DE=("boys" or "children" or "girls" or "young boys" or "young children" or "young girls") or TI=(child* OR schoolchild* OR kid or kids OR Boy or boys OR Girl or girls or Prepubescen* OR adolescen* Or minors Or teen* OR student* OR pupil* or preadolescen*) or AB=(child* OR schoolchild* OR kid or kids OR Boy or boys OR Girl or girls or Prepubescen* OR adolescen* Or minors Or teen* OR student* OR pupil* or preadolescen*))

Sociological Abstracts:

Search Query #6 ((DE=("adolescents" or "age groups" or "childhood" or "children" or "youth" or "students")) or ((TI=(child* OR schoolchild* OR kid or kids OR Boy or boys OR Girl or girls or Prepubescen* OR adolescen* Or minors Or teen* OR student* OR pupil* or preadolescen*) or AB=(child* OR schoolchild* OR kid or kids OR Boy or boys OR Girl or girls or Prepubescen* OR adolescen* Or minors Or teen* OR student* OR pupil* or preadolescen*)) or (DE=("adolescents" or "age groups" or "childhood" or "children" or "youth")))) and ((TI=(body within 3 size OR body within 3 shape OR overweight OR thin OR thinness OR skinny or body weights or obese or obesogenic or obesity or leptogenic) or AB=(body within 3 size OR body within 3 shape OR overweight OR thin OR thinness OR skinny or body weights or obese or obesogenic or obesity or leptogenic) or TI=(weight and body) or AB=(weight and body)) or(DE=("obesity")) or(DE=("body weight"))))

CRD databases

Sources

The Health Technology Database through the University of York NHS Centre for Reviews and Dissemination, <http://www.york.ac.uk/inst/crd>

It includes the following databases:

DARE contains over 5000 abstracts of quality assessed systematic reviews on the effects of interventions used in health and social care. Details of Cochrane reviews and protocols are also included.

NHS EED contains over 7000 abstracts of quality assessed economic evaluations.

DARE and **NHS EED** include details of abstracts in the process of being written and these can be 'fast-tracked' on request.

HTA brings together details of over 7000 completed and ongoing health technology assessments from around the world. The database is produced in collaboration with the INAHTA Secretariat, based at SBU, Sweden.

#2 child OR children OR adolescent OR youth OR young RESTRICT YR 1985 20084700 #3 obesity OR obese OR weight OR body AND mass AND index OR BMI OR overweight RESTRICT YR 1985 20082619 #4 sedentary OR inactive OR inactivity OR television OR TV OR computer OR online OR screen AND time RESTRICT YR 1985 20081540 #5#2 AND #3 AND #4 RESTRICT YR 1985 200863

CERUK-Plus

3 hits for child and obesity

3 records for child and weight

5 hits for young and weight

0 hits for adolescent and obesity, young and obesity, youth and obesity, child and obese, young and obese
adolescent and obese, youth and obese, adolescent and weight

2 Relevant hits:

Title	Children's Health and Well-Being
Project Status	This project has been completed.
Record No	720
Researcher	Armstrong, N. (Prof)
Researcher	Burrows, M. (Dr)
Researcher	Middlebrooke, A. R. (Dr)
Researcher	Welsman, J. R. (Dr)
Researcher	Williams, C. A. (Dr)
Researcher	Winsley, R. J. (Dr)
Researcher	Welford, D. (Dr)
Dates	1985 - 2004
Funding Type	Externally Funded Project
Funding Body	British Heart Foundation Healthy Heart Research Trust Northcott Devon Medical Foundation Physical Education Association Reebok Plc Sports Council
Keywords	Child Welfare
Keywords	Children
Keywords	Health
Keywords	Health Education
Keywords	Physical Activities
Keywords	Physical Education
Keywords	Physical Fitness

Abstract The Children's Health and Exercise Research Centre, under the direction of Professor Armstrong and colleagues, has been devoted to the study of children's health and well-being since its development from the coronary prevalence in children research study of factors known to be associated with coronary heart disease in adults, i.e. adverse lipid profiles, high blood pressure, obesity, cigarette smoking, low levels of physical fitness and sedentary lifestyles. Subsequent work has focused on developmental aspects of aerobic fitness, body composition and physical activity patterns; challenged conventional means of assessing and interpreting young people's body composition, fitness and physical activity; examined the effects of exercise training on children's health and fitness; and explored the implications of the data for school health education and physical education programmes. A series of integrated cross-sectional studies have involved 3,000 children aged 9 to 18 years. In addition, a 4 year longitudinal study of 270 children, aged 10 years at onset, has been completed. The data have described the prevalence of coronary risk factors in children and in particular, the low level of young people's habitual physical activity. The results of recent and ongoing studies have demonstrated that there is little evidence to suggest that the current generation of children and adolescents is less fit than its predecessors. Another longitudinal study has examined the responses of children to non-steady state exercise and demonstrated age differences in the response to heavy exercise. Additional studies have focused on muscle strength and power output during childhood and adolescence in relation to body size and magnetic resonance determined muscle cross-sectional area and volume.

Publications Armstrong, N., Balding, J., Gentle, P. and Kirby, B. (1990). 'Patterns of physical activity among 11-16-year-old British children', *British Medical Journal*, 301, 203-5.

Armstrong, N. and Welsman, J. (1997). *Young People and Physical Activity*. Oxford: Oxford University Press

Armstrong, N. and Welsman, J. (2001). 'Peak oxygen uptake in relation to growth and maturation in 11-17-year-old humans', *European Journal of Applied Physiology*, 85, 546-51.

Armstrong, N., Welsman, J. and Chia, M.Y.H. (2001). 'Short-term power output in relation to growth and maturation', *British Journal of Sports Medicine*, 35, 118-25.

Armstrong, N. and Welsman, J.R. (2002). 'Cardiovascular responses to submaximal treadmill running in 11 to 13-year-olds', *Acta Paediatrica*, 91, 125-31.

Fawcner, S.G., Armstrong, N., Potter, C.R. and Welsman, J.R. (2002). 'Oxygen uptake kinetics in children and adults after the onset of moderate-intensity exercise', *Journal of Sports Sciences*, 20, 319-26.

Fawcner, S.G. and Armstrong, N. (2003). 'Oxygen uptake kinetic response to exercise in children', *Vol 33, 9*, 651-69.

Fawcner, S.G. and Armstrong, N. (2004). 'Longitudinal changes in the kinetic response to heavy intensity exercise', *Journal of Applied Physiology*, 97, 2, 460-6.

Ratel, S., Williams, C.A., Oliver, J. and Armstrong, N. (2004). 'Effects of age and mode of exercise on power output profiles during repeated sprints', *European Journal of Applied Physiology*, 92, 1-2, 204-10.

Wood, L.E., Dixon S., Grant, C. and Armstrong, N. (2004). 'Elbow flexion and extension strength relative to body or muscle size in children', *Medicine and Science in Sport and Exercise*, 36, 1977-1984.

Fawcner, S.G. and Armstrong, N. (2004). 'Sex differences in the oxygen uptake kinetic response to heavy intensity exercise in prepubertal children', *European Journal of Applied Physiology*, 93, 1-2, 210-16.

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 School of Sport and Health Sciences
 St Luke's, Heavitree Road
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 EX1 2LU
 01392 264812
<http://www.exeter.ac.uk/cherc>

Title	Millennium Cohort Study: Second Sweep
Project Status	This project has been completed.
Record No	2821
Supervisor	Joshi, H. (Prof)
Supervisor	Marmot, M. (Prof)
Supervisor	Peckham, C. (Prof)
Researcher	Dex, S. (Prof)
Researcher	Smith, K. (Ms)
Researcher	Plewis, I. (Mr)
Researcher	Shepherd, P. (Mr)
Researcher	Butler, N. (Prof)
Researcher	Sadligh, M. (Mr)
Researcher	Dodwell, K. (Mr)
Researcher	Brown, D. (Ms)
Researcher	Hughes, G. (Mr)
Dates	04/2002 - 06/2005
Research Type	Collaborative Research
Funding Type	Externally Funded Project
Name of Sponsor	Economic and Social Research Council Office for National Statistics
Keywords	Child Care
Keywords	Child Poverty
Keywords	Disadvantaged
Keywords	Early Childhood Education and Care
Keywords	Ethnic Minorities
Keywords	Families
Keywords	Infants
Keywords	Longitudinal Studies
Background	The Millennium Cohort Study includes vital new information about the New Century's babies and their families for the four countries of the UK. The first survey successfully interviewed 18,553 families with 18,819 babies. More than half of the data are from areas of high child poverty or large ethnic minority populations, which were deliberately over-sampled. Data from the first survey were deposited in the UK Data Archive in June 2003.
Research Aims	The main aim of the second survey of the Millennium Cohort Study is to establish a longitudinal multipurpose data set, of high quality, tracking the diverse lives of the 'children of the new century' out of infancy and into early childhood, and laying the foundation for future follow-ups.

- Design & Scope** The sample was selected from a random sample of electoral wards, disproportionately stratified to ensure adequate representation of all four UK countries, deprived areas and areas with high concentrations of Black and Asian families. The sample design of the MCS differs from that of its predecessors (NCDS & BCS70) in that it took a whole year's births, and covers the whole of the United Kingdom for the first time. The sample was drawn slightly later in Scotland and Northern Ireland so as not to coincide with other surveys being carried out on families with babies in these areas at the same time.
- Sample** The first survey of MCS includes data on 18,553 families with 18,819 babies.
- Methods** Face-to-face interviews with the cohort members' mothers and (where resident) the fathers or father figures. This survey also contains a number of novel items: two sets of cognitive assessments, measurement of height and weight, interviewer observation of the neighbourhood and of home conditions, the collection of saliva samples and of a self-completion questionnaire from some older siblings.
- Conclusions** Fieldwork started in England and Wales in September 2003 and in Scotland and Northern Ireland in December 2003.
- Publications** JOSHI, H. *et al.* (2002). 'Mobile families and other challenges in the design of the Millennium Cohort Study' <http://www.cls.ioe.ac.uk/Cohort/MCS/Publications/mainpubs.htm>
 NATIONAL CENTRE FOR SOCIAL RESEARCH (2003). 'Millennium Cohort Study First Survey: Code Book and Edit Instructions' <http://www.data-archive.ac.uk/doc/4683/mrdoc/pdf/4683userguide.pdf>
 PLEWIS, I. (2003). 'Millennium Cohort Study: Technical Report on Sampling' <http://www.data-archive.ac.uk/doc/4683/mrdoc/pdf/4683userguide.pdf>
 SHEPHERD, P., SMITH, K., JOSHI, H. and DEX, S. 'Millennium Cohort Study First Survey: Guide to the SPSS Dataset' <http://www.data-archive.ac.uk/doc/4683/mrdoc/pdf/4683userguide.pdf>
 SMITH, K. and JOSHI, I. (2002). 'The Millennium Cohort Study', *Population Trends* (2002). No. 107. (The article is available in electronic format via http://www.statistics.gov.uk/downloads/theme_population/PT107.pdf)
 WARD, K. (2003). 'Millennium Parents: An examination of the relationship between family structures and attitudes towards parenting using secondary analysis of the Millennium Cohort Study. MA dissertation, University of Surrey.
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Appendix 2.3: Other searches: Authors contacted, websites searched and journals handsearched

Letter to authors:

Dear Colleague

I am a Research Officer at the Evidence for Practice and Policy Information Centre (EPPI-Centre) at the Institute of Education, University of London. We are currently working on a systematic review of studies on ‘the relationship between sedentary behaviour and obesity’ commissioned by the UK Government Department for Children, Schools and Families.

As part of the search strategy we are contacting eminent researchers in this field in order to obtain relevant research on the topic that can be included in the review.

With regard to this, I would be extremely grateful if you could notify us or preferably send us any research (published and unpublished) that you have carried out on: the relationships between obesity and sedentary behaviour and specifically

1. The effects of sedentary behaviour on obesity

And/or

2. The effects of obesity on sedentary behaviour

If you would like to discuss the work in more detail please contact the principal investigator Mark Newman (m.newman@ioe.ac.uk).

Thanking you,

Yours sincerely,

Naira Kalra

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Websites searched

Website searched	Website address	Search Results
The Health Evidence Bulletins, Wales	http://hebw.uwcm.ac.uk/	No studies identified through the preliminary search
The Effective Public Health Practice Project	http://www.city.hamilton.on.ca/sphs/EPHPP/ephppSumRev.htm	28 hits for obesity sedentary. Preliminary screening based on title and summary was conducted. Nothing relevant after full-text screening.
Sports England	http://www.sportengland.org/vosm/vosm.htm	7 hits identified in the preliminary search
HealthPromis, the public health database for England through the Health Development Agency	http://www.hda-online.org.uk/	No studies identified through the preliminary search
The Health Development Agency's website that describes the study design terms	http://www.hda.nhs.uk/evidence/indexing_results.html	Link to the National Institute of Health and Clinical Excellence (NICE), found one relevant study for full text screening
Evidence Network research and reviews through the Medical Research Council Social and Public Health Sciences Unit	http://www.msoc-mrc.gla.ac.uk http://www.sphsu.mrc.ac.uk/all_publications.php	44 hits relevant titles were identified
The Community Guide - Guide to Community Preventive Services - Systematic reviews and evidence-based recommendations	http://www.thecommunityguide.org/index.html	1 relevant hit for full-text screening, second hit was on adults. Therefore, it was not retrieved.
The Food Standards Agency	http://www.food.gov.uk	0 relevant hits
The Department of Health	http://www.dh.gov.uk	One Relevant study found
Google	www.google.com	First 10 pages of relevant hits for "child AND obesity AND sedentary". Relevant full-texts or abstracts were screened as on 15th and 16th Dec 2008
Google Scholar	www.google.com	First 10 pages of relevant hits for "child AND obesity AND sedentary". Relevant full-texts or abstracts were screened as on 16th and 17th Dec 2008

Journals Handsearched:

1. Obesity Reviews
2. Obesity and International Journal of Obesity

Appendix 2.4: EPPI-Centre keyword sheet including review-specific keywords

Review-specific keywords:

Section A: Purpose of the study

A.1 What is the purpose of the study?

NB This question refers only to the purpose of a study, not to the design or methods used.

A.1.1 Exploration of relationships

Please use this code for a study type which examines relationships and/or statistical associations between variables in order to build theories and develop hypotheses. These studies may describe a process or processes (what goes on) in order to explore how a particular state of affairs might be produced, maintained and changed.

These studies often consider variables such as social class and gender which are not interventions, although these studies may aid understanding, and may suggest possible interventions, as well as ways in which a programme design and implementation could be improved. These studies do not directly evaluate the effects of policies and practices.

A.1.2: What works

A study will only fall within this category if it measures effectiveness - i.e. the impact of a specific intervention or programme on a defined sample of recipients or subjects of the programme or intervention.

A.1.1 Non-intervention study
(exploration of relationships)

A.1.2 Intervention study
(what works?)

Section B: Participant details

<p>B.1 What ages are covered by the actual sample? <i>(If the study sample spans over both primary and secondary school, select both options)</i></p>	<p>B.1.1 6-11 <i>(Primary school)</i></p> <p>B.1.2 12-16 <i>(Secondary school)</i></p> <p>B.1.3 Unclear</p> <p>B.1.4 Not Reported</p>
<p>B.2 What is the sex of the participants?</p>	<p>B.2.1 Male</p> <p>B.2.2 Female</p> <p>B.2.3 Mixed</p> <p>B.2.4 Unclear</p> <p>B.2.5 Not reported</p>

Section C: Setting of the study

<p>C.1 In which country or countries was the study carried out? <i>(If a study compares or is carried out in more than one country, select the marker C.1.46 as well as all the individual countries in the study)</i></p>	<p>C.1.1 Australia</p> <p>C.1.2 Austria</p> <p>C.1.3 Belgium</p> <p>C.1.4 Canada</p> <p>C.1.5 China</p> <p>C.1.6 Croatia</p> <p>C.1.7 Czech Republic</p> <p>C.1.8 Denmark</p> <p>C.1.9 Estonia</p> <p>C.1.10 Finland</p> <p>C.1.11 France</p> <p>C.1.12 Germany</p> <p>C.1.13 Greece</p> <p>C.1.14 Greenland</p> <p>C.1.15 Hungary</p> <p>C.1.16 Iceland</p> <p>C.1.17 India</p> <p>C.1.18 Ireland</p> <p>C.1.19 Israel</p> <p>C.1.20 Italy</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

- C.1.21 Japan
- C.1.22 Korea
- C.1.23 Latvia
- C.1.24 Lithuania
- C.1.25 Luxemburg
- C.1.26 Macedonia
- C.1.27 Malta
- C.1.28 Mexico
- C.1.29 Netherlands
- C.1.30 New Zealand
- C.1.31 Norway
- C.1.32 Poland
- C.1.33 Portugal
- C.1.34 Russia
- C.1.35 Slovak Republic
- C.1.36 Slovenia
- C.1.37 Spain
- C.1.38 Sweden
- C.1.39 Switzerland
- C.1.40 Thailand
- C.1.41 Turkey
- C.1.42 UK
- C.1.43 Ukraine
- C.1.44 USA
- C.1.45 Other
- C.1.46 Marker: please select if this study compared more than one country

Section D: Variable description

D.1 How has sedentary behaviour been operationally defined?	<p>D.1.1 Inactivity <i>(usually defined as less than a certain explicit amount of physical activity)</i></p> <p>D.1.2 TV, film and video viewing <i>(including proxy measures for this such as no. of televisions in the house/presence of television in the bedroom)</i></p> <p>D.1.3 Computer use</p> <p>D.1.4 Playing video games</p> <p>D.1.5 Time spent sleeping</p> <p>D.1.6 Sitting in motorized transport</p> <p>D.1.7 Time spent in arts and crafts</p> <p>D.1.8 Listening to or playing music</p> <p>D.1.9 Playing board games</p> <p>D.1.10 Time spent doing homework/schoolwork or reading</p> <p>D.1.11 Time spent sitting</p> <p>D.1.12 Talking on the phone or hanging out</p> <p>D.1.13 Unclear</p> <p>D.1.14 Other</p>
D.2 How has obesity been operationally defined and measured?	<p>D.2.1 Body Mass Index <i>(Also mark if both weight and height have been measured)</i></p> <p>D.2.2 Fat mass <i>(Can also be reported as Percentage Fat)</i></p> <p>D.2.3 Skin fold thickness</p> <p>D.2.4 Waist to hip ratio</p> <p>D.2.5 Body weight</p> <p>D.2.6 Waist girth</p> <p>D.2.7 Unclear</p> <p>D.2.8 Other</p>

Section E: Direction of the relationship

(In the case of a study that only measures the simple correlation between the variables, unless specified by the author, the independent and dependent variable will be marked as unknown/not reported. In studies that measure the difference between groups, the variable on the basis of which groups have been divided is presumed to be the independent variable and the outcome on which these groups are compared is the dependent variable.)

E.1 Sedentary Behaviour	E.1.1 Independent variable E.1.2 Dependent variable E.1.3 Unclear E.1.4 Not reported
E.2 Obesity	E.2.1 Independent variable E.2.2 Dependent variable E.2.3 Unclear E.2.4 Not reported

Section F: Exploration/description of factors

F.1 What are the variables included by the author in the statistical analysis of relationship between obesity and sedentary behaviour?

(In the case of interventions or multi-component interventions do not code this section.)

(In the case of studies that measure simple correlations, linear regressions (with no controls) and simple t-tests etc measuring the difference between groups, mark variable as 'unknown'. However, if a third variable is introduced in the equation, it will be marked as a factor variable, e.g. difference in energy expenditure, food consumption, or metabolic rate between obese and non-obese children during a sedentary activity. Here, energy expenditure, metabolic rate or food consumption will be marked as a factor variable.)

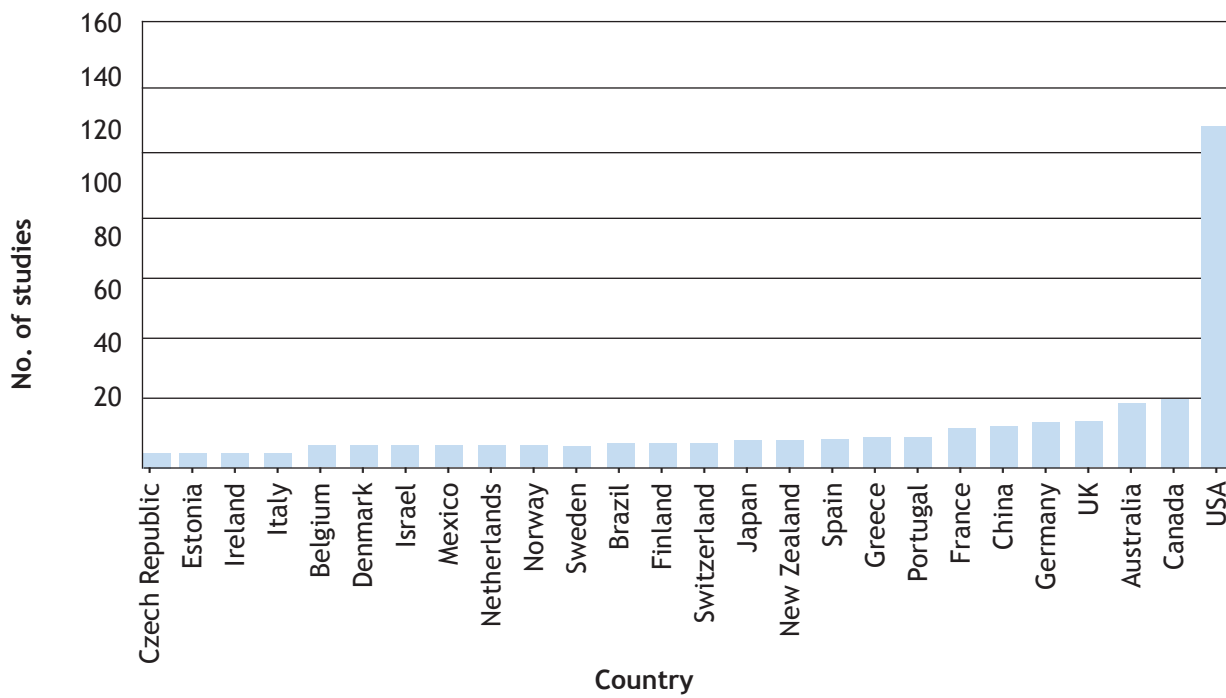
(In all other studies, any other variable that is in this statistical analysis of the relationship between obesity and sedentary behaviour will be identified as a 'factor variable' in the list of factors provided for this question e.g. in a regression these would be the control variables or the covariates.)

- F.1.1 Not Applicable- Intervention Study
- F.1.2 Ethnicity/cultural background
- F.1.3 Age
- F.1.4 Gender
- F.1.5 Socio Economic Status
- F.1.6 BMI (at previous point) or birth weight
- F.1.7 Height (for age)/ growth
- F.1.8 Physical activity/exercise
- F.1.9 Menarche history or timing
- F.1.10 Asthma
- F.1.11 Diabetes
- F.1.12 Metabolic rate/metabolic risk factors
- F.1.13 Mental health related factors such as depression
- F.1.14 Pubertal stage
(often measured by tanner staging)
- F.1.15 Meal frequency
- F.1.16 Food intake and nutrition intake
- F.1.17 Food security

- F.1.18 Lower Back pain
- F.1.19 Risk for Cardio-Vascular diseases
- F.1.20 Sleep disorders/sleepiness
- F.1.21 Blood pressure
- F.1.22 Rate of growth
(catch up growth)
- F.1.23 Intrauterine and Prenatal factors such as maternal smoking, breast feeding etc
- F.1.24 Parental education
- F.1.25 Parental obesity
- F.1.26 Parental health factors
(present maternal smoking, diabetes etc)
- F.1.27 Parent's sedentary behaviour
- F.1.28 Parent's physical activity
- F.1.29 Non parental care
- F.1.30 Order of birth
- F.1.31 Season of birth
- F.1.32 No. of siblings/no of children in the family/
No. of people in the household
- F.1.33 Infant feeding and weaning practice
- F.1.34 Other Family characteristics/ Family environment/ Obesogenic environment
- F.1.35 Neighbourhood characteristics
- F.1.36 Unclear
- F.1.37 Other
- F.1.38 Unknown/not reported

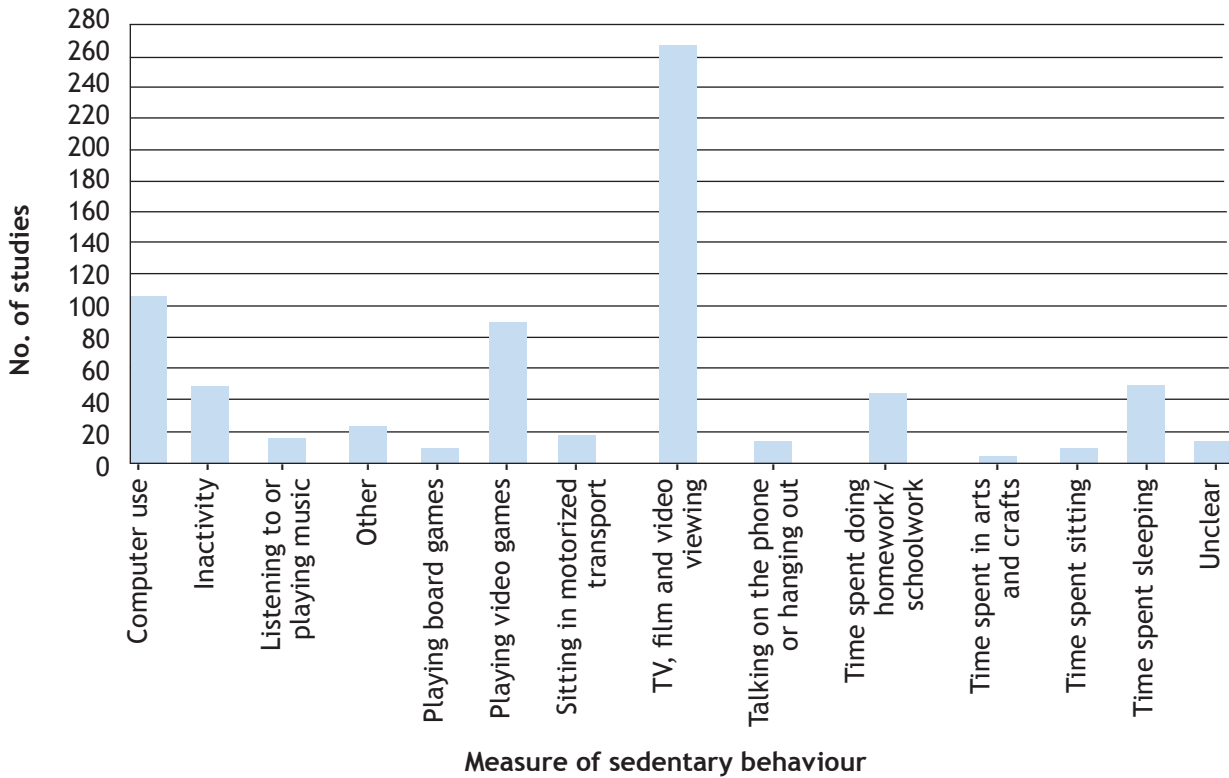
Appendix 2.5: Figures for Chapter 2

Figure 3.1: Setting of the studies



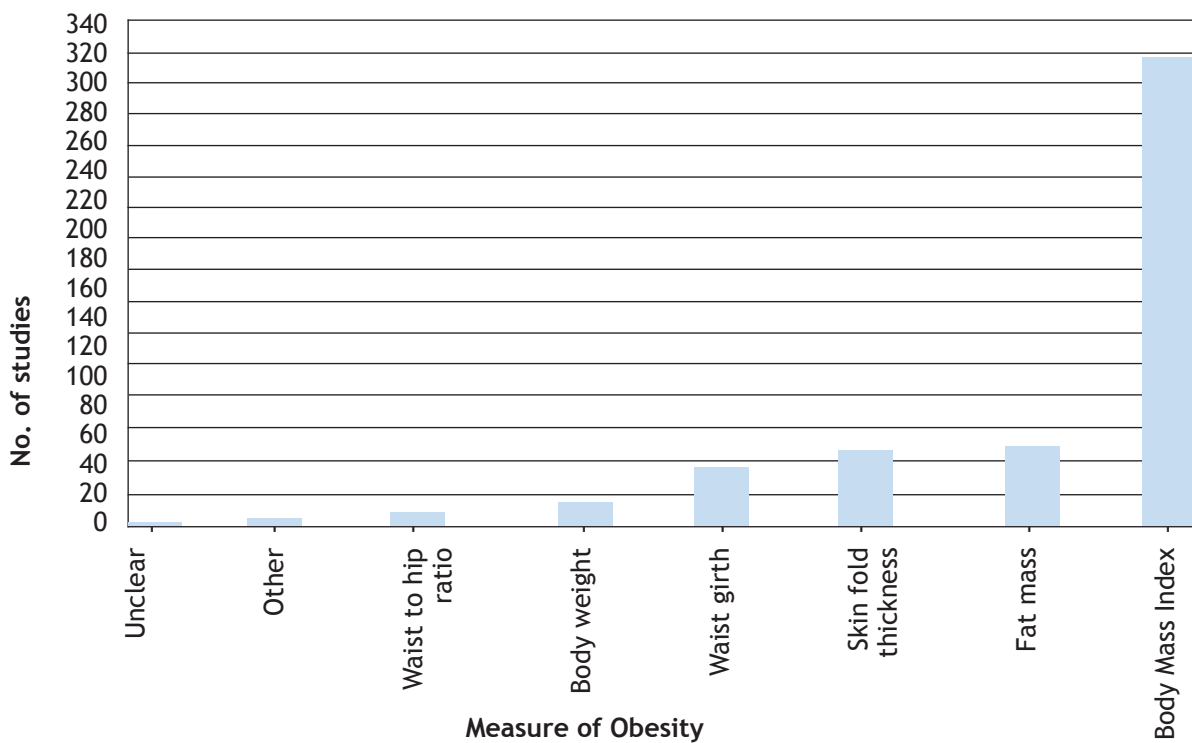
Note: the categories are not mutually exclusive

Figure 3.2: How was Sedentary Behaviour measured?



Note: the categories are not mutually exclusive

Figure 3.3: How was Obesity measured?



Note: the categories are not mutually exclusive

Figure 3.4: Setting of the intervention studies

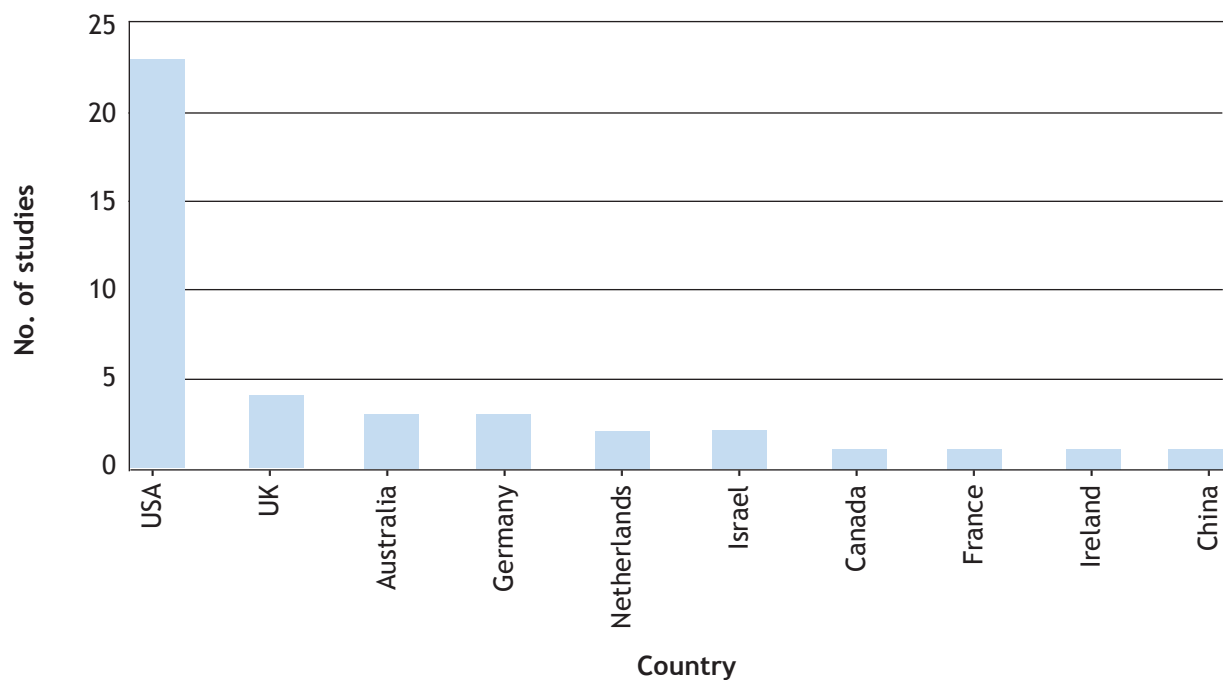
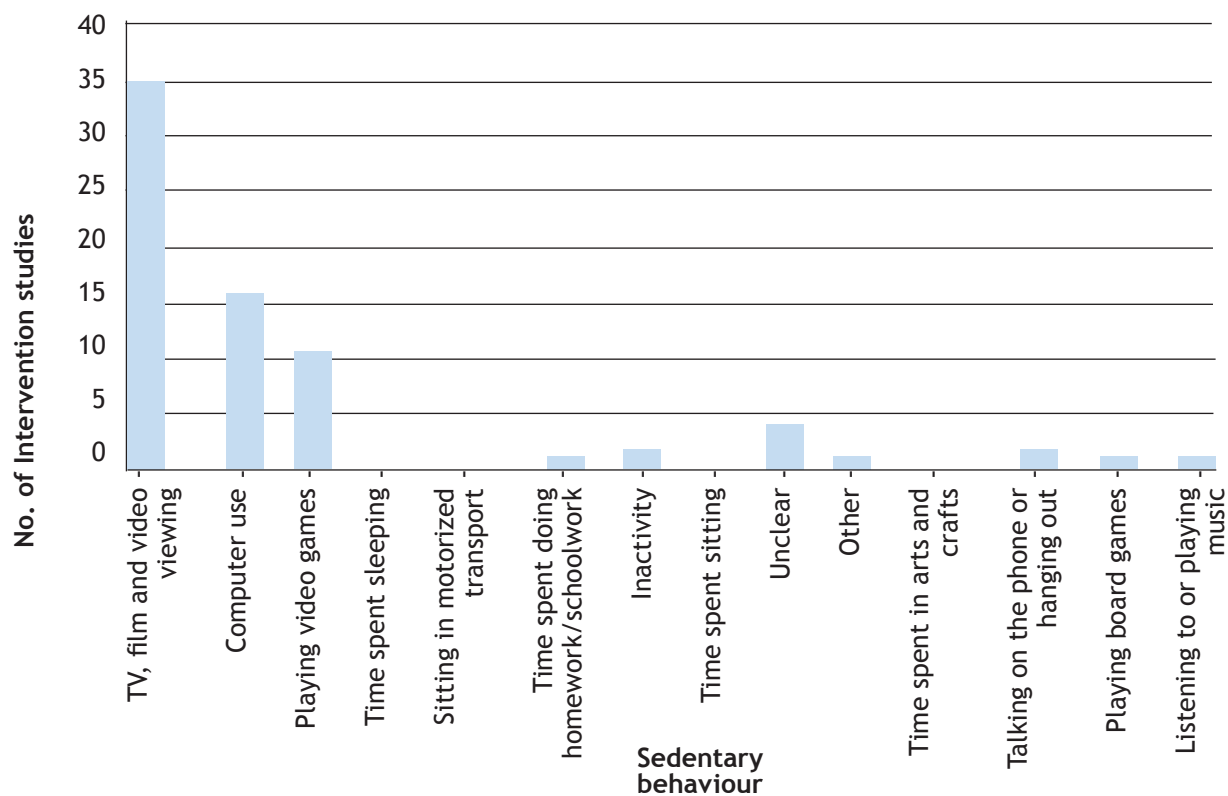


Figure 3.5: Types of sedentary behaviours targeted in the intervention studies



Note: the categories are not mutually exclusive

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The EPPI-Centre was established in 1993 to address the need for a systematic approach to the organisation and review of evidence-based work on social interventions. The work and publications of the Centre engage health and education policy makers, practitioners and service users in discussions about how researchers can make their work more relevant and how to use research findings.

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