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Literacy, health literacy and the association with health behaviours

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Master of Philosophy

Keele University

October 2017

SUBMISSION OF THESIS FOR A RESEARCH DEGREE**Part I. DECLARATION by the candidate for a research degree. To be bound in the thesis**

Degree for which thesis being submitted Masters of Philosophy

Title of thesis Literacy, health literacy and the associations with health behaviours

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Date of submission 20/1/17

Original registration date 1/10/13

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Abstract

Background

Socioeconomic status is directly related to health in the UK. People from non-skilled households are twice as likely to smoke, drink excessively, have a poor diet and insufficient activity levels compared to those in professional households. Those in lower socioeconomic groups tend to have lower literacy levels and lower educational achievement. Poor health literacy has been associated with adverse health outcomes and higher mortality, it is also hypothesised that literacy may have a role in health behaviours. This project explores the association between literacy and health behaviours.

Methods

A systematic review was conducted in October 2013 and updated in January 2015 to examine the association between literacy and health behaviours. Online electronic databases were search, key papers were reference checked and experts in the field were contacted for additional literature.

A secondary analysis was conducted on the Healthy Foundations data set, a large (n=4928), cross-sectional study. Unadjusted associations between educational achievement and individual health behaviours were initially explored using multinomial logistic regression; then analysed adjusting for age, gender, indices of multiple deprivation, national statistic socio-economic classification and ethnicity.

Results

The systematic review identified a total of 39 papers, papers were not excluded on quality. Overall the systematic review demonstrated inconsistent evidence exploring the association between literacy and diet, exercise, alcohol consumption, and smoking. The review highlighted insufficient evidence for drug use and condom use.

The analysis of the cross-sectional dataset demonstrated an association between low educational achievement and smoking, not doing any exercise, eating little or no fruit and vegetables, more risky sexual practices (not using condoms when at risk) and not drinking alcohol. A non-significant relationship was found between education and drug use.

Conclusion

Lower education is associated with smoking, not exercising, eating less fruit and vegetables and not using condoms; however more research is needed to strengthen this conclusion. There is inconsistent evidence when considering the associations between literacy, when investigated with objective tools, and health behaviours so further research in this area is recommended.

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Chapter 1- Literacy

Introduction

Literacy is one of the fundamental skills required by citizens for understanding the consequences and benefits of health related behaviours. The acquisition of knowledge takes place via the transfer of information using language encompassing reading, writing, listening and speaking. With an increasingly complex world of advances in technology and medicine and using the internet, low literacy skills are more problematic now than ever (Kirsch et al., 2002). This thesis explores literacy and what it represents; the psychological principles of behaviour, and the connection between literacy and health behaviours. The first chapter of the thesis will focus on the classifications and definitions of literacy and health literacy and will proceed to explain the measures for literacy and health literacy; observed correlations between literacy, socioeconomic status (SES) and health outcomes are finally considered.

Defining literacy

The term literacy initially seems an uncomplicated term which represents the ability to read and write; however on closer inspection it is much more complicated. The definition of literacy can mean the skill set of reading and writing but also how the information is interpreted and translated into oral language providing a framework for critical thinking and analysis (Burnett et al., 2005). This approach assumes that the skill set is independent of context, whereas some experts argue that literacy is a social skill embedded within society and that it should be defined in the context of the environment such as health literacy (health literacy is explored in the next

section). It should, however, be recognised that basic skills are likely to be necessary regardless of the context and so defining literacy by different contexts may overemphasize the environmental influence. Some experts view literacy as a dynamic learning process rather than an outcome of learning and by using critical reflection, literacy is enhanced (Burnett et al., 2005).

Different competencies are included in the term literacy, and each are individually different and will vary in importance depending on the setting. *Prose literacy* is the skill needed to understand and use written information such as newspapers, signposts, instruction manuals or patient information leaflets. The skills required for different documents may vary greatly. *Document literacy* is the ability to locate specific information in documents and forms for example completing job application forms, interpreting pay slips and bank statements. *Quantitative literacy* (numeracy) represents the numerical ability to use skills and knowledge to apply arithmetic to numbers in printed material. Such calculations include estimating the interest on a loan or checking the accuracy of a bill or for health: understanding the risks and benefits of health actions and behaviours. *Oral literacy* reflects the ability to communicate through speaking and listening. Situations where this may be particularly relevant are during medical consultations, asking for directions, or health promotion strategies (Kirsch et al., 2002).

Whilst categorising literacy into different skills is useful, in real life situations these skills are often used in combination and the fundamental significance of literacy is being able to *function*. Functioning within society requires contributing to, and benefiting from, the interaction with society (Kirsch et al., 2002). The International Adult Literacy Survey (IALS) defines literacy as “the ability to understand and

employ printed information in daily activities, at home, at work and in the community- to achieve one's goals, and to develop one's knowledge and potential" (Organisation for Economic Co-operation and Development., 2000). This is akin to other expert opinion that suggests literacy prepares individuals for social, civic and economic roles beyond the skills of reading and writing (Burnett et al., 2005) and that literacy allows critical perception and interpretation of the world (Freire, 1983). Therefore, it can be more valuable to think of literacy in terms of level of functional ability (Freebody & Luke, 1990; Nutbeam, 2000), although functional ability is content-specific. *Basic literacy* is having a basic reading and writing ability to function in everyday situations. *Communicative literacy* is the combined use of advanced cognitive, literacy and social skills required to participate in everyday life. Communicative literacy reflects the ability to extract information from various sources, comprehend and apply them to new situations. *Critical literacy* requires more advanced cognitive skills to critically analyse or evaluate information, and identify and cope with life situations. Whilst comprehension and critical appraisal of information are important components of critical literacy, social skills are also applied to exert greater control over life situations (Nutbeam, 2000). Individuals display greater autonomy and empowerment as literacy levels increase; this has been noted to be of particular importance in defining health literacy (Nutbeam, 2000) and the next section will describe health literacy in further detail.

Defining health literacy

Health literacy at its simplest could be defined as literacy in a health context and is strongly correlated with general literacy: having low literacy directly limits health literacy (Nutbeam, 1998). However, there are many definitions of health literacy and the meaning of health literacy is a source of debate (Baker, 2006); this section aims to explore and clarify the meaning of the term health literacy as used in this thesis.

One concept of health literacy is the ability to read and understand written material to function as a patient (Ad Hoc committee on health literacy for the council on scientific affairs, American Medical Association, 1999). In this definition health literacy and literacy are directly related to one another and if low general literacy is present then health literacy tends to be low. However, it is suggested that health literacy may be lower than general literacy as health literacy is content specific, requiring prior knowledge and skills in a health context (Ad Hoc committee on health literacy for the council on scientific affairs, American Medical Association, 1999). The level of health literacy required to function as a patient would depend on the setting and nature of the problem. To understand a simple instruction may only require a basic skill set; but to understand and manage complex medical conditions higher levels of health literacy will be required. However, prior knowledge and experience are also key factors in health literacy; if a topic is familiar then a lower skill set is required to comprehend the information. Hence interpreting literacy in a specific health context includes experiential influence. Take for example a person who has received a new diagnosis of diabetes; if the individual already has a close family member with a diagnosis of diabetes the complexities of the diagnosis may

be more easily understood compared to someone who has no experience of diabetes.

The Institute of Medicine defines health literacy as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Committee on health literacy board on neuroscience and behavioral health., 2004). This definition goes beyond the skills of prose and document literacy; it is inclusive of quantitative literacy, oral literacy, and the individual capacity to understand concepts (*communicative literacy*). Health literacy is described as the product of the interaction between individual literacy skills, the health care system, the education system, and broad social and cultural factors at home, work, and in the community. It is suggested that these elements could be adapted to enhance health literacy (Committee on health literacy board on neuroscience and behavioral health., 2004).

Until recently the World Health Organization (WHO) defined health literacy as “the motivation and ability to gain access to, understand and use information in ways which promote and maintain good health” (Nutbeam, 1998). A criticism of this definition may be that health literacy and motivation are two different concepts. The WHO has redefined health literacy as “the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health” (Greenhalgh, 2015). This new definition puts the WHO definition of health literacy in line with previously described definitions. It has similarities with the Institute of Medicine's definition, implying that health literacy is the skill set and knowledge required for accessing health information, appraising it and having the capabilities to take action

(*critical literacy*). Beyond other definitions of health literacy this definition recognises the importance of both individual and societal resources.

The complexities of literacy and health literacy have been explored and the definitions clarified in this section; and it is clear there is significant overlap between the two definitions. Literacy skills are basic reading and writing abilities which aid individuals to use advanced cognitive functions to participate in social and analytical processes to exert control over daily life. Health literacy is defined in a similar way but in the context of health. As the two terms signify similar abilities, in this thesis both terms will be considered to represent a similar skill set.

The next section will describe the most recognised surveys and tools used to estimate general literacy. There are many measures of literacy and health literacy, this section provides an overview but is not an exhaustive list. Specific measures of health literacy have been developed to estimate literacy in a health context and will be described following the measures used for general literacy.

Measurements of literacy

Literacy

Large scale surveys

The National Adult Literacy Survey (NALS) was a large comprehensive survey, aimed at providing prevalence estimates of literacy levels in the USA. 27,238 interviews were conducted in 1992 (Kirsch et al., 2002), the assessment took 45 minutes to complete and responses to each item were open-ended, rather than multiple choice. The basis of the NALS was that skills were modelled on theories relating to individual items on the test, to generalise performance to a literacy level. The NALS results provide an assessment of the level of prose, document and quantitative literacy. Levels range from one to five, where level one requires the least amount of skill. The NALS allowed descriptions of the knowledge and skills at different levels. (see Table 1.1) (Kirsch et al., 2002). The measure not only assesses prior knowledge and skills but additionally evaluates the ability to apply the skills in different contexts.

Table 1.1- The National Adult Literacy Survey (Kirsch et al., 2002)

Level	Prose	Document	Quantitative
1	Requires the reader to read short text to locate a single piece of information which is identical to or synonymous with the information given in the question.	Able to locate a piece of information based on a literal match or to enter information from personal knowledge onto a document.	The reader performs single, relatively simple arithmetic operations, such as addition.
2	The task required the reader to locate a single piece of information in the text; despite several possible answers being present. The reader is able to compare and contrast easily identifiable information.	The task requires the match of a piece of information but several distracters are present. Tasks may also ask the reader to cycle through information in a document or integrate information from various parts of a document.	Tasks at this level typically require readers to perform a single operation using numbers that are either stated in the task or easily located in the material.
3	Require literal or synonymous matches between the text and information given in the task. Readers can find information from dense or lengthy text. Readers are asked to generate a response from easily identifiable information in the text. Distracting information is present but not located near the correct information.	Some tasks in this level require the reader to integrate multiple pieces of information from one or more documents. Others ask readers to go through complex tables or graphs which contain information that is irrelevant or inappropriate to the task.	At this level, two or more numbers are typically needed to solve the problem, and these must be found in the material.
4	These tasks require multiple matches and find information from complex or lengthy passages. More complex processes are needed to perform successfully.	This level requires multiple matches in documents and integration information. Numerous responses are needed but it is not stated how many are required.	Requires two or more sequential procedures or a single operation in which the quantities are found in different types of displays or drawn from prior knowledge.
5	This level requires searching for information in dense text which contains a number of plausible answers. Some tasks require prior background knowledge or ask readers to contrast complex information.	Tasks in this level require the reader to search through complex displays that contain multiple distractors, to make high-level text-based inferences, and to use specialized knowledge.	These tasks require readers to perform multiple operations sequentially. They must find from text or rely on background knowledge to determine the quantities or operations needed.

The International Adult Literacy Survey (IALS) (Kirsch, 2001) was conducted in over 20 developed countries, comprising of 68,755 participants. The aim of the IALS was to assess literacy levels over cultural and linguistic boundaries. Based on the NALS scoring system to assess literacy, the IALS was developed in the USA and concerns were raised that the assessment favoured Anglo-Saxon cultures at the expense of the Latin cultures, and the translation into different languages changed the level of complexity, particularly when translating into French (Organisation for Economic Co-operation and Development., 2000). These concerns suggest that there may be difficulties translating literacy assessments into different languages and cultures.

The Skills for Life Survey conducted in 2003 and replicated in 2011 aimed to estimate the literacy skills of working age (16-65 years old) people throughout England. The survey had 6049 participants and used a number of items of varying difficulties that correlated with a specific literacy level required to achieve a level on the National Qualifications Framework (NQF). The NQF stratifies qualifications into levels, from entry level grades which correlate with expected reading age to levels based on the literacy and numeracy skills required to achieve a qualification (see Table 1.2).

Table 1.2- National Qualifications Framework (Department for Business Innovation and Skills, 2011)

Levels	Example of qualifications
Entry level	
1	-National school attainment aged 5-7 years old
2	-National school attainment aged 7-9 years old
3	-National school attainment at age 9-11 years old
Level 1	- GCSE (grade D-G) -NVQ level 1
Level 2	-GCSEs (grade A*-C) -NVQ level 2
Level 3	-AS or A levels -NVQ level 3
Level 4	-Certification of higher education -NVQ level 4
Level 5	-Diploma of higher education -Foundation degree
Level 6	-Bachelors degree -Graduate certificate
Level 7	-Masters -Postgraduate diploma/certificate
Level 8	-Doctorate -NVQ level 5

Level two on the NQF is equivalent to five GCSE's at A*-C and is the expected achievement level for English school leavers. An increasing amount of skill is necessary to achieve a particular level, each level is summarised below:

- **Entry level 1-** Can read short familiar text with repeated language patterns. Writing is limited to short simple sentences only.
- **Entry level 2-** Can read simple familiar text and find information from familiar sources. Is able to write simple sentences with an awareness of an audience for example writing a short letter or note
- **Entry level 3-** Reads with more independence and can obtain information from everyday resources such as newspapers. Writing can be adapted for intended audiences.
- **Level 1-** Is able read texts of longer length and obtain information from various resources such as text books. Can express ideas and opinions clearly in written format using a variety of styles and format appropriate to the audience.
- **Level 2-** Accurately reads text of varying complexity. Ideas and opinions can be clearly expressed in writing and style and format is adjusted for the purpose, content and audience.

In contrast to the NALS and IALS, the Skills for Life Survey was delivered on a computer and responses were multiple choice or written answers. Oral literacy was not assessed in any of the above mentioned surveys. These large scale surveys were able to estimate the literacy level of the population but were criticised for being expensive and time consuming to replicate (Wagner, 2005).

Objective tool to measure literacy

The Wide Range Achievement Test (WRAT) was initially developed in 1946 and since has been updated numerous times, the most recent version is WRAT-4. The WRAT has four main sections: word recognition, sentence comprehension, spelling and mathematic computation. The tool takes between 15-45 minutes to administer and results are on a continuous scale. Despite a number of studies using the WRAT to estimate health literacy, the WRAT uses educational resources and so is a measure of general literacy skills (Robertson, 2001).

Education

In the main, literacy skills are acquired in schools; traditionally educational attainment has been a popular proxy for literacy skills. Educational qualifications and to a lesser extent, years of completed or age left full time education, are an indicator of literacy skills (Kirsch, 2001). The previous popularity of this marker may be due to the inexpensive and simple process required to gather the information.

However, this proxy measure has limitations. Firstly, educational level is a measure of literacy skills at the time the qualification was achieved but literacy skills can fluctuate, deteriorate or appreciate over time. For example if an individual obtained a certain qualification but then did not need to read or write on a regular basis, the skills needed to achieve the qualification may depreciate. Whilst considering this, educational attainment may be less relevant the longer ago the qualification was obtained. Young to middle aged adults who achieved the same qualification level tend to have a similar distribution of literacy skills when comparing age groups; however people aged over 56 years tend to have lower literacy compared to younger people who achieved the same level (Department for Business Innovation and Skills, 2011), suggesting that lower literacy skills may be related to cognitive decline. Secondly, informal qualifications such as apprenticeships are often disregarded when assessing educational qualifications and so literacy skills may be underestimated in certain groups. Thirdly, schooling teaches literacy skills in the particular context of the learning environment, and if taken out of context, these skills may be less relevant in real life situations (Boudard & Jones, 2003). Finally, educational level can be used as a socioeconomic marker. Those who obtain higher qualifications are more likely to develop professional careers and earn a

higher income. Low or no educational attainment is predictive of future unemployment (Organisation for Economic Co-operation and Development., 2000). Therefore education represents more than just literacy skills.

Education has long been a marker of socioeconomic status (SES) and its use in this context is described below in more detail. When exploring associations between education and health behaviours there are concerns over how to interpret the results because education represents both socioeconomic status and literacy skills. It may be impossible to distinguish the true nature of the associations seen as education, SES and literacy are so intertwined. However, this limitation also applies when assessing literacy skills. At a given time, literacy is the result of education, socioeconomic background and workforce demands (Organisation for Economic Co-operation and Development., 2000). Higher paid occupations tend to demand higher literacy skills so consequently maintain and improve literacy. Therefore when an association is seen between literacy and an outcome, this association may be, in part, the effect of work place demands, and therefore increased literacy, but also other socioeconomic factors, such as better living conditions.

Nevertheless, a number of studies have demonstrated in general that those who obtain higher qualifications have higher literacy skills (Organisation for Economic Co-operation and Development., 2000; Department for Business Innovation and Skills, 2011), although it is recognised that educational level does not perfectly correlate with current literacy level. However the greatest correlation with literacy level is when education attainment is low (Kirsch et al., 2002). This may be due to initially having a

lower basic skill set which limits employment opportunities and makes it less likely to gain employment that improves literacy.

Overall literacy levels in less educated groups tend to be lower; approximately 77% of people who have not achieved any GCSEs have a below level 2 literacy level, this is in contrast to 41% of people achieving A levels or higher (Department for Education and Skills, 2003). This is a surprisingly high proportion of people who have achieved high educational qualifications and yet demonstrate low literacy skills in this survey. The overall correlations between educational level and health literacy tools have been explored. The Test of Functional Health Literacy Assessment (TOFHLA) has a correlation of $r=0.36$, Rapid Estimate of Adult Literacy in Medicine (REALM) $r=0.34$ and Newest Vital Sign (NVS) $r=0.41$ (Mottus et al., 2014), where $r=1.0$ is perfect correlation (The health literacy tools are described in detail on pages 21-25). Another study has assessed the correlation between health literacy (as measured using the Health Literacy Skills Instrument-a validated tool assessing oral, internet searching, document, prose and quantitative literacy) and education and found similar correlations ($r=0.47$) (Sun et al., 2013). These results do not demonstrate strong correlations between education and the health literacy measures but it should also be noted that Mottus et al also explored correlations between each health literacy measure and found poor correlations. The NVS had a correlation of $r=0.34$ with the REALM and $r=0.42$ with the TOFHLA. The REALM and TOFHLA had a similar correlation of $r=0.38$ with one another. Interestingly, most people in the study had very high scores in the REALM and TOFHLA but NVS scores were evenly distributed. However the Skills for life survey 2011, found that those achieving level one qualifications (OR 1.69, 95% CI 1.18 to 2.43)

or no qualifications (OR 2.49, 95% CI 1.68 to 3.70) were more likely to have weak literacy skills compared to those who achieved level three qualifications. The evidence suggests that no measure of health literacy/literacy and education are perfectly correlated but there are stronger associations when educational achievement is low, so while education is often used as a proxy for (health) literacy, analysis suggests that overall they may not actually be that strongly related.

Literate verses illiterate

The crudest method of classifying literacy is by dichotomising into literate - the ability to read and write, or illiterate - the inability to read and write. Classifying literacy in this way tends to be unhelpful in countries where education is the norm as most people would be classified as being literate (Boudard & Jones, 2003). Most people would report they can read and write but may not be able to deal with the complexities required to function in their daily life and the work place. In 2011 the Skills for Life Survey (Department for Business Innovation and Skills, 2011) demonstrated that only 1.0% of the working age adult population reported they could not read; using this self-report method, 99% of the population would be classified as literate but, from the results of the more detailed questions, over a third lacked the necessary skills to function and achieve their potential in everyday life.

In developing countries where free, widespread attendance in education is not common, dichotomising into literate and illiterate may provide information that is more useful, although in such settings education may be more strongly associated with socioeconomic status. For example, if a family needs their children to work in order for

the family to survive, education may not be a priority and the children may not attend school regularly. Therefore the observed benefits of being literate may be more related to higher SES (e.g. less deprivation and better living conditions) than to literacy.

Health literacy

Numerous measures have been developed to estimate health literacy which include objective measures and subjective measures. This summary aims to give an overview of the most commonly used measures of health literacy with the strongest models described based on the evidence. Included are the Rapid Estimate of Adult Literacy in Medicine, Test of Functional Health Literacy in Adults, Newest Vital Sign and a self-report measure. These measures are the most recognised and widely used tools to estimate health literacy but this is not an exhaustive list. It was not feasible, given the resources available to perform a systematic search and provide details of all previously developed measures of health literacy. Other measures of note are the European Health Literacy Survey (HLS-EU) (a self-report measure exploring perceived difficulty in carrying out health-related tasks) (HLS-EU Consortium, 2012) and the Cardiovascular dietary education system (TenHave et al., 1997) (a 200 item word recognition and pronunciation related to diet, nutrition and cardiovascular health) and the Woodcock-Johnson achievement test (Woodcock et al., 2001) a reading comprehension, speaking and listening test from educational literature. The objective measures will be described in this section and the subjective measures in the following section.

Objective tools

Tools estimating health literacy assess literacy in the context of health and tend to be simpler, less costly and less time consuming to deliver than the previously discussed large literacy surveys. The most widely used measures of health literacy do not fully capture the broad definition and concept of health literacy, with the majority of objective tools measuring prose, document and quantitative literacy. Table 1.3 summaries the most commonly used objective measures of health literacy.

Table 1.3- Most commonly used objective measures of health literacy

Tool	Description	Scoring system
Rapid Estimate of Adult Literacy in Medicine (REALM) (Davis et al., 1993)	66 item word recognition and pronunciation test of common medical terms.	<3 rd grade (8-9 years old), 4 th -6 th grade (9-12 years old), 7 th -8 th grade (12-14 years old), >8 th grade (13-14 years old).
Test of Functional Health Literacy in Adults (TOFHLA) (Parker et al., 1995)	Health focused 50 item reading comprehension test and 17 item quantitative skills assessment.	Inadequate, Marginal, Adequate
Newest Vital Sign (NVS) (Weiss et al., 2005)	Document and quantitative literacy assessed by 6 items regarding an ice cream nutrition label	Low literacy, possible low literacy, adequate literacy.

The Rapid Estimate of Adult Literacy in Medicine (REALM)

The REALM takes 5 minutes to complete and is a list of 66 lay medical words of varying complexity. There are three columns of varying difficulty, examples of the words are listed below.

- | | | |
|----------|----------------|--------------|
| • Fat | • Fatigue | • Allergic |
| • Flu | • Pelvic | • Menstrual |
| • Pill | • Jaundice | • Testicle |
| • Dose | • Infection | • Colitis |
| • Eye | • Exercise | • Emergency |
| • Stress | • Behaviour | • Medication |
| • Smear | • Prescription | • Occupation |
| • Nerves | • Notify | • Sexually |

Participants are asked to move down the list reading the word aloud and a mark is given for correct pronunciation. Participants can say “blank” if they do not want to try to pronounce words and can move onto the next word. There is no time limit and scoring is hidden from the participant. The raw scores are converted into the corresponding school year (grades) where a score of 0-18 is third grade (8-9 years old) or below, 19-44 fourth-sixth grade (9-12 years old), 45-60 seventh to eighth grade (12-14 years old) and 61-66 ninth grade (13-14 years old) and above. The REALM provides good validity

in the general population and correlates with the results from the WRAT-R (Davis et al., 1993).

The Test of Functional Health Literacy in Adults (TOFHLA)

Two years following the publication of the REALM, the TOFHLA was developed to provide a tool that could estimate functional health literacy (Parker et al., 1995). It takes over 20 minutes to administer and was developed using real life hospital material. The TOFHLA is a multiple choice reading comprehension test. The assessment takes sentences from a body of text but omits every 5th or 7th word, the participant can refer to the printed hospital material and choose which words have been omitted (Cloze method) (Bormuth, 1967). Documents included in the TOFHLA range from (simple) patient information leaflets to (complex) consent forms. The TOFHLA has a numerical section where participants are presented with a document and asked questions regarding the numerical aspect such as how to take the medication from the prescription given (Parker et al., 1995). This assessment provides a valuable insight into how individuals handle and respond to written hospital information. The TOFHLA has shown good correlation with the REALM ($r=0.84$) and the WRAT ($r=0.74$); and is a valid tool in a health care setting (Parker et al., 1995).

The Newest Vital Signs (NVS)

The NVS assesses understanding of an ice cream label by asking questions such as peanut oil is among the ingredients and the participant is asked can you eat this ice cream if you have a peanut allergy. The assessment also requires participants to perform numerical calculations. For example the label reports there are four servings

per container and 250 calories per serving one item asks: “if you eat the entire container, how many calories will you eat”. The participant is required to locate that 250 calories is for one serving, find that a container is four servings and multiply 250 by four. The NVS has been demonstrated to be a reliable and valid tool to predict limited literacy (Weiss et al., 2005).

Measuring health literacy with these methods is likely to be highly correlated with literacy as all the tests involve reading proffered material. Whilst most health literacy assessment tools fall short in assessing the full scope of the definition of health literacy, it is unknown whether using a more comprehensive tool would provide a better predictive value of health literacy (Baker, 2006).

Self-reported abilities

Health literacy measures have been criticised for being too lengthy to perform in clinical settings and concerns have been expressed that people with low literacy skills may find the assessments embarrassing (Chew et al., 2004). In an effort to negate these concerns proxy questions were developed to identify people who may have inadequate literacy. In a USA adult population 16 proxy questions were screened for correlation with the TOFHLA (Chew et al., 2004). Three of these questions had good sensitivity and specificity for predicting inadequate health literacy. The questions are below; possible responses to each item are - always, often, sometimes, occasionally, never. The area under the ROC curve (AUROC) provides information on sensitivity and

specificity of the question to predict the TOFHLA, when equal to 0.5 the accuracy is due to random chance and when equal to 1.0 there is perfect prediction of the TOFHLA.

- How often do you have problems learning about your medical condition because of difficulty understanding written information? (AUROC=0.76, 95% CI 0.62 to 0.90)
- How confident are you filling in medical forms by yourself? (AUROC=0.80, 95% CI 0.67 to 0.93)
- How often do you have someone (like a family member, friend, hospital/clinic worker, or caregiver) help you read hospital material? (AUROC=0.87, 95% CI 0.78 to 0.96)

However these results may not be generalisable to the whole population as the study had lower than anticipated external validity because the participants recruited were predominately male, white and 80% of the sample were over 46 years old (Chew et al., 2004). Wallace et al (Wallace et al., 2006) assessed the three health literacy screening questions in a USA adult population for accuracy to predict limited health literacy. The REALM was used to measure health literacy instead of the TOFHLA. The study population was recruited from a primary care clinic, with a mean age of 49 years old (SD 16.5) and 67.5% were female. Confidence in filling in forms was most predictive of limited health literacy (AUROC= 0.82, 95% CI 0.77 to 0.86). Both studies found that combining two or more questions did not improve their screening ability. Thus some later studies have only used one of the three screening questions. Assessments were

made to explore the sensitivity and specificity of the health literacy screening questions to predict educational attainment. Chew et al found an AUROC of 0.77, 95% CI 0.65 to 0.90; and Wallace et al found an AUROC=0.69, 95% CI 0.61 to 0.78, demonstrating moderate predictive performance.

In addition to being valid predictors of inadequate health literacy, the screening questions are straight forward, quick to deliver, inexpensive and save embarrassing assessments. Furthermore the questions do not directly measure ability and so are easily translated into other languages (Sarkar et al., 2010). The following section will discuss the prevalence of low literacy skills.

Prevalence of low literacy skills

Low levels of literacy skills are common in the UK. In 2006, the Leitch report (a report published by the UK government to assess the skill requirement to ensure the UK is economically and internationally competitive) estimated that 5 million people lack the literacy skills to be able to function in society (Leitch report, 2006). It is also reported that the proportion of people in England between 25-64 years of age with low or no qualifications is double that of Sweden, Japan and Canada (Leitch report, 2006). The 2011 Skills for Life Survey in England reported that since 2003, the proportion achieving literacy level 2 or above on the NQF has increased from 44.2% in 2003 to 56.6%. This is a successful achievement, however on inspecting the lowest two groups, the proportion in the entry level two or below groups has also increased (see Table 1.4) (Department for Business Innovation and Skills, 2011). This projection over time is a concern as the proportion of people in the lowest literacy groups is worse but the higher literacy groups are improving. This may represent a widening divide between the least educated and the remainder of the population. People who have few or no qualifications are more likely to be unemployed and live in poverty (Leitch report, 2006). An additional concern for these individuals is how this may impact on their health as unemployment is a significant risk factor for all-cause mortality (Roelfs et al., 2011).

Table 1.4 – Literacy level in England in 2003 and 2011 (Department for Business Innovation and Skills, 2011)

	Population estimate 2003 (%)	Population estimate 2011 (%)
Entry level 1 or below	1.1 million (3.4)	1.7 million (5.0)
Entry level 2	0.6 million (2.0)	0.7 million (2.1)
Entry level 3	3.5 million (10.8)	2.7 million (7.8)
Level 1	12.6 million (39.5)	9.7 million (28.5)
Level 2 or above	14.1 million (44.2)	19.3 million (56.6)

A large systematic review conducted in 2004 aimed to estimate the prevalence of limited health literacy in the USA. This review included 85 studies and data on 31,129 participants. Many measures were used to estimate health literacy, the most common being the TOFHLA and REALM. It was estimated that approximately one in four participants had lower health literacy and half had low or limited health literacy (Paasche-Orlow et al., 2005). Certain groups have a higher proportion of limited literacy and health literacy, and this is discussed in more detail next.

Observed associations with low literacy

Age

As already mentioned at the beginning of the chapter, people aged over 56 years tend to have lower literacy compared to younger people who achieved the same educational qualification, suggesting that literacy skills may depreciate with cognitive decline (Department for Business Innovation and Skills, 2011). This has been extensively researched in terms of health literacy. A systematic review exploring the prevalence of low health literacy found that studies with an average participant age of over 50 years old had a prevalence estimate of 37.9% (95% CI= 31.6 to 44.2) of low health literacy which was over double that of the lowest age group (prevalence=15.9%, 95% CI= 7.7 to 24.1) (Paasche-Orlow et al., 2005). Compared to 35-44 year olds people aged 55-65 are more likely to have lower literacy skills (OR= 1.46, 95% CI 1.13 to 1.90) (Department for Business, Innovation and Skills 2012). Older people tend to have more co-morbidities and so more contact with the healthcare system. Therefore as age increases health literacy is of particular importance but the data suggests that in older adults low health literacy is more prevalent.

Ethnicity

When assessing literacy, low literacy becomes more or less prevalent depending on ethnicity and whether the ethnic origins and primary language are native to the country. For example in the Skills for Life Survey (Department for Business, Innovation and Skills 2012) compared to White British/Irish people, Indian people (OR= 3.09, 95% CI

1.49 to 6.38) and Pakistani people (OR=2.87, 95% CI 1.13 to 7.30) whose first language was English were more likely to have lower literacy skills. Unsurprisingly the largest risk factor for having low literacy skills was English being the second language. In the Skills for Life survey people whose second language was English were more likely to have lower literacy skills compared to White British/Irish people across all ethnic origins including Indian (OR=8.27, 95% CI 4.73 to 14.47), Pakistani (OR= 22.19, 95% CI 8.07 to 60.98), and Black and White mixes (OR= 10.79, 95% CI 5.77 to 20.18). Ethnicity has also been researched in terms of health literacy and similar findings have been found. A large systematic review (Paasche-Orlow et al, 2005) assessing the prevalence estimates of limited health literacy and the associations with ethnicity found that Black people had the highest prevalence of limited health literacy. Von Wagner et al, 2007 conducted a study in the UK which found that having English as a second language was associated with limited functional health literacy (OR= 2.06, 95% CI 0.07 to 7.80) but was statistically non-significant.

Socioeconomic inequalities

Socioeconomic status (SES) is a measure that combines a number of social and economical determinants to quantify how an individual or group participates in terms of the economy and society (Miech & Hauser, 2001). SES can also be defined as the ability to create or consume goods that are valued in society (Miech & Hauser, 2001). The National Center for Education Statistics defines SES as “the access to financial, social, cultural, and human capital resources” and suggest that measures include

resources available from the household, neighbourhood and schools (National Center for Education Statistics, 2012). There are many possible markers of SES, however the most commonly used are education, occupation and income (Miech & Hauser, 2001).

The concept of SES has emerged through observed health outcomes associated with low income, low educational level and low-status jobs (Adler & Newman, 2002). They are powerful proxies, estimating that up to 80% of premature mortality is associated with these factors (Adler & Newman, 2002). Low SES has also been linked to increased morbidity. The National Statistic Socio-Economic Classification (NS-SEC) is a marker of SES using profession, ranging from high managerial professionals to never worked and long term unemployed (Rose & Pevalin, 2005). SES can be estimated using either the employment of the individual or of the main household earner (Department for Education and Skills, 2003). Low SES is associated with lower literacy, and managers and professionals tend to have higher literacy skills than anyone else (Department for Education and Skills, 2003). As stated previously literacy skills are influenced by employment and the requirements of the role. Therefore, it is expected that a role demanding high level literacy would improve and maintain literacy skills. Associations have also been found between literacy and annual income, in that more literate groups tend to earn more than lower literate groups (Department for Education and Skills, 2003).

In contrast to individual measures, the Indices of Multiple Deprivation (IMD) is a measure of deprivation of an area and individuals are classified based on characteristics of where they live rather than individualised factors. The measure includes income, employment, health, disability, education skills, training, barriers to

housing and services, crime and the local environment. Distribution of the literacy skills vary depending on IMD category; a higher proportion (69%) of those living in the most deprived areas of England have literacy skills below level 2 on the NQF, compared with those living in the less deprived areas (44%) (Department for Education and Skills, 2003). The discrepancy remains striking when comparing literacy at or below entry level 3 on the NQF: 27% living in the most deprived areas of England have literacy skills at or below entry level 3, which is in comparison to 8% in the least deprived areas (Department for Education and Skills, 2003).

In addition to socioeconomic associations, Government agencies have identified education as being of paramount importance to break the cycle of deprivation and social inequalities (Department of Education and Skills (DfES), 2003). Higher education is associated with lower unemployment rates and higher earnings. Having a more educated society enables the economy to be internationally competitive promoting robust and sustained economic growth. Economists view education as a valuable part of the economy to increase productivity, lower unemployment and increase earning potential (Department of Education and Skills (DfES), 2003). Education as a marker for socioeconomic status is complex, particularly when researchers aim to disentangle education and literacy to explore the effects of literacy on outcomes.

Health outcomes

The associations between education and health outcomes are well established, particularly in the context of SES as described above. However, in healthcare, health literacy is thought to be more important than general literacy skills as it is more context specific (Baker, 2006). It is hypothesised that health literacy may be part of the causal pathway seen between education and health outcomes (Ad Hoc committee on health literacy for the council on scientific affairs, American Medical Association, 1999). Research in the context of health outcomes has focused on health literacy rather than literacy and so this section will discuss the associations seen between health literacy and health outcomes.

There is a strong body of evidence demonstrating that low health literacy is associated with increased mortality (Berkman et al., 2004). One study in the USA concluded that people with inadequate health literacy have a higher mortality compared with people who have adequate health literacy (hazard ratio, the hazard in one group compared with proportion of the hazard in the other group =1.52, 95% CI 1.26 to 1.83) (Baker et al., 2007). Similarly, a study exploring mortality in older US adults found that once adjusting for income, education, health conditions and health behaviours (such as smoking), having limited health literacy increased mortality compared with adequate health literacy (HR=1.75, 95% CI 1.27 to 2.41) (Sudore et al., 2006). A more recent study exploring literacy in older adults in the UK supported previous research and, despite statistical adjustments for socioeconomic status, baseline health and health behaviours, they also found that having low health literacy increased mortality

compared to having adequate health literacy (HR= 1.47, 95% CI 1.20 to 1.79) (Bostock & Steptoe, 2012).

Berkman et al. (2011) devised a model for the relationship between health literacy and health outcomes (see Fig 1) encapsulating the complex nature of the relationship between health literacy and outcome. In this model it is hypothesised that health literacy affects knowledge and risk perceptions to influence attitudes, self-efficacy and the necessary skills to function as a patient. Numerous factors influence health behaviours such as social norms, attitudes, self-efficacy, support and access. Theoretical models of behaviour change and adherence are discussed in more detail in Chapter 2. The model in Figure 1.1, described by Berkman et al perceives the sole direct action of health literacy is through having knowledge and accurate perception of risk. However on considering the previously described definitions of literacy and health literacy (the basic reading and writing skills to allow a framework for analysis and critical thinking to exert control over daily life and health) it can be hypothesised that health literacy directly exerts effect on more than knowledge and risk perception. It could be hypothesised that it may inform attitudes, self-efficacy and the perception of social norms. Paasche-Orlow and Wolf (Paasche-Orlow & Wolf, 2007) devised a similar, more detailed conceptual model of health literacy and health outcomes (see Fig 2). They hypothesised that health literacy exerts a direct effect on access and utilisation of care, the interaction between the patient and provider, and self-care to effect outcome. This hypothesises that health literacy directly impacts on motivation, self-efficacy, beliefs and participation in decision making. This model also summarises how factors such as age, education and culture impact on health literacy. Each model has a slightly different

focus; Berkman et al divides behavioural action into the different stages of behavioural change (intent, initiation and adherence) and the model depicts that the health literacy influence is solely via knowledge and risk perception, whereas Paassche-Orlow and Wolf suggest that health literacy has a direct relationship between many factors related to self-care, patient-provider interaction, and access of health care which impacts on health rather than behavioural action. It is likely the actual relationship is a hybrid of the two models.

Figure 1.1- The conceptualised model of the effect of health literacy on health outcome (Berkman et al., 2011)

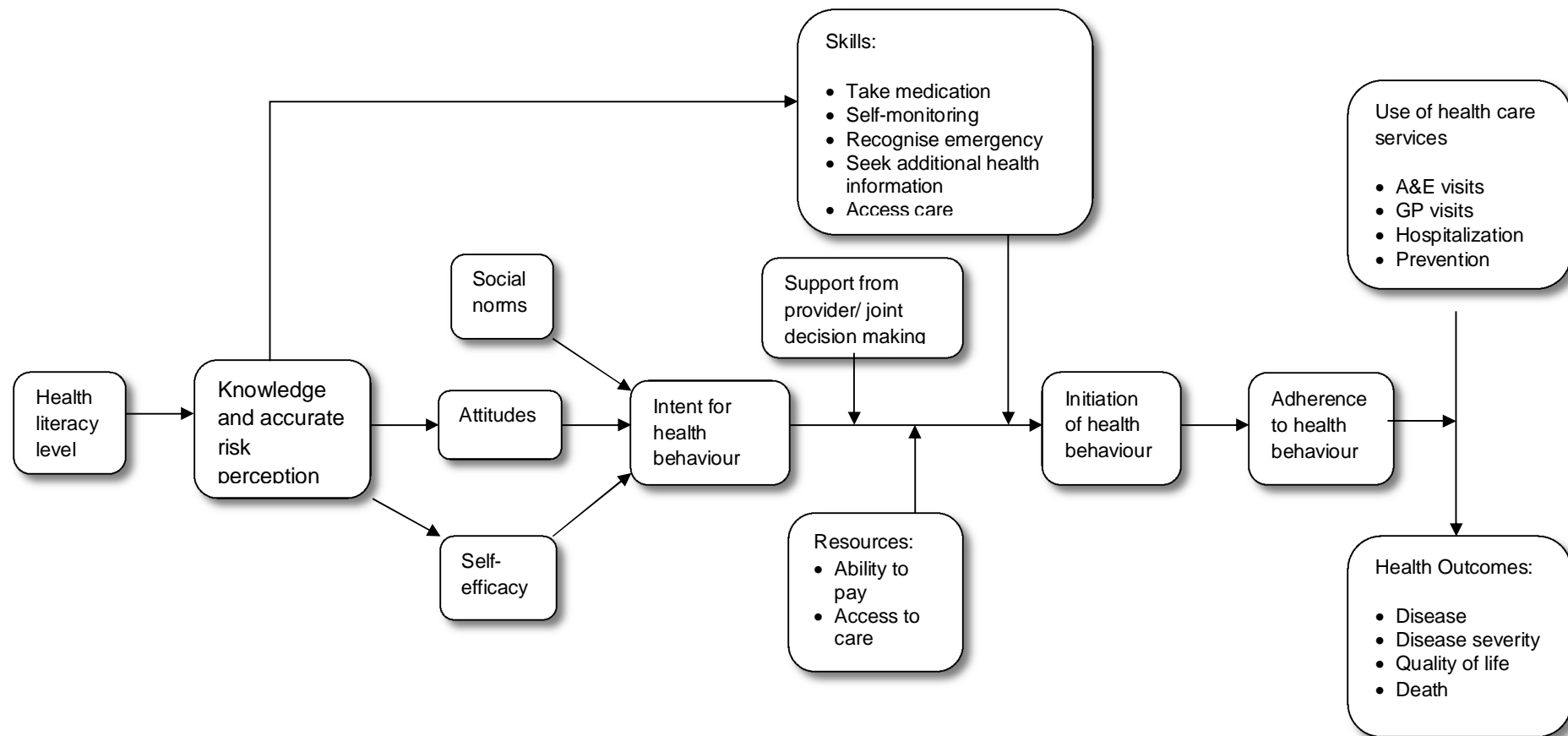
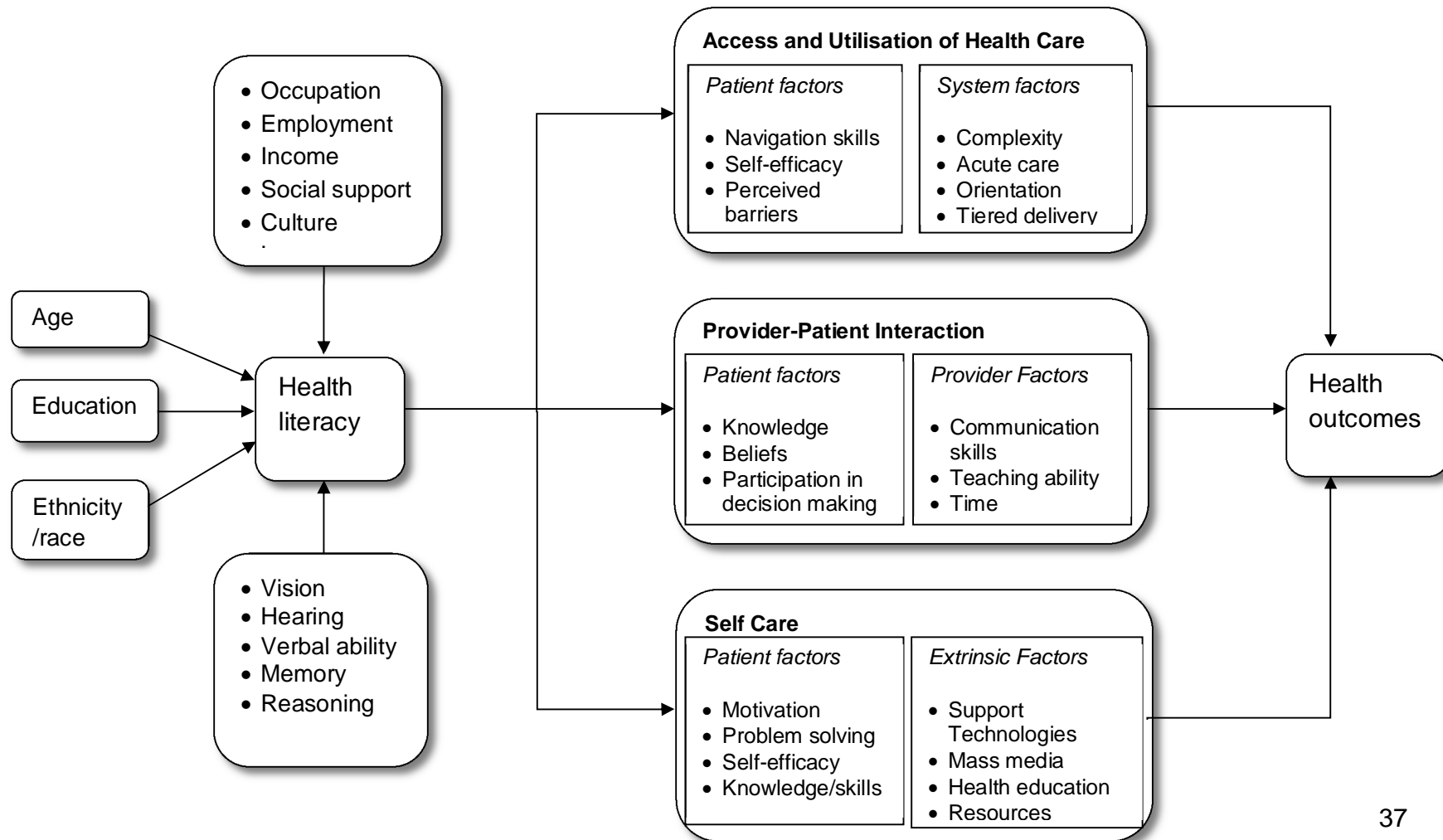


Figure 1.2- Conceptualised model of health literacy and outcome (Paasche-Orlow & Wolf, 2007)



Berkman et al. (2011) conducted a large, detailed systematic review which reaffirmed the strong body of evidence for the association between health literacy and mortality, but found that most other outcomes (such as medication adherence, chronic disease outcomes, asthma control, diabetes control, blood pressure control, health behaviours and health status) have insufficient evidence to draw reliable conclusions about causality/associations and advised that further research is needed. This review focused on health literacy as measured by objective tools so may have excluded potentially relevant studies investigating health behaviours. Also reported in the review was moderate evidence to support that low health literacy is associated with not taking medications as prescribed, difficulty interpreting medication labels and health messages, and lower overall health status in the elderly. This suggests that most relationships between low health literacy and outcome are yet to be established and the reason for the association between health literacy and mortality is yet to be explained.

Despite insufficient and mixed results exploring the causal mechanisms of the association between health literacy and morbidity and mortality, a number of intervention studies have been undertaken. A systematic review (Sheridan et al., 2011) evaluated the literature investigating the efficacy of interventions to improve health literacy and consequently health outcomes. It was found that studies utilising interventions of high intensity, delivered by a health professional with an emphasis on building skills and providing a theory base, improved outcomes such as self-care, diabetic control and blood pressure; it was also found that hospitalisation and emergency department visits were reduced. Some studies found that the most marked

results were in the groups with the lowest literacy skills. One study estimated the cost of the intervention was \$36.97 per patient per month for an intervention requiring an average of 2 hours and 34 minutes per patient each month. This systematic review demonstrates that not only is health literacy modifiable, but when improved, health outcomes can also be improved.

Summary

This chapter has clarified the definition and classifications of literacy and explored the different aspects of literacy such as prose, document and oral skills. Whilst considering literacy in the context of how it impacts functional ability, levels of literacy can be considered in terms of basic, communication and critical literacy. Literacy and health literacy are directly related and represent a similar skill set and so it is reasonable to assume that if someone has low literacy skills they are likely to have low health literacy. Both low literacy and low health literacy are common. The NALS, IALS and the Skills for Life Survey are detailed national and international surveys, which provide robust and accurate estimates of adult literacy skills. Health literacy measures tend to be more reproducible but perhaps at a cost of being less detailed and generalisable of global health literacy skills. The health literacy screening questions provide a valid, reliable and rapid alternative to screening for inadequate health literacy. Education is a proxy for literacy and is most useful in estimating low literacy skills, however should be used with caution as it is also a marker for SES.

Health literacy is associated with increased mortality but the exact mechanism of causality is yet to be established. It may be that health literacy directly impacts on people's decision making choices and behaviours, as outlined in Paasche-Orlow's and Wolf's model of health outcome. The next chapter will clarify the psychological theories behind health behaviours and describe how psychological factors influence behaviour change and maintenance.

Chapter 2- Health behaviours

Overview

The previous chapter examined literacy and health literacy and the observed associations between literacy/health literacy, socioeconomic status and health outcomes. Health behaviours are an important determinant of health outcomes and this chapter aims to explore health behaviours in detail. The disease burden health behaviours carry, the UK recommendations for a healthy lifestyle and the effect positive choices can have on health and mortality will be considered below. Finally theories of behaviour change and the individual factors influencing health behaviours will be explored.

Disease burden of health behaviours

Health behaviours directly impact on health and are major risk factors for morbidity and mortality (The World Health Organisation, 2002). Adopting a healthy lifestyle can reduce the risk of cardiovascular disease, diabetes, respiratory disease, cancer and communicable diseases such as HIV. Worldwide it is estimated that 14.4 million deaths, approximately a quarter of all deaths, occur each year as a result of health behaviours (The World Health Organisation, 2002). Of this approximately 19% are attributable to low fruit and vegetable consumption, 34% to smoking, 20% to unsafe sex, 13% to alcohol excess, 13% to physical inactivity and 1% due to illicit drug use (The World Health Organisation, 2002). Given the importance of these health

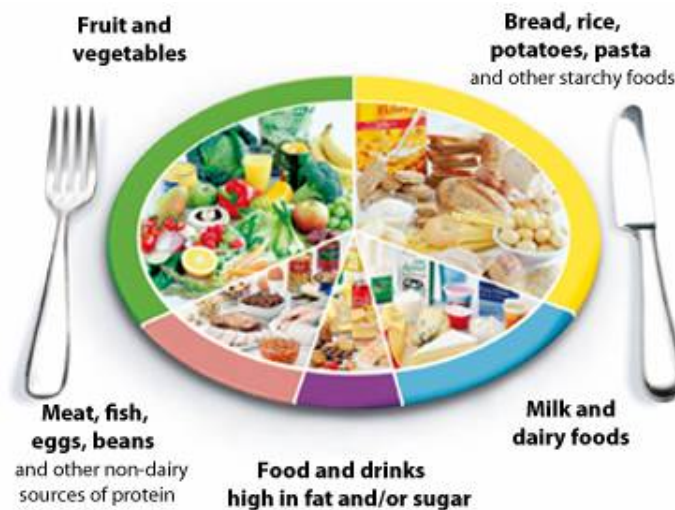
behaviours it was decided to focus on these five lifestyle behaviours. Whilst it is recognised other lifestyle behaviours are important to health, pragmatically, the dataset available to the research team (see Chapter 4) had data from the above mentioned behaviours so these are explored in further detail below.

Diet

In the UK the “eat well plate” is the basis for advice on a healthy diet (see Figure 2.1) (NHS Choices, 2013a). The “eat well plate” recommends that a third of the diet should be based on carbohydrates, a third on fruit and/or vegetables and the remaining third should contain a combination of dairy, meat and a small amount of foods containing high amounts of fat or sugar. In line with the eat well plate, the UK government recommends a minimum consumption of five portions of fruit and vegetables a day (NHS Choices, 2013b). A portion is 80 grams, roughly a ‘handful’ (NHS Choices, 2013b). Having higher fruit and vegetable consumption has been found to be associated with reduced mortality (Wang et al., 2014). A systematic review and meta-analysis demonstrated that there is a dose-response effect up to five portions a day (Wang et al., 2014). In England a large cohort study found 75.1% of the population eat less than five portions of fruit and vegetables a day (Oyebode et al., 2014). Similar to the systematic review they also found a dose-response effect, but this study found the effect was up to seven portions a day with a Hazard Ratio of 0.67 (95% CI 0.58 to 0.78). Lower socioeconomic groups (as estimated by occupation, annual income or highest educational achievement) tend to eat less fruit and vegetables compared to higher socioeconomic groups (Maguire & Monsivais, 2015). There are also observed variations in fruit and vegetable consumption in ethnic groups. For example, more

people from Chinese (54%) and African-Caribbean (44%) descent eat 5 portions of fruit and vegetables a day, compared to Pakistanis (19%). The higher consumption of fruit and vegetables in Chinese and African-Caribbean cultures reflects their traditional diets (Leung & Stanner, 2011).

Figure 2.1- The eat well plate (NHS Choices, 2013a)



Fibre is an important component of the diet; foods high in fibre include fruit and vegetables, nuts, whole-grain bread and cereals. Fibre has a localised effect on the bowel, decreasing bowel transit time and increasing stool volume, and has been associated with lowering cholesterol (Committee on Diet and Health, National Research Council, 1989). High fibre diets have found to reduce the risk of cardiovascular disease (risk ratio 0.91 per 7 grams/day (95% CI 0.88 to 0.94)

(Threapleton et al., 2013). The author was unable to find published evidence to support variations in fibre intake between socioeconomic and ethnic groups.

The amount of dietary fat consumed is directly related to serum cholesterol and triglyceride levels which are aetiological factors of cardiovascular disease; a diet high in fat raises cholesterol and triglyceride levels (Committee on Diet and Health, National Research Council, 1989). When comparing the fat intake of different socioeconomic groups one study found that there was no significant difference in fat consumption between different socioeconomic groups (Maguire & Monsivais, 2015). The evidence on fat consumption between ethnic groups is conflicting with some studies showing significantly lower consumption in fat in ethnic minority groups in the UK and others finding the opposite (Leung & Stanner, 2011).

Proteins are large structures made up of smaller molecules called amino acids. There are a total of nine amino acids and different proteins have different amounts and combinations of amino acids. The body does not need proteins in their large form but requires the smaller amino acids. Foods such as meat, fish, cow's milk and eggs contain relatively high concentrations of amino acids. In developed countries the main source of protein is from animal products which tend to contain a high proportion of saturated fats. Thus the effects seen with protein intake cannot easily be distinguished from fat intake in observational studies (Committee on Diet and Health, National Research Council, 1989). With this in mind, some studies have found that high protein intake is associated with increased cholesterol, bowel cancer and breast cancer (Committee on Diet and Health, National Research Council, 1989). However a recent systematic review and meta-analysis of randomised control trials found that diets high

in protein may cause a modest improvement in weight loss but have no effect on cardiovascular markers such as blood glucose, blood pressure or cholesterol (Santesso et al., 2012). Red meat in particular has been implicated in the association with bowel cancer (Chan & Giovannucci, 2010). A study assessing differences in red meat consumption along the socioeconomic gradient demonstrated that higher socioeconomic groups ate less red meat compared to lower socioeconomic groups (Maguire & Monsivais, 2015).

Carbohydrates can be classified into two groups- simple and complex. Simple carbohydrates are called sugars, the most commonly found sugars are glucose, fructose and sucrose. Glucose and fructose are found in fruits. White refined sugar is sucrose; one unit of sucrose consists of one unit of glucose chemically bound with one unit of fructose. Sucrose is also found in small amounts in fruits. During food processing sugar is often added to foods, this sugar is usually in the form of sucrose or high-fructose corn syrups (Committee on Diet and Health, National Research Council, 1989). Adding sugar, particularly fructose, to foods has been shown to increase triglycerides and cholesterol although the evidence linking sugar to obesity is inconsistent (Aller et al., 2011). Complex carbohydrates are larger structures of sugar units chemically bound together, for example starch contains many units of glucose (Committee on Diet and Health, National Research Council, 1989). Complex carbohydrates tend to take longer to digest and so prolong satiety (Aller et al., 2011). A recent systematic review concluded that diets low in carbohydrate are associated with increased mortality (RR=1.31 95% CI, 1.07 to 1.59) (Noto et al., 2013).

Diet is an important health behaviour which can improve morbidity and mortality if the recommended amount of fruit and vegetables are eaten or a minimum of 7 grams (g) per day of fibre is consumed. Conversely research has also provided data on increased cardiovascular risk and mortality when unhealthy choices are made to consume high levels of protein, fats and high-fructose syrup, and low amounts of carbohydrates. Higher socioeconomic groups are more likely to eat more fruit and vegetables, less red meat and less sugar which has important implications for health (Maguire & Monsivais, 2015).

Smoking

Smoking is a significant contributor to ill-health, as it increases the likelihood of developing chronic obstructive pulmonary disease, macular degeneration, diabetes, myocardial infarction, peripheral vascular disease and rheumatoid arthritis (U.S. Department of Health and Human Services, 2014). It is estimated the risk for developing diabetes is 30-40% higher in smokers than non-smokers. In expectant mothers premature labour and stillbirths are associated with smoking. Smoking increases the risk of lung, colorectal and breast cancers. The prognosis of cancer patients who smoke is significantly worse than non-smokers. All-cause mortality is higher in smokers compared to never smokers and it is estimated that current smokers have a reduced life expectancy of approximately 10 years (U.S. Department of Health and Human Services, 2014). Quitting smoking at any time has been shown to improve life expectancy (U.S. Department of Health and Human Services, 2014).

Over the last few years, smoking prevalence has remained largely static in the UK, however over the last 30 years the overall prevalence has been decreasing (Lifestyle statistics team, Health and Social Care Information Centre, 2014). In 1980, 39% of adults smoked, by 2002 26% of the population continued to smoke; in 2010 this had reduced to 20% and remained static in 2012 (Lifestyle statistics, Health and Social Care Information Centre, 2013b). Variations are seen depending on employment status. In 2012 a higher proportion of unemployed people smoked (39%) compared to employed people (21%) and fulltime students (17%) (Lifestyle statistics team, Health and Social Care Information Centre, 2014). More routine and manual workers smoked (33%) compared to people in intermediate professions (20%) and managerial and professional occupations (14%) (Lifestyle statistics team, Health and Social Care Information Centre, 2014). There are variations between ethnic groups in the UK and smoking status: Pakistani (29%) and Bangladeshi (40%) men have the highest prevalence of smoking whilst south Asian women have the lowest prevalence (2-5%) suggesting there is a cultural aspect to smoking (Leung & Stanner, 2011).

Risky sexual behaviours

Not using a condom and having multiple sexual partners are risk factors for sexually transmitted infections (STIs) (Fenton et al., 2001). STIs include chlamydia, gonorrhoea, trichomonas vaginalis, syphilis and the Human Immunodeficiency Virus (HIV). In the UK 6,360 people were newly diagnosed with HIV in 2012 and the overall prevalence was 1.5 per 1000. HIV is a virus mainly transmitted through sexual intercourse and is

a significant factor in morbidity and mortality (Aghaizu et al., 2013). Once diagnosed with HIV, most people need to take lifelong medications and over the last 10 years, there have been 2, 000 deaths in the UK attributable to HIV (Aghaizu et al., 2013). STIs can be prevented by practicing safe sexual behaviours. A survey conducted between 1999-2001 compared the results to a previous survey conducted in 1990-1991 and estimated sexual practices among adults in the UK. The prevalence of condom use for all respondents who had intercourse in the proceeding 4 weeks had risen from 18.3% to 24.4% in men and from 14.9% to 18.0% in women. However the average number of sexual partners had also increased for both genders (Fenton et al., 2001). Although this data is useful in providing an insight into the sexual practices in the UK, further research is needed to assess the frequency of condom use in those most at risk (i.e. participants with multiple or new partners). To the authors knowledge data is lacking in this area. A study has investigated condom use amongst young people aged 15-24 years old in South Africa and found that higher education and higher socioeconomic status are associated with condom use (Chimbindi et al., 2010). The evidence is sparse when investigating condom use in different ethnic groups and the author was unable to locate any UK studies describing condom use in ethnic minority groups.

Harmful alcohol consumption

In the UK the recommended amount of alcohol is a maximum of three to four units a day for men and two to three units a day for women (NHS Choices, 2013c). A unit is 8 g or 10 millilitres of pure alcohol. Alcohol consumption can be assessed on the amount

of alcohol drunk in a week, the amount of alcohol drunk at any one time and the frequency of drinking. In 2011 a survey of 18,367 UK individuals found that 41% did not drink alcohol in the preceding week (Office for National Statistics, 2013). Of those who did drink alcohol a quarter drank more than eight units or six units on any one occasion (binge drinking) for men or women respectively (Office for National Statistics, 2013). People in managerial and professional occupations were more likely to drink on five or more days out of a week and drink more than six/eight units on one occasion (Office for National Statistics, 2013). The number of hospital admissions due to alcohol related illness is increasing, in 2011/12 it was estimated 1,220,300 of hospital admissions were related to alcohol which is a 4% increase from the previous year but a 51% increase from 2002/3 (Lifestyle statistics, Health and Social Care Information Centre, 2013a). Despite professionals being more likely to binge drink, alcohol dependence is more likely to occur in the more deprived groups compared to the least deprived groups (Wilkinson & Marmot, 2003). In the UK over 90% of Pakistani and Bangladeshi people report to be non-drinkers, which is likely to be due to religious beliefs (Leung & Stanner, 2011).

A large systematic review conducted in 2005 demonstrated that when compared to not drinking, light levels of alcohol intake (up to five units a day in men and three units in women) was associated with decreased mortality (Castellnuovo et al., 2006). However higher levels of consumption on a daily basis or drinking patterns that were less frequent but at higher volumes on drinking days resulted in increased mortality. At a similar level of alcohol consumption, women are more susceptible to adverse outcomes than men. Drinking high levels of alcohol has been linked to several diseases and

exhibits a dose-response relationship. Alcohol consumption is a significant aetiological factor of malignancy of the mouth, oesophagus, liver and breast; depression; epilepsy; haemorrhagic stroke; liver cirrhosis; accidental injury involving drowning, falls, poisoning and road traffic accidents; and intentional injury through deliberate self-harm or suicide (Room et al., 2005).

Physical inactivity

The Department of Health recommends that adults should engage in a minimum of 150 minutes over a week of moderate activity or 75 minutes of vigorous activity; in bouts of at least 10 minutes duration. Moderate activity causes increased breathing depth and frequency but talking is still possible whereas vigorous activity increases breathing to a point where the individual is unable to talk (Department of Health, Physical Activity, Health Improvement and Protection, 2011). A national UK survey (Lifestyle statistics, Health and Social Care Information Centre, 2014) found 67% of men and 55% of women achieved the recommended amount for activity. However one in four of women and one in five men did less than 30 minutes of moderate or 15 minutes of vigorous activity a week. Associations have been observed between income and activity: 76% of men and 63% of women in the highest income groups meet the recommended guidelines; however this is in contrast to 55% of men and 47% of women in the lowest income groups.

A systematic review and meta-analysis estimated that overall physical activity provided an overall risk reduction of 0.65 (95% CI 0.60 to 0.71) (Samitz et al., 2011). There is a

dose-response effect with physical activity and mortality, with the largest effect seen when activity levels increase from being sedentary (Samitz et al., 2011). Physical activity is directly related to obesity and those who exercise are less likely to be overweight or obese (Lifestyle statistics, Health and Social Care Information Centre, 2014). Physical activity improves cardiovascular risk factors by lowering cholesterol and improving endothelial function. Exercise reduces adipose tissue, improves immune function, lowers insulin and reduces free radicals. In the elderly exercise has also been shown to be predictive of fewer falls, lower rates of osteoporosis, less disability and lower mortality (Samitz et al., 2011). When comparing physical activity between income groups in the UK, men in the highest three income groups are more likely to achieve the recommended amount of physical activity over a four week period compared to men in the lowest income group; women in the highest income group are more likely to achieve the recommended amount of physical activity compared to women in the lower income groups (NHS Information Centre, 2009). South Asians and Chinese living in the UK are less likely to partake in physical activity compared to the general population. Only half of Bangladeshi men and a third of Bangladeshi women partake in physical activity at least once a week (Leung & Stanner, 2011).

Illicit drug use

Illicit drugs are defined by the World Health Organisation as “the non-medical use of a variety of drugs that are prohibited by international law. These drugs include: amphetamines, cannabis, cocaine, heroin and other opioids and ecstasy (Degenhardt

et al., 2004). Cannabis is the most widely used illicit drug in the UK and 6.4% of adults report using cannabis in the last year. It is estimated that 8.9% of adults under the age of 60 have used illicit drugs in the last year. Between 2011/12 and 2012/13 the hospital admissions for illicit drug-related mental health and behavioural disorders increased by 5%, however over the previous 10 years hospital admissions had reduced by 15%. From 1993 to 2002 the number of deaths attributable to drug use has doubled but since 2002 the number of deaths due to illicit drug use has remained largely static. White men in lower socioeconomic groups are more likely to take illicit drugs and come to harm (Lifestyles Statistics, Health and Social Care Information Centre, 2013). A systematic review concluded that lower SES in childhood was associated with drug use in later life (Daniel et al., 2009).

Summary

Lifestyle choices are significant factors in determining health. Dietary choices modify cholesterol, risk of cardiovascular disease, the development of breast and bowel cancer, and life expectancy. Fruit and vegetable consumption and exercise have a dose-response effect, in that being more active and consuming more fruit and vegetables is associated with a greater improvement in mortality. It has long been known that smoking is a significant risk factor for cardiovascular and respiratory disease but there is also an association between smoking and developing macular degeneration, diabetes and rheumatoid arthritis. Not using a condom and having multiple sexual partners is a risk factor for contracting sexually transmitted infections

such as chlamydia and HIV. High alcohol consumption may cause malignancy, haemorrhagic stroke, cirrhosis and epilepsy; there is a dose-response effect with high alcohol consumption and mortality. Drug use has been implicated in causing mental health problems and behaviour disorders. Different health behaviours have higher or lower prevalence's in different ethnic groups compared to the UK general population, and there is a reoccurring pattern that lower socioeconomic groups tend to exhibit less healthy behaviours. The variations are yet to be fully understood and the following section will describe the influences which determine health behaviours.

Determinants of health behaviours

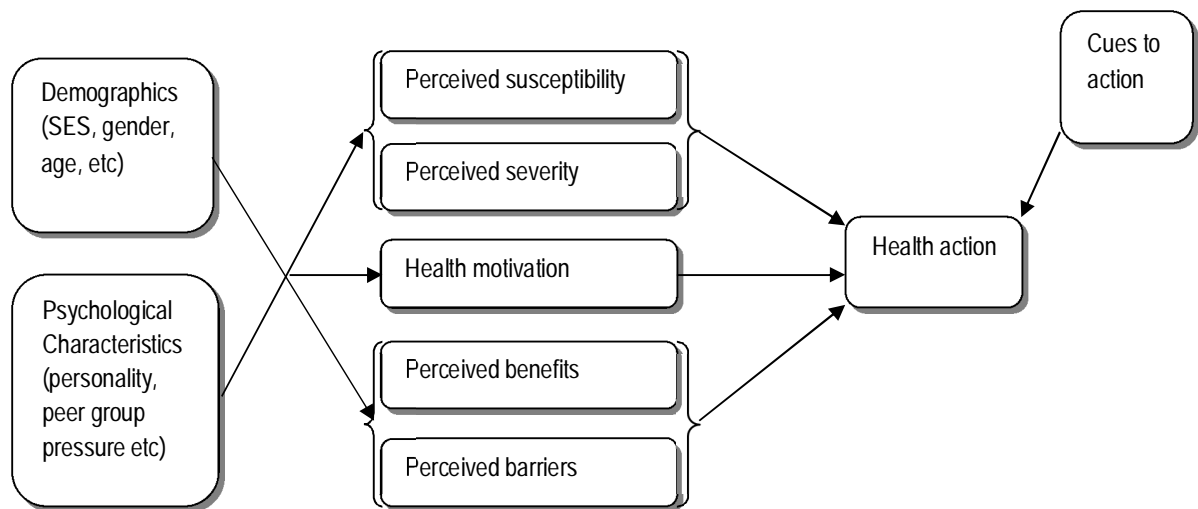
This section aims to summarise the literature describing the theories of behavioural change. First a brief overview of the most commonly referenced psychological models will be addressed and while many models for health behaviour change exist, Conner and Norman (Conner & Norman, 2005) cite the following as having the most support in terms of empirical evidence. Whilst it is important to consider the theoretical models no single model has demonstrated perfect prediction of health behaviours, therefore following their descriptions, detailed exploration of individual factors will be discussed.

Psychological models of health behaviour

Health belief model

First described in 1974, the basis of the health belief model is that health action occurs as a result of a belief system of the threat of illness (perceived susceptibility and severity of the consequences of illness) and behavioural outcomes (perceived benefits and barriers) (see Figure 2.2) (Abraham & Sheeran, 2005). Evaluation of behavioural outcomes is the appraisal of the efficacy and benefits of the health behaviour, and the barriers to carrying out the behaviour. Alongside the health belief systems is health motivation - the individual's awareness of and responsiveness to health. For example when considering condom use the "perceived susceptibility" is how at risk a person deems themselves to contracting an STI; the "perceived severity" is the severity of consequences of having an STI; The "perceived benefits" may be the belief that the condom would protect from getting an STI; the "perceived barriers" is the perceived negative outcome from using a condom such as embarrassment; the "health motivation" in this case may be not wanting to contract an STI; cues to action may be partner request to use a condom. These factors are influenced by external factors such as socioeconomic status, age, peer group pressures and personality. This model has been shown to predict many health behaviours such as smoking, diet and exercise (Conner & Norman, 2005).

Figure 2.2- The Health Belief Model (Abraham & Sheeran, 2005)

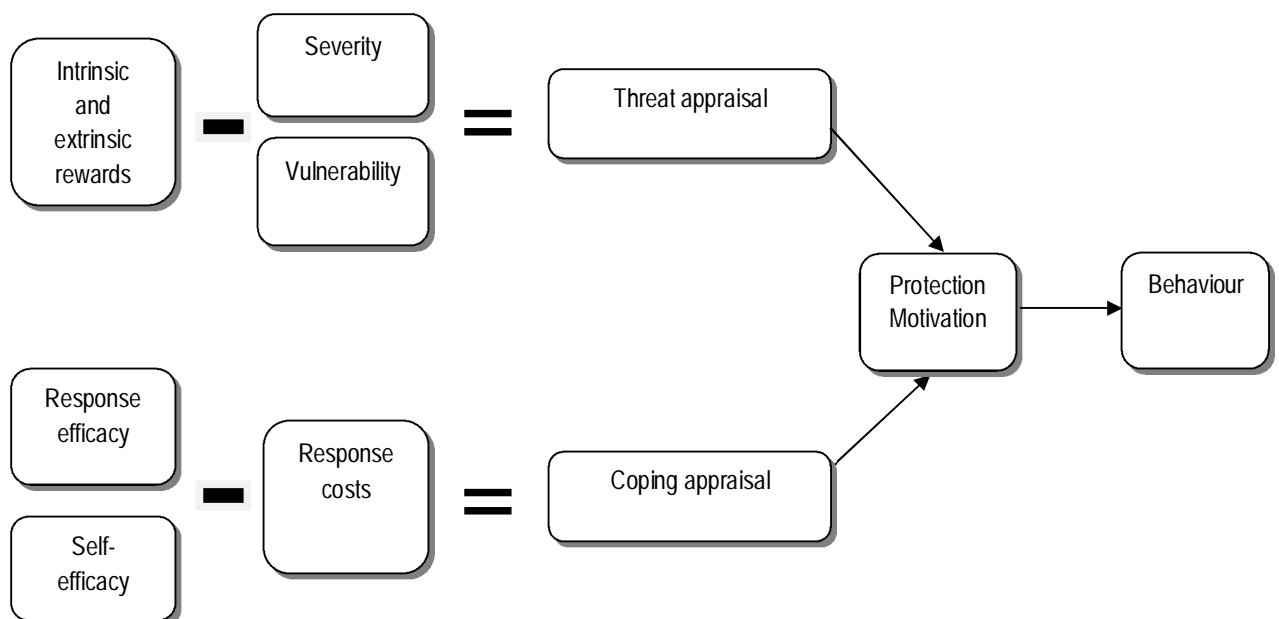


Protection motivation theory

First developed in 1975 to understand the concept of fear evaluation, the protection motivation theory describes two independent appraisals: adaptive (coping appraisal) and maladaptive (threat appraisal) responses to health threat (see Figure 2.3) (Norman et al., 2005). Coping appraisal involves the probability of adopting adaptive strategies to the health threat. It involves assessing the reduction in risk if the behaviour is carried out (response efficacy) and confidence in one's own ability to perform the behaviour successfully (self-efficacy) versus the cost of performing the behaviour (response costs) (Norman et al., 2005). For example for a smoker to develop an adaptive response to stop smoking they would need to be confident that they could stop smoking (self-efficacy), believe that stopping smoking would significantly improve their health (response efficacy) and that these beliefs would overcome the *response costs* such as becoming irritable or putting on weight. Threat appraisal is the likelihood that

maladaptive coping responses are employed. Severity and vulnerability to the threat are protective for developing maladaptive responses. The more severe the person perceives the threat to be and the more vulnerable the person feels towards the threat the less likely they will be to carry out maladaptive responses. However, intrinsic (e.g. pleasure) or extrinsic (e.g. social approval) factors may counteract the combined effect of severity and vulnerability. Maladaptive responses include coping strategies such as avoidance or denial. For example if there were intrinsic and extrinsic rewards when an individual smoked such as relaxation and social approval from other smokers and the individual did not perceive themselves to be vulnerable or that the consequences of smoking were exaggerated, they would continue to smoke. The appraisal processes feed into either adaptive or maladaptive responses (protection motivation) and so lead to behavioural intent (Norman et al., 2005).

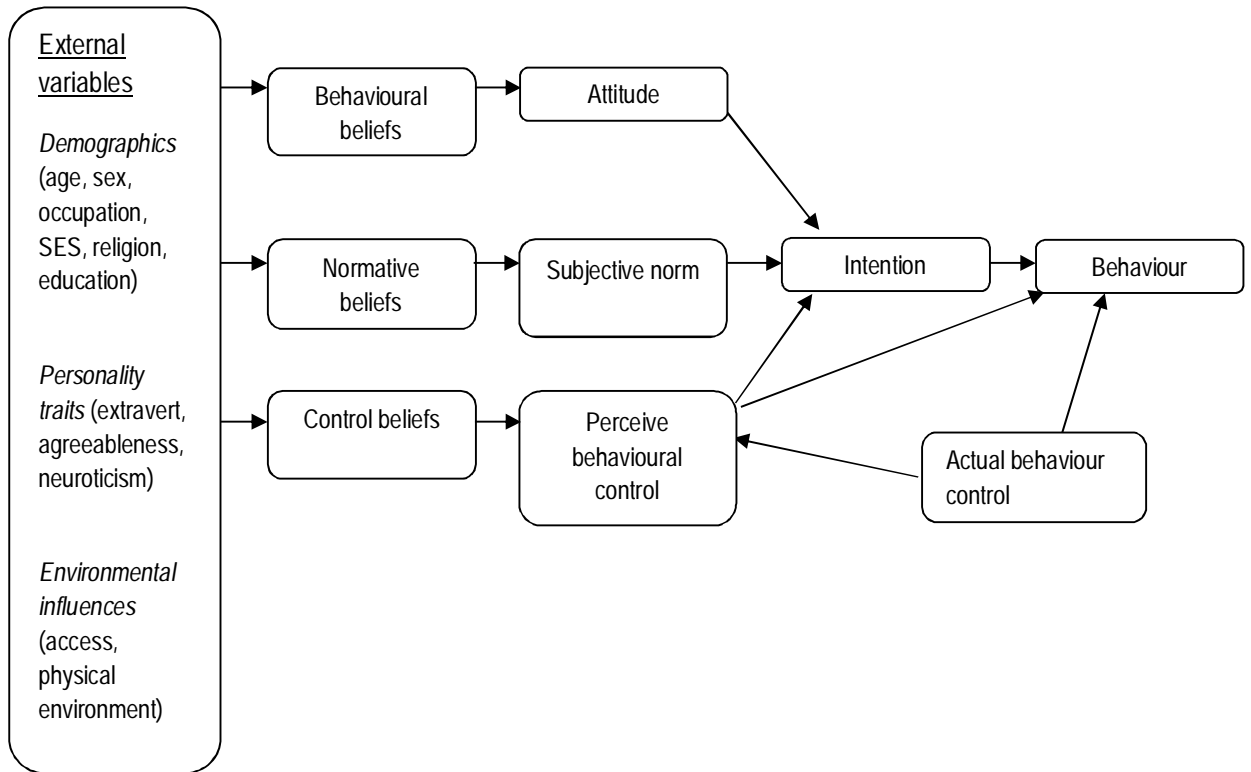
Figure 2.3- Protection Motivation Theory (Norman et al., 2005)



Theory of planned behaviour

The theory of planned behaviour first described in 1988 differentiates between behavioural intent and behavioural action (see Figure 2.4). It describes factors which determine whether an individual intends to conduct a behaviour and the influences on actual behaviour. Intention is modified by attitudes to the behaviour, whether significant people in the person's life conduct the behaviour (subjective norm) and the perceived locus of control. Perceived control is similar to self-efficacy, in that it is related to whether the person feels that they are in control of their health and that it is not the responsibility of others. Attitudes, subjective norms and perceived behavioural control are a result of a belief system, which in turn are dependent on external factors such as demographics, personality traits and environmental influences (Conner & Sparks, 2005). For example the individual's belief system informs attitudes about exercise - this may be that exercise is enjoyable and helps with weight loss. The subjective norms may be that society sees it as important that individuals exercise regularly, and the individual may feel confident they are able to commit to regular exercise and therefore intends to increase their physical activity levels which then develops into an actual increase in physical activity levels. This is modified by the actual control the individual has on whether they exercise or not. Interestingly, the only factor identified as exerting direct influence on behaviour is perceived or actual control, other factors influencing behaviour are through indirect effect via behavioural intention.

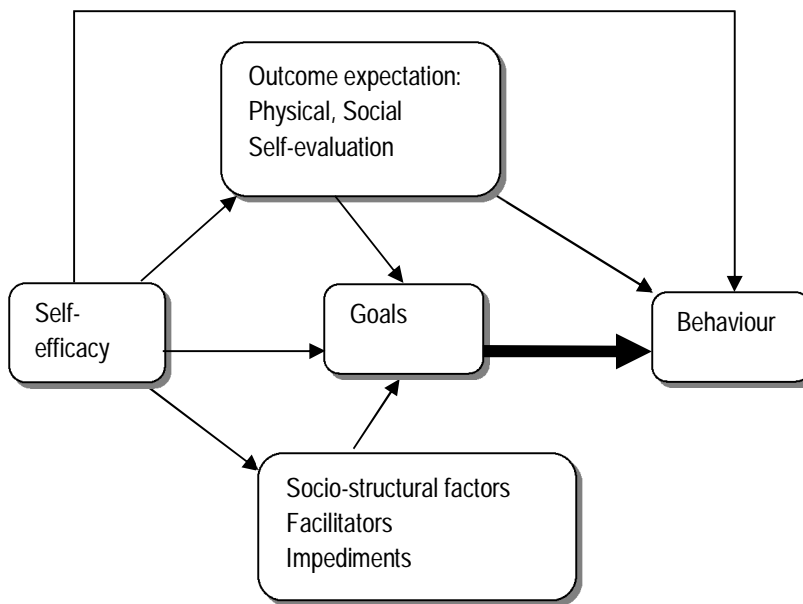
Figure 2.4- The theory of planned behaviour (Conner & Sparks, 2005).



Social cognitive theory

First described in 1977, the foundation of this model is self-efficacy (see Figure 2.5). Individuals set goals then change behaviour. Self-efficacy exerts a direct effect on goals and behaviour but also on the outcome expectation and socio-structural elements which in turn exert effect on goals and behaviour change. Individuals with high self-efficacy are more likely to set goals and achieve them than someone with lower self-efficacy. Goals are also influenced by the socio-structural factors such as external barriers, opportunities, health systems or environmental systems. High self-efficacy results in a perception that external barriers in the environment can be overcome. Outcome expectations include *physical expectations* (such as losing weight), *social expectations* (such as others response to behaviour change) and *self-evaluation* (such as feelings of regret or being proud of accomplishment). High self-efficacy enables a person to have positive, adaptive responses to outcome expectations which in turn directly affects goal setting and behaviour (Luszczyska & Schwarzer, 2005a). The meaning of self-efficacy will be described in more detail below.

Figure 2.5- Social cognitive theory (Luszczyska & Schwarzer, 2005a)



The transtheoretical model of change

Described in 1982, this model of change proposes there are different stages of behavioural change. The stages include pre-contemplation, contemplation, preparation, action and maintenance. Pre-contemplation is when the individual is not intending to change their behaviour. Contemplation is when they intend to take action within the next six months. Preparation is when the intention to change is more imminent and steps have been taken to prepare. Action is when the behaviour has changed over a period of time of less than six months and maintenance is when this behavioural change is continued for over six months. Individuals can transition through each stage in turn or may move between stages out of order (Sutton, 2005). For example a smoker may continue to smoke without considering the possibility of stopping smoking (pre-contemplation). They may develop numerous coughs and

colds one winter which may trigger them to consider stopping smoking (contemplation). However once they recover from the illnesses they continue to smoke with no intention to stop smoking (pre-contemplation). Years later they suddenly have a myocardial infarction and the advice is to stop smoking immediately, the individual stops smoking (action) and remains a non-smoker (maintenance).

It should be noted that most research investigating the predictive value of the models described above has investigated behavioural *intent* (Sheeran et al., 2005), but intention results in behavioural change in as little as a third of the time (Webb & Sheeran, 2006). Behavioural intent and action may be more highly associated for one-off health behaviours such as attending for cervical smears or a vaccination (Sheeran et al., 2005). However, lifestyle choices are not one-off actions - they require prolonged, sustained action to have an impact on health outcomes. Hence, it is particularly pertinent to distinguish between intention, action and maintenance when exploring lifestyle health behaviours (Sheeran et al., 2005).

Maintenance of behaviour

Habit is central to prolonged behavioural maintenance. Habit is defined as “a learned behavioural pattern initiated automatically by contextual cues” (Gardner et al., 2011). Habit behaviour is automatic, effortless and does not usually require a conscious reflective process, for example on waking and going to the bathroom an individual automatically brushes their teeth. The strength of the habit increases the more frequently it is performed and habits strongly engrained undermine behavioural intention. Environmental and external cues trigger a habit; in familiar and unchanged settings habit will guide behaviour, however in unfamiliar surroundings intentions will govern behavioural action until habits are formed. One study found that habit alone can explain 20% of the variance in nutrition and physical activity (Gardner et al., 2011). It is thought that during behavioural change two processes are at odds- the automatic unconscious habit and the conscious intention to change behaviour. In health promotion, environmental factors should support healthy habit formation and interventions may wish to consider promoting repetition of behaviour (Gardner et al., 2011).

When attempting to maintain healthy lifestyle behaviours over prolonged periods of time, lapses or failures are expected; the response to these is a key consideration. Self-efficacy is critical for maintaining behaviour change. Self-efficacy is the belief in one's own ability to achieve specific goals (Bandura A, 1977). High self-efficacy aids recovery from failures, supports positive interpretation of relapses, promotes perseverance to achieve goals and thus maintains behaviour. Self-efficacy is discussed in more detail later in this chapter in the “Internal factors” section.

When considering relapses, the relapse prevention model is a model that describes responses to high risk situations such as a person who is abstaining from alcohol and attends a party, or high risk emotional states such as feeling low and turning to food (Luszczyska & Schwarzer, 2005b). The high risk situations either trigger an adaptive coping response where the health behaviour is maintained which consequently improves self-efficacy and making relapse less likely; or ineffective coping strategies are used, which decrease self-efficacy and can result in relapse (Luszczyska & Schwarzer, 2005b). Identifying potential high risk situations and planning for them may help in preventing relapse (National Institute for Health and Clinical Excellence, 2014).

Whilst it is sensible to distinguish between initiation and maintenance of behaviours, common elements influence both initiation and maintenance such as environmental factors, culture, motivation and self-efficacy. The next section will describe individual components in more detail considering factors such as the environment and culture (external factors), and self-efficacy and motivation (internal factors).

External factors

The health belief model, the theory of planned behaviour and the relapse prevention model recognise that external influences have a direct or indirect impact on health behaviours. The social cognitive theory also includes external factors and proposes that the effects result from the indirect effect of perception and interpretation of them. External factors are influences which impact on the individual.

Socialisation, the passing down of beliefs, attitudes and behaviours from one generation to the next, has been highlighted as a key factor in health behaviours (Eckersley, 2006). Socialisation has been attributed to being one of the causative factors in health inequalities between socioeconomic groups (Eckersley, 2006). It is suggested that it predisposes to a specific way of thinking, feeling and behaving. Cultural inequalities may also be a result of socialisation. Culture in this context refers to the language, knowledge, beliefs and values that are passed between individuals and generations (Eckersley, 2006). For example dietary patterns vary between different cultures; one culture may have a traditional diet of rice and meat whereas other cultures may base their diet on vegetarian cuisine. Culture and socialisation exert a direct effect on individuals and are powerful predictors of health behaviour but as they are so embedded within a society their influence tends to be invisible to the population and so is often overlooked (Eckersley, 2006).

Social norms can be thought of as an aspect of culture, however there are different interpretations of the meaning “social norm”. Social norms are “the standards with which an individual assesses the appropriateness of a behaviour” (Ball et al., 2010). The theory of planned behaviour depicts that social norms or normative beliefs are a result of the belief system that a person holds regarding what constitutes normative behaviour. Within the term social norms the reference group may vary greatly from a family member, a peer the individual identifies with, a group the individual identifies with, to other significant people in their life such as a parent or aspirational individuals such as celebrities or sports personalities. Social norms may refer to whether the reference person carries out the behaviour, or their views and opinions about the behaviour. It can also be viewed as an aspect of social support to help maintain the behaviour (Ball et al., 2010). Social norms can be interpreted

and processed differently by different individuals therefore the magnitude of effect can vary. As there are many variants of what constitutes social norms, research in the area is weak. Despite this, a study (that defined social norms as the perception of the participant on what people they knew or other people in their neighbourhood were doing) demonstrated that eating fast food and exercising were influenced by social norms (Ball et al., 2010).

The environment in which an individual lives has been identified as an important factor in physical activity. It is suggested that living near green space and a natural environment promotes physical activity, and has stress relieving and recovery qualities (Health Council of the Netherlands and Dutch Advisory Council for research on spatial planning, nature and the environment, 2004; Mitchell & Popham, 2008). A study assessing all-cause mortality found that living near green spaces was associated with lower mortality (Mitchell & Popham, 2008). A recent UK study described a cross-sectional relationship between the number of fast food outlets in the immediate living environment and being overweight and diabetic (Bodicoat et al., 2014).

In 2008 the state of Los Angeles (LA) in the USA passed a policy to prevent new stand-alone fast food chains opening in South LA and evaluated its success four years later (Stuttm & Hattori, 2015). The policy allowed current fast food restaurants to remain open and new fast food chains could open if they were not stand-alone such as in shopping centres. Per year it was estimated South LA had similar annual increases in fast food chains compared to other areas of LA but the fast food restaurants were smaller and in shared spaces such as malls. Evaluation of the fast food policy in 2012 revealed obesity rates were not affected by this policy but it was suggested South LA continue to implement the policy as the authors hypothesise

having less free standing, smaller fast food restaurants has potential to change social norms and attitudes and thus have more impact in the long term. More research is required to form conclusions of the cause-effect relationship between the number of fast food chains and unhealthy diet; however an alternative hypothesis is that fast food chains are a marker of deprivation of an area. Fast food tends to be inexpensive and so people with less disposable income may be more likely to eat fast food and thus more fast food chains open in deprived areas.

The relationship between income and health behaviours is not as simple as it may first appear. There may be actual financial restraints on buying healthy foods, joining a gym etc. but the high prevalence rates of smokers in the lower socioeconomic groups contradicts this hypothesis. People with low income tend to exhibit more unhealthy behaviours such as smoking, high calorie diets and sedentariness. One theory for this observation may be that living on a low income causes prolonged periods of stress and these behaviours may provide short term relief and pleasure. Another possible explanation could be that health behaviours carry a long term risk which is not immediately apparent and there may be greater perceived imminent risks (such as housing problems). In this situation, the perceived risk of unhealthy behaviours may not be viewed as a priority (Benzeval et al., 2014).

As described at the beginning of the chapter, lower SES is associated with unhealthy behaviours. The relationship between SES and health behaviours is multifaceted, and complicated to disentangle. However, it is thought that the cause-effect relationship may be indirectly due to social norms, cultural differences (Eckersley, 2006), prolonged periods of stress, short term pleasure or relief by adopting unhealthy behaviours (e.g. pleasure with smoking) (Pampel et al., 2010),

financial difficulties, insecurity or lack of perceived control (Wilkinson & Marmot, 2003).

Internal factors

Internal factors are components originating from the individual such as perceptions, attitudes or beliefs. Risk perceptions are key components in most of the models described in this chapter, represented as susceptibility, vulnerability, threat appraisal and attitudes. The magnitude of risk results from evaluation of the specific threat (e.g. lung cancer in smoking or liver disease in alcohol dependence), the timeline (whether the threat is imminent or years away), symptom experience (such as a “smokers cough”), consequences (death or disability), and control (whether the disease can be prevented or cured) (Leventhal et al., 1998). The theory of the relationship between risk perception and action hinges on the belief that once an individual perceives their risk to be high, they develop intentions to change behaviour to reduce their risk. Interestingly, people tend to view risk by comparison to their peers, and most have a false optimism of their risk (Vollrath et al., 1999). Thus, smokers, drinkers and people who participate in risky sexual practices perceived their risk to be higher than people who do not partake in these behaviours, but their subjective risk tends to be lower than their actual risk (Vollrath et al., 1999). Many health promotion strategies are based on informing people of their risk. However solely focusing on increasing perception of risk is ineffective and other psychological influences should be considered (Marteau & Lerman, 2001).

Self-efficacy (the belief in one’s own ability to achieve specific goals) is the major component of social cognitive theory, is described in the theory of planned

behaviour and the protection motivation theory, and is critical for initiating and maintaining behaviour change. A behaviour is more likely to be initiated if an individual has high self-efficacy that they will be successful in achieving their goals. High self-efficacy is associated with setting challenging goals, overcoming obstacles and recovering from failures. Self-efficacy may change over time and is positively reinforced when goals are achieved (Bandura A., 1977). A meta-analysis exploring the relationship between smoking and self-efficacy demonstrated that those with higher self-efficacy at baseline were more likely to be successful in quitting and remaining a non-smoker (Gwaltney et al., 2009).

Self-motivation has been identified as a crucial component in the initiation and maintenance of behaviour change. The self-determination theory describes motivation as a continuous variable ranging between motivation and no motivation. No motivation is where the individual is in a state of not valuing the behaviour or the expected outcome and feeling incompetent initiating and maintaining the behaviour. At the other end of the spectrum the individual feels highly motivated; they have an intrinsic self-determination, enjoy the challenge of carrying out the behaviour and feel competent in doing so. Motivation is increased when positive feedback occurs, causing an improved feeling of competence. A sense of security and compliance with social norms also improves motivation. Motivation has been demonstrated to play a key role in maintenance of stopping smoking, diabetic dietary advice and physical activity (Sheeran et al., 2005).

Interventions aimed at modifying health behaviours

It is hypothesised that the most successful interventions are based on psychological principles (Marteau & Lerman, 2001), and with this in mind this section will explore the current literature investigating the efficacy of interventions to change smoking, diet, alcohol, illicit drug, sexual and exercise behaviours. A systematic review commissioned by the National Institute for Health and Care Excellence (NICE) in 2010 evaluated previously conducted systematic reviews exploring the efficacy of interventions for behaviour change. For smoking there was no evidence for interventions based on the transtheoretical model of change where individuals move through stages of behavioural change. However there was evidence that advice from health professionals, nurse delivered interventions, group counselling, telephone counselling and self-help reduced smoking. Interventions tasked with improving diet found that there was inconclusive evidence for health education or motivational interviewing; however lifestyle interventions within primary care, over the telephone or nutrition counselling improved diet. There was evidence that providing brief counselling in primary care also reduced alcohol consumption, but there was insufficient evidence to suggest that mass media or social norming campaigns had any effect on alcohol consumption. There is strong evidence supporting school based interventions involving parents and carers to improve childhood physical activity levels. Pedometers, telephone counselling or continued support from professionals offering advice and guidance can provide modest increases in activity levels; however these interventions have only been shown to have short-term effects. The evidence is inconclusive for interventions for illicit drug taking and risky sexual behaviours (Jepson et al., 2010).

In 2014 NICE published guidance for the recommendations on behaviour change interventions to improve physical activity, manage weight, stop smoking, reduce alcohol intake and promote safe sex (National Institute for Health and Clinical Excellence, 2014). In summary the report recommended that interventions should include goal setting, planning coping strategies and managing relapses. The individual should be provided with follow-up for monitoring whilst also encouraging self-monitoring, although it was noted that different behaviours may require different interventions of varied techniques and intensity. This report identified that robust evidence was lacking in addressing the effectiveness of improving physical activity, alcohol consumption, sexual practices and stopping smoking. When individuals exhibit multiple unhealthy behaviours effective interventions have not been explored and it is unclear whether multiple health behaviours should be targeted individually or in combination.

Between 2003 and 2008 estimates of the prevalence of smoking, drinking harmful amounts of alcohol, being sedentary and having low fruit and vegetable intake were carried out throughout the UK (Buck & Frosini, 2012). In 2003 people with no qualifications were 3 times more likely to smoke, drink harmful amounts of alcohol, lead sedentary lives and have low fruit and vegetable intake compared to more educated people (however it should be noted that this analysis did not adjust for deprivation or ethnicity). At follow-up in 2008, overall the UK population were less likely to exhibit all four unhealthy behaviours compared with baseline; however those with no qualifications were 5 times more likely to partake in the four unhealthy behaviours compared to more educated groups. The results demonstrate that the UK population as a whole are improving their lifestyle choices but the least educated are more resistant to behaviour change and so the divide between the least and

most educated is widening. Observed and hypothesised associations between health behaviours and SES have been described earlier in the chapter and may include social norms, cultural differences, prolonged periods of stress, short term relief, insecurity or lack of perceived control; but there is a lack of evidence investigating why people with lower education may be more resistant to behaviour change. As described in Chapter 1 people in lower socioeconomic groups tend to have lower education, less professional occupations and lower literacy skills. It is hypothesised that low literacy skills may be a factor behind the health inequality gradient and the reason why the least educated groups are more resistant to behaviour change. The aim of this thesis is to explore if literacy is associated with health behaviours with a view to help inform this hypothesis.

Summary

Lifestyle choices are significant factors in determining health. Health behaviours such as smoking, sedentariness, drug use and high alcohol consumption can lead to many conditions such as obesity, diabetes, breast cancer, lung cancer, cardiovascular disease and mental illness. Adopting healthier choices and achieving the government recommendations for diet, exercise and alcohol can reduce the risk of cardiovascular disease, diabetes, cancer and mortality.

Maintenance and behavioural change is a dynamic and complex process. There may be times in an individual's life where behaviour change is more likely, for example when external cues present such as a health scare, discussion with a health professional or changes in social norms. Many psychological pathways have been theorised but none have been shown to be perfect predictors in behaviour

change. Behaviour change is driven by internal psychological factors such as threat and susceptibility appraisal, perceived barriers, motivation, beliefs and self-efficacy but also influenced by external factors. Environment, culture, socioeconomic status resulting in social norms (Ball et al., 2010) influence health behaviours (see the social cognitive model described above) and it may be that literacy is an overarching determinant of many factors, for example perceived barriers, risk perception and motivation. It is possible that behaviour change is driven by different factors depending on the health behaviour which may be why interventions are effective in some health behaviour changes but ineffective in others.

Unfortunately there is a socioeconomic gradient exhibited in health behaviours. Lower socioeconomic groups tend to eat less fruit and vegetables, eat more red and processed meat, be current smokers, be less likely to achieve the exercise recommendations, and are more likely to be alcohol dependent and use illicit drugs compared to higher groups. Despite this, managerial and professionals of higher SES who drink alcohol tend to drink over six or eight units of alcohol in one session and drink on more than five days in a week. Ethnic variations of health behaviours exist compared to the general UK population, for example Bangladeshi men are more likely to smoke and both genders of Bangladeshi origin are less likely to partake in physical activity and be more likely to be non-drinkers. Why people choose to adopt healthy or unhealthy behaviour is not fully understood, but once a behaviour is maintained over a period of time it may become a habit rather than a conscious choice. Changing unhealthy behaviours into healthy behaviours requires a conscious effort, and successful initiation and maintenance is hinged upon numerous factors including self-efficacy, self-motivation, risk perception, planning for high risk situations, social support, social norms, the surrounding environment

and habit formation. Despite the wealth of psychological literature, many behavioural interventions either have modest, short term results or there is insufficient evidence to support their use.

Much of the research between health literacy and outcome has addressed the relationship with health literacy and illness management. The relationship between health literacy and health behaviours is less well understood. It is hypothesised that the associations seen between health literacy and mortality is in part due to literacy. Furthermore it is hypothesised that this association is due to the interaction between health literacy and health behaviours. This thesis aims to explore this hypothesis by identifying and evaluating the evidence investigating the association between (health) literacy and health behaviours through a systematic review and progress to further empirical work to add to this evidence by re-analysing data from a large cross-sectional study.

Chapter 3- Systematic review

Overview

In the previous chapters the definitions of literacy and health literacy and the observed associations between literacy/health literacy, socioeconomic status and health outcomes were examined, followed by an examination of the psychological principles behind health behaviours and a discussion of the associations between health behaviours and health outcomes. This chapter describes a systematic review which aims to assess the literature investigating the relationship between literacy and specific health behaviours. The World Health Organisation estimates there is a disease burden (as described in the previous chapter) with low fruit and vegetable consumption, smoking, unsafe sex, alcohol excess, physical inactivity and illicit drug use (The World Health Organisation, 2002), therefore these health behaviours will be the focus of this project. The health behaviours of interest include smoking, drinking alcohol, taking illicit drugs, unsafe sexual practices, diet and exercise. It is hypothesised those with low literacy levels will have poor health behaviours compared to those with higher literacy levels.

Research team

The research team comprised three reviewers. The lead reviewer (author of thesis), formulated the research question, inclusion/exclusion criteria, adapted the critical appraisal tool, performed and designed the search, assessed titles, abstracts and the full articles to include, and critically appraised all papers included. The remaining reviewers advised the lead reviewer and each applied the critical appraisal tool to

half of the included articles. In addition, one reviewer checked the excluded full texts and the results in the data extraction table.

Review question

The aim of this systematic review was to assess if there was an association between literacy and health behaviours. The health behaviours of interest included tobacco use, drinking harmful amounts of alcohol, illicit drug use, condom use, diet and exercise. It was predicted that low levels of literacy would be associated with more unhealthy behaviours.

Defining the variables

Literacy

Chapter 1 has provided detailed descriptions of the definitions, classifications and measures of literacy and health literacy. Measures of literacy and health literacy include surveys (such as the National Adult Literacy Survey (NALS)), objective tools (such as the Wide Range Achievement Test (WRAT) and the Test of Functional Health Literacy Assessment (TOFHLA)), self-reports of educational level, self-reports on whether an individual would consider themselves to be literate or illiterate, and validated self-reported tools for health literacy (Chew's three validated questions to screen for inadequate health literacy). All of these methods provide a useful estimate of literacy or health literacy and so were included in this review. However, validated, objective tools provide a reproducible and recent assessment

of an individual's ability, and so were deemed a better estimate than educational level, age left full time education or self-report of being literate or illiterate.

Tobacco use

This systematic review was concerned with current tobacco use, which included any form of tobacco use such as chewing or smoking.

Drinking alcohol

Excessive alcohol drinking was defined as drinking over the recommended UK guidelines: 14 units per week for females, 21 units per week for men and drinking no more than 2-3 units per day.

Illicit drug use

Illicit drug use was defined as the use of non-prescribed, illegal drugs.

Unsafe sexual practices

No condom use with new partners or having multiple sexual partners were considered unsafe sexual behaviours.

Diet

Diet quality was of interest rather than portion sizes as portion size would vary depending on individual requirements. Diet quality could be explored by assessing the amount and/or frequency of fat, sugar, fruit and vegetable consumption. Healthy eating index scores, such as “rate your plate” (Gans et al., 2000) could also be used to give an overall score of diet quality. Obesity and malnutrition can be seen as outcomes of various lifestyle factors so were not included.

Physical activity

Physical activity was defined as physical exertion which causes the individual to increase the heart rate, become warmer and increase respiratory rate.

Methods

Search strategy

Online electronic databases were searched from inception to October 2013. An updated search was performed in January 2015 from 2013 to 2015. Following discussion with an expert in systematic searches, five databases were selected to ensure the most relevant articles were found during the search. Each database is discussed in detail below.

Medline originates in the USA and provides mainly biomedical articles produced throughout the world. The database contains approximately 19 million references from 1946 onwards. References are indexed on Medical Subject Headings (MeSH) headings which can be searched for individually.

Embase contains mainly biomedical and pharmacological articles from 1974 onwards. The database contains approximately 22 million references covering 7,500 peer reviewed journals. Despite there being considerable overlap with Medline, Embase includes over 5 million records which are not included in Medline. Indexing occurs through Emtree which is a hierarchical structure of terms also including MeSH terms.

PsycInfo has over 3.5 million records from 1880 to present. Content coverage is psychology based, containing approximately 2,500 journals. Of the included records 12% are dissertations. The Thesaurus of Psychological Index Terms indexes records in a hierarchical structure.

Web of Science provides multidisciplinary coverage from over 12, 000 journals from 1990 onwards. Conference proceedings are also included.

Educational Resources Information Centre (ERIC) has access to resources relevant to education literature. ERIC contains more than 1.4 million records from 1966 onwards.

In addition to the electronic search, key systematic reviews, intervention studies and the included articles were checked for relevant references. Several experts in the field were contacted for unpublished literature.

Search strategy development

A combination of free text and index terms were used. The free text component on all five databases was identical. Abbreviations such as REALM (rapid estimate of adult literacy in medicine) yielded too many results; abbreviations were therefore not included in the free text search terms. To reduce the chance of irrelevant references free text terms were only searched for in the abstract and title. Each database uses different indexing terms so the indexing terms were individualised for each database. Due to the recent addition of health literacy to the indexing tree, health literacy was included as both an index term and a free text term.

Versions of the final search were run to assess the approximate number of hits from each database. This allowed the lead reviewer to assess the number of hits and adjust the search if too many or too few references were found. For example, including “reading ability” in the search found 70, 000 references, which was too many given the resources and time available; consequently, this term was excluded from the search. Prior to the search, to assess comprehensiveness, two key papers were identified and when the search was run the results were checked to ensure

these two papers were included. Once the search was drafted, the strategy was assessed by an expert in literature searches to ensure correct use of terms and truncations. Each term or index term was individually entered then combined once all terms had been run (see Box 3.1). If a single term did not find any papers the term was assessed for errors such as spelling mistakes.

Box 3.1 Search strategy for Medline

exp. Health literacy OR (Illiteracy OR "test of functional health literacy in adults" OR "rapid estimate of adult literacy in medicine" OR "wide range achievement test" OR "medical achievement reading test" OR "short assessment of health literacy" OR literacy OR "prose literacy" OR "document literacy" OR "International adult literacy survey" OR "national assessment of adult literacy" OR "health literacy")ti,ab

AND

(MeSH- health behaviour OR Drinking Behavior OR Smoking OR Food Habits OR Safe Sex OR Unsafe Sex OR Street Drugs OR Inhalant Abuse OR Marijuana Abuse OR Opioid-Related Disorders OR Phencyclidine Abuse OR Tobacco OR Smoking OR Exercise OR Physical Exertion OR Physical Fitness OR Sports OR Diet OR Food Habits OR body weight) OR ("safe sex" OR condom* OR "unsafe sex", "unprotected sex" OR "risky sexual behavior?" OR "healthy lifestyle\$" OR "health behavior?" OR healthy ADJ diet OR diet OR "fruit and vegetable?" OR "fat ADJ diet" OR "sugar ADJ diet" OR "calorie intake" OR alcohol ADJ drinking OR alcoholi\$ OR smoking OR tobacco OR illicit ADJ drug* OR street ADJ drug* OR "drug abuse" OR heroin OR cocaine OR ecstasy OR marijuana OR exercise OR fitness OR aerobic ADJ (activity\$ OR exercise\$)). ti,ab

LIMIT TO

Humans and English language

Health behaviour terms were searched and combined with "OR", as were literacy terms. The searches for literacy and health behaviours were then combined together

with “AND”. The search was limited to humans and the English language (see Appendix 3.1 for the full search strategy). The search was not limited to any particular study type but on assessment the inclusion/exclusion criteria were applied.

Eligibility criteria

See Table 3.1 for a summary of the inclusion and exclusion criteria. Observational studies were included if they presented results for literacy and the health behaviours of interest. Both cross-sectional and cohort studies were included. The review aimed to assess original pieces of research, therefore systematic reviews were excluded. Due to time and lack of translating resources, papers were excluded if they were not available in English.

We did not limit the population of interest to specific countries. Whilst being aware that results from other countries may not be generalisable to the UK population, it was felt that interesting similarities and differences could be explored.

Certain mental health conditions, such as depression and schizophrenia, have been linked to unhealthy behaviours such as smoking, drug use and alcohol excess therefore studies investigating health behaviours solely in people with mental health disorders were excluded from the review on the basis that the results could have been influenced by the mental health condition. Similarly, studies only including participants who had learning disabilities were excluded from the review on the grounds that cognitive function may be impaired. Studies investigating childhood literacy were also excluded given that this population would still be in education,

cognitive function would still be developing and certain health behaviours such as diet would be parent driven.

Table 3.1- Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> Observational cohort and cross-sectional studies Investigating literacy Outcomes <ul style="list-style-type: none"> Current tobacco user Current drinking Current illicit drug use Risky sexual behaviours-no condom use with a new partner/multiple partners Diet quality Exercise 1966 to present date 	<ul style="list-style-type: none"> Papers not in the English language Systematic reviews Mental health condition Learning disabilities Children Not specifically investigating the behaviours of interest

Article selection

Titles from each database were transferred to RefWorks (ProQuest, 2009), duplicates were assessed and deleted as appropriate. The lead reviewer assessed all titles, abstracts and full texts. If titles were of interest, the abstracts were read; if the information in the abstract was relevant to the research question, full texts were

requested. If abstracts were not available full texts were requested to investigate further. A second reviewer assessed the excluded full texts to ensure relevant papers were not overlooked and complete agreement was achieved between reviewers. One unpublished paper was provided by an expert in the field and four studies were obtained through reference checking.

Critical appraisal

The critical appraisal framework was modelled on the Critical Appraisal Skills Programme (CASP) (Public Health Resource Unit, England., 2013) but adjusted to be specifically relevant to the papers in this review (see below). The CASP tool was used as it was relevant to non-intervention studies, included items which the review team deemed important in order to assess the quality of studies and is commonly used in other reviews so promoted comparability. Other tools were initially considered, such as the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist (Strengthening the Reporting of Observational studies in Epidemiology, 2009). However STROBE is more of a checklist rather than a tool and it was felt that CASP was more suited to this systematic review.

1. Did the study address a clearly focused question?
2. Did the authors use an appropriate method to answer their question?
3. Following the responses from above questions, is it worth continuing?
4. Were the participants recruited in an acceptable way?
5. Was literacy accurately measured to minimize bias?

6. Was behaviour appropriately measured?
7. Have the authors identified important co-variables?
8. Have they taken account of the co-variants in the design and analysis?
9. Are the results precise? (Are p values or CI presented)
10. Do you believe the results? (consider chance/bias/confounders)

As stated previously, multiple measures of literacy were deemed acceptable which included both objective measures and self-reports. Behaviours were self-reported and this was also deemed acceptable. Initially the CASP tool included items assessing the quality of the follow-up, however once all papers were assessed it was found that the results of interest were taken from cross-sectional analyses, therefore these critical appraisal items on follow-up were not included. As a minimum, papers should have identified age, gender and an estimate of a socioeconomic variable such as income and occupation as co-variables because these factors could be confounders (von Wagner et al., 2009) (a confounder is a factor that is associated with both the dependent variable and the independent variable).

Some items were not included in the critical appraisal framework because they did not specifically relate to this systematic review. As a measure of consistency CASP includes “do the results of the study fit with the other available evidence”. This was originally included in the framework but it became apparent that research in this field was mixed and inconsistent. Therefore the question was removed as it did not add value to the assessment.

Data extraction

The lead reviewer recorded the author, year of publication, country, sample size, study objectives, method of literacy measurement, outcomes and results from each paper, and compiled the study characteristics table in the results section. A second reviewer examined whether the correct information had been extracted.

Associations

The purpose of this review was to investigate the relationships between literacy and specific health behaviours, and specifically whether low literacy levels were associated with poor health behaviours. Associations between variables can be assessed in a number of ways depending on the level of data available (nominal, ordinal or interval/ratio) and the study design.

Correlation coefficients describe the direction and strength of the relationship between two variables (Sim & Wright 2000). A coefficient is reported on a standardised scale between -1 and 1, a value of 0 indicates no correlation, and a value of -1 or 1 indicates a perfect negative or positive correlation respectively (Sim & Wright 2000). Cut-offs for strong, moderate and weak associations have been reported as .0 to .25 for a weak association; .26 to .50 for a moderate association; and .51 to 1.0 for a strong association (Sim & Wright 2000). A p value is given with the coefficient which indicates whether the association is statistically significant (a p value of 0.05 or below suggests that there is a 5% or less probability of that result occurring by chance). Different correlation coefficients are available depending on whether the data is normally distributed and has a linear association. Data that meets these criteria are assessed via Pearson's product moment correlation coefficient (r) while data that do not are assessed via Spearman's rho. The

interpretation of the correlation coefficients is the same regardless of the method used.

Regression is similar to correlation, but rather than reporting just the direction and strength of the association, linear regression provides information on the nature of that association (i.e. what specific value of one variable is related to that of another) (Sim & Wright 2000). Different coefficients are reported depending on the type of regression analysis employed; linear regression (which, like Pearson's correlation coefficient, assumes that data are normally distributed, have a linear relationship and an outcome variable measured on an interval/ratio scale) gives an r^2 value and a beta (β) value, while logistic regression (where the data have a non-linear relationship and the outcome variable is a binary value) gives an odds ratio (OR) and confidence intervals (CIs). The beta (β) values indicate the strength of the relationship between the variables of interest (i.e. the change in outcome that is associated with a unit change in the predictor) (Field 2009), with a higher value indicating a stronger association. The OR is the odds of an event occurring on one group compared to another (Field 2009), so in this context the odds of participating in negative health behaviours if you have low health literacy compared to high health literacy. An OR of 1 would indicate that the odds of an outcome occurring are equal in both groups (Field 2009). A value of greater than 1 indicates that as the predictor increases, the odds of the outcome occurring also increase, while ORs of less than 1 indicate that as the predictor increases the odds of the outcome occurring decrease. The CIs are the range of values around a statistic (in this case the OR or beta (β) value) within which we can be confident that the true value is contained (Field 2009). The CI is usually set at 95%. A CI containing 1 would indicate a non-

significant result, as this means that there is a chance of equal odds occurring in both groups.

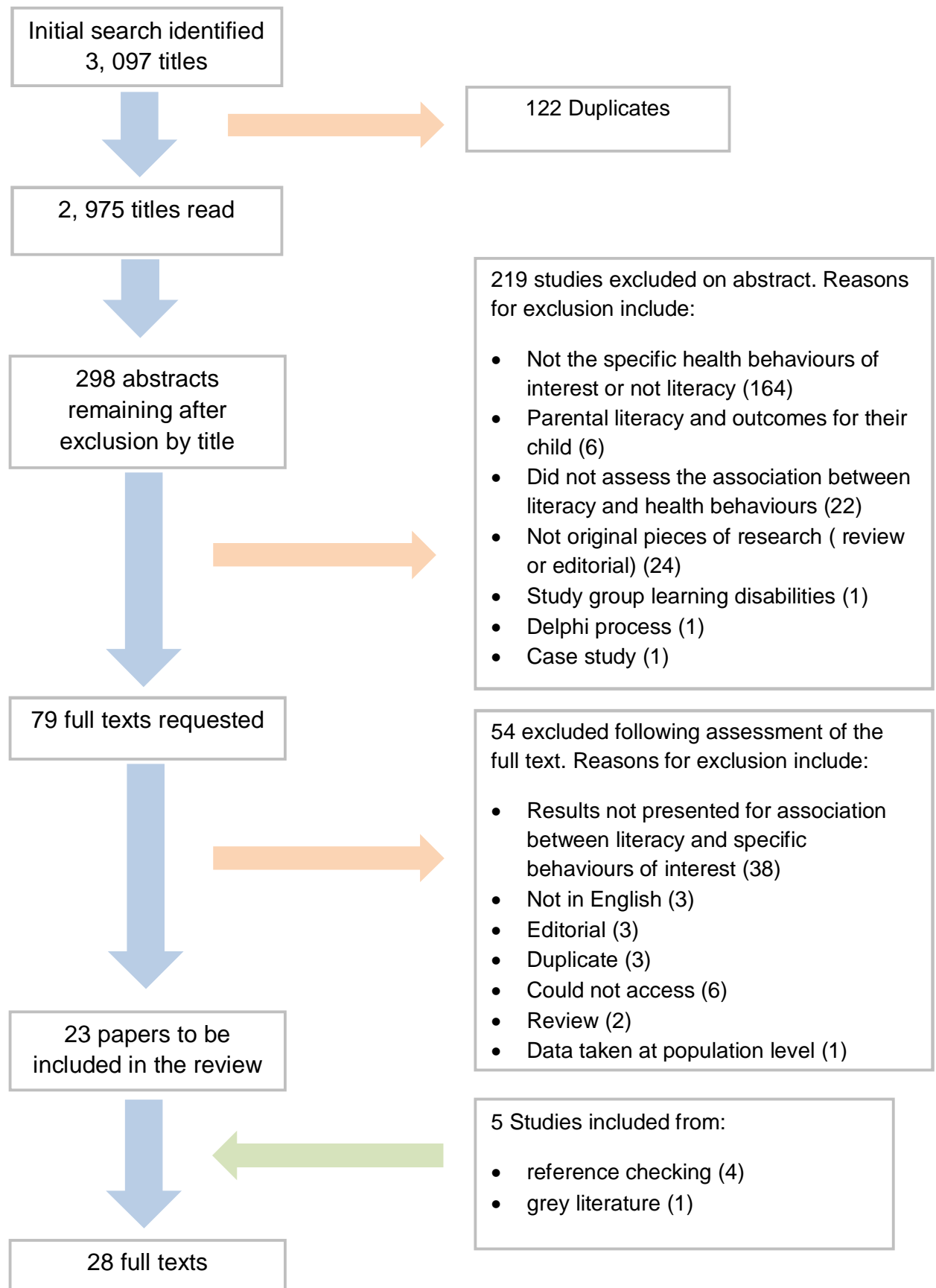
In summary, the measure of association for each study (correlation coefficient or regression coefficient) with statistically significant results being defined as p values of <0.05 or ORs of 95% CIs that do not contain 1.

Results

Search results

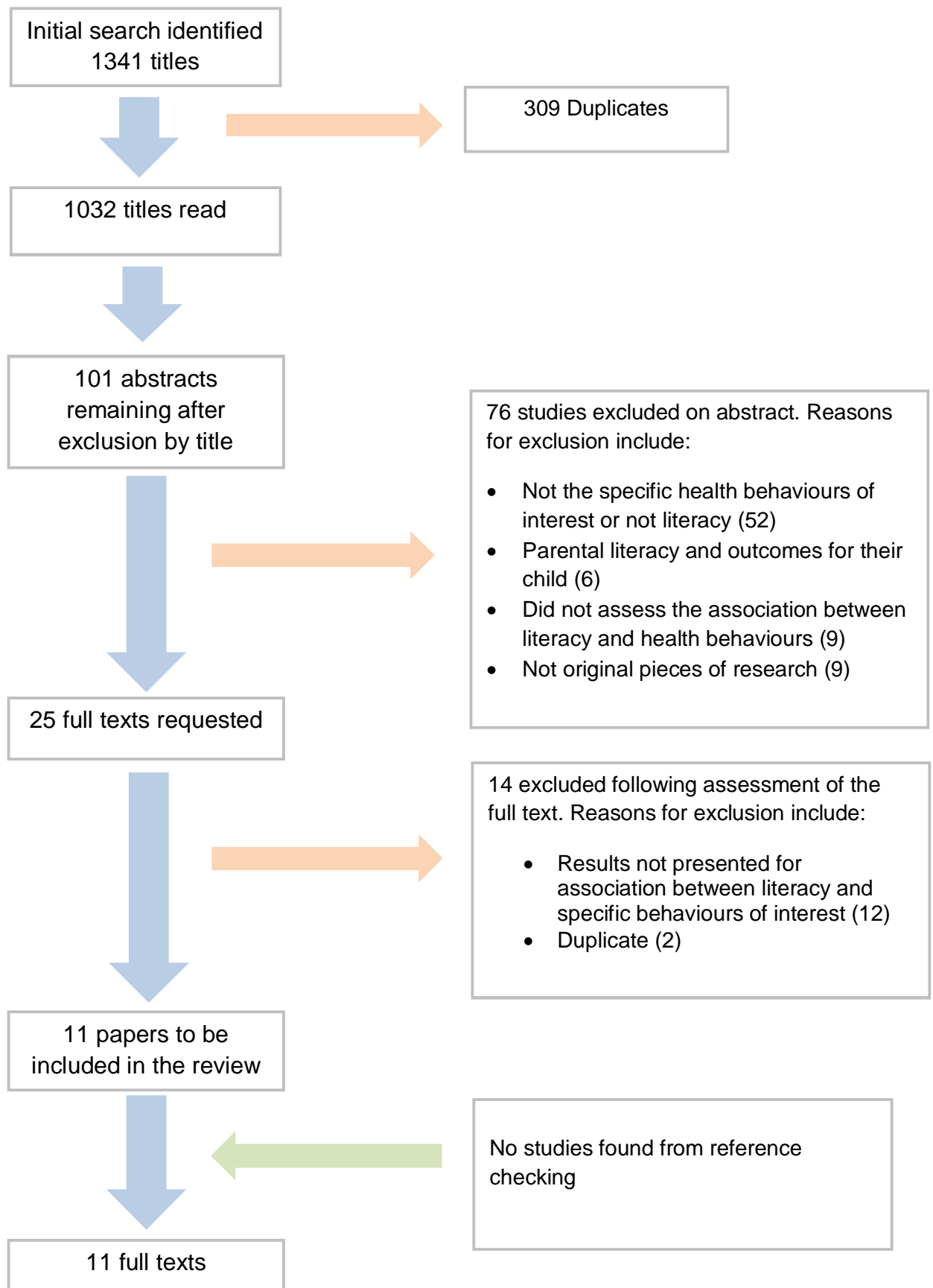
In the original online search in 2013 the lead reviewer assessed 2,975 titles and 2,677 were excluded on title alone (see Figure 1 for details of the selection process). The abstracts of the remaining 298 papers were read and 219 were excluded on the basis of the inclusion/exclusion criteria. Following assessment of 79 full texts, 23 papers from the search were included in the systematic review. Two potentially relevant papers and four PhD dissertations were unavailable via the British Library. Where studies were unavailable authors and, where applicable, supervisors of PhDs were contacted. Four papers were found through reference checking and one reference was provided by an expert.

Figure 3.1- Flow diagram of the selection process in October 2013



The updated search yielded 1,341 titles of which 309 were duplicates. By applying the above criteria to the remaining 1,032 titles, 101 were selected for further assessment. After reading the abstracts 25 full text papers were requested and 11 papers were included in the review. The selection process can be seen in Figure 3.2. Similar to the previous search the majority of abstracts were excluded on the grounds that the paper did not investigate literacy or the specific health behaviours of interest, 12 full texts were excluded as they did not present the results for the association between literacy and a behaviour. No additional studies were found from reference checking. From the initial search and the update a total of 39 papers were included in this systematic review.

Figure 3.2- Flow diagram of the selection process in January 2015



Critical appraisal

The quality of all studies was assessed by the lead reviewer and a second reviewer. Where disagreements arose, the specific paper was discussed and revisited by each reviewer. Agreement occurred 92% of the time. If disagreements persisted, a third reviewer was involved and consensus achieved. The results of the critical appraisal assessment can be viewed in Table 3.2. The quality of papers ranged from a score of between three and ten out of a maximum score of ten.

Table 3.2- Critical appraisal assessment of the papers included in the systematic review

Study	Clearly focused question	Appropriate method	Worth continuing?	Recruited in an acceptable	Literacy accurately measured	Behaviour appropriately measured	Identified important co-variates	Taken account of the co-variants in the design and analysis	P values or CI presented	Believe the results	Number of items fulfilled
Objective tool used to measure literacy											
Adams et al 2013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Arnold et al 2001	Y	Y	Y	Y	Y	Y	N	N	Y	Y	8
Bains & Egede, 2011	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Baker et al 2007	Y	Y	Y	Y	Y	Y	Y	N	N	Y	8
Bellows-Riecken 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Cha et al 2014	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	9
Chang 2009	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Hutchison et al 2014	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	9
Kim et al 2004	Y	Y	Y	Y	Y	Y	Y	N	N	?	7
Lee et al 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Li et al 2014	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	9
Martin et al 2012	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	9
Pryor 2012	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	9

Reisi et al 2014	Y	Y	Y	Y	Y	Y	N	N	N	Y	7
Speirs et al 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
TenHave et al 1997	Y	Y	Y	Y	Y	Y	Y	Y	?	?	8
Von Wagner et al 2007	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Vozikis et al 2014	Y	Y	Y	?	Y	?	Y	N	Y	Y	7
Wolf et al 2007	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Zoellner et al 2011	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Self-reported literacy											
Dermota et al 2013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Geboers et al 2014	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	9
HLS-EU Consortium 2012	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	9
Husson et al 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Mills et al 2012	Y	Y	Y	Y	Y	?	?	?	N	N	6
Smedberg et al 2014	Y	Y	Y	Y	Y	Y	N	?	Y	Y	8
Van der Heide et al 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Educational level as a marker of literacy											
Bogale et al 2009	Y	Y	Y	Y	?	Y	N	N	Y	Y	7
Bolivar et al 2010	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	9
Brega et al 2012	Y	Y	Y	Y	?	Y	N	Y	Y	Y	8
Daniel et al 2008	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Garg et al 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10

Kumar et al 2013	Y	Y	Y	?	?	Y	Y	N	Y	Y	7
Sinalkar et al 2012	Y	Y	Y	Y	Y	Y	?	?	Y	Y	8
Dichotomized literacy											
Batista et al 2013	Y	Y	Y	Y	?	Y	Y	N	Y	Y	8
Dandona et al 2005	Y	Y	Y	Y	?	Y	Y	N	Y	Y	8
John et al 2012	Y	Y	Y	Y	?	Y	Y	?	Y	Y	8
Mukho-padhyay et al 2009	Y	Y	Y	?	?	?	?	?	N	N	3
Subramanian et al 2008	Y	Y	Y	Y	?	Y	Y	N	Y	Y	8

Study characteristics

Full details of the study characteristics can be seen in Table 3.3. In total 39 papers, dating from 1997 to 2014, met the eligibility criteria for this systematic review. Of these, 11 were from developing countries, which included India, Cambodia, Ethiopia, Brazil, Iran, and Nepal. Studies conducted in developed countries included Australia, USA, Taiwan, Canada, UK, Spain, Bulgaria, Germany, Greece, Ireland, Netherlands and Poland. More studies were conducted in the USA (n=14) than any other country. Sample size ranged from 92 to 47,717. Behaviours were from participant self-reports but in addition one study used an accelerometer (a device similar to a pedometer but measures movement and acceleration rather than step count alone) to measure activity and one study used urinary cotinine (a chemical found in tobacco) to assess smoking status.

Table 3.3- Study characteristics

Study	Sample size	Country	Sample characteristics	Measure/tool used for literacy	Behaviour	Measure used for behaviour	Results
Objective tool used to measure literacy							
Adams et al 2013	2824	Australia	48.1% male	NVS	Diet Exercise Smoking	Fruit and vegetables eaten the previous day and usually. Frequency and duration of exercise the previous week Current smoking status	Limited health literacy was statistically non- significantly associated with no fruit consumption (OR 1.5, 95% CI 0.9 to 2.6), no vegetable consumption (OR 0.7, 95% CI 0.4 to 1.2), some physical activity (OR 1.2, 95% CI 0.8 to 1.7) and smoking (OR 1.1, 95% CI 0.8 to 1.4). Limited health literacy was associated with no physical activity (OR 2.2, 95% CI 1.5 to 3.2)
Arnold et al 2001	600	USA	50% white and 50% African Americans women. Age range 12-45 years, (mean 23years)	REALM	Smoking	Urinary cotinine and current smoking status	Descriptive statistics presented, no association statistics presented. The association between health literacy and current smoking status was statistically non-significant.
Bains & Egede, 2011	125	USA	Type 2 diabetics adults 72.5% female, 50.7% <65 years old	REALM-R	Diet Exercise	Diabetic self-care activities scale	The association between health literacy and diet (β 0.09, 95% CI -0.05 to 0.23, p value >0.05) and exercise (β -0.06, 95% CI -0.22 to 0.11, p value >0.05) was statistically non-significant.
Baker et al 2007	3260	USA	Medicare enrollees Mean age 74 years old Female 57%	S-TOFHLA	Smoking Alcohol	CAGE questions Current alcohol use	Descriptive data presented- A higher proportion of never smokers were seen in the inadequate health literacy group. A higher proportion of ex-smokers were seen in the

							adequate health literacy group (p<0.01). A higher proportion of non-drinkers were seen in the inadequate health literacy group. A higher proportion of light-moderate drinkers were seen in adequate literacy (p<0.01). No significant differences in harmful drinking using CAGE questions between literacy levels.
Bellows-Riecken 2012	65	Canada	Range 18-35 years old (mean 23) 43.1% female	REALM	Exercise	Accelerometer Self-reported	Health literacy was associated with physical activity (R=0.37 p<0.01).
Cha et al 2014	106	USA	Adults aged 18-29 years old who were inactive and overweight or obese. 78.6% female 70.0% African-American	NVS	Diet	Diet quality using Dietary Quality Index-Revised	Compared to high health literacy, low health literacy was associated with lower diet quality (B=-6.05, p<0.039)
Chang 2009	1597	Taiwan	High school students 48.8% female, mean age 17 (SD 1.02)	TOFHLA (Chinese translation)	Diet Exercise	The Health Promotion Scale	No significant association between health literacy and exercise (AOR 0.80 (95% CIs 0.56 to 1.14) Low health literacy was associated with lower nutrition score (OR 0.62, 95% CIs 0.43 to 0.89)
Hutchison et al 2014	662	USA	Recruited from outpatient primary care 67.3% female Mean age 55 years old (SD 11.3)	NVS	Diet	Diet quality calculated and a mean score for fruit and vegetable intake, salt intake and fat intake	Health literacy was not statistically associated with adequate diet (OR 1.18, 95% CI 0.50 to 2.79)

Kim et al 2004	92	USA	Hospital diabetes education participants Mean age 63 years, female 70%	TOFHLA	Diet Exercise	Diabetes Self-Care Activities Measure	Descriptive statistics only, no association statistics presented. Health literacy was statistically non-significantly associated with diet (p value = 0.472) or exercise (p value = 0.524).
Lee et al 2012	1754	Taiwan	Adult women, mean age 45.8 years	Mandarin Health Literacy Scale	Smoking	Current smoking status	Health literacy was associated with smoking status (OR 1.03, 95% CI 1.01 to 1.05)
Li et al 2014	740	Australia	Males aged over 40 years old.	NVS	Exercise Smoking Alcohol	Active/sedentary Current smoking status Alcohol use- none, low risk, medium risk or high risk.	Less than adequate health literacy was associated with being sedentary (OR 2.42, 95% CI 1.36 to 4.29). Health literacy was not statistically associated with smoking (OR 1.95, 95%CI 0.95 to 4.00) or alcohol consumption (OR 0.78, 95% CI 0.30 to 2.00)
Martin et al 2012	612	USA	Mean age 42.5 years, 60.5% female	Woodcock-Johnson Achievement Test	Smoking	Current smoking status	The association between health literacy and current smoking status was statistically non-significant (OR 1.06, 95% CI 0.98 to 1.15).
Pryor 2012	2067	USA	Aged 30-64 56.7% female	WRAT-3 and education	Diet	24 hour self-reported diet on food and beverages.	Health literacy and education were independently associated with nutrient based diet quality (R=0.313, p<0.001) and (R=0.811, p<0.001) respectively.
Reisi et al 2014	354	Iran	Adults over 60 years old, (mean 67, SD 7.0) 42.7% female	TOFHLA	Exercise Smoking Diet	Current smoking status Weekly exercise Weekly fruit and vegetable intake	Descriptive statistics only, no association statistics presented- Health literacy was not statistically associated with smoking (p value 0.22). A high proportion of inadequate health literacy exercised less or never exercised (p value <0.001) A higher proportion of the adequate health literacy ate more than four

							portions of fruit (p value <0.001) and more than five portions of vegetables per day (p value <0.001)
Speirs et al 2012	142	USA	76% female, Mean age 37 years old. Low income individuals	NVS	Diet	Eating low fat foods Adding fat to food Avoidance of extra fat	Adequate health literacy was associated with frying chicken less often $F=3.87$, $p<0.05$ Health literacy not significantly associated with overall fat consumption.
TenHave et al 1997	339	USA	primary care 74% female Age 40-70,	CARDES	Diet	Rate Your Plate score	Only descriptive data presented-- A higher proportion healthier rate your plate scores were seen with higher health literacy scores ($p=0.008$)
Von Wagner et al 2007	719	UK	Mean age 47.6 years, 57.8% female	TOFHLA	Diet Exercise Smoking	Fruit and vegetables consumed on a typical day Any exercise in the last 7 days Current smoking status	Health literacy was associated with fruit and vegetable consumption (OR 1.02, 95% CI 1.003 to 1.03) Health literacy not significantly associated with exercise in the last 7 days (OR 1.00, 95% CI 0.98 to 1.02) Literacy associated with not smoking (OR 1.02, 95% CI 1.0003 to 1.03).
Vozikis et al 2014	1526	Greece	University students aged 18-24 years 54% female	Four item comprehension test based on medicine information leaflet	Exercise Smoking Alcohol	Exercises more than once a week Current smoking status Daily alcohol consumption	Health literacy was associated with exercising more than once a week (OR=1.316, 95% CI 1.079 to 1.605). Health literacy was not statistically associated with smoking (OR 0.936, 95% CI 0.772 to 1.134) or alcohol (OR 0.917, 95% CI 0.727 to 1.157).
Wolf et al 2007	3260	USA	Medicare enrollees over 65 years old 57% female	S-TOFHLA	Smoking Alcohol Exercise	Past and current smoking status Current alcohol use and the CAGE questions Frequency of 20 minutes or more of exercise per week	Inadequate health literacy was not statistically associated with ever smoked (OR 0.9, 95% CI 0.7 to 1.1), alcohol (OR 1.3, 95% CI 0.6 to 3.0) or physical activity (OR 1.3, 95% CI 0.9 to 1.7).

Zoellner et al 2011	376	USA	76.3% female, mean age 45 years (range 18-84)	NVS	Diet	Food frequency questionnaire	Health literacy associated with a healthy eating index ($\beta=1.21$, $p<0.01$) Health literacy associated with reduced sugary drinks -33.69kcal/d ($p=0.01$)
Self-reported literacy							
Brega et al 2012	2594	USA	Diabetic adults 66.0% female	Self-reported confidence in reading and completing medical forms	Diet Exercise	Frequency of eating specific food groups categorized into healthy and unhealthy foods Number of minutes of exercise in a week	No significant association between literacy and healthy food consumption (standardised parameter estimate= 0.68, p value >0.05) or literacy and unhealthy food consumption (standardized parameter estimate = 0.001, p value >0.05) was demonstrated. . Literacy was negatively associated with exercise (standardized parameter estimate= -0.097, $p<0.05$)
Dermota et al 2013	11,930	Switzerland	Male aged 17-26 years old (mean 20.0)	Ease of understanding health information	Smoking Alcohol Drug use	Current smoking status Risk of alcohol use including quantity and frequency of use. Risk of cannabis use- a not at risk user uses less than twice a week, an at risk user uses twice a week or more per week.	Compared to not smoking, health literacy was associated with smoking (OR=1.14, 95% CI 1.04 to 1.24) but statistically non-significant for being an occasional smoker (OR 0.96, 95% CI 0.85 to 1.08). Compared to not drinking alcohol, health literacy was associated with being an at risk user of alcohol (OR=1.21, 95% CI 1.05 to 1.40) and a not at risk drinker (OR=1.27, 95%CI 1.06 to 1.44) Compared with not using cannabis, health literacy was associated with being an at risk user (OR=1.15, 95% CI 1.04 to 1.27) but statistically non- significant for non-at risk users (OR 1.02, 95% CI 0.91 to 1.13).

Geboers et al 2014	538	Netherlands	55 years and older 58.9% female 46.0% with low educational status.	Three previously validated questions- by Chew et al ^[8]	Diet Exercise	Compliance with exercise guidelines (at least 30mins of exercise at least 5 times a week) Compliance with fruit and vegetable consumption guidelines (at least 200g of vegetables and two pieces of fruit per day)	Compared with adequate health literacy, inadequate health literacy was associated with poor compliance with the exercise guidelines (OR 1.74, 95%CI 1.16 to 2.59) but non-significantly associated with the dietary guidelines (OR 1.20, 95%CI 0.75 to 1.92).
HLS-EU Consortium 2012	8232	8 EU countries: Austria, Bulgaria, Germany, Greece, Ireland, Netherlands, Poland, and Spain	Aged 15 years and older. Mean age between 43-47 years old	HLS-EU-Q	Exercise Smoking Alcohol	Frequency of exercising Current smoking Number of drinks in a month	The association between smoking and literacy was inconsistent in different countries and overall non-significant ($r=-0.009$, p value >0.05). Literacy was negatively associated with exercise ($r= -0.189$, p value <0.01) Literacy was associated with alcohol consumption ($r= 0.065$, p value <0.01)
Husson et al 2014	1643	Netherlands	Colorectal cancer survivors 42.9% female	Three previously validated questions- by Chew et al ^[8]	Exercise Smoking Alcohol	Compliance with exercise guidelines (at least 30mins of exercise at least 5 times a week) Current smoking status Average weekly alcohol consumption in the last 12 months	Only descriptive data, no association statistics presented- A higher proportion meeting the exercise guidelines are in the medium or high literacy groups (p value <0.01). Higher proportions in the low literacy group are non-drinkers and lower proportions in the low literacy group are moderate or heavy drinkers (p value <0.01). Proportion of smoking status was found to be non-significant between different literacy groups (p value 0.06)
Mills et al 2012	389	USA	50% Female,		Smoking	Current smoking status	

			Mean age 40.6 year	Self-reported reading confidence and aid needed with medical reading material	Alcohol Diet	Largest number of drinks had on one occasion in the last month Portions of fruit or vegetables a week	Health literacy was associated with lower rates of tobacco use ($\beta = -0.142$, $p < 0.05$) and fruit and veg consumption ($\beta = -0.119$, $p < 0.05$). No significant association between literacy and alcohol consumption ($\beta = 0.046$, $p > 0.05$)
Smedberg et al 2014	8344	15 European countries -Austria -Croatia -Finland -France -Iceland -Italy -Netherlands -Norway -Poland -Russia -Serbia -Slovenia -Sweden -Switzerland -UK	Pregnant women and new mothers with a child aged less and 1 year old.	Three previously validated questions- by Chew et al ^[8] Highest educational level	Smoking	Continued smoking during pregnancy	Low health literacy is associated with continued smoking during pregnancy (OR=1.49, 95% CI 1.08 to 2.06). Compared with having an education above high school level, having only a high school education (OR=2.53, 95% CI 2.05 to 3.11) or less than high school education (OR=3.64, 95% CI 2.58 to 5.14) is associated with smoking during pregnancy
Van der Heide et al 2014	1714	Netherlands	49.6% female	Three previously validated questions- by Chew et al ^[8]	Exercise Smoking	Diabetic self-care activities measure Current smoking status	Exercise was associated with health literacy ($B = 0.13$, $p < 0.05$). The association with literacy and smoking was statistically non-significant (OR 0.99, 95% CI 0.81 to 1.22).

Educational level as a marker of literacy							
Bogale et al 2009	200	Rural Ethiopia	Women aged 13-24	Educational level	Condom use	Do you use condoms?	Only descriptive data, no association statistics presented- A higher proportion of condom use is in higher educational level ($p<0.01$) A higher proportion of illiterate do not use condoms ($p<0.01$)
Bolivar et al 2010	13193	Spain	Aged 16 years and older. 51.3% female	Educational level	Exercise	Frequency of exercise in free time	Compared to being educated to a graduate level, no educational level was associated with sedentariness in males (OR=2.47, 95% CI 1.91 to 3.21) and females (OR= 2.68, 95% CI 2.04 to 3.52) Compared to being educated to a graduate level, having only a primary school education was associated with sedentariness in males (OR=1.88, 95% CI 1.55 to 2.28) and females (OR=1.48, 95% CI 1.21 to 1.81).
Daniel et al 2008	832	India	51.6% female Aged 16 and over	Educational level	Smoking and any form of tobacco use	Current tobacco use	Compared to being educated for over 10 years, illiteracy (OR=10.65, 95%CI 3.88 to 29.23), primary school (OR=4.68, 95% CI 1.85 to 11.83) or middle-high school (OR=3.02, 95% CI 1.34 to 6.80) was associated with tobacco use.
Garg et al 2012	911	India	Mean age 44.9 years, range 30-59 49.6% female	Educational level	Smoking	Current and past smoking	Compared to having a high school or above education, illiteracy (OR=2.36, 95% CI 1.30 to 4.27) and primary – middle school education (OR=2.07, 95%CI 1.27-3.38) was associated with current smoking.

Kumar et al 2013	946	India	Age 10 and over Mean age 25.3 years (SD 9.0) 47.6% female	Educational level	Alcohol	Had any alcohol in the last 12 months AUDIT tool	Illiteracy (OR=6.163, 95% CI 2.14 to 17.72) and lower educational level (OR=2.57, 95% CI 1.26 to 5.28) was associated with alcohol use in the last 12 months.
Sinalkar et al 2012	313	India	Females aged 15-49 Mean age 32.3 years	Educational level	Tobacco use	Smoking or any tobacco use	Illiteracy was associated with tobacco use (OR=2.02, 95%CI 1.02 to 4.04).
Smedberg et al 2014	8344	15 European countries -Austria -Croatia -Finland -France -Iceland -Italy -Netherlands -Norway -Poland -Russia -Serbia -Slovenia -Sweden -Switzerland -UK	Pregnant women and new mothers with a child aged less and 1 year old.	Highest educational level	Smoking	Continued smoking during pregnancy	Compared with having an education above high school level, having only a high school education (OR=2.53, 95% CI 2.05 to 3.11) or less than high school education (OR=3.64, 95% CI 2.58 to 5.14) is associated with smoking during pregnancy.
Dichotomized literacy							
Batista et al 2013	1815	Brazil	HIV infected people aged over 18 years old 37.7% female Mean age 39.6 years old (SD9.6)	Literate/illiterate	Smoking	Current smoking status	Compared to being literate, being illiterate is associated with being a current smoker OR 1.66 (1.03-2.69).
Dandona et al 2005	6648	India	Female sex workers Mean age 27.3 years (range 16-54)	Literate/illiterate	Condom use	Usual practices of condom use	Illiteracy was associated with no or inconsistent condom use (OR=1.32, CI 95% 1.13 to 1.55).

John et al 2012	47 717	Cambodia	Over 14 years old	Literate/illiterate	Smoking	Current smoking status	Illiteracy was associated with smoking both in urban areas (OR=1.91, 95% CI 1.382 to 2.638) and rural areas (OR 1.54, 95% CI 1.335 to 1.770)
Mukhopadhyay et al 2009	199	Nepal	Pregnant women	Literate/illiterate	Diet	Consumption of specific food groups whilst pregnant	Descriptive data, no association statistics presented- a higher proportion of women consumed special foods during the antepartum period.
Subramanian et al 2008	4821	India	Male clients of female sex workers	Literate/illiterate	Condom use	Usual practices of condom use with female sex workers	Illiteracy was associated with inconsistent condom use (OR 1.39, 95% CI 1.14 to 1.69)

Results described based on how literacy was measured

Approximately half of the studies ($n=20$) measured literacy using an objective tool. The most commonly used were TOFHLA, REALM, and NVS. One study used the Cardiovascular Dietary Education System (CARDES) (TenHave et al., 1997), an objective measure of health literacy which had not been previously validated (see Table 3.4 for a summary of the tools used to estimate literacy). Studies using objective tools were from developed countries apart from one study which was conducted in Iran. Of the 31 associations explored using objective tools, 20 were statistically non-significant. Of the Eleven associations that were significant; six demonstrated that literacy was associated with a healthier diet, three showed that literacy was associated with exercise, one found literacy to be associated with no exercise and one association found that literacy was associated with smoking. Significance did not vary based on the tool used. Six of the statistically non-significant results were descriptive data only with p values provided. Fourteen associations were statistically non-significant for these two papers showed literacy was associated with a healthier diet while two papers demonstrated literacy was associated with a less healthy diet; one paper found literacy was associated with exercise, while two papers found literacy was associated with no exercise; one paper found literacy to be associated with more alcohol consumption and one paper found literacy was associated with less alcohol consumption; three papers found literacy to be associated with smoking and two found literacy was associated with not smoking.

Eight studies used self-reports to estimate literacy, all of these self-reported tools had been validated. The most commonly used was a three item health literacy screening tool which incorporates a self-report of confidence in filling in forms,

frequency of needing help with reading written medical material and problems learning about medical conditions (Chew et al., 2004). These questions have been shown to have a high correlation with the TOHFLA (Chew et al., 2004; Chew et al., 2008) (see Chapter 1 for further details). The European Health Literacy Survey (HLS-EU) is a self-report measure exploring perceived difficulty in carrying out health-related tasks (see Table 3.4). Of the 17 associations examined using self-reported tools the results were mixed. Three studies found a non-significant relationship between diet and literacy while one study found that literacy was associated with less fruit consumption; two studies found that literacy was associated with more exercise while two studies found literacy to be associated with less exercise; two studies found lower literacy to be associated with more alcohol consumption whilst one study found there was a non-significant association; two studies found higher literacy was associated with smoking, one study found the opposite results and two studies found a non-significant association; one study demonstrated that literacy was associated with cannabis use.

Papers that used a tool to objectively measure literacy or used a self-reported measure, on average, fulfilled more of the critical appraisal criteria than papers which dichotomised literacy or used education as a proxy measure.

Table 3.4- Measures of literacy in the studies included

Tool	Description	Scoring system
TOFHLA (Parker et al., 1995)	Health focused 50 item reading comprehension test and 17 item quantitative skills assessment. S-TOFHLA is the short form of TOFHLA	Inadequate, Marginal, Adequate
REALM (Davies et al., 1991)	66 item word recognition and pronunciation test of common medical terms.	<3 rd grade, 4th-6th grade, 7th-8 th grade, >8 th grade.
Wide Range Achievement Test (WRAT-3/R) (Robertson, 2001)	A 57-item measure of literacy using word recognition, pronunciation, spelling and quantitative literacy from educational literature.	Continuous scale.
NVS(Weiss et al., 2005)	Document and quantitative literacy assessed by 6 items regarding an ice cream nutrition label	Low literacy, possible low literacy, adequate literacy.
Woodcock-Johnson achievement test (Woodcock et al., 2001)	Test of reading comprehension, speaking and listening from educational literature.	Continuous scale.
Cardiovascular dietary education system (TenHave et al., 1997)	A 200 item word recognition and pronunciation related to diet, nutrition and cardiovascular health.	<5 th grade, 5th-8 th grade, >8 th grade
European Health Literacy Survey (HLS-EU) (HLS-EU consortium, 2012)	Examines access, understanding, appraisal and application relevant to health decision making and tasks using 47 items. Each item assesses self-reported perceived difficulty of selected health relevant tasks.	Continuous scale.

Seven studies used educational level (e.g. illiterate, primary school, secondary school) as a marker for literacy; four of which were undertaken in India, one in Ethiopia, one in Spain and one study over 15 European countries. Of the seven associations investigated all demonstrated that education was significantly associated with a health behaviour, four of the associations were with smoking, one with alcohol, one with condom use and one with exercise.

Five studies dichotomised literacy into literate or illiterate. All of these studies were from developing countries and all but one study demonstrated significant results. Two studies found that illiteracy was associated with inconsistent condom use and two studies demonstrated an association with smoking.

Results described by health behaviour

Diet

Sixteen papers assessed associations between literacy and diet (Table 3.5). Diet was assessed by nutritional scores, fruit and vegetable consumption and the diabetic self-care activities measure (a self-reported questionnaire including items on consumption of certain food groups such as carbohydrates, fat, meat and fruit and vegetables) (Toobert et al., 2000). All but two studies (Mukhopadhyay & Sarkar, 2009; Reisi et al., 2014) were undertaken in developed countries.

Overall half the studies ($n=8$) did not determine a significant relationship between literacy and diet (Kim et al., 2004; Mukhopadhyay & Sarkar, 2009; Bains & Egede, 2011; Speirs et al., 2012; Brega et al., 2012; Hutchison et al., 2014; Geboers et al., 2014; Adams et al., 2013); seven of these studies were from developed countries and there were no patterns in the direction of the associations. The remaining half ($n=8$) (TenHave et al., 1997; von Wagner et al., 2007; Chang, 2011; Zoellner et al., 2011; Mills et al., 2012; Pryor et al., 2012; Cha et al., 2014; Reisi et al., 2014) found that higher levels of literacy were associated with better diet quality. Seven of the studies were conducted in developed countries.

Of the six studies using “rate your plate” or other nutrition scores to calculate a healthy diet, four found literacy to be correlated with a healthier diet (TenHave et al., 1997; Zoellner et al., 2011; Brega et al., 2012; Cha et al., 2014). Results were mixed in papers assessing fruit and vegetable consumption (von Wagner et al., 2007; Mills et al., 2012; Reisi et al., 2014; Geboers et al., 2014; Adams et al., 2013); for example higher literacy was associated with less fruit consumption (Mills et al., 2012), more fruit and vegetable consumption (von Wagner et al., 2007; Reisi et al., 2014) or no

association was found (Geboers et al., 2014; Adams et al., 2013). Studies using the diabetic self-care activities measure did not find a significant relationship between literacy and diet (Kim et al., 2004; Bains & Egede, 2011). There were no differences in critical appraisal scores between studies that showed a significant relationship and those that did not.

Table 3.5- Results of studies in developed countries, investigating literacy and diet

Paper	Country	Marker of literacy	Measure of diet	Results
Adams et al 2013	Australia	NVS	Fruit and vegetable consumption	Literacy was statistically insignificantly associated with no fruit (OR1.5, 95% CI 0.9 to 2.6) and vegetable (OR 0.7, 95% CI 0.4 to 1.2) consumption
Baines et al 2011	USA	REALM-R	Diabetic Self Care Activity scale	The association between literacy and current diet was statistically non-significant (β 0.09, 95% CI 0.05 to 0.23, p value >0.05)
Cha et al 2014	USA	NVS	Diet quality using Dietary Quality Index-Revised	Compared to high health literacy, low health literacy was associated with lower diet quality ($B=-6.05$, $p<0.039$)
Chang 2009	Taiwan	TOFHLA (Chinese translation)	Nutrition score	Low literacy level was associated with lower nutrition score (OR 0.62, 95% CIs 0.43 to 0.89)
Hutchison et al 2014	USA	NVS	Diet quality calculated and a mean score for fruit and vegetable intake, salt intake and fat intake	Health literacy was not statistically associated with adequate diet (OR 1.18, 95% CI 0.50 to 2.79)
Kim et al 2004	USA	TOFHLA	Diabetes Self-Care Activities Measure	Descriptive statistics only, no association statistics presented. Literacy was not statistically associated with diet (p value = 0.472)
Pryor 2012	USA	WRAT-3	Nutrition score	Literacy and education were independently associated with nutrient based diet quality ($R=0.313$, $p<0.001$) and ($R=0.811$, $p<0.001$) respectively.

Reisi et al 2014	Iran	TOFHLA	Weekly fruit and vegetable intake	Descriptive statistics only, no associations statistics presented- a higher proportion of the adequate health literacy ate more than four portions of fruit and more than five portions of vegetables per day
Speirs et al 2012	USA	NVS	Diet	Adequate literacy was associated with frying chicken less often $F=3.87$, $p<0.05$ Literacy not significantly associated with overall fat consumption.
TenHave et al 1997	USA	CARDES	Nutrition score	Lower literacy was associated with lower rate your plate score ($p=0.008$)
Von Wagner et al 2007	UK	TOFHLA	Fruit and vegetable consumption	Literacy was associated with more fruit and vegetable consumption (OR=1.02, 95% CI 1.003 to 1.03)
Zoellner et al 2011	USA	NVS	Nutrition score	Literacy positively associated with healthy eating index $\beta=1.21$ ($p<0.01$) Literacy associated with reduced sugary drinks -33.69kcal/d ($p=0.01$)
Brega et al 2012	USA	Self-reported confidence in reading and completing medical forms	An adapted version of the Multifactor Screener from the National Health Interview Survey	Literacy was non-significantly associated with healthy food consumption (standardised parameter estimate= 0.68, p value >0.05) or unhealthy food consumption (standardised parameter estimate =0.001, p value >0.05)
Geboers et al 2014	Netherlands	Three previously validated questions- by Chew et al	Compliance with fruit and vegetable consumption guidelines (at least 200g of vegetables and two pieces of fruit per day)	Literacy was non-significantly associated with adherence the dietary guidelines on fruit and vegetable consumption (OR 1.20, 95% CI 0.75 to 1.92)
Mills et al 2012	USA	Self-reported reading confidence and aid needed with medical reading material	Fruit consumption	HL correlated with less fruit intake $\beta= -.0119$, $p<0.05$
Mukho-padhyay et al 2009	Nepal	Literacy/illiteracy	Diet	Descriptive data only, no association statistics presented. A higher proportion of women consumed special foods whilst pregnant.

Exercise

Exercise was investigated by sixteen studies (Table 3.6). The most common way of estimating exercise was self-reports of frequency and/or duration of exercise in the last week or in a usual week, other methods included self-reported exercise within the diabetic self-care activities measure (Toobert et al., 2000) or an accelerometer. All but one (Reisi et al., 2014) were studies undertaken in developed countries. Nine studies (Kim et al., 2004; Wolf et al., 2007; von Wagner et al., 2007; Chang, 2011; Bains & Egede, 2011; Bellows-Riecken, 2013; Reisi et al., 2014; Li et al., 2014; Adams et al., 2013) used objective tools and three studies (Geboers et al., 2014; Husson et al., 2014; van der Heide et al., 2014) used Chew et al's validated health literacy screening questions (Chew et al., 2008).

Overall, results were inconsistent. Half ($n=8$) demonstrated a significant relationship between higher literacy level and exercising more (Bolivar et al., 2010; Bellows-Riecken, 2013; Geboers et al., 2014; Husson et al., 2014; Li et al., 2014; Reisi et al., 2014; van der Heide et al., 2014; Vozikis et al., 2014), however two of the studies only presented descriptive data and did not show the strength of the associations (Reisi et al., 2014; Husson et al., 2014). Three studies found that higher literacy was associated with being more sedentary (Adams et al., 2013; HLS-EU consortium, 2012; Brega et al., 2012). Five studies did not show a significant association (Kim et al., 2004; von Wagner et al., 2007; Wolf et al., 2007; Bains & Egede, 2011; Chang, 2011; Adams et al., 2013). The associations of these papers did not demonstrate any consistent direction of associations: two papers showed literacy was associated with less exercise, one paper had an OR of 1.0, one paper only

presented descriptive data and no statistics for associations and one paper found literacy was associated with exercise. All of these studies used objective tools to measure health literacy.

Table 3.6- Results of studies investigating literacy with exercise

Paper	Country	Marker of literacy	Measure of exercise	Results
Adams et al 2013	Australia	NVS	Length of time and frequency of partaking in physical activity	Literacy was statistically not significantly associated with some physical activity (OR 1.2, 95% CI 0.8 to 1.7). Limited health literacy was associated with no physical activity (OR 2.2, 95% CI 1.5 to 3.2)
Baines et al 2011	USA	REALM-R	Diabetic Self Care Activity scale	Health literacy was not significantly associated with exercise (β -0.06, 95% CI -0.22 to 0.11, p value >0.05).
Bellows-Riecken 2012	Canada	REALM	Physical activity measured using accelerometer	Health literacy was associated with physical activity $R=0.37$ $p<0.01$
Chang 2009	Taiwan	Chinese translation of TOFHLA	Physical activity frequency	No significant effect of literacy on exercise (OR 0.80, 95%CI, 0.56 TO 1.14)
Kim et al 2004	USA	TOFHLA	Diabetes Self-Care Activities Measure	Descriptive statistics only, no association statistics presented. Literacy was not associated with exercise (p value =0.524)
Li et al 2014	Australia	NVS	Active/sedentary	Less than adequate health literacy was associated with being sedentary (OR=2.42, 95% CI 1.36 to 4.29).
Reisi et al 2014	Iran	TOFHLA	Weekly exercise	Descriptive statistics only, no association statistics presented- a high proportion of inadequate health literacy

				exercised less or never exercised (p value <0.001).
Von Wagner et al 2007	UK	TOFHLA	Any form of physical exercise in the last 7days	Literacy was not a significant predictor of physical activity (OR 1.00, 95% CI 0.98 to 1.02).
Vozikis et al 2014	Greece	TOFHLA	Exercises more than once a week	Health literacy was associated with exercising more than once a week (OR=1.316, 95% CI 1.079 to 1.605).
Wolf et al 2007	USA	S-TOFHLA	Frequency of physical activity per week	Inadequate health literacy was not statistically associated with exercise (OR 1.3, 95% CI 0.9 to 1.7)
Bolivar et al 2010	USA	Educational level	Amount of physical activity spent in free time	No educational attainment and only attaining primary school education (OR=1.88, CI 1.55 to 2.28) was associated with sedentariness
Brega et al 2012	USA	Self-reported confidence in reading and completing medical forms	Number of minutes per week partaking in physical activity	Literacy was negatively associated with physical activity (standardized parameter estimate= -0.097, p<0.05)
Geboers et al 2014	Netherlands	Three previously validated questions- by Chew et al	Compliance with exercise guidelines (at least 30mins of exercise at least 5 times a week)	Compared with adequate health literacy, inadequate health literacy was associated with poor compliance with the exercise guidelines (OR1.74, 95%CI 1.16 to 2.59)
HLS-EU Consortium 2012	8 EU countries	HLS-EU	Physical activity frequency	Literacy was negatively associated with physical activity (r= -0.189, p <0.01)
Husson et al 2014	Netherlands	Three previously validated questions- by Chew et al	Compliance with exercise guidelines (at least 30mins of exercise at least 5 times a week)	Descriptive data only, no association statistics presented- a higher proportion meeting the exercise guidelines are in the medium or high literacy groups.
Van der Heide et al 2014	Netherlands	Three previously validated questions- by Chew et al	Diabetic self-care activities measure	Exercise was associated with health literacy (B=0.13, p<0.05).

Alcohol consumption

Alcohol consumption was calculated using self-reports of weekly or yearly intake, the CAGE questions (Ewing, 1984) (a four item tool used to screen for problematic alcohol consumption) or highest number of drinks on one occasion in the last month. Three studies used validated objective tools, four studies used self-reports of literacy and one study used education as a proxy; no patterns appeared between the measures of literacy and results.

Eight papers explored the relationship between literacy and alcohol use; overall results were inconsistent (Table 3.7). Half of the studies (n=4) did not show a significant association between literacy and alcohol consumption (Wolf et al., 2007; Mills et al., 2012; Dermota et al., 2013; Vozikis et al., 2014); three studies showed that literacy was associated with less alcohol consumption and one showed that literacy was associated with more alcohol consumption. Two studies showed that illiteracy was associated with alcohol use (HLS-EU consortium, 2012; Kumar et al., 2013); of these one study demonstrated that illiteracy and low literacy levels were associated with alcohol use in the last 12 months (Kumar et al., 2013) and the other performed over 8 different countries (HLS-EU consortium, 2012) demonstrated overall a weak association between literacy and alcohol consumption ($r=0.065$, $p<0.01$), however there was within country variation and only three countries demonstrated significant correlations. Two studies presented cross-tabulation and chi-square analysis of alcohol and literacy, which showed a higher proportion of non-drinkers were seen in the lower literacy group ($p<0.01$) (Baker et al., 2007; Husson et al., 2014) . One study demonstrated that higher health literacy was related to at-risk drinking (Dermota et al., 2013) however no significant association between the CAGE questions and literacy were seen (Wolf et al., 2007; Baker et al., 2007) .

Table 3.7- Results of the studies investigating alcohol consumption with literacy in developed countries

Paper	Country	Marker of literacy	Measure of alcohol use	Results
Baker et al 2007	USA	S-TOFHLA	Alcohol intake categorised into none drinker, low-moderate or heavy. Harmful drinking defined at scoring two or more on the CAGE questions	Descriptive statistics only, no association statistics presented.. P <0.01 for comparisons across all groups, inadequate health literacy were more likely to be non-drinkers. No significant difference between harmful drinking using CAGE questions and literacy level.
Li et al 2014	Australia	NVS	Alcohol use- none, low risk, medium risk or high risk	Less than adequate literacy was non-significantly associated with alcohol consumption (OR 0.78, 95% CI 0.30 to 2.00)
Vozikis et al 2014	Greece	Four item comprehension test based on medicine information leaflet	Daily alcohol consumption	Health literacy was not statistically associated with alcohol consumption (OR 0.917, 95% CI 0.727 to 1.157)
Wolf et al 2007	USA	S-TOFHLA	Current alcohol use categorised into none drinker, low-moderate or heavy drinker.	Inadequate literacy was statistically not significantly associated with alcohol intake (OR 1.3, 95% CI 0.6 to 3.0).
Dermota et al 2013	Switzerland	Self-report on the ease of understanding health information	Risk of alcohol use including quantity and frequency of use.	Compared to not drinking alcohol, health literacy was associated with being an at risk user of alcohol (OR=1.21, 95% CI 1.05 to 1.40) and a not at risk drinker (OR=1.27, 95%CI 1.06 to 1.44)
HLS-EU CONSORTIUM 2012	8 EU countries	HLS-EU	Alcohol categorised in to very excessive alcohol consumers, excessive, moderate alcohol, light or no alcohol consumption	Literacy was associated with alcohol consumption (r= 0.065, p<0.01)

Husson et al 2014	Netherlands	Three previously validated questions- by Chew et al	Average weekly alcohol consumption in the last 12 months	Only descriptive data presented- higher proportions in the low literacy group are non-drinkers and lower proportions in the low literacy group are moderate or heavy drinkers.
Mills et al 2012	USA	Self-reported reading confidence and aid needed with medical reading material	Largest number of drinks on one occasion in the last month	No significant correlation between literacy and alcohol consumption ($\beta=0.046$, p value >0.05).
Kumar et al 2013	India	Educational level	AUDIT tool and alcohol use in the last 12 months	Illiteracy (OR=6.163, 95% CI 2.14 to 17.72) and lower educational level (OR=2.57, 95% CI 1.26 to 5.28) was associated with alcohol use in the last 12 months.

Smoking

Twenty-one studies assessed the relationship between literacy and current smoking status (Table 3.8). Overall results were inconsistent but some patterns did emerge. Eight studies (Daniel et al., 2008; Mills et al., 2012; John et al., 2012; Sinalkar et al., 2012; Garg et al., 2012; Batista et al., 2013; Husson et al., 2014; Smedberg et al., 2014) demonstrated that low levels of literacy were associated with smoking. Of these studies, six of the strongest associations were with educational level or self-reported illiterate/literate (Daniel et al., 2008; Garg et al., 2012; John et al., 2012; Sinalkar et al., 2012; Batista et al., 2013; Smedberg et al., 2014). All studies that used educational level or self-reported illiterate/literate showed a significant association with smoking. One study (Smedberg et al., 2014) assessed the relationship between literacy (estimated by Chew et al's validated questions and highest educational achievement) and smoking during pregnancy over 15 different EU countries. Both estimates of literacy demonstrated lower literacy levels were correlated with smoking, however the stronger association was seen with education. Seven studies were from developing countries and five (estimating literacy by education or dichotomising into literate/illiterate) found a significant association, one study showed higher literacy (using the Health Literacy Scale) was associated with smoking and one showed literacy (estimated using the TOFHLA) was not associated with smoking.

Nine studies found literacy to be non-significant in the association with smoking status (Wolf et al., 2007; Martin et al., 2012; HLS-EU consortium, 2012; Li et al., 2014; Reisi et al., 2014; van der Heide et al., 2014; Vozikis et al., 2014; Arnold et al., 2001; Adams et al., 2013); all of these studies used tools to measure literacy, rather than education, and all but one (Reisi et al., 2014) were from developed

countries. One of these studies (HLS-EU consortium, 2012) used the same methodology over eight European countries and despite showing a non-significant association overall, there was variation in associations, for example in Bulgaria higher health literacy was associated with smoking but in Ireland higher health literacy was associated with not smoking and in other countries such as Spain non-significant associations were demonstrated. Two of these studies presented descriptive data only, from the seven studies which showed non-significant statistical associations three found literacy was associated with smoking and four found literacy was associated with not smoking.

Four studies found higher literacy to be correlated with smoking (von Wagner et al., 2007; Mills et al., 2012; Lee et al., 2012; Dermota et al., 2013). Two estimated literacy by confidence in filling in forms and ease of understanding health information and two used objective tools (von Wagner et al., 2007; Lee et al., 2012) .

Table 3.8- Results of the studies investigating literacy with smoking

Paper	Country	Measure used for literacy	Results
Adams et al 2013	Australia	NVS	Limited literacy was not significantly associated with smoking (OR 1.1, 95% CI 0.8 to 1.4)
Arnold et al 2001	USA	REALM	Descriptive statistics only. Literacy was statistically not related to smoking status
Baker et al 2007	USA	S-TOFHLA in either language	Descriptive statistics only, no association statistics presented. A higher proportion of never smokers were in the inadequate literacy group. A higher proportion of ex-smokers were seen in the adequate health literacy group ($p<0.01$).

Lee et al 2012	Taiwan	Mandarin Health literacy scale	Health literacy was associated with smoking status (OR=1.03, 95% CI 1.01 to 1.05)
Li et al 2014	Australia	NVS	Health literacy was not statistically associated with smoking (OR 1.95, 95% CI 0.95 to 4.00)
Martin et al 2012	USA	Woodcock-Johnson achievement test	Non-significant association found between literacy and current smoking status (OR 1.06, 95% CI 0.98 to 1.15)
Reisi et al 2014	Iran	TOFHLA	Descriptive statistics only, no association statistics presented. Health literacy was not statistically associated with smoking (p value 0.22)
Von Wagner et al 2007	UK	TOFHLA	Literacy was associated with smoking (OR 1.02, 95% CI 1.0003 to 1.03)
Vozikis et al 2014	Greece	Four item comprehension test based on medicine information leaflet	Health literacy was not statistically associated with smoking (OR 0.936, 95%CI 0.772 to 1.134)
Wolf et al 2007	USA	S-TOFHLA	Inadequate literacy was not associated with smoking (OR 0.9, 95% CI 0.7 to 1.1)
Dermota et al 2013	Switzerland	Self-reported ease of understanding health information	Compared to not smoking, health literacy was associated with smoking (OR=1.14, 95% CI 1.04 to 1.24) but statistically non-significant for being an occasional smoker (OR 0.96, 95% CI 0.85 to 1.08).
HLS-EU CONSORTIUM 2012	8 European countries	HLS-EU-Q (self-perceived measure of HL)	The association between smoking and literacy was inconsistent in different countries and overall not significant ($r=-0.009$, p value >0.05).
Husson et al 2014	Netherlands	Three previously validated questions- by Chew et al	Only descriptive data, no association statistics presented- a higher proportion in the low literacy group has never smoked (p value <0.01).
Mills et al 2012	USA	Self-reported reading confidence and aid needed with medical reading material	Literacy correlated with tobacco use ($r= -0.142$, $p<0.05$)

Smedberg et al 2014	15 European countries	Three previously validated questions- by Chew et al and highest educational level	Low health literacy is associated with continued smoking during pregnancy (OR=1.49, 95% CI 1.08 to 2.06). Compared with having an education above high school level, having only a high school education (OR=2.53, 95% CI 2.05 to 3.11) or less than high school education (OR=3.64, 95% CI 2.58 to 5.14) is associated with smoking during pregnancy
Van der Heide et al 2014	Netherlands	Three previously validated questions- by Chew et al	The association with literacy and smoking was statistically non-significant (OR 0.99, 95% CI 0.81 to 1.22)
Daniel et al 2008	India	Educational level	Tobacco use was associated with illiteracy (OR=19.63, 95% CI 7.51 to 51.29), highest education being primary school (OR 8.09, 95% CI 3.33 to 19.62) or middle-high school (OR=4.13, 95% CI 1.87 to 9.13)
Garg et al 2012	India	Educational level	Current smoking was associated with illiteracy (OR 2.36, 95% CI 1.30 to 4.27) and with lower education (OR 2.07, 95% CI 1.27-3.38)
Sinalkar et al 2012	India	Educational level	Literacy was associated with tobacco use (OR 2.02, 95% CI 1.02 to 4.04)
Batista et al 2013	Brazil	Literate/illiterate	Compared to being literate, being illiterate is associated with being a current smoker (OR 1.66 95% CI 1.03-2.69)
John et al 2012	Cambodia	Literate/illiterate	Illiteracy was associated with smoking both in urban areas (OR 1.91, 95% CI 1.382 to 2.638) and rural areas (OR 1.54, 95% CI 1.335 to 1.770)

Illicit drug use

One study, undertaken in Switzerland, explored the association between literacy and cannabis use (Dermota et al., 2013). This study estimated literacy with self-

reports on the ease of understanding health information and asked men aged 17-26 years old if they smoked cannabis and the frequency of use. “Not at risk” cannabis use was deemed at being once a week or less, whereas “at risk” use was deemed at more than once a week. Low literacy was associated with being an at risk user (OR=1.15, 95% CI 1.04 to 1.27).

Table 3.9 Results of the studies investigating literacy with illicit drug use

Paper	Population	Measure of literacy	Results
Dermota et al 2013	Swedish men aged 17-26 years old	Ease of understanding health information	Compared with not using cannabis, health literacy was associated with being an at risk user (OR=1.15, 95% CI 1.04 to 1.27) but statistically non-significant for non-at risk users (OR 1.02, 95% CI 0.91 to 1.13).

Safe sexual practices

Two papers demonstrated that being illiterate was associated with no or inconsistent condom use (Dandona et al., 2005; Subramanian et al., 2008) (see Table 3.9). Both studies were conducted in the Indian sex trade, one study assessed the male clients of female sex workers and the other assessed female sex workers. In addition, one study conducted in rural Ethiopia with young women presented cross-tabulations and chi-squared information demonstrating a higher proportion of educated women use condoms and a higher proportion of illiterate women do not use condoms (Bogale et al., 2009).

Table 3.10- Results of studies investigating literacy with condom use in developing countries

Paper	Population	Measure of literacy	Results
Bogale et al 2009	Rural Ethiopia.	Educational level	Only descriptive data, no association statistics presented, Those with higher educational attainment were more likely to use condoms compare to those who were illiterate ($p<0.01$)
Dandona et al 2005	Female sex workers in India	Educational level	Illiteracy was associated with no or inconsistent condom use (OR 1.32, CI 95% 1.13 to 1.55)
Subramanian et al 2008	Male clients of female sex workers in India	Literate/illiterate	Illiteracy was associated with inconsistent condom use (OR 1.39 95%CI 1.14 to 1.69)

Discussion

Summary of results

The aim of this systematic review was to investigate whether there was an association between literacy and specified health behaviours. Overall this study has demonstrated inconsistencies in the evidence exploring the association between literacy and diet, exercise, alcohol consumption, and smoking. Only one study investigated drug use and literacy, and the findings showed a correlation between low literacy and smoking cannabis. This review highlights insufficiencies in the evidence examining drug use and literacy. A lack of research was also identified when investigating the association between literacy and condom use, particularly in developed countries and the general population in developing countries. Studies exploring the association between condom use and literacy found that illiteracy was related to inconsistent or no condom use. The overall inconsistencies and large amount of non-significant associations are surprising given the high level of evidence for the associations between literacy and morbidity and mortality (Berkman et al., 2011). Previous literature does not indicate that health behaviours are associated with literacy and so cannot conclude whether health behaviours are responsible for the increase in morbidity and mortality seen in low literate groups.

This review has found education and illiteracy to be correlated with certain health behaviours, particularly smoking. As described in Chapter 1 educational level can also be used as a marker for socioeconomic status and socioeconomic status has been linked to health and health behaviours. The Marmot Review, in England, demonstrated that those in lower socioeconomic groups are more likely to smoke, have alcohol dependence and be obese (The Marmot review, 2010). Consideration

needs to be given to the interaction between socioeconomic factors and education, particularly in developing countries where this relationship may be even more apparent. Where education or illiteracy was used as a proxy for literacy 11 of 12 studies found a significant association with lower literacy and unhealthy behaviour. Only two of these studies were from developed countries (Bolivar et al., 2010) and four adjusted for socioeconomic factors (Daniel et al., 2008; Bolivar et al., 2010; Garg et al., 2012). Interestingly Smedburg et al in addition to using educational level, also explored the relationship between smoking and literacy using the three validated questions from Chew et al. This study demonstrated that despite statistical adjustments, education was a stronger predictor of smoking during pregnancy than confidence in filling in forms. This study suggests that education encompasses more than the sole influence of literacy (or literacy as measured by Chew et al's proxy questions). In order to separate socioeconomic influences and literacy/education, adjustment for socioeconomic factors is paramount but not all studies included in this review made this adjustment. Interestingly, when comparing the results according to whether studies adjusted for socioeconomic factors or not, the significance of results do not differ. This may indicate literacy and socioeconomic status are so intertwined that even despite statistical adjustment they cannot be separated.

Of the 11 studies undertaken in developing countries five used educational level as a marker of literacy, five graded literacy as literate/illiterate and one used the TOFHLA; all but two found a significant association. It is not possible from this review to conclusively explain the differing significant associations found between developing and developed countries. One study from Iran used the TOFHLA and did not show significant associations which indicates it may be due to the proxies

used to estimate literacy (educational level and being illiterate or literate) rather than where the study was undertaken. The proportion of illiterate people in developing countries may be higher compared to developed countries if only a proportion of people can afford to have their children in school; so measuring literacy by self-reported ability to read and write and dichotomising in this way, is more appropriate than in developed countries; however to assess the true relationship with literacy there needs to be further research in developing countries using objective tools. The HLS-EU consortium conducted their study over eight different countries in Europe and despite the same methods being undertaken in each country inconsistencies were found between countries, suggesting that the associations between literacy and health behaviours may be multifactorial.

The reasons for and against undertaking health behaviours are complex and as previously described in Chapter 2 many external and internal factors influence behaviour such as living conditions, environmental conditions, cultural differences, social norms, self-efficacy and motivation (Conner & Norman, 2005). Some of these factors may differ between countries and so it may not be reasonable to generalise the results from one study to the worldwide population. For example in the UK public health campaigns have changed cultural perspectives and behaviours on smoking-many public places enforce a smoking ban and most people recognise that smoking is detrimental to health regardless of individual literacy level. Culturally this may not be the case in other countries and so literacy may be more important in these countries. In HLS-EU consortium 2012 between country variations were seen in the associations between literacy and smoking, drinking and exercising. Although all countries included in this study were developed there were still variations, signifying that the inconsistencies in results may be due to differing cultures.

The results of this systematic review are in keeping with an earlier systematic review which deemed that the evidence for the associations between health literacy and health promoting behaviours was either insufficient or mixed (Berkman et al., 2011). However this earlier review focused solely on health literacy (as measured with objective tools) in developed countries. In recent years a great deal of studies have been published in this field and by including other measures of literacy this review has analysed many more studies allowing an in-depth interpretation. To our knowledge this is the first systematic review investigating literacy and health behaviours in both developed and developing countries.

Strengths and limitations

Search strategy

A detailed and rigorous search was developed in conjunction with an expert in systematic reviews and performed over several electronic databases. Given the time scale and resources available the search was restricted to the English language which may have impacted on the number of papers found from non-English speaking countries. Education was used as a proxy measure for literacy but was not included in the search strategy. Education is frequently used to estimate socioeconomic status but socioeconomic status or similar terms were not included in the search strategy. To include socioeconomic status and education would have yielded too many results which would have been unmanageable given the resources available. However it is recognised that studies from the UK and developed countries may have explored education in relation to socioeconomic status and so

could have aided the interpretation and discussion of results surrounding the differing results of associations with literacy tools and education.

Through assessing references from key papers, four additional papers were obtained. Therefore it is reasonable to assume that the majority of relevant papers investigating literacy were found during the search. A number of studies, particularly PhD dissertations were unavailable despite contacting authors and supervisors directly and requesting from the British Library. Systematic reviews rely on published studies, which is a challenge when trying to eliminate publication bias. In order to combat under reporting of negative findings, experts in the field were contacted for unpublished material. Inclusion and exclusion criteria were developed at the beginning of the project to ensure the methods reflected the research question. A second reviewer assessed all excluded full texts and a 100% agreement was achieved.

Critical Appraisal

The critical appraisal framework was developed from a well-recognised and accepted method of critical appraisal. The framework was adapted in order to be specific and relevant to the research question. Two reviewers independently assessed the quality of all the papers and a high degree of agreement was achieved.

The research team deemed the majority of the studies included in this review to be good quality. There were two papers that fulfilled less than seven out of ten of the critical appraisal criteria. Mills et al demonstrated a higher literacy was associated with smoking, less fruit consumption but had no significant association with alcohol.

This was the only study to demonstrate a negative association between literacy and diet, and literacy and smoking but given the inconsistent results between studies this did not impact on the overall results. Mukhopadhyay and Sarkar (Mukhopadhyay & Sarkar, 2009) showed no association between literacy and fruit and vegetable consumption.

Data extraction

Where there was incomplete reporting, efforts were made to check the articles that were referenced and contact the authors directly. Data from the studies were extracted and compiled in a table, the table was examined by a second reviewer and additional data were inserted if necessary.

Results

Individual papers expressed literacy and outcomes differently which did not allow for exact comparisons. For example, this review examined papers using objective measurements for literacy and health literacy, but also self-reported educational level, highest qualification, self-reported tools of health literacy and dichotomising into literate and illiterate. In addition, outcomes were measured in a variety of ways such as diet expressed as nutrition scores or consumption of specific food groups. Despite there being significant overlap between methods of measuring literacy and health behaviours, exact comparisons cannot be made between studies which consequently reduces the strength of results; and it is for this reason a meta-analysis could not be performed.

Implications for research

This review has provided a platform for future research investigating literacy and health behaviours. There have been inconsistencies in the evidence presented for literacy and diet, exercise, alcohol consumption and smoking. Only one study was found investigating drug use and no studies from the general population investigated condom use. The lack of evidence for drug use and condom use may be due to the difficulties and logistics of investigating potentially sensitive and personal questions. Further evidence is needed in these research areas. There was a lack of evidence undertaken in developing countries using objective measures of literacy; future research should consider using objective measurements of literacy to assess the relationship further.

To ascertain if literacy is an independent factor associated with certain health behaviours or whether it is a marker of socioeconomic status is a challenging undertaking. A consideration may be for studies to use validated tools to measure socioeconomic status and develop statistical analyses where socioeconomic status can be accounted and adjusted for accordingly.

This review has provided a useful insight into the current available evidence assessing the associations between literacy and health behaviours. It can be concluded the evidence is predominantly inconsistent and more original research is needed. The review has found gaps in areas of research investigating literacy and condom use and illicit drug use. The following chapter will describe a secondary analysis which adds to the current body of evidence and aims to explore the association between literacy and health behaviours.

Chapter 4- Cross-sectional analysis

Overview

The results from the systematic review described in Chapter 3 have provided a platform for further research to explore the associations between literacy and drinking alcohol, smoking, diet, exercise, drugs use and condom use. The aim of this study was to add to the current evidence exploring the association between literacy and the previously specified health behaviours. As described in Chapter 1 there is considerable overlap between the terms health literacy and literacy. Throughout this chapter the term literacy will encompass both health literacy and literacy. When describing previous research it will be clarified whether the research undertaken explored literacy, health literacy or education.

This chapter examines secondary analysis of a previously conducted study “Healthy Foundations” which is described in more detail below. The role of the present research team was to develop the research question, aims and hypothesis. The author of this thesis designed the secondary analysis plan including selection of items from the questionnaire and demographics used in the adjusted analysis. Statistical analysis was performed by the author of this thesis. Reporting of study characteristics, results, and the author’s conclusions are original formulations.

The Healthy Foundations study

The authors of “The Healthy Foundations” reports (Department of Health, 2010a; Department of Health, 2010b) developed the survey, completed the interviews and reported prevalence estimates on segmentation of health attitudes and motivations.

Information on the methodology, questionnaire and response rates were extracted from the reports and are described in this section. Two databases were produced; one from respondents who were under 16 years of age (n=115) and another from respondents who were 16 years of age or over (n=4928). Available to the present research team was the database of the respondents 16 years old and over.

Study design

The Healthy Foundations study was a cross-sectional survey commissioned by the Department of Health throughout England in 2008 (Department of Health, 2010b). The purpose of this study was to identify attitudes and motivations towards health behaviours and subsequently subdivide the population into five segments to help inform future health promotion strategies. The primary aim of segmentation was to locate the greatest need in the population and identify approaches that could be applied to groups in the most disadvantaged and deprived segments. To give an over representation of deprivation, 42.9% (n=2161) of the sample was taken from the 10% most deprived areas in England. The remaining 57.1% (n= 2882) of the total sample were taken from a national sampling frame in England. After stratification by indices of multiple deprivation (IMD) (Noble et al., 2008), strategic health authority and population density, 166 and 255 sampling points were obtained from the nationally representative and the deprived sample respectively.

Within each sampling point, a random start point was selected, and every “nth” address thereafter was drawn. A total of 11,612 addresses were sampled and eligibility doorstep screening was undertaken. People were eligible if they were

between 12-74 years of age and consented to interview. Young people under the age of 18 years old required parental consent.

Interviews were conducted between March and June 2008. In an effort to maximise response rate, interviewers visited the house at varying times of the day a minimum of six times over a three-week period. If more than one person at the address was eligible, a person/household was selected at random using a Kish grid (Kish, 1949). A Kish grid is a method used to select people/households using a predetermined table. Each person is assigned a number and then the predetermined table is consulted as to which number (person) will be interviewed (Kish, 1949). In an effort to increase the number of interviews conducted with people from ethnic minorities, participants from the nationally representative sample were asked whether they knew the ethnic identity of the household at the next address listed, which was usually next door. The interviewer would attempt an interview at that address if the respondent said the household was from an ethnic minority group or stated that they did not know their ethnic background.

Response rate

From the nationally representative sample 6407 addresses were identified, 1141 were invalid for reasons such as vacant, demolished or no eligible respondents (see Table 4.1 for full details of the ineligible addresses). In addition, 4858 addresses were identified from the 10% most deprived areas in England, 956 addresses were ineligible for similar reasons as the nationally representative sample (Table 4.1). From all addresses identified, the overall proportion eligible was 80.4%. From the eligible households, 2161 interviews from the deprived areas and 2882 from the

nationally representative sample were completed (see Table 4.2). Once the target number of interviews was achieved no further interviews were completed. The total response rate from the eligible addresses was 55.0%.

Table 4.1- Sample from the addresses identified

	National representative sample (n=6407)	Sample from 10% most deprived areas (n=3902)
Valid addresses	5266 (82.2)	3,902 (80.3)
Ineligible addresses		
Vacant	202(3.2)	230 (4.7)
Derelict/demolished	31(0.5)	57 (1.2)
Non-residential	66(1.0)	72 (1.5)
Not found	36(0.6)	27 (0.6)
Unsure if occupied after 6+ calls	150(2.3)	186 (3.8)
No eligible respondent	656 (10.2)	384 (7.9)

Table 4.2-Response rates from the sample

	National representative sample (n=5266)	Sample from 10% most deprived areas (n=3902)
Completed interviews	2882 (54.7)	2161 (44.5)
Reasons for not completing an interview		
Too ill	50 (0.9)	45 (0.9)
Away during fieldwork	36 (0.7)	15 (0.3)
Refused before householder selection	814 (15.5)	459 (9.4)
Refused after householder selection	592 (11.2)	386 (7.9)
No parental permission for child interview	5 (0.1)	4 (0.1)
Office refusal	75 (1.4)	37 (0.8)
Occupier in but not answering door after 6+ calls	32 (0.5)	35(0.7)
Entry to block or scheme refused	5 (0.1)	23 (0.5)
Occupied but no contact with adult aged 18+ after 6+ calls	218 (4.1)	245 (5.0)
Some contact but screening questionnaire not completed after 6+ calls	363 (6.9)	282 (5.8)
Mother tongue required	30 (0.6)	34 (0.7)
Not needed, target reached	92 (1.7)	115 (2.4)
Other	72 (1.4)	61 (1.3)

Questionnaire summary of items

The survey took approximately an hour to complete and collected information on demographics, household income, employment status, motivational constructs, environmental factors, self-reported health behaviours, perceived health status and education.

Where possible questions were taken from previously validated tools such as the IMD and the Social Capital Question Bank. A number of items were modified to fit the purpose of the study.

Potentially sensitive questions comprising of items on smoking, drinking alcohol, drug taking and condom use were put in the same section of the questionnaire where a number of different interviewing techniques were offered. Participants were given a choice of questions being administered via computer assisted interviewing using a laptop, allowing the respondent to directly input their response privately; being asked questions via headphones with the respondent pressing numbers to privately indicate their answer; or continuing to answer questions with the interviewer present.

The secondary analysis of literacy and health behaviours

Aim

To explore if literacy is significantly associated with health behaviours. The health behaviours of interest include smoking, drinking alcohol, fruit and vegetable consumption, exercise, drug taking and condom use.

Hypothesis

It is hypothesised that having lower literacy levels is associated with unhealthy behaviours, specifically: drinking more than the recommended intake of alcohol, smoking, illicit drug use, infrequent or no condom use, low fruit and vegetable intake and a sedentary lifestyle.

Measurements

The questionnaire items used for the each variable can be seen in Appendix 4.1.

Literacy

For this analysis two questionnaire items could have been used to estimate literacy. One item reported highest educational achievement and one item asked “how confident do you feel reading written English?”. The possible responses for confidence in reading were: very confident, quite confident, not very confident or not confident at all. This question had not been previously validated as an effective and reliable proxy to estimate literacy level and the majority of the dataset (n=4655, 94.5%) reported they were either very confident or quite confident. It was decided

that this proxy measure should not be used in this study because it seemed unlikely that reliable and robust conclusions would be made from this item.

Rowlands et al 2014 (Rowlands et al., 2014), previously demonstrated that functional health literacy was significantly reduced if highest educational achievement was below level two on the English National Qualification Framework (NQF) (Qualifications and curriculum authority, 2006); providing evidence that low educational achievement can be used as a proxy for low literacy. The NQF stratifies qualifications into levels (one to eight) based on the literacy and numeracy skills required to achieve a qualification. Level two on the NQF is equivalent to five GCSE's at A*-C and is the expected achievement level for English school leavers. In 2008 (the year the survey was undertaken) the legal age a student could leave full time education in England was 15 or 16 years old providing they attended until the end of the school year (Gov.UK, 4th September 2014). Level two on the NQF was therefore deemed an appropriate threshold to dichotomise educational level. When participants were asked to report their highest educational achievement, if they were unsure which qualifications they had achieved a comprehensive list of qualifications were read out and the interviewer recorded the highest qualification from the response (the question and list of qualifications read out can be seen in Appendix 4.1).

The qualifications reported by respondents can be seen in Table 4.3 below. Using this method to dichotomise educational achievement, some respondents were excluded from the analysis because the level of qualification was unclear, this included people who responded with "other", "don't know", "no answer" or "not stated". City and Guilds and overseas qualifications are umbrella terms which have

different levels ranging from level one to level six on the NQF, consequently the level achieved was unclear and so these items were also excluded from the analysis. Educational achievement was used as a proxy for literacy therefore the results in this chapter will be reported in terms of literacy; below level two will be called low literacy and achieving level two or above will be called adequate literacy.

Table 4.3- Educational achievement categorized low and adequate literacy

Low Literacy (Below Level 2)	Adequate Literacy (Level 2 or above)	Excluded
<ul style="list-style-type: none"> - Any GCSEs/O levels, but fewer than 5 at grades A*-C - None/no educational qualifications 	<ul style="list-style-type: none"> - Doctorate/ Masters - First degree/ PGCE - Two or more A levels - Five or more GCSEs/O levels at grades A*-C or CSEs at grade 1 - Nursing qualifications - Teaching qualifications 	<ul style="list-style-type: none"> -City and Guilds -Overseas qualifications - Other - Don't know - No answer - Not stated

Alcohol

Alcohol consumption was estimated using two items assessing self-reports of how much alcohol was drunk in the last seven days (see Appendix 4.1). Units of alcohol were estimated to provide a weekly intake of alcohol.

In the UK, Government recommendations for alcohol consumption are up to 14 units/week for females and 21 units/week for males. A recent systematic review and meta-analysis (Castelnuovo et al., 2006) demonstrated that moderate amounts of alcohol consumption lead to reduced mortality. Reductions in mortality were demonstrated in females consuming up to 21 units/week and up to 34 units/week for males, increased mortality was seen above these levels. To identify those who

were drinking harmful levels of alcohol a “harmful drinking” category was included above these units. Alcohol was categorised into:

- No alcohol in the last 7 days,
- Alcohol intake recommended or less than recommended for gender in the last 7 days (1-14 units/week for females and 1-21 units/week for males),
- Alcohol intake more than recommended in the last 7 days for gender (15-21 units/week for females, 22-34 units/week for males),
- Harmful drinking (>21units/week for females, >34units/week for males).

Exercise

Weekly exercise duration was estimated using three items from the questionnaire exploring frequency and duration of exercise in a typical week (see Appendix 4.1 for full details of the items). The Department of Health recommends UK adults should do 150 minutes/week of exercise. Given the short and longer term benefits of exercise it is suggested that five 30 minute sessions of moderate intensity exercise is most beneficial (Department of Health, Physical Activity, Health Improvement and Protection, 2011). Exercise was categorised into the following:

- Less than 1 session of ≥ 30 mins/week
- 1-4sessions of ≥ 30 mins/week
- 5+ sessions of ≥ 30 mins/week

Smoking

Smoking status was assessed by asking current smoking status, the item taken from the questionnaire can be seen in Appendix 4.1. For the analysis smoking was dichotomised into current smoker or current non-smoker. Ex-smokers were included in the non-smoker category as it was felt that to become an ex-smoker, regardless of the time not smoked, a process of behaviour change had taken place.

Diet

The questionnaire explored fruit and vegetable consumption by asking how many portions of fruit and vegetables a person *usually* eats in a typical week and how much they *actually* ate yesterday. Reporting on fruit and vegetables usually eaten has more potential for reporting bias so the amount eaten yesterday was used for the analysis (see Appendix 4.1).

The World Health Organisation (WHO) recommends a daily minimum consumption of 400g of fruit and vegetables (Report of a Joint FAO/WHO Expert Consultation, 2003). As described in Chapter 2 the UK has adopted a “5 a day” health strategy and a dose-response relationship has been found. Although a recent study has shown mortality could be improved by eating up to 7+ portions of fruit and vegetables (Oyebode et al., 2014) the UK recommendations remain at 5 a day as there is not enough evidence to support increasing the recommendations up to 7 portions a day. In the present study fruit and vegetable consumption was categorised into:

- No fruit and vegetables eaten the previous day
- Less than recommended (1-4 portions) eaten the previous day
- Recommended or more (5+ portions) eaten the previous day

Drug use

The drug use item was taken from the British Crime Survey (MacDonald, 1999) and enquired about illicit drug use in the last 12 months (see Appendix 4.1). The aim of the study was to assess if literacy was associated with any illicit drug use and so this was dichotomised into:

- Taken illicit drugs in the last 12 months
- Not taken illicit drugs in the last 12 months.

Condom use

Questions on condom use were asked to participants aged 18-54. The questionnaire items can be seen in Appendix 4.1. In an effort to find guidelines on when condom use is appropriate multiple resources were assessed including The British Association for Sexual Health and HIV website (British Association for Sexual Health and HIV, 6th October 2014), the e-learning modules from the Diploma of the Faculty of Sexual & Reproductive Healthcare (DFSRH) (e-learning for healthcare,) and the NHS choices website (NHS Choices, 2013). No guidelines were found which specified when condoms should be used. Consequently, the research team (which included three General Practitioners, two of whom hold the DFSRH) used clinical judgment to decide if a reason for not using a condom was low or high risk

of contracting sexually transmitted disease. Respondents could choose all items on the list that applied to them; the possible answers were categorised into three groups (high risk, risk uncertain or low risk) which are shown below:

Low risk for STI contraction

- You are in a long-term relationship/have only one faithful partner
- You have not had sex in the past year

Risk uncertain

- You/your partner use a different type of contraception
- You are trying to get pregnant
- You are trying to get <a partner> pregnant
- You/your partner has been sterilized
- Your partner does not like using condoms
- Your partner refused
- You do not like using condoms
- No condoms were available
- No reason

No single response fell into the high risk category because other information on circumstances (such as being in a long term relationship) were needed before being categorised at high risk. If any of the options from the “risk uncertain” were selected but none of the lower risk items selected, the research team agreed there was higher

risk of sexually transmitted infections. Condom use was dichotomised into low or higher risk and included the responses below:

- Low risk- used condoms in the last year *or* did not use condoms but were low risk (i.e. not had sex in the last 12 months or were in a long term relationship/had one faithful partner)
- Higher risk- did not use condoms in the last year and did not have any of the lower risk factors (i.e. had unprotected sex but not in a long term relationship/had one faithful partner)

Analysis

In order to assess the association between literacy and each health behaviour, multinomial logistic regression was used. Multinomial regression is a form of logistic regression which can be used when the outcome has more than two categories; it has a number of assumptions, these can be viewed in Table 4.4 where the relevance of each assumption to this study is discussed. Binary logistic regression was used when there were only two categories in the outcome variable.

Table 4.4- Assumptions of multinomial logistic regression (Starkweather & Moske, 2011)

Multinomial logistic regression assumptions	Relevance in this study
<u>Independence of the dependent variable choices</u> <i>The odds of being in one category instead of another does not depend on the presence or absence of other alternatives</i>	The outcome variables are unrelated and do not affect the presence or absence of being in a category of another outcome variable.
<u>The data are case specific</u> <i>Each independent variable has a single value for each case</i>	Participants can only fall into one category for each variable.
<u>Multicollinearity</u> <i>The predictor variables should not be highly correlated</i>	There is only one predictor variable therefore there is no possibility of collinearity.
<u>Non-perfect separation</u> <i>The dependent variable cannot be perfectly predicted from the independent variable for any case</i>	The dependent variable (health behaviours) cannot be perfectly predicted by the independent variables (educational achievement). This is demonstrated in the cross-tabulation in the results section (Table 4.7).

A reference category was used for each variable and an Odds Ratio (OR) presented for a category comparative to the reference category for each variable. The OR is a relative measure of effect, which allows the comparison of a group with another group in the study. The reference category was the healthiest category for the question asked. For example, the reference category for smoking was non-smoker,

full details of the categories and reference category can be seen in Table 4.5. The reference category for education was adequate literacy (achieving level 2 or above on the NQF). 95% Confidence intervals (CI) were evaluated and results considered significant if the value of 1 was not contained within the confidence intervals.

Table 4.5- Outcome categories and reference category used

Outcome categories	Categories and Reference category
Alcohol consumption	None Recommended or less for gender More than recommended for gender but would not cause harm Harmful drinking (above 21 units/week for women and 35 units/week for men)
Exercise	No exercise Less than recommended (1-4 30min sessions/wk) Recommended or above (5x 30mins sessions)
Smoking	Current non-smoker Smoker
Diet	No fruit or vegetables yesterday Less than recommended fruit and vegetable consumption (1-4 portions) Recommended or more fruit and vegetable consumption yesterday (5+ portions)
Drug use	Yes No
Condom use	Low risk for STI (Used condoms in the last 12m or not used condoms but are either in a long term relationship or have not had intercourse in the last 12months) Have had sex in the last 12 months and didn't use condoms and are not in a long term relationship

The analysis was conducted in IBM SPSS version 22.0 (IBM corp, 2012).

Frequencies, means and standard deviations (SD) were calculated where applicable for each variable and demographics. Unadjusted associations between literacy and individual health behaviours were analysed and are presented. The associations were then analysed adjusting for age, gender, indices of multiple

deprivation (IMD) (Noble et al., 2008), national statistic socio-economic classification (NS-SEC) (Rose & Pevalin, 2005) and ethnicity.

IMD is a measure of deprivation of an area and includes measures of income, employment, health, disability, local skills, training, barriers to housing and services, crime and the local environment. The weighted scores are grouped into six groups, group six the most deprived and group one the least deprived (Noble et al., 2008). NS-SEC is a marker of socio-economic class using profession, ranging from high managerial professionals to never worked and long term unemployed (Rose & Pevalin, 2005). As described in Chapters 1 and 2, socioeconomic status, ethnicity and age is associated with either one or both health behaviours and literacy. In addition gender is also a recognised determinant of health. Given that these may be potential confounding factors they were adjusted for in the analysis. Both NS-SEC and IMD were measure in this study, it was felt that both measures assess socioeconomic status in different ways and so both were used in the adjusted model.

Results

Study Characteristics

The mean age of the sample was 44.7 years (SD= 16.4, range 16-74), 57.1% of the sample were female. As a result of directly selecting households in deprived areas, over half (n=2605, 52.9%) were in IMD group 5-6 (the most deprived groups). The majority of the sample were white British (n=4083, 82.9%) and 2102 (42.7%)

participants had low literacy (below level 2 national qualifications). Full details of the study characteristics and missing data can be seen in Table 4.6.

A minority of participants drank alcohol to a harmful level (n=544, 11.0%), had no fruit or vegetable the previous day (n=479, 9.7%) or had taken illicit drugs in the last year (n=478, 9.7%). A large proportion of the study group did not partake in regular exercise (n=2032, 41.2%) and nearly a third of the sample were smokers (n=1382, 28.0%).

From the questions analysed the most frequently unanswered items resulting in missing data were from potentially sensitive and personal questions relating to health behaviours. Questions regarding condom use had 41.6% (n=2050) missing data, although 83.4% (n=1709) of the missing data were because the question was not asked to them because they were either below 18 or above 54 years old (the data base used included those aged 16 and older). If respondents preferred not to answer, did not state a reason or selected "other reason" for not using condoms they were excluded from the analysis as it was unclear what their risk was, consequently n=166 (3.4%) were excluded for this reason. As a result 55.0% (n=2712) of the sample were analysed for condom use. Similarly there were a large amount of missing data (n=1322, 26.8%) for alcohol intake thus 72.8% (n=3587) of the sample could be included in the analysis for alcohol use.

Table 4.6- Study characteristics

	Frequencies(%) n=4928
<u>Age</u>	
16-34	1573 (31.9)
35-54	1766 (35.8)
55-74	1589 (32.2)
<u>Gender</u>	
Male	2111 (42.8)
Female	2814 (57.1)
Other	3 (0.1)
<u>IMD</u>	
1-2	1077 (21.9)
3-4	1246 (25.3)
5-6	2605 (52.9)
<u>Ethnicity</u>	
White British	4083 (82.9)
Not white British	845 (17.1)
<u>Highest educational attainment</u>	
Below level 2	2102 (42.7)
Level 2 or above	2643 (53.6)
Excluded	183 (3.7)
<u>Alcohol</u>	
Recommended or less for gender	1418 (28.8)
None	1237 (25.1)
More than recommended for gender	388 (7.9)
Harmful drinking (above 21 units/week for women and 35 units/week for men)	544 (11.0)
Missing	1322 (26.8)
Excluded (don't know/prefer to say)	19 (0.4)
<u>Exercise</u>	
No exercise	2032 (41.2)
Less than recommended(1-4 30min sessions/wk)	1348 (27.4)
Recommended or above (5x 30mins sessions)	1548 (31.4)
<u>Smoking status</u>	
Current non-smoker	3311 (67.2)
Smoker	1382 (28.0)
Excluded (don't know/prefer not to say)	137 (2.8)
Missing	98 (2.0)
<u>Fruit and vegetable intake</u>	
No fruit or vegetables yesterday	479 (9.7)
Less than recommended fruit or vegetables (1-4)	2665 (54.1)
Recommended or more fruit or vegetables yesterday (5+)	1779 (36.1)
Missing	5 (0.1)
<u>Condom use</u>	
Used condoms in the last 12m or not used but have a low risk reason	2146 (43.5)
Didn't use condoms in the last 12m and do not have a low risk reason	566 (11.5)
Excluded (prefer not to answer, other reason, not stated)	166 (3.4)
Missing	2050 (41.6)
<u>Illicit drug use</u>	
Yes	478 (9.7)
No	4378 (88.8)
Missing	72 (1.5)

Cross tabulation of results

Cross tabulation of the outcome variables and literacy can be seen in Table 4.7. A larger proportion of participants in the low literacy group had not had a drink in the last 7 days (40.0%) compared to 30.3% in the adequate literacy group. A similar proportion of the high and low literacy groups drank harmful amounts of alcohol, 16.6% and 13.6% respectively. A larger proportion of people in the low literacy group had not done any exercise in the last 7 days (48.8%) compared with 35.2% in the adequate literacy group. A lower proportion of participants in the low literacy group used condoms (54.7%) compared to 70.8% in the adequate literacy group. A lower proportion of participants in the low literacy group ate the recommended amount of fruit and vegetables in the preceding day (28.0%) compared to 42.7% in the adequate literacy group. A similar proportion of the high and low literacy groups had taken drugs in the last 12 months, 10.8% and 8.6% respectively

Table 4.7- Cross tabulation of literacy and outcome variables

	Low literacy	Adequate literacy
<u>Alcohol</u>		
Recommended or less for the gender	527 (37.1)	849 (41.2)
None	568 (40.0)	624 (30.3)
More than recommended for the gender	132 (9.3)	245 (11.9)
Harmful drinking (>21 units for females, >35 units for males)	193 (13.6)	341 (16.6)
<u>Exercise</u>		
No exercise	1025 (48.8)	930 (35.2)
Less than recommended(1-4 30min sessions/wk)	451 (21.5)	847 (32.0)
Recommended or above (5x 30mins sessions)	626 (29.8)	866 (32.8)
<u>Smoking status</u>		
Non-smoker	1238 (62.5)	1956 (76.8)
Smoker	742 (37.5)	591 (23.2)
<u>Fruit and vegetable intake</u>		
Recommended or more fruit and vegetables yesterday (5+)	587 (28.0)	1127 (42.7)
Less than recommended fruit or vegetables (1-4)	1216 (58.0)	1346 (50.9)
No fruit or veg yesterday	295 (14.1)	169 (6.4)
<u>Condom use</u>		
Used condoms in the last 12m or didn't but lower risk of STIs	641 (74.1)	1438 (81.6)
Didn't use condoms in the last 12m	224 (25.9)	325 (18.4)
<u>Illicit drug use</u>		
Yes	175 (8.6)	286 (10.8)
No	1871 (91.4)	2350 (89.2)

Multinomial logistic regression results

Health behaviours

Unadjusted and adjusted results are shown in Table 4.8. When comparing the results from the unadjusted and adjusted analysis, results were similar between the two analyses for smoking, fruit and vegetable intake, alcohol consumption and

condom use. In comparison to being a non-smoker, lower literacy was associated with being a current smoker (OR=1.77, 95% CI 1.52 to 2.07). Compared to eating the recommended or more than the recommended amount of fruit and vegetables the previous day, lower literacy was associated with eating less than the recommended amount of fruit and vegetables the previous day (OR= 1.82, 95% CI 1.57 to 2.11) and eating no fruit or vegetables the previous day (OR=3.37, 95% CI 2.67 to 4.31). Compared with drinking the recommended or less than the recommended amount of alcohol, lower literacy was associated with no alcohol in the preceding 7 days (OR=1.46, 95% CI 1.22 to 1.75). However compared with staying within the recommended limits of alcohol, lower literacy was not significantly associated with drinking more than recommended for gender or drinking harmful amounts. Compared with the group at lower risk of STI, low literacy was associated with more risky sexual practices as defined by not using condoms in the preceding 12 months (OR= 1.54, 95% CI 1.23 to 1.91).

Compared with taking the weekly recommended amount of exercise, lower literacy was associated with no exercise in the previous 7 days (OR=1.53, 95% CI 1.33 to 1.75) but being less likely to do less than the recommended amount of exercise (OR= 0.74, 95% CI 0.63 to 0.86). After adjustment, only the association between lower literacy and no exercise remained significant (OR=1.27, 95% CI 1.09 to 1.49).

Compared with not taking drugs, lower literacy was associated with less drug taking (OR=0.77, 95% CI 0.63 to 0.93). Following adjustments, the relationship between lower literacy and drug taking was non-significant.

Table 4.8- Multinomial regression for the association between lower literacy and health behaviours

Health behaviours	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Alcohol		
Recommended or less for the gender	1.0	1.0
None	1.47 (1.25 to 1.72)	1.46 (1.22 to 1.75)
More than recommended for the gender	0.87 (0.68 to 1.10)	0.89 (0.68 to 1.17)
Harmful drinking (>21 units for females, >35 units for males)	0.91 (0.74 to 1.12)	1.03 (0.81 to 1.30)
Exercise		
Recommended or above (5x 30mins sessions)	1.0	1.0
Less than recommended (1-4 30min sessions/wk)	0.74 (0.63 to 0.86)	0.88 (0.74 to 1.05)
No exercise	1.53 (1.33 to 1.75)	1.27 (1.09 to 1.49)
Smoking status		
Non-smoker	1.0	1.0
Smoker	1.98 (1.74 to 2.26)	1.77 (1.52 to 2.07)
Fruit and vegetable intake		
Recommended or more fruit or vegetables yesterday (5+)	1.0	1.0
Less than recommended fruit or vegetables (1-4)	1.74 (1.53 to 1.97)	1.82 (1.57 to 2.11)
No fruit or veg yesterday	3.35 (2.71 to 4.15)	3.37 (2.67 to 4.31)
Condom use		
Used condoms in the last 12m	1.0	1.0
Didn't use condoms in the last 12m in the absence of a low risk reason	1.55 (1.27 to 1.88)	1.54 (1.23 to 1.91)
Illicit drug use		
No	1.0	1.0
Yes	0.77 (0.63 to 0.93)	0.97 (0.77 to 1.22)

*Adjusted for age, gender, IMD, NS-SEC and ethnicity

Discussion

Summary of results

Health behaviours

This study has demonstrated an association between lower literacy level (as measured by low educational achievement) and smoking, not doing any exercise, eating little or no fruit and vegetables, more risky sexual practices (not using condoms when at risk of STIs) and not drinking alcohol.

The findings in the present study are consistent with previous findings exploring the associations between education and smoking, exercise and condom use. To the author's knowledge no studies have previously investigated the relationship between education and diet in the general English population. When assessing the determinants of a healthy diet, previous studies have found education to be the strongest determinant of a healthy diet among UK women aged 20-34 years old (Robinson et al., 2004) and among participants in Denmark (Groth et al., 2001). However previous results are inconsistent for the association between health literacy (when measured using objective tools) and all health behaviours investigated in this study. The variations in the results will be explored further in the next chapter. Prior to this study, research investigating the association between literacy and condom use has only been conducted in developing countries; to our knowledge this study is the first to show this correlation within the English general population.

Interestingly, the association between literacy and alcohol consumption was inconsistent depending on the category. Compared to the reference category

(drinking within the UK recommended limits), lower literacy was associated with drinking no alcohol. Baker et al (Baker et al., 2007) demonstrated that respondents with an “inadequate health literacy” score on the Test of Functional Health Literacy in Adults (TOFHLA) are more likely to be non-drinkers ($p < 0.01$), although further analysis and ORs were not presented in the paper. Wolf et al. (2007) used a similar analysis to the present study to assess the association with TOFHLA scores and alcohol consumption, but unlike the present study the results were statistically non-significant. Wolf et al chose no alcohol consumption as reference category; however, on changing the reference category to no alcohol in the last 7 days in the present analysis (see Appendix 4.2) the findings show that compared to drinking no alcohol, low literacy is associated with being less likely to drink the recommended amount of alcohol (OR=0.69, 95%CI 0.57 to 0.82), less likely to drink more than recommended (OR=0.61, 95% CI 0.46 to 0.80) and less likely to drink harmful amounts of alcohol (OR=0.70, 95% CI 0.55 to 0.89). These findings reiterate that in this study low literacy was associated with consuming less alcohol. A recent review of the evidence commissioned by the Organisation for Economic Cooperation and Development (OECD) also found that English people who are more educated are more likely to drink alcohol, binge drink and/or drink to a harmful amount compared to people who are less educated (Organisation for Economic Co-operation and Development, 2015). Seemingly in contrast to this, the Marmot review in 2010 (The Marmot review, 2010) reported that those in more deprived areas are more likely to have alcohol dependence. If the effects seen in education are due to it being a marker of socioeconomic status then the opposite associations would be expected. Monetary factors may also be part of the associations seen between education and health behaviours. If people earn more money they have more disposable income

so may drink alcohol more frequently, eat more (expensive) health foods, join gyms and take up hobbies requiring equipment. However when only considering economic factors it would be expected that lower income would be associated with being a non-smoker. In the Healthy Foundations analysis lower income (earning less than an annual income of £27, 000) was associated with smoking, eating less fruit and vegetables, being sedentary and drinking less alcohol (see Appendix 4.3). However when adjusting for income in the main analysis (Appendix 4.4) there is little effect on the results, suggesting deprivation, occupation, income and education are so intertwined they are difficult to separate and/or suggesting more nuanced cultural factors are also at play.

Despite there being a non-significant relationship between drug use and literacy level to our knowledge this is the first study in England to investigate this. One study conducted in Switzerland has previously found low literacy to be associated with using cannabis.

Strength and limitations

Study design

This extensive dataset commissioned by the Department of Health has a number of unique qualities. Not only does the survey include nearly 5000 participants throughout England but over-sampling from 10% of the most deprived areas and of ethnic minority groups provides a rich data source to explore the relationships between health behaviours and literacy in this dataset. Because of over-sampling in the most deprived areas (52.9% of the sample were in the most deprived areas of

England) the dataset is not representative of the general population. Addresses were selected at random using a Kish grid in order to minimise selection bias. The overall response rate from the total number of addresses issued was 55.0% which is lower than expected for face to face interviewing. There was no available data to the research team describing non-respondents and therefore unknown if potential bias has been introduced. Despite this, 57.1% were female and there were satisfactory proportions of participants in each age group (Table 4.6).

Measurements and Outcomes

The study was originally designed to inform health strategies by segmenting the population, and therefore was not specifically designed to answer the secondary analysis research question presented here. Self reported education was used as a proxy measure for literacy. As described previously in Chapter 2, education does have a correlation with literacy but it is a marker of literacy at a specific time point and becomes less relevant the longer ago the qualification was achieved. Using self reported education is a less desirable measure than validated tools and is a consequence of the study design not being specifically designed for this research question. Education can also be used as an indication of socioeconomic status because usually the higher the qualification the more likely an individual will go on to have a professional occupation. In order to reduce socioeconomic status being a confounder, the adjusted model included both IMD and NS-SEC.

The questionnaire items used to report health behaviours were comparable to similar items used in well-known studies such as the Health Survey for England and the British Crime Survey. Reporting bias is a concern for self-reported behaviours,

to minimise this, where possible the items analysed reported on specific time frames e.g. the number of fruit and vegetables ate yesterday, alcohol consumed in the last 7 days. Despite this, having measures that are self reported have the potential to introduce bias. Participants may recall events differently (recall bias) and may change their response depending on social acceptability. In order to truly measure and observe lifestyle behaviours elimination bias large amounts of resources would be needed, for most studies this is not feasible and therefore it is common practice for these behaviours to be self reported.

This dataset provides a unique opportunity to explore the association between educational achievement and sensitive information on condom and illicit drug use in the UK general population that to our knowledge has not been addressed previously in other research. Unfortunately, condom use was only assessed in participants aged 18-54 years old resulting in large amounts of missing data. Bias is a concern when large amounts of missing data are present such as with alcohol consumption, condom use and drug use. Participants may not have answered questions related to these topics due to preferring not to divulge personal and sensitive information. The implication of this is potential under reporting. As a consequence the results relating to condom use, alcohol consumption and drug use needs to take account of the large amounts of missing data. To try to reduce under-reporting bias participants were given the opportunity to answer sensitive questions in private.

Analysis

The analysis was performed in SPSS version 22.0 and adjusted for potential confounders i.e. age, gender, IMD, ethnicity and NS-SEC. Reference categories

were chosen carefully in order to address the research questions. Multinomial regression was used as there were multiple categories in the outcome measures. The analysis was a secondary analysis on a previously conducted data set. This gave the research team access to a large, useable data set which allowed meaningful results to be achieved within the limited timeframe and resources available. However, the original Health Foundations Study was not specifically designed to answer the secondary analysis research question presented here. This may have impacted on the focus of the study for example the secondary analysis would have been stronger if a validated tool had been used to measure or estimate literacy.

Conclusion

This study has demonstrated an association between low literacy (as measured by highest educational achievement) and not drinking alcohol, smoking, not exercising, eating less fruit and vegetables and not using condoms.

Education is an important factor in health and health behaviours. In England, there have been recent changes to the age a person can claim benefits and leave full time education; those born after 1997 must now stay in some form of education or training until 18 years of age. Not only will this have implications for the workplace but as demonstrated in this study, lower education is associated with unhealthy behaviours, therefore by increasing educational level public health and health

behaviours may improve as a consequence. It would be of interest to policy makers, researchers and public health consultants to investigate if this is true.

Whilst it must be remembered that education is a proxy measure for (health) literacy they do not represent exactly the same thing. Highest educational achievement is a qualification at a single time point, however literacy or health literacy is dynamic and can change over time. As described in Chapter 1, measurement of literacy and proxy measures do not correlate fully. Additionally education can also be a marker of socioeconomic status, however it is hoped that this is negated by adjusting for socioeconomic factors in the analysis.

This study has added to the body of health literacy and literacy research described in Chapters 1 and 3 and provided a platform for future studies. More evidence is required to assess the associations between literacy and health behaviours. Beyond associations, projects may wish to focus on causal relationships in follow-up studies which will strengthen current evidence. Additional research could focus on interventions to improve health literacy skills and measure changes in health behaviours which could ultimately aid policy makers in public health legislation. The final chapter of this thesis will summarise the main findings of this project and discuss important considerations when interpreting the results.

Chapter 5- Discussion and conclusion

Overview

The thesis began by describing the background of health literacy, literacy and health behaviours; a systematic review and a cross-sectional analysis have been presented with conclusions being drawn from the empirical studies individually. In this chapter the overall findings will be discussed. The chapter will begin by reviewing the aims of the thesis and summarising the results. The similarities and differences of the overall results will be explored in general and then for each behaviour in turn. The results in terms of the outcome variables and literacy will then be considered. Finally the thesis will be concluded with future implications for clinical practice, policy and research.

Aims of the thesis

Chapter 1 defined literacy and health literacy and explored observed associations between low literacy and health literacy. Low health literacy is associated with increased morbidity and mortality. It was hypothesised that this association is in part due to the association between literacy and health behaviours and that people with lower literacy skills would exhibit more unhealthy behaviours and thus have an increased morbidity and mortality. This thesis aimed to explore the association between literacy and health behaviours.

Summary of results

The systematic review

Overall the systematic review demonstrated inconsistencies in the evidence exploring the association between literacy and diet, exercise, alcohol consumption, and smoking. The review highlighted insufficiencies in the evidence for drug use and condom use; one study of drug use found that literacy was associated with cannabis use and studies investigating condom use found that low literacy was associated with no or inconsistent condom use. This review could not conclude that literacy is associated with health behaviours, and suggested further original research was needed.

The cross-sectional study

The cross-sectional analysis conducted in this thesis found an association between low literacy (as measured by highest educational achievement) and smoking, not exercising, eating less fruit and vegetables and not using condoms. The relationship between education and drinking alcohol was in the opposite expected direction with lower education being associated with not drinking alcohol. A non-significant relationship was found between literacy and use of illicit drugs in the previous 12 months. These results suggest that lower educational level is associated with four unhealthy behaviours (excluding alcohol and drug taking).

Comparison of the systematic review and cross-sectional study

Studies in the systematic review that used education as a marker of literacy found similar results to the cross-sectional study undertaken as part of this thesis - that lower education was significantly associated with an unhealthy behaviour. The systematic review included seven papers evaluating education and health behaviours: four papers found that lower education was associated with smoking (Daniel et al., 2008; Garg et al., 2012; Sinalkar et al., 2012; Smedberg et al., 2014); one paper demonstrated that lower education was associated with inconsistent condom use (Bogale et al., 2009); one paper showed that lower education was associated with sedentariness (Bolivar et al., 2010) and one paper found that lower education was associated with having drunk alcohol in the last 12 months (Kumar et al., 2013). The cross-sectional analysis conducted in this thesis adds to this research and supports that lower education is associated with smoking, not exercising, eating less fruit and vegetables and not using condoms. However the results from the present cross-sectional analysis and the paper from the systematic review investigating education and alcohol do have different results and this will be discussed in more detail below under the section “alcohol”.

When comparing the overall results of the systematic review, including papers that used objective tools (i.e. TOFHLA, REALM, NVS), self-reported measures of health literacy and dichotomised literacy, with the results of the cross-sectional analysis which used highest qualification, the results are inconsistent with many studies demonstrating non-significant associations. Whilst considering that these different proxies are three different constructs of literacy, it may not be surprising that they show different associations with health behaviours, although as they all represent

literacy it would be expected that results show some consistency. Many studies have found that those with lower educational qualification achievement tend to have lower literacy levels but the correlations are not strong (see Chapter 1) and so we cannot assume education and other measures of literacy represent the same constructs. The results of the systematic review may also be variable reflecting different methods and measures of health literacy and cultures of participants. Systematic reviews are a valuable aspect of research as they consolidate many studies and many thousands of participant data to answer a research question. However due to different methods of sampling, measuring literacy and analysing the data it can be difficult to make exact comparisons and so strong conclusions cannot always be made. Cross-sectional analyses present results from one data set and so the results are not as compelling as results of a systematic review but they have the value of providing empirical research where evidence is lacking. To fully understand the relationship between literacy, education and health behaviours more research is needed which can be compared to existing research. This is discussed further in the latter part of the chapter.

The individual health behaviours

Each health behaviour will be discussed below, comparing the results from the systematic review and cross-sectional study. Table 5.1 summarises the results of the systematic review and the cross-sectional analysis conducted in this thesis for each behaviour.

Diet

No papers from the systematic review assessed education and diet so exact comparisons cannot be made to the cross-sectional analysis conducted in this thesis; highlighting the important contribution of this cross-sectional study in providing evidence for this relationship. When assessing fruit and vegetable consumption the results from the systematic review were mixed, as were the results when assessing diet in general- half of the studies determined a non-significant association and half showed that literacy was associated with better diet quality. The cross-sectional analysis conducted in this thesis found that lower educational achievement was associated with lower fruit and vegetable consumption. There are several possible reasons for this finding. Health messages surrounding diet are numerous and complex stating for example that diets should be low in salt, sugar and fat; and high in fruit and vegetables. Conflicting information in health promotion may be that fruits contain sugar and some fats are good fats such as olive oil. In addition food labels can be misleading and confusing, as foods may be marketed as a health product but may actually be unhealthy in terms of the amount of fat, sugar or salt they contain. Given the complexity of information it was expected that literacy would play a fundamental role in dietary choices. However, as described in Chapter 1 and 2, health behaviours are multifactorial. Financial and cultural components may be important factors, which may undermine the process of critical evaluation of food choices. This may be demonstrated in the cross-sectional analysis conducted in this thesis as education is a marker of socio-economic status (SES) and as SES is itself associated with poorer diet, SES may be acting as a confounder.

Exercise

One study in the systematic review found that lower educational achievement was associated with sedentariness, which corroborates with the findings of the cross-sectional analysis conducted in this thesis. However, when considering the other papers in the systematic review, six studies used objective tools and found non-significant associations between literacy and exercise. In general exercise was classified and reported in similar ways and most studies were from developed countries. Exercise or physical exertion can be achieved in many different ways such as partaking in hobbies, as transport (cycling or walking) or in employment (manual jobs). Manual work was often not considered when exercise was investigated. Therefore if low education is associated with lower SES but a higher likelihood of work-related exercise, studies not including work-related exercise might under-report exercise in the lower education group so might give inflated associations between education and exercise level. Area-level deprivation might be expected to exert an effect through deprived areas tending to have less green spaces which has been shown to be associated with lower activity levels. In addition there may be financial barriers which prevent people taking up hobbies.

It is noticeable that there is a lack of research on exercise levels in developing countries. A possible reason for this could be because sedentariness may not be as much of a concern in developing countries as in developed countries; this may be due in part to the fact that people may be less reliant on cars for transport and spend less time watching TV and on computers.

Alcohol

As previously described in Chapter 4, alcohol is a complicated outcome variable to explore as there are different patterns of drinking which may be embedded within different cultures. For example some cultures prohibit drinking, Mediterranean cultures often drink frequent small amounts of alcohol with meals and other countries such as the UK have a culture of some people engaging in binge drinking socially. Additionally countries may have different national guidance on the recommended weekly amount of alcohol intake. Therefore it may not be appropriate to compare the results over different cultures or countries. One study in the systematic review (from India) (Kumar et al., 2013) assessed whether education was associated with harmful drinking using the AUDIT tool (an objective screening tool for harmful drinking patterns) and asked participants if they had drunk alcohol in the last year. There was no significant association between the AUDIT tool and education but lower education was associated with having consumed alcohol in the previous year. Nearly two thirds (60.7%) of those who had drunk alcohol in the last year were not at risk of harmful drinking. The cross-sectional analysis conducted in this thesis found that low education was associated with no alcohol consumption. However on changing the reference category to no alcohol lower education was associated with being less likely to drink any alcohol (Appendix 4.2) and being less likely to be a harmful drinker. Therefore the results of these two studies do not support each other's conclusions but do not contradict either because the classification of alcohol consumption is different, so they cannot be exactly compared. The remaining studies from the systematic review found weak associations between literacy and alcohol consumption (n=1) or non-significant results (n=4). However the present study supports a report which found that people

in managerial and professional occupations (those most likely to have obtained higher educational qualifications) were more likely to drink on five or more days out of a week and drink more than six/eight units on one occasion (Office for National Statistics, 2013).

The results in the cross-sectional analysis conducted in this thesis were slightly unexpected and demonstrate that lower education is associated with consuming less alcohol and not related to harmful drinking. There may be a financial explanation for the negative association between low literacy and harmful drinking in that, if budgets are strained, people may be less likely to spend money on non-essential items. In addition, health messages for alcohol can be conflicting because small regular amounts of alcohol are beneficial whilst higher levels are harmful, the volume of drink per unit of alcohol varies widely between different alcoholic drinks and recommended alcohol limits vary between sexes. It was expected that to fully understand and comply with the guidelines literacy and health literacy would be fundamental but it appears that the relationship is more complex and may include not only skills to understand healthy alcohol consumption messages but also reflects culture, social norms, finances, health motivation and beliefs.

Smoking

Four studies from the systematic review assessed the association between education and smoking; all results are consistent with the cross-sectional analysis conducted in this thesis which found that lower education was associated with smoking. However when assessing the overall results for smoking in the systematic review the results are inconsistent and mixed with most studies using objective

measures of skills finding a non-significant relationship. Smoking is slightly different than the other health behaviours such as diet and exercise as it contains nicotine which is a highly addictive substance and, although alcohol can also be addictive, unlike alcohol, any exposure to smoking is detrimental to health. Culture and socialisation may be fundamental in smoking initiation but factors aiding quitting may be different. Perhaps more informative analyses could be undertaken when exploring smoking with the focus being on initiation and quitting rather than dichotomising into current smokers and non-smokers (this is discussed in more detail in “implication” later in the chapter). The results seen in this thesis may demonstrate that education is a marker of deprivation whereas literacy is not such a strong marker of poverty. In the UK smoking is a very expensive habit and so when considering cost, it would be expected that lower educated groups would not smoke. Counteracting this is the hypothesis that if people initiate a smoking habit and then find themselves being unable to quit (due to addiction) then in this instance the addiction may undermine the financial consequences.

Condom use

In the systematic review the three studies examining condom use were conducted in the Indian sex trade or rural Ethiopia. They concluded that illiteracy was associated with inconsistent or no condom use. The systematic review did not find any papers from developed countries investigating condom use. The lack of research may be due to the stigmatisation and concern that condom use is a sensitive and personal topic which participants may find intrusive. However most people who were asked about condom use (those aged 18 to 54 years old) from the

cross-sectional analysis conducted in this thesis provided answers; this demonstrates that questions on condom use are well tolerated, at least in the UK. The results from the cross-sectional analysis conducted in this thesis support that lower education is associated with more risky sexual behaviour. However the studies found in the systematic review may not be generalisable to the UK population as they were conducted in the Indian sex trade and rural Ethiopia and so more studies are needed before firm conclusions are drawn.

Drug use

The cross-sectional analysis conducted in this thesis did not find a significant association between drug use and education in the adjusted analysis. This is in contrast to a paper in the systematic review which found that literacy was associated with cannabis use. The cross-sectional analysis conducted in this thesis addressed all types of illicit drug use in the last 12 months whilst the study included in the systematic review examined cannabis use only and estimated literacy using a self-reported tool so direct comparisons cannot be made. The inconsistencies suggest that more research is needed to make direct comparisons and form strong conclusions. The lack of evidence may be due to the stigma attached to drug use and so studies may need to be more complex to account for this. For example in the Healthy Foundations study the questionnaire was designed to allow people to answer these questions without the interviewer present so that these potentially sensitive questions could be answered in private. Given that most projects tend to have a finite amount of resources this could be a barrier to research teams undertaking such projects.

Table 5.1 -Summary of results of the empirical research in this thesis

	Systematic review	Cross-sectional analysis
Diet	Half of the studies (n=8) found a non-significant association and half showed that literacy was associated with better diet quality.	Lower educational achievement was associated with less fruit and vegetable consumption the previous day
Exercise	One study found that lower educational achievement was associated with sedentariness. Six studies used objective tools and found non-significant associations between literacy and exercise	Lower educational achievement was associated with not exercising the previous week
Alcohol	Half of the studies (n=4) did not show a significant association between literacy and alcohol intake. Two studies showed illiteracy was associated with alcohol use. Two studies presented cross-tabulation and chi-squared data showing a higher proportion of non-drinkers were seen in the lower literate groups.	Lower educational achievement was associated with not drinking alcohol in the previous week.
Smoking	Eight studies found low literacy (six studies estimated literacy using educational achievement) was associated with smoking. Nine studies found a non-significant association between literacy and smoking (eight of these studies used a tool to estimate literacy). Four studies found higher literacy was associated with smoker (two studies used objective measures and two used subjective measures of literacy)	Lower educational achievement was associated with smoking
Condom use	Two papers demonstrated that being illiterate was associated with no or inconsistent condom use. One study presented cross-tabulations and chi-squared information demonstrating a higher proportion of educated women used condoms	Lower educational achievement was associated with not using a condom (in the absence of low risk reasons)
Illicit drug use	One study found that low literacy was associated with being an at risk user of cannabis.	There was a non-significant association between lower educational achievement and not using drugs in the last year.

In summary, this section has discussed the results of the systematic review and compared the results to the cross-sectional analysis. Direct comparisons can be made to the cross-sectional analysis conducted in this thesis when developed countries have investigated education and health behaviours. However only two papers from the systematic review met these criteria (most papers using education as a marker for literacy were undertaken in developing countries) and both of the results (one examined literacy and smoking (Smedberg et al., 2014), the other literacy and exercise (Bolivar et al., 2010)) are consistent with the cross-sectional analysis. Whilst other comparisons can be made, one should be mindful that health behaviours are multifactorial and it may not be appropriate to make comparisons between different cultures because social norms, external barriers and socialisation will vary. On reviewing the results it is clear that education is associated with health behaviours but more research is needed to strengthen this conclusion, particularly in exploring the associations with diet, exercise, drug use, condom use and alcohol intake. The associations between literacy using objective and self-reported tools and health behaviours are inconsistent for all health behaviours explored.

Evaluation of the overall results

The strengths and limitations of the systematic review and cross-sectional analysis conducted in this thesis have been explored individually in the relevant chapters and so are not repeated again in this chapter. This section will discuss and appraise the entire thesis. The psychological components of health behaviours will be summarised in terms of stages of behaviour and then an evaluation of the results will follow whilst considering the complex nature of health behaviours. Finally the issues surrounding defining and classifying literacy will be discussed, and how this impacts on interpretation of the results will be explored.

Health behaviours

Lifestyle and behavioural choices are complex psychological processes. First the individual needs to have the environmental opportunity and socialisation to initiate the behaviour, then they need to make many conscious decisions to do the behaviour many times over before it becomes a habit (i.e. an unconscious act). Exposure to many health behaviours begins early in life as children or young adults and many behaviours are learnt from being exposed to parental and peer behaviour. For example a child of a parental smoker is more likely to smoke than a child of a parent who doesn't smoke (Gilman et al., 2009). Therefore initiation of behaviours in early life may be more strongly linked to socialisation, culture and the environment. Socialisation has been attributed to being one of the causative factors in health inequalities between socioeconomic groups. It is suggested that it

predisposes to a specific way of thinking, feeling and behaving (Eckersley, 2006) and so is particularly important in the passing down of behaviours.

Once an individual has acquired a health behaviour there may be times when the behaviour changes. Successful lifestyle behaviour change requires frequent and sustained choices rather than one off decisions and is dependent on factors such as risk perception, self-efficacy, self-motivation, environmental factors and social norms. Internal factors such as risk perception, self-efficacy and self-motivation are potentially modifiable. When evaluating the systematic review and the cross-sectional analysis in terms of internal modifiable factors, no study (including the present study) included or controlled for these. It may be that there are difficulties measuring certain factors or as in the present study, the analysis is part of a secondary analysis and so the study questionnaire is not specifically designed for the research question. Whilst considering the psychological models described in Chapter 2, it appears that health literacy is an overarching factor of the models and may affect many of the components. Take for instance the Health Belief Model, perceived susceptibility, severity benefits and barriers may be effected by literacy. Similarly health literacy may affect the threat appraisal in the Protection Motivation Theory. This is also hypothesised by Berkman (Berkman et al., 2011) and Paasche-Orlow and Wolf (Paasche-Orlow & Wolf, 2007) (Chapter 1 pages 36-37) that literacy may influence risk perception, self-efficacy, motivation, knowledge and communication and thus indirectly influence health behaviours. However in this thesis we have not found consistent evidence which supports these hypothesised health literacy models in lifestyle health behaviours. The lack of strong evidence may be that all research in this thesis was from cross-sectional analyses (a snap shot in time) but behaviour is a dynamic, changeable process. For example when

looking at smoking in a cross-sectional analysis we look at smoking versus not smoking, and the non-smoker group includes those who have never smoked and those who have quit. The process of behaviour change is therefore not taken into account i.e. those who have stopped smoking have initiated and maintained a change whereas a lifelong never smoker will not need to exhibit psychological processes to change behaviour. For all of the health behaviours this needs to be a consideration. In the cross-sectional analysis conducted in this thesis, the smoking categories were considered but it was felt ex-smokers should be included as non-smokers because they had undergone a process of behaviour change. It may have been useful to exclude never smokers from the analysis to understand if education became more strongly associated with continued smoking. But this may have biased the results because excluding never smokers may have excluded a higher proportion of the adequate education group.

Perhaps literacy is less important when behaviours are initiated in early life but more important for initiating and maintaining behaviour change and hence the reason we found mixed, inconsistent results in the studies from the systematic review. The associations between education and health behaviours have shown significant results which may be due to the effect of SES rather than the sole influence of literacy; education level is a proxy for literacy and health literacy and becomes less relevant the longer ago the last contact with education and may be influenced by post-formal education experiences such as type of work and lifelong learning. Future studies may wish to focus on the association between current literacy and behaviour change rather than a cross-sectional snap shot in time such as investigating characteristics of people who successfully stop smoking. However the role of

literacy in health behaviours may be equally as complex as the psychological principles.

Intervention studies have shown that different interventions vary in success for different behaviours (Jepson et al., 2010) suggesting that different processes occur to maintain and change the various behaviours investigated in this thesis. For example smoking is discrete (current smoker or non-smoker) and any exposure is detrimental to health, but to have a healthy diet is not so clear cut, as there are many different factors involved in a healthy diet such as fruit and vegetable intake, fat intake, salt intake and calorific content, and there may be varying national and cultural opinions as to what constitutes a healthy diet. However it is hypothesised that literacy indirectly influences health behaviours by effecting knowledge, motivation, self-efficacy and risk perception. Therefore it was deemed appropriate that we explored all health behaviours and literacy in similar ways.

Some health behaviours, such as alcohol consumption, dietary choices, exercise and contraception, are influenced by lifestyle and culture. Different cultures may occur both between countries and within countries through religious beliefs or different SES groups (Eckersley, 2006). With this in mind, it may not be appropriate to compare studies investigating health behaviours between different countries, particularly between countries that have great variations in their culture. However, the number of studies conducted in the UK are limited - the systematic review included only two studies from the UK which investigated literacy and health behaviours (one investigated fruit and vegetable consumption, exercise and smoking (von Wagner et al., 2007) and the other smoking in pregnancy (Smedberg et al., 2014)); but only one study presented the results solely for the UK. This study

found that literacy was associated with fruit and vegetable consumption (OR1.02, 95% CI 1.00 to 1.03) and not with smoking (OR 1.02, 95% CI 1.00 to 1.03), and non-significant associations were seen between literacy and exercise (von Wagner et al., 2007). Only having one UK study to compare our results highlights the valuable contribution of this thesis.

Literacy

On initial planning of the project the primary focus was to investigate the relationship between health literacy and health behaviours as most health research focused on health literacy. However on reviewing definitions of health literacy it was felt that health literacy and literacy were closely linked and, at a fundamental level, represented similar skills, it therefore seemed appropriate to investigate both health literacy and literacy. Health behaviours are everyday lifestyle choices, and although they are related to health they are not carried out in a health environment and so to only explore health literacy may have excluded relevant research in the systematic review. The challenge was then to define both terms and there have been many definitions and classifications of the terms (as described in Chapter 1). The recent World Health Organization (WHO) definition of health literacy “the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health” (Greenhalgh, 2015) is a welcome addition. The WHO definition is unique because it shares the responsibility between societal resources as well as the individual. However this has not been measured in any of the research included in this thesis and may be challenging for future projects. Investigating both health

literacy and literacy was complicated because there are many measures and ways of classifying them. There are objective measures of literacy and health literacy but some argue that the measures are inadequate at providing useful information on functional ability (Baker, 2006). Furthermore in the cross-sectional analysis conducted in this thesis education was used as a proxy measure of literacy which may have made the results more complicated because education is a marker of SES. As discussed earlier, the relevance of an individual's education level can decrease the further away in time the individual is from their formal education, and may not adequately represent current literacy levels. It was unfortunate that the question in the Healthy Foundations questionnaire "how confident do you feel reading written English?" was not previously validated and could not provide meaningful groups of functional literacy ability, as this item could have better reflected current literacy skills. The systematic review demonstrates that the results are different when comparing education and literacy measured objectively thus confirming that education does not represent the same thing as literacy alone.

In a cross-sectional representation (as in the included research in the systematic review and in the study described in Chapter 4) only associations can be drawn. This can be problematic when interpreting the results as literacy, education and occupation are closely linked and all interact with each other. Having higher educational achievement tends to infer higher literacy skills which in general lead to more professional occupations and in turn an occupation requiring regular and frequent literacy skills which may help maintain literacy levels. This may be why low literacy disproportionately affects people in deprived areas living in poverty. In the adjusted cross-sectional analysis Indices of Multiple Deprivation (IMD) and National Statistic Socio-Economic Classification (NS-SEC) were adjusted for but did not

greatly change the OR from the unadjusted analysis. This suggests that, despite statistical adjustments, deprivation, occupation and education are so intertwined they are difficult to separate. Alternatively it may suggest that these variables are not confounders. It is not, therefore, possible to conclude whether the associations seen are due to education being a marker of SES or due to literacy.

Implications

Practical implications

Public health and health promotion, particularly focusing on health behaviours, are becoming increasingly important with the growing burden of long term conditions, for example obesity and diabetes. This project aimed to discover if literacy and health literacy were associated with health behaviours in order to find a modifiable factor that could aid health behaviour change. It was found that low education is associated with unhealthy behaviours (excluding drug and alcohol use) but it is not possible to form conclusions for literacy or health literacy alone.

Low education is an important marker for unhealthy behaviours, multi-morbidity and mortality and thus health inequalities. The Royal Collage of General Practitioners (RCGP) recently identified six strategies for reducing health inequalities, of which one was for General Practitioners (GPs) to take a proactive and preventative approach, rather than a reactive approach to health (Baker et al., 2015). A simple way to do this may be for GP surgeries to collect data on highest educational achievement from all patients registered and use this as a marker to highlight those which may be at risk for health inequalities. In clinical practice highest educational achievement is an easily available demographic and unlike literacy measures does not require individual testing or a trained individual to collect data. By using this information on educational level, resources and health professionals can be directed to the most at risk for having unhealthy behaviours, increased morbidity and mortality. Knowing about highest educational achievement may also be useful when providing appointments to patients; those with low or no educational qualifications may benefit from longer appointments for individualised and extended discussions

surrounding their health or for public health screening for health behaviours, cervical smears and vaccination uptake. Within clinical practice this may improve the quality of care and health of patients with lower literacy. It must be remembered, however, that, as previously discussed, education level is not a perfect predictor for literacy or health literacy and so collecting highest educational level for this purpose would highlight people who may be at higher risk of high levels of morbidity and mortality rather than using educational level as a proxy for literacy or health literacy. However this is based on the stipulation that there are enough resources to provide longer appointments and additional services, and in the current environment where primary care services are under resourced in the UK this may not be immediately achievable.

Policy implications

Targeting health behaviours at a public health level is challenging because there are so many different factors to consider, and sustained and repetitive action from the individual is required to achieve a healthy lifestyle. Deciding how and what to target in public policy is not an easy decision particularly in the absence of consistent, strong evidence. Buck (Buck & Frosini, 2012) demonstrated that despite UK public health campaigns the least educated were the most resistant to change, and a systematic review commissioned by NICE to find the most successful interventions for behaviour change found that most interventions had small, modest and mostly short term benefits (Jepson et al., 2010). The systematic review concluded that the evidence is mixed in assessing the associations between literacy and health behaviours but there appears to be more evidence supporting the

association between education and health behaviours. Future policies may need to target education and perhaps life skills, including skills required to successfully manage one's health. In 1999 the WHO produced a report recommending "skills for life" were taught in all schools (Department of Mental Health, World Health Organization, 1999). The report specified that life skills should enable children and adolescents to make healthy choices and carry out healthy behaviours throughout their lives. Whilst it is recognised that life skills are open to wide interpretation, they encompass interpersonal, personal, social, cognitive and affective skills to function successfully (Department for Education, 2/12/14). Life skills could be considered to include those broadly similar to the WHO definition of health literacy (the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health). Furthermore life skills are important for health promotion and development, primary prevention of disease and disability, socialisation, and preparing children for changing social circumstances. Life skills education can be integrated into existing school subjects or as a separate subject. Despite this, life skills are not in the mandatory curriculum in English schools (Department for Education, 2/12/14). However in 2001 the English government launched the "Skills for Life" program in an effort to improve the numeracy and literacy skills in the adult working population, offering adults without a level two qualification on the NQF free literacy and numeracy training. As described in Chapter 1, the literacy skills of adults in England improved from 2003 to 2011, but the proportion in the lowest literacy group increased (Department for Business Innovation and Skills, 2011). For people who are unemployed free education is available for those claiming job seekers allowance. The Skills for Life and free education for the unemployed require the

individual to actively enroll and attend in addition to their preexisting life commitments. The most in need of this education (the lowest literate groups) may be the individuals who did not enjoy or engage well with the education system and so may have low self-efficacy for education. This may result in them being less motivated and disempowered to actively seek enrolment on these courses, and so this approach may fail to engage the groups who are most in need. Perhaps policy makers should focus on how best to incorporate life skills (and health literacy) within the existing school curriculum, and focus on providing extra support and investment for all to achieve level two on the NQF whilst in school. This will improve literacy from a young age, may negate the skills for life courses in adulthood and ensure adequate literacy skills for all. However educational achievement is not solely influenced by school resources; factors such as the family background, local communities and peer relationships are important determinants. The evidence suggests the single most important factor in educational achievement is family (The Marmot review, 2010) and so future policies should approach educational inequalities with a more integrated approach improving family links between education and the local community (The Marmot review, 2010).

Research implications

In England the guidance on age leaving education changed in 2015; students can leave school when 16 years old but then must be in full time education, training or apprenticeships, or work 20 hours or more a week whilst in part-time education or training; and they cannot claim unemployment benefit before 18 years of age. The age students can leave education in Scotland and Wales has remained the same at

16 years old. This change in England may have been to improve the economy but this could also be an important step for health behaviours and health outcomes. This is a good opportunity for future research to assess whether literacy and health improves as a result of increasing the age of compulsory education in England whilst being able to compare the results to similar cultures in Scotland and Wales where the school leaving age is 16 years old. However it is recognised that increasing the school leaving age does not necessarily translate into higher qualifications and if the content of education does not incorporate life skills this may be a missed opportunity.

More UK based studies are required to investigate the role literacy and health literacy have in health behaviours; this could in turn influence public health policy. It would be beneficial for studies to investigate education alongside measures of health literacy and/or literacy so comparisons can continue to be made between the results. In measuring and defining literacy and health literacy there needs to be a universally accepted measure and definition so studies can be easily compared.

Whilst considering future research, it may be of value to investigate behaviour *change* rather than exploring cross-sectional relationships, for example comparing likelihood of quitting smoking by assessing ex-smokers and current smokers. Observational cohort or intervention studies investigating behaviour change would provide a greater understanding of the role education and literacy play in changing health behaviours. This may include, for example, an observational cohort assessing those wishing to change certain health behaviours for example smoking cessation or weight management groups. Baseline health literacy could be measured to observe if there is a correlation between successful behaviour change.

Conclusion

This thesis has explored the associations between literacy, health literacy and health behaviours. The evidence is that lower education is associated with smoking, not exercising, eating less fruit and vegetables and not using condoms; however more research is needed to strengthen this conclusion. The association between education and drinking alcohol was the opposite to the expected direction in the cross-sectional analysis conducted in this thesis, with lower education being associated with not drinking alcohol. More research is needed to establish the true relationship between alcohol and education. The evidence is inconsistent when considering the associations between health literacy and literacy (when investigated with objective tools) and health behaviours, and so more research is needed.

This thesis adds to the body of literature on health literacy and may aid health and education policies in England. The lack of evidence investigating drug use and condom use, and the lack of UK based studies in the systematic review highlights the important contribution of the findings from the cross-sectional analysis conducted in this thesis.

References

- Abraham, C. & Sheeran, P. 2005, "The health belief model" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 28-43.
- Ad Hoc committee on health literacy for the council on scientific affairs, American Medical Association 1999, "Health literacy. Report of the council on scientific affairs", *Journal of the American Medical Association*, vol. 281, no. 6, pp. 552-557.
- Adams, R.J., Piantadosi, C., Ettridge, K., Miller, C., Wilson, C., Tucker, G. & Hill, C.L. 2013, "Functional health literacy mediates the relationship between socioeconomic status, perceptions and lifestyle behaviors related to cancer risk in an Australian population.", *Patient Education and Counseling*, vol. 91, no. 2, pp. 206-212.
- Adler, N. & Newman, K. 2002, "Socioeconomic disparities in health: pathways and policies", *Health Affairs*, vol. 21, no. 2, pp. 60-76.
- Aghaizu, A., Brown, A., Nardone, A., Gill, O., Delpech, V. & Contributors. 2013, "HIV in the United Kingdom 2013 report: data to end 2012 ", *Public Health England, London*, .
- Aller, E., Abete, I., Astrup, A., Martinez, A. & van Baak, M. 2011, "Starches, Sugars and Obesity", *Nutrients*, vol. 3, pp. 341-369.
- Arnold, C.L., Davis, T.C., Berkel, H.J., Jackson, R.H., Nandy, I. & London, S. 2001, "Smoking status, reading level and knowledge of tobacco effects among low-income pregnant women.", *Preventive Medicine: An International Journal Devoted to Practice and Theory*, vol. 32, no. 4, pp. 313-320.
- Bains, S.S. & Egede, L.E. 2011, "Associations between health literacy, diabetes knowledge, self-care behaviors, and glycemic control in a low income population with type 2 diabetes.", *Diabetes Technology & Therapeutics*, vol. 13, no. 3, pp. 335-341.
- Baker, D. 2006, "The meaning and the measure of health literacy", *Journal of General Internal Medicine*, vol. 21, pp. 878-883.
- Baker, D., Wolf, M., Feinglass, J., Thompson, J., Gazmararian, J. & Huang, J. 2007, "Health literacy and mortality among elderly persons", *Archives of Internal Medicine*, vol. 167, no. 14, pp. 1503-1509.
- Baker, M., Mawby, R. & Ware, J. 2015, *Health Inequalities*, Royal College of General Practitioners, London.
- Ball, K., Jeffery, R., Abbott, G., McNaughton, S. & Crawford, D. 2010, "Is healthy behavior contagious: associations of social norms with physical activity and healthy eating", *International Journal of Behavioral Nutrition and Physical*

Activity, [Online], vol. 7, no. 86. Available from:
<http://www.ijbnpa.org/content/7/1/86>.

- Bandura A 1977, "Self-efficacy: toward a unifying theory of behavioural change", *Psychological Review*, vol. 84, no. 2, pp. 191-215.
- Batista, J., Militao de Albuquerque Mde, F., Ximenes, R.A., Miranda-Filho Dde, B., Lacerda de Melo, H.R., Maruza, M., Moura, L.V., Pinto da Costa Ferraz, E.J. & Rodrigues, L.C. 2013, "Prevalence and socioeconomic factors associated with smoking in people living with HIV by sex, in Recife, Brazil", *Brazilian Journal of Epidemiology*, vol. 16, no. 2, pp. 432-443.
- Bellows-Riecken, K. 2013, "Reading into physical activity: Exploring relationships between health literacy and physical activity in the community.", *Dissertation Abstracts International Section A: Humanities and Social Sciences*, vol. 74(1-A).
- Benzeval, M., Bond, L., Campbell, M., Egan, M., Lorenc, T., Petticrew, M. & Popham, F. 2014, *How does money influence health?*, Joseph Rowtree Foundation, MRC/CSO Social and Public Health Sciences Unit 2014, York, UK.
- Berkman, N., DeWalt, D., Pignone, M., Sheridan, S., Lohr, K., Lux, L., Sutton, S., Swinson, T. & Bonito, A. 2004, *Literacy and Health Outcomes. Evidence Report/Technology Assessment. Report 87*.
- Berkman, N., Sheridan, S., Donahue, K., Halpern, D., Viera, A., Crotty, K., Holland, A., Brasure, M., Lohr, K., Harden, E., Tant, E., Wallace, I. & Viswanathan, M. 2011, *Health literacy interventions and outcomes: an updated systematic review. Evidence Report/Technology Assessment No.199*.
- Bodicoat, D., Carter, P., Comber, A., Edwardson, C., Gray, L., Hill, S., Webb, D., Yates, T., Davies, M. & Khunti, K. 2014, "Is the number of fast-food outlets in the neighbourhood related to screen-detected type 2 diabetes mellitus and associated risk factors?", *Public Health Nutrition*, vol. 18, no. 9, pp. 1698-1705.
- Bogale, G.W., Boer, H. & Seydel, E.R. 2009, "HIV-prevention knowledge among illiterate and low-literate women in rural Amhara, Ethiopia.", *African Journal of AIDS Research*, vol. 8, no. 3, pp. 349-357.
- Bolivar, J., Daponte, A., Rodriguez, M. & Sanchez, J.J. 2010, "The influence of individual, social and physical environment factors on physical activity in the adult population in Andalusia, Spain.", *International Journal of Environmental Research & Public Health [Electronic Resource]*, vol. 7, no. 1, pp. 60-77.
- Bormuth, J.R. 1967, "Cloze readability procedure.", CSEIP Occasional Report no. 1, University of California, Los Angeles.

- Bostock, S. & Steptoe, A. 2012, "Association between low functional health literacy and mortality in older adults: longitudinal cohort study.", *British Medical Journal*, vol. 344, no. <http://dx.doi.org/10.1136/bmj.e1602>.
- Boudard, E. & Jones, S. 2003, "The IALS approach to defining and measuring literacy skills", *International Journal of Education and Research*, vol. 39, pp. 191-204.
- Brega, A.G., Ang, A., Vega, W., Jiang, L., Beals, J., Mitchell, C.M., Moore, K., Manson, S.M., Acton, K.J. & Roubideaux, Y. 2012, "Mechanisms underlying the relationship between health literacy and glycemic control in American Indians and Alaska Natives.", *Patient Education & Counseling*, vol. 88, no. 1, pp. 61-68.
- British Association for Sexual Health and HIV 6th October 2014, , *BASHH Clinical Effectiveness Group Guidelines*. Available: <http://www.bashh.org/BASHH/Guidelines/Guidelines/BASHH/Guidelines/Guidelines.aspx> [2014, 10th October].
- Buck, D. & Frosini, F. 2012, *Clustering of unhealthy behaviours over time. Implications for policy and practice. The Kings Fund Report*.
- Burnett, N., Packer, S., Bella, N., Benavot, A., Buchert, L., Caillaud, F., Cavicchioni, V., Djioze, V., Font-Giner, A., Fransman, J., Guttman, C., Hinchliffe, K., Leclercq, F., Nsengimana, D., Nzomini, B., Barry, U., Phillips, M., Suzuki, I., Yahil, E., Kennedy, A. & Lind, A. 2005, "Chapter 6. Understandings of literacy" in *Education for all global monitoring report 2006* United Nations Educational, Scientific and Cultural Organization, France, pp. 147-159.
- Castelnuovo, A., Costanzo, S., Bagnardi, V., Donati, M., Iacoviello, L. & de Gaetano, G. 2006, "Alcohol dosing and total mortality in men and women: an updated meta-analysis of 34 prospective studies", *Archives of Internal Medicine*, , no. 166, pp. 2437-2445.
- Cha, E., Kim, K.H., Lerner, H.M., Dawkins, C.R., Bello, M.K., Umpierrez, G. & Dunbar, S.B. 2014, "Health literacy, self-efficacy, food label use, and diet in young adults", *American Journal of Health Behavior*, vol. 38, no. 3, pp. 331-339.
- Chan, A. & Giovannucci, E. 2010, "Primary Prevention of Colorectal Cancer", *Gastroenterology*, vol. 138, no. 6, pp. 2029-2043.
- Chang, L.C. 2011, "Health literacy, self-reported status and health promoting behaviours for adolescents in Taiwan.", *Journal of Clinical Nursing*, vol. 20, no. 1-2, pp. 190-196.
- Chew, L., Bradley, K. & Boyko, E. 2004, "Brief questions to identify patients with inadequate health literacy.", *Family Medicine*, vol. 36, no. 8, pp. 588-594.

- Chew, L., Griffin, J., Partin, M., Noorbaloochi, S., Grill, J., Snyder, A., Bradley, K., Nugent, S., Baines, A. & VanRyn, M. 2008, "Validation of screening questions for limited health literacy in a large VA outpatient population", *Journal of General Internal Medicine*, vol. 23, no. 5, pp. 561-566.
- Chimbindi, N., McGrath, N., Herbst, K., Tint, K. & Newell, M. 2010, "Socio-demographic determinants of condom use among sexually active young adults in rural KwaZulu-Natal, South Africa", *The Open AIDS Journal*, vol. 4, pp. 88-95.
- Committee on Diet and Health, National Research Council 1989, *Diet and health: implications for reducing chronic disease risk*, National Academies Press, Washington D.C.
- Committee on health literacy board on neuroscience and behavioral health. 2004, "Health literacy. A prescription to end confusion.", *Institute of Medicine of The National Academies*, .
- Conner, M. & Norman, P. 2005, *Predicting health behaviour*, 2nd edn, Open University Press, Berkshire, England.
- Conner, M. & Sparks, P. 2005, "Theory of planned behaviour and health behaviour" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 170-222.
- Dandona, R., Dandona, L., Gutierrez, J.P., Kumar, A.G., McPherson, S., Samuels, F., Bertozzi, S.M. & ASCI FPP Study, T. 2005, "High risk of HIV in non-brothel based female sex workers in India.", *BioMed Central Public Health*, [Online], vol. 5, , pp. 87. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208909/>. [20050915].
- Daniel, J., Hickman, M., Macleod, J., Wiles, N., Lingford-Hughes, A., Farrell, M., Araya, R., Skapinakis, P., Haynes, J. & Lewis, G. 2009, "Is socioeconomic status in early life associated with drug use? A systematic review of the evidence", *Drug & Alcohol Review*, vol. 28, pp. 142-153.
- Daniel, A.B., Nagaraj, K. & Kamath, R. 2008, "Prevalence and determinants of tobacco use in a highly literate rural community in southern India.", *National Medical Journal of India*, vol. 21, no. 4, pp. 163-165.
- Davies, T., Crouch, M., Long, S., Jackson, R., Bates, P., George, R. & Bairnsfather, L. 1991, "Rapid assesement of literacy levels of adult primary care patients", *Family Medicine*, vol. 23, pp. 433-435.
- Davis, T., Long, S., Jackson, R., Mayeaux, E., George, R., Murphy, P. & Crouch, M. 1993, "Rapid estimate of adult literacy in medicine: a shortened screening instrument", *Family Medicine*, vol. 25, no. 6, pp. 391-395.
- Degenhardt, L., Hall, W., Lynskey, M. & Warner-Smith, M. 2004, "Chapter 13: Illicit drug use" in *Comparative quantification of health risks: global and regional*

burden of disease attributable to selected major risk factors, eds. M. Ezzati, A. Lopez, A. Rodgers & C. Murray, 2nd edn, World Health Organization, Geneva.

Department for Business Innovation and Skills 2011, *2011 skills for life survey: headline findings*.

Department for Business, Innovation and Skills 2012, *2011 Skills for Life Survey: Annexes*.

Department for Education 2/12/14, , *Statutory guidance. National curriculum in England: framework for key stages 1 to 4*. Available: <https://www.gov.uk/government/publications/national-curriculum-in-england-framework-for-key-stages-1-to-4/the-national-curriculum-in-england-framework-for-key-stages-1-to-4> [2015, 16/6].

Department for Education and Skills 2003, *The Skills for Life Survey. A national needs and impact survey of literacy, numeracy and ICT skills*, Her Majesty's Stationery Office.

Department of Education and Skills (DfES) 2003, *Education and skills: the economic benefit*.

Department of Health 2010a, *The healthy foundations lifestage segmentation. Research report No. 2: the qualitative analysis of the motivation segments*.

Department of Health 2010b, "The healthy foundations lifestages segmentation. Research report No. 1: creating the segmentation using a quantitative survey of the general population of England", *NHS*, .

Department of Health, Physical Activity, Health Improvement and Protection 2011, *Start active, stay active. A report on physical activity for health from the four home countries Chief Medical Officers*.

Department of Mental Health, World Health Organization 1999, *Partners in life skills education. Conclusions from a United Nations inter-agency meeting.*, World Health Organization, Geneva.

Dermota, P., Wang, J., Dey, M., Gmel, G., Studer, J. & Mohler-Kuo, M. 2013, "Health literacy and substance use in young Swiss men", *International Journal of Public Health*, vol. 58, no. 6, pp. 939-948.

Eckersley, R. 2006, "Is modern western culture a health hazard?", *International Journal of Epidemiology*, vol. 35, pp. 252-258.

e-learning for healthcare , *Sexual and reproductive healthcare*. Available: <http://portal.e-lfh.org.uk/> [2014, 2/12].

Ewing, J. 1984, "Detecting alcoholism. The CAGE questionnaire", *Journal of the American Medical Association*, vol. 252, no. 14, pp. 1905-1907.

- Fenton, K., Koroivessis, C., Johnson, A., McCadden, A., McManus, S., Wellings, K., Mercer, C., Carder, C., Copas, A., Nanchahal, K., Macdowall, W. & Ridgway, G. 2001, "Sexual behaviour in Britain: reported sexually transmitted infections and prevalent genital chlamydia trachomatis infection", *Lancet*, vol. 358, pp. 1851-1854.
- Field, A. (2009). *Discovering statistics using SPSS*. 3rd Ed. London: Sage.
- Freebody, P. & Luke, A. 1990, "Literacies' programs: debates and demands in cultural context", *Prospect: An Australian Journal of TESOL*, vol. 5, no. 3, pp. 7-16.
- Freire, P. 1983, "The importance of the act of reading", *Journal of Education*, vol. 165, pp. 5-11.
- Gans, K., Hixson, M., Eaton, C. & Lasater, T. 2000, "Rate your plate: a dietary assessment and educational tool for blood cholesterol control", *Nutrition in Clinical Care*, vol. 3, no. 3, pp. 163-169.
- Gardner, B., de Bruijn, G. & Lally, P. 2011, "A systematic review and meta-analysis of applications of the self-report habit index to nutrition and physical activity behaviours", *Annals of Behavioral Medicine*, vol. 42, pp. 174-187.
- Garg, A., Singh, M., Gupta, V.K., Garg, S., Daga, M.K. & Saha, R. 2012, "Prevalence and correlates of tobacco smoking, awareness of hazards, and quitting behavior among persons aged 30 years or above in a resettlement colony of Delhi, India.", *Lung India*, vol. 29, no. 4, pp. 336-340.
- Geboers, B., de Winter, A.F., Luten, K.A., Jansen, C.J.M. & Reijneveld, S.A. 2014, "The association of health literacy with physical activity and nutritional behavior in older adults, and its social cognitive mediators.", *Journal of Health Communication*, vol. 19, no. Suppl 2, pp. 61-76.
- Gilman, S., Rende, R., Boergers, J., Abrams, D., Buka, S., Clark, M., Colby, S., Hitsman, B., Kazura, A., Lipsitt, L., Lloyd-Richardson, E., Rogers, M., Stanton, C., Stroud, L. & Niaura, R. 2009, "Parental smoking and adolescent smoking initiation: an intergenerational perspective on tobacco control", *Pediatrics*, [Online], vol. 123, no. 2, pp. e274–e281. doi:10.1542/peds.2008-2251. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2632764/>.
- Gov.UK 4th September 2014, , *School leaving age*. Available: <https://www.gov.uk/when-you-can-leave-school> [2014, 10/10].
- Greenhalgh, T. 2015, "Health literacy: towards system level solutions. A new World Health Organization toolkit aimed at low and middle income countries could reduce health inequalities in the rest of the world too.", *British Medical Journal*, [Online], vol. 350, , pp. h1026. Available from: <http://www.bmj.com/content/350/bmj.h1026.full.pdf+html>.
- Groth, M., Fagt, S. & Brøndsted, L. 2001, "Social determinants of dietary habits in Denmark", *European Journal of Clinical Nutrition*, vol. 55, no. 11, pp. 959-966.

- Gwaltney, C., Metrik, J., Kahler, C. & Shiffman, S. 2009, "Self-efficacy and smoking cessation: A meta-analysis", [Online], vol. 23, no. 1. Available from: doi:10.1037/a0013529.
- Health Council of the Netherlands and Dutch Advisory Council for research on spatial planning, nature and the environment 2004, "Nature and health. The influence of nature on social, psychological and physical well-being.", *The Hague: Health Council of the Netherlands and RMNO*, .
- HLS-EU consortium 2012, *Comparative report of health literacy in eight EU member states. The European health literacy survey HLS-EU*.
- Husson, O., Mols, F., Fransen, M.P., van de Poll-Franse, L.V. & Ezendam, N.P. 2014, "Low subjective health literacy is associated with adverse health behaviors and worse health-related quality of life among colorectal cancer survivors: results from the profiles registry", *Psycho-oncology*, vol. 24, pp. 478-486.
- Hutchison, J., Warren-Findlow, J., Dulin, M., Tapp, H. & Kuhn, L. 2014, "The association between health literacy and diet adherence among primary care patients with hypertension", *Journal of Health Disparities Research and Practice*, vol. 7, no. 2, pp. 109-126.
- IBM corp 2012, *IBM SPSS Statistics for Windows*.
- Jepson, R., Harris, F., Platt, S. & Tannahill, C. 2010, "The effectiveness of interventions to change six health behaviours: a review of reviews", *BioMed Central Public Health*, [Online], vol. 10, no. 538. Available from: <http://www.biomedcentral.com/1471-2458/10/538>.
- John, R.M., Ross, H. & Blecher, E. 2012, "Tobacco expenditures and its implications for household resource allocation in Cambodia.", *Tobacco Control*, vol. 21, no. 3, pp. 341-346.
- Kim, S., Love, F., Quistberg, D. & Shea, J. 2004, "Association of health literacy with self-management behavior in patients with diabetes", *Diabetes Care*, vol. 27, no. 12, pp. 2980-2982.
- Kirsch, I. 2001, *The International Adult Literacy Survey (IALS): understanding what was measured*.
- Kirsch, I., Jungeblut, A., Jenkins, L. & Kolstad, A. 2002, *Adult literacy in America. A first look at the findings of the national adult literacy survey*.
- Kish, L. 1949, "A procedure for objective respondents selection within the household", *Journal of the American Statistical Association*, vol. 4, pp. 380-387.
- Kumar, G., Premarajan, K., Subitha, L., Suguna, E., Vinayagamoorthy. & Kumar, V. 2013, "Prevalence and pattern of alcohol consumption using alcohol use

- disorders identification test in rural Tamil Nadu, India", *Journal of Clinical and Diagnostic Research*, vol. 7, no. 8, pp. 1637-1639.
- Lee, S.D., Tsai, T., Tsai, Y. & Kuo, K.N. 2012, "Health literacy and women's health-related behaviors in Taiwan.", *Health Education & Behavior*, vol. 39, no. 2, pp. 210-218.
- Leitch report 2006, "Review of skills. Prosperity for all in the global economy- world class skills", .
- Leung, G. & Stanner, S. 2011, "Diets of minority ethnic groups in the UK: influence on chronic disease risk and implications for prevention", *Nutrition Bulletin*, vol. 36, pp. 161-198.
- Leventhal, H., Leventhal, E. & Contrada, R. 1998, "Self-regulation, health, and behavior: a perceptual-cognitive approach", *Psychology and health*, vol. 13, pp. 717-733.
- Li, J.J., Appleton, S.L., Wittert, G.A., Vakulin, A., McEvoy, R.D., Antic, N.A. & Adams, R.J. 2014, "The relationship between functional health literacy and obstructive sleep apnea and its related risk factors and comorbidities in a population cohort of men", *Sleep*, vol. 37, no. 3, pp. 571-578.
- Lifestyle statistics team, Health and Social Care Information Centre 2014, *Statistics on smoking, England 2014*.
- Lifestyle statistics, Health and Social Care Information Centre 2014, *Statistics on obesity, physical activity and diet: England 2014*.
- Lifestyle statistics, Health and Social Care Information Centre 2013a, *Statistics on Alcohol: England, 2013*.
- Lifestyle statistics, Health and Social Care Information Centre 2013b, *Statistics on smoking: England, 2013*.
- Lifestyles Statistics, Health and Social Care Information Centre 2013, *Statistics on drug misuse: England 2013*.
- Luszczyska, A. & Schwarzer, R. 2005a, "Social cognitive theory" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 127-136.
- Luszczyska, A. & Schwarzer, R. 2005b, "Social cognitive theory" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 159-160.
- MacDonald, Z. 1999, "Illicit drug use in the UK. Evidence from the British Crime Survey", *British Journal of Criminology*, vol. 39, no. 4, pp. 585-608.

- Maguire, E. & Monsivais, P. 2015, "Socio-economic dietary inequalities in UK adults: an updated picture of key food groups and nutrients from national surveillance data", *British Journal of Nutrition*, vol. 113, pp. 181-189.
- Marteau, T. & Lerman, C. 2001, "Genetic risk and behavioural change", *British Medical Journal*, vol. 322, pp. 1056-1059.
- Martin, L.T., Haas, A., Schonlau, M., Derose, K.P., Rosenfeld, L., Rudd, R. & Buka, S.L. 2012, "Which literacy skills are associated with smoking?", *Journal of Epidemiology and Community Health*, vol. 66, no. 2, pp. 189-192.
- Miech, R. & Hauser, R. 2001, "Socioeconomic status and health at midlife: a comparison of educational attainment with occupation-based indicators", *Annals of Epidemiology*, vol. 11, no. 2, pp. 75-84.
- Mills, S.D., Sobel, R.M., Booker, A., Malcarne, V. & Sadler, G. 2012, "Cancer beliefs, health literacy, and cancer-related health behaviors in Hispanic Americans", *Annals of Behavioral Medicine*, vol. 43, pp. S91.
- Mitchell, R. & Popham, R. 2008, "Effect of exposure to natural environment on health inequalities: an observational population study", *Lancet*, vol. 372, pp. 1655-1660.
- Mottus, R., Johnson, W., Murray, C., Wolf, M.S., Starr, J.M. & Deary, I.J. 2014, "Towards understanding the links between health literacy and physical health", *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*, vol. 33, no. 2, pp. 164-173.
- Mukhopadhyay, S. & Sarkar, A. 2009, "Pregnancy-related food habits among women of rural Sikkim, India.", *Public Health Nutrition*, vol. 12, no. 12, pp. 2317-2322.
- National Center for Education Statistics 2012, *Improving the measurement of socioeconomic status for the national assessment of educational progress: a theoretical foundation*.
- National Institute for Health and Clinical Excellence 2014, *Behaviour change: individual approaches*.
- NHS Choices 2013a, , *The eat well plate*. Available: <http://www.nhs.uk/livewell/goodfood/pages/eatwell-plate.aspx> [2015, March].
- NHS Choices 2013b, 12/12/13-last update, *5 a day FAQs*. Available: <http://www.nhs.uk/Livewell/5ADAY/Pages/FAQs.aspx> [2015, 4th April].
- NHS Choices 2013c, , *Alcohol units* [Homepage of Gov.uk]. Available: <http://www.nhs.uk/livewell/alcohol/pages/alcohol-units.aspx> [2015, 15th April].

- NHS Choices 2013d, , *Contraception guide. Condoms*. Available: <http://www.nhs.uk/conditions/contraception-guide/pages/male-condoms.aspx> [2014, 10th October].
- NHS Information Centre 2009, *Health Survey for England 2008. Physical activity and fitness*.
- Noble, M., McLennan, D., Wilkinson, K., Whitworth, A. & Barnes, H. 2008, *The English Indices of Deprivation 2007*.
- Norman, P., Boer, H. & Seydel, E. 2005, "Protection motivation theory" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 81-86.
- Noto, H., Goto, A., Tsujimoto, T. & Noda, M. 2013, "Low-carbohydrate diets and all-cause mortality: a systematic review and meta-analysis of observational studies", *PLoS ONE*, vol. 8, no. 1, pp. doi:10.1371/journal.pone.0055030.
- Nutbeam, D. 2000, "Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century", *Health Promotion International*, vol. 15, no. 3, pp. 259-267.
- Nutbeam, D. 1998, "Health promotion glossary", *Health Promotion International*, vol. 13, no. 4, pp. 349-364.
- Office for National Statistics 2013, "Chapter 2- drinking (general lifestyle survey overview- a report on the 2011 general lifestyle survey)", .
- Organisation for Economic Co-operation and Development 2015, "Tackling harmful alcohol use: economics and public health policy.", *OECD publishing*, , no. 9789264181069-en, pp. 60-69.
- Organisation for Economic Co-operation and Development. 2000, *Literacy in the information age. Final report of the International Adult Literacy Survey*.
- Oyebode, O., Gordon-Dseagu, V., Walker, A. & Mindell, J. 2014, "Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data", *Journal of Epidemiology and Community Health*, vol. 68, pp. 856-862.
- Paasche-Orlow, M., Parker, R., Gazmararian, J., Nielsen-Bohlman, L. & Rudd, R. 2005, "The prevalence of limited health literacy", *Journal of General Internal Medicine*, vol. 20, pp. 175-184.
- Paasche-Orlow, M. & Wolf, M. 2007, "The causal pathways linking health literacy to outcomes", *American Journal of Health Behavior*, vol. 31, no. 1, pp. 19-26.
- Pampel, F., Krueger, P. & Denney, J. 2010, "Socioeconomic Disparities in Health Behaviors", *Annual Review of Sociology*, vol. 36, pp. 349-370.

Parker, R., Baker, D. & Williams, M. 1995, "The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills", *Journal of General Internal Medicine*, vol. 10, pp. 537-541.

ProQuest 2009, *Refworks*.

Pryor, L., Fanelli-Kuczmarski, M., Cotugna, N., Hotchkiss, L., Kitner-Triolo, M., Zonderman, A. & Evans, M.K. 2012, "The Relationship between literacy and diet quality among Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study participants", *Journal of the Academy of Nutrition & Dietetics*, vol. 112, no. 9, pp. A62.

Public Health Resource Unit, England. 2013, , *Critical Appraisal Skills Programme (CASP): Cohort Study Checklist*. Available: <http://www.casp-uk.net/> [2013, October].

Qualifications and curriculum authority 2006, "The National Qualifications Framework", QCA/06/2298, .

Reisi, M., Javadzade, S.H., Heydarabadi, A.B., Mostafavi, F., Tavassoli, E. & Sharifirad, G. 2014, "The relationship between functional health literacy and health promoting behaviors among older adults", *Journal of Education and Health Promotion*, [Online], vol. 3, , pp. 119-9531.145925. eCollection 2014. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4275619/>.

Report of a Joint FAO/WHO Expert Consultation 2003, *Diet, nutrition and the prevention of chronic diseases*, World Health Organization, Geneva.

Robertson, G. 2001, "Wide-range achievement test" in *The Corsini Encyclopedia of Psychology*, eds. I. Weiner & W. Craighead, 3rd edn, Wiley, New York, pp. 1857-1858.

Robinson, S., Crozier, S., Borland, S., Hammond, J., Barker, D. & Inskip, H. 2004, "Impact of educational attainment on the quality of young women's diets", *European Journal of Clinical Nutrition*, vol. 58, no. 1174, pp. 1180.

Roelfs, D., Short, E., Davidson, K. & Schwartz, J. 2011, "Losing life and livelihood: A systematic review and meta-analysis of unemployment and all-cause mortality", *Social Science & Medicine*, vol. 72, pp. 840-854.

Room, R., Babor, T. & Rehm, J. 2005, "Alcohol and public health", *Lancet*, vol. 365, pp. 519-530.

Rose, D. & Pevalin, D. 2005, *The national statistic socio-economic classification: origins, development and use*, Institute for Social and Economic Research. University of Essex, Basingstoke, England.

Rowlands, G., Protheroe, J., Winkley, J., Richardson, M., Seed, P. & Rudd, R. 2014, "A mismatch between population health literacy and the complexity of health information: an observational study", *The British Journal of General*

Practice : the journal of the Royal College of General Practitioners, vol. 65, no. 635, pp. 379-386.

- Samitz, G., Egger, M. & Zwahlen, M. 2011, "Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies", *Journal of Epidemiology*, vol. 40, pp. 1382-1400.
- Santesso, N., Akl, E., M Bianchi, M., Mente, A., Mustafa, R., Heels-Ansdell, D. & Schunemann, H. 2012, "Effects of higher- versus lower-protein diets on health outcomes: a systematic review and meta-analysis", *European Journal of Clinical Nutrition*, vol. 66, pp. 780-788.
- Sarkar, U., Schillinger, D., Lopez, A. & Sudore, R. 2010, "Validation of self-reported health literacy questions among diverse English and Spanish-speaking populations", *Journal of General Internal Medicine*, vol. 26, no. 3, pp. 265-271.
- Sheeran, P., Milnes, S., Webb, T. & Gallwitzer, P. 2005, "Implementation, intentions and health behaviour" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 276-317.
- Sheridan, S., Halpern, D., Viera, A., Berkman, N., Donahue, K. & Crotty, K. 2011, "Interventions for individuals with low health literacy: a systematic review", *Journal of Health Communication*, vol. 16, pp. 30-54.
- Sim, J. & Wright, C. 2000, "Research in health care: Concepts, designs and methods." Cheltenham: Nelson Thornes.
- Sinalkar, D.R., Kunwar, R. & Bagal, R. 2012, "Tobacco consumption and its association with education among women residing in a rural area of Maharashtra: A cross-sectional study.", *Medical Journal Armed Forces India*, vol. 68, no. 4, pp. 335-338.
- Smedberg, J., Lupattelli, A., Mardby, A.C. & Nordeng, H. 2014, "Characteristics of women who continue smoking during pregnancy: a cross-sectional study of pregnant women and new mothers in 15 European countries", *BioMed Central pregnancy and childbirth*, [Online], vol. 14, , pp. 213-2393-14-213. Available from: <http://www.biomedcentral.com/1471-2393/14/213>.
- Speirs, K.E., Messina, L.A., Munger, A.L. & Grutzmacher, S.K. 2012, "Health literacy and nutrition behaviors among low-income adults.", *Journal of Health Care for the Poor and Underserved*, vol. 23, no. 3, pp. 1082-1091.
- Starkweather, J. & Moske, A. 2011, *Multinomial logistic regression*. Available: www.unt.edu/rss/class/Jon/Benchmarks/MLR_JDS_Aug2011.pdf.
- Strengthening the Reporting of Observational studies in Epidemiology. 2009, STROBE statement. Available: <http://strobe-statement.org/index.php?id=strobe-home> [2017, 18th January].

- Stuttm, R. & Hattori, A. 2015, "Diet and obesity in Los Angeles County 2007e2012: Is there a measurable effect of the 2008“Fast-Food Ban”?", *Social Sciences & Medicine*, vol. 133, pp. 205-211.
- Subramanian, T., Gupte, M.D., Paranjape, R.S., Brahmam, G.N., Ramakrishnan, L., Adhikary, R., Kangusamy, B., Thomas, B.E., Kallam, S., Girish, C.P. & IBBA Study, T. 2008, "HIV, sexually transmitted infections and sexual behaviour of male clients of female sex workers in Andhra Pradesh, Tamil Nadu and Maharashtra, India: results of a cross-sectional survey.", *AIDS*, vol. 22, no. Suppl 5, pp. S69-79.
- Sudore, R.L., Yaffe, K., Satterfield, S., Harris, T.B., Mehta, K.M., Simonsick, E.M., Newman, A.B., Rosano, C., Rooks, R., Rubin, S.M., Ayonayon, H.N. & Schillinger, D. 2006, "Limited literacy and mortality in the elderly: The health, aging, and body composition study.", *Journal of General Internal Medicine*, vol. 21, no. 8, pp. 806-812.
- Sun, X., Shi, Y., Zeng, Q., Wang, Y., Du, W., Wei, N., Xie, R., Chang, C. 2013, "Determinants of health literacy and health behaviour regarding infectious respiratory disease: a pathway model", *BioMed Central Public Health*, [Online], vol. 13, no. 261. Available from: <http://www.biomedcentral.com/1471-2458/13/261>.
- Sutton, S. 2005, "Stage theories of health behaviour" in *Predicting health behaviour*, eds. M. Conner & P. Norman, 2nd edn, Open University Press, Berkshire, England, pp. 225-230.
- TenHave, T., VanHorn, B., Kumanyika, S., Askov, E., Matthews, Y. & AdamsCampbell, L. 1997, "Literacy assessment in a cardiovascular nutrition education setting", *Patient Education and Counseling*, vol. 31, no. 2, pp. 139-150.
- The Marmot review 2010, *Fair society, health lives. Strategic review of health inequalities in England post 2010*.
- The World Health Organisation 2002, "Reducing risk, promoting healthy life", *The World Health Organisation*, .
- Threapleton, D., Greenwood, D., Evans, C., Cleghorn, C., Nykjaer, C., Woodhead, C., Cade, J., Gale, C. & Burley, V. 2013, "Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis", *British Medical Journal*, [Online], vol. 347, , pp. doi: 10.1136/bmj.f6879. Available from: doi: <http://dx.doi.org/10.1136/bmj.f6879>.
- Toobert, D., Hampson, S. & Glasgow, R. 2000, "The summary of diabetes self-care activities measure", *Diabetes Care*, vol. 23, pp. 943-950.
- U.S. Department of Health and Human Services 2014, *The health consequences of smoking—50 years of progress. A report of the surgeon general*.

- van der Heide, I., Ueters, E., Rademakers, J., Struijs, J.N., Schuit, A.J. & Baan, C.A. 2014, "Associations among health literacy, diabetes knowledge, and self-management behavior in adults with diabetes: Results of a Dutch cross-sectional study.", *Journal of Health Communication*, vol. 19, no. Suppl 2, pp. 115-131.
- Vollrath, M., Knoch, D. & Cassano, L. 1999, "Personality, risky health behaviour, and perceived susceptibility to health risks", *European Journal of Personality*, vol. 13, pp. 39-50.
- von Wagner, C., Knight, C., Steptoe, A. & Wardle, J. 2007, "Functional health literacy and health-promoting behaviour in a national sample of British adults.", *Journal of Epidemiology and Community Health*, vol. 61, no. 12, pp. 1086-1090.
- von Wagner, C., Steptoe, A., Wolf, M.S. & Wardle, J. 2009, "Health literacy and health actions: a review and a framework from health psychology", *Health Education & Behavior*, vol. 36, no. 5, pp. 860-877.
- Vozikis, A., Drivas, K. & Milioris, K. 2014, "Health literacy among university students in Greece: determinants and association with self-perceived health, health behaviours and health risks", *Archives of Public Health = Archives belges de sante publique*, vol. 72, no. 1, pp. 15-3258-72-15. eCollection 2014.
- Wagner, D. 2005, *Monitoring and measuring literacy. Background paper prepared for the education for all global monitoring report 2006: literacy for life.*
- Wallace, L., Rogers, E., Roskos, S., Holiday, D. & Weiss, B. 2006, "Screening items to identify patients with limited health literacy skills", *Journal of General Internal Medicine*, vol. 21, pp. 874-877.
- Wang, X., Ouyang, Y., Liu, J., Zhu, M., Zhao, G., Bao, W. & Hu, F. 2014, "Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies", *British Medical Journal*, vol. 349, no. doi: 10.1136/bmj.g4490.
- Webb, T. & Sheeran, P. 2006, "Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence", *Psychological Bulletin*, vol. 132, no. 2, pp. 249-268.
- Weiss, B., Mays, M., Martz, W., Castro, K., DeWalt, D., Pignone, M., Mockbee, J. & Hale, F. 2005, "Quick assessment of literacy in primary care: the newest vital sign", *The Annals of Family Medicine*, vol. 3, no. 6, pp. 514-522.
- Wilkinson, R. & Marmot, M. 2003, *Social determinants for health. The solid facts: 2nd edition*, World Health Organization, Europe, Denmark.

- Wolf, M.S., Gazmararian, J.A. & Baker, D.W. 2007, "Health literacy and health risk behaviors among older adults.", *American Journal of Preventive Medicine*, vol. 32, no. 1, pp. 19-24.
- Woodcock, R., McGrew, K. & Mather, N. 2001, *Wookcock-Johnson III*, Riverside publishing, Itasca IL.
- Zoellner, J., You, W., Connell, C., Smith-Ray, R.L., Allen, K., Tucker, K.L., Davy, B.M. & Estabrooks, P. 2011, "Health literacy is associated with healthy eating index scores and sugar-sweetened beverage intake: findings from the rural Lower Mississippi Delta.", *Journal of the American Dietetic Association*, vol. 111, no. 7, pp. 1012-1020.

Appendix 3.1- Search strategy

Medline

Literacy

MeSH- Health literacy.

Free text – illiteracy, “test of functional health literacy in adults”, “rapid estimate of adult literacy in medicine”, “wide range achievement test”, “medical achievement reading test”, “short assessment of health literacy”, literacy, “prose literacy”, “document literacy”, “International adult literacy survey”, “national assessment of adult literacy”, “health literacy”

Health behaviours

MeSH- health behavior, Drinking Behavior; Smoking; Food Habits; Safe Sex; Unsafe Sex; Street Drugs; Inhalant Abuse; Marijuana Abuse; Opioid-Related Disorders; Phencyclidine Abuse; Tobacco; Smoking; Exercise, Physical Exertion, Physical Fitness, Sports, Diet, Food Habits, body weight

Free text – “safe sex”, condom*, “unsafe sex”, “unprotected sex”, “risky sexual behavior”, “healthy lifestyle”, “health behavior”, healthy ADJ diet, diet, “fruit and vegetable”, “fat ADJ diet”, “sugar ADJ diet”, “calorie intake”, alcohol ADJ drinking, alcoholi\$, smoking, tobacco, illicit ADJ drug*, street ADJ drug*, “drug abuse”, heroin, cocaine, ecstasy, marijuana, exercise, fitness, aerobic ADJ (activity OR exercise)

PsychInfo

Literacy

Subject headings- Literacy, Health Literacy, Reading Skills, Reading Ability, Writing Skills, Word Recognition,

Free text – illiteracy, literacy, “prose literacy”, “document literacy”, “test of functional health literacy in adults”, “rapid estimate of adult literacy in medicine”, “wide range achievement test”, “medical achievement reading test”, “short assessment of health literacy”, “International adult literacy survey”, “national assessment of adult literacy”, “health literacy”

Health behaviours

Subject headings- Health behaviour, safe sex, Condoms, Sexual Risk Taking, active living, aerobic exercise, exercise, diets, lifestyle, physical activity, activity level, Physical Fitness, Weight Control, eating behaviour, Alcohol Abuse, Alcohol Drinking Patterns, Alcoholism, Binge Drinking, Drug Addiction, Drug Dependency, Heroin Addiction, Drug Abuse, Inhalant Abuse, Polydrug Abuse, Intravenous Drug Usage, Marijuana Usage, Tobacco Smoking,

Free text- “safe sex”, condom*, “unsafe sex”, “unprotected sex”, “risky sexual behavio\$2*”, “healthy lifestyle\$”, “health behavio?r”, healthy ADJ diet, diet, “fruit and vegetable\$1”, “fat ADJ diet”, “sugar ADJ diet”, “calorie intake”, alcohol ADJ drinking, alcoholi\$, smoking, tobacco, illicit ADJ drug*, street ADJ drug*, “drug abuse”, heroin, cocaine, ecstasy, marijuana, exercise, fitness, aerobic ADJ (activit* OR exercise*)

Embase

Literacy

Subject headings- Health literacy, Reading,

Free text- illiteracy, literacy, "prose literacy", "document literacy", "test of functional health literacy in adults", "rapid estimate of adult literacy in medicine", "wide range achievement test", "medical achievement reading test", "short assessment of health literacy", "International adult literacy survey", "national assessment of adult literacy", "health literacy"

Health behaviours

Subject headings- health behavior, high risk behavior, drinking behavior, unsafe sex, unprotected sex, safe sex, "condom use", aerobic exercise, exercise, diet, carbohydrate diet, high fibre diet, low calory diet, Mediterranean diet, low carbohydrate diet, protein diet, vegetarian diet, fat intake, cholesterol intake, alcohol abuse, alcoholism, binge drinking, smoking, cannabis smoking, drug abuse, inhalant abuse, intravenous drug abuse, multiple drug abuse, illicit drug

Free text- "safe sex", condom*, "unsafe sex", "unprotected sex", "risky sexual behavio?r", "healthy lifestyle\$", "health behavio?r", healthy ADJ diet, diet, "fruit and vegetable\$1", "fat ADJ diet", "sugar ADJ diet", "calorie intake", alcohol ADJ drinking, alcoholi\$, smoking, tobacco, illicit ADJ drug*, street ADJ drug*, "drug abuse", heroin, cocaine, ecstasy, marijuana, exercise, fitness, aerobic ADJ (activit* OR exercise*)

Web of Science

Literacy

illiteracy, literacy, “prose literacy”, “document literacy”, “test of functional health literacy in adults”, “rapid estimate of adult literacy in medicine”, “wide range achievement test”, “medical achievement reading test”, “short assessment of health literacy”, “International adult literacy survey”, “national assessment of adult literacy”, “health literacy”,

Health behaviours

“safe sex”, condom*, “unsafe sex”, “unprotected sex”, “risky sexual behavior*”, “healthy lifestyle*”, “health behavior*”, “healthy diet”, diet, “fruit and vegetable*”, “fat diet”, “sugar diet”, “calorie intake”, “alcohol drinking”, “drinking alcohol”, alcoholi*, smoking, tobacco, “illicit drug*”, street drug*”, “drug abuse”, heroin, cocaine, ecstasy, marijuana, exercise, fitness, “aerobic activity*”, “aerobic exercise*”

Educational resources information centre

Literacy

Thesaurus - Adult literacy, functional literacy, functional reading, reading skill, reading ability, writing ability, literacy, illiteracy, reading difficulties,

Free text- illiteracy, literacy, “prose literacy”, “document literacy”, “test of functional health literacy in adults”, “rapid estimate of adult literacy in medicine”, “wide range achievement test”, “medical achievement reading test”, “short assessment of health

literacy", "International adult literacy survey", "national assessment of adult literacy",
"health literacy",

Health behaviours

Thesaurus- health behavior, Drug abuse, drinking, alcohol abuse, alcoholism, marijuana, cocaine, narcotics, safer sex, safe sex practices, protected sex, safe sex, condom use, exercise, physical fitness, physical activity level, eating habits, body weight, obesity, nutrition, smoking,

Free text- - "safe sex", condom*, "unsafe sex", "unprotected sex", "risky sexual behavior", "healthy lifestyle", "health behavior", healthy ADJ diet, diet, "fruit and vegetable", "fat ADJ diet", "sugar ADJ diet", "calorie intake", alcohol ADJ drinking, alcoholism, smoking, tobacco, illicit ADJ drug*, street ADJ drug*, "drug abuse", heroin, cocaine, ecstasy, marijuana, exercise, fitness, aerobic ADJ (activity OR exercise*)

Appendix 4.1- Questionnaire items used

Question taken from the questionnaire	Possible responses
<p>Educational achievement</p> <p>Which qualifications do you have?</p> <p><i>Note: if uncertain, ask which they think they have. Code first/highest which applies</i></p> <p><i>If other, please enter full details to enable us to accurately code</i></p> <p><i>If necessary: Read from the top and tell me the first on the list that applies.</i></p>	<p>1. Any of these qualifications</p> <ul style="list-style-type: none"> •Doctorate •Masters •Postgraduate Diploma •Postgraduate Certificate <p>2. Any of these qualifications</p> <ul style="list-style-type: none"> •First degree •PGCE •HND •NVQ/SVQ Level 4 •SCOTVEC Higher <p>3. Any of these qualifications</p> <ul style="list-style-type: none"> •2 or more A levels •4 or more AS levels •3 or more Scottish Highers •GNVQ/GSVQ Advanced •BTEC National Diploma •NVQ/SVQ Level 3 •SCOTVEC National •Completed Trade Apprenticeship <p>4. Any of these qualifications</p> <ul style="list-style-type: none"> •5 or more GCSEs/O levels at grades A*–C or CSEs at grade 1 •1 A level •3 or fewer AS levels •1 or 2 Scottish Highers •GNVQ/GSVQ Intermediate level

	<ul style="list-style-type: none"> • You do not like using condoms • Other reason • No reason • Don't know • Prefer not to answer
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Appendix 4.2- Adjusted and unadjusted analysis for alcohol reference category none

Health behaviours	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Alcohol		
None	1.0	1.0
Recommended or less for the gender	0.68 (0.58 to 0.80)	0.69 (0.57 to 0.82)
More than recommended for the gender	0.59 (0.47 to 0.75)	0.61 (0.46 to 0.80)
Harmful drinking (>21 units for females, >35 units for males)	0.62 (0.50 to 0.77)	0.70 (0.55 to 0.89)

Appendix 4.3- Unadjusted analysis for low income and health behaviours

Health behaviours	Unadjusted OR (95% CI)
Alcohol	
Recommended or less for the gender	1.0
None	1.47 (1.25 to 1.72)
More than recommended for the gender	0.87 (0.68 to 1.10)
Harmful drinking (>21 units for females, >35 units for males)	0.91 (0.74 to 1.12)
Exercise	
Recommended or above (5x 30mins sessions)	1.0
Less than recommended (1-4 30min sessions/wk)	0.66 (0.56 to 0.78)
No exercise	1.39 (1.18 to 1.65)
Smoking status	
Non-smoker	1.0
Smoker	2.18 (1.85 to 2.56)
Fruit and vegetable intake	
Recommended or more fruit or vegetables yesterday (5+)	1.0
Less than recommended fruit or vegetables (1-4)	2.60 (1.97 to 3.44)
No fruit or veg yesterday	
Condom use	
Used condoms in the last 12m	1.0
Didn't use condoms in the last 12m in the absence of a low risk reason	1.02 (0.82 to 1.25)
Illicit drug use	
No	1.0
Yes	0.50 (0.03 to 7.98)

Appendix 4.4 - Adjusted analysis (including income) for low education and health behaviours

Health behaviours	Adjusted* OR (95% CI)
Alcohol	
Recommended or less for the gender	1.0
None	1.49 (1.21 to 1.83)
More than recommended for the gender	0.90 (0.67 to 1.22)
Harmful drinking (>21 units for females, >35 units for males)	1.09 (0.83 to 1.42)
Exercise	
Recommended or above (5x 30mins sessions)	1.0
Less than recommended (1-4 30min sessions/wk)	0.93 (0.76 to 1.14)
No exercise	1.25 (1.04 to 1.50)
Smoking status	
Non-smoker	1.0
Smoker	1.82 (1.53 to 2.17)
Fruit and vegetable intake	
Recommended or more fruit or vegetables yesterday (5+)	1.0
Less than recommended fruit or vegetables (1-4)	1.89 (1.59 to 2.25)
No fruit or veg yesterday	3.65 (2.74 to 4.86)
Condom use	
Used condoms in the last 12m	1.0
Didn't use condoms in the last 12m in the absence of a low risk reason	1.39 (1.09 to 1.77)
Illicit drug use	
No	1.0
Yes	1.00 (0.77 to 1.30)

*adjusted for age, gender, ethnicity, IMD, NS-SEC and income

