



# **Reviews of Scientific Evidence and Policies on Nutrition and Physical Activity**

Objective E: Existence, need and usefulness of nutrition and physical activity guidelines for specific population groups



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## **Preface**

### **About this project**

Overweight, obesity and their related diseases represent a leading cause of morbidity and mortality, and pose a major challenge for the sustainability of healthcare systems of EU Member States. The growing prevalence of overweight and obesity among all age groups across Europe constitutes a serious concern for policy makers. Tackling this issue requires a comprehensive response that reflects the multifactorial and complex nature of obesity and overweight. One particularly important area of focus has been on the development of preventative strategies which include nutritional and physical activity interventions.

The European Commission Directorate General for Health and Food Safety (DG SANTE) recognises the significant challenges policy makers face in developing effective and efficient policy interventions relating to diet and physical activity. One such challenge includes the complexity and breadth of the evidence base. By providing independent, accurate summaries of recent and relevant information and statistics on determinants of diet and physical activity and their impact on health, this project aims to support policy makers to continue to develop policy instruments which enable people to make healthier lifestyle choices. In particular, this project aims to support the development of healthier behaviours in vulnerable and/or at-risk subpopulations (including children, pregnant and lactating women, and older adults) and low socio-economic status groups (including low income and education).

### **About this series**

This evidence review is one of eight reviews relating to different determinants of diet and physical activity.

Seven of the reviews are of the scientific evidence and policies in the following areas:

- Knowledge, attitudes and behaviours contributing to positive energy balance (objective area A1);
- Dietary and physical activity patterns in Europe (objective area B1);
- Consumption of fruit juices, artificially and sugar-sweetened beverages and its impact on weight status and health (objective area B2);
- Consumption of high-fructose syrup and its impact on weight status and health (objective area B3);
- Relationship between weight status and physical activity with school and work performance outcomes (objective area C);
- Early warning indicators of obesity and physical inactivity trends (objective area D);
- Nutrition and physical activity guidelines for specific population groups (objective area E).

Building on these seven reviews, the final review (objective area A2) examines specifically the evidence for effective and efficient policies and interventions in terms of promoting, supporting and improving nutritional and physical activity behaviours at both individual and population level.

All reviews, and their summaries, are available on the DG SANTE webpage [here](#).

### **Approach and purpose**

The reviews have been designed to provide policymakers with summaries of recent and relevant evidence in these key areas of interest. Given the broad scope of each of the reviews, it should be stressed that they are not intended to be rigorous systematic reviews of all literature published in this field. Rather, they are intended as pragmatic reviews combining a comprehensive search methodology with expert academic input, facilitated through workshops, to provide a practical and accurate summary of key issues and tackling broad lines of enquiry, with the greater aim of supporting the

development and improvement of policies in this area. Each of the project's eight methodologies and analyses was reviewed by DG SANTE and academic experts in these topics.

While the methods to conduct this comprehensive literature review are systematic, it is *not* a systematic review. This review does not systematically analyse literature to identify *all* relevant published data and/or appraise its quality. Methods to conduct the literature review consisted of five steps: (1) refining the research questions, (2) developing a search approach and databases, (3) conducting literature searches, (4) screening articles for inclusion; and (5) abstracting and synthesising relevant data.

To minimise bias, the literature search approach included identification of a priori search parameters (also considered first level inclusion and exclusion criteria), agreed with DG SANTE, to guide searches and inform screening and selection processes for data inclusion. Due to the immense number of literature search results at step 3, the application of quite limiting exclusion criteria at step 4 was deemed necessary. This may however have resulted in not screening all potentially relevant literature. All relevant articles that were found appropriate for inclusion were reviewed for relevance to each objective area, and the scope of the specific research questions. Furthermore, the inclusion of different types of scientific evidence (from systematic reviews and peer-reviewed original articles down to BSc theses) and the presentation of this scientific evidence next to grey literature information presented a challenge in terms of maintaining an understanding of the quality and weight of the evidence. The authors addressed this to some extent by structuring the document in such a way that peer-reviewed and grey literature are clearly identified. The full methodology and steps taken for each review is included in Annex of this document.

DG SANTE and the Joint Research Centre (JRC) provided input on all stages of the project and comments on the literature reviews. Expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews. Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed.

The methodology used across all eight reviews remained consistent, and within each review a detailed summary of the approach is provided, along with a full bibliography for further reading.

## Glossary

The following definitions are common definitions that are used across all eight objective areas. Where a study uses a different definition, this will be highlighted on an individual basis in the review.

Table 1. Definitions of terms used across the reviews

Term	Definition	Source
Adult obesity	An abnormal or excessive fat accumulation that presents a risk to health, with a BMI of 30 or more.	World Health Organisation (WHO) ( <a href="http://www.who.int/topics/obesity/en/">http://www.who.int/topics/obesity/en/</a> )
Adult overweight	An abnormal or excessive fat accumulation that presents a risk to health, with a BMI equal to or more than 25.	WHO ( <a href="http://www.who.int/topics/obesity/en/">http://www.who.int/topics/obesity/en/</a> )
Alcopops	Pre-mixed beverages containing a spirit, wine or malt combined with a non-alcoholic drink.	1. Anderson, P., Suhrcke, M. and Brookes, C. (2012) An overview of the market for alcohol beverages of potentially particular appeal to minors. London: HAPI.
Artificially sweetened beverages (ASBs)	Beverages sweetened with low-calorie or zero-calories sweeteners such as sucralose, aspartame, saccharin, stevia or sugar alcohols.	ICF definition based on all literature identified in objective area B2 literature review
Body Mass Index	A person's weight (in kilograms) divided by the square of his or her height (in metres).	WHO ( <a href="http://apps.who.int/bmi/index.jsp?introPage=intro_3.html">http://apps.who.int/bmi/index.jsp?introPage=intro_3.html</a> )
Child/adolescent obesity	There are different systems available to measure child or adolescent obesity for different ages.  Children under 5 obesity is weight-for-height greater than 3 standard deviations above WHO Child Growth Standards median;  Children aged 5-19 overweight is BMI-for-age	WHO  <a href="http://www.who.int/mediacentre/factsheets/fs311/en/">http://www.who.int/mediacentre/factsheets/fs311/en/</a>  (Other definitions are available for different national and international systems).

Term	Definition	Source
	greater than 2 standard deviation above the WHO Growth Reference median.	
Child/adolescent overweight	<p>There are different systems available to measure child or adolescent overweight for different ages.</p> <p>Children under 5 overweight is weight-for-height greater than 2 standard deviations above WHO Child Growth Standards median;</p> <p>Children aged 5-19 overweight is BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median.</p>	<p>WHO</p> <p><a href="http://www.who.int/mediacentre/factsheets/fs311/en/">http://www.who.int/mediacentre/factsheets/fs311/en/</a></p> <p>(Other definitions are available for different national and international systems).</p>
Exercise	Exercise, is a subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective.	<p>WHO</p> <p>(<a href="http://www.who.int/dietphysicalactivity/pa/en/">http://www.who.int/dietphysicalactivity/pa/en/</a>)</p>
Insufficient physical activity	Physical activity that does not meet WHO recommended levels of at least 60 minutes a day of moderate-vigorous activity for children and adolescents and at least 150 minutes of moderate-intensity aerobic physical activity throughout the week for adults.	<p>WHO</p> <p><a href="http://www.who.int/mediacentre/factsheets/fs385/en/">http://www.who.int/mediacentre/factsheets/fs385/en/</a></p>
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure.	<p>WHO</p> <p>(<a href="http://www.who.int/topics/physical_activity/en/">http://www.who.int/topics/physical_activity/en/</a>)</p>
Physical inactivity	A lack of physical activity	<p>WHO</p> <p>(<a href="http://www.who.int/diet">http://www.who.int/diet</a></p>

Term	Definition	Source
Sedentary behaviour	Any waking behaviour characterized by an energy expenditure $\leq 1.5$ metabolic equivalents (METs) while in a sitting or reclining posture.	Tremblay, M. S., et al. (2017). Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. <i>The International Journal of Behavioral Nutrition and Physical Activity</i> , 14, 75. <a href="http://doi.org/10.1186/s12966-017-0525-8">http://doi.org/10.1186/s12966-017-0525-8</a>
Sugar sweetened beverages (SSBs)	Any beverage with added sugars. This includes soft drinks, soda, fruit drinks, punch, sports drinks, sweetened tea and coffee drinks, energy drinks and sweetened milk. These beverages may be sweetened with added sugars such as sucrose (table sugar) or high fructose corn syrup, which is what distinguishes them from 100% fruit juice and beverages with non-caloric sweeteners (e.g., aspartame, saccharin or sucralose).	US Department of Agriculture. 2010. <i>US Department of Health and Human Services. Dietary guidelines for Americans, 2010</i> . 7th edition, Washington (DC): US Government Printing Office

## **Objective E: Existence, need and usefulness of nutrition and physical activity guidelines for specific population groups**

This report presents a comprehensive review of the scientific evidence and policies on the existence, need and usefulness of nutrition and physical activity guidelines for specific population groups at national and European level. The population groups searched included children, older adults, pregnant and breastfeeding women, hospitalised or bed-ridden patients, patients with specific diseases, and, citizens of certain Body-Mass Index (BMI) or physically inactive.

The report includes the following sections.

- **Introduction**, describing the scope of the review, the principal research questions, and, the limitations to the review;
- **Methodology**, describing how the reviews were undertaken and relevant findings extracted;
- **Findings** from the peer-reviewed and grey literature, presented according to each research question; and
- **Conclusions** drawn from the overall findings and outlining any gaps in the knowledge.

### **1 Introduction**

Physical activity and nutrition/dietary behaviour are important aspects of primary prevention of obesity and non-communicable diseases (NCD) for populations of all ages and abilities. They are also important for reducing the impact of disease once diagnosed (secondary prevention) and helping to manage the long-term impact of disease (tertiary prevention) among populations with NCDs such as diabetes, cardiovascular disease, and cancer. Although physical activity and healthier nutrition/dietary behaviour are universally associated with positive health outcomes, the needs and recommendations for distinct population groups can vary. There is consensus among leading organisations such as the WHO and OECD on the importance of having targeted actions for specific population groups accompanying population-wide approaches.

#### **1.1 Scope of the review**

The purpose and scope of this review is to examine the need for, and usefulness of having, physical activity and nutrition guidelines for specific population groups by analysing the health impacts from providing such guidelines. The review *does not* aim to describe current guidelines and/or assess the specific recommendations within guidelines. The review additionally aims to examine the consequences of obesity and physical inactivity with regard to managing health and recovery times from health conditions.

#### **1.2 Research questions for this review**

The review addresses the following questions:

- What would be the health impact of providing guidelines for improving the nutrition and physical activity of certain population groups?
- What are the consequences of overweight, obesity and physical (in) activity in terms of health outcomes and recovery times?

The findings from the third research question (mentioned below) are included in Objective A2, as an overarching objective area report on existing policies in the broader thematic area of nutrition and physical activity:

- What policies are more effective and efficient in this area (information, advertising, taxation, reformulation, regulations, partnerships, etc.)?

### **1.3 Limitations to the review**

Limitations in the research must be noted. The review acknowledges that not all populations groups are covered, particularly for research question two. The review is based on the search methodology agreed with the client at the initial phase of the project. Not all population groups were included in the search strategy, hence why only certain populations groups are covered in this review. The population groups that structured the review were selected to give a general overview of various population groups for which guidelines could be, or have been, created: children; older adults; pregnant and breastfeeding women; hospitalised or bed-ridden patients; patients with specific diseases; and, citizens of certain Body-Mass Index (BMI) or physically inactive. Additionally, for the selected population groups limited evidence was found, such as for hospitalized and bed ridden patients, and, patients with specific diseases. The review acknowledges where further research is needed, specifically in expanding the focus to other population groups.

## **2 Methodology**

The review is based primarily on peer reviewed literature (which is prioritised), with grey literature used to supplement any gaps (but treated with caution and the strength of the evidence assessed). For each set of literature specific search terms and inclusion and exclusion criteria were used; and quality checks undertaken. The research questions and search terms were confirmed with DG SANTE at the start of, and then refined during a review point within, the process.

After the initial searching and extraction of literature, drafts were provided to DG SANTE and the Joint Research Centre (JRC) for review. Expert workshops (with experts from relevant academic and policy-making fields) were then held to discuss findings and highlight any additional sources to fill gaps, in order to improve the series of reviews. The final outputs of the study ('the reviews' as presented here for E) were then reviewed by a topic expert at the University of Birmingham.

While the methods to conduct this comprehensive literature review are systematic it is not a systematic review. More information on the methodology can be found in the Annexes.

### **2.1 Peer review method**

To search for and extract the most relevant peer reviewed literature the following steps were taken: refining the research questions; developing a search approach and databases; conducting literature searches; screening articles for inclusion; and abstracting and synthesizing relevant data.

A total of 7363 search hits of peer reviewed literature were initially retrieved using selected search terms per research question. A total of 1999 duplicates were found and removed from the search hits resulting in 5,364 search results for E. From the 5,364 articles, the team aimed to screen 200 of the most recent titles and abstracts for each research question to create a manageable amount of material within the resources for the study; and on the premise that the most recent material was most relevant science). Where there was a lack of literature that answered the research questions, more than 200 articles were screened. From the 1330 most recent titles and abstracts screened, 77 were deemed of potential relevance and reviewed as full texts. From the 77 deemed relevant and reviewed as full texts 25<sup>1</sup> publications were selected for inclusion, in the final review.

The full peer reviewed searching and extraction methodology is outlined in Annex 1.

### **2.2 Grey literature method**

To search for and extract the most relevant grey literature the following steps were taken: searching for publications using agreed keywords and databases; screening of search results and exclusion of less relevant literature; and, extraction and review of remaining documents. The grey literature search process was a more fluid and dynamic process, where hand searching was also utilised to find the most relevant sources.

A total of 70398 search hits of grey literature were initially retrieved using selected search terms. A total of 3520 search results were retrieved and saved for E. From the 3520 articles, the team excluded 3326 based on lack of relevance to the research questions. From the 194 results saved in the library 132 were excluded based on the inclusion/exclusion criteria, quality of evidence and relevant to the research questions. From the 62 deemed relevant and reviewed as full texts, 11 publications were selected for inclusion, in this final review. The full grey literature searching and extraction methodology is outlined in Annex 4.

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<sup>1</sup> The full list of references included from the peer-reviewed literature can be found in Annex 3 and includes three publications recommended by the external expert review panel.

### 3 Findings and discussion

#### 3.1 Research question 1: What would be the health impacts of providing guidelines for improving the nutrition and physical activity of certain population groups?

A lack of evidence was found on evaluating the impact of guidelines. Much of the evidence found was focused on describing guidelines and recommendations, and the general effects that nutrition and physical activity can have on health. This has resulted in a limited number of studies presented. The review acknowledges that further research is needed to be conducted on evaluating the impact and usefulness of guidelines. The following section is split into nutrition guidelines, physical activity guidelines, and factors influencing the effectiveness of guidelines.

##### 3.1.1 Summary of findings

###### Nutritional guidelines

- Adherence to dietary recommendations can have a positive health impact and reduce the number of deaths attributable to cancer and cardiovascular disease among adults.
- Nutritional guidelines for children could reduce the risk of NCDs in later life.
- Guidelines may need to be tailored to specific health conditions in order to have a positive health impact, for example in pregnant and breastfeeding women.
- There is uncertainty over whether specific nutritional guidelines for older individuals would have more positive health impacts than those for all adults in general.

###### Physical activity guidelines

- There is a gap in the research on evaluating the direct health impacts of different physical activity guidelines for children and adolescents.
- There is a general consensus in the literature that regular physical activity in all ages is associated with immediate and long-term physical and psychological wellbeing.
- The recommended intensity level of physical activity will vary according to weight, which can make measuring the impact that specific guidelines have more difficult, due to this potential resulting variation in activity levels.
- The literature suggests that physical activity guidelines should not differ between adult population groups, unless individuals have specific health conditions.
- For population sub-groups with specific health conditions, it is widely recognised in the literature that nutrition and physical activity guidelines should be adapted to the individual so that the most beneficial health impacts can be achieved.
- The impact of guidelines will vary depending on the context in which they are implemented – they need to be supported by other policy actions which create environments and conditions that make it easier for people to make healthier choices.

### **3.1.2 Nutrition guidelines**

#### **Adherence to dietary recommendations can have a positive health impact and reduce the number of deaths attributable to cancer and cardiovascular disease among adults.**

Two statistical modelling studies provide insights into the potential reduction in mortality among general populations in the UK and Canada. Scarborough et al. (2012), found that adhering to UK dietary guidelines would have significant health benefits. The authors constructed a statistical model that considered the relationship between consumption of different dietary components, biomarkers such as blood pressure, cholesterol, and obesity, and how this relationship impacted mortality rates from coronary heart disease, strokes, and cancer.<sup>2</sup> They found that if dietary recommendations for choosing fruits, vegetables, saturated fat, and salt were achieved<sup>3</sup>, there would be a reduction of 33,000 deaths (among people aged 75 years or younger) per year from stroke, cardiovascular disease, and cancer. The greatest impact was found in Northern Ireland and Scotland.

Similarly, Belanger et al. (2014) examined the impact on mortality prevention of adhering to Canadian national dietary guidelines. Their statistical modelling based on data from a national survey indicated that nearly 30,540 deaths per year in Canada could be avoided by adhering to the sex-specific dietary guidelines for adults over 15 years of age. The dietary consumption patterns that were assessed and included in the model were intake of fruits and vegetables, fibre, salt, total fat, mono-unsaturated fat, polyunsaturated fat, saturated fat, and trans-fat.<sup>4</sup> Results indicated that recommendations for fruit and vegetable<sup>5</sup> intake demonstrated the most potential for mortality prevention.

#### **Nutritional guidelines for children could reduce the risk of NCDs in later life.**

Gidding et al. (2005) conducted a non-systematic review intended to provide healthcare providers with dietary recommendations for healthy children and adolescents. These dietary recommendations were based on reviews of the epidemiological evidence for the risk factors for cardiovascular disease and have been assessed as lowering risk prevalence and either delaying or preventing onset of cardiovascular disease. Gidding et al. concluded that children from the age of 2 years and older should follow the same dietary requirements as adults to reduce their risk of cardiovascular disease. The recommendations include decreasing the intake of sugar-sweetened beverages, increasing the consumption of fish, especially oily fish, and reducing salt intake, including salt from processed foods.

#### **Guidelines may need to be tailored to specific health conditions in order to have a positive health impact, for example in pregnant and breastfeeding women.**

The importance of providing tailored nutrition guidelines to pregnant and breastfeeding women is becoming increasingly recognised. Maternal nutritional status has a significant effect on the nutritional status of the child, when in foetal development, and when breastfeeding (WHO, 2016). Improving maternal nutritional health can reduce the impact of morbidity and risk factors attributed to NCDs. The WHO Regional Office for Europe (2016), in their review of scientific publications from 2010 to 2015 highlight the importance of promoting nutritional guidelines to pregnant and breastfeeding women, to promote the health of both the mother and child. The

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<sup>2</sup> Scarborough et al. (2012) used effect sizes from a meta-analysis of individual-level studies quantifying the impact of increased consumption or increased risk level on disease outcomes to inform the model.

<sup>3</sup> Recommendations considered: five portions of fruit and vegetables a day; salt intake reduced to 3.5g per day; saturated fat intake reduced to 3% of total energy.

<sup>4</sup> The recommendations included 8-10 portions of fruit and vegetables per day for men, 7-8 for women; 30-38g per day of fibre for men, 21-25g per day for women; 20-35% total energy to come from fat; salt intake should not exceed 5.8 g per day.

<sup>5</sup> The authors calculated recommended daily amounts from the guidelines: for men, 525.5 g/d for fruits and 437.0 g/d for vegetables. For women, the recommendations are 451.5 g/d for fruits and 423.5 g/d for vegetables.

report explains that pregnancy is a unique window of opportunity to engage with women and their families. It can be a time of intense contact with health care services and professionals. It can be assumed that pregnant women are generally motivated to make changes to their eating and physical activity habits for the benefit of their infants and themselves. Based on a survey of country offices within the region, the report highlights that not all countries do offer specific guidelines for pregnant women; it did not comment on the impact of guidelines in the countries that do. However, recent observational studies in Canada indicate that pregnant women's adherence to national dietary recommendations is low, suggesting a need for any nutritional guidelines to be particularly promoted to pregnant women in order to have any impact at all (Jarman, Bell, Nerenberg, and Robson, 2017).

**There is uncertainty over whether specific nutritional guidelines for older individuals would have more positive health impacts than those for all adults in general.** Among older adults, malnutrition is associated with a high risk of death, therefore the maintenance of a good nutritional balance is important (Poniewierka 2012). Gidding et al (2005) note that recommendations on the amount of daily calorie intake can vary by age, gender, and, activity level. For example, food intake for people over the age of 70 years can decrease due to decreased energy usage (Lichtenstein et al., 2008). Based on their initial Modified Food Pyramid for adults aged over 70 years, Lichtenstein et al. (2008) offer a modified version of the dietary requirements for adults, where daily intake is less but vitamin and mineral intake remains constant or can even increase. However, a feasibility study conducted by the European Commission's Joint Research Centre (JRC) on dietary recommendations for older adults in the European Union, found that dietary recommendations for healthy adults are appropriate for older adults, except for some nutrients (Mak 2014). In regards to how to increase the nutrient intake in the older adult population, there is insufficient evidence showing the effectiveness of vitamin and nutrient supplements for positive health impacts, compared to increasing nutrient intake from natural food sources (Mak and Calderia 2014). More research is needed in this area to determine which guidelines have the most health impact for the older adult population and how the guidelines can be achieved.

### **3.1.3 Physical activity guidelines**

**There is a gap in the research on evaluating the direct health impacts of different physical activity guidelines for children and adolescents.** Physical activity is widely recognised as beneficial for the health of children and adolescents, yet the health impact from guidelines is difficult to determine as there is uncertainty on what amount of physical activity lead to the greatest health benefit.

**There is a general consensus in the literature that regular physical activity in all ages is associated with immediate and long-term physical and psychological wellbeing.** For example, the WHO and the UK Department for Health have both produced reports, based on evidence from reviews and observational and experimental studies, demonstrating that higher levels of physical activity (moderate-to-vigorous intensity) were positively associated with more favourable health outcomes, and improvements in health-related measures in children and adolescents (WHO, 2010; UK Department for Health, 2011). In adults, improved health outcomes have been associated with the improved cardio-respiratory fitness that comes with regular vigorous physical activity (Nordic Council of Ministers, 2014). Clinical and epidemiological studies have demonstrated that moderate physical activity, even if it does not lead to the same improved fitness, also has favourable impacts on several risk factors for coronary heart disease and type-2 diabetes (Nordic Council of Ministers, 2014).

**While guidelines recommend a level and amount of moderate-vigorous intensity of exercise for all adults, people who are overweight or obese may first need to work at a lower intensity for longer.** In discussing the development of revised physical activity guidelines in 2011 the UK Department for

Health (2011) cautions that it found that for those who are overweight or obese, achieving a healthy weight is likely to require a greater level of activity than the 150 minutes recommended for all adults, and should be accompanied by dietary changes to reduce calorie intake. They recommend further that people who are overweight or obese should first aim to gradually build up to 150 minutes of moderate intensity activity per week (UK Department for Health, 2011) before increasing intensity. It is likely that overweight or obese adults are not adhering to these guidelines; a 2015 English statistical bulletin from the UK's Health and Social Care information Centre (HSCIC, 2015) reported evidence from the 2008 Health Survey for England<sup>6</sup> showing a clear association between adhering to UK guidelines for physical activity and the BMI of a person<sup>7</sup>. This can therefore make evaluating the impact of them difficult, if people are not following them in a uniform way.

**However, the literature suggests that physical activity guidelines should not differ between adult population groups, unless individuals have specific health conditions.** The WHO recommends that the same physical activity guidelines should apply to all adults regardless of gender, race, ethnicity, or income level, unless health conditions prohibit it (WHO, 2010). Adults with disabilities are also encouraged to follow the recommendations, although it is acknowledged that adjustments may need to be made for individuals, depending on capacity for exercise and specific health risks or limitations (WHO, 2010). Similarly, the review by the UK Department for Health report (2011) found no evidence that the guidelines should be different for different groups of adults, including those with disabilities although it also acknowledges the limitations in opportunities for some members of this group. The study states that even relatively small increases in physical activity are associated with some protection against NCDs and an improved quality of life. While it also recommends 150 minutes of moderate-to-vigorous activity for all adults per week, the review found that for those who are overweight or obese, achieving a healthy weight is likely to require a greater level of activity than the 150 minutes, and should be accompanied by dietary changes to reduce calorie intake. People who are overweight or obese should first aim to gradually build up to 150 minutes of moderate intensity activity per week. The review found that this will provide substantial health benefits even in the absence of reductions in body weight.

With regard to age, Nelson et al. (2007), based on evidence from an expert panel review<sup>8</sup>, found that guidelines for regular physical activity in older adults can reduce the risk of or help manage NCDs, as well as reduce the risk of depression and anxiety. The panel made recommendations that were similar to those for all adults, with the same expected health benefits, but included some important differences:

- The intensity of aerobic activity should be relative to an older person's aerobic capacity;
- Activities that increase flexibility are recommended;
- Balance exercises are recommended for older adults at risk of falls.

These differences were included in order to take into account any chronic medical conditions, lower levels of fitness or functional limitations that are more likely to be experienced by older adults. In terms of specific health benefits, as with other peer-reviewed literature, Nelson et al. found that there was evidence of a dose-response relationship between physical activity and the prevention of weight gain for older adults. Other reports emphasised the need for older adults to aim for similar levels of

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<sup>6</sup> A 2016 statistical bulletin is available but does not discuss these figures in particular, which were only analysed in a particular wave, 2008, of the Health Survey for England.

<sup>7</sup> Both men and women who were overweight (BMI 25-29.9 kg/m<sup>2</sup>) or obese (BMI ≥30 kg/m<sup>2</sup>) were less likely to meet the recommendations compared with men and women who were not overweight or obese (BMI <25 kg/m<sup>2</sup>).

<sup>8</sup> Experts were from the sectors of public health, behavioural science, epidemiology, exercise science, medicine and gerontology.

activity to those of all adults. The WHO (2010) and the UK Department for Health (2011) reports state that it is important for adults to maintain, if physically able, the same levels of physical activity throughout their later adulthood to achieve and/or maintain positive health impacts. The UK Department for Health additionally recommends that it is even more important for older adults to meet or exceed physical activity guidelines as a lack of physical activity in older adults exacerbates issues such as a loss of muscle strength and excess fat, which can impair an individual's ability to undertake daily tasks due to decreased function and mobility.

**For population sub-groups with specific health conditions, it is widely recognised in the literature that nutrition and physical activity guidelines should be adapted to the individual so that the most beneficial health impacts can be achieved.** For example, individuals with diabetes should have specific nutrition and physical activity guidelines dependent on their type of diabetes. In a non-systematic review of the evidence, Hayes and Kriska (2008) found that regular physical activity (and insulin management measures) can help prevent or delay the onset of diabetes-specific complications such as numbness of the limbs (neuropathy), retina damage/vision impairment and kidney damage, as well as reduce the risk of cardiovascular disease. In their review of the recommendations from the European Association for the Study of Diabetes and the evidence base associated with the recommendations, Mann et al. (2004) found that the guidelines which will have the greatest positive health impacts on individuals with diabetes have to be specific to the type of diabetes that person has. Examples of recommendations include, patients with type 1 diabetes and evidence of kidney damage should consume a restricted protein diet, at a maximum of 0.8 g per kg body weight per day, and, if blood glucose levels are satisfactory, intakes of free sugars up to 50 g/day may be included in the diet of people with type 1 or type 2 diabetes (Mann et al. 2004). Other recommendations mirrored those for the general population. By tailoring guidelines in this way, the authors found that people with different types of diabetes can manage their blood sugar better; maintain quality of renal function and reduce BMI (which has been found to be linked with increased mortality in diabetic individuals).

#### **3.1.4 Factors influencing the effectiveness of guidelines**

**The impact of guidelines could vary depending on the context in which they are implemented.** The literature suggests that there are other factors that can affect the health impact of guidelines and that guidelines alone cannot change people's behaviour (UK Department of Health, 2011). For example, for physical activity guidelines to have a large health impact, they must be accompanied by concerted actions that create environments and conditions that make it easier for people to be more physically active and less sedentary (UK Department of Health, 2011). The case study below is an example of how the context in which guidelines are implemented can affect their overall health impact.

#### **Case study: Guidelines that are adapted to a local context could increase their overall effectiveness**

Harris et al. (2006) analysed the Australian Better Health Initiative (ABHI) Implementation Plan, developed as part of a Council of Australian Governments Reform Package. The aim of the initiative was to achieve better health for all Australians. The (University of New South Wales (UNSW)) study conducted a health impact assessment to make practical recommendations to improve the equity of the proposed strategies. The study analysed the potential impact of physical activity and nutrition guidelines for two to five-year-old children in childcare settings. After affirming that developing physical activity and nutrition guidelines for this group can potentially have a positive impact on the health of children and on the prevention of NCDs later in life, the study suggests that the

implementation and impact of the guidelines could vary depending on the local context where the guidelines are implemented and the socio-economic situation of the parents. Children living in rural and remote areas where there are few services and those children whose parents are unable to afford services or reach them could experience a more limited implementation of the guidelines. Guidelines may be differentially taken up by children services providers with a chance that those services that are part of larger organisations, or with wealthier parents, being able to adopt the guidelines more easily. Also, there may be a greater impact on children in long day care and the guidelines may impact on the cost of food provided by child care services.

The health impact of guidelines needs to be further researched as there is limited evaluation of the overall effectiveness of creating and promoting guidelines.

### **3.2 Research question 2: What are the consequences of overweight, obesity, and physical (in)activity in health outcomes and recovery times?**

Research indicates that being overweight, obese or physically inactive can increase the adverse effects of NCDs such as cardiovascular disease, diabetes and cancer. Being able to manage weight through nutrition and physical activity is important in the management of health conditions such as pregnancy and physical injury, as well as for improving recovery times. The following section presents the peer-reviewed and grey literature findings that were found for specific health conditions and diseases. This review does not aim to cover health outcomes and recovery times from all diseases and health conditions and acknowledges that there are gaps for further research. Limited evidence was found that specifically linked overweight, obesity, and physical (in)activity to health outcomes and recovery times from a number of health conditions, so the review includes studies looking at the general effect of nutrition (for example the benefits of particular diets) and physical activity in these areas.

#### **3.2.1 Summary of findings**

- Regular physical activity can help manage cardiovascular disease in individuals through improving blood pressure and cholesterol levels.
- High levels of aerobic fitness could have greater impact on health outcomes from cardiovascular disease than the presence of obesity.
- Avoidance of weight gain can reduce the risk of some cancers.
- Physical activity can lead to a decrease in risk of cancer recurrence, mortality, and an improvement in cancer survivors' survival and functioning.
- Physiotherapy as a form of physical activity could improve the recovery time of breast cancer patients who have undergone surgery.
- Obesity and overweight can increase the risk of sustaining injury in adults.
- Youths who are obese may take longer to recover from a combined physical injury than youths of a normal weight.
- Maternal obesity, before and after conception, can increase the risk of pregnancy-related complications.

### 3.2.2 Cardiovascular Disease

#### **Regular physical activity can help manage cardiovascular disease in individuals through improving blood pressure and cholesterol levels.**

Thompson and Franklin (2004) report that exercise-based rehabilitation after a heart attack can reduce mortality rates. The authors report on a meta-analysis of 48 RCTs reporting a 20% reduction in total mortality and cardiac mortality reduced by 26% in patients enrolled in cardiac rehabilitation programs. It is cautioned by Thompson et al. (2013) that clinicians should follow guidelines and risk assessment protocols before encouraging cardiac rehabilitation patients to engage in physical activity, particularly for patients at high risk, which could include patients who are overweight or obese.

#### **Levels of aerobic fitness could have greater impact on health outcomes from cardiovascular disease than the presence of obesity.**

Fogelholm (2010) conducted a systematic review to study the relative health risks of poor cardio-respiratory fitness (or physical inactivity) in normal-weight people versus obesity in individuals with good cardio-respiratory fitness in Finland, Brazil, Greece, UK, US, Norway, and Sweden. The authors found that the risk for all-cause and cardiovascular mortality was lower in individuals with high BMI and good aerobic fitness, compared with individuals with normal BMI and poor fitness. This suggests that even among obese individuals, good aerobic fitness may be more important for cardiovascular health than absence of obesity. However, having high BMI even with high physical activity was a greater risk for the incidence of type 2 diabetes and the prevalence of cardiovascular and diabetes risk factors, compared with normal BMI with high physical activity.

#### **Specific diets may contribute to primary and secondary prevention of, and health outcomes from, cardiovascular disease.**

A review of meta-analyses of intervention and cohort prospective studies and by Eilat-Adar et al. (2013) showed that following a Mediterranean diet<sup>9</sup> of high fat intake could reduce cardiovascular morbidity and mortality in both primary and secondary prevention. Eilat-Adar et al. (2013) assessed the association between nutrition and cardiovascular disease from a non-systematic review of the literature on diet. The diets assessed were: low-fat diet<sup>10</sup>, low-carbohydrate diet<sup>11</sup>, Mediterranean diet, and the dietary approaches to stop hypertension [DASH]<sup>12</sup> diet. The review was based on a comprehensive literature review of meta-analyses of interventions, prospective cohort studies and cardiovascular health outcomes, and systematic reviews. Evidence was categorized based on the strength of findings and level of evidence (e.g. highest level of evidence was data derived from multiple randomized clinical trials or meta-analyses). Evidence was finalized and approved by an expert committee; and was also reviewed by outside specialists from the Israeli Heart Society and Israeli Dietetic Association. Dietary patterns were identified as having benefits for specific medical conditions. Notably, the use of DASH diet for hypertension; and low-carbohydrate diets for overweight individuals and for metabolic syndrome.

Another study, by Ignarro et al. (2007), found that diets high in fibre can reduce the risk of cardiovascular disease, and diets high in omega-3 fatty acids can reduce inflammation, prevent vascular calcification and can therefore serve in the primary and secondary prevention of cardiovascular disease. Ignarro et al. (2007) reviewed evidence exploring links between specific nutritional factors (e.g. lycopene, polyphenols, dietary fibre and fatty acids) and cardiovascular disease. No methodology

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<sup>9</sup> Mediterranean diet includes high fat intake (40-50% total daily calories) with saturated fat comprising  $\leq 8\%$  and mono-unsaturated fat comprising 15-25% of total calories.

<sup>10</sup> Low-fat diets are typically based on total fat consumption of 25-35% total calories, with no more than 7-10% from saturated fat, and less than 1% from trans fat.

<sup>11</sup> Low-carbohydrate diets are defined as consumption of 30-130 g of carbohydrate per day or up to 45% of total calories.

<sup>12</sup> The DASH diet is high in fruit and vegetables, low-fat dairy products, whole grains, chicken, fish and nuts. It is low in fat, meat, sweets, and sodas.

is identified by the authors beyond “examining the scientific evidence”. Ignarro et al. (2007) identified epidemiologic (non-clinical trial) evidence that lycopene is protective against cardiovascular disease. Examining the evidence related to polyphenols (anti-oxidants) in pomegranate fruit and grapes, the authors identified that polyphenols can protect against vascular damage. Findings from cohort studies demonstrated consistent evidence of dietary fibre being protective against cardiovascular disease and report that increased intake of whole-grain dietary fibre, fruits and vegetables should be used as an approach to prevention. Additionally, the authors found that epidemiological and clinical trials provided evidence that omega-3 fatty acids (e.g. fish oils and plants rich in alpha-linolenic acid) reduce inflammation, prevent vascular calcification and can therefore serve in the primary and secondary prevention of cardiovascular disease.

### **3.2.3 Cancer**

**Avoidance of weight gain can prevent the risk of some cancers.** The World Cancer Research Fund estimates that a third of the most common cancers in high income countries, and roughly a quarter of cancers in lower income countries, could be prevented through healthier dietary behaviour, being physically active, and keeping a constant healthy weight (World Cancer Research Fund International / American Institute for Cancer Research, n.d.). Estimations are based on calculating the percentage of cancer preventability by appropriate diet, nutrition, physical activity and body fatness in the USA, UK, Brazil, and China. Additionally, the International Agency for Research on Cancer stated that obesity-related cancer burden represents up to 9% of burden among women in Europe, North America, and the Middle East (Lauby-Secretan et al., 2016). Cancer Research UK further states excess body weight is the second largest preventable cause of cancer each year in the UK, and that keeping a healthy weight could prevent 18,100 new cancer cases per year in the UK, which is 5% of all new cancer cases per year (Cancer Research UK, 2014). In the searching process for this review, studies reported either the effect of obesity and overweight on the health outcomes and recovery time for patients that have, or have had, cancer, or the overall effects of nutrition and physical activity on the risk of cancer reoccurrence and recovery time.

**Physical activity can lead to a decrease in risk of cancer recurrence, mortality, and an improvement in cancer survival and functioning.** A systematic review and meta-analysis<sup>13</sup>, found that exercise of a moderate intensity for cancer survivors can reduce fatigue and improve mobility (Dennett et al., 2016). All studies included in the review were randomized trials. The authors included studies with aerobic or resistance exercises as a key intervention component, as well as sufficient reporting of dose (intensity or duration). Combinations of aerobic and resistance exercises had the largest treatment effect, with smaller effects for aerobic or resistance exercise alone. The authors found that there was a negative dose-response effect for exercise intensity on fatigue, meaning that moderate-intensity exercise was more effective at reducing fatigue than high intensity exercise; the same effect was found with respect to walking endurance.

Rock et al. (2012) additionally found strong evidence that physical activity can positively impact physical functioning, fatigue and quality of life of cancer patients and there is some evidence to suggest physical activity does not interfere with chemotherapy. The evidence was summarised from an expert group, convened by the American Cancer Society (ACS), made of up experts in nutrition, physical activity, and cancer survivorship who evaluated the scientific evidence and best clinical practices

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<sup>13</sup> Of the 42 trials, 19 included only aerobic and 5 only resistance exercises, and 14 used a combination of both. Four other trials compared one form of exercise to another. About half were supervised by a professional (n=23), most by physio- or kinesiio-therapists. The duration of interventions ranged from 15 days to 1 year, with most lasting at least 12 weeks. The exercise sessions were 10-90 minutes, 2-3 times a week, with the average length of exercise per week at 104 minutes.

that were related to nutrition and physical activity recommendations once an individual was diagnosed with cancer. Evidence showed that physical activity during treatment improves bone health and muscle strength post-treatment (Rock et al. 2012). In addition, physical activity is particularly important for cancer survivors who are disease-free because those who have had cancer have a higher risk of other cancers and NCDs (e.g. cardiovascular disease and diabetes). Observational studies demonstrated physically active survivors of breast, colorectal, prostate, and ovarian cancer have improved survival rates and lower risk of recurrence (Rock et al. 2012). It must be noted that these associations may be dependent on individual level clinical factors, such as type of cancer, meaning that cancer treatment and guidelines may need to be individualized based on need and health status of the individual. The guidelines from the ACS encourage patients to work closely with physicians to develop an individualised physical activity plan, avoid inactivity and return to normal activity as soon as possible following diagnosis, exercise at least 150 minutes per week, and include strength training at least two days per week (Rock et al. 2012).

**Physiotherapy as a form of physical activity could improve the recovery time of breast cancer patients who have undergone surgery.** A systematic review of articles from Korea, Spain, US, Canada, Israel, Netherlands, and the UK showed the effectiveness of different exercise interventions on health outcomes (lymphedema and upper arm morbidity) in women with breast cancer who had undergone surgery (Chung, Hwang and Park, 2013)<sup>14</sup>. Physiotherapy was found to be effective in improving outcomes such as range of motion and shoulder function, especially when initiated early after surgery. Measuring the effect of exercise on lymphedema was limited by the fact that only two of the seven studies measured lymphedema beyond six months. While these two studies did show an effect of exercise, the other five did not, underscoring the need for more long term studies as lymphedema onset can occur within two years of surgery. These studies also showed the effectiveness of exercise on other factors such as improving quality of life (n=4) and decreasing fatigue (n=1). The authors further found that interventions that had supervised exercise activities achieved higher adherence than self-directed ones, and thus provided more benefits.

### **3.2.4 Physical injury**

**Obesity and overweight can increase the risk of sustaining injury in adults.** Finkelstein et al. (2007) analysed a nationally representative dataset of 42,304 noninstitutionalized adults from the United States in order to quantify the relationship between BMI and rates of medically attended injuries by mechanism (e.g. fall, sport-related, motor vehicle); their nature (e.g. dislocation, fracture, sprain); and between injury treatment cost and BMI. The authors used regression analysis to estimate the odds of sustaining any injury by nature or by mechanism for overweight (BMI between 25 and 29.9 kg/m<sup>2</sup>) and three categories of obese individuals compared with those of normal weight. If an injury occurred, a second set of regressions was performed to test whether obese individuals had greater injury treatment costs. They found a clear association between BMI and the probability of sustaining an injury, with the odds of sustaining an injury to be 15% (overweight) to 48% (Class III obesity (BMI 35.0-39.9 kg/m<sup>2</sup>) greater among those with excess weight. In particular, their results suggested that the incidence of injuries related to falls will likely increase as obesity rates continue to rise, along with increases in sprains/strains, lower extremity fractures, and joint dislocations. However, their cost regression analysis did not yield strong results to indicate that the costs of treating an injury are independent of BMI.

**Youths who are obese may take longer to recover from a combined physical injury than youths of a normal weight.** In a cross-sectional analysis, Warsh,

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<sup>14</sup> The types of interventions contained in the studies included physiotherapy (n=3), combined physiotherapy and physical training (n=1), comprehensive rehabilitation not involving physiotherapy (n=2), aerobic exercise (n=2), weight lifting (n=1), aqua lymphatic therapy (n=1), and a dance program (n=1).

Jansen, and Pickett (2010) analysed 2,831 youths, aged 11-16, who reported experiencing an injury. The authors computed relative hazards for non-recovery from injury events among normal weight, overweight, and obese youths. The International Obesity Task Force age and gender specific BMI standards for youth were utilized to categorize youths as normal weight, overweight (BMI of 25), or obese (BMI of 30). Measurements were self-reported. The authors found that students who experienced a combined injury (e.g. broken bone and ankle sprain) and who were obese took longer to recover than normal weight students. However, there was not a statistically significant difference in recovery time for either broken bones or sprains or strains as individual injuries. Additionally, the authors found no evidence of BMI status modifying the relationship between youths' (age 11-16) physical activity participation and risk of injury.

### **3.2.5 Pregnancy**

**Maternal obesity, before and after conception, can increase the risk of pregnancy related complications.** The WHO (2016) found that as the number of overweight and obese women entering pregnancy has increased; pregnancy-related complications are becoming more important women's health issues. A review of evidence on maternal nutrition (Poston et al. 2016) found that pre-pregnancy overweight and obesity are associated with impaired fertility, higher risk of preterm birth, difficulties during labour and delivery, risk of post-partum haemorrhage, co-morbidities, and mortality. Maternal nutrition is also associated with an increased risk of gestational hypertension and diabetes, which are strongly correlated with large-for-gestational-age infants and can alter the offspring's glucose and lipid metabolism and induce hypertension.

Further research is needed in this area on the effects of obesity in pregnant women on health outcomes of the mother and child, and recovery times after giving birth.

## **4 Conclusion**

There is limited evidence assessing the health impact of providing guidelines to particular populations. Beyond a small number of studies, for example, looking at the dose-response association established between the amount of moderate-to-vigorous physical activity and health benefits, the experimental evidence base mainly provides general rationale for nutritional and physical activity guidelines, for example, the impact of maternal nutrition during pregnancy on the health and future health of the unborn child. Apart from statistical modelling, it has not been well established how the act of providing guidelines specifically affects these health outcomes – further research is required in this area. The effectiveness of guidelines can vary depending on the context in which guidelines are implemented and the target population. Additional research is needed on the impact of the social, environmental, and political environment in which guidelines are implemented to understand how guidelines can be used in the most effective and efficient way.

Despite this, the rationale and need for providing nutritional and physical activity guidelines to different populations remains clear, given the different potential health outcomes associated with poor nutrition, overweight and obesity, and physical (in)activity. These include the increased risk of diseases, particularly type 2 diabetes and cardiovascular diseases, and BMI appears to have an association with an increased risk of injury and longer recovery times after injury. Diet and physical activity can also play an important role in both the prevention and management of NCDs, necessitating the need for guidelines for people with different conditions.

## **Annex 1 Peer-reviewed literature review methodology**

This sub-section describes the approach taken between March 2016 and January 2018 to gather and synthesise the evidence.

### **A1.1 Research questions for this review**

In this comprehensive review, current literature was gathered and synthesised, addressing objective E. This literature review provides a review of relevant, recent studies using the methodology presented below to summarise this topic. While the methods to conduct this comprehensive literature review are systematic it is not a systematic review. Note that unlike a systematic review, this review does not systematically analyse literature to identify *all* relevant published data and/or appraise its quality. To explore the above stated topics, the literature review was conducted around the following agreed questions:

- What would be the health impact of providing guidelines for improving the nutrition and physical activity of certain population groups?
- What are the consequences of overweight, obesity and physical (in)activity in health outcomes and recovery times?

The findings from the third research question (mentioned below) are included in Objective A2, as an overarching objective area report on existing policies in the broader thematic area of nutrition and physical activity.

- What policies are more effective and efficient in this area (information, advertising, taxation, reformulation, regulations, partnerships, etc.)?

The methodology for the peer-reviewed literature is described below, with greater detail on search terms provided in other Annexes.

### **A1.2 Peer-Reviewed Literature**

Methods to conduct the literature review consisted of five steps: (1) refining the research questions, (2) developing a search approach and databases, (3) conducting literature searches (Stage 1 below), (4) screening articles for inclusion (Stage 2 below); and (5) abstracting and synthesizing relevant data (Stage 3 below).

In step 1, in partnership with DG SANTE the research questions above were confirmed. In step 2, the 3 stage approach noted below and databases were confirmed. To minimise bias, the literature search approach included identification of a priori search parameters (also considered first level inclusion and exclusion criteria) to guide searches and inform screening and selection processes for data inclusion. Steps 3, 4, and 5 followed the process below:

- Conduct searches and document results (Stage 1);
- Screening search results (title and abstract) for relevance (Stage 2);
- Review full publication and abstract key characteristics and study findings (Stage 3).

Searches were conducted in multiple databases and screened following the procedures below. Following the literature review pilot, it was agreed to merge Stages 1 and 2.

#### **A1.2.1 Stage 1: Conduct Searches and Document Results**

In Stage 1, searches were conducted using search terms and criteria agreed with DG SANTE, with filters set for databases to ensure accurate inclusion and exclusion of literature, as shown in tables below. The search terms used were specific to each of the three research questions. Literature searches were conducted in PubMed, EBSCO (CINAHL, ERIC, PsycInfo) and Embase. The reviewers used title and abstract [tiab] key word searches in EBSCO, PubMed and Embase. Medical Subject Heading (MeSH)

terms were also used in PubMed and Embase searches. Searches included publications with all availability types (i.e. free full text and pay/subscription access).

*Table 2. Inclusion and exclusion criteria applied at stage 1*

<b>Set database filters to include</b>	<b>Set database filters to exclude:</b>
Published between 1/1/2005-31/5/2016	Articles published before 1/1/2005
Peer-reviewed scientific publications: Original research Systematic reviews Meta-analyses	Editorial comments/commentaries Dissertations Theses Opinion articles
Article published in English, French, German, Italian Polish and/or Spanish	Article not published in English, French, German, Italian Polish and/or Spanish

In addition to reviewing studies in databases noted above, in order to help ensure inclusion of high quality literature (e.g., literature having gone through more formal quality assessments), systematic reviews and meta-analyses were reviewed for inclusion in the literature review. Searches for systematic reviews were conducted in Cochrane Review and [healthvidence.org](http://healthvidence.org).

As noted a separate search was carried out for each research question, resulting in three groups of publications for screening for Objective E. After the searches, the results were reviewed to ensure they accurately met search parameters and duplicates were removed for screening in Stage 2.

### **A1.2.2 Stage 2: Screening search results (title and abstract) for relevance**

At stage 2, two screening levels were used: level 1 quality check and level 2 screening. Additional screening (level 3), specific to the Objective E research questions was conducted to further facilitate obtaining relevant literature where this was necessary. Stage 2 screenings were done simultaneously. These screening inclusion and exclusion criteria are shown below.

#### **A1.2.2.1 Stage 2 Level 1 Initial Screening (Quality check)**

Search hits from all databases searched in Stage 1 were grouped by the 3 research questions and search terms to which they were related. Duplicate hits were deleted, and search hits by research question were organised from the most recent publications in 2017 going back in time to 2005, saved in an Excel file for that specific research question, and provided to reviewers for screening. These date parameters were agreed with DG SANTE as part of the pragmatic approach to managing the review material.

Using screening criteria in Table 2, reviewers screened the title and abstract of up to the first 200 hits per research question in each Excel file to identify literature to move forward for review<sup>15</sup>. This was done to ensure the screening process was manageable given project timelines yet captured the most recent and relevant literature.<sup>16</sup>

<sup>15</sup> As there was a lack of relevant literature for Objective E, for some research questions more than 200 relevant hits were looked at.

<sup>16</sup> Results for each research question were screened separately, however, as screening took place, team members considered if articles might be relevant to other research questions, and if so, coded the article as such.

### A1.2.2.2 Stage 2 Level 2 Subsequent Screening

Simultaneous with the Level 1 initial screening check, more detailed overall inclusion and exclusion criteria were applied by the reviewers to the title and abstract to screen publications. These criteria, are shown below in Table 3, Table 4, and, Table 5.

Table 3. Inclusion/exclusion criteria: stage 2, level 1 screening

Category	Inclusion criteria	Exclusion criteria
Date	Published between 1/1/2005-31/5/2016 <sup>17</sup>	Articles published before 1/1/2005
Publication type	Peer-reviewed scientific publications Original research Systematic reviews Meta-analyses	Editorial comments/commentaries Dissertations Theses Opinion articles Non-academic journal
Language	Article published in English, French, German, Italian Polish and/or Spanish	Articles in all other languages

Table 4. Inclusion/exclusion criteria: stage 2, level 2 screening

Category	Inclusion criteria	Exclusion criteria
Geography	Studies conducted in America, Australia, Canada, European Countries, Great Britain, Mexico or Brazil <sup>18</sup>	Studies in all other countries
Human subject	Human-focused research	Animal-focused research
Behaviour/ Outcome	Studies specific to guidelines for physical activity and nutrition  Studies specific to the evidence-base for physical activity and nutrition guidelines among certain populations such as children, adolescents, adults, older adults, people with cancer, people with heart	

<sup>17</sup> During screening, publications prior to 2005, and publications such as commentaries, dissertations or editorials were screened out, as were publications focusing on animals (rather than humans). Also note that ad hoc searches conducted post screening to supplement screened literature could have included literature post 2016.

<sup>18</sup> Note that systematic reviews could have references including other countries. Also ad hoc searches conducted post screening to supplement screened literature may have included other countries.

Category	Inclusion criteria	Exclusion criteria
	disease, people with diabetes, pregnant women or people with asthma	
General population	Studies where the population of focus includes children, adults or older adults in the general population	

Table 5. Inclusion/exclusion criteria: stage 2, level 3 objective area specific final screening

Category	Inclusion criteria	Exclusion criteria
<b>Objective area specific screening criteria for Objective E</b>		
Primary Objective E inclusion/exclusion criteria		
Although not specified in the original methodology, in order to secure data relevant to the objective area, reviewers applied criteria specific to objective search terms at stage 2. Articles meeting two primary inclusion criteria listed here were coded as "include". Any publication with one or more exclusion criteria was coded as "exclude".	Studies specific to the benefits of adhering to physical activity and nutrition guidelines	Studies examining broad associations between diet and physical activity
	Studies describing the specific dietary or physical activity needs of certain populations (children, adults, older adults, people with certain chronic conditions)	Studies examining associations between activity or nutrition and health outcomes among a specific occupation (nurses, truck drivers, shift workers)
	Studies focused on recovery from injury, surgery or disease outcomes among overweight/obese compared with healthy weight	Studies specific to recovery from injury or surgery or disease outcomes in the general population (no comparisons by weight or activity status)
	Studies focused on recovery from injury, surgery or disease outcomes among active individuals compared with those who are inactive	
	Studies specific to the implementation of policies or interventions focused on guidelines for physical activity or nutrition to change the environment/environmental opportunities (e.g., school physical	Studies that examine the impact of individual-level interventions to adhere to guidelines or policies

Category	Inclusion criteria	Exclusion criteria
	activity/PE recommendations or requirements; food labelling; school nutrition guidelines)	

From 1330 publications screened in stage 2, 77 publications were deemed of potential relevance, coded as “Include” and selected for full article review after stage 2 screening.

### **A1.2.3 Stage 3: Full Article Review and Synthesis**

77 publications were exported for review of full text in this Objective E literature review. After reading the full text, if the article was still deemed relevant for inclusion (based on consideration of the objective and if the article helped answer research questions), it was saved for use and reference in the bibliography. Following reading articles full text in this stage, 25 publications were selected for inclusion.

At each stage in this process, the team met to discuss successful strategies, challenges, and recommendations to improve the literature review processes. Note that although this is a comprehensive literature review and does not include a formal quality assessment process commonly conducted in systematic reviews, the team documented study designs (e.g., cross sectional, experimental) and the articles were checked by reviewers for signs of bias and poor quality research design. Further, the lead reviewer for each objective area conducted blind quality assurance checks for up to 10% of the coded articles. Any disagreements were discussed as a group and resolved with the review task lead.

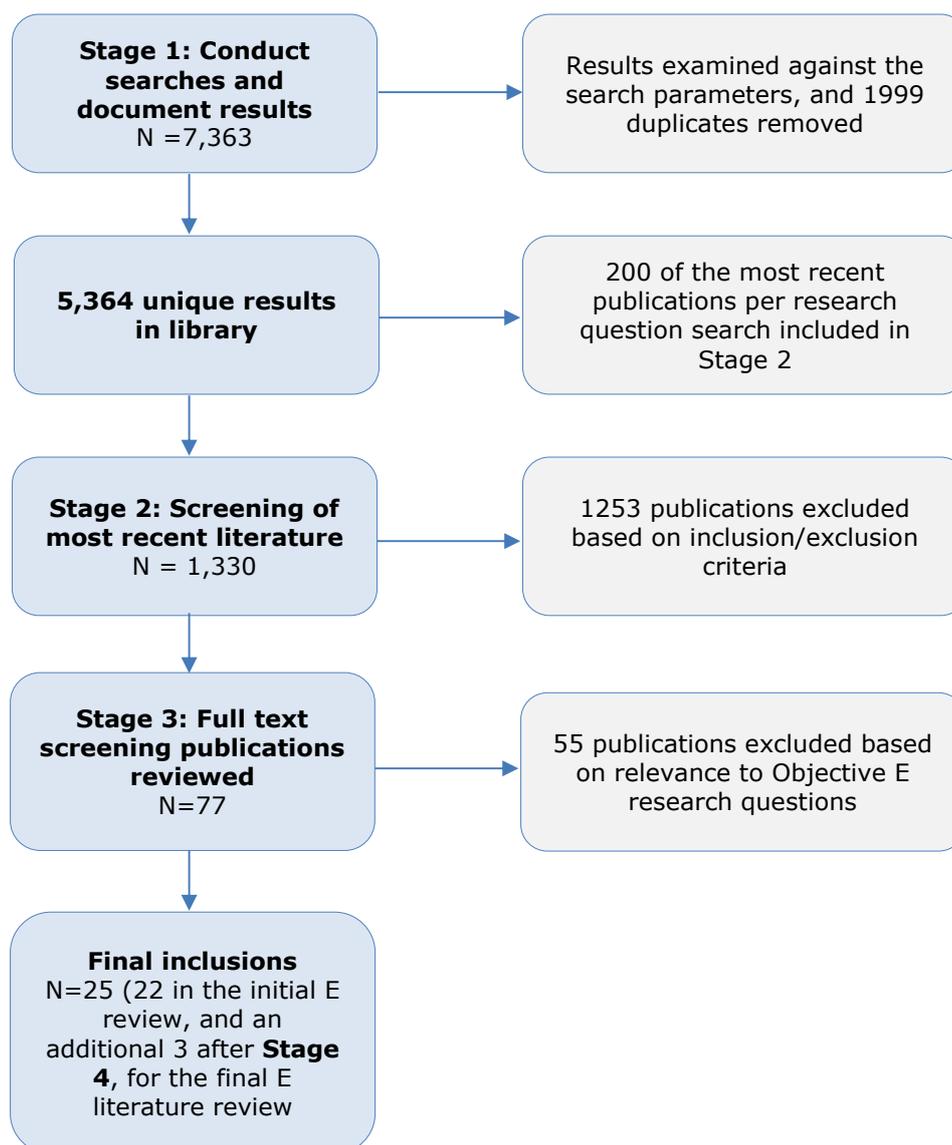
### **A1.2.4 External expert reviews and input**

Upon completion of the draft set of comprehensive literature reviews, expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews, Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed. As a result of this exercise, three additional references were screened and incorporated into these reviews.

### **A1.2.5 Number of included and excluded publications**

The diagram in Figure 1 below shows the number of articles identified in peer-reviewed literature searches, and the filtering out of literature at successive stages to arrive at the final number of 25 publications whose full text was reviewed and summarised for this review. The diagram also includes additional relevant references proposed by external experts, and incorporated into this final comprehensive review (as reflected in the final inclusion count of n=25).

Figure 1. Diagram showing number of included and excluded publications at each stage – peer reviewed literature



As shown in Figure 1, total of 7,363 search hits of peer reviewed literature were initially retrieved using selected search terms per research question. A total of 1,999 duplicates were found and removed from the search hits resulting in 5,364 search results for E. Normal practice for this series of reviews was to screen 200 of the most recent titles and abstracts for each of the research questions, to create a manageable amount of material within the resources for the study; and on the premise that the most recent material was most relevant science. However, due to the lack of literature found, 1,330 were screened, of which 77 were deemed of potential relevance and reviewed as full texts. From the 77 deemed relevant and reviewed as full texts (including suggested texts from the expert panel), 25<sup>19</sup> publications were selected for inclusion, in this final review.

<sup>19</sup> The full list of references included from the peer-reviewed literature can be found in Annex 3 and includes three publications recommend by the external expert review panel.

## Annex 2 Peer-reviewed literature search terms

Objective E search terms, research question one: what would be the health impact of providing guidelines for improving the nutrition and physical activity of certain populations groups?

Primary term:	Combined with:	And with:	And with:
Nutrition [mh]	Guideline [tiab]	Evaluation [tiab]	Children [tiab]
Diet [mh]	Recommendation [tiab]	Assessment [tiab]	Elderly [tiab]
Dietary [mh]	Scheme [tiab]	Health impact [tiab]	Older adult [tiab]
Food [mh]	Guideline as topic [mh]	Health outcome [tiab]	Pregnant women [tiab]
Screen time [mh]	Guideline* EBSCO	Impact [tiab]	Breastfeeding women [tiab]
Nutrition EBSCO	Recommendation* EBSCO	Evaluation EBSCO	Diabetic [tiab]
Diet EBSCO	Scheme EBSCO	Assessment EBSCO	Heart Disease [tiab]
Food EBSCO		Health impact EBSCO	Cancer [tiab]
Physical Activity EBSCO		Health outcome EBSCO	Inactive [tiab]
Screen time EBSCO		Impact EBSCO	Children EBSCO
Body mass index EBSCO			Elderly EBSCO
BMI EBSCO			Older adult EBSCO
			Pregnant women EBSCO
			Breastfeeding women EBSCO
			Diabetic EBSCO
			Heart Disease EBSCO
			Cancer EBSCO
			Inactive EBSCO

*Objective E search terms, research question two: what are the consequences of overweight, obesity and physical (in)activity in health outcomes and recovery times?*

<b>Primary term:</b>		<b>Combined with:</b>	
Exercise	[mh]	Recovery time	[tiab]
Physical fitness	[mh]	Impact	[tiab]
Physical endurance	[mh]	Consequence	[tiab]
Sedentary lifestyle	[mh]	Health Consequence	[tiab]
Exercise	[tiab]	Health impact	[tiab]
Physical fitness	[tiab]	Recovery time	EBSCO
Physical endurance	[tiab]	Impact	EBSCO
Physical activity	[tiab]	Consequence	EBSCO
Screen time	[tiab]	Health Consequence	EBSCO
Physical inactivity	[tiab]	Health impact	EBSCO
Obesity	[tiab]		
Obese	[tiab]		
Overweight	[tiab]		
Exercise	EBSCO		
Physical fitness	EBSCO		
Physical endurance	EBSCO		
Sedentary lifestyle	EBSCO		
Physical activity	EBSCO		
Screen time	EBSCO		
Sedentary time	EBSCO		
Physical inactivity	EBSCO		
Obesity	EBSCO		
Obese	EBSCO		
Overweight	EBSCO		

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## Annex 4 Grey literature review methodology

This sub-section describes the approach taken between March 2016 and January 2018 to gather and synthesise the evidence.

### A4.1 Detailed search and review methodology

The review followed a process with five main stages:

- Searching for publications using set keywords and databases;
- Screening of search results for relevance;
- Screen results against inclusion/exclusion criteria, quality and relevance;
- Extraction of full texts and final screening process; and
- External expert reviews and input.

### A4.2 Stage 1: Conducting searches and documenting results

#### A4.2.1 Searching for grey literature

The search terms initially used were agreed upon in the inception phase. The main key words were either specific to the objective or broader thematic terms; for Objective E the main key words included both 'Specific population groups (e.g. Children)' and 'Nutrition'. A second list of search terms was also used – these combination words were used to guide the search and produce the most relevant results; for objective E, the key word 'Nutrition' would be combined with the broader term 'nutrition guidelines'.

Table 6. Search terms use for objective E grey literature review

Search parameters	
Scientific evidence and policies of EU Member State initiatives	
Published in English, French, German, Italian, Polish and/or Spanish	
Date range (1995 – 2017)	
Key words and suggested combinations of search terms	
Key words:	Combined with:
Nutrition	Prevention guidelines
Physical activity	Prevention policies, prevention programs (programmes)
Physical inactivity	Health determinants
Obesity	Health outcomes (to include disease recovery times)
Overweight	Health impacts
Body Mass Index (BMI)	Evaluation
Health inequalities	Policy evaluations
Specific population groups: children, elderly (old or older adults), pregnant and breastfeeding women, hospitalised or bed-ridden patients, institutionalized adults, patients with specific diseases, citizens with certain Body-Mass Index (BMI) or physical inactivity levels, pre-diabetics, children, vulnerable groups (prisoners, Roma, other groups), shift workers	Regulation
	Nutrition guidelines
	Physical activity guidelines
	Member States (of the EU) / Country (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark,

### Search parameters

Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom)

#### A4.2.2 Using set key words in databases, search engines and websites

In order to appropriately link and define the relationship between the key and combination search terms, the Boolean operators 'AND', 'NOT' and 'OR' were used in the search engines. In particular, the use of 'AND' helped to narrow the number of hits to ensure that only documents which included all the search terms showed up. Further, if a search led to a high number of irrelevant hits, a repeat search was conducted and key words which were separated by spaces or other characters (e.g. Health impacts) were enclosed in quotation marks (e.g. "health impacts") to return only those documents that matched the search terms exactly.

The set key words and combination words were used to generate results in databases, search engines and websites recommend by the pilot review:

- Search Europa
- European Sources
- Eurostat
- NICE
- Open grey
- WHO websites

NICE evidence database and Search Europa yielded the most results. The grey literature search was a fluid and dynamic process. Initial searches with just one key and combination word led to a large number of results, many of which were not relevant to the objective question. For example, just using the key word 'nutrition' with the combination word 'evaluation' yielded many results which were not linked to guidelines. The grey literature team decided to combine more key and combinations words when searching such as 'nutrition', 'guidelines' and 'evaluation' so that searches were more focused on the objective's research questions. Additional hand searching was used to supplement the key and combination word. In addition, search results from other objectives that were relevant were included. For example, four search results identified in the searching process for objective A2 were included in the search results for objective E.

#### A4.2.3 Additional hand searching

As per the recommendation made in the pilot review, hand searching was also used to supplement the key word searches. Hand searching involved extending the basic key

word searches by using additional, contextual information. For example, in objective E phrases such as “Impact of obesity on clinical outcomes” were used to search for more relevant results to answer the research question ‘*What are the consequences of overweight, obesity and physical (in)activity in health outcomes and recovery times?*’ This process ensured that highly-focused and relevant search results were generated for the original key words, in this case, “obesity” and “health outcomes”. All hand searches for this objective were completed on Google.

#### **A4.3 Stage 2: Screen search results for relevance**

Most databases, search engines and websites offered the use of a relevancy filter<sup>20</sup> which automatically sorts results in order of their applicability to the key terms in the search engine. When a relevancy filter was not available, the links were manually screened by the appearance of the key search terms in the title of the source and the abstract (where available). For database and search engines, initially the top 50 most relevant search results were looked at per search string. If there were less than 50 results, all were looked at. The titles and abstracts were then examined for key search terms in the grey literature and relevance to the research questions.

Extra hand searching was conducted when search strings did not produce enough relevant information, and/or, when the top 50 results did not produce the most relevant literature.

Following the expert workshop (see stage 5 below), experts recommended further sources which were reviewed in the final redraft of the review.

Overall 194 results from the searching for objective E were saved into a library.

#### **A4.4 Stage 3: Screen results against inclusion/exclusion criteria, quality and relevance**

Results were then screened against agreed inclusion and exclusion criteria detailed in Table 7 below.

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<sup>20</sup> ‘Sorting by relevance’ on databases and search engines enables a connection to be established between the information in the database, the search string entered and any search filters chosen. If the keywords appear in a Title or Author field, the system shows these results first in the list of search returns. Less relevant articles e.g. ones where the keyword appears less often or may only appear in the actual content, appear later in the list of search results.

Table 7. Grey literature inclusion and exclusion criteria

Inclusion	Exclusion
Published between 1995-2017	Published or enacted prior to 1995
Government reports from European Commission, European Parliament and EU Member States.	Non-nutrition and physical activity themed/focused
Think tank reports/publications	Industry-produced publications
Academic papers, conference papers and abstracts	Industry-produced project evaluation reports
Bibliographies	Industry-produced good practice reports
Programme evaluation reports <sup>21</sup>	Publications focusing on animal nutrition and physical activity
Standard/best practices documents	Blog or personal think thought pieces
Policy initiatives at European and/or national level- run by governments, not-for profit organisations	Newsletters or news articles
Industry funded publications (As regards the grey literature reviews, particular care will be exerted in assessing any inclusion of industry-funded literature. These will be justified and discussed with the client).	Theses and dissertations (2010 and older)
Primary theme/focus is human nutrition and physical activity	
Publication available via accessible databases	
Published in English, French, German, Italian, Polish and/or Spanish	
Theses and dissertations (post-2010 only)	

Due to the large number of results still returned after this screening the data parameters were further refined to only include those reports published 2005-2017.

Following this criteria screening and exclusion of search results, the remaining results were checked for quality and relevance.

#### A4.4.1 Exclusion based on quality checklist

The quality check was based on the AACODS checklist (AACODS)<sup>22</sup> which included:

- Authority

<sup>21</sup> For example: Hallsworth M, Ling T. (2007) *The EU platform on diet, physical activity, and health: second monitoring progress report*. Cambridge: RAND Corporation, [http://www.rand.org/content/dam/rand/pubs/technical\\_reports/2008/RAND\\_TR609.pdf](http://www.rand.org/content/dam/rand/pubs/technical_reports/2008/RAND_TR609.pdf)

<sup>22</sup> Please see the full outline of the AACODS checklist here: [https://dspace.flinders.edu.au/jspui/bitstream/2328/3326/4/AACODS\\_Checklist.pdf](https://dspace.flinders.edu.au/jspui/bitstream/2328/3326/4/AACODS_Checklist.pdf)

- Is the author credible?
- Accuracy
  - Is the document supported by documented and authoritative references?
  - Is there a clearly stated methodology?
  - Is the document representative of work in the field?
- Coverage
  - Have limitations been imposed and are they clearly stated?
- Objectivity
  - Can bias be detected (if so the bias was clearly stated in the extraction form)?
- Date
  - Does the document have a clearly stated date relating to the content?
- Significance
  - Is the document relevant?
  - Would the document enrich the findings?

The remaining grey literature was examined further so that only results most relevant to the objective were extracted. In particular, each article was examined for text relating to the key terms and questions under the objective. For example, in Objective E, the text was examined for reference to the research question '*what would be the health impacts of providing guidelines for improving the nutrition and physical activity of certain population groups?*' In total 132 results were excluded during this screening process; 62 results were extracted.

#### **A4.5 Stage 4: Extraction of full texts and final screening process**

A data extraction template in Excel was used to capture the following categories of information: 1) identifying information for each publication, 2) study design characteristics, 3) sample characteristics, 4) intervention characteristics, 5) content (behaviour/outcome) focus, 6) description of results, 7) assessment of rigour/bias and 8) objective specific information. In total 62 results were extracted.

After extraction, the review author read through all of the extracted data and a final screening process excluded more results due to quality or a lack of enough relevant information, now made obvious after extraction. Sources were also excluded from the grey literature where this was superseded by either more rigorous peer reviewed research on the same theme, or more recent statistics. In total, 55 results were excluded.

A thematic analysis was applied to the remaining extracted data and their findings synthesised with those of the peer reviewed literature. Any identified bias in sources which passed the inclusion criteria is highlighted in the analysis.

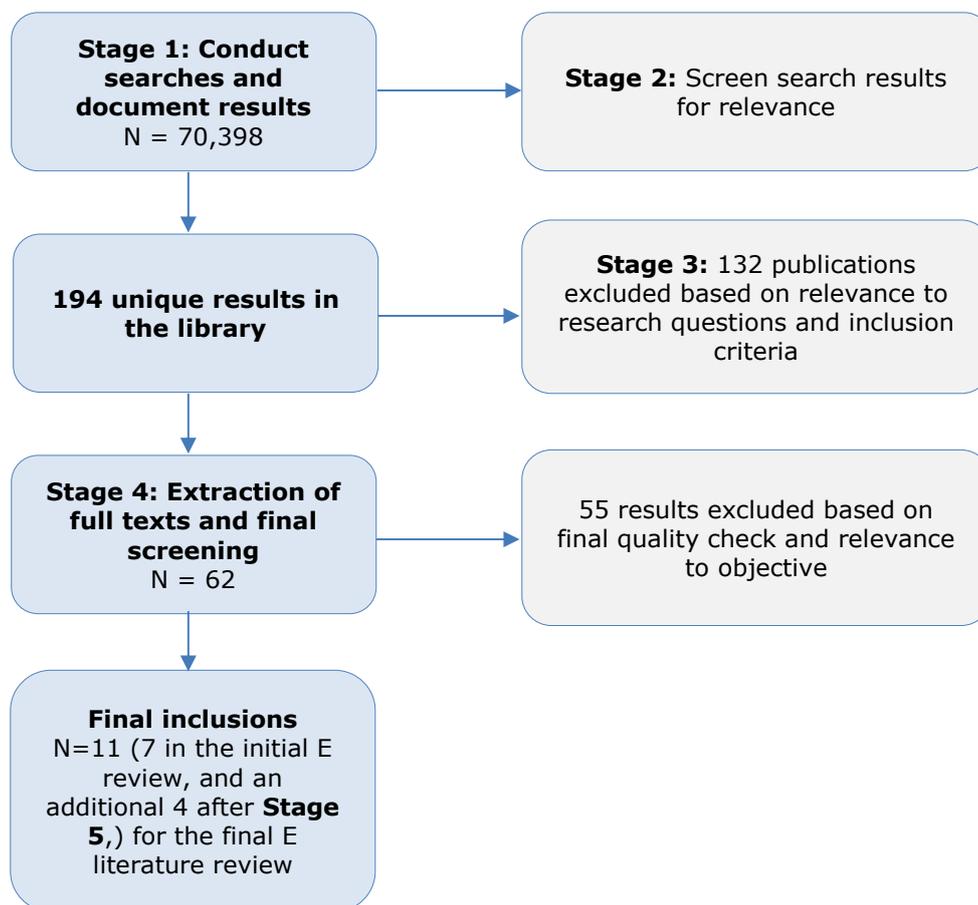
#### **A4.6 Stage 5: External expert reviews and input**

Upon completion of the draft set of comprehensive literature reviews, expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews. Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed. As a result of this exercise, four additional references were screened and incorporated into these reviews.

#### A4.7 Number of included and excluded references

The diagram in Figure 2 below shows the number of articles identified in grey literature searches, and the filtering out of literature at successive stages to arrive at the final number of 12 publications whose full text was reviewed and summarised for this review. The diagram also includes additional relevant references proposed by external experts, and incorporated into this final comprehensive review.

Figure 2. Diagram showing number of included and excluded publications at each stage – grey literature



As shown in Figure 2, a total of 70,398 search hits were retrieved. From the 194 results saved in the library 132 were excluded based on the relevance to Objective E. Following this, 62 results were extracted fully. An additional 55 results were then excluded based on inclusion/exclusion criteria, quality of evidence and relevance to the research question. In Stage 5, supplementary searches were conducted and/or articles recommended by experts during the workshops were looked at and another 4 grey literature sources were included in the final review.

## Annex 5 Grey literature bibliography

Cancer Research UK (2014) *Statistics on Preventable Cancer*. [ONLINE] Available at: <http://www.cancerresearchuk.org/health-professional/cancer-statistics/risk/preventable-cancers#heading-Zero> (accessed on 18<sup>th</sup> December 2017)

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