



Effects of overweight, obesity and/or inadequate physical activity on school and work performance

Review of Scientific Evidence and Policies on Nutrition and Physical Activity-Objective Area C: A comprehensive review of the scientific evidence on the effect of overweight/obesity and/or inadequate physical activity on school or work performance

Summary Report



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Contents

Contents	iv
Preface.....	5
About this project	5
About this series	5
Approach and purpose.....	5
Objective C: A comprehensive review of the scientific evidence and policies on the effect of overweight/obesity and/or inadequate physical activity on school or work performance	7
1.1 Scope of the review	7
1.2 Methodology	7
1.3 Research questions for this review	7
What are the consequences of overweight, obesity and physical (in)activity in students' performance (from kindergarten to college)?	8
What are the consequences of overweight, obesity and physical (in)activity in workers' performance?	9
Conclusion.....	11
Annex 1 Peer reviewed literature bibliography	12
Annex 2 Grey literature bibliography	14
Annex 3 Glossary	15

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 the full literature review documents.

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.

Objective C: A comprehensive review of the scientific evidence and policies on the effect of overweight/obesity and/or inadequate physical activity on school or work performance

This report presents the findings of a peer-reviewed literature and grey literature review related to the non-health effects of overweight/obesity and/or inadequate physical activity. These include the impact on the labour market in terms of impaired performance – calculated as the indirect costs of obesity and physical inactivity. This review therefore considers this particular effect, after first considering the consequences of overweight, obesity or physical inactivity upon children and their performance at school.

1.1 Scope of the review

To ensure the most relevant sources were reviewed, we focused primarily on literature published after 2005, unless otherwise stated. Studies reported different measures of school and work performance. Among students this included test scores; memory and reading ability. Among workers, we consider measures such as productivity and work participation, as well as absenteeism and presenteeism. Effective policies relating to the provision of school-based and work-based interventions are described in another review in the series, Objective A2.

1.2 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). A full description of the methodology used for all literature reviews can be found in the original literature review report. The review draws on 48 peer-reviewed and 27 grey literature sources selected as relevant. These findings were presented at an expert workshop, following which one further peer-reviewed and one grey literature source were added.

1.3 Research questions for this review

In this review, we focus on the most current literature (peer-reviewed original research and systematic reviews, as well as grey literature) that addresses the relationships between overweight/obesity or physical activity and school or work performance. The research addressed the following questions specified for the review:

- What are the **consequences** of overweight, obesity and physical (in)activity for **students' performance** (from kindergarten to college)?
- What are the **consequences** of overweight, obesity and physical (in)activity for **workers' performance**?

What are the consequences of overweight, obesity and physical (in)activity in students' performance (from kindergarten to college)?

Findings related to associations either between weight status (overweight or obesity) or physical (in)activity and academic performance were not straightforward – either because evidence was not conclusive (for weight status) or because there was great variation in study design and measures used, which was particularly true for studies of physical (in)activity.

Consequences of overweight and/or obesity in academic performance

Several peer reviewed sources, including systematic reviews of longitudinal studies, found mixed evidence of a negative association between overweight or obesity and student academic performance, with some patterns identified but no strong conclusive relationship emerging. For example, while a systematic review by Taras and Potts-Datema (2005) concluded obesity was broadly associated with poorer levels of academic performance, a recent systematic review of 31 longitudinal studies (Martin et al., 2017) could only find this association between overweight or obesity and lower maths grade attainment among adolescent girls.

In the peer-reviewed studies, where a negative association between weight (overweight and obesity) and academic performance was observed, subsequent analyses of data often found these relationships weaken or become nonsignificant when social-cultural variables such as parent socioeconomic position (Li et al., 2008, Datar et al., 2005) child physical activity (Roberts et al., 2010), race/ethnicity (Datar et al., 2005) or weight-based teasing (Martin et al., 2017; Krukowski et al., 2009) are introduced. This suggests that these variables have a stronger influence on academic performance than weight status independently or that there is a potentially complex causal pathway for overweight/obese school age children's academic performance.

Three reviews published as grey literature (Cullen, 2011, Merot et al., 2007, Mathieson and Koller, 2006), elaborated further on psychosocial explanations for an association between weight status and academic performance or cognitive outcomes. For example, Mathieson and Koller (2006) discuss how children's sense of self-worth and confidence is undermined by stigma from others about their weight (expressed through teasing). Furthermore, that self-consciousness about weight or lack of fitness can lead youth to avoid physical activity. Cullen (2011) highlighted that obese children can have lower expectations of themselves in terms of school performance and educational future, and may also be subject to lower expectations from their teachers. They also highlight that if obese children react to bullying, potentially with violence, this can sometimes (though perhaps unfairly) result in their own exclusions, early exit from education and thus lower attainment. (Cullen 2011)

Consequences of physical (in)activity and academic performance

With regards to physical (in)activity and academic performance, findings identified focused more on the kind of association observed rather than explanations for it. Peer-reviewed sources identified a positive relationship between physical activity and school performance, but found different strengths of association and some evidence of no association at all. For example, three systematic reviews found either: a weak to moderate positive association between different measures of physical fitness (as opposed to activity) and cognitive performance (Santana et al., 2017); a positive association between physical activity and academic performance (but few high quality studies to show this association) (Singh et al. 2012); or, a positive association between physical activity and academic performance in only half of studies considered (Rasberry et al., 2011). Variations in study design, and measures used for physical (in)activity further complicate the strength of the conclusions it is possible to make.

A number of peer-reviewed studies, including a meta-analysis, did establish an association between improvements in academic performance and participation in school-based physical activity interventions (Howie et al. 2015, Fedewa and Ahn 2011, Donnelly and Lambourne 2011). In particular, Fedewa and Ahn's (2011) meta-analysis of 59 intervention studies of school-aged children found effects were greater for physical activity interventions that: involved small and medium group classes, provided a total of 36-70 hrs of activity during the academic year, made the intervention/physical activity available three days per week and involved physical activity that focused on development/motor skills and cardiovascular fitness. The measures of academic performance that showed the most significant improvement across the studies considered were grades in mathematics; intelligence quotient (IQ) scores and reading ability, but these were not the only measures considered; this further illustrates the complexity of this field of research.

What are the consequences of overweight, obesity and physical (in)activity in workers' performance?

The focus of findings in the peer-reviewed literature on associations between overweight, obesity and physical (in)activity and workers' performance primarily related to quantifying indirect economic costs of reductions in productivity or levels of work participation among overweight, obese or physically inactive workers. The grey literature also discussed their association with different elements of work performance – presenteeism (workers who are present but not productive), rate of employment, salary and job satisfaction; a gendered pattern emerged in some cases. There appears to be strong evidence of a link between overweight, obesity and physical inactivity and loss of productivity, but a less clear explanation of the causality of that relationship. This is consistent with the evidence relating to school academic performance discussed above.

Overweight, obesity and physical inactivity and their indirect economic costs

Much of the literature emphasised a link between overweight, obesity and/or physical inactivity and a loss of productivity at work, expressed as 'indirect economic costs', (as opposed to the direct costs of healthcare resource use). However, there was variance across studies regarding which factors were considered to contribute to these calculations and total costs depend on local context. This was illustrated even within one review of studies based in of 2 European and 2 North American nations (Dee et al., 2014) – the costs and different measures are described in the Table 2 below. Dee et al. found that as population BMI increases, indirect costs (e.g., loss of productivity) also increase.

Table 1. *Indirect costs of obesity across different countries in Dee et al. (2014)*

Country	Amount of costs	Factors considered
Canada	CA\$5 billion	Morbidity due to long and short term disability
USA	\$42.8 billion USD	Presenteeism and absenteeism
Sweden	SEK 2.93 billion	Lost productivity due to increased mortality
Germany	€5.019 billion (as of 2002)	Sickness absence, early retirement and mortality using human capital approach

However, the grey literature cautioned that as studies have mostly been cost-of-illness studies (cross-sectional, and restricted to particular time periods) or used mathematical

modelling on virtual population cohorts, they do not fully capture the social and economic cost of obesity related illnesses, low self-esteem and mental health issues, for both individuals and wider society (Loughnane and Murphy, 2015; McDaid et al., 2005).

Obesity and physical inactivity consequences for work participation

Several international and national panel surveys involving large samples have found that lack of physical activity and obesity in particular (rather than overweight) are health risk factors that can lead to decreased workforce participation and increased absenteeism. Klarenbach et al. (2006) found that in Canada, increasing severity of obesity was associated with decreasing likelihood of active participation in the workforce, independent of other demographic, socioeconomic, and health conditions. A longitudinal study of a US panel survey, (Tunceli et al., 2006) found that women who were employed and categorized as obese were more likely to report a work limitation i.e., any physical or nervous condition that limited the type or amount of work. A similar trend existed with men, although it was not statistically significant. From an analysis of a pan-European survey, Alavinia and Burdorf (2008) found that among workers aged 50-64 physical inactivity and obesity had an effect on nonparticipation in the labour market (either through unemployment or early retirement) which was consistent across most European countries, except France.

Obesity and other aspects of work performance

The grey literature review found evidence that further explored the association between weight status, in particular (as opposed to physical activity) and different aspects of work performance, identifying a gendered effect in some cases. These include:

- **Presenteeism:** Oortwijn et al. (2011) emphasised the adverse link between obesity and physical inactivity with reduced on-the-job productivity (presenteeism) as a result of linked health issues. They found evidence that the average percentage of productivity loss (presenteeism) among workers with cardiovascular disease is 7% (equivalent to a half hour per day).
- **Rate of employment** Analyses of French and pan-European surveys found that rate of employment was lower among obese people than non-obese people although this was among older worker- (OECD, 2016) or female-specific samples (Coudin and Souletie, 2016). A WHO literature review similarly found that obese women are less likely to be upwardly socially mobile, more likely to be unemployed and suffer absenteeism from work (Loring and Robertson 2014).
- **Salary** An OECD review found that obese people earn up to 18% less than non-obese people, even when in equivalent posts doing similar jobs (OECD 2010). Elsewhere, a gendered relationship was also found relating to salary in a French survey sample (Coudin and Souletie, 2016) with a 1 point increase in BMI score was associated with a reduction in salary of 0.3% for obese women, but no significant difference for men.
- **Job satisfaction** An analysis of an Italian labour survey found a negative relationship between overweight and obesity and nine components of job satisfaction, although, not overall job satisfaction, with variations in weight status and gender. (Giovanni et al., 2015)

None of the studies provided strong, single explanations for why these links between employment and wages and weight exist. Figueras and McKee (2012) call for more research into the explanation for this complex relationship between obesity, socioeconomic factors and workplace productivity, and the variation that exists across studies and countries.

Conclusion

Among children and young people, evidence for the associations between overweight and/or obesity with academic performance is not conclusive or straightforward. Population-based studies (including longitudinal) evidence indicates that other socioeconomic or psychosocial factors (such as parental socioeconomic status or weight-based teasing) may influence this relationship. The use of subjective self-report measures may also explain the variability in associations found.

The literature suggests physical activity can positively impact cognitive and academic performance among young people. However, it is not possible to conclude about the strength of this association due to high variation in study designs and methods. Research that adopts more consistent methodologies is required to facilitate better comparisons across studies, and to investigate other factors that may influence this association.

Overweight and obesity have a negative impact on employment and work performance in adulthood. National economies are incurring significant indirect costs as a result of different aspects of lost work productivity, resulting from overweight, obesity or physical inactivity. Evidence suggests that a significant negative impact of obesity on elements of work-related performance (rates of employment, salary and aspects of job satisfaction) is felt mainly by women.

This provides some additional non-health-related motivations for seeking to improve the health behaviours of individuals in Europe. However, given the complexity and inconclusive nature of the evidence, relating to children and adolescents in particular, these areas should be considered as part of a broader holistic approach to tackling overweight, obesity and physical inactivity and should continue to be investigated.

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Annex 3 Glossary

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

Table 2. 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) (http://www.who.int/topics/obesity/en/)
Adult overweight	An abnormal or excessive fat accumulation that presents a risk to health, with a BMI equal to or more than 25.	WHO (http://www.who.int/topics/obesity/en/)
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 (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html)
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 http://www.who.int/mediacentre/factsheets/fs311/en/ (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>http://www.who.int/mediacentre/factsheets/fs311/en/</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.	WHO (http://www.who.int/dietphysicalactivity/pa/en/)
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.	WHO http://www.who.int/mediacentre/factsheets/fs385/en/
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure.	WHO (http://www.who.int/topics/physical_activity/en/)
Physical inactivity	A lack of physical activity	WHO (http://www.who.int/dietphysicalactivity/pa/en/)

Term	Definition	Source
Sedentary behaviour	Any waking behaviour characterized by an energy expenditure ≤ 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. http://doi.org/10.1186/s12966-017-0525-8
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

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