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# Physical health and well-being in children and youth

## REVIEW OF THE LITERATURE

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**PHYSICAL HEALTH AND WELL-BEING IN CHILDREN AND YOUTH: REVIEW OF THE LITERATURE**

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## **ABSTRACT**

This paper provides an overview of trends in physical health outcomes of young people over the last several decades. It makes the argument for the importance of physical health and well-being for the individual and society, including its role in education outcomes. The paper then examines interventions, identifying common factors of effective intervention design to improve physical health among young people. It ends with a discussion of remaining gaps in our knowledge and the implications of this body of research on education, communities and families.

## **RÉSUMÉ**

Ce document donne un aperçu des tendances liées aux conclusions établies en matière de santé physique des jeunes au cours des dernières décennies. Il plaide en faveur de l'importance de la santé physique et du bien-être pour l'individu et la société, y compris son rôle en matière d'éducation. Ce document aborde ensuite les interventions, relevant les éléments communs d'un plan d'intervention efficace visant à améliorer la santé physique des jeunes. Il se termine avec une discussion sur les connaissances qui nous manquent encore et les implications liées à ce corpus de recherche sur l'éducation, les communautés et les familles.

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## Introduction

Physical health is positively associated with child academic achievement, and participation in workforce and society. Current and projected trends in physical health outcomes in part reflect the changing nature of countries and societies, family structure and the rise of technology. Of all the social determinants of health (for instance; income, education, housing) education is often identified as the most modifiable determinant (McGill, 2016). Many of the other social determinants are linked to what can be referred to as an intergenerational cycle of poverty, and while there are policy options to improve income, housing and so forth, exposing children in the early years of life to quality education can fundamentally change the trajectory of health outcomes associated with deprivation in a cost-effective way (OECD, 2010a; Reynolds and Temple, 2008; Solar and Irwin, 2010).

That is, education in the early years is inextricably linked with healthy development, thus even if a child is born into an environment where there is high deprivation, access to quality education in the early years of life (including in the home environment), gives them a better chance of achieving optimal development, and beginning school at the same 'level' as their peers who may have been born into more affluent home environments (Arnold and Doctoroff, 2003; McGill, 2016; Solar and Irwin, 2010). As these children move through their schooling, even if they are continuing to grow up in high deprivation, if they have continued access to quality education and a supportive home environment, there is a greater likelihood that they can achieve education outcomes, and engage in healthy lifestyle behaviours (McGill, 2016; OECD, 2010a; Solar and Irwin, 2010). In addition, if they continue to achieve and stay in school, they are more likely to pursue further education beyond secondary school, and hence are more likely to have an occupation with a good income, and thus move into a higher socio-economic strata and enjoy the health benefits associated with this (provided they still engage in healthy lifestyle behaviours) (Solar and Irwin, 2010).

Thus, education is an avenue for children and young people in low socio-economic circumstances, to move out of these circumstances provided they are brought up in a positive home environment (which can be supported by parenting education), and have access to quality education during childhood and adolescence (McGill, 2016; OECD, 2010a; Reynolds and Temple, 2008). While this explanation simplifies many of the pathways through which education can improve socio-economic circumstances, the idea is that while the other social determinants are not fixed, they are comparatively more difficult (and expensive) to modify and hence, education in OECD countries currently is considered the most modifiable determinant for improving health and well-being (Marmot, 2005; McGill, 2016).

This short background paper discusses important trends in physical health outcomes and lifestyle behaviours among children and adolescents in OECD countries. Mediators of these trends are investigated and an overview of interventions to address poor physical health is also provided. Towards the end of the paper, the implications the trends and interventions raise for education, families and the wider school community are identified.

This paper is intended to support a wider investigation to conceptualise the skills children and young people need to function effectively in current society. The 21st Century Children project is being conducted by the Centre for Educational Research and Innovation [CERI], and will utilise multi-disciplinary research to understand necessary skills for children and young people, and develop a framework to guide education research and policy that supports the development of these skills (CERI, n.d.). Through this process, implications for educators, parents and caregivers and primary care providers for delineating their role in the development of children and young people will be raised.

In addition to physical health and well-being, emotional well-being, family and peers and the rise of new technologies are three other areas being investigated as part of the project. Thus, the content of this



paper should be considered with the view that physical health is not separate from other aspects of health and development, including emotional well-being. However, for the sake of brevity, factors that influence physical health, such as emotional well-being are acknowledged but not discussed in depth in this paper<sup>1</sup>.

### *Trends in physical health outcomes among young people*

Data collated by the OECD, the World Health Organization and published research was reviewed for physical activity, overweight and obesity, dietary habits, substance use and sleep patterns. The trends in this data indicate that children and young people are engaging in behaviours that put their physical health at risk, and that this behaviour is influenced by characteristics of changing society, including but not limited to, the increasing use of technology and changing family structures. The table below summarises the main trends and indicates the direction of the trend for each physical health indicator for most OECD countries, a more detailed description of trend information is provided below the table.

**Table 1. Summary of physical health behaviour trends 2000 - 2016 (OECD countries only)<sup>2</sup>**

Physical health indicator	Trend direction (OECD average)
<b>Inadequate physical activity</b>	↑
<b>Overweight and obesity</b>	↑
<b>Poor dietary habits</b>	↑
<b>High alcohol consumption</b>	↓
<b>Tobacco use among children and adolescents</b>	↓
<b>Poor sleep duration and quality</b>	↑

Note: Green downwards pointing arrow = positive reductions in the prevalence of risky behaviour, red upwards pointing arrow = increases in the prevalence of risky behaviour

#### *Physical activity*

According to information provided by the World Health Organization (crude estimates only), 81.64% of young people in OECD countries are participating in <60 minutes of moderate to vigorous physical activity per day (World Health Organization, 2015b). Longitudinal studies conducted in the UK and US indicate that over time participation in structured physical activities like organised sport is declining and participation in physical education in secondary school has declined from 1993 – 2013 (Bassett, John, Conger, Fitzhugh, and Coe, 2015; Booth, Rowlands, and Dollman, 2015). Recent PISA data also verifies this trend, indicating that participation in physical education declines with age, and that there are differences in time spent participating in physical education between junior and senior secondary school students (OECD, 2017b). Overall, the data and research indicates that the proportion of physical activity children and young people are engaging in has and is decreasing over time.

#### *Nutrition*

In the last several decades, change in nutrition habits has been particularly evident. There has been an increasing over-consumption of specific food groups including soft drinks, sweets, salty snacks and fast food (Roblin, 2007). With regard to fruit and vegetable consumption, for those OECD countries

<sup>1</sup> Published, peer-reviewed primary and secondary research, centrally-held data and grey literature have been reviewed in the process of drafting this paper, refer to Annex A for an overview of the search approach and included sources.

<sup>2</sup> Trends were examined over time; however for some indicators a complete data set was not available for the 2000 – 2016 time periods. Interpretations of trends were made based on real (not projected) available data; future projections were reviewed only to further enhance interpretation.

completing the Health Behaviour in School-aged Children survey, fruit and vegetable consumption has increased between 2001-02, and 2009-10 (OECD, 2013; OECD/EU, 2016). However it also appears that total energy consumption in OECD countries has also increased over time (OECD/WHO, 2012). Thus while fruit and vegetable consumption may be increasing, so too is the consumption of food groups that are particularly unhealthy and help to explain increases in total energy consumption (OECD/WHO, 2012; Roblin, 2007).

### *Overweight and obesity*

While the cause of obesity is acknowledged as being multi-factorial, the role of nutrition, dietary habits and physical activity has been established as a direct influence on weight, in combination with genetics, family and environmental factors, and an individuals' metabolic profile and cardiovascular health (Kalyoncu, Pars, Bora-Gunes, Karabulut, and Aslan, 2014).

Body Mass Index (BMI) values are monitored over time as an indicator of overweight and obesity, and this data is housed by the World Health Organization for the majority of OECD countries. Although monitored BMI values are estimates only, based on the information collected there has been a steady annual increase in BMI estimates from 2010 to 2014 (recent data obtained for 2014). In 2013 to 2014, BMI increased by  $0.053\text{kgm}^2$  among males and  $0.021\text{kgm}^2$  among females (World Health Organization, 2017).

Rates of overweight and obesity (as defined by BMI categories), have increased particularly in the last decade, and are projected to continue to increase. However, longitudinal data has indicated that in most OECD countries, obesity tends to increase in prevalence with age, and then it plateaus. The age at which the plateau is evident differs between OECD countries (OECD, 2010b, 2014a; Sassi, Devaux, Cecchini, Rustichelli, 2009). More recent longitudinal data suggests that while projections indicate that childhood obesity will continue to increase, there is considerable variation in the rate of this increase among OECD countries. Current data indicates the increasing trend for childhood obesity has stabilised in Italy, Korea, Spain and the United Kingdom. Reasons for this stabilisation are associated with considerable investment in public health and education policy, through government and industry collaboration (OECD, 2017a).

Finally, with regards to variation in the projected rates of increase in overall (child and adult) obesity, proportions of projected increases are higher among countries with previously low prevalence of obesity (Korea and Switzerland). Comparatively, in some countries with a high prevalence of obesity there are proportionately slower rates of projected increase, for instance the rate of increase in overall obesity in the United Kingdom is projected to be slower than that of the United States (OECD, 2017a).

### *Alcohol consumption*

Weekly alcohol consumption data is gathered by the World Health Organization, according to 2010 data, weekly alcohol consumption among 15-18 year olds decreased from 2005 to 2010 (-4.31% decrease among males, -3.07% decrease among females) (World Health Organization, 2014). In OECD countries, the incidence of repeated drunkenness (self-reported being drunk more than twice in life), has declined considerably between 1994 compared with 2014 (OECD, 2013; OECD/EU, 2016).

### *Tobacco use*

In comparison to data gathered on the above risky behaviours, information about smoking prevalence is comparatively more recent and complete. As at 2015 (the most recent non-projected data), the average prevalence of young people aged 15 years or older using tobacco within OECD countries is 30.3% of males, and 20.4% of females. Projections of the prevalence of tobacco use in 2020 and 2025

indicate a continued reduction in use among the majority of OECD countries (World Health Organization, 2015b). These estimates are verified by the OECD Health Indicators, which indicate that declining smoking prevalence has occurred since 1990 for most OECD countries (OECD, 2013; OECD/EU, 2016).

It should be noted that there is little global data gathered on active tobacco use among children, particularly those aged younger than 15 years in OECD countries. A cross-sectional survey in the United Kingdom indicated that there may be a proportion of children younger than 15 that are using tobacco, potentially for the first time (JSNA Blackpool, 2016). Specifically, a local school health survey conducted in a primary school in Blackpool indicated that 3 per cent of children aged 8 – 11 years reported they had tried smoking cigarettes at least once in their life time (JSNA Blackpool, 2016). While age at onset of tobacco use is important, so too is the influence of second-hand smoke during childhood. Exposure is more common among children, and the health consequences of exposure to second-hand smoke mirror that of active smoking (World Health Organization, 2016). The estimated percentage of children under the age of 15 years who have been exposed to second-hand smoke in 2004 was 40 per cent globally, and 39 percent among high income countries the majority of whom are OECD countries (World Health Organization, 2016). A cohort study completed in Denmark, indicated that the majority of exposure to second-hand smoke occurred in the home environment and during early life, from prenatal stage through to preschool, exposure decreased during primary school, where children begin to spend comparatively larger proportions of time outside the home environment (Milanzi et al., 2017).

#### *Other drug consumption*

Reliable global prevalence data on the consumption of prescription drugs and other illicit drugs is not widely available. However, one area of drug consumption that is reportedly growing in some OECD countries, particularly in the United States is the consumption of cognitive enhancement drugs. These include methylphenidate (Ritalin), prescribed amphetamines (Adderall, Attentin), modafinil (prescribed for some sleep disorders) and acetylcholinesterase inhibitors which are drugs used in the treatment of Alzheimer's disease (Franke et al., 2011; Franke, Bagusat, Rust, Engel, and Lieb, 2014; Racine and Forlini, 2008). Based on available data, consumption is most common among university students in the United States, with an estimated prevalence of 8.3 per cent. Of these, the majority of students report using Ritalin (Franke et al., 2011). Estimates available for Switzerland and Germany indicate a lower prevalence in comparison (6.2 per cent and 1.2 per cent respectively). Across these countries, prevalence tends to be higher among male students, and students with low academic performance (Franke et al., 2011; Racine and Forlini, 2008). The research completed on the effects of consumption is comparatively minimal, and little is known about the long-term effect of ongoing use, however clinical researchers tend to suggest that the issue is commonly sensationalised, and the cognitive effects of the prescription cognitive enhancing drugs in healthy individuals are small, although they tend to be greater among sleep-deprived users (Franke et al., 2011; Greely, Campbell, Sahakian, Harris, and Kessler, 2008; Zonneveld, Dijkstra, and Ringoir, 2008). However, it is important to note that according to researchers, the long-term effect of ongoing consumption has the potential to negatively influence mental health. While addiction is unlikely as these drugs have an extended release formula (that is, they do not give the user a large 'high'), it is plausible that the continued effect of enhanced cognition could yield undesirable side effects on mental health, for instance it may increase the ability to recall negative life experiences in detail (Greely et al., 2008).

#### *Sleep*

Complete longitudinal data on sleep duration and quality among OECD countries is not available. However, a recent study examined data on internet activity, specifically time spent on and offline, and self-reported data gathered from the American Time Use Survey to predict sleep duration among 30 OECD countries, the average estimated sleep duration per night among OECD countries was 8.87 hours, with the shortest sleep duration estimated for Japan at 7.27 hours, and the longest duration was estimated for Spain

at 9.96 hours per night. While the findings are interesting, data was not examined by sub-group, particularly for different age groups, however the research does provide a duration estimate for additional longitudinal follow-up studies to utilise. Currently longitudinal studies in the UK and the US have estimated that overall sleep duration (across all ages) has decreased over the last twenty years (Matricciani, Olds, Blunden, Rigney, and Williams, 2012; Reiter and Rosen, 2014).

### *Mediators of trends*

The physical health trends outlined above are influenced by a variety of mediators which include but are not limited to; individual psycho-social factors, socio-economic status, gender and age. The relationship between these factors and physical health outcomes is discussed, with empirical evidence provided where available. While there are also more clinically-oriented mediators of physical health trends (genetics) in addition to those included here, these are to an extent non-modifiable, and hence are not discussed.

#### *Individual psycho-social factors*

Considerable evidence exists for individual psycho-social factors to mediate risky lifestyle behaviour trends. Specifically, self-efficacy and intentions to change behaviour have been established as mediators of physical activity, that is, when individuals feel more able to participate in physical activity, and have made plans to do so they will be more likely to participate in physical activity. Similarly, attitude, knowledge and habit strength were found to be mediators of dietary behaviour interventions, thus when individuals have a positive attitude towards nutrition, know what food they need to eat, how to prepare it and so forth they will be more likely to eat nutritious food (van Stralen et al., 2011).

#### *Socio-economic status*

Socio-economic status or disadvantage is a mediator of a number of physical health trends (OECD, 2014a, 2015a; Sassi, 2010; Sassi et al., 2009). It is important to note however, that socio-economic status is a proxy for an underlying relationship between a factor usually caused by material disadvantage and an increased likelihood for engaging in risky lifestyle behaviours. For instance, residing in a community environment where there is less access to a garden, green space or safe facilities for physical activity increases the likelihood that individuals residing in that community will be less physically active (Schalkwijk, van der Zwaard, Nijpels, Elders, and Platt, 2017). This environmental factor (which is more common in areas with low cost housing), is independently related to physical activity regardless of parental knowledge or education on the importance of regular physical activity (Schalkwijk et al., 2017).

#### *Gender and age*

Two mediators of sleep behaviour and physical activity are gender and age. At all ages, females are more likely to plan to sleep longer, and on average do sleep longer compared with males, although these disparities are more marked with age (Walch, Cochran, and Forger, 2016). Older age groups generally had shorter sleep duration and earlier wake times compared with younger people. In addition, females are reportedly more sensitive to changes in sunrise and sunset (Walch et al., 2016). Further in usage patterns of prescription cognitive enhancing drugs and illicit drug consumption, males are more likely to consume these substances compared with females (Franke et al., 2011).

Participation in physical education and opportunities available for physical education also differ among males and females. Much advances have been made in regard to interventions that maximise equitable participation in physical activity across genders, but according to the world-wide survey of physical education conducted by UNESCO, in some countries there is still a persistent perspective (often

influenced by culture and religion) that there are barriers to participating in physical education for females (United Nations Educational Scientific and Cultural Organization, 2014).

### **Physical health in the broader context: technology, society and family structures**

Technology, society, family structures and the home environment all directly influence physical health trends. Sleep quality and duration is highly affected by technology. Use of technology affects sleep behaviour, and 85% of UK adolescents report that they use at least one type of technology before sleeping (Reiter and Rosen, 2014). Associations with exposure to blue light (light that is emitted from many mobile devices) and delayed sleep onset, duration and quality also indicate a direct relationship between technology use and sleep patterns (Reiter and Rosen, 2014).

Similarly, television viewing is significantly associated with an increased risk for overweight, indeed with every additional hour of time spent watching television, there is an estimated 20% increased risk of overweight among adolescents (Knutson and Lauderdale, 2007). This risk estimate reflects the relationship between television viewing, poor dietary habits and inadequate physical activity, that is television viewing does not independently cause overweight and obesity (Felez-Nobrega, Hillman, Cirera, and Puig-Ribera, 2017). Although proportion of screen time can directly influence cognitive outcomes, with some studies identifying a reduced working memory and a reduced probability of engaging in physical activity as a result of time spent in front of a screen (Felez-Nobrega et al., 2017). At a more conceptual level, despite the continued advancement of technology and its use in the classroom environment, little is known about how this exposure affects the physical health and development of children and adults. Given the pace of advancement and the short period in which prolonged daily exposure to different technologies has become more common, longitudinal information about how this influences physical health is scarce, apart from the clear association between exposure and sleep patterns.

Further, changing family structures and environments have an influence on physical health and well-being. With an increasing proportion of single parent families, and parents spending more time outside of the home often in employment, or commuting to work, the home environment changes. One of these changes is reflected in patterns of cooking and nutrition in the home environment such as an increase in the proportion of pre-prepared food consumed outside the home, this trend is positively associated with the prevalence of obesity at the population level (Roblin, 2007). Given that early life experiences of nutrition, cooking and eating behaviours are highly predictive of nutrition and eating behaviours in later life, children and young people are at risk of establishing and sustaining poor dietary habits (OECD, 2017b; Roblin, 2007). The same is true for physical activity, if regular physical activity is not reinforced in the home environment, or not pursued in leisure time; children and young people are less likely to engage in regular physical activity later in life (OECD, 2017b). It should be noted, that these changes to the home environment for migrant families and for minority ethnic groups also influence the opportunities for parents and caregivers to support their children to connect with and develop their cultural identity, which can be supported by participating in food preparation, learning cooking techniques and engaging in physical activity as a family (Weller and Turkon, 2015).

Changing patterns of transport, related to infrastructure, urban planning and changing family structures has influenced the prevalence of active transport associated with commuting to and from school or work. Active transport which induces incidental physical activity has been steadily declining for the last decade in most industrialised countries (Bassett et al., 2015; Booth et al., 2015; Roblin, 2007). While not wholly responsible, city infrastructure and rising urbanisation has a role to play in ensuring facilities exist to support and encourage safe active transport (OECD, 2014b). The provision of such facilities would increase the likelihood that parents feel comfortable for themselves and their children to actively commute to school or work, instead of driving or taking other forms of passive transport (Bassett et al., 2015; Booth et al., 2015).

Finally, also in relation to changing society, growing income inequality has direct consequences on physical health and well-being, which are reflected in the relationship between socio-economic disadvantage and physical health trends. Income inequality in OECD countries has been growing since the 1980s, and current levels are the highest they have been in three decades (OECD, 2015b). The material disadvantage associated with this directly affects physical health, but also the societal level consequences associated with growing inequality can also negatively influence physical health and well-being, such as lower social cohesion and political instability (OECD, 2015b).

### **Importance of physical health and well-being**

The physical health trends outlined above are concerning because of how important good physical health is to quality of life, and participation in culture, work and society. Poor physical health has been associated with a rising prevalence of non-communicable diseases, particularly cardiovascular diseases and type II diabetes (diabetes mellitus), poor academic outcomes, proportionately more days off work, and, lower quality of life (World Health Organization, 2008). Healthy lifestyle behaviours are protective factors for many non-communicable diseases and in a more general sense they are also protective for overall well-being. Participating in physical activity for example, is reported to improve self-reported overall health status (Granger et al., 2017).

### ***Clinical manifestation of physical health trends***

There are clinical consequences for the increasing prevalence of children and young people who have a high BMI, are inadequately physically active, have poor nutrition and are consuming high amounts of alcohol, tobacco and other substances. The prevalence of diabetes mellitus and cardiovascular diseases in children and adolescents has increased in response to increasing BMI and prevalence of overweight and obesity (Van Buren and Tibbs, 2014). It is important not to understate the importance of these diseases which were historically considered diseases of adulthood, the fact they are now evident in children as young as two years old is a concern (Van Buren and Tibbs, 2014).

Similarly, regarding sleep, the prevalence of disorders such as delayed sleep-phase syndrome (DSPS) has significantly increased in response to shorter sleep duration and quality over the last decade. This disorder occurs when individuals delay their bedtime but do not change the time they are waking up. Thus over a week a sleep deficit accumulates, and accordingly individuals tend to sleep in late over the weekend (Reiter and Rosen, 2014). Delayed Sleep Phase Syndrome (DSPS) results from a chronic sleep deficit and poor sleep hygiene.

### ***Physical health and well-being and participation in school, workforce and society***

The influence of physical health on education and participation in the workforce and society is widely documented. Consequences of poor physical health are usually expressed in large proportions of time away from school and work, or decreased productivity while at school and work (Felez-Nobrega et al., 2017). Healthy lifestyle behaviours such as physical activity are associated with productivity, for instance moderate physical activity is positively associated with improvements in working memory (Felez-Nobrega et al., 2017). There is also a relationship between physical activity and academic performance, this is stronger among young children, compared with adults (Felez-Nobrega et al., 2017).

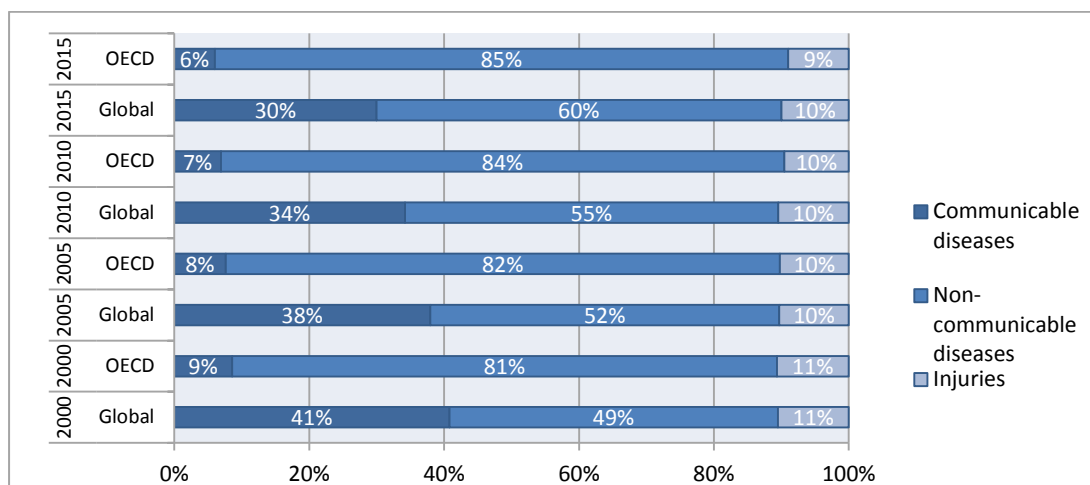
Not only does poor physical health affect individuals in terms of their school performance and work productivity, there are also consequences of these effects for society and nations as a whole. RAND investigated this in an economic evaluation of the costs of poor and insufficient sleep in five OECD countries. Their research identified that the costs of insufficient sleep associated with reduced productivity and premature mortality were substantial. Of the five countries investigated, insufficient sleep costs to

Japan in USD were proportionately the highest at \$138 billion per year (2.92% GDP), followed by the US at 411 billion USD (2.28% GDP), the United Kingdom at \$50 billion (1.86% GDP), Germany at \$60 billion (1.56% GDP) and finally Canada at 21.4 billion CAD (1.35% GDP) (Hafner, Stepanek, Taylor, Troxel, and van Stolk, 2016).

### *Physical health and quality of life*

Quality of life is also affected by poor physical health, the global burden of disease data indicates that causes of reduced quality of life (measured in disability-adjusted life years [DALY]) are associated with engagement in unhealthy lifestyle behaviours (World Health Organization, 2008). There is a strong relationship between non-communicable diseases and risky lifestyle behaviours, this is particularly true for cardiovascular diseases and diabetes mellitus, while there are other factors involved as noted earlier in the paper. The figure below shows the proportion of DALYs attributable to disease categories for all countries, and those for OECD countries for 2000, 2005, 2010, and 2015. As evident in the figure overleaf, there is a consistently greater proportion of non-communicable diseases associated with reduced quality of life in OECD countries compared with all countries globally. Conversely, there is a comparatively greater proportion of communicable diseases associated with reduced quality of life in all countries, as compared with only OECD countries. Indeed, by 2015, 85% of years of life influenced by poor health were attributable to non-communicable diseases in OECD countries. Proportion of life years influenced by disability associated with injury is largely constant for both OECD countries and all countries combined.

**Figure 1. Proportion of disability-adjusted life years by disease category from 2000 to 2015<sup>3</sup>**



Source: Author's own work based on Institute for Health Metrics and Evaluation, 2017, GBD Compare, <https://vizhub.healthdata.org/gbd-compare/>.

To provide a little more detail, the difference in proportions of disability-adjusted life years by disease category are outlined in the table overleaf. The table indicates that from 2000 to 2015 the proportion of disease burden attributable to disease is consistently less in OECD countries than in all

<sup>3</sup> Non-communicable diseases include all cancers; diabetes, urogenital, blood and endocrine disorders; cardiovascular diseases; cerebrovascular diseases; chronic respiratory diseases; chronic liver diseases; digestive diseases; neurological conditions; mental and substance use disorders; musculoskeletal conditions; birth defects and skin disorders. Communicable diseases include HIV/AIDS; tuberculosis; diarrheal diseases; contracted respiratory and intestinal diseases; all infections including sexually transmitted infections; all other conditions that can be contracted from individuals or organisms. Injuries are inclusive of road traffic injury, accidents, intentional and unintentional injuries; self-harm; and injury associated with war, violence and environmental events.

countries. By 2015 an additional 24% of disease burden in all countries is attributable to communicable disease compared with OECD countries alone. The opposite is true for non-communicable diseases; indeed, the difference in disease burden attributable to non-communicable disease in OECD countries is 25% greater than that of the burden attributable to non-communicable diseases for all countries. However, when examining differences in proportions by disease sub-group, it is evident that non-OECD countries are also experiencing increases in non-communicable diseases, particularly with respect to cardiovascular disease; by 2015 there was only a 1% difference in disease burden attributable to cardiovascular disease between OECD countries and all countries.

**Table 2. Change in proportions (%) of reduced quality of life by disease category among all countries and OECD countries from 2000 to 2015**

Disease category	2000	2005	2010	2015
<b>Diarrhoea, lower respiratory, and other common infectious diseases</b>	<b>-12</b>	<b>-10</b>	<b>-9</b>	<b>-2</b>
<b>HIV/AIDS and TB</b>	<b>-4</b>	<b>-5</b>	<b>-5</b>	<b>-4</b>
<b>Communicable diseases (total)</b>	<b>-32</b>	<b>-30</b>	<b>-27</b>	<b>-24</b>
<b>Cardiovascular diseases</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Diabetes, urogenital, blood, and endocrine diseases</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>Mental and substance-use disorders</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>
<b>Non-communicable diseases (total)</b>	<b>32</b>	<b>30</b>	<b>28</b>	<b>25</b>

Note: Green text indicates there is a lower proportion of reduced quality of life (measured in DALYs) associated with this disease category for OECD countries. Red text indicates there is a higher proportion of reduced quality of life (measured in DALYs) associated with this disease category for OECD countries.

Source: Author's own work based on Institute for Health Metrics and Evaluation, 2017, GBD Compare, <https://vizhub.healthdata.org/gbd-compare/>.

Hence, the global disease burden data highlights that the increased prevalence of inadequate physical activity, poor dietary habits, substance abuse and overweight and obesity in OECD countries, could explain in part the differences in proportions between the causes of Disability-Adjusted Life Years (DALYS) among OECD countries compared with all countries. A considerable proportion of global DALYS are associated with preventable conditions highly related to risky lifestyle behaviours, including ischaemic heart disease, cerebrovascular disease, alcohol use disorders and diabetes mellitus which collectively comprise 18.5% of global DALYS (World Health Organization, 2008).

### Interventions for improving physical health and well-being

Given the concerning data on the prevalence and burden of non-communicable diseases related to the increased prevalence of unhealthy lifestyle behaviours, there is a wealth of literature documenting the effectiveness of interventions to change behaviour, construct home, school and community environments that support behaviour change, and intervene early in life to prevent the occurrence of non-communicable diseases. It should be noted that the focus of these interventions is about supporting and promoting healthy lifestyle behaviours to schools, communities and families, using strengths-based approaches.

Table 3 provides an overview of the types and relative effectiveness of interventions that have been developed to improve physical health and well-being in young children and adolescents. Interventions have been grouped based on their primary setting (school, home or community), and main behaviour change component (changing attitudes, role modelling). An indication of relative effectiveness is provided for each group of interventions, as well as considerations for implementing these interventions. The rapid review of evidence was utilised to develop this table, and specific details about the reviewed interventions and effect sizes can be found in Annex A: Literature Search Strategy.



**Table 3. Physical health and well-being interventions**

Intervention setting	Intervention component	Effectiveness +++ (high), ++ (medium), + (low)	Implementation consideration(s)
School- based	<b>Build awareness and knowledge of healthy behaviours (knowledge-based curricula)</b> (Carney, Myers, Louw, and Okwundu, 2016; Faggiano, Minozzi, Versino, and Buscemi, 2014)	++ <sup>4</sup>	• These interventions improve knowledge but tend to have no effect on behavioural intentions, or behaviour change.
	<b>Change attitudes towards risky behaviour (social competence)</b> (Faggiano et al., 2014)	+++ <sup>5</sup>	• Interventions usually incorporate a component of behavioural modelling.
	<b>Build healthy school environment</b> (Dobbins, Husson, DeCorby, and LaRocca, 2013; Martin, Saunders, Shenkin, and Sproule, 2014; Maynard, Solis, Miller, and Brendel, 2017; Witjzes et al., 2017)	+++	• These approaches need to include the whole-school community. For interventions associated with the play environment – they need to evolve and develop with children and young people as they grow. • Building a supportive school culture is also key to effective, sustained behaviour change.
	<b>Teachers/staff as role models</b> (Maynard et al., 2017)	++	• Teachers need to have adequate training, time and resources and school leaders need to support healthy lifestyles- healthy behaviour modelling by staff. Healthy behaviours also need to be supported by an intervention within a healthy school environment.
Home-based	<b>Health promotion during prenatal period and in early infancy</b> (Liao, Liao, Durand, and Dunton, 2014; Roblin, 2007; Waters et al., 2011)	+++	• Healthy lifestyle behaviours including nutritious diet and physical activity are strong predictors of long-term lifestyle behaviours in adolescence and adulthood.
	<b>Parents/caregivers as role models</b> (Blake, Sheeber, Youssef, Raniti, and Allen, 2017; Busch, Altenburg, Harmsen, and Chinapaw, 2017)	+++ <sup>6</sup>	• Modelling has the strongest influence on behaviour when conducted during early life, ongoing modelling throughout childhood and adolescence can also help to embed healthy lifestyle behaviours in the home environment.
	<b>Whole-family participation in healthy lifestyle behaviours</b> (Kalyoncu et al., 2014; Waters et al., 2011)	++	• The main benefit for these interventions is that they make behaviour changes more sustainable. • Whole-family participation usually needs to be structured and supported by an external intervention for it to work effectively. For instance, interventions such as a school-based health promotion with a home-based component could support whole-family participation.
Community-based	<b>Community development for supporting physical health</b> (Schalkwijk et al., 2017; Stanton and Grimshaw, 2013; Witjzes et al., 2017)	++ <sup>7</sup>	• These interventions are usually targeted at communities in disadvantaged areas, and they tend to work best for those groups, as they are often focussed on improving public facilities, e.g. access to green space, public transport.

Note: High effectiveness (+++) = interventions within this category have evidence that healthy behaviour change has occurred, and change is of a comparatively large magnitude and may be sustained over time, relative effect size could be >0.6. Medium effectiveness (++) = interventions within this category have evidence that health behaviour change is occurring to some degree, a relative effective size would be 0.4 – 0.6. Low effectiveness (+) = interventions within this category have some evidence that an aspect of health behaviour is changing to a small degree, for instance perhaps awareness of need to change behaviour has increased significantly, however the individual has not yet begun to change their behaviour, but is making plans to do. A relative effect size for the low category would be <0.4. Effectiveness judgements have been made with quantitative evidence if available and using researchers' judgements about the degree of behaviour change, compared to baseline and degree of readiness for change. It should be noted that the judgements have been made on the evidence reviewed in this rapid review, and that the information provided is intended to give the reader a sense of the comparative effect of different types of interventions. An overview of individual interventions is provided in Annex A: Literature Search Strategy and Intervention Effect Index.

<sup>4</sup> Improvements in knowledge of risks associated with using drugs.

<sup>5</sup> RR=0.90[0.81, 1.01] at 12 month follow-up for drug use.

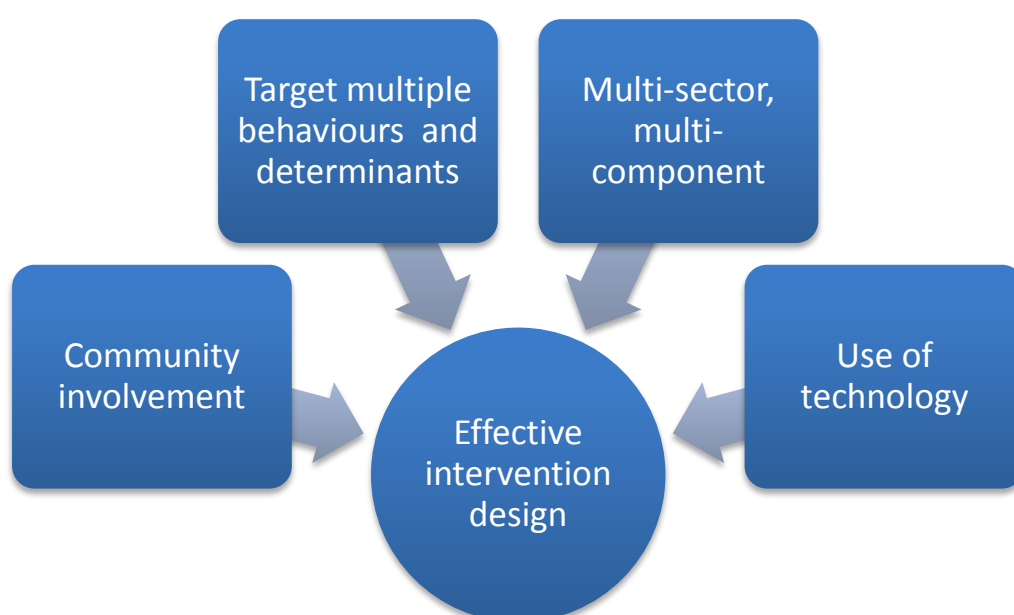
<sup>6</sup> Improvements in interventions incorporating this component have been observed in blood pressure, compliance with healthy behaviour and uptake of regular physical activity.

<sup>7</sup> Effectiveness with regards to improving healthy lifestyle behaviours is improved when implemented in conjunction with focussed health promotion interventions.

## Effective intervention design

Due to the wealth of intervention research, features associated with intervention design that contribute to and can maximise effectiveness for improving behaviours related to good physical health have been identified. These features include targeting multiple behaviours, employing integrated multi-component behaviour change strategies, using technology where appropriate and understanding appropriate intervention duration for achieving desired behaviour change(s). These features in conjunction with each other can collectively comprise an intervention design (as noted in the figure below) that has been shown to be effective in improving physical health and well-being. Of course, it should be noted that design alone cannot create effect. Implementation also has an influence, as well as many other external variables. Each of the five design features are described in more detail below.

**Figure 2. Features of Effective Intervention Design**



### *Community involvement in intervention design and implementation*

Community involvement can maximise reach and engagement by improving the appropriateness of the intervention, often by ensuring it is culturally relevant (Kalyoncu et al., 2014; The National Academies of Sciences, Engineering and Medicine, 2017; Van Buren and Tibbs, 2014). Similarly, by involving the community in intervention design and implementation there is often an opportunity to make use of existing infrastructure, and critically build on the strengths in the community such as improving existing park facilities, or clearing public land to create parks or sports grounds (Bassett et al., 2015; Schalkwijk et al., 2017; The National Academies of Sciences, Engineering and Medicine, 2017). In terms of intervention planning, community involvement is also logical and efficient as it can often reduce overall costs, and increase the probability of sustained implementation of the intervention (The National Academies of Sciences, Engineering and Medicine, 2017).

### *Targeting multiple behaviours and behavioural determinants*

Interventions (regardless of setting), tend to be more effective when multiple but related behaviours are being targeted (Martin et al., 2014; Stanton and Grimshaw, 2013). For instance, targeting

dietary habits and participation in physical activity can be mutually beneficial, that is improving one's diet can increase energy for physical activity, and if the target outcome is a clinical indicator such as BMI, the effect of improved diet with an increase in physical activity could be greater than targeting either behaviour individually.

#### *Multi-sector, multi-component integrated behaviour change strategies*

In addition to targeting multiple and complementary behaviours, intervention designs that incorporate multiple sectors and behaviour change strategies were also identified to be more effective than intervention designs that do not. For instance, involving local primary health care practitioners in a school-based intervention aiming to improve dietary habits could improve effectiveness as messaging could be interpreted as more legitimate, and the intervention could offer an opportunity for risk assessment and screening for conditions associated with poor dietary habits (The National Academies of Sciences, Engineering and Medicine, 2017; Trost, Blair, and Khan, 2014).

Further, interventions that incorporate a behaviour change model that considers the stages of behaviour change (trans theoretical model of behaviour change), the need for multiple strategies and a component that encourages motivation for behaviour such as a support group, are more effective than interventions that include either a stages of change model or a motivation component separately (Stanton and Grimshaw, 2013).

#### *Use of technology in interventions*

Due to the need to be mindful of feasibility in intervention design and delivery, investigating the place of technology in acting as a site and delivery mechanism for interventions is evident in much of the recent health and education intervention research. Computer-mediated interventions and interventions that incorporate the use of mobile devices in supporting smoking cessation, reducing alcohol consumption and marijuana use and encouraging healthy nutrition and regular physical activity have been reviewed. For these interventions, the factor that moderated success was the degree to which the messaging and intervention content was tailored to the individuals (Civljak, Stead, Hartmann-Boyce, Sheikh, and Car, 2013; Smedslund et al., 2017). That is when an intervention was adapted based on participants' needs, preferences or stage of behaviour change, it was found to be more effective at achieving the desired behaviour change, which is where the use of technology holds opportunity.

### **What do we still not know about physical health and well-being?**

A significant amount of knowledge about physical health trends and interventions to improve physical health among children and young people exists. However, there are several gaps in the published research, specifically; limited empirical evidence for the causal relationship between identified mediators and physical health outcomes; examples of effective intervention designs and implementation plans; empirical evidence on the impact of technology in interventions; and quality time-series data on physical activity, weight, nutrition indicators, and substance use (other than tobacco).

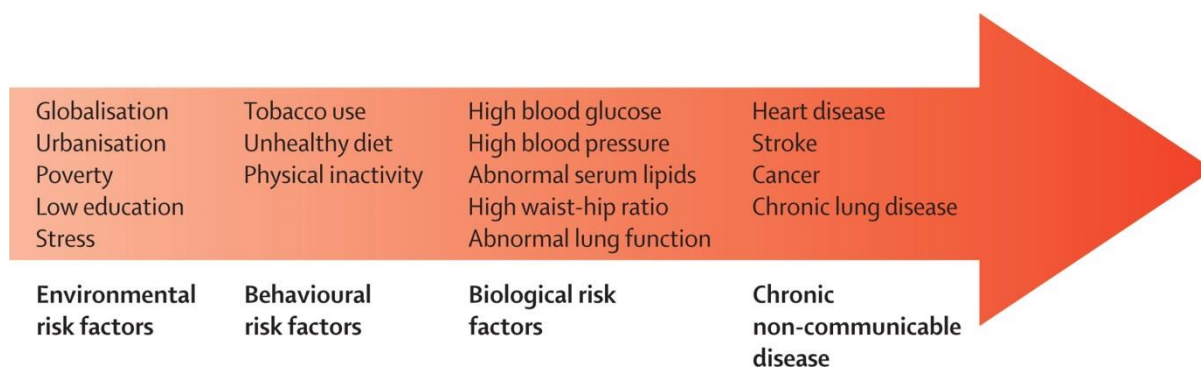
#### *Causal relationships between mediators and outcomes*

According to the research reviewed, variables that have been statistically identified as mediating physical health trends such as overweight and obesity, and participation in physical activity, have been ascertained via associations only. Often these statistical associations were also not significant.

Further as this paper has discussed, physical health trends are influenced by external variables including family structure, school environment. However, each of these variables individually have not

been identified as statistically associated with the physical health outcome. Some of these trends are noted in the left-hand side of the figure below.

**Figure 3. The causation pathway for chronic non-communicable disease**



Source: Adapted from Dans, A. et al. (2011), Lancet, Vol. 377/9766, [https://doi.org/10.1016/S0140-6736\(10\)61506-1](https://doi.org/10.1016/S0140-6736(10)61506-1).

The absence of empirical data with which to establish causal relationships between mediators and outcomes is problematic for intervention design and particularly for funding effective interventions as rationales for interventions acting on the relationship between mediators and outcomes can be weakened. For instance, the relationship between the factors identified as ‘environmental risk factors’ and those identified as ‘behavioural risk factors’ has comparatively little empirical evidence, compared to for example the relationship between the ‘biological risk factors’ and ‘chronic non-communicable disease’ listed in the above figure.

According to researchers, findings demonstrating relationships between mediators and outcomes should not be disregarded even in the presence of limited evidence, rather investment in high-quality longitudinal research designs to establish causality between mediators and outcomes is needed to understand the relationships better (Eime, Young, Harvey, Charity, and Payne, 2013; Schalkwijk et al., 2017; Van Buren and Tibbs, 2014).

### ***Intervention design and implementation features***

Similar to the relationship between identified mediators and physical health outcomes, there is also a relationship, albeit ill-defined, between the design and implementation of interventions and their effects on physical health behaviours and/or outcomes (The National Academies of Sciences, Engineering and Medicine, 2017; Van Buren and Tibbs, 2014). The features of effective intervention design are outlined in section 3.1; however, the features of effective intervention implementation are not as well-evidenced.

While understanding what intervention design features moderate effect is helpful for intervention designers, there is a paucity of published examples of intervention designs and implementation plans; often this information is not included in common peer-reviewed health intervention studies. Intervention repositories such as the Teaching and Learning Toolkit managed by the Education Endowment Foundation provide information about groups of interventions, and links to intervention projects which support those involved in education, and service delivery more broadly (Education Endowment Foundation, n.d.). However, information about effective intervention implementation is sparse, despite the relationship between implementation and intervention effect (The National Academies of Sciences, Engineering and Medicine, 2017).

An example of a feature of intervention implementation, about which there is limited published information, is the duration of interventions. The efficacy of brief interventions has been identified for improving nutrition and physical activity and reducing the consumption of alcohol, marijuana and other drugs (Carney et al., 2016). However, the challenge for these interventions is to understand whether effects are maintained in the long term, the paucity of longitudinal research on these interventions makes addressing this question impossible. Although, when compared to the counterfactual of no intervention, brief interventions could be recommended for promoting healthy lifestyle behaviours even if they may not be maintained.

### ***Impact of technology***

As discussed in section 3.1, technology appears to hold a great opportunity for intervention. Apart from an economic argument, and an implementation feasibility perspective, the comparative impact of using technology in interventions is not conclusive (Smedslund et al., 2017). That is, as for the influence of external variables, evidence about how the degree, type and duration of technology use influences intervention effect is minimal. For intervention designs to incorporate technology in a way that maximises overall effect, detailed information about these aspects is necessary.

### ***Intervention designs that incorporate school, family, community and the broader government***

Similar to the impact of using technology, the evidence of the influence of school, family, community and local and national government involvement in health promotion interventions illustrates that interventions that have some level of involvement of these groups tend to be more effective (The National Academies of Sciences, Engineering and Medicine, 2017; World Health Organization, 1998).

However, due to limited detail about intervention design and implementation in the literature it is not clear why this is the case, theoretical frameworks such as systems and complexity theory are used to justify the relationship, however the utility of these explanations for intervention designers and implementers is limited in the absence of detailed examples of intervention designs that incorporate stakeholders in school, family, community and government (Frood, Johnston, Matteson, and Finegood, 2013).

### ***Physical health trend data***

Finally, it is important to note that the quality of data on several important physical health indicators including but not limited to; weight, physical activity, nutrition and dietary intake, and substance use (other than tobacco), is lacking. For instance, for weight, BMI is commonly measured, despite the problems associated with the measure, however other measures of adiposity, like waist circumference could yield more relevant information for overall physical health (van Dijk, Takken, Prinsen, and Wittink, 2012). Monitoring waist circumference, for example, would also give more accurate information about changes in body chemistry that reflect increased risk of clinical conditions like but not limited to cardiovascular diseases which BMI is not sensitive to.

Similarly, data about participation in physical activity over time is limited also due to differences in approaches to measurement, and the reliability of measurement tools. As a consequence, longitudinal research indicates conflicting information about trends over time, and while the global data observatory housed at the World Health Organization provides information about the proportions of young people achieving daily physical activity targets, this information is fraught because activity targets have and are likely to continue to change, reducing the accuracy of analysis of trends over time (World Health Organization, 2015a).

Comparatively, nutrition data is of considerable quality for malnutrition prevalence and child mortality indicators associated with malnutrition. However, data tracking energy over-consumption or poor quality diet in more detail that is not only in terms of total energy consumption would enable change in diet quality to be examined. Thus global monitoring of more specific indicators of diet quality may permit change to be observed in a more timely manner, rather than waiting to see change in clinical outcomes due to improved nutrition, which could take decades and reduces scope for prevention initiatives (van Dijk et al., 2012).

With respect to substance use, and abuse, monitoring the usage and consumption of highly addictive substances, such as amphetamines while practically challenging given many of these are illicit, would afford important information about children and young people engaging in these risky behaviours. Global estimates of illicit drug consumption including amphetamines, particularly crystalline methamphetamine and prescription cognitive enhancing drugs are increasing among young people (Degenhardt and Hall, 2012; Franke et al., 2014; United Nations Office on Drugs and Crime, 2015). Suggested improvements to current measurement approaches could involve indirect methods such as sharing proportions of people receiving drug treatment, and using the multiplier method to estimate prevalence (Degenhardt and Hall, 2012).

### **Implications for education, community and families**

The physical health issues identified in this paper raise important implications for educators, community members, parents and caregivers and primary care providers. Overall the findings indicate that each of these stakeholder groups has a significant role to play in supporting healthy lifestyle behaviours among children and young people. Stakeholders from these groups should be involved in the design and implementation of interventions to support behaviour change, and ideally teachers, school staff and parents/caregivers would also participate in the interventions. Beyond the resourcing required for teachers and school/staff to participate, it is also necessary to consider what their individual and organisational level of competency or readiness is to contribute to intervention design and implementation. Similarly, for families and primary care providers, the same understanding of readiness is necessary. As highlighted throughout the paper there is also considerable need for further research into effective intervention design, and effective approaches to embed a multi-sector perspective into interventions.

### ***Teacher/school staff competency***

The extent of teachers and school staff members' knowledge of physical health, and consequently their ability to develop physical health curricula that incorporates relevant and up-to-date information is an important consideration. The findings of the World-Wide Survey on Physical Education by UNESCO revealed that there is considerable variance in the quality and delivery of curriculum for physical education across 232 UNESCO-member countries. Much of these differences are reported to be associated with higher or lower-income countries, thus it is not clear the extent to which they hold true for OECD countries specifically. However recent reforms to relate physical education and health education curricula were more common among higher income countries, many of whom are OECD countries (United Nations Educational Scientific and Cultural Organization, 2014).

Some consideration could be given to incorporating universal health education for all teachers regardless of their subject area(s), taking care not to de-value physical education specialist teachers. Engaging with initial teacher education on this issue could also help to release some resources at the school-level, and involve higher education in school-based health promotion.

***Role for primary carers in promoting physical health and well-being***

Given the degree to which the tailoring of intervention messaging and content to individual participants can maximise effect, the role for primary carers in supporting this tailoring process could be investigated. For instance, the possibility for primary carers to screen individuals to determine their level of risk and accordingly what behaviour changes are required for individuals to reduce their risk and improve their physical health could be investigated. If feasible, this could enable intervention design, content and implementation to be tailored to individuals.

The possibility of establishing collaborative networks/partnership could be investigated to improve and facilitate communication between educators, primary care providers and parents/caregivers which could be utilised to design and implement health promotion interventions in school, in the home environment and in the community.

***Parents/caregivers role and the home environment***

The role of parents/caregivers extends throughout the life course but is particularly influential during early life, and through adolescence. Equipping parents/caregivers with the skills and education necessary to positively influence their child's start to life by establishing a home environment that is supportive of healthy lifestyle behaviours will thus have a lasting effect (Roblin, 2007). The role of parents, peers and family members during adolescence is important as young people are at high risk of poor mental health, and may consider trying substances such as smoking or alcohol (Cairns, Yap, Reavley, and Jorm, 2015). At this stage of life, adolescents also tend to be exposed to greater levels of peer pressure, and are more vulnerable to the effects of peer pressure, as this corresponds to a desire for group acceptance given the developmental stage, and also in many cases the transition to secondary or high school (Cairns et al., 2015; Schwartz, Gorman, Nakamoto, and McKay, 2006). Thus, increasing the readiness of parents/caregivers to construct a home environment that is supportive of healthy lifestyle behaviours is necessary. This extends beyond education; parents/caregivers need to be cognisant of what opportunities exist in their community to participate in physical activity and organised sport. Accordingly, they need to be connected to their local community. Parents who are aware and understand what constitutes a supportive home environment for healthy lifestyles, and what is available in their community to support regular physical activity will be able to meaningfully engage in intervention design and implementation.

***Public health investment***

Investing in public health initiatives could support and reinforce school-based interventions and messaging, as well as those occurring in the community. This implies a need to integrate physical health interventions so as not to dilute or confuse messages and supports for healthy lifestyle behaviours. As with involving primary carers, investigating the scope for public health practitioners and policy makers to participate in collaborative networks may help to address this concern. Overall, public health investment could support the development of a system of intervention for improving and maintaining physical health and well-being, embedding health *in* education and in so doing develop necessarily complex, multi-level, multi-sector interventions that include stakeholders in the design and implementation and ultimately improve and maintain the physical health and well-being of children and adolescents in OECD countries.

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## Annex A: Literature Search Strategy and Intervention Effect Index

1. This annex provides an overview of the search strategy, literature reviewed and where possible effect size information for synthesised interventions targeting physical health and well-being. It is important to note that a rapid evidence assessment (REA) methodology was used in the literature review. The search strategy employed in REAs commonly refines the selection of studies and restricts them to those that were published in the last 10 years, are peer-reviewed and available in the English language. The process of identifying and evaluating relevant literature is efficient and useful for those involved in policy development and intervention design. It should also be noted that the purpose of the review was not primarily to conclude what interventions are effective for specific physical health outcomes; rather it was to identify examples of what interventions are being implemented and identify how effective they are. Similarly, it was also important for the review to incorporate (as much as possible) quality information on physical health and well-being of children and adolescents in OECD countries, hence the OECD iLibrary was utilised. A broad search strategy is described below for the REA.

### Main search strategy

2. The following databases and websites were used to source literature documenting physical health and well-being trends and interventions for children and adolescents in the general population: Ovid MEDLINE, Cochrane Collaboration, Campbell Collaboration, World Health Organization (global data indicators), OECD iLibrary and UNESCO.

3. Search terms were created for ‘play’, ‘physical activity’, ‘eating habits’, ‘obesity’, ‘risk behaviours’, and ‘sleep’.

- **Play:** leisure OR leisure activity OR outside school leisure AND physical activity sport AND outdoor education.
- **Eating habits:** nutrition AND/OR diet AND/OR eating behaviour AND/OR dietary habits.
- **Obesity:** overweight AND/OR high BMI AND/OR obes\*.
- **Risky health behaviours:** substance OR drug AND/OR alcohol AND/OR party\* AND/OR unsafe sex.
- **Sleep:** sleep behaviour AND/OR sleep patterns AND/OR sleep duration AND/OR sleep quality.

4. Search terms were entered under ‘key words’ in MEDLINE, and in the search function in the other databases and websites. Results from all searches were limited from 2007 to 2017 in English.

The following primary and secondary research studies were included:

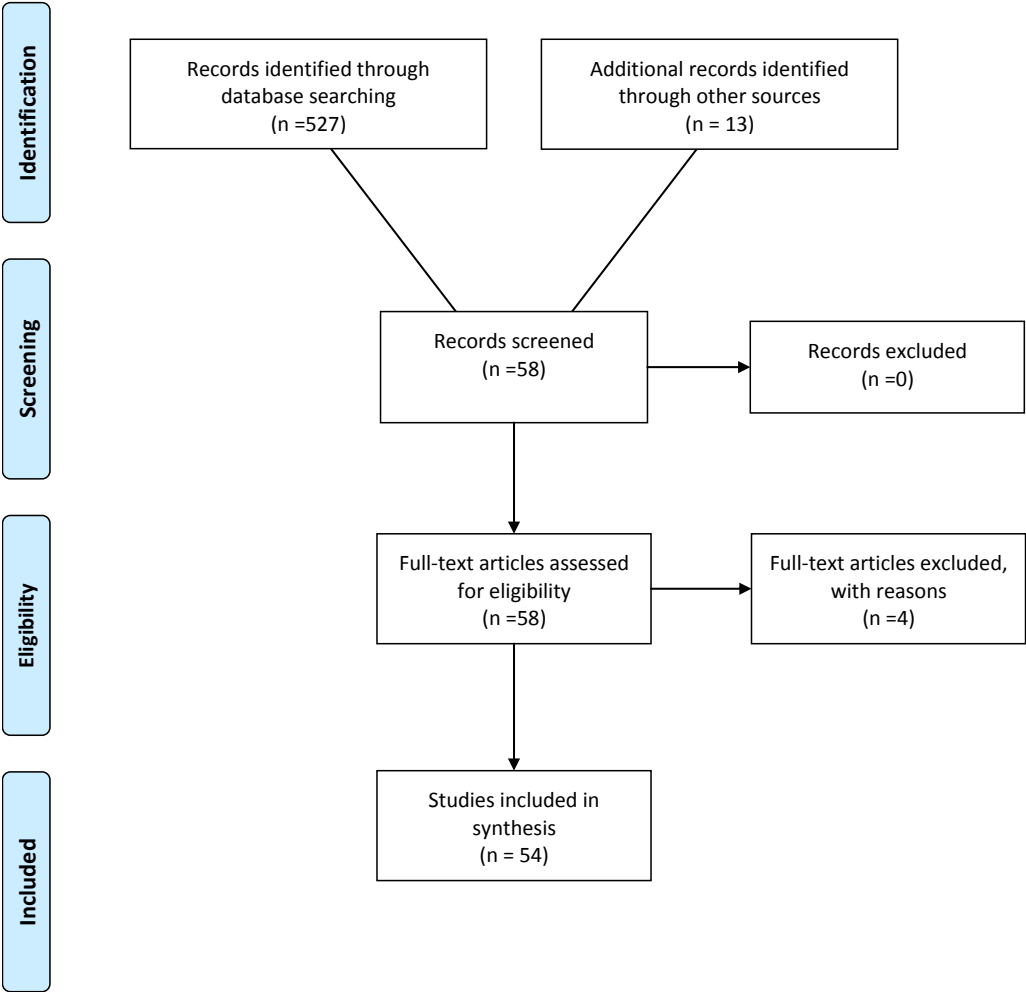
- Systematic reviews AND meta-analyses of interventions (school-based and non-school based) that improve physical activity, nutrition, risky behaviour and sleep
- Longitudinal studies of trends in play, physical activity, nutrition, obesity, risky health behaviour and sleep
- Commentary/discussion papers on trends in each of the areas

Studies were accepted for screening if they were:

- Conducted in OECD member countries
- Published within the last 10 years (unless study was a seminal work)
- Focussed on school age/youth to early adulthood
- Incorporates non-clinical intervention research

A brief Prevention and Recovery Information System for Monitoring and Analysis (PRISMA) statement for the results of the search strategy is in Figure A.1 to summarise the review process.

Figure A.1 PRISMA Statement for Physical Health and Well-being Review





5. The majority of included studies were sourced from MEDLINE, a summary of sources from included studies reviewed is provided in the table A.1.

**Table A.1 Sources of Included Studies**

Database/website	Number of included studies
<b>Cochrane Collaboration</b>	7
<b>Campbell Collaboration</b>	2
<b>MEDLINE</b>	13
<b>WHO</b>	4
<b>UNESCO</b>	1
<b>OECD iLibrary</b>	15
<b>Non-specified</b>	12

6. The majority of included studies were published recently in 2017, as per the information provided in the table A.2.

**Table A.2 Year of Publication for Included Studies**

Year of publication	Number of included studies
<b>2003</b>	1
<b>2007</b>	2
<b>2009</b>	2
<b>2010</b>	3
<b>2011</b>	4
<b>2012</b>	1
<b>2013</b>	7
<b>2014</b>	8
<b>2015</b>	7
<b>2016</b>	4
<b>2017</b>	15
<b>Total</b>	54

7. As noted above, outcome or effect size information was extracted from systematic reviews, and those studies that incorporated a meta-analysis of interventions. Other information associated with interventions including cost has been extracted where provided to provide an indication of feasibility; however, for the majority of studies, cost-effectiveness, utility or benefit was not evaluated. The following table summarises the information extracted from intervention studies and reviews included in the REA.

Table A.3 Intervention Effects/Outcomes Index

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Blake, Sheeber, Youssef, Raniti and Allen (2017)</b>	9 randomised and non-randomised controlled trials, total n= 357	Systematic review and meta-analysis	Interventions reviewed including cognitive-behavioural sleep interventions among adolescents. Some interventions also incorporated a mindfulness component.	Duration ranged from 6 –12 weeks.	Total sleep time/duration improved in all interventions (M=29.47min [17.18, 41.75]), as did sleep onset latency (M=21.44min [-30.78, -12.11]). The wake after sleep onset also improved with a moderate effect size (d= 0.59[0.36, 0.82]). Participants reported high levels of satisfaction with interventions as well.	No information provided.	Sleep education, scheduling, personalised bedtimes and relaxation and mindfulness were identified as the most helpful components of interventions by participants. Authors also noted the importance of conducting sleep interventions in the home, as school-based sleep education programs have generally been concluded to be ineffective at improving sleep among adolescents.
<b>Busch, Altenburg, Harmsen and Chinapaw (2017)</b>	11 cluster-randomised and non-randomised controlled trials, total n= 11, 535	Systematic review	School, home, parent workplace and community-based interventions that aim to improve sleep duration and/or bedtime routines among children (4-12 years). Most interventions targeted multiple behaviours in addition to sleep, these included physical activity, diet and watching television.	Intervention duration varied, with a short educational intervention of only 50 minutes, to a long-term intervention of 5.5 years. Most interventions were under 12 months.	5 of 11 interventions reviewed indicated a positive effect on sleep duration; these effects were sustained 2 years post intervention. Other sleep related outcomes within these interventions included less variability in sleep duration, and reduced sleep onset latency.	No information provided.	A combination of settings shows some promise given the role of parental behaviour on sleep, similarly the incorporation of multiple settings in intervention delivery has been shown to improve behaviour change outcomes (according to health promoting school literature). Integrated behaviour change strategies, as well as improving other health behaviours also maximised effects of intervention on sleep outcomes. This is important because there are relationships between some healthy behaviours with sleep, for instance less physical activity can result in less tiredness or fatigue symptoms and hence can influence sleep duration, or conversely greater daytime tiredness as a result of less sleep duration can affect physical activity behaviour. Interventions reviewed that targeted children's sleep by integrating a combination of other behaviours were largely effective, compared to those that only targeted sleep as an individual behaviour.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Carney, Myers, Louw and Okwundu (2016)</b>	6 randomised controlled trials, total n= 1, 259	Systematic review and meta-analysis	Interventions were all brief and school-based, and were conducted with adolescents who were using alcohol and other drugs. Interventions included screening, motivational interviewing, provision of information and discussion via brochures and follow-up appointments for further discussion.	Up to four intervention sessions, total time ranges from 45 minutes to 3 hours.	The brief interventions were effective at reducing cannabis frequency and abuse, and alcohol use, dependence and abuse at short-term follow up. At long-term follow-up, interventions reduced alcohol abuse (SMD= -0.72[-1.05, -0.40]), cannabis frequency (SMD= -0.56 [-0.75, -0.36]), cannabis abuse (SMD= -0.62[-0.95, -0.29]), and dependence (SMD=-0.96[-1.30, -0.63]). At long-term follow-up there was also an effect of the interventions on adolescents' delinquent or problem behaviours (SMD= -0.78[-1.11,-0.45]).	No formal economic evaluation was conducted; however, authors noted that brief-interventions are generally more cost-effective than more traditional, longer interventions for adolescents using substances.	Effects observed indicate that brief school-based interventions are effective at reducing alcohol and cannabis use, and effects can be maintained over time when compared to no intervention. However, the systematic review findings indicated that the effect of brief school interventions were not greater than interventions that only incorporated the dissemination of information. Quality of evidence was moderate to low, and so findings should be interpreted with caution.
<b>Civiljak, Stead, Hartmann-Boyce, Sheikh and Car (2013)</b>	20 randomised and quasi-randomised trials, total n=33, 813	Systematic review and meta-analysis	Internet-based interventions targeting reducing smoking behaviour, and encouraging cessation.	Range from 1.75 months (7 weeks) to 12 months.	Internet-based interventions were effective at influencing smoking behaviour. Tailored interventions yielded greater effects on smoking cessation (RR=2.05, compared with RR-1.48).	Two of the reviewed studies incorporated a cost-effectiveness analysis. Both studies concluded the interventions were cost-effective in comparison largely because they were delivered via the internet. An estimate total cost of internet-based programs for 5000 participants was USD 2000.00, and the cost of providing telephone counselling to 1000 participants was USD 100, 000.00.	Internet-based interventions were effective at reducing smoking behaviour, and in particular when the intervention messaging was tailored to individuals' effects on smoking cessation were greater.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Dobbins, Husson, DeCorby and LaRocca (2013)</b>	44 randomised controlled trials, total n= 36, 593	Systematic review	School-based physical activity interventions (educational, health promotion, counselling and management strategies to promote health and physical fitness).	Range from 3 months – 6 years	Physical activity rates (% of participants' physical activity): 53%– 92% (post intervention) (OR=2.74[2.01, 3.75]). Physical activity duration (minutes engaged in physical activity): 5 – 45 minutes greater than at baseline/pre-intervention. Duration of television watching reduced from 5 – 60 minutes per day between baseline and post intervention. Maximum oxygen uptake (VO <sub>2</sub> max) improved, from 1.6 – 3.7mL/kg per min at post intervention compared with baseline assessment.	No information provided.	Changes in physical activity duration were observed <i>within</i> school hours, and were more marked among children compared with adolescents. Overall effects were small.
<b>Faggiano, Minozzi, Versino and Buscemi (2014)</b>	51 randomised controlled trials, total n= 129, 029	Systematic review and meta-analysis	Universal school-based interventions for Preventing drug use. Interventions incorporated knowledge-focussed curricula, social competence curricula, social norms, and approaches that combined the previous three types.	Range from 1 hour to 3 years	Compared with knowledge-focussed curricula, social competence interventions were more effective (RR=0.90 [0.81, 1.01]) on marijuana use at less than 12 months, this effect slightly reduced at 12month+ follow up (RR=0.86 [0.74, 1.00]). No effect was found on hard drug use. These effects were similar for social norms approaches compared with knowledge-based curricula (RR=0.88[0.72, 1.07]) on marijuana use at less than 12 months post intervention. The combined approach compared with knowledge-based curricula was also more effective on marijuana use at less than 12 months post intervention (RR=0.79 [0.59, 1.05]) and sustained at more than 12 months post intervention (RR=0.83, [0.69, 0.99]).	No information provided.	Overall, interventions combining social competence and influence approaches had better effects that were sustained at longer term follow-up. Knowledge-focussed curricula interventions had no effect on behavioural intentions, only improvements in knowledge.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Kalyoncu, Pars, Bora-Gunes, Karabulut and Aslan (2014)</b>	9 randomised and non-randomised controlled trials, total n= 5,502	Systematic review	Nutrition preventive interventions were reviewed, and studies using the dietary protocol for reducing hypertension (DASH) were included. There was a combination of community-based intervention and school-based intervention.	Duration ranged considerably, as some studies were longitudinal, looking at the effects of nutrition from infancy until 27 years of age.	Reviewed studies examining the relationship between breastfeeding and blood pressure, indicated that breastfed infants have lower diastolic blood pressure in youth. Similarly, among children who have had a low saturated fat diet from infancy to 15 years, both systolic and diastolic blood pressure was 1.0mmHg lower than the general population. Studies utilising the pre-established dietary protocol for hypertension reduction (DASH) also concluded it reduced blood pressure. Caffeine intake was identified as increasing systolic blood pressure during the day, and consumption of low fat compared with whole fat dairy had no impact on blood pressure.	No information provided.	Overall, interventions that are based in the community, and incorporate tailored messaging and delivery are effective at reducing hypertension. Similarly, family-based interventions are also effective, and family emotional support is particularly important for females as it encourages adherence to the intervention (in this case a nutrition protocol). Health promotion activities overall indicate that the family tends to have the greatest effects on lowering blood pressure (compared with the school and community). Authors suggest that long-term individualised web-based approaches that involve parents could be the most promising option for preventing hypertension.
<b>Liao, Liao, Durand and Dunton (2013)</b>	25 randomised controlled trials, total n= 7, 409	Systematic review and meta-analysis	Interventions aiming to increase physical activity and improve BMI.	Duration ranged from 1.5 months to four and a half years.	Main summary effect of the interventions on BMI change, was $g = -0.60$ to $-0.089$ , for single component interventions summary effect was $g = -0.154$ . No effects were significant. While the meta-analysis results indicated that effects of interventions on BMI reductions were not clinically significant ( $<0.25$ BMI unit change), they are considered to of public health significance at the population level, among non-obese children.	No information provided.	The differences between the effects of multi-component and single-component interventions, while not significant presents interesting information about the potential impact of the degree to which participants found changing one behaviour easier than focussing on changing multiple behaviours. However, the meta-analysis was focussed on the clinical impact of the interventions, and did not measure changes in the desired behaviour (physical activity, duration of sedentary behaviour). Overall, interventions that aim to reduce sedentary behaviour are effective in reducing BMI, however the combination of a physical activity promotion and diet component did not seem to contribute to or enhance the magnitude of effect.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Martin, Saunders, Shenkin and Sproule (2014)</b>	6 randomised controlled trials, total n= 674	Meta- analysis <sup>8</sup>	Multi-component lifestyle interventions AND physical activity interventions among overweight and obese children and adolescents included interventions to increase physical activity, dietary and nutrition interventions, interventions to decrease sedentary behaviour and psychological interventions for weight management.	10 weeks – 2 years	Overall school achievement (scale 0 – 100) significantly increased according to one study (school-based healthy lifestyle education + nutrition) (MD=1.78[0.8, 2.76]) Mathematics achievement (scale 0 – 200) significantly increased according to one single component physical activity intervention (MD=3.00[0.78, 5.22]), executive function (scale 0-100) significantly increased (MD=3.00, SD=15) and working memory (scale 0-100) significantly increased (MD= 3.00, SD= 15).	None provided.	Multi-component/complex interventions have greater potential to improve overall achievement; single component interventions can be effective at improvement specific aspects of achievement, e.g. executive functioning.
<b>Maynard, Solis, Miller and Brendel (2017)</b>	61 randomised controlled trials, quasi-experimental designs, pre-post designs. Total n= 6, 207	Systematic review, and meta-analysis (31 studies)	Interventions were all delivered in a school setting, and included a mindfulness component or strategy.	Range from 1 month to 7 months.	Mindfulness interventions have a small but significant effect on cognitive outcomes (g=0.25 ,[0.06, 0.43]), socioemotional outcomes (g=0.22,[0.14, 0.30]), academic outcomes (g=0.27[-0.04, 0.57]) and behavioural outcomes (g=0.14 [-0.02, 0.30]) were observed.	No formal economic evaluation was conducted, however authors note that there may be some opportunity cost associated with intervention taking time away from usual instruction.	The impacts of mindfulness are positive, however long-term effects of continued practice are not yet known. Interventions tended to have the greatest and most robust effects on socioemotional and cognitive outcomes, whereas effects on academic and behavioural were less robust.

<sup>8</sup> Pooled standard effect size could not be calculated due to differences in study designs.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Smedslund, Wollscheid, Fang, Nilsen, Steiro and Larun (2017).</b>	60 randomised controlled trials, cluster-randomised controlled trials and quasi-randomised controlled trials, total n= 33, 316	Systematic review and meta-analysis	Brief computerised interventions (any intervention that is provided by an electronic device) implemented with young people (15-25 years).	Intervention delivered within one hour.	There is a small intervention effect on reducing alcohol consumption (SMD=-0.17[-0.27,-0.08]), however this effect was not maintained over time.	No formal economic evaluation was conducted, however authors from studies reviewed and the overall review confirmed that brief computerised interventions can be implemented at low cost, and reach a large audience, in comparison to group or one-to-one based interventions.	Overall brief computerised interventions for reducing alcohol consumption are effective, while the effects are small. Interventions that incorporate feedback and multiple 'doses' also appear to be more effective. No conclusion about the effectiveness of interventions on cannabis consumption is possible.
<b>Stanton and Grimshaw (2013)</b>	28 cluster-randomised controlled trials, randomised controlled trials, and non-randomised trials. Total n= 6, 920	Systematic review and meta-analysis	A variety of interventions were reviewed, they included pharmacotherapy, psycho-social interventions and behaviour change programmes with an ecological focus. Interventions were largely school-based, some also incorporated sessions or components conducted in a health service clinic.	Range from 34 minutes to 1 year.	Interventions were effective, in particular those were based on the trans theoretical model of behaviour change, which yielded a moderate effect on smoking cessation (Pooled RR=1.56[1.21, 2.01]), compared with those only incorporating a motivational component (Pooled RR=1.60 [1.28, 2.01]).	No information provided.	Interventions based on the trans theoretical model demonstrate moderate effects on smoking cessation, however it is also possible that interventions utilising multiple behaviour change models could also be effective, this could not be determined within the review. It is suggested that interventions that respond to the stages of change/readiness for change, include a motivational component and cognitive-based therapy could be effective at encouraging quitting behaviour among young people who smoke.

Reference	N (no of studies/ participants)	Design	Intervention type	Intervention duration	Effect size/outcome	Cost information	Conclusion
<b>Waters, et al. (2011)</b>	37 randomised and non-randomised controlled trials, total n= 27 946	Systematic review and meta-analysis (37 studies meta-analysed)	A combination of school-based healthy lifestyle interventions. Some interventions also focussed on encouraging parent support, and suggesting home activities to encourage sustaining behaviour outside of school environment).	Intervention duration range was between 3 months – 48 months (4 years)	Significant reduction in BMI among children in the intervention (MD= -0.15kgm <sup>2</sup> [-0.21, -0.09]).	No studies conducted formal economic evaluation, however one reported costs of intervention (nursery setting) was inexpensive (per capita EUR 297.00) and for the home-based component resource materials cost(EUR 24.00). Other interventions were delivered by school staff that had been trained to deliver the intervention.	Effects on adiposity as measured by BMI are small and not clinically significant. However, given that the intervention is being conducted with a 'general' population of children, at a population level this reduction is significant for long-term changes in weight trends.  Authors identified that the following intervention components related to effectiveness: <ul style="list-style-type: none"> <li>• School curriculum that supports good nutrition</li> <li>• Physical activity and positive body image promotion</li> <li>• Increase in physical activity sessions and development of movement skills during school hours</li> <li>• Improved nutritional quality of school food</li> <li>• School environment and culture supports healthy eating and physical activity</li> <li>• Support for teachers to implement intervention</li> <li>• Parent support for encouraging healthy behaviour in the home</li> </ul>
<b>Witjes, van de Gaar, van Grieken, de Kroon, Mackenback, van Lenthe, Jansen and Raat (2017)</b>	11 randomised and non-randomised controlled trials, total n= 13, 033	Systematic review	Interventions promoting physical activity among socially disadvantaged children were conducted in community, early childhood or school settings.	Not reported	All interventions targeted multiple lifestyle behaviours influenced on at least one measure of adiposity (BMI, body fat percentage, weight, skinfolds or waist circumference). Intervention effectiveness was largely modest, and effects were not maintained at long-term follow up.	No information provided.	The majority of interventions were implemented in schools. Interventions that targeted multiple lifestyle behaviours and individual, family and environmental determinants positively influenced weight measures. Those interventions that were targeting specific, single lifestyle behaviour were effective only in changing that specific behaviour. Authors advocate for intervention designs to target all behaviours where changes are desired, it is not sufficient to rely on 'spill-over effects'. In addition, designs need to incorporate both cultural tailoring and focus on environmental change for supporting desired behaviour- that is targeting structural barriers to behaviour change.