



Review article

Policies for promotion of physical activity and prevention of obesity in adolescence

Russell R. Pate*, Jennifer I. Flynn, Marsha Dowda

Department of Exercise Science, University of South Carolina, Columbia, SC 29208, USA

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Abstract

Obesity rates among children and adolescents in developed countries have increased dramatically since the 1970s. During that same period, numerous secular changes have combined to reduce the demand for physical activity in day-to-day life, and many barriers to physical activity are now evident. As a consequence, most children and adolescents do not meet the accepted public health guidelines for physical activity. Accordingly, public health interventions are needed to increase physical activity in adolescence. Such interventions, if successfully implemented, can be expected to improve fitness and health as well as reduce the prevalence of overweight and obesity in young people. Promotion of physical activity in populations of children and adolescents will require comprehensive strategic planning and adoption of new policies in multiple societal sectors. This paper highlights nine initiatives that can address the problem of physical activity in children. The initiatives are to: establish comprehensive school physical activity programming; demand high quality physical education; require physical activity in early child care and education; require physical activity in afterschool programs; create equity in community resources; activate youth sports programs; re-normalize active transport to school; institutionalize clinic-based physical activity assessment and counseling; and build activity-friendly homes. A case will be made for comprehensive national and international strategic planning aimed at effective and large-scale implementation of these initiatives and tactics.

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Introduction

Physical activity provides a wide range of health benefits to children and adolescents. It is clearly documented that higher levels of physical activity are associated with better physical fitness, body composition, bone health, and cardiometabolic risk status in young people.¹ Substantial evidence suggests that physical activity promotes good mental health as well as improved cognition and school performance.¹ Accordingly, public health authorities around the world have adopted physical activity guidelines for children and adolescents, and

these recommendations typically call for young people to be active for 60 minutes per day at intensities in the moderate-to-vigorous range.^{2,3} Despite the extensive evidence that physical activity provides adolescents with important health benefits, most children and adolescents in developed nations do not meet the accepted physical activity guideline.⁴

Concern regarding the physical activity behavior of young people has been heightened by a remarkable increase in the prevalence of childhood obesity.⁵ It is clear that obesity rates are highest in the same nations that manifest the lowest compliance with physical activity guidelines,⁴ and mounting evidence shows that low physical activity is a consistent predictor of increased risk for development of overweight and obesity in young people.⁶ It seems likely that both low physical activity and high obesity rates in children and adolescents

* Corresponding author. Department of Exercise Science, University of South Carolina, 921 Assembly Street, Suite 212, Columbia, SC 29208, USA.

E-mail address: rpate@mailbox.sc.edu (R.R. Pate).

are related to fundamental changes in societies that have had the effect of reducing the demand for physical activity and presenting barriers that reduce physical activity levels. These changes include reductions in active transport,^{7,8} increased time spent using digital devices,⁹ and restructuring of the home/family environment. These societal changes represent challenges that will have to be overcome if physical activity levels of contemporary children and adolescents are to be increased.

This article is intended to present a set of evidence-based initiatives that could be launched as part of a comprehensive public health approach to promoting physical activity and preventing obesity in young people.

Can we successfully intervene to increase children's physical activity?

While societal changes may present major challenges to promoting physical activity in contemporary adolescents, substantial scientific evidence indicates that physical activity levels can be increased. Several major reviews of the youth physical activity intervention literature have been published.^{10–12} They include a Cochrane Review which concluded, on the basis of a review of 44 diverse intervention studies, that children in intervention groups were more active than those in control groups.¹⁰ Other reviews have focused on specific intervention strategies and interventions conducted in specific settings. The United States (US) Department of Health and Human Services (USHHS) conducted a review of youth physical activity interventions in a range of settings and concluded that the strongest evidence of effectiveness was for school-based interventions.¹³ Enhanced school-based physical education was identified as effective by both USHHS and by the Guide to Community Preventive Services. So, it seems appropriate to conclude that effective intervention methods are available. What is needed is a comprehensive approach to implementing effective intervention strategies at the community, state/province, and national levels.

Will increasing physical activity reduce obesity rates in youth?

Obesity rates in adolescence have increased dramatically over the past three decades. The increases have been particularly pronounced in the most developed and technologically advanced nations, but marked increases have been seen worldwide.¹⁴ Mounting evidence suggests that declining physical activity is a major factor underlying that trend, and it is becoming increasingly clear that reduction of childhood obesity rates will require increasing children's physical activity levels. It has long been known that more physically active adolescents tend to be leaner than less active ones.¹ It is clear, based on the findings of randomized trials, that increasing physically activity can reduce adiposity in overweight adolescents.¹⁵ However, reduction of the population prevalence of obesity will depend on effective prevention, not treatment of the problem. Accordingly, the findings of prospective

observational studies with high-quality measures of adiposity and factors that may increase risk of developing overweight and obesity are particularly relevant. This body of knowledge has been growing, and the findings of these studies have been reviewed.^{16,17} A consistent finding has been that children and adolescents who are at the low end of the physical activity continuum are at increased risk of excessive increases in adiposity.^{16,17} These findings indicate that promotion of physical activity should be a central component of the public health effort to reduce childhood obesity.

Initiatives to increase physical activity in youth

Adolescents are physically active in many different places for many different reasons, and their physical activity takes many different forms. Accordingly, the effort to increase physical activity levels of adolescents will have to be pursued through actions in multiple societal sectors. Changing physical activity behavior at the community level will require implementation of policies and programs that can reach large numbers of adolescents with interventions that are known to be effective in increasing physical activity. In the following sections of this article we describe nine initiatives that are evidence-based and that, if implemented with fidelity, can collectively increase the physical activity levels of children and adolescents.

Establish comprehensive school physical activity programs

A comprehensive school physical activity program is a school-based, multicomponent approach to increasing physical activity that reflects strong coordination and synergy across all of its components. These components include quality physical education as the foundation; physical activity before and after school; physical activity during school; teacher and staff involvement in promoting physical activity; and family and community engagement. Data from a longitudinal study shows that moderate-to-vigorous physical activity (MVPA) during the school day decreases from fifth to seventh grade (Lau et al., unpublished).

A meta-analysis by Russ et al¹⁸ found that multicomponent interventions conducted in the US have produced a small, significant effect on physical activity levels of adolescents. However, no studies to date have examined interventions that include all five components of the Comprehensive School Physical Activity Model. A review of school-based interventions conducted in Europe found similar results.¹⁹ The review reported that interventions that combined education about physical activity with environmental components (organized activity breaks, increased physical education time, and recess) produced better results than those that did not focus on environmental factors.

In the US, the Centers for Disease Control and Prevention (CDC) and the Society of Health and Physical Activity Educators have published a Comprehensive School Physical Activity Program step-by-step guide to help school districts

implement multicomponent school-based interventions.²⁰ The guide and subsequent training program provide physical education coordinators and teachers, classroom teachers, school administrators, recess supervisors, before- and after-school program supervisors, parents, and community members with the necessary resources and tools to develop or improve a comprehensive school physical activity program.

Demand high-quality physical education

Physical education classes provide an important opportunity for physical activity during the school day. Recent data show that ~30% of adolescents attend daily physical education classes, and 48% attend at least one physical education class per week. A meta-analysis by Hollis et al²¹ identified 13 studies from nine countries and found that the percentage of physical education lesson time spent in MVPA ranged from 11.4% to 88.5%. The mean lesson time spent in MVPA was 44.8%, which did not meet the US CDC or the United Kingdom (UK) Association of Physical Education criteria recommendation that at least 50% of physical education time be spent in MVPA.

However, intervention studies focused on increasing the amount of time children spend in MVPA during physical education have been successful. Pate et al²² found that girls enrolled in physical education reported more MVPA and vigorous physical activity, and a higher percentage reported a daily average of one or more 30-minute blocks of vigorous physical activity. Girls enrolled in physical education reported 12–32% more MVPA blocks and 33–60% more vigorous physical activity compared to those not enrolled in physical education. Furthermore, it has been shown that physical education classes can be enhanced to increase the amount of time spent in high-intensity physical activity. Luepker et al²³ conducted an intervention that included enhanced physical education courses for third and fifth grade students. The intensity of physical activity during physical education classes as well as child-reported daily vigorous physical activity both increased as a result of the intervention.

In 2015, for the first time, physical education was added to the US Every Student Succeeds legislation (S. 1177). Specifically, physical education was added to the list of what defines a well-rounded education (courses, activities, and programming for the purpose of providing all students access to an enriched curriculum and educational experience). The addition of physical education is significant as it will now allow for the access to significant funding sources to improve physical education classes.

Require physical activity in early childcare and education

Many young children attend preschools and other structured child development programs (over 90% in Europe, 49% in Australia, 61% in the US).^{24–26} Studies have shown that young children are inactive while in preschool. Pate et al²⁷ used direct observation of 3–5-year-old children and found that ~87% of all observations were sedentary, and only 3% of

observed time was spent in MVPA. Similar levels of sedentary activity in preschools were also found in Australia and the UK.²⁸ Government agencies and health authorities have recommended that preschool-age children accumulate 3 hours per day of total physical activity.^{29–32} Studies have assessed the percent of preschoolers who meet that guideline and estimates vary widely, from 5% in Australia³³ to 84% in Canada³⁴ and 100% in the UK.³⁵ In the US, Pate et al³⁶ reported from two preschool studies that only 40–50% of children met the guidelines.

A meta-analysis of the effectiveness of preschool physical activity interventions indicated that effect sizes were small-to-moderate on general physical activity and moderate on MVPA.³⁷ One recent intervention found that providing 4-year-old children with opportunities to be active increased MVPA in intervention children as compared to children in control preschools at follow-up (7.4 min/hand 6.6 min/h, respectively).³⁸

The Institute of Medicine has set goals to increase physical activity levels in young children,²⁹ and every state in the US has implemented at least one regulation related to the promotion of physical activity in young children.³⁹ Most states have a regulation to provide outdoor (98% child care centers) and indoor environments (94% of centers) that have a variety of adequate space and portable play equipment. One example of a state that has developed early childhood policies is South Carolina, which implemented the “ABC Grow Health Physical Activity Standards” for preschools and childcare centers. These standards require teachers to plan physical activities and promote outdoor play, and centers and preschools to provide a variety of play materials to promote activity indoors and outdoors.

Require physical activity in afterschool programs

Nearly 6 million youth in the US attend some form of afterschool programming on a regular basis.^{40,41} A study by Trost et al⁴² found that during afterschool programs, children spend roughly 40% of their time in sedentary behavior and only 20 minutes in MVPA.

A meta-analysis found that afterschool interventions have a positive effect on children's physical activity levels and physical fitness.⁴¹ A study by Beets et al⁴³ conducted an afterschool intervention in 20 afterschool programs that served > 1700 children. The study evaluated an intervention designed to assist after-school programs in meeting a policy goal that children accumulate at least 30 min/d of MVPA. The intervention emphasized intentional programming of physical activity opportunities and also included training for staff and program leaders to help integrate physical activity into the program schedule. Following the intervention, ~20% of children achieved the 30 min/d of MVPA compared to only 14% in the control group.

The Young Men's Christian Association (YMCA), an organization that focuses on youth development, healthy living, and social responsibility, is one of the leading organizations to serve US adolescents through afterschool programming. In 2011, the YMCA committed to developing and implementing

the Healthy Eating and Physical Activity (HEPA) Standards. Related to physical activity, the standards state that YMCA afterschool programs should: (1) provide children and adolescents with at least 30 minutes of physical activity per day; (2) include a mixture of moderate and vigorous activity and bone/muscle strengthening activities; and (3) include outdoor play whenever possible. At present, > 90% of local YMCAs have committed to implanting the HEPA standards.⁴⁴

Create equity in the built environment

The built environment includes the neighborhoods and communities surrounding the places in which children live. It has been shown that broad aspects of the community, including socioeconomic status, influence children's physical activity. Gordon-Larsen et al⁴⁵ reported that higher socioeconomic status communities had greater odds of having more than one physical activity facility, and that lower socioeconomic status and minority communities were less likely to have a physical activity facility. In addition, an increasing number of physical activity facilities was associated with decreased overweight and increased odds of participating in MVPA > 5 times per week. A review by Ding et al⁴⁶ found that access and proximity to recreational facilities were among factors that were related to physical activity.

Several organizations are implementing policies and programs to improve the built environment as it relates to children and physical activity. One example is The City Project, which works to achieve equal justice, democracy, and livability for all. Led by Robert Garcia, the organization has had several successes related to creating equity in the physical activity built environment. Examples include the Urban Park Movement and the United Teachers of Los Angeles Lawsuit. For the Urban Park Movement, The City Project provided policy and legal advocacy to help create the 40-acre Rio de Los Angeles State Park.^{47,48} For the Teachers of Los Angeles Lawsuit, The City Project filed complaints under civil rights and education laws to address the discrepancies in the enforcement of physical education classes in southern California school districts. As a result, the Board of Education passed a resolution to enforce physical education laws.^{47,48}

Despite the known difficulties with improving the built environment, the US Report Card on Physical Activity for Children and Youth rate the community and the built environment a B–, the highest rating of all US physical activity indicators. The indicator is based on the fact that 86% of US adolescents live in neighborhoods with at least one park or playground.⁴⁹

Activate youth sports programs

Participation in sports programs/activity classes is one way that youth can accumulate MVPA. However, most countries are not providing optimal youth sports opportunities. The benchmark from the Global Summit on the Physical Activity of Children for organized sport participation indicated that no countries received an A ($\geq 80\%$); two countries (New Zealand

and Australia) received Bs (60–79%); eight countries (Canada, Finland, Ghana, Kenya, South Africa, England, Ireland, and US) received Cs (40–59%); and five countries (Colombia, Mexico, Nigeria, Scotland and Mozambique) had lower grades or an incomplete assessment.⁵⁰ One study reported on the amount of objectively measured MPVA obtained during youth sport practices.⁵¹ A total of 200 adolescents aged 7–14 years were divided into meeting or not meeting 60 minutes of MVPA during practice, and only 24% of participants met the 60-minute PA guideline during practice.

Sports and activity classes do provide opportunities to participate in MVPA. A study by O'Neill et al⁵² found that girls participating in dance classes obtained about 10 min/h of MVPA and 43 minutes of light activity.⁵² Another study used a representative sample of US students in Grades 9–12.⁵³ Students who reported participation in sports during the past 12 months were more likely to achieve ≥ 60 minutes of daily VPA on 7 days [odds ratio (OR) = 1.74], ≥ 20 min/d on ≥ 3 da/wk (OR = 1.92), and ≥ 3 d/wk in participation in muscle-strengthening PA (OR = 1.53).⁵³

One example of a large-scale initiative in the US is the youth sports initiative of the Aspen Institute, Project Play. Project Play has developed a cross-sector plan that incorporates eight strategies that adults can use to help increase youth physical activity through sport participation. The strategies are: ask children what they want, reintroduce free play, encourage sport sampling, revitalize in-town leagues, think small, design for development, train all coaches, and emphasize prevention.⁵⁴

Re-normalize active transport to school

Active transport to school has declined in the US since the mid 1960s.⁷ In 60% of US schools, < 10% of students are reported to walk or cycle to school, while in only ~10% of schools > 50% of students walk or cycle to school.⁵⁵ Results from the 15 Countries Report Card on Physical Activity for Children and Youth indicate that a number of countries received a grade lower than B,^{56–63} indicating that < 60% of children from those countries walked or cycled to school.

A review of intervention studies from the US, Australia, and the UK found small effect sizes on active transport.⁶⁴ Fifth grade students ($n = 219$, from 8 randomly selected urban and suburban elementary schools) self-reported their mode of transportation to and from school and wore accelerometers over 5 weekdays.⁶⁵ Regular active transport students spent significantly more time in MVPA (8.5%) than irregular or non-active transport students. Another study use a pilot cluster randomized trial to evaluate a “walking school bus” program by questionnaire and accelerometry at before and after in control ($n = 79$) and intervention ($n = 70$) groups.⁶⁶ Intervention children increased weekly commuting by walking from 24% to 54% while control children decreased weekly commuting from 40% to 33%. Objectively measured MVPA increased in intervention children (from 47 minutes to 49 minutes) and declined in control children (46 minutes to 41 minutes).

There has been progress in the US to increase active transport to school. One example is the Safe Routes National Center for Safe Routes to School Partnership.⁶⁷ This non-profit organization advances policy changes that support local and state investments in active transportation and healthy community design.

Institutionalize clinic-based physical activity assessment and counseling

Over 80% of children aged 0–17 years received a well-child visit in the previous 12 months.⁶⁸ These visits provide an opportunity for clinicians to provide annual physical activity counseling to children and adolescents, as recommended by leading health organizations.^{69–71} However, many barriers exist to counseling patients about physical activity, including lack of time, lack of reimbursement, limited clinician knowledge and skills, and lack of practical tools, administrative support systems, and systems for follow-up.^{72–74} Even children who are identified as overweight or obese may not receive counseling. In a recent study, 34% were correctly identified as being overweight or obese, but only 11% and 26% were counseled about diet and physical activity, respectively.⁷⁵

Heath et al¹² reviewed physical activity interventions from around the world and reported a small effect size of 0.16 for physical activity counseling (in healthcare settings) across all ages. One of those studies, a randomized controlled trial of adolescent boys and girls (11–15 years), assessed two experimental conditions.⁷⁶ The first was a primary care office-based, computer-assisted diet and physical activity intervention that used goal setting and brief counseling. The second was a comparison condition that addressed sun exposure protection. In boys, self-reported active days per week increased significantly in the PA group from before to after (intervention vs control 4.1 d/wk to 4.4 d/wk vs 3.8 d/wk to 3.8 d/wk), but PA did not increase in girls (intervention vs control 3.3 d/wk to 3.4 d/wk vs 3.1 d/wk to 3.3 d/wk).

In 2007, the American Medical Association and American College of Sports Medicine introduced an initiative to promote physical activity in the healthcare setting, Exercise is Medicine (EIM).^{77,78} EIM calls for physical activity to be considered by all healthcare providers as a vital sign in every patient.⁷⁹ EIM has also become a global health initiative (2010–2013);⁷⁸ as of 2014, 39 countries and seven regional partners were participating in EIM.

Building activity-friendly home environments

The home environment, which includes space and equipment for physical activity as well as the parents and siblings, has been shown to significantly influence children's physical activity levels. Lowry et al⁵³ reported that 76% of 12–17-year-olds received at least some form of encouragement from their parents to be physically active in the past week. However, only 83% of US parents reported being active with their child. According to the Global Summit on Physical

Activity of Children benchmarks, the US received an incomplete score, as insufficient data were available to score the progress of family and peer influences on physical activity. Other countries, including Australia, Canada, Finland, Kenya, and New Zealand, all received a C, indicating that much work is left to be done to understand how to improve the home environments to increase physical activity in adolescence.⁵⁰

Interventions to improve the home environment have commonly sought to engage parents as the agents of change. A review and meta-analysis by Brown et al⁸⁰ found a small effect size to increase physical activity through engaging the family. In the UK, the “Healthy Dads, Healthy Kids” initiative has been implemented in six communities in partnership with local schools. The intervention, which includes face-to-face sessions and home-based components, has been shown to be effective in increasing physical activity levels in fathers and children.⁸¹

Organizations such as the YMCA of the US have emphasized physically active lifestyles for many years. One initiative, “Healthy Family Home,” emphasizes healthy living and has a website that provides families with tips, strategies, and toolkits to help them increase the amount of time they spend being active.⁸²

Implementing a comprehensive public health strategy

Each of the aforementioned initiatives is evidence based, so there is good reason to believe that each approach can help promote physical activity in adolescents at the community level. However, it is unlikely that any one of the initiatives could singularly produce the desired outcome. Rather, it is more likely that success will result from application of a comprehensive approach that includes all of the initiatives described above, coordinated and implemented by application of proven public health strategies. These include: (1) Planning – Comprehensive physical activity promotion plans will be needed at the national, regional and municipal levels; (2) Leadership – Competent and committed leadership will be needed in order to effectively implement well-designed plans for promoting physical activity in youth; (3) Surveillance – Effective public health promotion programs include robust surveillance systems that support proper targeting of interventions and long-term monitoring of changes; (4) Evaluation – Both the processes of promoting physical activity and the desired outcome itself should be evaluated on an ongoing basis; (5) Policy Research – Physical activity is a relatively new focus of public health, and policy research will be needed to identify initiatives that can be translated to effective policies; and (6) Advocacy – A well-coordinated and well-resourced effort will be required to effectively advocate for adoption of important policies.

In summary, a comprehensive, multi-sector strategy will be needed to increase physical activity in adolescents in developed and developing nations. Continuing advances of public health, including reduction of obesity rates in young people, will require that promotion of physical activity be given high priority by international and national public health systems.

Conflicts of interest

All authors declare no conflicts of interest.

References

1. U.S. Department of Health and Human Services. *2008 Physical Activity Guidelines for Americans*. U.S. Department of Health and Human Services; 2008. <http://www.health.gov/paguidelines/> [Accessed 3 October 2016].
2. *Global Recommendations on Physical Activity for Health*; 2010. <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/> [Accessed 11 October 2016].
3. World Health Organization. *Global recommendations on physical activity for health: 5–17 years*. WHO; 2011. http://www.who.int/dietphysicalactivity/factsheet_young_people/en/index.html [Accessed 3 October 2016].
4. Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet*. 2012;380:247–257.
5. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. *JAMA*. 2012;307:483–490.
6. Katzmarzyk PT, Barreira TV, Broyles ST, et al. Physical activity, sedentary time, and obesity in an international sample of children. *Med Sci Sports Exerc*. 2015;47:2062–2069.
7. McDonald NC. Active transportation to school: trends among U.S. schoolchildren, 1969–2001. *Am J Prev Med*. 2007;32:509–516.
8. van der Ploeg HP, Merom D, Corpuz G, Bauman AE. Trends in Australian children traveling to school 1971–2003: burning petrol or carbohydrates? *Prev Med*. 2008;46:60–62.
9. Roberts DF, Foehr UG, Rideout VJ, Brodie M. *Kids Media @ the New Millennium*. Menlo Park, CA: Henry J. Kaiser Family Foundation; 1999.
10. Dobbins M, Husson H, DeCorby K, LaRocca RL. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database Syst Rev*. 2013;2:CD007651.
11. Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). *BMJ*. 2012;345:e5888.
12. Heath GW, Parra DC, Sarmiento OL, et al. Evidence-based intervention in physical activity: lessons from around the world. *Lancet*. 2012;380:272–281.
13. Physical Activity Guidelines for Americans Midcourse Report Subcommittee of the President's Council on Fitness, Sports and Nutrition. *Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Among Youth*. Washington, DC: US Department of Health and Human Services; 2012.
14. Swinburn BA, Sacks G, Hall KD, et al. The global obesity pandemic: shaped by global drivers and local environments. *Lancet*. 2011;378:804–814.
15. Gutin B, Yin Z, Johnson M, Barbeau P. Preliminary findings of the effect of a 3-year after-school physical activity intervention on fitness and body fat: the Medical College of Georgia FitKid Project. *Int J Pediatr Obes*. 2008;3(suppl. 1):3–9.
16. Pate RR, O'Neill JR, Liese AD, et al. Factors associated with development of excessive fatness in children and adolescents: a review of prospective studies. *Obes Rev*. 2013;14:645–658.
17. Ramires VV, Dumith SC, Goncalves H. Longitudinal association between physical activity and body fat during adolescence: a systematic review. *J Phys Act Health*. 2015;12:1344–1358.
18. Russ LB, Webster CA, Beets MW, Phillips DS. Systematic review and meta-analysis of multi-component interventions through schools to increase physical activity. *J Phys Act Health*. 2015;12:1436–1446.
19. De Bourdeaudhuij I, Van Cauwenbergh E, Spittaels H, et al. School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obes Rev*. 2011;12:205–216.
20. Centers for Disease Control and Prevention. *Comprehensive School Physical Activity Program (CSPAP)*. <https://www.cdc.gov/healthyschools/physicalactivity/cspap.htm>. [Accessed 3 October 2016].
21. Hollis JL, Williams AJ, Sutherland R, et al. A systematic review and meta-analysis of moderate-to-vigorous physical activity levels in elementary school physical education lessons. *Prev Med*. 2016;86:34–54.
22. Pate RR, Ward DS, O'Neill JR, Dowda M. Enrollment in physical education is associated with overall physical activity in adolescent girls. *Res Q Exerc Sport*. 2007;78:265–270.
23. Luepker RV, Perry CL, McKinlay SM, et al. Outcomes of a field trial to improve children's dietary patterns and physical activity. The Child and Adolescent Trial for Cardiovascular Health. *JAMA*. 1996;275:768–776.
24. European Commission. *Childcare Services for School Age Children: A Comparative Review of 33 Countries*. Luxembourg: Publications Office of the European Union; 2013.
25. Department of Education, Employment and Workplace Relations. *Child Care in Australia*. Canberra: DEEWR; 2013.
26. United States Census Bureau. *Who's Minding the Kids?*. Child Care Arrangements; 2011. <https://www.census.gov/prod/2013pubs/p70-135.pdf> [Accessed 3 October 2016].
27. Pate RR, McIver K, Dowda M, Brown WH, Addy C. Directly observed physical activity levels in preschool children. *J Sch Health*. 2008;78:438–444.
28. Sugiyama T, Okely AD, Masters JM, Moore GT. Attributes of child care centers and outdoor play areas associated with preschoolers' physical activity and sedentary behavior. *Environ Behav*. 2012;44:334–349.
29. Institute of Medicine. *Early Childhood Obesity Prevention Policies*. Washington, DC: The National Academies Press; 2011.
30. Department of Health and Ageing. *National Physical Activity Guidelines for Australians. Physical Activity Recommendations for 0-5 Year Olds*. Canberra: Commonwealth of Australia; 2010.
31. Canadian Society for Exercise Physiology. *Canadian Physical Activity Guidelines and Canadian Sedentary Behaviour Guidelines: Your Plan to Get Active Every Day*; 2012. <http://www.csep.ca/guidelines> [Accessed 3 October 2016].
32. Chief Medical Officers of England Scotland Wales and Northern Ireland. *Start Active, Stay Active: A Report on Physical Activity for Health from the Four Home Countries Chief Medical Officers*. London: Department of Health, Physical Activity, Health Improvement and Protection; 2011.
33. Hinkley T, Salmon J, Okely AD, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc*. 2012;44:458–465.
34. Colley RC, Garriguet D, Adamo KB, et al. Physical activity and sedentary behavior during the early years in Canada: a cross-sectional study. *Int J Behav Nutr Phys Act*. 2013;10:54.
35. Hesketh KR, McMinn AM, Ekelund U, et al. Objectively measured physical activity in four-year-old British children: a cross-sectional analysis of activity patterns segmented across the day. *Int J Behav Nutr Phys Act*. 2014;11:1.
36. Pate RR, O'Neill JR, Brown WH, Pfeiffer KA, Dowda M, Addy CL. Prevalence of compliance with a new physical activity guideline for preschool-age children. *Child Obes*. 2015;11:415–420.
37. Gordon ES, Tucker P, Burke SM, Carron AV. Effectiveness of physical activity interventions for preschoolers: a meta-analysis. *Res Q Exerc Sport*. 2013;84:287–294.
38. Pate RR, Brown WH, Pfeiffer KA, et al. An intervention to increase physical activity in children: a randomized controlled trial with 4-year-olds in preschools. *Am J Prev Med*. 2016;51:12–22.
39. Duffey KJ, Slining MM, Benjamin Neelon SE. States lack physical activity policies in child care that are consistent with national recommendations. *Child Obes*. 2014;10:491–500.
40. Smith EP. The role of afterschool settings in positive youth development. *J Adolesc Health*. 2007;41:219–220.
41. Beets MW, Beighle A, Erwin HE, Huberty JL. After-school program impact on physical activity and fitness: a meta-analysis. *Am J Prev Med*. 2009;36:527–537.

42. Trost SG, Rosenkranz RR, Dziewaltowski D. Physical activity levels among children attending after-school programs. *Med Sci Sports Exerc.* 2008;40:622–629.
43. Beets MW, Weaver RG, Turner-McGrievy G, et al. Making policy practice in afterschool programs: a randomized controlled trial on physical activity changes. *Am J Prev Med.* 2015;48:694–706.
44. Young Men's Christian Association. *Meet HEPA: Healthy Eating and Physical Activity (HEPA) Standards.* <http://www.ymca.net/hepa>. [Accessed 3 October 2016].
45. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics.* 2006;117:417–424.
46. Ding D, Sallis JF, Kerr J, Lee S, Rosenberg DE. Neighborhood environment and physical activity among youth a review. *Am J Pre Med.* 2011;41:442–455.
47. Garcia R, Bracho A, Cantero P, Glenn BA. "Pushing" physical activity, and justice. *Prev Med.* 2009;49:330–333.
48. Garcia R, Fenwick C. Social science, equal justice, and public health policy: lessons from Los Angeles. *J Public Health Policy.* 2009;30(suppl 1):S26–S32.
49. Dentro KN, Beals K, Crouter SE, et al. Results from the United States' 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S105–S112.
50. Tremblay MS. 2014 global Summit on the physical activity of children. *J Phys Act Health.* 2014;11(suppl 1):S1–S2.
51. Leek D, Carlson JA, Cain KL, et al. Physical activity during youth sports practices. *Arch Pediatr Adolesc Med.* 2011;165:294–299.
52. O'Neill JR, Pate RR, Beets MW. Physical activity levels of adolescent girls during dance classes. *J Phys Act Health.* 2012;9:382–388.
53. Lowry R, Lee SM, Fulton JE, Demissie Z, Kann L. Obesity and other correlates of physical activity and sedentary behaviors among US high school students. *J Obes.* 2013;2013:276318.
54. The Aspen Institute. *Project Play.* <https://www.aspeninstitute.org/tag/project-play/>. [Accessed 3 October 2016].
55. Everett Jones S, Sliwa S. School factors associated with the percentage of students who walk or bike to school, School Health Policies and Practices Study, 2014. *Prev Chronic Dis.* 2016;13:E63.
56. Draper C, Basset S, de Villiers A, Lambert EV, Group HW. Results from South Africa's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S98–S104.
57. Gray CE, Barnes JD, Cowie Bonne J, et al. Results from Canada's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S26–S32.
58. Harrington DM, Belton S, Coppinger T, et al. Results from Ireland's 2014 report card on physical activity in children and youth. *J Phys Act Health.* 2014;11(suppl 1):S63–S68.
59. Maddison R, Dale LP, Marsh S, LeBlanc AG, Oliver M. Results from New Zealand's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S83–S87.
60. Ocansey R, Aryeetey R, Sofu S, Delali MB, Pambo P, Nyawornota VK. Results from Ghana's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S58–S62.
61. Reilly JJ, Dick S, McNeill G, Tremblay MS. Results from Scotland's 2013 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S93–S97.
62. Schranz N, Olds T, Cliff D, et al. Results from Australia's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014; 11(suppl 1):S21–S25.
63. Standage M, Wilkie HJ, Jago R, Foster C, Goad MA, Cumming SP. Results from England's 2014 report card on physical activity for children and youth. *J Phys Act Health.* 2014;11(suppl 1):S45–S50.
64. Chillan P, Evenson KR, Vaughn A, Ward DS. A systematic review of interventions for promoting active transportation to school. *Int J Behav Nutr Phys Act.* 2011;8:10.
65. Sirard JR, Riner Jr WF, McIver KL, Pate RR. Physical activity and active commuting to elementary school. *Med Sci Sports Exerc.* 2005;37: 2062–2069.
66. Mendoza JA, Watson K, Baranowski T, Nicklas TA, Uscanga DK, Hanfling MJ. The walking school bus and children's physical activity: a pilot cluster randomized controlled trial. *Pediatrics.* 2011;128: e537–e544.
67. National Center for Safe Routes to School. *Safe Routes Partnership.* <http://saferoutespartnership.org>. [Accessed 3 October 2016].
68. Federal Interagency Forum on Child and Family Statistics. *America's Children: Key National Indicators of Well-Being, 2013.* Washington, DC: U.S. Government Printing Office; 2013.
69. Kavey RE, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. *Circulation.* 2003;107:1562–1566.
70. Green M, Palfrey JS. *Bright Futures: Guidelines for Health Supervision of Infants, Children and Adolescents.* Arlington, VA: National Center for Education in Maternal and Child Health; 2002.
71. Patrick K, Spear B, Holt K, Sofia D. *Bright Futures in Practice: Guidelines for Physical Activity.* Arlington, VA: National Center for Education in Maternal and Child Health; 2001.
72. Sallis JF, Patrick K, Frank E, Pratt M, Wechsler H, Galuska DA. Interventions in health care settings to promote healthful eating and physical activity in children and adolescents. *Prev Med.* 2000;31: S112–S120.
73. Story MT, Neumark-Stzainer DR, Sherwood NE, et al. Management of child and adolescent obesity: attitudes, barriers, skills, and training needs among health care professionals. *Pediatrics.* 2002;110:210–214.
74. Meriwether RA, Lobelo F, Pate RR. Physical activity in youth: clinical intervention to promote physical activity. *Am J Lifestyle Med.* 2008;2: 7–25.
75. Reyes I. An Evaluation of the identification and management of overweight and obesity in a pediatric clinic. *J Pediatr Health Care.* 2015;29: e9–e14.
76. Patrick K, Calfas KJ, Norman GJ, et al. Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors: PACE+ for adolescents. *Arch Pediatr Adolesc Med.* 2006;160:128–136.
77. American College of Sports Medicine. *Exercise is Medicine: Healthcare Providers' Action Guide;* 2008. www.exerciseismedicine.org/assets/page_documents/Complete_HCP_Action_Guide.pdf [Accessed 11 October 2016].
78. Lobelo F, Stoutenberg M, Hutber A. The exercise is medicine global health initiative: a 2014 update. *Br J Sports Med.* 2014;48:1627–1633.
79. Coleman KJ, Ngor E, Reynolds K, et al. Initial validation of an exercise "vital sign" in electronic medical records. *Med Sci Sports Exerc.* 2012;44: 2071–2076.
80. Brown HE, Atkin AJ, Panter J, Wong G, Chinapaw MJ, van Sluijs EM. Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. *Obes Rev.* 2016;17: 345–360.
81. Morgan PJ, Collins CE, Plotnikoff RC, et al. The 'Healthy Dads, Healthy Kids' community randomized controlled trial: a community-based healthy lifestyle program for fathers and their children. *Prev Med.* 2014;61: 90–99.
82. Young Men's Christian Association. *Healthy Family Home.* <http://www.ymca.net/healthy-family-home/index.html> [Accessed 11 October 2016]