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## Physical Activity of Children: A Global Matrix of Grades Comparing 15 Countries

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The Active Healthy Kids Canada (AHKC) Report Card on Physical Activity for Children and Youth has been effective in *powering the movement to get kids moving* by influencing priorities, policies, and practice in Canada. The AHKC Report Card process was replicated in 14 additional countries from 5 continents using 9 common indicators (Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behavior, Family and Peers, School, Community and Built Environment, and Government Strategies and Investments), a harmonized process and a standardized grading framework. The 15 Report Cards were presented at the Global Summit on the Physical Activity of Children in Toronto on May 20, 2014. The consolidated findings are summarized here in the form of a global matrix of grades. There is a large spread in grades across countries for most indicators. Countries that lead in certain indicators lag in others. Overall, the grades for indicators of physical activity (PA) around the world are low/poor. Many countries have insufficient information to assign a grade, particularly for the Active Play and Family and Peers indicators. Grades for Sedentary Behaviors are, in general, better in low income countries. The Community and Built Environment indicator received high grades in high income countries and notably lower grades in low income countries. There was a pattern of higher PA and lower sedentary behavior in countries reporting poorer infrastructure, and lower PA and higher sedentary behavior in countries reporting better infrastructure, which presents an interesting paradox. Many surveillance and research gaps and weaknesses were apparent. International cooperation and cross-fertilization is encouraged to tackle existing challenges, understand underlying mechanisms, derive innovative solutions, and overcome the expanding childhood inactivity crisis.

**Keywords:** active transportation, comparison, international, play, policy, sedentary behavior, sport

The Active Healthy Kids Canada (AHKC) Report Card on Physical Activity for Children and Youth<sup>1,2</sup> has been effective in *powering the movement to get kids moving* by influencing priorities, policies, and practice in Canada.<sup>3</sup> Details of the development of the AHKC Report Card and its impact have been previously described.<sup>1-5</sup> The AHKC Report Card was designed to serve as a knowledge translation instrument, aimed at increasing and accelerating the dissemination of research, practice-based evidence and evidence-based practice through effective and strategic synthesis, exchange, mobilization, and application of knowledge while facilitating interactions among researchers and knowledge users.<sup>6,7</sup> The AHKC Report Card has served as an advocacy mechanism to drive social action by stimulating debate, motivating policy, practice, and behavior modification and inspiring change in Canada.<sup>1-3</sup>

In response to growing international concern over childhood physical inactivity, AHKC ([www.activehealthykids.ca](http://www.activehealthykids.ca)) hosted a Global Summit on the Physical Activity of Children in May of 2014.<sup>8</sup> The Summit brought together researchers, practitioners, policy-makers, and funders from the physical activity (PA), sport, recreation, education, fitness, transportation, early childhood development, public health, and medical sectors from across the globe. A highlight of the Summit was the presentation of Report Cards from 15 countries,<sup>1,9-22</sup> which were modeled after the AHKC Report Card,<sup>1,2,4,5</sup> adapted to each country's local or specific context, and followed procedures that were harmonized with the Canadian process.<sup>1,2</sup> Details of the process in each country are briefly described in this issue of the *Journal of Physical Activity and Health*.<sup>1,9-22</sup>

This paper consolidates findings from the 15 countries, creating a "global matrix" of common indicators graded by each country

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using the best available evidence in their jurisdiction. The *global matrix* not only assesses global variation in indicators related to PA, but also serves as a tool to motivate change, facilitate advocacy, and cross-fertilize efforts aimed at empowering *the movement to get kids moving* around the world.

## Global Matrix Participants and Procedures

Plans to engage countries to participate in the Global Summit on the Physical Activity of Children began in 2012. Through individual contacts, word of mouth, the International Study of Childhood Obesity, Lifestyle, and the Environment principal investigators,<sup>23</sup> and Internet notices, researchers were encouraged and coached to develop a Report Card for their respective countries for release or presentation at the Global Summit. Three countries (Kenya, Mexico, South Africa) completed their Report Cards for the second or third time. The general process for developing a Report Card included the aggregation and consolidation of the best available evidence and information synthesized into public facing, policy-focused, and research-based outputs, most notably the Report Card.<sup>1-5</sup> Although the AHKC Report Card has had as many as 24 indicators graded in a given year, a decision was made a priori to condense the indicators to 9 for the purpose of the *global matrix* comparisons. The indicators included 5 behaviors: Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behavior; and 4 key influences: Family and Peers, School, Community and Built Environment, and Government Strategies and Investments. The grading framework and benchmarks that guided the process of assigning a grade to each indicator are provided in Tables 1 and 2, respectively. Because the quality and quantity of data and evidence available in each country varied substantially, the benchmarks also varied. To be as comprehensive as possible when assessing the evidence to inform the grades for factors influencing PA, several benchmarks were considered (Table 2). This process has been used for the AHKC Report Cards for the past 10 years. The Expert Group in each country discussed the total evidence base before reaching consensus on the grade assigned for each indicator. To enhance the comparability of grades among jurisdictions, standardized guidance was provided by the AHKC Report Card leaders, including participation in most grade assignment processes. Expert Groups consisting of childhood PA researchers, practitioners, and leaders from each country were invited to identify available information and serve as a consensus committee for assigning grades. Country-specific details for each Report Card are summarized in the individual papers in this special issue of the journal.<sup>1,9-22</sup> Despite variation in country data sources and the extent to which country Expert Groups were able to apply the recommended benchmarks, it is believed that the grades across all indicators are comparable and certainly informative of global variation in important factors related to PA among children and youth. Internet links to the Report Cards for each country are provided in Table 3.

## Global Matrix Results

Table 4 presents the global matrix in rank order by grade. For most indicators there is a large spread in grades across countries. Countries that are leading in certain indicators are lagging in others. Overall the grades for indicators of PA behavior around the world are low/poor. Many countries have insufficient information to assign a grade, particularly for the Active Play and Family and Peers indicators. Grades for Sedentary Behavior in general are better in low-income countries. The Community and Built Environment indicator received high grades in high-income countries and notably lower grades in lower-income countries. There was a pattern of higher PA and lower sedentary behavior in countries reporting poorer infrastructure and lower PA and higher sedentary behavior in countries reporting better infrastructure. Similarly, some countries have relatively high grades for the policy environment but relatively low grades for the health behavior indicators the policies are targeting.

## Discussion

Perhaps the most notable finding from the global matrix is the substantial variation in the grades assigned to the 9 indicators of PA. This is encouraging for at least 3 reasons. First, it demonstrates that at least some countries are succeeding in each of the important indicators examined in the global matrix. Second, such international variation consolidated in this fashion presents an opportunity for cross-fertilization of ideas for improving the grades. Third, the global matrix provides a framework for research aimed at understanding the differences between and within different nations (eg, urban versus rural differences). It is also clear from Table 4 that no one country is leading or lagging in all indicators but, rather, each country has its own blend of successes and challenges at this point in time. Overall there is much that needs to be done to enhance the PA behaviors and opportunities for children and youth around the world, and tackling this challenge together may provide unique insights that could not be achieved in isolation. A discussion of who is leading and lagging in each indicator is presented below in the context of existing international research. Subsequently, important disparities and inequities, research and surveillance gaps and needs, recommendations for improving the grades, and future directions are discussed.

### Who is Leading and Lagging?

**Overall Physical Activity.** New Zealand and Mozambique reported the highest grades (“B”) for Overall Physical Activity while 10 countries reported low or failing grades (“D” or “F”), suggesting there is widespread evidence of a childhood physical inactivity crisis. This was consistent with a comprehensive analysis that included data from 105 countries around the world: only 20% of

**Table 1 Grading Framework for the Report Card**

Grade	Interpretation
A	We are succeeding with a large majority of children and youth ( $\geq 80\%$ )
B	We are succeeding with well over half of children and youth (60–79%)
C	We are succeeding with about half of children and youth (40–59%)
D	We are succeeding with less than half but some children and youth (20–39%)
F	We are succeeding with very few children and youth ( $< 20\%$ )

**Table 2 Benchmarks Used to Guide the Grade Assignment for Each Indicator**

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet physical activity guidelines
Organized Sport Participation	% of children and youth who participate in organized sport and/or physical activity programs
Active Play	% of children and youth who engage in unstructured/unorganized active play for several hours a day
Active Transportation	% of children and youth who use active transportation to get to and from places (school, park, mall, friend's place)
Sedentary Behavior	% of children and youth who meet sedentary behavior or screen-time guidelines
Family and Peers	% of parents who facilitate physical activity and sport opportunities for their children (eg, volunteering, coaching, driving, paying for membership fees and equipment)
	% of parents who meet the physical activity guidelines for adults
	% of parents who are physically active with their kids
	% of children and youth with friends and peers who encourage and support them to be physically active
	% of children and youth who encourage and support their friends and peers to be physically active
School	% of schools with active school policies (eg, Daily Physical Activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time)
	% of schools where the majority ( $\geq 80\%$ ) of students are taught by a PE specialist
	% of schools where the majority ( $\geq 80\%$ ) of students are offered at least 150 minutes of PE per week
	% of schools that offer physical activity opportunities (excluding PE) to the majority ( $\geq 80\%$ ) of their students
	% of parents with children and youth who have access to physical activity opportunities at school in addition to PE
	% of schools with students who have regular access to facilities and equipment that support physical activity (eg, gymnasium, outdoor playgrounds, sporting fields, equipment in good condition)
Community and the Built Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (eg, variety, location, cost, quality)
	% of communities/municipalities that report they have policies promoting physical activity
	% of communities/municipalities that report infrastructure (eg, sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity
	% of children or parents with facilities, programs, parks, and playgrounds available to them in their community
	% of children or parents living in a safe neighborhood where they can be physically active
	% of children or parents reporting well-maintained facilities, parks/playgrounds in their community that are safe
	% of children and youth who report being outdoors for several hours a day
Government Strategies and Investments	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth
	Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth
	Demonstrated progress through the key stages of public policy making (ie, policy agenda, policy formation, policy implementation, policy evaluation, and decisions about the future)

Abbreviations: PE, Physical Education.

13- and 15-year-olds reported getting at least 60 minutes of daily moderate- to vigorous-intensity physical activity (MVPA).<sup>24</sup> While Report Card grades were generally higher in low-middle income countries (Mozambique, Kenya, Mexico, Nigeria), this relationship was not uniform as New Zealand reported a high grade and Ghana a low grade for Overall Physical Activity.

Significant variation in sampling and measurement procedures among countries limits comparison and understanding of PA behaviors. These limitations have been discussed in detail elsewhere.<sup>25–28</sup> Nevertheless, international comparisons can illustrate potentially important patterns and trends. For example the Mozambique Report Card manuscript ascribes the inherently high activity level

**Table 3 Internet Addresses for Individual Country Report Cards**

Jurisdiction	Weblink
Australia	<a href="http://www.activehealthykids.com.au">www.activehealthykids.com.au</a>
Canada	<a href="http://www.activehealthykids.ca">www.activehealthykids.ca</a>
Colombia	<a href="http://epiandes.uniandes.edu.co">epiandes.uniandes.edu.co</a>
England	<a href="http://www.activehealthykidsengland.co.uk">www.activehealthykidsengland.co.uk</a>
Finland	<a href="http://www.jyu.fi/sport/ReportCard">www.jyu.fi/sport/ReportCard</a>
Ghana	<a href="http://alwag.org/family/ahk-gh/rc2014">alwag.org/family/ahk-gh/rc2014</a>
Ireland	<a href="http://www.getirelandactive.ie/get-info/reportcard">www.getirelandactive.ie/get-info/reportcard</a>
Kenya	<a href="http://www.hakkenya.org">www.hakkenya.org</a>
Mexico	<a href="http://obesired.mx/blog">obesired.mx/blog</a>
Mozambique	<a href="http://www.up.ac.mz/cidaf/reportcard">www.up.ac.mz/cidaf/reportcard</a>
New Zealand	<a href="http://www.nihi.auckland.ac.nz/PhysicalActivityReportCard">www.nihi.auckland.ac.nz/PhysicalActivityReportCard</a>
Nigeria	<a href="http://nigerianheart.org/articles.php?xid=1">http://nigerianheart.org/articles.php?xid=1</a>
Scotland	<a href="http://www.activehealthykidsscotland.co.uk">www.activehealthykidsscotland.co.uk</a>
South Africa	<a href="https://www.vitalityschools.co.za/schools/educationaltools/research.do">https://www.vitalityschools.co.za/schools/educationaltools/research.do</a>
United States	<a href="http://www.physicalactivityplan.org">www.physicalactivityplan.org</a>

of children to necessary active transportation and household and subsistence chores,<sup>17</sup> similar to Kenya;<sup>15</sup> however, New Zealand's grade seems to be achieved primarily through organized sport participation and active play.<sup>18</sup>

The more global observation that PA levels of children and youth in many countries are low is supported by self-reported PA data for children and youth from 39 countries around the world: only 23%, 19%, and 15% of 11-, 13-, and 15-year-olds, respectively, reported at least 60 minutes of daily MVPA.<sup>29</sup> Intuitively it seems that PA levels of children and youth have declined in recent decades. Some circumstantial evidence supports this intuition including an examination of anthropological and lifestyle transitions.<sup>30–34</sup> Although empirical surveillance evidence to support the temporal decline in childhood and adolescent PA levels appears lacking, such evidence may be constrained by measurement issues.<sup>28</sup>

Temporal changes in physical fitness are supportive of a decline in habitual PA. An analysis of survey data for over 25 million 9- to 17-year-olds from 28 countries has demonstrated international declines in the ability of children and adolescents to perform aerobic exercise (−4% per decade) since 1975.<sup>35,36</sup> Canadian data have also shown a dramatic decrease in fitness levels in one generation.<sup>37,38</sup> There is considerable geographical variability in aerobic fitness, with children and adolescents from Northern Europe performing the best (mean percentile ± 95% CI: 72 ± 0.4%), followed by African children (55 ± 2.0%), those from the Pacific Rim (50 ± 1.6%), Central/Western Europe (50 ± 0.4%), Southern Europe (36 ± 3.2%), and South America (30 ± 0.4%).<sup>39</sup> Because of this geographical variability, the global declines are much more important in children and youth from countries that have poorer baseline aerobic fitness. A recent systematic review examining temporal trends in PA and fitness among children and youth in sub-Saharan Africa found insufficient evidence to determine any clear changes over time.<sup>40</sup> The review did find adverse associations between PA, sedentary behaviors, and fitness, and urban living and higher socioeconomic status, suggesting that traditional economic development may paradoxically be related to reduced healthy active lifestyles and fitness.<sup>40</sup>

**Organized Sport Participation.** Most countries had sufficient evidence to grade the Organized Sport Participation indicator. New Zealand and Australia reported the highest grades, with approximately two-thirds of children in these countries participating in organized sport.<sup>9,18</sup> Most countries clustered around a “C” grade, indicating that about one-half of children and youth participated in sport. Evidence from Australia<sup>41–43</sup> and the United States<sup>44</sup> suggested that these relatively high grades were set to continue given recent increases (+5% points per decade) in the prevalence of children who regularly participated in organized sport. The Mozambique Report Card (“F”) suggested that the opportunity and availability of organized sport were limited, though data were lacking.

Evaluation of grades for Organized Sport Participation, on one hand, and School and Community and the Built Environment, on the other, suggested a relationship among these indicators. Countries with relatively good grades for Organized Sport Participation also reported relatively good grades for School and Community and the Built Environment (eg, Australia, Canada, Finland), whereas countries with low grades for Organized Sport Participation reported low grades for School and Community and the Built Environment (eg, Colombia, Mexico, Mozambique). This makes sense since organized sport and PA opportunities require space, facilities, equipment, and supervision. While most countries had some data on sport participation, details of the quality, frequency, duration, intensity, context (eg, physical education, extracurricular, community sport), and seasonality of participation varied significantly and/or were generally lacking.

**Active Play.** The 2012 AHKC Report Card asked the question “Is active play extinct?”<sup>5,45</sup> It cited evidence showing low levels of active play (defined here as freely chosen, spontaneous and self-directed physical activity involving an element of fun<sup>46,47</sup>) in Canada and evidence of downward trends.<sup>5,45</sup> Active play has historically occurred outdoors but with the allure of electronic screens, children and youth are increasingly spending their time indoors and usually sedentary (see Sedentary Behavior indicator below). Although Canadians value outdoor time, they strongly agree that children do not spend enough time outdoors.<sup>48</sup> Only 5 countries felt they had

**Table 4 Global Matrix Presented in Rank Order by Grade**

Grade	Overall Physical Activity	Organized Sport Participation	Active Play	Active Transportation	Sedentary Behaviors	Family & Peers	School	Community & Built Environment	Government Strategies & Investments
A+									
A							England	Australia	
A-								Canada	
B+								Canada	
B	Mozambique New Zealand	New Zealand	New Zealand	Finland Kenya Mozambique Nigeria	Ghana Kenya		Finland	England Finland Ireland Scotland	Colombia Finland Scotland South Africa
B-		Australia		Mexico			Australia New Zealand	United States	
C+	Mexico	Canada					Canada		Australia
C	Kenya Nigeria	Finland Ghana Kenya South Africa	Kenya Mozambique	England Scotland South Africa	New Zealand	Australia Canada Finland Kenya New Zealand	Kenya Mozambique	New Zealand	Canada Kenya Mexico Mozambique
C-		England Ireland United States	Nigeria	New Zealand	Ireland		Ireland United States		
D+	England								
D	Colombia Ghana Finland South Africa	Colombia Mexico	Finland	Australia Canada Ghana Ireland	Colombia Finland Mexico United States		Ghana Mexico South Africa	Ghana South Africa	Ghana
D-	Australia Canada Ireland United States				Australia	Scotland			

(continued)

Table 4 (continued)

Grade	Overall Physical Activity	Organized Sport Participation	Active Play	Active Transportation	Sedentary Behaviors	Family & Peers	School	Community & Built Environment	Government Strategies & Investments
F	Scotland	Mozambique		United States	Canada Nigeria Scotland South Africa		Colombia	Mexico Mozambique	
INC		Nigeria Scotland	Australia Canada Colombia England Ghana Ireland Mexico Scotland South Africa United States	Colombia	England Mozambique	Colombia England Ghana Ireland Mexico Mozambique Nigeria South Africa United States	Nigeria	Colombia Kenya Nigeria	England Ireland New Zealand United States Nigeria

Note. The grade for each indicator is based on the percentage of children and youth meeting a defined benchmark: A is 81%–100%; B is 61%–80%; C is 41%–60%; D is 21%–40%; F is 0%–20%. No grade was assigned when the data were considered to be incomplete (INC). The Overall Physical Activity indicator in the England Report Card was scored as C/D and for the purpose of the international comparison a D+ assigned.

enough data to grade this indicator. Grades ranged from “B” in New Zealand to “D” in Finland. Data from New Zealand indicated that approximately three-quarters of children reported participating in active play,<sup>49</sup> spending on average 78 minutes per day in free play.<sup>50</sup> In contrast, the Finland Adolescent Health and Lifestyle Survey<sup>51</sup> found only one-third of 12- to 18-year-olds participated in physical activities outside school or sports clubs at least 4 times per week.<sup>52</sup> Ten countries graded this indicator as “incomplete” because of insufficient data and/or lack of clarity on the benchmark or the definition of active play. Canada has struggled with grading this indicator across its 10 years of producing Report Cards for similar reasons.<sup>3</sup>

It is commonly believed in developed countries that active, unstructured (free) play is decreasing for a variety of reasons, including increased screen time, safety concerns (eg, traffic, stranger danger), emphasis on organized youth sports, and parental work schedules. The same concern is emerging in developing countries, especially in urban and peri-urban areas.<sup>31,32</sup> If active play was MVPA it should be captured in the Overall Physical Activity grade. However, most active play is likely light-intensity PA, and the importance of light/incidental PA, especially in the form of active play, is largely unknown and likely varies significantly among countries and in urban and rural areas in lesser developed countries. Furthermore, incidental active play may be sporadic and difficult to quantify or recall through self-report, and impossible to discern with pedometers or accelerometers. Interestingly, children aged 7–12 years from 25 countries were interviewed about their favorite pastime and “playing with friends” was the top response (30%); it was more popular among children in Scandinavian countries and Japan ( $\geq 40\%$ ).<sup>53</sup> Data from the United States between 1981–2003 showed that for children aged 6–12 years “playing” was the most common pastime after television viewing.<sup>34</sup>

**Active Transportation.** All countries except Colombia graded the Active Transportation indicator, with grades ranging from “B” in Finland, Kenya, Nigeria, and Mozambique to “F” in the United States. Active transportation may be a necessity for some children in countries such as Nigeria,<sup>19</sup> Kenya,<sup>15</sup> and Mozambique,<sup>17</sup> whereas it may be more a cultural norm in Finland. In Finland, approximately 75% of children and youth actively commuted to school when the distance  $\leq 3$  km.<sup>54</sup> In contrast, in the United States  $< 15\%$  of children and youth used active transportation to get to and from school.<sup>22</sup> The most robust data available in most countries related specifically to active school transportation.<sup>55,56</sup> The percentage of children and youth in Canada, the United States, the United Kingdom, Australia, and New Zealand who cycled to/from school was generally low, whereas the prevalence of cycling or walking to/from school in countries from continental Europe and in China was relatively high compared with what is seen in North America, the United Kingdom, and Australasia.<sup>57</sup>

Studies from North America typically report lower levels of active school transport in secondary school students than in primary school students.<sup>58–62</sup> This age-related or school transition-related decline may not be universal and may not always follow the age-related decline generally seen in overall PA. For example, Ireland did not observe such declines in active transportation.<sup>14</sup>

Even though active transportation has been associated with increased PA and fitness<sup>63</sup> evidence suggests that levels of active transportation are declining.<sup>64,65</sup> There have been consistent declines in children’s use of active transportation in recent decades, with declines in the prevalence of cycling or walking to/from school observed in Australia (–7 percentage points per decade, 1971–2004),<sup>42,66,67</sup> Brazil (–16 percentage points per decade, 2002–07),<sup>68</sup> Canada (–8 percentage points per decade, 1986–96),<sup>69</sup> Switzerland

(–7 percentage points per decade, 1994–2005),<sup>70</sup> the United Kingdom (–6 percentage points per decade, 1975–2012),<sup>71–73</sup> and the United States (–8 percentage points per decade, 1969–2009).<sup>74,75</sup> Parents in Canada<sup>76</sup> and Kenya<sup>32</sup> have reported that their children do not use active transportation as frequently as they (parents) did as children. Circumstantial evidence of a temporal decline in active transportation other than to/from school can also be gleaned from evidence of a restriction of independent mobility afforded to children,<sup>77</sup> which would limit their active travel opportunities. For example, temporal trends in socially or culturally acceptable roaming distances where children are allowed to wander freely almost certainly vary substantially across and within countries although this is poorly understood. Furthermore, active transportation, whether for school, work, chores, or play varies dramatically between urban and rural settings, particularly in developing countries where automobile transport is often not available.<sup>30–32</sup> It will be important to carefully monitor active transportation behaviors in rural areas in developing countries as they transition to motorized transport and subsistence demands become increasingly mechanized.

**Sedentary Behavior.** As with other indicators there is significant global variation in sedentary behaviors although the majority of countries have very poor or failing grades. Ghana and Kenya reported the best grades on this indicator; well over half of children and youth reported spending no more than 2 hours per day on screen time. Intuitively it seems that less access to sedentary behavior promoting devices (eg, motorized vehicles, electronic screens) would be associated with less sedentary behavior. Indeed, recent research comparing 17 high-, middle-, and low-income countries demonstrated that ownership of household devices, including televisions, computers, and cars, increased as country income level increased, and that ownership was positively associated with obesity and diabetes in low- and middle-income countries.<sup>64</sup> Of particular relevance to the present discussion, this relationship was partially mediated by decreased PA and increased sedentary behavior.<sup>78</sup> As the world becomes increasingly “wired,” auto-dependent and urbanized, the temptation and convenience of sedentary living seems likely to increase. Self-report sedentary behavior data on representative samples of children and youth from 39 countries around the world revealed that 56%, 65%, and 63% of 11-, 13-, and 15-year-olds, respectively, watched 2 or more hours of television per day on weekdays.<sup>29</sup> In a study of parents from 25 countries around the world, 44% of parents agreed that their children spent too much time watching television or playing electronic games.<sup>53</sup>

The overall findings from the global matrix and international surveys suggest that when sedentary behaviors are high, PA levels are low. As a result, there is growing recognition of the importance of reducing sedentary behavior in children in addition to promoting PA.<sup>79,80</sup> Canada has recently developed specific Sedentary Behaviour Guidelines<sup>81,82</sup> that are separate and distinct from existing PA guidelines. The United Kingdom<sup>83</sup> and Australia<sup>84–86</sup> have also recently made specific recommendations about limiting sedentary time to promote healthy growth and development of children. Such guidelines or recommendations are not common yet in developing countries and it seems public health messaging around limiting screen time in particular may be important as lifestyle transitions occur throughout the world. It is important to note that screen time consists of much more than traditional television viewing which should be reflected in future surveillance. While the sedentary behavior indicator was informed in all countries exclusively by screen-time, or specifically television viewing time, nonscreen sedentary behaviors, and their relationship with health outcomes are important to understand and require further research.



**Family and Peers.** While the importance of family and peer support for the promotion of PA is universally recognized and substantiated by recent reviews,<sup>87–90</sup> this indicator is very difficult to grade based on a lack of empirical data adhering to the grading framework (Table 1). This difficulty was apparent in the report card grades summarized in this overview: 9 countries assigned an “incomplete” grade due to lack of data. The countries that did assign grades were tightly clustered around a “C” grade, with less variability than for any other indicator. As can be seen from Table 2, a variety of benchmarks were used to inform this indicator, with the availability of data to grade against each benchmark varying among countries.<sup>1,9,12,15,18,20</sup> A survey of parents in 25 countries with children birth to 12 years of age in 2010 noted an average of 14.3 hours per week spent with their children in all types of play during a typical week; means ranged from 10.5 hours in Denmark to 20.0 hours in China.<sup>53</sup> Note, however, that family size and composition, employment logistics, urban-rural residence, climate, and variable definitions of “play” may confound the results and interpretations. Hence, given the available data, it is difficult to draw any firm conclusions from these findings.

**School.** Grades for the School indicator ranged from “A-” in England to “F” in Colombia with a relatively even distribution of grades by other countries between these extremes. The top 5 grades were from high-income countries while the bottom 4 grades were from middle- to low-income countries. The high grade for England represented favorable composite evidence on school physical education (PE) delivery, school policies and investments in PA, and school facilities and availability.<sup>11</sup> The low grade in Colombia was based on the observation that only 6.1% of school-aged children received PE classes from a professional instructor.<sup>91</sup> Of interest, grades for the Overall Physical Activity indicator did not appear to be closely related to school-based opportunities for PE or PA.

International comparisons of PE and school-based delivery of PA are scarce. A recent comparison of 30 European countries around initiatives and strategies to promote PE and PA in schools, time spent on PE, curriculum details, PE assessment, teacher education, and extracurricular sports highlighted important differences across Europe,<sup>92</sup> and noted that PE in some European countries was now < 10% of total curricular time.<sup>92</sup> Elsewhere, it has been reported that the quality and/or quantity of PE has recently diminished in many countries in recent years, with losses of 15%–20% of weekly time allocation due to cost-reduction or time allocation for other school subjects,<sup>69,93,94</sup> though areas of Australia have actually shown small increases.<sup>42,66</sup> Moreover, there is a discrepancy between curricular schedules and actual practice in many countries,<sup>93</sup> an issue raised in the Kenya and Ireland report cards.<sup>14,15</sup> Unsatisfactory infrastructure, lack of equipment and financial resources, lack of training of PE teachers, a gap between policy and practice, curricular demands that exceed teacher competence, and over-sized classes are other concerns raised by PE leaders from around the world.<sup>93</sup>

**Community and the Built Environment.** This indicator received the highest grades, on average, with 7 countries assigning grades of ≥ “B-.” While the grades were generally high, they ranged from “A-” in Australia to “F” in Mexico and Mozambique. A general pattern of higher grades in higher-income countries and lower grades in lower-income countries was evident, which makes intuitive sense. Although there is much emphasis on improving the built environment, it is already reported as quite good in many countries. Canadians quite reliably reported rather good PA infrastructure, availability, and programming.<sup>3</sup> Despite consistent high grades for the Community and Built Environment indicator in Canada,

the actual reported use of parks, playgrounds, and programs was quite low.<sup>95</sup> It appears that perceptions of quality and safety of local facilities and infrastructure did not necessarily translate into PA. On a more global scale, this same relationship appeared to emerge with countries that reported rather good PA environments in the community generally showing poor Overall Physical Activity grades, while countries with lower grades on Community and Built Environment generally showing higher Overall Physical Activity grades.

Other results from several countries have also challenged conventional thinking about the relationship between PA and characteristics of the built environment.<sup>96</sup> Using latent class analysis of built environment features reported by adults from 11 countries, 5 neighborhood patterns emerged across countries; 2 were specifically associated with meeting PA guidelines: first, an overall activity supportive environment (eg, many shops and transit stops within walking distance, sidewalks on most streets, low cost recreation facilities near-by), and second, highly walkable yet unsafe environments with few recreation amenities.<sup>96</sup> Although this study was adult-centric, the results add evidence that relationships between the environment and PA are complex and probably specific to geographic area, culture, and/or country.<sup>96</sup>

While there is universal support for the promotion of PA enhancing environments, evidence suggests a need to challenge how such environments should be defined. In some cases, it may be that “less is more” for the promotion of exploratory play and incidental PA for some children. Nevertheless, international comparisons as evident in the global matrix and other surveys<sup>96</sup> are invaluable in assessing the universality of interventions and approaches, while emphasizing the need to use cross-cultural research in the search for solutions to the childhood inactivity crisis.

**Government Strategies and Investments.** The Government Strategies and Investments indicator was difficult to grade. Assigned grades relied more on expert consensus than the grading framework (Table 1). Nevertheless, 10 countries felt confident assigning a grade. Grades were tightly bunched in the “B” and “C” range indicating an overall favorable assessment, regardless of the income or development status of the country. The individual country report cards discussed a variety of policies, strategies, and investments related to different indicators and collectively represent a catalog of ideas for governments to consider.<sup>1,9–22</sup>

Many countries had relatively high grades for the policy environment both in schools and in governments, but relatively low grades for the indicators of health behaviors that the policies were targeting. Whether this reflects ineffective policies, lack of implementation or the reactive nature of policy development is unclear. The fact that more developed countries had more developed policy environments than less developed countries, but generally had lower levels of desired behaviors indicates a major mismatch (ie, policies and strategies may have been reactive to problems after they had emerged rather than preventive). Further, the implementation of reparative policies may be suboptimal (eg, ineffective, unsustainable, insufficiently scaled). Given the experience from developed countries, it may be opportune to rally support for the implementation of proactive campaigns, strategies, and investments in developing countries in an effort to preserve inherent healthy active living behaviors.

**Other Indicators.** While not discussed in the context of the global matrix it is worth noting that most countries added additional indicators to their Report Cards; indicators of particular relevance or importance to their jurisdiction. Examples of additional indicators

included body weight status (overweight and/or obesity, in some cases in the presence of persistence underweight), nutrition/healthy eating indicators, physical fitness, motor skills, and nongovernmental strategies and investments. Details are reported in individual country Report Cards.<sup>1,9–22</sup>

## Disparities and Inequities

Variability in the grades comprising the global matrix demonstrates disparities and inequities in indicators related to PA at the country level. Such variation, while generally considered in need of repair to “level the playing field,” provides rich, comparative information that can assist jurisdictions and challenge conventional wisdom. For example, should higher-income countries be encouraged to relax efforts to construct environments for children to play (thereby lowering their grades), or should low-income countries be encouraged to invest in constructing environments shown to promote PA in other jurisdictions (thereby improving their grades)?

It is worth highlighting that very little information on the accessibility and opportunity for PA among children and youth with a disability (physical, mental, sensory) was reported in the country Report Cards. This group with special needs not only represents a significant proportion of children and youth globally,<sup>97,98</sup> it is among the most vulnerable to physical inactivity and also the group that might gain the greatest benefit from a “level playing field.” The prevalence of children and youth with disabilities varies substantially among countries and disability category.<sup>98</sup> Understanding and learning from international variability in efforts to address disparities and inequities among this marginalized population could increase awareness and provoke required changes. This is an area where more research and surveillance is required.

Disparities and inequities exist within countries, but the extent varies among countries.<sup>1,9–22</sup> The most notable within-country

disparity or inequity gradient related to the Organized Sport Participation indicator. Because participation in organized sport often requires resources (registration fees, equipment, travel), it is more susceptible to socioeconomic or geographic (urban-rural) gradients. Such gradients were noted in several Report Cards. Most countries also reported a gender bias favoring boys in organized sport participation. International and cultural variation in gender roles and expectations complicate the transferability of interventions to help level the playing field between genders.

## Research and Surveillance Gaps and Needs

- While this global matrix with 15 nations is a major advance, there are a number of “geographical gaps,” notably the lack of representation from Asia, the Eastern Mediterranean, and Arab countries, much of Eastern and Western Europe, South America, Pacific Islands, and the Caribbean (see Figure 1). It is hoped that the creation of the first global matrix will encourage nations from these under-represented areas to develop Report Cards in the future and further our understanding of global variation while assisting with solution cross-fertilization. Efforts are currently underway in at least 4 additional countries (Hong Kong, Japan, Malaysia, Wales).
- There is a need for more research on the correlates and determinants of PA and sedentary behaviors in children and youth in different countries. Determinants likely vary by region and across cultures. This information is essential to the identification of future Report Card indicators and novel intervention possibilities.
- There is a need for robust, standardized measures of PA and sedentary behaviors on children and youth from countries around the world.



**Figure 1** — Global map indicating location of countries participating in the global matrix.

- There is a need for healthy movement behavior information on young children (toddlers and preschoolers, aged 1–5 years) from countries around the world to understand best practices for the promotion of healthy growth and developmental trajectories.
- More research and surveillance are required to assess the levels and importance of active, unstructured play and/or light-intensity PA and understand their relationship with holistic health outcomes.
- Enhanced efforts are required to collect public health surveillance data for those indicators that could not be graded (graded incomplete); to improve the measurement of existing indicators with better, standardized measures and more representative samples; to extend measures to include emerging health behaviors which have not been measured in surveillance in the past (eg, sitting time, breaks in sitting time, nonscreen time sedentary behaviors, light PA); and to include marginalized groups.
- International, cross-cultural efforts should be used to inform creative solutions and interventions to influence the habitual movement behaviors of children around the world, recognizing the variation in social norms and environmental realities while respecting the biologically rooted and curiosity-driven desires and impulses of children and youth. Countries should take advantage of policy work/documents that have been developed in other countries (eg, PA strategies, active play plans, cycle frameworks). An inventory and library of existing documents in each country should be created for reference purposes.
- Volunteerism can be an important nongovernmental, community-based support for sport and PA. While delivery of sport and PA opportunities should not be reliant on volunteers, models of practice worldwide on how to involve and retain volunteers or lay leaders would be useful.

## Conclusion

Though not specific to the global matrix a recent Delphi survey of international experts established a ranked set of international research priorities in child and adolescent PA and sedentary behavior.<sup>99</sup> The top 3 priorities were: development of effective and sustainable interventions to increase long-term PA among children and youth; assessment of policy and/or environmental changes and their influence on PA and sedentary behaviors of children and youth; and implementation of prospective, longitudinal studies to examine the independent effects of PA and sedentary behaviors on health from birth to middle age.<sup>99</sup>

## Recommendations for Improving the Grades and Future Directions

- Expand our work as a global community of childhood PA researchers and advocates to learn from one another and challenge conventional within country solutions with international cross-fertilization of ideas and approaches. This may be facilitated by the creation of a global federation or network of active healthy kids organizations or research or advocacy groups.
- International efforts are needed to establish a core list of indicators, with clear definitions and documented benchmarks, to serve future global matrix efforts.
- Developing countries should take advantage of PA and sedentary behavior guideline work already done in many high-income countries, and build on this foundation to create and promote culturally relevant guidelines for the respective countries. This would serve to promote healthy living awareness and messaging while assisting with future surveillance.
- Countries should use the between-nation variation in grades revealed by the global matrix to stimulate greater policy efforts aimed at improving the grades.
- Conduct regular capacity building courses to support healthy active living research in various jurisdictions.
- There is a need to gather and promote promising practices and programs from low- and middle-income settings and marginalized communities in high-income settings that have managed to overcome the problems of crime and safety, environmental justice, resource limitations, and competing agendas. If such examples cannot be found, then there is a need for funders, sponsors, and donors to create a call for such demonstration projects, with sufficient funding to build in rigorous evaluation.

The global matrix provides new information upon which researchers, advocates, practitioners, and policy-makers can reflect and derive inspiration for future work. International cooperation and cross-fertilization is encouraged to conquer existing challenges, understand underlying mechanisms, derive innovative solutions and overcome the expanding childhood physical inactivity crisis.

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