

# Active play: An important physical activity strategy in the fight against childhood obesity

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## ABSTRACT

**OBJECTIVES:** To quantify and compare the number of calories that school-aged Canadian children expend to meet established benchmarks for active play and organized physical activities (i.e., organized sport, physical education, active transportation).

**METHODS:** This study was informed by the benchmarks (i.e., amount of activity a child needs to be sufficiently active) and grades (i.e., how Canada as a country is doing) for the physical activity domains included in the Active Healthy Kids Canada Report Card on Physical Activity for Children and Youth. Established physical activity energy expenditure data were used to calculate the number of calories that the average 6-11 year old child would expend to meet the Report Card physical activity benchmarks. The increase in energy expenditure at the population-level that would occur if each Report Card grade was to improve by one letter grade was estimated based on the aforementioned estimates and the proportion of the population impacted should the grade improve.

**RESULTS:** When averaged across all 365 days of the year, the average 6-11 year old Canadian would expend an added 186 kcal/day to meet the active play benchmark, 23 kcal/day to meet the organized sport benchmark, 6 kcal/day to meet the physical education benchmark, and 16 kcal/day to meet the active transportation to school benchmark. Increasing the Report Card grades for these four domains would address 37%, 1%, 1%, and 3% of the energy gap, respectively.

**CONCLUSION:** Initiatives aimed at increasing physical activity in an attempt to address childhood obesity should include an active play component.

**KEY WORDS:** Child; play and playthings; motor activity

La traduction du résumé se trouve à la fin de l'article.

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Childhood obesity is a recognized public health issue in Canada.<sup>1</sup> Most childhood obesity interventions include a physical activity (PA) component. Unfortunately, these interventions have minimally impacted the body weight and total PA of children, likely because the amount of PA prescribed was insufficient.<sup>2</sup> Interventions that substantially impact the amount of PA children accumulate could have a more meaningful impact on their body weight, as observed in adults.<sup>3,4</sup>

Children accumulate their PA by engaging in active play (also referred to as physically active play, PA play, and active free play) and organized PA such as organized sport, active transportation, and physical education and other organized school activities. Active play refers to PA comprised of games or symbolic play and includes playground activities, ball games played in the street, and backyard games like tag and red rover.<sup>5</sup> It is typically unsupervised and self-directed by children. Organized sport is governed by rules and is usually engaged in competitively and under adult supervision, such as a hockey game, soccer practice, and dance class. Active transportation is transportation that is self-propelled and includes walking and biking. Physical education is a school class that encourages motor skill development in a movement setting. Daily physical activity (DPA) is also part of the school curriculum in some provinces. It focuses on energy expenditure rather than skill development.

While attempting to increase the PA of children, research has focused on the organized forms of PA and has largely ignored

active play.<sup>2,6</sup> Because children have the opportunity to participate in active play for prolonged periods daily, it could have a major impact on their energy expenditure. In support of this notion, the emergence of the childhood obesity epidemic in the 1980s<sup>7,8</sup> corresponded with the demise of outdoor active play.<sup>9,10</sup>

The Active Healthy Kids Canada Report Card on Physical Activity for Children and Youth,<sup>11</sup> hereafter referred to as the Report Card, provides a framework to assess the role of active play and the organized forms of PA on obesity. The Report Card is a knowledge synthesis and advocacy tool that is recognized as being a credible source for insight and understanding on childhood PA.<sup>11</sup> A key component of the Report Card is the grades for the different forms of PA. The grading process for each form of PA starts with a benchmark of what a child needs to achieve to get a sufficient amount of PA. Grades are assigned based on the proportion of Canadian children achieving the benchmark.

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**Table 1.** Steps used to calculate the energy expenditure for each form of physical activity and example based on organized sport

Step #	Step description	Step process	Example calculation based on organized sport
1	Determine the time per day, when averaged across all 365 calendar days, a child would participate in the activity to meet the Report Card benchmark.	Multiply the frequency of participation by the duration per session.	2.6 sessions/wk X 60 min/session = 22.29 min/day
2	Determine the time per day, when averaged across all 365 calendar days, spent at a light (1.5-2.99 METS), moderate (3.00-5.99 METS), and vigorous ( $\geq 6.0$ METS) intensity while participating in the activity.	Multiply Step 1 results by the proportion of the activity time spent at a light, moderate, and vigorous intensity.	<ul style="list-style-type: none"> <li>• 35% @ light intensity = 7.80 min/day</li> <li>• 18% @ moderate intensity = 4.01 min/day</li> <li>• 14% @ vigorous intensity = 3.12 min/day</li> </ul>
3	Determine MET values in excess of sedentary behaviour for light, moderate, and vigorous intensity.	Assign mid-point MET value to each intensity range (2.25 for light intensity, 4.5 for moderate intensity, 8.0 for vigorous intensity, or 6.0 when studies combined moderate and vigorous activities) and subtract MET value at mid-point of sedentary behaviour range (1.25).	<ul style="list-style-type: none"> <li>• <math>2.25 - 1.25 = 1</math> MET for light intensity</li> <li>• <math>4.5 - 1.25 = 3.25</math> METS for moderate intensity</li> <li>• <math>8.0 - 1.25 = 6.75</math> METS for vigorous intensity</li> </ul>
4	Determine the kcal per day expended while participating in the activity.	* Multiply 33.4 by the Step 3 results by the Step 2 results (after having divided the Step 2 results by 60 to convert from min/day to hr/day). Sum the values for the 3 intensities.	<ul style="list-style-type: none"> <li>• <math>33.4 \times 1 \times (7.80 \div 60) = 4.3</math> kcal/day @ a light intensity</li> <li>• <math>33.4 \times 3.25 \times (4.01 \div 60) = 7.3</math> kcal/day @ a moderate intensity</li> <li>• <math>33.4 \times 6.75 \times (3.12 \div 60) = 11.7</math> kcal/day @ a vigorous intensity</li> <li>• <math>4.3 + 7.3 + 11.7 = 23.3</math> kcal/day</li> </ul>

\* The average Canadian 6-11 year old child weighs 33.4 kg. For each MET (metabolic equivalent), 1 kcal is expended for every kg of body weight for every hour.

The purpose of this study was to use the Report Card as a guide to quantify and compare: 1) the number of calories an average Canadian school-aged child (6-11 years of age) expends to meet the Report Card benchmarks for active play and the organized forms of PA, and 2) the expected increase in caloric expenditure when averaged across the entire school-aged population should the proportion meeting the benchmarks increase.

## METHODS

### Overview

This study relied on existing PA survey data, established PA energy expenditure data, and the Report Card.<sup>5,11</sup> The Report Card is generated annually by a group of experts from the research, government, and non-profit sectors. It starts with a benchmark of what children need to achieve to get a sufficient amount of PA, and then grades the different forms of PA, including: organized sport, active transportation, PA in school, active play, and sedentary behaviours (e.g., screen time). Grades are assigned based on the proportion of Canadian children achieving the benchmarks (A = 81-100%, B = 61-80%, C = 41-60%, D = 21-40%, F = 0-20%) by examining PA studies conducted across the country, with an emphasis placed on objective measures and representative data. Grades are lowered by one letter grade if significant disparities exist.

### Caloric expenditure calculations

For each form of PA, the number of calories per average day the average 6-11 year old Canadian child would expend to meet the Report Card benchmark was calculated using the 4 steps outlined in Table 1. These calculations reflect the calories (kcal) expended in excess of the kcal expended if the time spent in PA was spent being sedentary. The information for Steps 1 and 2 are explained under "Information on Frequency, Duration, and Intensity of Activities". Step 4 was based on knowledge that the average body weight of 6-11 year old Canadians is 33.4 kg.<sup>12</sup>

Population-level calculations were based on how many additional kcal/day would be expended, when averaged across all 6-11 year old Canadians, if the 2013 Report Card grades were

improved by one letter grade. These calculations provide policy-makers with the expected change in caloric expenditure should Canada, as a nation, be successful at improving child PA levels. For these calculations, the kcal that an individual child expends to achieve the benchmark (Step 4 in Table 1) was multiplied by the proportion of the population who would need to be affected for the grade to improve. To improve by one letter, an extra 20% of the population would be affected, unless the grade were improved by decreasing disparities.<sup>5</sup> More information on Report Card grades and criteria for improving grades is found under the subsection of the Methods titled "Information on Report Card grades".

The proportion of the energy gap addressed if the grades were improved by one letter grade was also calculated. The energy gap is the population-level change in the balance between energy expenditure and intake that is needed to offset weight gain above that needed for healthy growth.<sup>13</sup> If the energy gap were eliminated, over time the prevalence of childhood obesity would return to what it was prior to the start of the obesity epidemic. The energy gap is ~100 kcal/day.<sup>13</sup>

### Information on frequency, duration, and intensity of activities

#### Organized Sport

The organized sport benchmark is regular participation in organized sport programs.<sup>5</sup> The calculations were based on reports that children in organized sport participate 2.6 times/week<sup>14</sup> on average and assumed that each session lasts 60 minutes. This equates to 22 minutes/day when averaged across all calendar days. When averaging results from 4 studies, accelerometer data obtained from children playing several organized sports indicate that 33% of the time is spent sedentary (e.g., instruction time, sitting on sidelines), 35% at a light intensity, 16% at a moderate intensity, and 16% at a vigorous intensity.<sup>15-17</sup>

#### Active Transportation

While active transportation to school only covers one travel destination, it is the focus of active transportation interventions

## ACTIVE PLAY AND ENERGY EXPENDITURE

and the caloric expenditure calculations. School-based active transportation interventions are geared towards children who live near their school; children who travel >1 mile (1.6 km) to school are typically eligible for bussing.<sup>18</sup> As 94% of children who use active transportation to get to school do so by walking,<sup>5,19</sup> the calculations were done for walking. The normal walking pace for 6-12 year olds is 4.18 km/hour,<sup>20</sup> which is equivalent to 3.6 METS (metabolic equivalent of task).<sup>21</sup> The calculations assumed that the average child would walk 0.5 miles to and 0.5 miles home from school, which equates to 23.0 minutes on days they attend school. Because there are ~195 school days/year<sup>22</sup> and because children miss an average of 5 school days/year,<sup>23</sup> children would walk an added 12.0 minutes/day when averaged over all 365 calendar days. As school is not the only destination children walk to, the kcal expended for each additional 1 km walked (14.4 minutes/day of walking) was also calculated.

### *Physical Education and Other Organized School Activities*

The benchmark for physical education is getting ≥150 minutes per school week of physical education,<sup>5</sup> or 30 minutes per school day. This equals 15.6 minutes/day when averaged across all days of the year. Accelerometer data collected on 8-11 year olds during physical education indicate that 74% of the time is spent sedentary (e.g., instruction time, waiting in line), 14% at a light intensity, and 12% at a moderate-to-vigorous intensity.<sup>24</sup>

In addition to physical education, Alberta, British Columbia, and Ontario have instituted daily physical activity (DPA) into the curriculum. Ontario's DPA policy was used as the benchmark for the calculations. Ontario's policy is that grade 1-8 students get 20 minutes of sustained moderate-to-vigorous PA daily during instructional time.<sup>25</sup> Data collected on grade 5 students (~10 year olds) participating in a DPA type program suggest that the average intensity across a DPA period is 4.8 METS.<sup>26</sup> The caloric expenditure calculations were based on that intensity and assumed that children would get 20 minutes of DPA on 190 days/year, or 10.4 minutes/day when averaged across all calendar days.

### *Active Play and Screen Time*

Active play and screen time (e.g., television, computers, video games) were considered simultaneously for two reasons. First, these represent highly unorganized and unsupervised activities that children engage in during their free time. Second, I postulate that active play in a child's free time has been largely replaced with sedentary screen time pursuits in recent decades. Conversely, organized physical activities are not correlated to screen time.<sup>27</sup>

Individual-level estimates were determined by looking at the differences in caloric expenditure of screen time (1.25 METS<sup>28</sup>) and active play. This was done for a 60 minutes/day period as well as a period of time that corresponded to the difference between the benchmark for screen time (2 hours/day)<sup>29</sup> and the average daily screen time of 11-year-old Canadians (5.8 hours/day).<sup>5,19,30</sup> The 3.8-hour difference between the screen time benchmark and the average screen time of 11 year olds is consistent with the benchmark for active play, which is that children engage in active play for several hours daily.<sup>5</sup> Based on accelerometer data collected from 8-11 year old Canadians while they were allowed to play at school during recess and lunch, it

was assumed that 54% of active play time is spent sedentary, 19% at a light intensity, and 27% at a moderate-to-vigorous intensity.<sup>24</sup>

## Information on Report Card grades

### *Organized Sport*

Received a C grade in recent Report Cards.<sup>5,19</sup> While 75% of 5-19 year olds participate, which puts the grade at a B, income disparities lower the grade to a C.<sup>5,19</sup> To eliminate the income disparity and improve the grade to a B, organized sport participation would need to increase from 64% to 78% within the lowest income quartile and from 74% to 78% in the second lowest quartile.<sup>19</sup> Thus, for the grade to improve, an additional 5% of the population would have to participate ((14% X 25%) + (4% X 25%)).

### *Active Transportation*

Received a D grade in the 2013 Report Card as only 24% of children use active transportation to get to and from school.<sup>5</sup> To increase to a C grade, this would need to increase by 20%. The population-level estimates were based on getting children who live within one mile of their school (0.5 miles on average), but are driven there by their parents, to walk to school instead.

### *Physical Education and Other Organized School Activities*

Physical education was given a C grade in the Report Card.<sup>5</sup> Participation rates approach 100% in grade 1 to 6 students (6-11 year olds), but these children only get an average of 120 minutes per school week of physical education.<sup>19</sup> The grade would improve if physical education were increased by 30 minutes per school week, or 3.1 minutes/day when averaged across all days of the year.

Only Ontario, British Columbia, and Alberta have DPA programs and 64% of 6-11 year old Canadians live in these provinces.<sup>31</sup> Another way to improve this grade would be to get more jurisdictions to implement DPA such that the proportion of children in DPA increases to 84%.

### *Active Play and Screen Time*

Screen time was graded an F in the Report Card based on evidence that 19% of 11-15 year olds meet screen guidelines, with age and gender disparities.<sup>5</sup> The population-level energy expenditure estimate for improving the active play and screen time grades was based on applying the individual-level estimates for meeting the benchmark to 20% of the population.

## RESULTS

A summary of the findings is provided in Table 2. Details on each form of PA are below.

### **Organized sport**

School-aged children achieving the organized sport benchmark expend 23 kcal/day more than children who spend equivalent time being sedentary. Only 5% more of the child population would need to participate in organized sport to improve the Report Card grade. Increasing organized sport energy expenditure by 23 kcal/day in 5% of the child population equates to

**Table 2.** Summary of physical activity benchmarks, Report Card grades, and caloric expenditure data

Form of physical activity	Criteria to achieve benchmark	Report Card grade in 2013	Caloric expenditure gain achieved for a typical child meeting the benchmark	Caloric expenditure gain averaged across the child population that would be achieved by improving the Report Card grade	Proportion of energy gap eliminated by improving the Report Card grade
Organized sport	Participation in organized sport and/or physical activity programs.	C	23 kcal/day	1 kcal/day	1%
Active transportation	Use active transportation to get to and from places (e.g., school, park, friend's house)	D	‡ 16 kcal/day for walking to and from school § 18 kcal/day for each additional km per day walked to places	‡ 3 kcal/day	‡ 3%
* Physical education and † daily physical activity at school	* At least 150 minutes of physical education per school week. † At least 20 minutes of sustained moderate-to-vigorous physical activity each school day during instructional time	C	* 6 kcal/day † 21 kcal/day	* 1 kcal/day † 4 kcal/day	* 1% † 4%
Active play and ¶ screen time	Engage in unstructured and unorganized activities for several hours a day ¶ Up to 2 hours per day of recreational screen time	F	,¶ 186 kcal/day	,¶ 37 kcal/day	,¶ 37%

\* Active Healthy Kids Canada benchmark for participation in physical education at school (150 minutes per school week).

† Ontario policy for daily physical activity (DPA) at school (20 minutes of sustained moderate-to-vigorous physical activity every school day during instructional time).

‡ Active travel to school (walking 0.5 miles to school and 0.5 miles home from school on 190 days/year).

§ Active travel in general (per each 1 km/day walked in place of using motorized transportation).

|| Active Healthy Kids Canada benchmark for active play (several hours a day of unstructured and unorganized activities).

¶ Active Healthy Kids Canada benchmark for screen time (up to 2 hours per day of recreational screen time).

1 kcal/day when averaged across the entire population. This represents 1% of the energy gap.

### Active transportation

School-aged children expend an extra 18 kcal/day for each km/day that they walk instead of using motorized transportation. When averaged across all calendar days, children who walk 0.5 miles both to and from school expend 16 kcal/day more than children who do no walking to and from school. An extra 3 kcal/day per child would be expended at the population level if the Report Card grade were improved to a C by getting 20% more children to walk to school. This represents 2% of the energy gap.

### Physical education and DPA

Participating in 150 minutes/week of physical education increases energy expenditure by 6 kcal/day when averaged across all 365 calendar days. To improve the physical education grade, primary school children would need to accumulate 30 additional minutes per school week of physical education. If this were achieved, 1 additional kcal/day would be expended in school-aged children and 1% of the energy gap would be addressed.

When averaged across all days of the year, 6-11 year olds who get 20 minutes per school day of DPA expend 21 kcal/day more than children who get no DPA. If more jurisdictions adopted DPA and the proportion of children participating increased by 20%, an extra 4 kcal/day would be expended when averaged across all Canadian children. This equates to 4% of the energy gap.

### Active play and screen time

Every hour/day that a school-aged child spends in active play rather than screen time increases their daily caloric expenditure by 49 kcal. A child who accumulates the recommended maximum of 2 hours/day of screen time expends 186 kcal/day more than a child who accumulates the national average of

5.8 hours/day of screen time if the 3.8-hour difference is spent in active play. An extra 37 kcal/day per child would be expended, on average, and 37% of the energy gap would be addressed if the Report Card grade were improved to a D.

## DISCUSSION

Key findings are that: 1) active play is the form of PA where school-aged children expend the most calories to meet the Report Card benchmarks, and 2) public health initiatives aimed at addressing childhood obesity by increasing PA would likely be unsuccessful if an active play component were not included.

Recent Report Cards have highlighted the substantial lack of research, policies, and interventions aimed at active play.<sup>5,19</sup> If active play levels are insufficient, as speculated based on reports that contemporary children spend less time outdoors than children of previous generations,<sup>9,32</sup> the findings of this paper imply that a lack of active play contributes to the childhood obesity crisis. In fact, an estimated 37% of the energy gap would be eliminated by improving the active play and screen time grades from a failing grade to a D.

The observation that meeting benchmarks for the organized forms of physical activity has a small influence on caloric expenditure is consistent with a recent systematic review which found that interventions attempting to change participation in organized PA have a small impact on total PA levels and body weight.<sup>2</sup> School-based obesity interventions are particularly abundant. A consideration for any intervention that occurs around or within the school day is that children only attend school on ~190 days/year. Furthermore, the intensity of organized PA that occurs at school is typically low. For instance, only 12% of a physical education class taught by a regular teacher is spent in moderate-to-vigorous PA.<sup>24</sup> Perhaps emphasis should be placed on increasing the quality of these organized activities rather than the quantity. Indeed, children are more

active in their physical education classes when they are taught by specialist teachers.<sup>33</sup>

About half of the time children are engaged in active play, they are moving at a light, moderate, or vigorous intensity.<sup>24,34</sup> Active Healthy Kids Canada recommends that children engage in active play for several hours every day.<sup>5</sup> Some may argue that the time requirement for the active play benchmark is unrealistic since children have busy schedules. Data collected in several national surveys counter this argument as children spend several hours/day of their free time in front of an electronic screen.<sup>5,19,30</sup> Even replacing 1 hour/day of screen time with active play would burn 49 kcal/day, which is equivalent to what would be expended by meeting the benchmarks for organized sport (23 kcal/day), active travel to school (16 kcal/day), and physical education (6 kcal/day) combined. Of course, developing effective strategies and interventions for active play will be challenging. One of the few published studies on the determinants of active play suggests that several intrapersonal factors (e.g., child preferences for activity), interpersonal factors (e.g., number of siblings, household income, parent's perceptions of crime, parent supervision), and physical environment factors (e.g., quality of playgrounds in neighbourhood) are relevant,<sup>35</sup> suggesting that effective active play interventions will be multifaceted.

The following should be considered when interpreting the caloric expenditure calculations. First, they assume that an increase in one form of PA would not lead to a decrease in another form or to changes in caloric intake or resting energy expenditure. Second, they focus on the role of PA in obesity. The beneficial role of PA on several other aspects of physical and mental health should be equally emphasized.<sup>6</sup> Third, the Report Card benchmarks focus on the quantity of the activities, and the calculations were based on these quantities and the intensity that children currently achieve when participating. Increasing the intensity of some organized activities would be another strategy. Finally, the population-level estimates reflect the theoretical increase in caloric expenditure should there be a modest but realistic improvement in the Report Card grades. Even the improvements in grades calculated herein would result in a below-A grade.

In summary, this paper highlights the role of active play in childhood obesity. It is hoped that these findings will stimulate discussion, research, action, and potentially policies around active play.

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## RÉSUMÉ

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**OBJECTIFS :** Chiffrer et comparer le nombre de calories dépensées par les enfants canadiens d'âge scolaire pour respecter des balises établies pour le jeu actif et les activités physiques structurées (sport organisé, éducation physique, transport actif).

**MÉTHODE :** Notre étude était étayée par les balises (la quantité d'activité dont un enfant a besoin pour être suffisamment actif) et les notes (la performance du Canada en tant que pays) attribuées aux domaines d'activité physique inclus dans le *Bulletin canadien de l'activité physique* chez les jeunes de Jeunes en forme Canada. Les données attestées sur la force dépensée pour l'activité physique ont servi à calculer le nombre de calories que l'enfant moyen de 6 à 11 ans dépenserait pour respecter les balises d'activité physique du Bulletin. Nous avons estimé quelle serait l'augmentation de la force dépensée à l'échelle de la population si chaque note alphabétique du Bulletin s'améliorait d'un niveau, d'après les estimations susmentionnées, et la proportion de la population touchée si la note s'améliorait.

**RÉSULTATS :** Lorsqu'on fait une moyenne sur les 365 jours de l'année, l'enfant canadien moyen de 6 à 11 ans dépenserait 186 kcal/jour de plus pour respecter la balise du jeu actif, 23 kcal/jour pour celle du sport organisé, 6 kcal/jour pour celle de l'éducation physique et 16 kcal/jour pour celle du transport actif pour aller à l'école. Hausser les notes du Bulletin dans ces quatre domaines permettrait de résorber 37 %, 1 %, 1 % et 3 % du fossé énergétique, respectivement.

**CONCLUSION :** Les initiatives visant à accroître l'activité physique afin de lutter contre l'obésité juvénile devraient inclure un élément de jeu actif.

**MOTS CLÉS :** enfant; jeux et jouets; activité motrice