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A Quasi-Experimental Study of the Effects of an Outdoor Learning Program on Physical Activity Patterns of Children with a Migrant Background: the PASE Study

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Introduction: Despite the recognized benefits of physical activity on health, most youth, especially those with a migrant background, do not meet movement guidelines. Outdoor learning is recognized as a promising intervention to address this issue. The objective of this quasi-experimental study was to measure the effects of the PASE (“*Outdoors, Health and Environment*”) outdoor learning program on the physical activity of students with a migrant background compared to a control group with similar sociocultural characteristics.

Methods: In October 2019, 91 participants from six elementary grade 6 classes (47.3% female, age 11.61 ± 0.41) wore a validated accelerometer for 7 consecutive days. Three comparative analyses were performed: full week, school day, and activity domains. The Mann-Whitney U test for independent samples was used to compare the differences in means and Cohen’s *d* was calculated to obtain their effect sizes.

Results: Analysis of the full week revealed no significant differences between groups. Analysis of school days without physical education classes showed that girls exposed to PASE spent a greater percentage of their time in MVPA than those in the control group (+4.30%, 95% CI = 1.93 to 6.68; $p < 0.01$) with a strong effect size ($d = 1.14$). In the activity domain analysis, more time in MVPA was spent in PASE outdoor learning than in the regular classroom (+11.15%, 95% CI = 9.70 to 12.61; $p < 0.01$) with a strong effect size ($d = 3.63$).

Conclusion: Outdoor learning has positive effects on the physical activity of students with a migrant background during school hours. Further studies are needed to confirm these observations.

Keywords: Outdoor Education; Outdoor Learning; Udeskole; Physical Activity; Accelerometer; Immigration

Introduction

A large body of research demonstrates the widespread health benefits of physical activity (PA) (World Health Organization, 2010). However, rates of physical inactivity remain alarmingly high, especially in high-income countries (Guthold et al., 2018). Physical inactivity is currently the 4th leading risk factor for death worldwide (World Health Organization, 2010), prompting some authors to refer to a current “physical inactivity crisis” (Tremblay et al., 2014). Calls for action to promote PA, such as the 2010 Toronto Charter for Physical Activity, tend to target school-aged youth (Bull et al., 2010) because active youth are more likely to remain active as adults (Shephard and Trudeau, 2013). Movement recommendations issued by the Canadian 24-hour Movement Guidelines state that 5 to 17 year olds should engage daily in an average of at least 60 min of moderate to vigorous physical activity (MVPA), several hours of structured and unstructured light physical activity, and outdoor time; should limit leisurely screen time to two hours; and should get 9 to 11 hours of sleep per night (Tremblay et al., 2016). However, changes in lifestyles and reduced opportunities for PA practice (Hills et al., 2015) have brought the rate of compliance with PA recommendations among youth to

concerning levels (Guthold et al., 2019). In 2014–2015, average daily MVPA measured by accelerometer was 55 min among Canadian youth and only 33.2% reached the 60 min threshold, with a lower proportion for girls and adolescents (Colley et al., 2017).

Intervention targets to increase physical activity among youth

Diverse interventions to address the problem of PA deficiency among youth have been proposed (Bull et al., 2010, Hills et al., 2015, Milton et al., 2021). Here, we review three key intervention targets: a) increasing PA among youth with a migrant background; b) using school as a privileged target for intervention; and c) increasing time spent outdoors.

First and foremost, it is important to prioritize support for the most vulnerable groups when promoting PA. A recent systematic review concluded that the immigration process is known to have a negative impact on youth PA. Thus, youth with a migrant background represent a group at risk of low PA (Lacoste et al., 2020). Language, socioeconomic status, and discrimination (Taverno et al., 2010) are factors that particularly hinder organized physical activity among youth with a migrant background, which might underlie the finding that the more recent the immigration, the less PA practiced by immigrant youth (Kukaswadia et al., 2014). Recently, this observation was challenged by Danish authors who assessed PA of immigrant youth using accelerometers (Nielsen et al., 2013). They observed that immigrant youth participate less in organized PAs but compensate with unorganized free PAs that might not be captured by the questionnaires. Nevertheless, this study is from a particular cultural context and further studies are needed to generalize the results to other countries. Also, climate may be a barrier in countries with harsh winters (Rothe et al., 2010) and is a factor that has not been considered in many studies (Tucker and Gilliland, 2007). Thus, developing programs that enhance adaptation to climate severity could potentially promote PA.

Second, the school environment plays a key role in addressing physical inactivity as youth spend many hours of their day there and nearly half of the calendar days (Frayssse et al., 2019, Hills et al., 2015). Furthermore, unlike optional leisure or after-school programs, for which participation is often biased, school is mandatory and provides an opportunity to reach youth regardless of their socio-economic status or their physical or intellectual abilities (Bentsen et al., 2019). Unfortunately, students also spend most of their time in sedentary activities. This places the responsibility for meeting PA recommendations on physical education (PE) classes and recess, which currently seems insufficient. As such, integrating alternatives to be active through transportation to school, extracurricular activities, breaks, and also classroom work itself might be a priority (Hills et al., 2015).

Finally, Canadian researchers and policy makers have highlighted the importance of the outdoor environment in PA intervention (Lefebvre et al., 2017; Tremblay et al., 2015). Studies using accelerometers to measure PA among Canadian youth show an association between each additional hour spent outdoors and an increase in MVPA as well as a decrease in sedentary behavior (Larouche et al., 2016; Larouche et al., 2017). However, outdoor play among youth has declined over time (Bassett et al., 2015; Louv, 2008). Lack of outdoor play might be even more problematic for immigrant children, who participate in less outdoor play than non-immigrant children (Conrad et al., 2013).

Given these observations, interventions combining school and the outdoor environment might represent a promising pathway to promote increased PA among youth with a migrant background. In this sense, outdoor learning is recognized as a practice that combines these two intervention targets (Bentsen et al., 2019). Systematic reviews show that outdoor learning activities have positive effects on PA while boosting academic learning and promoting student well-being (Becker et al., 2017; Kuo et al., 2019; Mygind et al., 2020).

Outdoor learning in the past and today

The term Outdoor Education is a semantic umbrella that includes dozens of concepts and approaches (Beames et al., 2012; Joyce, 2012). To reframe activities focused specifically on the school content, other expressions have appeared: Education Outside the Classroom, Learning Outside the Classroom, and Udeskole. The latter is used in Scandinavia to describe “regular and compulsory out-of-school learning activities in natural and cultural environments, such as forests, parks, local communities, factories and farms” (Bentsen & Jensen, 2012). The use of Udeskole has grown in recent years, with approximately 19.5% of Danish schools integrating it into their curricula (Barfod et al., 2021), and this approach has had a strong influence on the education systems of several other countries (Passy et al., 2019). More recently, systematic reviews have applied the expression “outdoor learning” to bring together under the same name “regular and structured learning experiences for school-aged children in on-campus or off-campus outdoor settings” (Mann et al., 2021, p.2).

In Quebec, Canada, this movement is gaining momentum. Organizations and resources have emerged in recent years to support this approach in school settings, which are also promoted by new specialized university

programs (Gadai et al., in press, 2021). Recently, the Quebec Ministry of Education produced a scientific review on the benefits of outdoor activities, with the aim of promoting them in all sectors of activity, including education (Lefebvre et al., 2017). Quebec has similarities with Scandinavia in terms of climate, biodiversity, and to some extent, outdoor practices (Henderson, 2007). However, it seems that outdoor learning is not as well developed in Quebec and, as a result, few studies have focused on it, hence the relevance of this study.

Studies of physical activity in outdoor learning settings

To the best of our knowledge, only seven studies have investigated elementary school children's PA in outdoor learning contexts using objective and quantifiable measures. Results indicate that boys practice more MVPA and girls increase their light physical activity more in outdoor learning contexts than the control group. All other studies showed a significant increase in PA in the outdoor learning context, most notably in boys (Dettweiler et al., 2017; Fiskum & Jacobsen, 2012; Grønningsæter et al., 2007; Mygind, 2016; Romar et al., 2018).

Most studies were observational except for two that compared intervention and control groups (Dettweiler et al., 2017; Schneller, Duncan, et al., 2017). Thus, more studies with a quasi-experimental design are called for (Becker et al., 2017). The two largest in terms of sample size ($N = 361$) are from the Danish TEACHOUT research project on *Udeskole* practices (Schneller, Duncan, et al., 2017; Schneller, Schipperijn, et al., 2017). None of these studies focused on students with a migrant background, a group that is less active and spends less time outdoors (Conrad et al., 2013; Lacoste et al., 2020). Furthermore, they all come from Scandinavia or Finland, regions known to be at the forefront of outdoor learning practices.

The PASE program

The program studied here is called PASE (Plein Air, Santé et Environnement) which means Outdoors, Health and Environment. PASE is an adaptation of the principles of outdoor learning implemented among grade 6 students in an elementary school in Montreal, Canada. Every two weeks during the school year, students go outside the school for the day to study the subjects in the curriculum. These field trips are usually directed to the city's major parks and require travel by public transportation. Some weeks are supplemented with other outdoor learning activities in nearby small parks or on the school grounds. Activities can be sedentary (e.g., reading a book, writing a poem, doing exercises in a notebook), mildly active (e.g., measuring distances, observing flora) and active (e.g., introduction to canoeing, biking to a destination). All PASE activities are mandatory and supervised by regular and PE teachers.

Objectives

The objective of this study is to measure the impact of PASE on the PA of elementary students with a migrant background in Quebec. More specifically, we aim:

- a) To compare accelerometry-assessed MVPA measures between the PASE group and the control group (CG) over the week of data collection.
- b) To compare accelerometry-assessed MVPA measures during PASE activities with measures outside of PASE activity domains.

Methods

Study Design

The study used a quasi-experimental design, a recognized approach for evaluating program effects (Brousselle et al., 2011). An intervention group (IG) received PASE programming and a control group (CG) of students with similar characteristics received regular classroom instruction.

Quebec context

The study took place in the province of Quebec, Canada, in the urban area of Montreal. Each province has its own Ministry of Education, which is responsible for its curriculum. Quebec elementary students in the public sector are assigned to a school based on where they live. Each group has a regular teacher responsible for teaching French, which is the official language (reading, writing, oral communication), mathematics, science and technology, ethics and religious culture, and art. Students also attend three other courses offered by specialists: another art form of the school's choice, English (second language), and PE. Two hours per week are allocated to PE, with some variations depending on the school. In 2019, the Quebec government prescribed two mandatory 20-minute recesses in addition to a 45-minute lunch period spent outside when the weather permits.

Participants and recruitment

In this study, the IG consisted of three grade 6 classes in a Montreal elementary school. This school is among the ten most cosmopolitan in Quebec with 95.06% of students born outside of Canada (CGTSIM, 2020) and a disadvantage index rating of 10 out of 10, reflecting the most disadvantaged (Ministère de l'Éducation et de l'Enseignement supérieur du Québec, 2020). The students had never experienced a PASE program in their prior schooling and they did not choose the program. To our knowledge, this elementary school is the only one that piloted such a program in a high cultural density, low socio-economic environment in Quebec at the time of the study.

A recruitment phase was conducted to find an equivalent CG in terms of number of participants. Three inclusion criteria guided selection of the CG to avoid selection bias (Brousselle et al., 2011): 1) location; 2) socio-cultural and socio-economic similarity; and 3) similar grade level. Two tools were used to identify eligible schools: a student socio-cultural portrait tool and a public school disadvantage index (CGTSIM, 2020; Ministère de l'Éducation et de l'Enseignement supérieur du Québec, 2020). Schools in the same region with more than 90% of births outside Canada were first identified. Then, schools with a socio-economic background rated from 1 to 7 out of 10 were eliminated. Five schools fit the profile. Following telephone contacts with principals, one school that met the inclusion criteria was selected to represent the CG. This school had three grade 6 classrooms, as did the PASE group, and the students did not participate in any outdoor learning activities in their prior schooling or during the data collection phase. Students in both schools received the same number of hours of PE and recess during the week of data collection.

Activities during the PASE study

During the week of experimentation, three PASE classes went on a full-day field trip to a park. There they did a math activity, a reading activity, and a rabaska¹ (large group canoeing) initiation activity. To get to and from the site, they used public transportation for about two hours. Two groups out of the three did two other periods outside in the playground during the week. These included writing, math and an ethics and religious culture lesson in workbooks under the supervision of their teacher. During these activities, weather conditions were not a factor that would have disrupted the normal course of the activities.

Data collection

The following information was collected from each student in the week prior to the intervention: a) weight, b) height, c) dominant hand, d) date of birth, and e) gender. Body mass index (BMI, kg/m²) was calculated and categorized by comparison to World Health Organization references based on age and gender as: a) underweight, <3rd percentile, b) normal weight, ≥3rd percentile <85th percentile, c) overweight, ≥85th percentile <97th percentile, d) obesity, ≥97th percentile (Dietitians of Canada and Canadian Paediatric Society, 2014). Overweight and obesity were grouped into a single category (Overweight) for descriptive analyses (Lamontagne & Hamel, 2016).

Information on participants' and their parents' origins and native and home language was collected by questionnaire. Immigration generation categories were derived following Coll and Marks (2012). First-generation immigrant children are foreign-born, second-generation children have one or both foreign-born parents, and for third or higher generation children, both the child and parents are host-born.

Accelerometer data collection was conducted during the 3rd week of October 2019. Accelerometers were delivered to the classroom on Monday afternoon and were collected on Tuesday afternoon the following week. Recording was done over 7 consecutive days following the first wake-up.

Measurement of physical activity

Each participant wore a validated GENEActiv Original accelerometer (ActivInsights, Ltd.) on the wrist of the dominant hand for 7 days. The device has a wristband, is waterproof, and data are not visible to the participant. A protocol for using the accelerometers was developed using suggestions from McCann et al. (2016) to minimize the amount of time not worn (Appendix A). Prior to the handover of the accelerometer, the devices were calibrated at 85.7 Hz and according to the participant's personal characteristics (i.e., age, weight, height, dominant hand). Each participant was assigned an alphanumeric code and an accelerometer number.

At the time of handover, instructions were issued to never remove the device, even in the shower, unless requested by a trainer (e.g., combat sport). They were asked to always keep the watch on the wrist of the dominant hand and to report a damaged watch as soon as possible. The devices were removed and the raw

¹ This is a large canoe with typically 12 paddlers and a coxswain (<https://fr.wikipedia.org/wiki/Rabaska>).

data were downloaded the same day to a computer in (.bin) format using the manufacturer-supplied open-source software GENEActiv version 3.2 (ActivInsights, Ltd., 2016).

Data analysis

Analysis of accelerometry data

Data processing was performed in R software, version 4.0.3 (<http://cran.r-project.org/>) using the GGIR library, version 2.1–0 (Migueles et al., 2019). For this study, we used the MVPA intensity threshold from a study in children of the same age wearing a GENEActiv wrist accelerometer and performing standardized PA in the laboratory (Hildebrand et al., 2014). This study proposed a MVPA threshold of ≥ 191.6 mg. The calculation of minutes of MVPA per day is based on the average of 60s epoch. When the average of a 60s epoch is ≥ 191.6 mg, it is included for the calculation of MVPA minutes for the day, otherwise it is excluded.

Three analyses were performed on the results. The first compared time spent in MVPA over a 24-hour period and a full week (7 days) between 2 groups. Based on similar studies, participants were included in the analysis if they recorded valid data for ≥ 16 h per day (Sabia et al., 2014) for at least four days (Troiano et al., 2008) including at least one weekend day (da Silva et al., 2014). The second identified differences between groups based on one school day. This was calculated over the time frame of the participating schools from 7:50 a.m. to 3:03 p.m. where each participant receives 300 minutes of class time. Data from a school day were included in the analysis when they had at least 95% valid time. The third analysis was designed to compare groups in each of the activity domains. In this case, participants had to have recorded 95% or more valid time for each period included in the domain. Other details of the protocol are available in Appendix A.

Valid data exclude accelerometer non-use time, which corresponds to a range of values less than 50.0 mg over one hour or a standard deviation of less than 13.0 mg for at least 2 of the 3 accelerometer axes. A more detailed description can be found in previous publications (da Silva et al., 2014; van Hees et al., 2013).

Statistical analyses

Comparisons of the cross-tabulation of characteristics between the PASE group and the CG were tested by Pearson's χ^2 for nominal values and the nonparametric Mann-Whitney test for independent samples for comparisons of means. The independent-samples t test for means was used for age comparison. The non-parametric Mann-Whitney test was used for all other statistical analyses of comparisons of means. Cohen's d was computed for the independent t-tests to obtain the effect size of each significant difference in means. The significance level was set at $p < .05$ and statistical analyses were performed using SPSS 27.0 software for Windows (IBM Corp., Armonk, NY, USA).

Ethics approval and consent to participate

This research project was approved by the ethics review board of the authors' university (certificate #3671) and by the school boards of participating schools (#6.12.614). Parents of the participants were given oral information at a meeting and gave their written informed consent, as did participating students.

Results

PASE and control group characteristics

Table 1 presents the characteristics of project participants in the PASE (IG) and CG. There were significantly more 1st generation immigrant students in the PASE group than in the CG (31.2%, $p < .01$). However, only one participant in the entire sample was 3rd generation immigrant and above (born in Canada as well as both parents). This participant was grouped with 2nd generation immigrant participants in a category "2nd generation and above". Students reported 16 different languages spoken at home in the full sample, of which Arabic (38%), French (36%) and English (8%) were the most represented. There was no significant difference in the language spoken at home between the two groups. The study sample thus had a varied immigration background profile but was predominantly Arabic speaking. Four CG participants failed to complete the questionnaire on immigration related information.

There were no significant differences in prevalence of overweight between groups. However, prevalence in the sample (41.8%) was notably higher than the average among 6 to 17 year olds in Quebec (24.9%) (Lamontagne & Hamel, 2016).

Table 2 presents the comparison of average MVPA in minutes per day. Only one outcome from the IG (1.10%) and ten outcomes from the CG (10.99%) were discarded from the analysis for the full week as they did not meet the inclusion criteria.

Table 1: Characteristics of participants included in the study^a.

Categories	Sub-categories	Groups			p-value	Total Mean (±) / n(%)
		PASE		CG		
		Mean (±) / n(%)	Mean (±) / n(%)	Mean (±) / n(%)		
Age		11.56 (0.42)	11.67 (0.39)	0.24 ^b	11.61 (0.41)	
Wearing time in hrs/day ^c		23.83 (0.47)	23.53 (1.14)	0.85	23.68 (0.87)	
Weight status	Overweight ^d	19 (45.2%)	19 (38.8%)	0.53	38 (41.8%)	
Gender	Boys	24 (57.1%)	24 (49.0%)	0.44	48 (52.7%)	
	Girls	18 (42.9%)	25 (51.0%)		43 (47.3%)	
Immigration Status ^e	1 st generation	29 (69.0%)	17 (37.8%)	<0.01	46 (52.9%)	
	2 nd generation+	13 (31.0%)	28 (62.2%)		41 (47.1%)	
Language spoken at home ^e	French	14 (33.3%)	17 (37.8%)	0.67	31 (35.6%)	
	Other	28 (66.7%)	28 (62.2%)		56 (64.4%)	
PASE ^f	0 min	1 (2.4%)	49 (100.0%)	<0.01	50 (54.9%)	
	300 min	13 (31.0%)	0 (0.0%)		13 (14.3%)	
	420 min	28 (66.7%)	0 (0.0%)		28 (30.8%)	
Total		42 (100.0%)	49 (100.0%)		91 (100.0%)	

a) Significance level $p < 0.05$ are in bold; non-parametric Mann-Whitney test for independent samples for comparisons of means; Pearson's Chi-2 test for comparisons of percentages. b) Independent samples t-test c) Accelerometer wear time per day d) Overweight and obesity combined; e) Four missing data points; f) Number of minutes of PASE in the week at school (300 min = 1 day).

Table 2: Comparison of average MVPA in minutes per day^a.

Categories	Sub-categories	Groups					Total	
		PASE		CG		p-value	n	Mean (±)
		n	Mean (±)	n	Mean (±)			
MVPA in min/day, week and weekend 24h	Boys	23	99.24 (40.25)	18	113.88 (32.71)	0.17	41	105.67 (37.41)
	Girls	18	49.03 (23.18)	21	47.55 (28.48)	0.69	39	48.23 (25.84)
	Total	41	77.20 (90.00)	39	78.16 (45.03)	0.96	80	77.67 (43.18)
MVPA in min/day, school schedule	Boys	23	64.35 (20.83)	18	68.51 (17.17)	0.48	41	66.17 (19.18)
	Girls	18	41.42 (19.10)	21	31.73 (18.68)	0.13	39	36.20 (19.26)
	Total	41	54.28 (22.94)	39	48.71 (25.69)	0.36	80	51.56 (24.33)
MVPA in min/day, weekend 24h	Boys	23	80.98 (47.17)	18	69.53 (31.08)	0.36	41	75.95 (40.84)
	Girls	18	25.86 (14.07)	21	40.62 (39.77)	0.51	39	33.81 (31.25)
	Total	41	56.78 (45.55)	39	53.96 (38.44)	0.99	80	55.41 (41.99)

MVPA: Moderate to vigorous physical activity; a) Significance level $p < 0.05$ are in bold; non-parametric Mann-Whitney test for independent samples.

Average MVPA (minutes per day) in the IG and CG was similar for boys, girls, and the total sample, and did not differ significantly by immigration status or language spoken at home.

There was a large gender difference in the average time spent in MVPA across the entire sample. Over a 24-hour period, girls compared to boys were significantly less active per day (-57.43 min, 95% CI = -43.05 to -71.82; $p < 0.01$). Girls were also less active than boys over the course of the school day (-29.97 min; 95% CI = -21.41 to -38.53; $p < 0.01$).

Comparisons between a PASE day and a day with or without physical education

Figure 1 presents comparisons of the percent of time spent in MVPA on a school day between groups, for days when the IG had scheduled PASE, but no PE and the CG had or did not have scheduled PE.

Differences between groups are observed when the CG did not have scheduled PE. Notably, girls in the PASE group spent a significantly greater percentage of time in MVPA compared to girls in the CG (+4,30%; 95% CI = 1.93 to 6.68; $p < 0.01$) with a strong effect size ($d = 1.14$) (Appendix E). There was no significant difference among groups for boys.

There were no significant differences between groups when the CG had scheduled PE ($p = 0.10$). In other words, a school day when students are exposed to PASE may resemble a day when there was a PE class for CG students in terms of MVPA.

Comparisons across activity areas

Figure 2 presents comparisons between percent of time in MVPA for PASE periods (for IG only) versus that of different domains in a school day. The percent of time spent in MVPA in the classroom, PE, recess, and before/after school domains were calculated from the full sample (IG and CG combined).

The only comparison that was not significant was between PASE girls and recess girls ($p = 0.09$). In other words, a PASE period resembles recess in terms of MVPA production. We also find that students spent more time in MVPA when in PASE rather than in the regular classroom (+11.15%, 95% CI = 9.70 to 12.61; $p < 0.01$) with a strong effect size ($d = 3.63$) (Appendix F). The effect size of the PASE boys vs. before/after school boys was medium ($d = 0.60$) and all other effects sizes were strong (Appendix F).

Overall, PASE exposure contributed less to MVPA time than a PE class and recess (except for girls), but students were more active in PASE than in classroom instruction, before/after school, and on weekends.

Discussion

The purpose of this study was to measure MVPA of students with a migrant background exposed to PASE, and to compare results with a CG for a full day (24 hours), a school day, and between activity domains to better understand the role that outdoor learning plays in a student's PA patterns. Results show that the PASE program contributed significantly and with a strong effect size to physical activity in two areas. First, girls were more active on days when there was outdoor learning compared to regular days when no

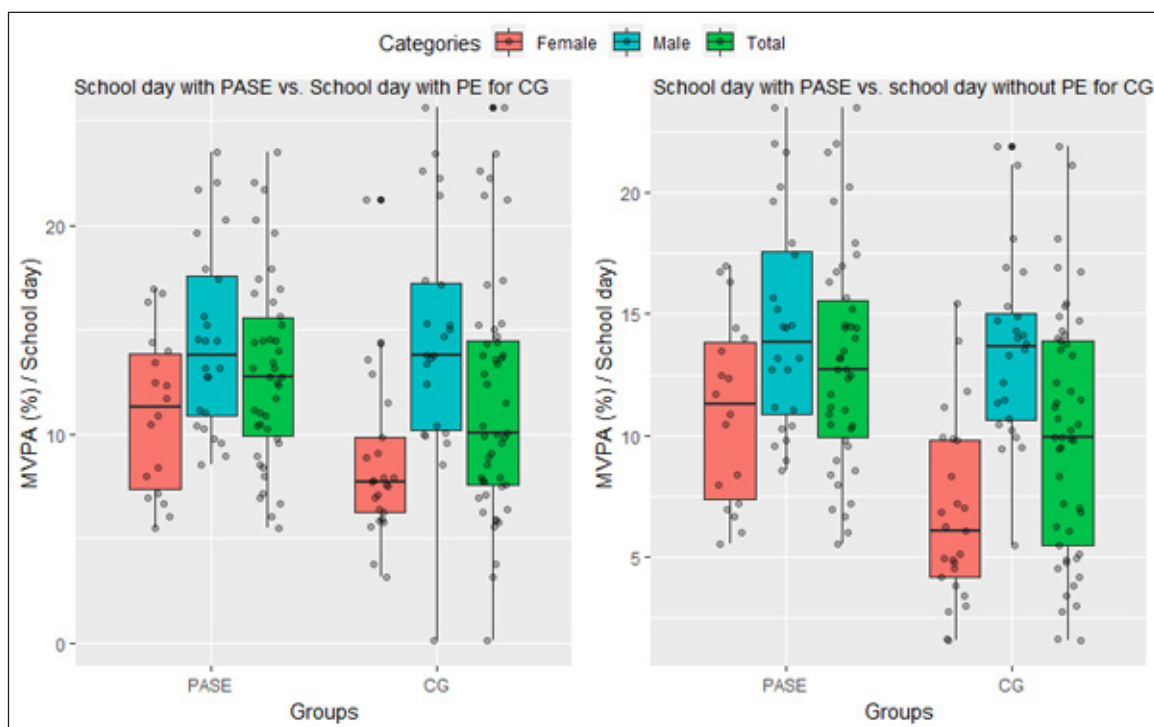


Figure 1: Comparisons of average percent of time spent in MVPA on school days.

MVPA: Moderate to vigorous physical activity; Significance level $p < 0.05$ identified by a letter; non-parametric Mann-Whitney test for independent samples for comparisons of means.

physical education classes were scheduled. Second, for both boys and girls, outdoor learning sessions were more physically active than those inside the classroom walls. In here we contextualize results in terms of migration background, gender differences, and with a focus on activity domains.

Effects of outdoor learning on PA patterns of children with a migrant background

The data in **Table 2** are consistent with the study by Schneller, Duncan, et al. (2017) of the Danish TEACHOUT research project, which also applied a 24-hour protocol. Compared to the Brazilian cohort, from the study conducted by da Silva et al. (2014), boys in our study were more active, but girls were less active (Appendix B). This may be because the Brazilian sample was representative of the population rather than targeting children with a migrant background. The larger gender gap in our study may reflect a population with migrant background.

Table 2 shows that the school environment is very important for the practice of MVPA. During their 7-hour school day, students participate in almost as much MVPA as on a full weekend day. Considering that the majority of school activities are sedentary, the physically active moments of a school day take on special importance. Nielsen et al. (2013) observed that children with a migrant background in Denmark are more active in unorganized activities outside of the school schedule, which tends to level out differences with non-immigrant children, who are more present in organized sports. However, our study instead shows that MVPA was lower during unorganized periods (e.g., weekend, before/after school). In the urban context of our study, it could be that children play less freely outside their homes, which would explain the lower MVPA time in these periods. The study by Conrad et al. (2013) that identified that German children with a migrant background spend 20 minutes more in MVPA at home and 15 minutes less outside also seems to support this hypothesis.

Effects of PASE by gender

The study by Schneller, Duncan, et al. (2017) of the Danish TEACHOUT research project reported that boys in their IG practiced more MVPA than boys in their CG. This difference may stem from the fact that PASE teachers' practices are likely different from Scandinavian and Finnish teachers' practices. For example, Romar et al. (2018) explain that *Udeskole* practice includes time where students are free to move around, whether during breaks or in field investigations. Thus, boys who have a stronger intrinsic motivation to move (Rosenfeld, 2017) are free to reach MVPA thresholds more regularly in *Udeskole*. For PASE teachers, activities were more directed, which may limit boys' movement. This can also be seen in the different activity areas (**Figure 2**) where we see that boys are much more active when activities are not led by an adult such as during recess. This phenomenon seems to be reversed for girls.

The gender gap in average daily minutes of MVPA in this study was 52 min (**Table 2**). A similar gender gap has been reported many times in the literature (Colley et al., 2017; Guthold et al., 2019). However, it appears to be larger for children with a migrant background, and less marked in adolescents (Jekauc et al., 2012). When evaluating the specific domains of the school day in this study, we see that PE is particularly helpful in closing the gap between boys and girls (**Figure 2**). Rosenfeld (2017) notes that for boys, motivation to move is primarily intrinsic. As a result, they do not need a PE class to get more active. For girls, a mix of intrinsic and extrinsic factors tend to guide their PA practice. Programs that emphasize the social dimension of physical activity, and that provide an enjoyable environment, can therefore promote PA among girls. This clarification may explain the significant differences in girls between a school day with PASE and CG school days without PE (**Figure 1**). In the study of activity domains, we also find that PASE periods generate more MVPA than unorganized periods such as before/after school and on weekends (**Figure 2**). Compared to recess, PASE provided an equivalent picture. Because PASE periods included many adult-facilitated activities and were conducted in a stimulating natural setting, this practice likely provides the support needed to promote girls' MVPA.

Effects of PASE in school activity domains

Our study shows no difference in comparisons between the PASE group and CG when analyzed over the full 24-hour week or over school hours (**Table 2**). It should be kept in mind, however, that the main goal of PASE is learning the curriculum content and not PA, which represents a secondary or indirect goal. Overall, the contribution of PASE over the entire week in a 24-hour protocol is too slight to make a significant difference and the evaluation must be carried out on segments of the day to see effects.

Specifically, the percent of time spent in MVPA increases by 11.15% when in PASE than when sitting in class (**Figure 2**). This contribution is strong enough to show a significant difference when comparing a day that includes PASE with a day when students are only in class, i.e., without PE (**Figure 1**).

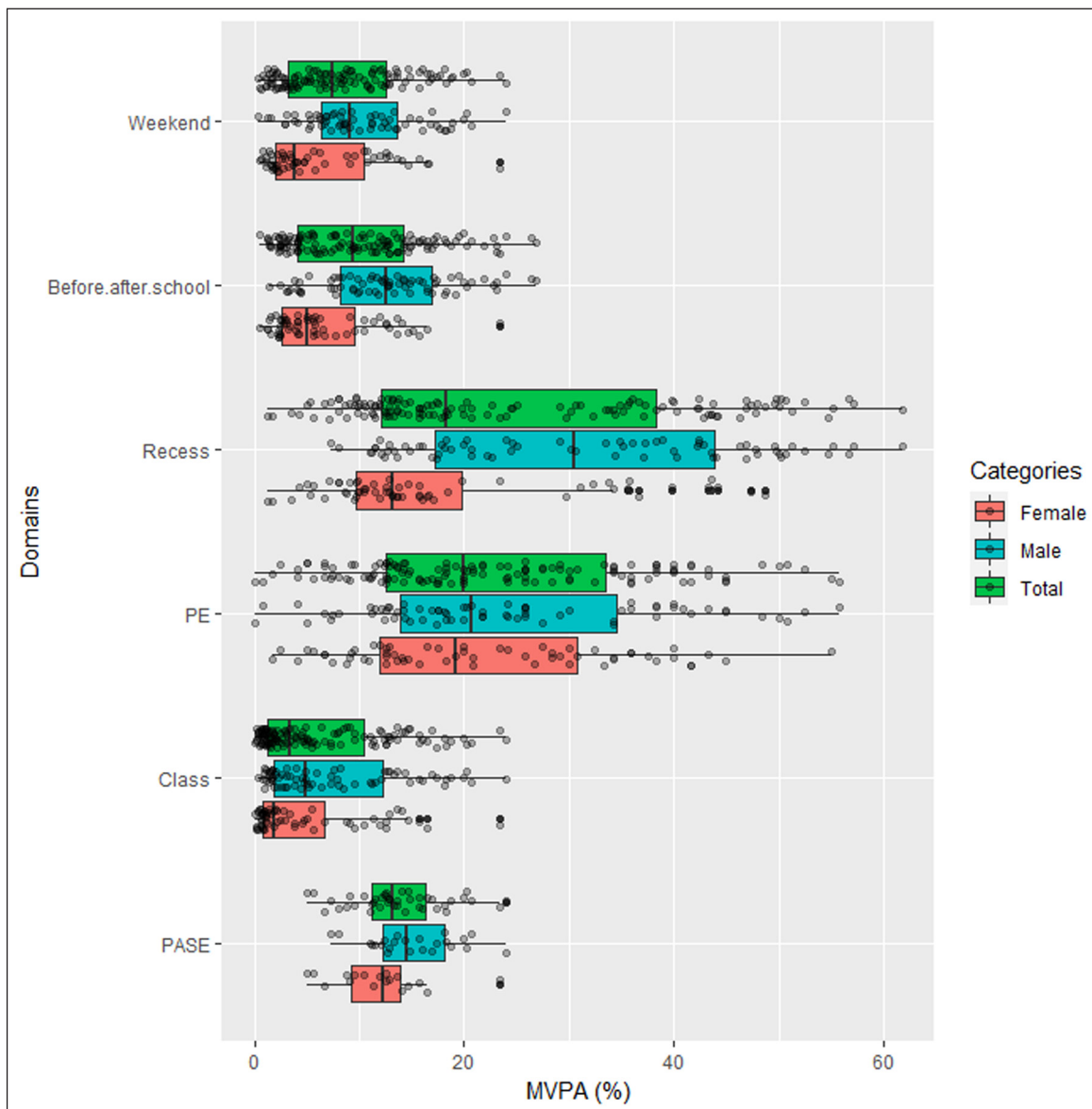


Figure 2: Comparisons of average proportions of time spent in PASE by domain.

MVPA: Moderate to vigorous physical activity. Significance level $p < 0.05$; Non-significant differences identified by a letter; Non-parametric Mann-Whitney test for independent samples for comparisons of means.

As expected, PE contributes to a large percentage of students' MVPA. **Figure 2** shows that, on average, students spend 27.07% of the PE period in MVPA. However, since the school schedule allows for only two 60-minute periods of PE per week, other sources of active time are needed, such as recess. Recess represents the most important period for MVPA for boys. However, girls' levels of MVPA are only half that of boys during recess. For girls, finding other ways to promote MVPA is thus important.

In our study, a field trip was scheduled for Thursday. It included a two-hour public transportation and a rabaska activity. During the rest of the week, two groups also did academic activities in the schoolyard for 120 min per student. Thus, we compared the two types of outdoor classes to test whether the Thursday field trip had a disproportionate effect on overall PA in the PASE group (Appendix C). Contrary to our hypothesis, there was no significant difference between the two types of outdoor classes; the long transit time likely explains this lack of difference. PA during rabaska, like cycling or swimming, is also less well captured by accelerometers (Troiano et al., 2014). However, overall, long travel times likely lessened the effects of PASE on student PA, a point that should be considered when planning activities.

The PASE teacher team also scheduled a short 10- to 15-minute walk to start the day, which they called "getting off to a good start." This activity was repeated two or three times a week depending on the group. In

our study, this short period was captured as a time included in the class period, since it was not long enough to represent outdoor learning. Therefore, for indoor class time, the PASE group had 1.73% more MVPAs than the CG group (Appendix D). Teachers who become accustomed to teaching outdoors may be more comfortable with planning more active activities, which may be an indirect effect of PASE.

The comparison between the PASE and CG PE periods (Appendix D) shows that the CG was much more active than the PASE group. The teachers explained this observation by the fact that one period in PE was used to prepare the students for their rabaska outing. During this period, students sat miming the action of paddling in sync with their peers. Therefore, it is possible that the accelerometers detected less movement during this period. This may be a relevant point to consider in assessments of outdoor learning programs, as preparatory activities may be required prior to outings, modulating MVPA production during certain periods.

Limitations

To the best of our knowledge, this study is the first of its kind in Canada that focuses specifically on students with a migrant background. In this context, the use of accelerometers can be considered as a strength (Moore et al., 2007). However, given the difference in immigration status between the two groups, it would have been relevant to control for the level of parental PA for each group.

Also, the purpose of this outdoor learning program is directly related to academic content. Therefore, it is not surprising to see only minor improvements in students' participation in MVPA. Analyses of light PA during these periods will provide a more complete perspective of the effects of outdoor learning on students' physical inactivity, especially in a school context.

In addition, several barriers to outdoor play have been identified in the literature, including safety issues related to traffic and weather conditions. The PASE context faces the same barriers and provides opportunities for teachers to address these elements with their students, which might indirectly reinforce outdoor play. Longitudinal studies would provide more insight into these effects. The study design originally called for multiple data collections throughout the year to capture these effects. Unfortunately, the COVID-19 pandemic caused schools to close, preventing subsequent accelerometry data collection. A pre- and post-program follow-up study would provide a better understanding of long-term program effects.

We also observed that, in this case, most of the IG students do not live in the same neighborhood as the school. As a result, most must travel by school bus. CG students remain in the same neighborhood, which provides more opportunities for active travel. This may have affected the comparisons between groups for the before/after and full week assessment.

Finally, given the relatively small sample size, further studies are needed to better contextualize and generalize the results.

Conclusion

This quasi-experimental study provides some insights into an outdoor learning program implemented and measured in a Quebec context. First, when analyzing the effect of PASE over a full day, this approach appears to promote a higher average rate of MVPA for girls and not for boys compared to a day without PE. In contrast, the full week analysis does not show significant differences between groups. Second, by isolating activity domains, we find that students spend significantly more time in MVPA when they are in PASE than in the regular classroom. Thus, outdoor learning appears to be an educational approach that can help students with a migrant background reach recommended MVPA levels. Moreover, it may have a long-term effect by educating students to spend time outdoors.

Finally, future studies should examine best practices to better train teachers who are interested in implementing this type of program and who want their students to be more active.

Additional File

The additional file for this article can be found as follows:

- **Appendices.** Appendix A–F. DOI: <https://doi.org/10.5334/paah.133.s1>

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Competing Interests

The authors have no competing interests to declare.

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Authors Contributions

YL participated in the design of the study and data collection, performed statistical analysis, and drafted the manuscript. KD, PB and TG participated in the design of the study and helped draft the manuscript. All authors have read and approved the final manuscript.

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