

# When the world stops: The impact of COVID-19 on physical activity and physical literacy

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## Short Report

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# Abstract

Matched pre-during pandemic comparison (160 children) revealed a substantial reduction in physical activity ( $p < 0.001$ ,  $r_{rb} = 0.83$ ), environmental participation ( $p = 0.046$ ,  $r_{rb} = 0.16$ ), movement valuation ( $p < 0.001$ ,  $r_{rb} = 0.61$ ), and parent perceptions of children's physical literacy ( $p < 0.001$ ,  $r_{rb} = 0.56$ ). Examining physical activity trajectories, higher pre-pandemic physical literacy protected children from pandemic related activity decline. Emerging from the pandemic, interventions should address children's eroded belief in movement, and consider physical literacy levels of children in individualizing movement opportunities for restoration of activity levels.

## Novelty

- A substantial reduction in physical activity was associated with children who had lower physical literacy and resulted in reductions in children's valuation of movement.

## Introduction

There exist various physical literacy (PL) definitions, often dependent on the circumstances in which PL is applied, the majority of which include a holistic combination of affective (motivation and confidence), physical (competence), cognitive (knowledge and understanding), and behavioural (active participation) components (Edwards et al. 2017; Tremblay et al. 2018). For this study, PL will be defined based on Canada's 2015 consensus statement: "physical literacy is the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (Tremblay et al., 2018, p.1). Given the low pre-pandemic physical activity (PA) levels, with less than half of Canadian children meeting the recommendations of 60 minutes of moderate to vigorous PA per day (Roberts et al. 2017), the gradual decline in PA as children age (Farooq et al. 2018), and the importance of the development of PL for well-being (Cairney et al. 2019), the current pandemic poses an additional threat to the development of physically literate and physically active children. Upon the classification of COVID-19 as a global pandemic in March 2020, Canadian children's movement opportunities were greatly reduced with the closure of spaces including schools, childcare facilities, fitness/recreation centres, and playgrounds. In Canada-wide cross-sectional studies, children self-reported they were less physically active, more sedentary, and spent less time outdoors due to the pandemic (Moore et al. 2020, 2021); similar findings have been reported globally (Tison et al. 2020).

Access to multiple environments and type of environment play important roles in levels of PA participation (Sallis et al. 2016; Dudley et al. 2017). During the early months of the pandemic, most government restrictions and guidelines enforced shelter-in-place orders, accompanied by the closure of many spaces where children typically move. As one of those spaces, schools shifted rapidly to online learning both nationally and globally, highlighting another aspect of children's lives that was significantly altered. Further, the loss of the school as a location where the majority of children's movement takes place (vander Ploeg et al. 2012) (e.g., recess, physical education, intramurals) resulted in early negative

effects on movement behaviours (Moore et al. 2020; Mitra et al. 2020). Thus, the varied movement experiences and opportunities for positive challenge that are critical to PL development (Jefferies 2020) were substantially diminished. Cairney and colleague's framework supports the relationship between PA and PL, and the connection to health outcomes (Cairney et al. 2019). As such, it is conceivable and can be postulated that those children with well-developed PL may be protected from negative pandemic effects. In this way, children with higher levels of PL may have enhanced movement agency relative to their less physically literate peers (Gurdal and Sorbring 2018).

To date, little is known regarding how the pandemic has influenced PA levels of children, and there is an absence of data on PL. This study employed a pre/during pandemic repeated measures design to examine the impact of the pandemic restrictions on PA and PL.

## **Methods**

### **Participants**

Recruitment of participating children and parents took place prior to the beginning of COVID-19. Ethical approval was obtained from the University of Saskatchewan's Behavioural Research Ethics Board (BEH 17-455). Parents/guardians provided written informed consent for their child and themselves to participate, and written child assent was obtained.

### **Pandemic Context**

Pre-pandemic measures were collected in May/June of 2019, and pandemic measures were collected during the same weeks of May/June 2020. The pandemic data set was collected during phase two of reopening in the province of Saskatchewan, which included gradual reopening of retail and personal services. At the time of follow-up data collection, schools, childcare facilities, fitness/recreation centres, and playgrounds remained closed as they had been since the onset of the pandemic in March 2020.

### **Measurements**

PA was assessed by the validated, Physical Activity Questionnaire for Children (PAQ-C) seven-day recall (Kowalski et al. 2004; Janz et al. 2008), and PL using the validated PLAYself (Jefferies et al. 2020) and PLAYparent tools (Sport for Life 2013).

For the PAQ-C, a validated threshold (Voss et al. 2017) was used to assess whether children were above or below the Canadian PA guidelines based on minutes of moderate to vigorous activity (Roberts et al. 2017). Further, this threshold was used to create four categories of PA trajectories from pre pandemic to during the pandemic; HH = meeting the PA guidelines at both times, LL = not meeting at both times, HL = shifted from meeting to not, and LH = shifted from not meeting to meeting.

PLAYself includes three self-assessed unidimensionally distinct subscales; environmental participation (6 items, maximum possible score = 30), self-description of PL (12 items, maximum possible score = 48),

and valuing literacies (9 items, maximum possible score = 36) (Jefferies et al. 2020). PLAYparent is a 20-question survey with sections assessing parent perceptions of competence, confidence, understanding, and environmental participation related to their child's movement behaviours, maximum possible score = 57 (Sport for Life 2013).

## Statistical analyses

Descriptive statistics were computed and are reported as Median (IQR). One-sided Wilcoxon signed-rank tests were employed for paired pre to during pandemic measures. Sex differences were analyzed using one-sided Mann-Whitney U tests. Effect sizes were calculated using the non-parametric data method and reported as rank biserial correlation ( $r_{rb}$ ). All analyses were performed using Jamovi (version 1.2.27.0) and significance was set at  $p < 0.05$ .

## Results

A sample of 160 children (83 female and 77 male) with an pre-pandemic average age of  $11.1 \pm 1.39$  years (range = 8 to 14 years) completed PAQ-C and PLAYself, and 182 parents/guardians completed PLAYparent surveys, from three communities in Saskatchewan, Canada. Table 1 reports the pre-pandemic to pandemic PA and PL measures. Using the validated PAQ-C threshold, 28% of children did not meet the PA guidelines pre-pandemic, while 66% fell below threshold during the pandemic. Further, using an absolute difference in PAQ-C scores, 85% of children demonstrated a decrease in PA levels from the pre-pandemic timepoint. There was no significant difference in the change in any PA or PL variables by sex ( $p = 0.227$  to  $0.919$ ).

A significant overall reduction in the valuation of literacies subscale of PLAYself was found (Table 1). Closer inspection of the literacies components revealed significantly decreased valuation of movement (PL) in all three contexts: at school ( $p < 0.001$ ,  $r_{rb} = 0.581$ ), at home ( $p < 0.001$ ,  $r_{rb} = 0.527$ ), friends ( $p < 0.001$ ,  $r_{rb} = 0.973$ ). Whereas the valuation of literacy ( $p = 0.012$ ,  $r_{rb} = 0.305$ ) and numeracy ( $p < 0.001$ ,  $r_{rb} = 0.433$ ) only diminished from pre-pandemic to pandemic in the school context. The valuation of PL was significantly greater than literacy and numeracy in all contexts, even during the pandemic. Further, context specific devaluations (i.e., school > home > with friends) were apparent for literacy ( $p < 0.001$ ,  $r_{rb} = 1.00$ ) and numeracy ( $p < 0.001$ ,  $r_{rb} = 1.00$ ), whereas there were no context specific devaluation gradients for PL (according to Kruskal-Wallis analysis).

INSERT TABLE 1 HERE

## Physical Activity Trajectories

Table 2 reports the child's PL sub-scales categorized on the participant's pre-pandemic to pandemic PA trajectories (HH, HL, LL). Those children who remained above the PA threshold into the pandemic (HH), were associated with the highest PL levels in all three subscales. Significant gradients in PL subscales were evident from HH to HL to LL. The parental assessment of children's PL also revealed a statistically

significant gradient that paralleled that observed for the children. There were no differences (Chi square analysis) in the proportion of boys and girls within each PA trajectory. Participants who went from below to above the threshold (LH) were not included in the analysis due to low sample size (5.7%).

**INSERT TABLE 2 HERE**

## **Discussion**

This novel study assessed the impact of COVID-19 on PA and PL using a repeated measures design. This study revealed substantial reductions in PA impacting over 85% of the children, along with an increase of 38% in the number of children not meeting PA guidelines, as a result of the pandemic. These findings, based upon repeated measures align with the emerging cross-sectional data (Tison et al. 2020; Moore et al. 2020, 2021). Since these children aged a year, it is important to consider the age-related effect on PA. The reductions in PA in this study (-0.8 on PAQ-C) far exceed those associated with previously reported age-related decreases in PA (-0.04) in an age-matched cohort using the same instrument (Thompson et al. 2003). This reflects that the vast majority of PA reduction observed in the current cohort is related to the pandemic. We further explored the trend of declining PA with age in more recent publications (Farooq et al. 2018; Pate et al. 2022) and although all demonstrate declines using different measures of PA, the decrease from one year to the next is gradual, and would not be reflective of a decrease of 1 point on a 5 point scale within one year as seen in our study.

The child's self-description of PL for the whole sample did not change with the pandemic (Table 1), however, when participants were categorized into pre-pandemic to pandemic PA trajectories (HH, HL, LL), a PL gradient was observed for all PL subscales, as well as the parental assessment of the child's PL. This association between PA trajectories and PL are consistent with the PL to PA to health conceptual framework (Cairney et al. 2019), and support the postulation of PL as a putative protective factor. Plausible explanations for this finding are that children with higher PL may have exhibited greater agency for their own movement behaviours (Gurdal and Sorbring 2018), or that the parents of this specific sub-group offered movement opportunities for their children during the pandemic. Both pre-pandemic and pandemic related data indicate that parental support is critical to a child's movement behaviour, as PA levels are higher in individuals with support from parents (Rhodes et al. 2019; Moore et al. 2020, 2021).

Further, since distinct PL for PA trajectory subgroups were identified, and consistent with trajectories identified in motor competence literature (Robinson et al. 2015), this would support the need for individualized strategies to re-engage children dependent on the category in which they fall. This finding is consistent with that reported by Bremer et al. (2020) showing a relationship between PL and PA. Interestingly, for developing a post-pandemic recovery strategy, these results point to the use of the intrinsic valuation inherent in PL (Cairney et al. 2019, Stuckey et al. 2021), rather than instrumental valuation PA (meeting guidelines to avoid non-communicable disease), as PL necessarily requires an individualized or perhaps sub-group based approach consistent with the sub-groups reported here.

One novel but disturbing finding was that the impact of the pandemic was not restricted solely to a behavioural change (PA and PL), but that decreased PA was concomitant with a reduced valuation of movement across three movement contexts (school, family, friends). First, this suggests that remediation efforts should take place not only in schools, but also in community and at home. This is a very important consideration in the approaches used to recover PA levels of children post-pandemic, especially since the children with both HH and HL trajectories had reduced valuation of movement. Second, pandemic restrictions could have contributed to movement challenges for children, but messaging from government, parents, and others may have reinforced a lesser value of movement during this time. Perhaps there is a need to redirect funds to secure new ways for children to move with adequate safety in pandemic, recovery, and post-pandemic times (Lawson Foundation 2020).

## Strengths and Limitations

Although there is increased power of the “within subjects” design utilized in this study, the second measurement was obtained at one, relatively early time point, and one specific region of lockdown during the pandemic, and, as such the subsequent impact of an additional year of restrictions needs to be considered, as well as the moderate variation of pandemic restrictions on children worldwide. Further, although this study examined children to 8 to 14 years of age, the mean age represents a pre-pubescent sample, and the extrapolation to youth in general is cautioned. This study is also limited by the utilization of a self-reported measure of PA, as this may mis-represent the actual PA levels of participants. Typically, self-reported PA is higher than actual levels, so the significant drop in PA observed may be more severe if measured objectively.

## Conclusion

In conclusion, this study found that children’s PA and PL were significantly negatively impacted by the pandemic as reported by children and their parents. Additionally, the PL gradient present dependent on PA trajectories may suggest protective effects to PA change, but these effects need further investigation. Strategic actions to mitigate these changes and reverse the trend are critical, and role models should engage in a coordinated effort to construct positive movement challenges based on the PL engine (Jefferies 2020; Stuckey et al. 2021), so as to re-establish and enhance positive movement behaviours and beliefs (Jefferies 2020). This study provides PA and PL evidence to support decision makers in developing mitigation strategies for the pandemic that are appropriate to children individually, as this study found that not all children were impacted by the pandemic in the same way.

## Declarations

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**Conflict of interest statement:** The authors declare there are no competing interests.

**Data availability statement:** The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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## Tables 1-2

Tables 1-2 are not available with this version.