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The Impact of the COVID-19 Pandemic on Childhood Physical Activity: Insight into Canadian Children's Experiences

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Abstract

Research on the impact of the 2019 novel coronavirus (COVID-19) pandemic on physical activity in Canadian children is mounting. The objective of this study was to describe children's physical activity within the first four months of the pandemic using quantitative and qualitative methods. Sixteen children aged 10 to 13 years and 11 parents (six parent-child dyads and four parent-child-child triads) participated in this study. Data sources included demographic surveys, seven-day physical activity journals, and separate child and parent interviews. The children demonstrated a strong preference for play-based physical activity, which most often occurred with others (i.e., coactivity). The children's seven-day physical activity journals revealed that adherence to the Canadian Society for Exercise Physiology's (CSEP) recommendation for 60 minutes of daily moderate to vigorous physical activity (MVPA) was below pre-pandemic provincial levels. According to the children and their parents, reduced physical activity was largely due to limited opportunities for play-based coactivity as a result of public health restrictions.

Keywords: Childhood physical activity; coactivity; COVID-19; public health restrictions

Résumé

Les recherches sur l'influence de la pandémie de COVID-19 sur l'activité physique des enfants canadiens sont de plus en plus nombreuses. L'objectif de la présente recherche était de décrire l'activité physique des enfants durant les quatre premiers mois de la pandémie à l'aide de techniques quantitative et qualitative. Seize enfants âgés de 10 à 13 ans et 11 parents ont participé à la recherche. De nombreuses données ont été utilisées : des données démographiques, un journal d'activité physique de sept jours et des entrevues individuelles avec les parents et les enfants. Les enfants ont affirmé préférer les activités physiques sous forme de « jeu libre », le plus souvent avec des pairs. Les journaux des enfants ont révélé que l'adhésion à la recommandation de la Société canadienne de physiologie de l'exercice (SCPE) de 60 minutes quotidiennes d'activité physique modérée ou vigoureuse était inférieure au niveau pré-pandémique provincial. Selon les enfants et leurs parents, la réduction de l'activité physique est en grande partie due aux occasions limitées de jeu libre avec des pairs suite aux restrictions sanitaires de la santé publique.

Mots-clés : activité physique des enfants; activité avec des pairs; COVID–19; restrictions sanitaires de la santé publique

Introduction

Physical activity plays an important role in children's growth and development. Compared to their physically inactive counterparts, physically active children enjoy greater physical and psychosocial wellbeing (Carson et al., 2017; Janssen & Leblanc, 2010). Children who regularly engage in moderate to vigorous physical activity (MVPA) are less likely to suffer from mental illness (Bailey et al., 2018) and several studies suggest that regular engagement improves cognitive function (e.g., Ardoy et al., 2014; Wassenaar et al., 2019). From a behavioural perspective, children who form healthy physical activity habits tend to continue these habits into adulthood (Ladwig et al., 2018; Whitehead, 2010a).

To promote healthy growth and development, the Canadian Society for Exercise Physiology ([CSEP] 2018) recommends that children accumulate at least 60 minutes of daily MVPA. Unfortunately, several longitudinal studies suggest that Canadian children are not meeting this recommendation. Although guideline adherence varies by study, at best, just over one-third of Canadian children accumulate 60 minutes of daily MVPA (Cameron et al., 2016; Colley et al., 2017).

The ongoing 2019 novel coronavirus (COVID-19) pandemic has significantly disrupted the lives of Canadian children. A recent study by Moore and colleagues (2020) investigated the impact of the pandemic on physical activity behaviours of Canadian children and youth. They reported a significant reduction in already low adherence, with less than 20% of children and youth meeting CSEP's recommendation for 60 minutes of daily MVPA in the first month after the World Health Organization had declared COVID-19 a global pandemic (World Health Organization, 2020).

Given the emerging research on the negative impact of the COVID-19 pandemic, the aim of this study was to solicit input directly from children and their parents. The approach was to first quantify pandemic physical activity levels among participating children and then learn directly from the children and their parents how the pandemic has impacted their physical activity. Special emphasis was placed on learning about preferred modes of physical activity and understanding the mechanisms by which the pandemic influenced physical activity.

Methodology

To investigate how the COVID-19 pandemic has impacted physical activity in children, this study employed a pluralistic approach. Pluralism is eclectic in its reliance on multiple research paradigms (Johnson, 2017). Pluralism does not attempt to favor one particular worldview over another, instead it attempts to honor each equally by integrating their ontological and epistemological assumptions (Creswell & Plano-Clark, 2017).

In the context of this study, the focus was inwards on the experiences of the children and their parents. The goal was to describe the impact of the COVID-19 pandemic on their physical activity by way of quantitative descriptive statistics and qualitative journaling and interviewing. Post-positivistic assumptions on mean and standard deviation (Hoy & Adams, 2016) informed the quantitative aspects whereas constructivist assumptions on the importance of the social environment in constructing behaviour (Gall et al., 2007) informed the qualitative aspects. No emphasis was placed on establishing statistical generalizability; instead, the priority was to situate the children's physical activity experiences related to the pandemic within existing research (i.e., analytical generalizability, Yin, 2017).

Participants

Sixteen middle-aged children (seven boys, nine girls; mean age of 12 ± 1 years) and 11 parents (three mothers, eight fathers; mean age of 42 ± 4 years) participated in this study. The participants belonged to 11 different families (six parent-child dyads and four parent-child-child triads). Children aged 10 to 13 years were recruited for this study because this age range represents an important window in the development of physical activity behaviours (Whitehead, 2010b). Middle-aged children also tend to be able to recall details related to their experiences and possess the necessary verbal skills to articulate their thoughts in interview settings (Docherty & Sandelowski, 1999; Ponizovsky-Bergelson et al., 2019).

Participants were recruited through recuring social media advertising campaigns until satisfactory data saturation and participant diversity was achieved. With respect to data saturation, the plan was to launch as many campaigns as needed until a point was reached where no new codes or relationships between codes emerged (Marshall & Rossman, 2014). To ensure that a diverse array of perceptions and experiences related to childhood physical activity were gathered, recruitment campaigns were to be repeated until multiple children across different physical activity levels, gender, and family after-tax income had been recruited. Sufficient data saturation and participant diversity (seven children met and nine children did not meet CSEP's recommendation for 60 minutes of daily MVPA; nine girls and seven boys; six children above and eight children below Canadian median family after-tax income) was reached after the first social media advertising campaign. All the parents (n=11) and children (n=16) who were recruited in the campaign completed the study in full.

Setting

This study was conducted in a medium-sized city in western Canada. The city is approximately 250 kilometers away from a large urban centre but is otherwise surrounded by rural areas. The children and parents completed all study requirements (see data collection section) as the provincial public health restrictions related to the COVID-19 pandemic moved from Stage 1 to Stage 2 (June and July of 2020). Recruitment for the study occurred at the beginning of Stage 1.

During Stage 1, day camps and summer schools resumed operations with occupancy limits and playgrounds reopened. With the start of Stage 2, public health authorities permitted team sports to resume practices and games; fitness and sport centres, including gyms and arenas resumed operations with occupancy limits; and, public health authorities instituted more flexible cohort guidelines, including multiple household cohorts of a maximum of 15 people, and a 50-player region-only cohort limit for competitive sports.

Prior to Stage 1, the province was in a state of emergency due to the emerging effects of the COVID-19 pandemic. During this time, public health authorities put in place strong public health restrictions to manage COVID-19. These restrictions included school and facility closures and organized sport cancellations. Throughout the state of emergency, Stage 1, and Stage 2, public health authorities mandated two meters of physical distancing. At different time-points, several jurisdictions in the province also implemented bylaws that mandated masks be worn in public indoor spaces.

Data Collection

The primary investigator, who is also the primary author collected and analyzed all the study's data. Before any data was collected parents provided written consent for their child or children's participation as well as their own participation. The children provided written assent for their participation. The parents returned the consent and assent forms by e-mail. Once consent and

assent was obtained, the demographic surveys were e-mailed to the parents. The survey questions asked the parents to provide basic information such as family after-tax income, the children's gender, and the children's pre-pandemic sport participation.

After the demographic surveys were e-mailed back, physical activity journals and pedometers (Multifunctional Sport Pedometer, Pingko, inc.) were mailed to the children. They were instructed to complete daily journal entries for seven days. Each entry contained a space for the children to write down the duration and the type of physical activity along with their daily steps, which they measured using the provided pedometers. The children were instructed to wear the pedometers for seven consecutive days and record the daily steps in their physical activity journal at the end of each day. The seven-day step-count protocol was consistent with the valid and reliable Canadian Assessment for Physical Literacy (Francis et al., 2016; Longmuir et al., 2015). The physical activity journals also included a space where children were asked to write down how physical activity made them feel and who (if anyone) they were physically active with. Once the children completed the journals, the parents scanned them and e-mailed them back.

Upon completion of the physical activity journals, the children and parents were invited to a 30- to 45-minute interview. The child and parent interviews were conducted separately, but as recommended by the institutional research ethics board the parents were allowed to attend their children's interviews if they wished. Two of the 11 parents were present in their children's interviews. The interview format did not encompass a predefined question sequence; instead, the interview conversation was guided by the entries from the physical activity journals (i.e., guided topical interview style [Gall et al., 2007; Marshall & Rossman, 2014]). The interview focused on the activities documented in the physical activity journals along with the children and parents' experiences during the first four months of the COVID-19 pandemic. To comply with public health restrictions and ensure the safety of the participants, the interviews were conducted using Zoom's videoconferencing platform (Zoom Video Communications, Inc.). The Zoom videoconferencing platform is as an effective tool for collecting qualitative data (Archibald et al., 2019). The platform is easy to use, accessible, and has embedded data management features and security options.

Before starting the interviews, the children and their parents were reminded of their right to withdraw at any point, without repercussions. They were also made aware that there were no right or wrong answers to the interview questions and that the primary investigator was merely interested in hearing their thoughts. The Zoom-embedded recording feature was used to record the interviews.

Ethics

Prior to commencing this study, ethical approval from the relevant institutional research ethics board was obtained. The research ethics board deemed the study appropriate, safe, and consistent with the most current version of the Tri-Council Policy for the Ethical Conduct of Research Involving Humans.

Data Analysis

Demographic, daily-step, and physical activity type data from the demographic surveys and physical activity journals were copied into an Excel spreadsheet (Microsoft Corporation, Microsoft Office 2016). Excel was utilized to group parents and children based on gender and family after-tax income, and to calculate the children's average daily steps. Tudor-Locke and colleagues' (2011) conversion (60 minutes of daily MVPA guideline adherence by age-gender: ≥13,000 steps/day for 6–11-year-old boys; ≥11,000 steps/day for 6–11-year-old girls, and ≥10,000 steps/day for 12–19-year-olds) was referenced to determine whether the children's daily steps were

sufficient to meet CSEP's recommendation for 60 minutes of daily MVPA. Self-reported physical activity type was organized by total cumulative minutes for the seven-day journaling period.

The data streams were analyzed in the same order as the interviews (i.e., by family and always ending with the parents). The analytic approach outlined by Marshall & Rossman (2014) served as a framework for analyzing the interview transcripts and text from the open-ended physical activity journal entries. The first phase consisted of the transcription of the Zoom recorded interview audio and the open-ended portion of the physical activity journals. Zoom contains a feature that allows users to record audio, video, and chat text. Users can then download each file separately to a computer or stream them from the browser. To transcribe the Zoom audio file to text, the audio was played at a reduced speed and the text was entered into Word (Microsoft Corporation, Microsoft Office 2016). The audio was transcribed word-for-word and included pauses, and fillers (e.g., um, ah, like). After transcription, the primary investigator read and re-read the transcripts to establish familiarity, document first impressions, and generate an initial code framework.

The coding process started with first organizing all the transcripts into family frameworks that consisted of codes from the initial code framework. The codes within each family were then revisited and new emerging codes and relationships between codes were sought. The same process was repeated with the remaining transcripts on a family-by-family basis. The codes reflected statements that struck the primary investigator as important with respect to physical activity, the children and parents repeated in several places, or the children and parents explicitly highlighted as important.

The codes and relationships between codes were then re-evaluated and linked within a thematic map. No substantive changes to the codes or the relationships between codes were made during this phase; the focus was instead on consolidating codes into interconnected categories and themes.

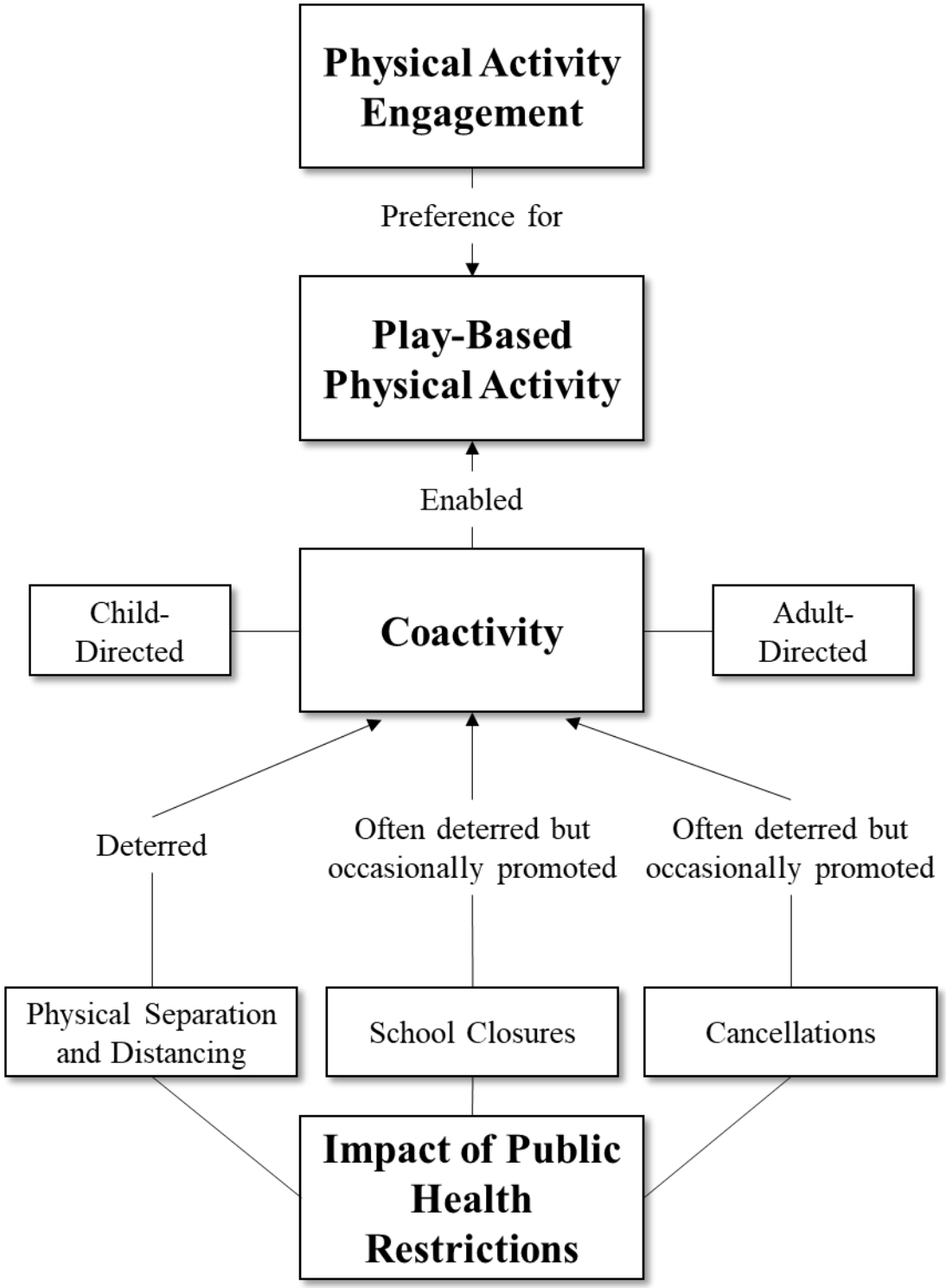
Trustworthiness

Triangulation, member-checks, and peer-debriefs were used to establish trustworthiness (Lincoln & Guba, 1985). Child and parent data was processed by way of triangulating three different streams (i.e., demographic surveys, physical activity journals, and interviews). The primary investigator conducted member-checks by sending children and their parents a detailed description of the interpretation so that they could determine whether the primary investigator accurately and sufficiently captured their perceptions and experiences. A request from one parent was received to correct an error in the date and time of their child's youth group activity; however, the correction did not impact the results of the thematic analysis. During and after the data analysis, the primary investigator shared their interpretations with their doctoral supervisor, who is also the secondary author of this publication. The peer-debriefs did not yield any conflicting information or interpretations that were deemed to limit the study's trustworthiness.

Results

The results are broken down into quantitative and qualitative data streams. The quantitative stream consists of step-count data and physical activity entries from the physical activity journals, as well as sport participation history from the demographic surveys. The results from the thematic analysis, which incorporates the open-ended responses from the physical activity journal and the interview transcripts, constitute the qualitative stream. The combined results of the quantitative and qualitative streams are summarized in Figure 1.

Figure 1.
Combined Summary of Quantitative and Qualitative Data Streams



Quantitative Data

Self-reported data from the physical activity journals revealed that the children (n = 16) took an average of 10,167 ± 5,086 daily steps during the seven-day journaling period. The seven boys took an average of 13,111 ± 5,357 daily steps and the nine girls took an average of 7,877 ± 3,672 daily steps. Table 1 breaks down the children's adherence to CSEP's recommendation for 60 minutes of daily MVPA by gender.

The physical activity entries from the physical activity journals highlighted that outdoor physical activity was the most popular among the children who participated in the study. In terms of average weekly minutes per single activity, children spent most of their time (383 ± 403 minutes) playing outdoors (e.g., tag games, trampoline, pick-up soccer). Average weekly minutes spent across different physical activities are presented in Figure 2.

Based on feedback from the demographic surveys, the children who participated in this study accumulated many of their weekly physical activity minutes in organized sport and school settings prior to the COVID-19 pandemic. Figure 3 shows the children's diverse exposure to organized sport. All but one child had been exposed to at least one form of organized sport. Basketball, baseball/softball, and soccer were the three most popular organized sports with respect to total number of children registered.

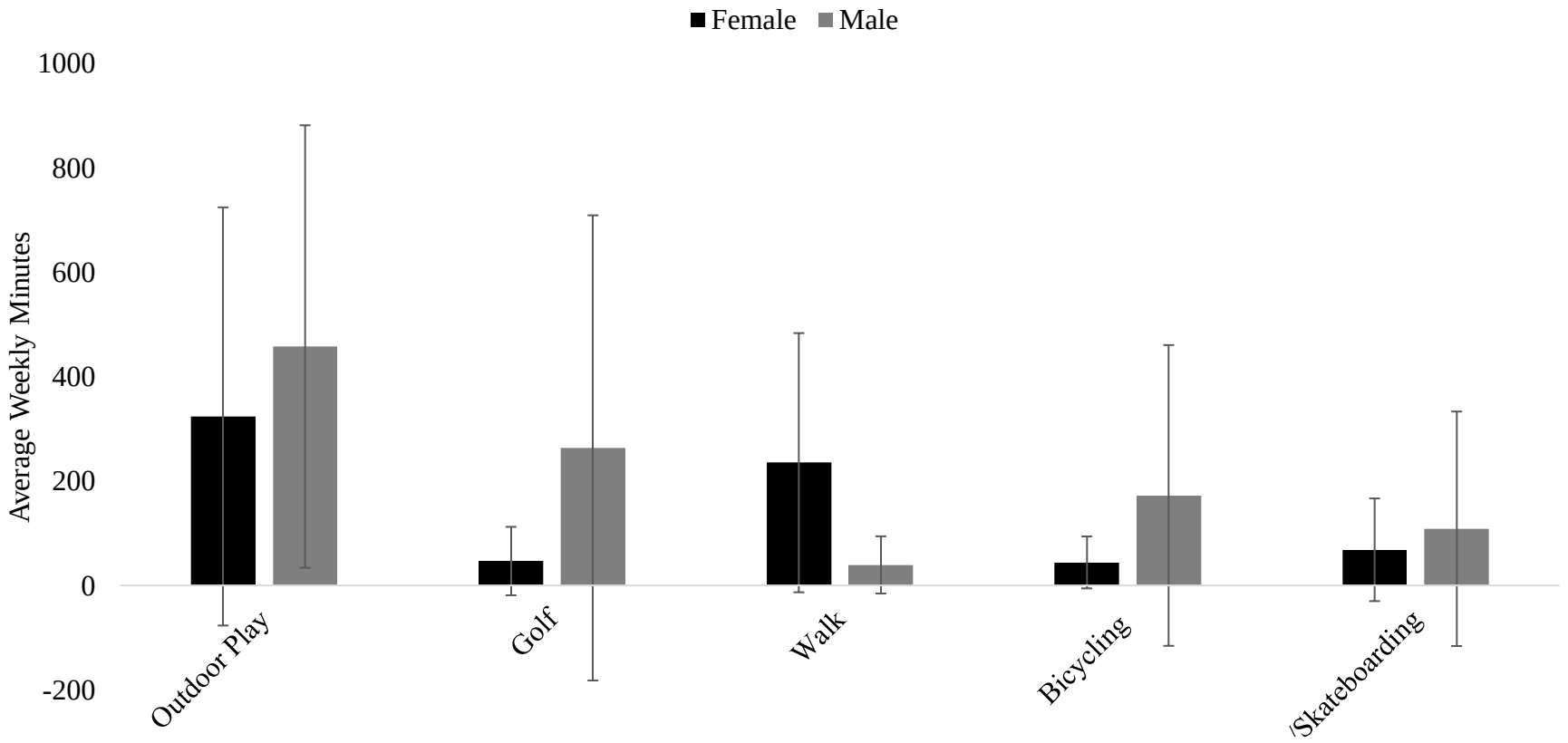
Table 1

Adherence to the CSEP's Recommendation for 60 Minutes of Daily MVPA.

	Met CSEP's recommendation for 60 minutes of daily MVPA	Did not meet CSEP's recommendation for 60 minutes of daily MVPA
Boys	6	1
Girls	1	8

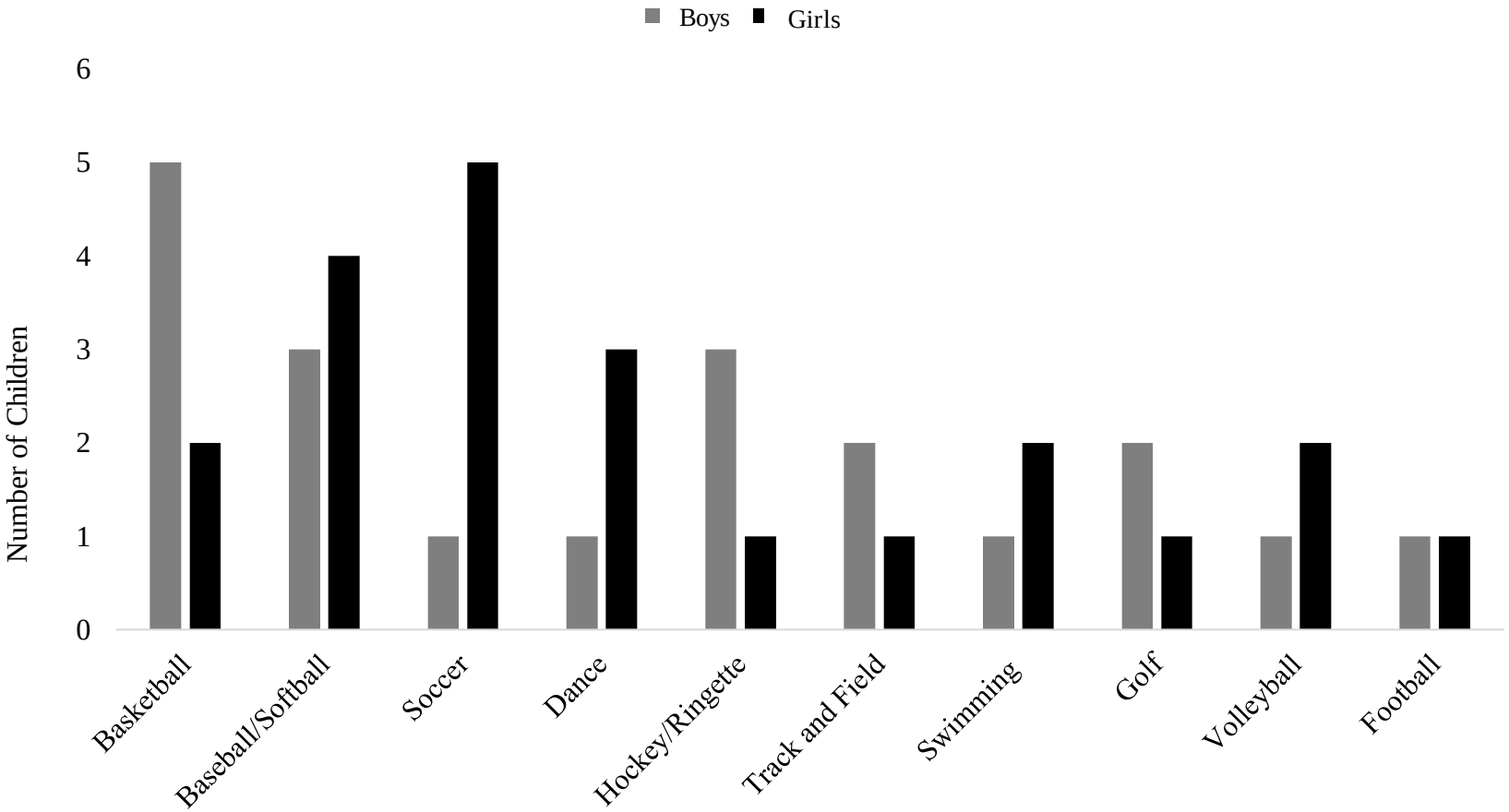
Note. Number of children by gender and adherence to the Canadian Society for Exercise Physiology's (CSEP) recommendation for 60 minutes of daily moderate to vigorous physical activity (MVPA [2018]). Based on Tudor-Locke and colleagues' (2011) review, the proposed age-gender adherence to the Canadian Society for Exercise Physiology's recommendation for 60 minutes of daily moderate to vigorous physical activity were: ≥13,000 steps/day for 6–11-year-old boys; ≥11,000 steps/day for 6–11-year-old girls, and ≥10,000 steps/day for 12–19-year-olds.

Figure 2.
Average Weekly Minutes Across Different Physical Activities



Note. Self-reported physical activity distribution for seven boys and nine girls over a seven-day period. Values are expressed as mean ± 1 standard deviation.

Figure 3.
Pre-Pandemic Organized Sport Participation



Note. Number of children registered in various organized sports prior to the COVID-19 pandemic.

Qualitative Data

The thematic analysis revealed three interdependent themes: Play-based physical activity, coactivity, and impact of public health restrictions related to the COVID-19 pandemic. The coactivity and public health restriction themes were further divided into adult-directed coactivity, child-directed coactivity, physical distancing, school closures, and organized sport cancellations, respectively. Table 1 outlines data sources by themes and categories.

Table 1

Thematic Analysis: Data Sources by Theme, Category, and Participants

Child(ren) Pseudonyms	Parent Pseudonyms	Play-Based Physical Activity	Coactivity		Impact of Public Health Restrictions		
		-	Adult-Directed	Child-Directed	Physical Distancing	School Closures	Organized Sport Cancellations
Riley	Tiffany	Q	Qq	q	q	Qq	Qq
Zack	Cindy	Q	Q	Qq	Qq	Qq	Qq
Michaela	Jillian	Q	Qq	Qq	q	Qq	-
Allie, James	Dora	Q	QQq	QQq	-	QQ	QQ
Marc, Jordan	Jamie	Qq	-	QQq	QQ	Qq	QQq
Eva, David	Darlene	QQ	QQq	QQq	-	QQq	QQq
Scarlett	Melanie	Qq	Qq	Q	Q	Q	q
Janelle, Kayla	Jeremy	QQ	QQq	QQ	Q	QQ	Qq
Kurtis, Adison	John	QQ	QQq	QQq	Qq	QQq	Qq
Alex	Gabrielle	Q	Qq	Qq	-	Q	Q
Lexi	Peter	Qq	Qq	Qq	Qq	-	-

Note. Q = direct interview quote(s) and/or physical activity journal comment(s) from one child in the family; QQ = direct interview quote(s) and/or physical activity journal comment(s) from two children of the same family; q = direct interview quote(s) from parent.

Play-Based Physical Activity. Based on the physical activity journals, the children engaged in a variety of physical activity during the seven-day journaling period. Outdoor play was the most popular (Figure 2). When the children and their parents were asked about their physical activity preferences during the interview, they most often referenced play-based physical activity. The children were drawn to trampoline, golf, and various outdoor games because they include an active play component. Tag games appeared particularly popular. The following dialogue describes how Marc plays grounder*s* with his peers:

> *Interviewer:* Tell me how grounders work.
>
> *Marc:* So, there is this one guy who is it, and he's on the ground and once he's on the ground he has to close his eyes and try to tag people on the equipment. Whoever gets tagged has to go on the ground and is then it (p. 7).

Grounders is a tag game with many different variations. The object of the game is to avoid being *it.* The person who is *it* has their eyes closed and must listen to the footsteps of the other players and try to tag them. *Grounders* is most often played on playgrounds (Scouts Canada, 2014).

When asked why they were drawn to play-based physical activity, the children and their parents offered a simple explanation—a play-based approach makes physical activity enjoyable and meaningful. For Kurtis, one of his favorite pastimes is playing video games. When he was asked why he was drawn to play-based physical activity, he said that it is "almost kind of like a video game" (p. 4). Play-based physical activity, as the children and parents pointed out, are fun and provided opportunities for limited social interactions amidst public health restrictions.

Coactivity

Coactivity refers to physical activity that actively involves at least one other person (O'Dwyer et al., 2012; Rhodes & Lim, 2018). A child venturing out for a bike ride with a parent, participating in a soccer team practice, or playing grounders with peers exemplifies how coactivity can take form. Based on the analysis of the comments from interview transcripts and physical activity journals, coactivity either took the form of adult-directed coactivity or child-directed coactivity.

Adult-Directed Coactivity. Adult-directed coactivity encompassed all coactivity during which an adult generally determined the nature of the physical activity. In many cases, adults were directly involved in the activity and exerted a coercive influence, as the following dialogue with Kurtis suggests:

> *Interviewer:* Thinking of [your father and your sister], how do they help you be physically active?
>
> *Kurtis:* Um, well, my dad usually makes us go for walks and I appreciate that, but sometimes I just don't really want to. I just want to stay at home. (p. 7).

In other cases, adults were not directly involved. Instead, the children were coactive with other children and the adults instructed or coached. Riley's mother offered an example of how Riley's dance coach attempted to create online play-based coactivity during the province-wide state of emergency in April of 2020:

> Through COVID-19, actually, [Riley and her dance group] started having chat groups and they get together, they chat, they send videos to each other, they have dance-offs where they have to choreograph and score each other. Even if not in person, she has definitely kept those interactions (p. 4).

Child-Directed Coactivity. Child-directed coactivity differed from adult-directed coactivity in that the children initiated and determined the nature of the coactivity. Over the seven-day journaling period, this type of coactivity primarily took place on playgrounds, in backyards,

and in parks. Child-directed coactivity allowed children to collaborate and find ways to be physically active through play. The following dialogue with James demonstrates how he and his friends organized a pick-up basketball game:

> *Interviewer:* Okay, so when you play basketball how do you guys get organized? Do you play three-on-three, or…?
>
> *James:* So, we just go out on the court and get organized. We usually nominate team captains and then rock-paper-scissor to see who can pick first and then we just make sure that the teams are even. Some people sit and others play and then we swap out. It's pretty organized considering it's a group of middle-schoolers who are organizing it. And, it's the kids that ref it so when there's a foul, we just say there's a foul and the other team gets the ball. That's what it is, so, for a game of basketball organized by middle-schoolers it's, pretty fun (p. 9).

Based on data from the seven-day physical activity journals, an average of four out of every five physical activities involved at least one other person, which made coactivity the main form of physical activity.

> *Interviewer:* Would you say you're more physically active by yourself or more so with your friends or family or someone else?
>
> *Alex:* More with friends and family.
>
> *Interviewer:* Yeah? And why do you think that is? Being more active with others?
>
> *Alex:* It's boring playing by yourself. It will be fun for like five minutes and then you just get bored and want to go inside (Alex, p. 11).

When asked why the children preferred coactivity, they referenced enjoyment as the main reason: "When you're with your friends you have more fun things to do—it's way funner in numbers" (Eva, p. 5).

For the children who participated in this study, play-based physical activity hinged on the participation of another party. Coactivity enabled play-based physical activity, which in turn made physical activity enjoyable. As Alex's previous comments (p. 11) and Lexi's following comment highlight, not having someone to be physically active with deterred their overall physical activity:

> *Interviewer:* Do you feel your brother helps you be physically active?
>
> *Lexi:* Yeah, because if I didn't have my brother then I probably wouldn't go outside as much because I would be so bored by myself. All the games we play, I wouldn't be able to play those by myself. Sometimes I try to go outside by myself, but I come running back in the next minute because I find it so boring by myself (p. 8).

Impact of Public Health Restrictions

Public health restrictions related to the COVID-19 pandemic greatly influenced the children's physical activity. The most influential restrictions were physical distancing, school closures, and organized sport cancellations.

Physical Distancing. During the state of emergency, public health guidelines stipulated that households remain fully separated from others. For the children, that meant no physical interactions with individuals that were not part of their household, such as peers and extended family. Towards the end of the state of emergency, the guidelines allowed for cohort formation, which permitted limited household interactions. Despite this, requirements for physical distancing minimized interactions outside of the household, as John pointed out:

> *Interviewer*: Okay, um. I'm going to go to COVID-19. How has COVID-19 impacted physical activity for [your children]?
> *John:* Their physical activity has definitely dropped off quite a bit. Um, and, you know, it's been a mix of, you know, where they can go to even be physically active with others–It really tethered them to home (p. 4).

During the state of emergency, many parents did not feel comfortable allowing their children to interact with large groups of children. Cindy pointed out that because of this, the extent and variety of child-directed coactivity was much more restricted:

> I also learned with where we're at with COVID-19 right now, [Zack] is doing a lot of the same things because, you know, some families aren't letting their kids play with other kids. And so, we have certain families that he's hanging out with. And those kids do the same things. And it's also stuff that's right within our neighbourhood, aside from golfing (p. 1).

With the introduction of cohorts and the progression into Stage 1, the opportunities for children to gather with peers and extended family members slowly increased. Many of the children and parents referred to the transition to Stage 1 as a return to almost normal, pre-COVID-19 interactions, especially outdoors. Jillian's comment revealed her daughter's re-engagement with her peers during the seven-day journaling period in Stage 1:

> *Interviewer:* Can you speak about [Michaela's] friends, and, um, what type of physical activities she likes to do with her friends?
> *Jillian:* Um, the frisbee golf thing that they went on last week, the youths from our church, they get together every week and do an activity. During COVID-19, they weren't doing anything, but now that the restrictions have lifted, they can do stuff outside like frisbee golf and biking (p. 4).

School Closures. During the state of emergency and Stage 1, public health authorities required schools and other facilities (e.g., gyms, fitness centers, pools) to close to the public. When schools across the province closed, the children transitioned to home-based, online-learning. For most of the children, that translated to one or two hours of videoconferencing with additional tasks to be completed outside of that time. The educational focus was on the core subjects (i.e., math, English language arts, social studies, science), as Darlene's comments highlight:

> *Interviewer:* What is [Eva and David's] school format under COVID-19 before they ended for summer?
> *Darlene:* Straight online. Um, they would get their assignments at the beginning of the week for the whole week, and they would meet their teacher. Eva would meet her teacher everyday for the group, the whole class, they would meet and read a book. David would meet twice a week with his class, and they would, um, what would they do? They would do a bunch of different things.
> *Interviewer:* And would they do anything for physical education?
> *Darlene:* No, mandated only [English language arts]. No, that must not be true, that must only be for my grade, [English language arts] and math. They did do social and science for an hour of each [day], I'm not sure, but not [physical education], no art, no extra, no music (p. 10).

School closures forced the children into the home during much of the day. Most children and parents perceived this as having a negative impact on their physical activity. The children felt that it robbed them of opportunities to be coactive. However, the new online-learning format also meant

that school days were often much shorter, which created more free time. Some of the children, including James, used the time to engage in child-directed coactivity:

> *Interviewer:* How has COVID-19 impacted your physical activity?
>
> *James:* I think it has made me more physically active because there's nothing else to do, nothing to get in the way. I got a new bike and that's all that I do right now is go bike riding. That's made me more physically active because there's nothing else to do. I got my bike like three or four weeks ago and I've been going down to the river bottom with my friends or jumping on the trampoline. Sometimes we play a game of hit where you jump on the trampoline, and you hit each other like in hockey. I think it has made me more physically active because I have more time to be physically active. That's what I think (p. 10).

Being home during the school week gave many families the opportunity to reconnect and be physically active together, primarily by way of adult-directed coactivity. The dialogue with David outlines how he cherished the extra family time:

> *Interviewer:* Okay. How has COVID-19 affected physical activity with your family? Do you do more? Do you do less?
>
> *David:* I think I do more because I hang out with them more and we spend more time together. We have more time to think about going camping or going for walks. And, we go on our walks because we are not at school.
>
> *Interviewer:* And do you enjoy that extra time with family?
>
> *David:* Yeah (p. 4).

For other children, public health restrictions disrupted their parents' daily routine, which limited coactivity. For these children, much of the extra, non-academic free time turned into sedentary time (e.g., screen time), as the following dialogue with Alex and his mother (Gabrielle) highlights:

> *Interviewer:* So, school took two hours each day. What did you do with the extra time?
>
> *Alex:* Nothing.
>
> *Gabrielle:* Too much [video gaming].

Organized Sport Cancellations. During the state of emergency and Stage 1, physical activity and sport organizations were mandated to cease face-to-face operations. For the children, this meant no practices or competitions. Like school closures, public health authorities' cancellation of organized sports forced children and parents to find alternatives. Many children struggled initially, and they felt that their physical activity decreased.

Organized sport cancellations reduced the children's physical activity by way of limiting opportunities for adult-directed coactivity; however, the effects were not entirely negative. Many of the children simply found different ways to be physically active. This physical activity primarily took the form of family- and peer-based coactivity. Cindy commented favourably on her son's shift away from structured school- and sport-based adult-directed coactivity to unstructured child-directed coactivity:

> I think you got from [Zack] that he's like a super organized team sports guy, right? So, he is kind of like your typical hockey player. He's kind of told where to be, what time to be there, what to do. And, that's kind of what he does. This has been actually kind of good for him, because all of a sudden, it's like he and his buddy, they're just biking down in the [river bottom] for two, three hours, you know, just figuring stuff out. And he's at the park playing soccer with tons of different age groups of kids (p. 1).

Children and parents also highlighted that because of school closures and organized sport cancellations, more of their physical activity took place outdoors. Especially as the cold winter

weather ended in late April and early May. The two most popular activities during the seven-day physical activity journaling period were outdoor play and golf. Golf courses in the province were the first sporting facilities that were permitted to open during the late stages of the state of emergency, and many of the families took advantage. The dialogue with Dora captures the importance of the outdoors during the initial pandemic response and Stage 1:

> *Interviewer:* COVID-19, can you describe how that has impacted your physical activity as a family?
>
> *Dora:* I'd say as a family we do more family stuff. We have gone for more bike rides and family walks. For them as individuals, if it wasn't COVID-19, we would have more structure but because of COVID-19 we have more unstructured physical activity and I think that's just as important. Them running around at the park and being creative is just as important as having structure.
>
> *Interviewer:* You feel that there have been any shifts in the type of physical activity? You already mentioned unstructured versus structured.
>
> *Dora:* Right, at the beginning it was still winter and cold out and you couldn't be around anyone so absolutely that made a difference. They weren't out biking with friends or running around with friends, but we were creative, we actually built a ski hill in our yard because we have a pretty good-sized yard. We built up snow with a jump and they spent hours out there doing that for a couple of weeks (p. 4).

Discussion

Physical activity in Canadian children has been negatively impacted by the COVID-19 pandemic (Moore et al., 2020). This is of particular concern as pre-pandemic engagement was already low (Cameron et al., 2016; Colley et al., 2017). Self-reported step-count data from this study suggests that adherence to CSEP's recommendation for 60 minutes of daily MVPA was above the pre-pandemic national level. Seven of the 16 children, or 44%, accumulated sufficient average daily steps to meet CSEP's recommendation for 60 minutes of daily MVPA, which compares to 36% of a national sample of children who met that mark between 2007 and 2015 (Colley et al., 2017). However, the children's 44% adherence rate falls far short of the provincial level, which was above 70% prior to the pandemic (Pujadas-Botey et al., 2016).

Several studies have highlighted gender differences in adherence to CSEP's recommendation for 60 minutes of daily MVPA (e.g., Cameron et al., 2016; Colley et al., 2017). Data from the Canadian Health Measures Survey shows that, on average, girls accumulate 33% less daily MVPA than boys (Colley et al., 2017), which translates to approximately 2% fewer girls than boys meeting CSEP's recommendation for 60 minutes of daily MVPA (Cameron et al., 2016). Six of the seven boys that participated in this study met CSEP's recommendation for 60 minutes of daily MVPA. In contrast, only one of the nine girls met the recommendation. Although the sample of this study was small and non-random, the difference in adherence between the study's boys and girls is troubling as it is far greater than the comparatively moderate differences observed in national samples (Cameron et al., 2016; Colley et al., 2017).

Research suggests that social factors greatly influence physical activity in girls (Laird et al., 2016). Generally, there is a positive relationship between physical activity in girls and support from family and peers. This support often takes the form of encouragement and sharing in the experience (i.e., coactivity). For many of the girls who participated in this study, family support remained unchanged during the COVID-19 pandemic; however, public health restrictions

impacted the girls' ability to gather with peers, especially during the province's state of emergency in March and April of 2020. Fewer opportunities for coactivity with peers as a result of public health restrictions may have had a disproportionately negative effect on the study's girls when compared to the boys, which may explain the large gender discrepancy in the adherence to CSEP's recommendation for 60 minutes of daily MVPA.

Analysis of the physical activity journals and interview transcripts revealed that children preferred and most often took part in play-based physical activity. Strong preferences for play-based physical activity have been reported by Resaland et al. (2019). The children who participated in their study awarded the highest preference ranks to game- and play-based physical activities such as soccer, dodgeball, swimming, and water play. They awarded lower ranks to physical activities that did not include play or game components, such as jogging and rope-skipping. The preference and popularity of play-based physical activity among the children who participated in this study was likely due to the fact that play-based physical activity maximizes inherent enjoyment (Côté et al., 2009). Play-based physical activity allows children to engage in physical activity with minimal equipment, in a variety of spaces, and with any number of children (Côté et al., 2009). This flexibility for children to adapt physical activity on the fly to meet their own needs fosters a sense of autonomy. Autonomy, within a self-determination framework, is often a source of motivation for continued engagement in physical activity (Deci & Ryan, 1985; Dishman et al., 2015; Fenton et al., 2014; Seghers et al., 2014).

When it comes to coactivity—the second major theme of the qualitative portion of this study—the existing body of research focuses primarily on how family-based coactivity can improve physical activity and decrease sedentary time in children. Some studies (e.g., O'Connor et al., 2009; van Sluijs et al., 2011) provide evidence for a minimal effect of coactivity interventions on childhood physical activity, while others (e.g., O'Dwyer et al., 2012) report decreased sedentary time and increased physical activity in those families that participated in coactivity interventions. The experiences of this study's children suggest that for coactivity to be effective in promoting overall physical activity, a play-based orientation is likely important.

Another interesting finding was that most of the children's play-based physical activity appeared to occur in the form of child-directed coactivity. Together with a play-based orientation, child-directed coactivity offered the children autonomy to collaboratively align their chosen activities with their internalized goals (Deci & Ryan, 1985). This autonomy helped motivate children to seek out similar opportunities on a recurring basis. In contrast, adult-directed coactivity was more often aligned with the goals of the adults, which limited autonomy and thus reduced the likelihood that children would seek out similar opportunities without adult direction.

Peers play a vital role in the physical activity behaviours of children (Garcia et al., 2016). Frequently cited reasons for why children participate in physical activity are "just because my friends do" and "I like being together with my friends" (Pawlowski et al., 2018, p. 45). Perhaps not surprisingly, Tulchin-Francis et al. (2021) reported that decreases in childhood physical activity observed during the COVID-19 pandemic were partially due to fewer interactions with peers. For the children who participated in this study, peer interactions varied by the extend of public health restrictions. These were most restrictive during the province's state of emergency in March and April of 2020. During this time, the children had virtually no interactions outside of the household. As a result, child-directed coactivity with peers was very limited, which led to fewer opportunities for play-based physical activity. Since play-based physical activity was the preferred mode of physical activity, fewer opportunities for play-based physical activity were perceived as having a negative impact on overall physical activity.

Prior to the COVID-19 pandemic, many Canadian children received most of their daily physical activity in school and organized sport settings (Canadian Fitness & Lifestyle Research Institute, 2018; Patton & McDougall, 2009). For children who were accustomed to the structured physical activity that schools and organized sports provided, their closures and cancellations had a particularly negative effect. Yomoda and Kurita (2021) reported that COVID-19 related declines in overall physical activity were greatest among children who regularly participated in organized sports. Many of the children and especially the parents that participated in this study spoke positively about the pre-pandemic school- and sport-derived structure. For some, the loss of this structure was perceived to have led to increased physical inactivity. However, less school- and sport-derived structure also created more room for child-directed coactivity, which allowed some children to explore different ways to be physically active.

Having physically active parents and siblings appeared to protect against physical activity declines caused by public health restrictions related to the COVID-19 pandemic (Moore et al., 2020; Yomoda & Kurita, 2021). Requirements for physical distancing, school closures, and organized sport cancellations impacted where and how physical activity for the study's children took place. Collectively, these restrictions caused the pool of individuals the children could be coactive with to shrink. For many of them, coactivity with parents and siblings filled the void left by reduced coactivity with peers. For some children, however, COVID-19 related disruptions to their parents' daily routines left them with fewer opportunities to be coactive.

Another consequence of the COVID-19 pandemic is that Canadian children reportedly spent less time outdoors (Moore et al., 2020). This represents a barrier to childhood physical activity as time spent outdoors is positively associated with MVPA (Larouche et al., 2019). Interestingly, the tendency towards less outdoor time was not observed in the children who participated in this study. In fact, virtually all the self-reported physical activity recorded during the seven-day journaling period occurred outdoors. Outdoor play was the most popular activity in terms of total average weekly minutes. Because of requirements for physical distancing, school closures, and organized sport cancellations, outdoor spaces were often the only places accessible to the children. Outdoor spaces like playgrounds, parks, and backyards were suitable for a large variety of physical activity. Locally, most of these spaces are perceived as safe and children were often permitted to venture out by themselves, which in turn promoted child-directed coactivity. One reason why observed outdoor time of the study's children during the pandemic appeared to contradict that of Moore et al. (2020) may be related to the time of data collection. Moore et al. (2020) collected their data in April of 2020, whereas data for this study was collected in June and July of 2020 when the weather was comparatively warmer, dryer and perhaps more conducive to outdoor physical activity.

In sum, the children who participated in this study prefer play-based physical activity, which most often occurs through coactivity. Public health restrictions related to the COVID-19 pandemic limited opportunities for the children to partake in play-based coactivity. For many of them, especially girls, this meant they did not accumulate sufficient average daily steps to meet CSEP's recommendation for 60 minutes of daily MVPA. Although children and their parents' perceptions regarding the impact of the pandemic on childhood physical activity were generally negative, their experiences greatly varied. For instance, children with physically active families spoke about the positive impact that the pandemic had on their ability to be physically active together.

Implications and Future Directions

Physical activity is important for optimal health in both children and adults. Public health restrictions have helped to mitigate the spread of COVID-19, but they have undoubtably impacted childhood physical activity (Moore et al., 2020). Our study highlights that physical distancing, school closures, and organized sport cancellations changed and often limited children's physical activity, especially that of girls. The good news is that educators, parents, coaches, and other caregivers can support children's physical activity even amidst strict public health restrictions. Given this study's findings about children's preference for play-based coactivity, consistent efforts to create opportunities for play-based coactivity may help promote overall physical activity. COVID-19 friendly play-based coactivity could include outdoor play, games that require little to no physical contact (e.g., scavenger hunts, potato sack races), and physical activity-based virtual games (e.g., Nintendo Wii, Pokémon Go) that allow multiple players to remotely connect.

Future research should determine whether COVID-19 pandemic related gender differences in physical activity are detected in large nationally representative samples. If so, the associated factors should be identified, and children's perceptions and experiences documented. More research is also needed to determine whether coactivity leads to overall increases in physical activity in children, and which forms of coactivity (i.e., adult-directed, child-directed) prove most effective. It will also be important to study provincial and regional differences in the impact of COVID-19 related public health restrictions on the physical activity behaviours of children. As these and other questions are answered, experts and policy makers will be better equipped to address the potential negative long-term effects of the pandemic.

Limitations

The main limitation of this study is the lack of pre-pandemic physical activity data. Without this data, MVPA comparisons could only be made against pre-pandemic provincial and national norms. Additional limitations are related to the seven-day physical activity journal entries. The self-reported nature of the journal entries made them subject to social desirability and recall biases. Furthermore, descriptive statistics were applied to a relatively small sample (n=16) of participants, which limits the statistical generalizability of the results.

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