Parental Sociodemographic Characteristics, Parental Concerns, and Children’s Physical Activity During the COVID-19 Pandemic

by

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Abstract

INTRODUCTION: Physical activity (PA) is key to children's health, but nearly half of Canadian children do not meet the recommended levels, which has been exacerbated by the COVID-19 pandemic. Identifying correlates and mechanisms influencing PA can inform public health policies and interventions, especially during health crises. This thesis examined the relationships between parental sociodemographic characteristics, parental concerns, and children's PA, and to determine if parental concerns mediated the relationship between parental sociodemographic characteristics and children's PA during the COVID-19 pandemic.

METHODS: The study utilized the 2020 Statistics Canada survey, Impacts of COVID-19 on Canadians - Parenting during the Pandemic, proxy-reported data from 5,863 parents of children aged 6-14 years. Multiple logistic regression, Spearman correlations, and mediation analyses were conducted to address the objectives.

RESULTS: Of 5863 parents 91.2% were women, 53.4% were working from home, 15.7% were working outside the home, and 30.9% were working both from home and outside the home during the pandemic. Three quarters (74.3%) of the parents had a university education, 91.9% were a non-visible minority, and 89.3% were Canadian-born. Almost half (47.7%) of the parents reported concerns for the amount of PA among their children and 46.7% reported that their children engage in low to moderate levels of PA. Parents without a university education (OR 1.38, 95% CI 1.18,1.62) and with high concerns for the amount of PA among their children (OR 3.91, 95% CI 3.44, 4.46) were associated with low to moderate PA among their children compared to their university educated and less concerned counterparts. Parental concerns for the amount of PA among their children partially mediated the relationship between parental visible
minority status and children’s PA (47%) and the relationship between parental immigration status and children's PA (33%).

**CONCLUSIONS**: Parents, particularly their concerns and education levels, may play an important role in shaping children’s PA. Also, parents and children from marginalized groups including visible minority and immigrants, may require more support and resources to increase their opportunities and access to PA participation. Future intervention strategies for PA promotion efforts may focus on children within these communities as we recover from the pandemic.
Co-Authorship

This master’s thesis was completed by Ajay Bains under the guidance and supervision of Dr. Eun-Young Lee. Data for this thesis was sourced from the *Impacts of COVID-19 on Canadians - Parenting during the Pandemic 2020* survey conducted by Statistics Canada collected in June 2020. The conceptualization of the thesis project was a joint effort by both Ajay Bains and Dr. Eun-Young Lee. Ajay Bains, with support from Heejun Lim, analyzed data from the *Impacts of COVID-19 on Canadians - Parenting during the Pandemic 2020* survey. Ajay Bains wrote the literature review, interpreted the results, and wrote the entirety of this thesis. Dr Eun-Young Lee provided ongoing support and guidance for all aspects of this thesis and assisted in editing.
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List of Abbreviations

BMI - Body Mass Index
CI - Confidence Interval
GPS - Global Positioning Systems
LIPA - Light Intensity Physical Activity
MVPA - Moderate to Vigorous Physical Activity
OR - Odds Ratio
PA - Physical Activity
SEM - Socioecological Model
SES - Socioeconomic Status
Chapter 1
Introduction

1.1 General Overview

Health benefits of engaging in regular physical activity (PA) among children are well established (Carson et al., 2017). Given such evidence, the 24-Hour Movement Guidelines were created in 2016, spearheaded by Canadian researchers (ParticipACTION, 2020; Tremblay et al., 2016). Within these guidelines, behavioural recommendations are ascribed to children and youth aged 5-17 years for PA, in addition to sleep and sedentary behaviour (Tremblay et al., 2016). Specifically, the PA recommendations suggest children and youth to participate in moderate- to vigorous-intensity physical activity (MVPA) for at least 60 minutes daily (Tremblay et al., 2016). Notwithstanding the clear association between PA and positive health outcomes, a recent report indicated that almost half (49%) of Canadian children and youth are failing to meet the recommended level for daily PA (ParticipACTION, 2022).

To promote PA among children, identifying important correlates and mechanisms that explain the lowered patterns of PA during the COVID-19 pandemic is required. A better understanding of the correlates of PA during the COVID-19 pandemic would help identify populations groups at risk and in turn help policy makers, stakeholders, and practitioners to develop effective interventions/programs that could be tailored to these populations.

A theoretical framework that helps to better understand the correlates of PA is socioecological modelling. The socioecological model (SEM) outlines that health behaviour can be influenced by multiple levels of correlates. These levels include intrapersonal, interpersonal, organizational, community, and public policy (Spence & Lee, 2003). Among
these, interpersonal level correlates have been known to be important for children; in particular, it is suggested that parents play an important role in facilitating their children’s PA (Rhodes et al., 2020). Furthermore, parental sociodemographic characteristics are known to be important correlates that influence children’s health behaviour, including PA (Gustafson & Rhodes, 2006). For example, parental visible minority status (Colley & Watt, 2022), immigration status (Colley & Watt, 2022), gender (Rosenfeld & Tomiyama, 2021; Solomon-Moore et al., 2018), parental employment (Dwyer et al., 2008; Hesketh et al., 2006; Pombo et al., 2020) and education (Gilic et al., 2020; Jiménez-Pavón et al., 2012) have been identified as important parental-level correlates that influence children’s health behaviour, including physical activity.

The COVID-19 pandemic, which was announced in early 2020, negatively affected the already low levels of engagement in PA among children (Guerrero et al., 2020; Moore et al., 2020). To help decrease the transmission of COVID-19 infections, community-wide lockdowns and stay-home orders were implemented in Canada and across the world. Parks, schools, and afterschool programs were closed or restricted, which in turn, had a negative impact on PA engagement among children (Guerrero et al., 2020; Moore et al., 2020). Specifically, during the COVID-19 pandemic (Fall 2020), only 37% of children and youth aged 5-17 years met the PA recommendation (ParticipACTION, 2022), which is a 14% decrease from the pre-COVID-19 pandemic era (51%) (ParticipACTION, 2022). Systematic and scoping reviews indicated that a decrease in PA levels was observed among children just one year into the COVID-19 pandemic (Caputo & Reichert, 2020; Kharel et al., 2021; Paterson et al., 2021; Rossi et al., 2021). It is also noted that changes in health behaviours shown during the pandemic may carry over even after the pandemic is over (Kovacs et al.,
This points to the need for promoting and fostering participation in PA among children as we recover from the COVID-19 pandemic era.

The COVID-19 pandemic may have also further exacerbated the negative influence of the already existing disadvantages associated with parental sociodemographic characteristics on children’s PA. Early COVID-19 research indicated that individuals with low SES face more challenges than individuals with middle- to high-socioeconomic backgrounds during the COVID-19 pandemic, with loss of employment, longer days staying at a small, confined home, or lack of childcare support (Patel et al., 2020). Furthermore, children of the racial/ethnic minority communities were also less likely to engage in sufficient levels of PA during the COVID-19 pandemic (Nagata et al., 2022). The COVID-19 pandemic has also shown to increase parental concerns toward their children’s PA. Preliminary research indicated that parents who are more anxious about their children engaging in PA had fewer visits to nearby parks that may have contributed to lower overall PA levels (McCormack et al., 2020).

Though the World Health Organization declared the end to the COVID-19 pandemic as a global health emergency on May 5th, 2023 (United Nations, 2023), understanding the relationships between parental sociodemographic characteristics, parental concerns, and children’s PA during the times of public health crises like the COVID-19 pandemic is important. This is because human existence will continue to be threatened by intensifying natural disasters and other infectious diseases. Furthermore, rather than simply investigating parental sociodemographic characteristics and parental concerns for PA as co-exposures for children’s PA, investigating mechanisms between these three variables is beneficial to develop effective interventions to promote PA among children.
On top of parental sociodemographic characteristics, such as gender, race/ethnicity, SES, the immigrant status, playing an important role in children’s PA (Colley & Watt, 2022; Dwyer et al., 2008; Gilic et al., 2020; Gustafson & Rhodes, 2006; Hesketh et al., 2006; Jiménez-Pavón et al., 2012; Pombo et al., 2020; Rosenfeld & Tomiyama, 2021; Solomon-Moore et al., 2018), parental concerns for children’s PA could vary based on parental sociodemographic characteristics. For instance, ethnically diverse parents in the UK are known to have heightened concerns for their children’s engagement in PA due to safety concerns, adverse weather, lack of resources, and lack of access (Trigwell et al., 2015). Furthermore, British Pakistani girls showed lower levels of PA than White British girls, and parental concerns were cited as important barriers among British Pakistani girls (Hornby-Turner et al., 2014). Moreover, parents residing in neighbourhoods of high SES reported fewer safety concerns regarding their children's PA than parents in lower SES neighbourhoods (Galaviz et al., 2016). Additionally, challenges and barriers to support and maintain healthy diet and physical activity for children were reported by parents with multiethnic backgrounds in the UK (Rawlins et al., 2013). For example, lack of knowledge on the adequate amount of physical activity and absence or poor quality of PA facilities were identified as barriers to supporting children’s PA. Together, the hypothesized pathway that may explain the complex relationships between parental sociodemographic characteristics, parental concerns, and children's PA is illustrated in Figure 1.
Evidence is lacking in Canada; however, a qualitative study found that a lack of safe space to play is a major concern for South Asian adolescents living in Canada with culture-specific barriers for girls (Rajaraman et al., 2015). In addition, one study showed that newcomer families to Canada prefer to have their children engage in culturally relevant PA, rather than PA programs already available locally (Lane et al., 2021). Given these, parental concerns for PA may explain the relationships between parental sociodemographic characteristics and children’s PA. Parental concerns for child’s PA levels are also particularly relevant during the COVID-19 pandemic with closures of school and other services that
served as providing opportunities to PA for children (e.g., local gyms, sport programs, physical education classes, recess).

To date, there are no studies that examined the mechanisms between parental sociodemographic characteristics, parental concerns, and children’s PA. However, numerous studies have identified both parental sociodemographic characteristics and parental concerns as important correlates. A recent review on the correlates of outdoor play suggested that investigating the mechanisms between multiple layers of correlates is important for future research (Lee et al., 2021). The literature supports that parents of visible minority, parents with an immigrant status, a low-income background, change in parent’s work arrangements, parental gender, and parents who show heightened anxiety for PA may experience more challenges in supporting their children’s PA during the COVID-19 pandemic (Gopalan & Misra, 2020; McCormack et al., 2020). However, the mechanisms between parental sociodemographic characteristics, parental concerns, and children’s PA are not well understood. Furthermore, the interplay between these three variables is unknown in the context of the COVID-19 pandemic. Given that children’s PA is influenced heavily by parents, particularly for younger children (Rhodes et al., 2020; Yao & Rhodes, 2015), it is crucial to have a better understanding of the mechanisms between multiple correlates, in this case, parental sociodemographic characteristics, parental concerns, and children’s PA.

Mediation analysis is a useful statistical technique when investigating mechanisms between more than three variables, particularly when these three variables are speculated to be on a causal pathway. By employing a series of linear regressions, this analytical approach determines potential underpinning causal pathways that unravel the ‘why’ of the relationship between two variables (VanderWeele, 2016).
1.2 Objectives and Hypothesis

The objectives of this thesis were to examine 1) the associations between parental sociodemographic characteristics, parental concerns, and children’s PA and 2) whether parental concerns about children’s PA mediates the association between parental sociodemographic characteristics and children’s PA. It is hypothesized that 1) parental sociodemographic characteristics and parental concerns will be associated with children’s PA and 2) parental concerns would mediate the relationship between parental sociodemographic characteristics and children’s PA during the COVID-19 pandemic.

1.3 Scientific and Public Health Significance

The COVID-19 pandemic caught the world off guard, and it magnified the pre-existing issues in public health. Research on the factors that contribute to the engagement of PA among children is well-established. However, the mechanisms explaining how children’s PA is affected by parental sociodemographic characteristics and concerns are less understood. Furthermore, with public health restrictions during the COVID-19 pandemic, schools and services were closed, which led families to spend much more time together at home. This particular living condition may have influenced children’s PA and parents’ ability to support their children’s PA. Preliminary studies on the COVID-19 pandemic and children’s PA showed that PA has decreased due to the COVID-19 pandemic (Guerrero et al., 2020; Moore et al., 2020). Though it is known that the COVID-19 pandemic and public health restrictions further created inequity in different population groups in terms of employment, income, living conditions, and so on (Gopalan & Misra, 2020), less is understood on which population groups are more affected in terms of PA opportunities and how parental concerns for their children’s PA played a role during the period of confinement and isolation. The outcome of
this thesis will contribute to building more evidence on interpersonal factors that influence children’s PA and the role that parental concerns play in explaining the association between parental sociodemographic characteristics and children’s PA. The knowledge produced from this thesis can be used to inform decisions on public health and develop more effective PA promotion policies and programs to ensure equal opportunities for PA among children with diverse backgrounds, particularly in times of public health crises like the COVID-19 pandemic.

1.4 Thesis Organization

This thesis is a manuscript-based thesis and is organized based on the guidelines provided by the School of Graduate Studies at Queen’s University for a manuscript-based thesis. Chapter 1 is a general overview of the subject area for this thesis. Chapter 2 is a literature review of key terms and definitions, PA before and during the COVID-19 pandemic, the theoretical framework of the SEM, the known correlates associated with PA before and during COVID-19, and an overview of the mediation statistical analysis method. Chapter 3 consists of the primary research manuscript, examining the associations between parental sociodemographic characteristics, parental concerns, and children's PA. Additionally, it explores the mediating role of parental concerns in the relationship between parental sociodemographic characteristics and children's PA in Canada during the COVID-19 pandemic. Chapter 4 is a general discussion in which key findings, strength, limitations, implications of research, and future direction of research are discussed.

1.5 Positionality as a Researcher

As an able-bodied first-generation Canadian male belonging to a visible minority group, my positionality is shaped by my personal experiences and cultural background. These
experiences have inspired me to explore the associations between parental sociodemographic characteristics, parental concerns, and children’s PA.

My interest in this topic first began during my upbringing. As a highly active visible minority and child of first-generation immigrants, I often wondered why other children with similar identities as mine were not as physically active as I was as a child. I remember going to a soccer tournament just outside of Red Deer, Alberta around the age of 10. I noticed that the children who were involved in the sport looked very similar in their appearance and that there were not many children who looked like me. As I got older my beliefs and values of helping others led me to early childhood PA/education as a profession and this led me to my undergraduate degree of physical literacy at Mount Royal University. It was at Mount Royal during my capstone project that I was able to research the health behaviours of Canadian immigrants in their native homeland and compare it to their health behaviour in Canada. I once again noticed the lack of positive health behaviours among visible minorities/immigrants in Canada. I also noticed these differences during my professional career, and it was through these experiences that I decided to pursue graduate school so I could better understand why participation in PA and sports is generally low among visible minorities and immigrants.

I am aware of how my positionality affects my viewpoint, how I connect with others, how people see me, and how I conduct myself in society. As a graduate student, I am aware of how fortunate I am to have access to education and opportunities for both personal and professional development. Yet, I am also aware of the difficulties that come with being a visible minority and obtaining a graduate degree. These difficulties have given me a distinctive viewpoint on the value of inclusion, diversity, and equity in my research. I understand my positionality is not separate from the work I have done during my master’s
thesis but instead has influenced the topic I have chosen, how I read and interpret studies, and how I conduct my writing for my thesis.
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Chapter 2

Literature Review

2.1 Introduction

This literature review provides an overview of the literature on parental sociodemographic characteristics, parental concerns, and physical activity (PA) among children before and during the COVID-19 pandemic. The beginning of this literature review (Section 2.2) provides key terms and operationalization of key terms of this thesis. Section 2.3 describes the benefits of PA among children and section 2.4 describes children’s PA engagement before and during the COVID-19 pandemic. Section 2.5 introduces the socioecological model, the theoretical framework utilized in this thesis. Section 2.6 provides an overview of the associations between parental influence on PA, sociodemographic characteristics, concerns, and children’s PA before and during the COVID-19 pandemic. The final section 2.7 discusses the main statistical technique used in this thesis, a mediation analysis.

2.2 Key Terms and Operationalization

2.2.1 Sociodemographic Characteristics

The term sociodemographic is used throughout this thesis and refers to the demographic, economic, and social groups that define individuals in a sample, population, or specific group (Abdullah, 2019). Some examples of sociodemographic characteristics include age, gender, migrant status, employment status, and income (Abdullah, 2019).

2.2.2 Parental Concerns for Children’s Physical Activity
Parental concerns are operationalized as concerns felt by parents regarding the amount of PA in which their child engages in. Previous studies have suggested that parental concerns are context specific and can play a role in the engagement of PA among children (Rodríguez-Oliveros et al., 2011; Timperio et al., 2004). The contexts for concerns felt by parents include fear of injury/illness, neighbourhood safety, traffic safety, and/or “stranger danger” perceived by parents (Carver et al., 2008; Rodríguez-Oliveros et al., 2011; Timperio et al., 2004). Parental concerns have also shown to be associated with parental sociodemographic characteristics. For example, concerns about safety have shown associations with parents of multi-ethnic backgrounds (Trigwell et al., 2015).

2.2.3 Physical Activity

PA is defined as any bodily movement that is initiated by skeletal muscles that requires an expenditure of energy (Caspersen et al., 1985). There are many ways children can become physically active from participating in structured activities such as physical education (Ramstetter et al., 2010) and sports, to unstructured activities such as play and active transportation (Nicaise et al., 2011; Riddoch & Boreham, 1995).

2.3 Benefits of Physical Activity

Engaging in PA offers a myriad of health and wellness benefits among children. Engaging in PA has shown to have improved cardiovascular health (Carson et al., 2016; Kuzik et al., 2017; Saunders et al., 2016) and supports the developmentally appropriate distribution of body fat (e.g., body mass index [BMI], waist circumference) (Roberts et al., 2005; Roman-viñas et al., 2016; Tremblay et al., 2010). Children engaging in PA is also associated with positive cognitive health including better brain health (Colley et al., 2019; Craig et al., 2013; Tomkinson et al., 2019) and higher academic achievements in the form of
higher grades (Esteban-Cornejo et al., 2014) as well as better health-related quality of life (Sallis et al., 2006). There are emerging studies outlining the importance of PA on children’s mental and psychosocial health and wellness (Poitras et al., 2017). Specifically, higher PA is associated with lower levels of hyperactive and inattentive behaviours (Xu et al., 2015), smartphone addiction (Pyper et al., 2017), and mood disorders (Cox & Paley, 1997). Finally, when high levels of PA is combined with the other healthy movement behaviours such as lower sedentary time and optimal sleep, research has shown that it is associated with the greatest health and wellness outcomes for children (Huffman et al., 2018; Lloyd et al., 2014).

2.4 Children’s Physical Activity and the COVID-19 Pandemic

2.4.1 Children’s Physical Activity Before the COVID-19 Pandemic

While there is a clear understating of what PA is and the health benefits associated with regular participation in PA, approximately half of Canadian children are still falling well short of these guidelines (Carson et al., 2017; ParticipACTION, 2022). One mode of evaluating children’s PA levels and supporting systems is via the ParticipACTION Report Card (ParticipACTION, 2022). Within this Report Card, letter grades are assigned to 14 indicators related to PA and influencing factors as part of comprehensive evaluation (ParticipACTION, 2020; ParticipACTION, 2022). These letter grades are based on current data on each indicator which are compared against established benchmarks (ParticipACTION, 2020; ParticipACTION, 2022). One of these indicators is the overall PA for children and youth aged 5-17 years. The most recent 2022 Report Card described that 51% of Canadian children and youth aged 5-17 years met the recommendations for the PA guidelines proposed by the 24-Hour Movement Guidelines before the COVID-19 pandemic (Fall 2018) (ParticipACTION, 2022).
2.4.2 Children’s Physical Activity During the COVID-19 Pandemic

In March 2020, the World Health Organization (WHO) officially declared COVID-19 as a global pandemic (WHO, 2020). The pandemic led to changes in public health policies and regulations which affected the daily lives of parents and children, including the opportunities for PA (Moore et al., 2020). These policies and regulations included a physical distancing requirement of two meters, postponement of sporting events, and a reduction of park and playground use (Government of Canada, 2020). Through these attempts to curb close contact and the spread of infection, places conducive to children’s PA such as parks, schools, and afterschool facilities were closed or practiced restrictions that drove down the engagement (Moore et al., 2020). With already low prevalence of meeting the PA recommendation among children before the COVID-19 pandemic (ParticipACTION, 2022), the new policies and regulations affected PA among children negatively (Moore et al., 2020).

Numerous studies published at the beginning of the COVID-19 pandemic investigated the changes in the prevalence of PA among children in Canada after the public health restrictions were implemented. These studies found that during the early stages of the pandemic, when the rules and regulations were new and strict, there was evidence of a decrease in PA (compared to pre-COVID PA) among Canadian children (Caldwell et al., 2022; Guerrero et al., 2020; Moore et al., 2020). Additionally, a follow-up study to Moore and colleagues (2020) surveyed parents six months after (October 2020) the initial survey (April 2020) and found that Canadian children aged 5-17 years meeting the PA recommendation continued to drop under strict lockdown measures (18.5% to 14.6%) (Moore et al., 2021).

Several reviews were conducted to investigate the prevalence and changes of PA among children during the COVID-19 pandemic (Caputo & Reichert, 2020; Kharel et al., 2021; Paterson et al., 2021; Rossi et al., 2021). These reviews unanimously reported a decline
in PA among children (Caputo & Reichert, 2020; Kharel et al., 2021; Paterson et al., 2021; Rossi et al., 2021) with decreases in different PA modalities, including the amount of time exercising (Sciberras et al., 2020), energy expenditure (de Matos et al., 2020), and moderate to vigorous physical activity (MVPA) (Lopez-Gil 2021). In particular, a scoping review revealed a decline in PA during the COVID-19 pandemic compared to before the pandemic, with a decrease ranging from 10.8 mins/day to 91 mins/day among children (Rossi et al., 2021).

Characteristics that contributed to the reduction of PA during the beginning of the COVID-19 pandemic were also studied. At the interpersonal level, both parents/guardians working from home (Pombo et al., 2020), lowered perceived capability to support healthy movement behaviours felt by parents (Guerrero et al., 2020), and parents with heighten anxiety were identified as an influencing factor to the decline of children’s PA (McCormack et al., 2020). At the environment level, time spent outdoors, where children get the majority of their PA (Truelove et al., 2018), decreased and was replaced with home-based, indoor PA (Guerrero et al., 2020; Moore et al., 2020; Paterson et al., 2021). COVID-19 itself was also a major factor in negatively influencing children’s PA; provinces in Canada with the highest prevalence of COVID-19 (e.g., Ontario, Alberta, British Columbia) resulted in lowered odds of PA engagement in children (Caldwell et al., 2022).

Though lowered PA due to the COVID-19 pandemic among children was commonly reported, it is also important to mention that some studies found contradicting results. Specifically, during the COVID-19 pandemic, some studies reported stable PA levels (Dragun et al., 2020) while others reported an increase in unstructured PA (Schmidt et al., 2020). Factors that contributed to increased engagement of PA during the pandemic at the intrapersonal level included gender (boys reported more PA than girls) (Gilic et al., 2020),
younger age, and being physically fit with prior PA engagement (Ng et al., 2020). Parental support and modeling, living in a two-parent or multi-child household, coming from a higher income household, and having set routines were reported as factors favourable to children’s PA at the interpersonal level (Moore et al., 2020; Cachon-Zagalaz et al., 2021; Pombo et al., 2020; Paterson et al., 2021). At the environmental level, living in a house, residing in low-density neighborhoods, and having access to parks in high-density areas were associated with higher odds of children engaging in PA (Mitra et al., 2020). At the global level, countries with milder restrictions, such as Germany, Sweden, and Western Australia, had higher levels of PA among children due to outdoor activities being allowed while practicing social distancing (Kharel et al., 2021; Wunsch et al., 2022).

2.4.3 Children’s Physical Activity as we Recover from the COVID-19 Pandemic

As we begin to recover from the COVID-19 pandemic and the rules and regulations are being eased, there has been an interest among PA researchers to observe PA levels pre- and post- pandemic among children. Aubert and colleagues (2022) reported children’s PA levels pre- and post-pandemic among 57 countries. Based on this study, prior to the COVID-19 pandemic, 27-33% of children among the 57 participant countries met the overall PA recommendation and post-COVID, 34-39% of children met the PA recommendation. This study also included data from Canada, which showed that 27-33% of Canadian children met the PA recommendation as the COVID-19 pandemic requirements eased (Aubert et al., 2022). This study demonstrated that as COVID-19 restrictions were being eased, the proportion of children meeting the recommended 60 minutes of MVPA/day improved but remained low even after the ease of the public health restrictions (Aubert et al., 2022). This highlights the ongoing need for efforts to enhance PA levels among children and improve
their overall health. A concern of public health is that the temporary changes in PA behaviour caused by the COVID-19 pandemic rules and regulations may sustain longer than we expect (Kovacs et al., 2022). To promote PA among children in the post-pandemic era, interventions such as increasing opportunities for PA in school (recess, extracurricular programs), spending time outdoors in unstructured play, and incorporating movement breaks are suggested (Aubert et al., 2022; Riazi et al., 2021; Moore et al., 2022). Establishing or improving a national surveillance system to underrepresented populations, improving access to public spaces and facilities, and implementing policies that address inequalities (targeting girls, low-income families, marginalized populations) have also been suggested to support PA beyond the pandemic (Aubert et al., 2022; Kovacs et al., 2022).

2.5 Theoretical Framework: Socioecological Modeling

There are several correlates that contribute to the engagement of PA among children (Sallis & Owen, 1997). To help organize these correlates, the socioecological model (SEM) for PA can be used (Spence & Lee, 2003). SEM suggests that an individual's behaviour is affected by multiple levels of influence (Spence & Lee, 2003). The levels of influence within SEM are interdependent, meaning that a change at one level of influence may cause a change at another level or multiple levels of influence within SEM (Kelly, 1990). This interdependence of the levels within SEM can provide effective strategies for intervention by considering multiple factors for health promotion efforts (Gauvin et al., 2001). Within SEM, children's PA behaviours can be determined by several correlates categorized into the following five levels of influence (see Figure 2): intrapersonal/individual, interpersonal, organizational, environmental, and public policy levels (Sallis et al., 2006).
Note. This figure was adapted from a SEM model first produced by Sallis and colleagues in 2006, positing that health behaviours are influenced by individual, social environment, physical environment, and public policies. From “An Ecological Approach to Creating Active Living Communities,” by Sallis et al., 2006, Annual Review of Public Health v.27 p.301

2.5.1 Correlates of Children’s Physical Activity Within the Socioecological Model Framework

According to the literature, sociodemographic correlates such as age, gender, household income, and race/ethnicity are intrapersonal/individual level correlates that are associated with children’s engagement in PA (Sallis et al., 2006). Additionally, psychological characteristics such as self-esteem, body image, self-efficacy, and attitudes toward PA are also potential intrapersonal/individual correlates (Sallis et al., 2000).
At the interpersonal level, major correlates of children’s PA include parental modelling and parental support for PA behaviours (Rhodes et al., 2020; Yao & Rhodes, 2015) and parental sociodemographic characteristics such as parental visible monitory status (Colley & Watt, 2022; Nagata et al., 2022), immigration status (Colley & Watt, 2022), gender (Rosenfeld & Tomiyama, 2021; Solomon-Moore et al., 2018), education (Gilic et al., 2020; Jiménez-Pavón et al., 2012), and employment (Dwyer et al., 2008; Hesketh et al., 2006; Pombo et al., 2020).

At the organizational level, correlates for children’s PA include school and childcare facilities and curriculum (Gottfried & Le, 2017), afterschool programs (Galvez et al., 2013), and school outdoor environments (playing equipment and recess duration) that promote and foster children’s PA participation (Cardon et al., 2008).

At the environmental level, known correlates of children’s PA include access to sport and recreations facilities and parks (Sallies et al., 2018), street design such as cul-de-sacs (Veitch et al., 2011), neighbourhood safety (Carver et al., 2008), traffic speed and volume (de Vet, 2011), time outdoors (Sterdt et al., 2014), and walking and biking facilities (Oliveira et al., 2014).

Public policy level correlates for children’s PA are, for example, polices that allocate resources that directly or indirectly encourage or restrict PA behaviours (McLeroy et al., 1988). During the COVID-19 pandemic, a specific public policy level correlate for children’s PA included the rules and regulations governments implemented to help curb the spread of COVID-19. For example, in Canada, the rules and regulations implemented included a physical distancing requirement of two meters, limiting interactions within large groups of
people, postponing sporting events, and prohibiting or reducing the use of parks and playgrounds. (Government of Canada, 2020).

The following sections focuses on the interpersonal level correlates, in particular, parental sociodemographic characteristics and concerns, and the influence of these correlates on children’s PA, given their importance highlighted in the previous literature in relation to children’s PA.

**2.6 Parental Influence on Children’s Physical Activity**

Children’s PA can occur in a variety of settings from home, childcare, and school, to community. Within these settings, parents play the most important role in children’s PA behaviours (Taylor et al., 1994). The parent-child relationship is not only important in increasing the engagement of PA among parents but also their children (Rhodes & Lim, 2018). Parents can affect their children’s PA behaviours through a variety of mechanisms (Trost & Loprinzi, 2011). These mechanisms may include providing resources that increase PA engagement, modelling of PA behaviours, removing barriers to PA, as well as providing positive reinforcement and support for children’s PA (Rhodes et al., 2020).

Parents also influence the type and intensity of PA among children (Edwardson and Gorely, 2010; Petersen et al., 2020). For example, organized PA among children is known to be influenced by parents via role modeling, providing transportation, and offering encouragement to influence organized PA (Edwardson and Gorely, 2010). Limited longitudinal data suggests that parental support is a predictor of organized PA among children over time, while the levels of fathers’ PA is a predictor of overall PA among adolescents (Edwardson and Gorely, 2010).
The COVID-19 pandemic may have negatively influenced the role parents play on PA among their children. According to Petersen and colleagues (2021), public health restrictions resulted in the closure of public places that provided PA opportunities for children, this has in turn contributed to the reduction in PA levels among children. For example, parents reported that a decline in PA levels among their children was due to cancellation of organized sports (Ostermeier et al., 2022), an important setting in which children obtained the majority of their PA (Hebert et al., 2015). Parents also reported that awareness of PA opportunities was limited, financial constraints due to price increases caused by increased demand for PA opportunities, and safety concerns due to the COVID-19 pandemic were all factors that negatively affected PA among their children (Ostermeier et al., 2022). Conversely, parents reported that access to outdoor space in which children could engage in PA and virtual PA classes/seminars were positive influences for their children’s PA levels (Ostermeier et al., 2022).

Research has shown that parental sociodemographic characteristics, such as gender, income, race/ethnicity, immigration status, and education levels, can affect parental concerns and attitudes towards their children’s PA. Studies have found that mothers are often more involved in promoting PA for their children than fathers (Lloyd et al., 2014). Parents with higher education levels and income are also more likely to encourage their children to be physically active, report lower safety concerns for PA, and provide them with access to PA and sport opportunities (Datar et al., 2014; Galaviz et al., 2016). On the other hand, parents who belong to visible minority groups may face barriers to PA themselves and for their children due to cultural norms or lack of access to safe and affordable PA options (Hornby-Turner et al., 2014; Trigwell et al., 2015). In the following section, the associations between
parental sociodemographic characteristics, parental concerns towards their children PA, and children’s PA are discussed.

### 2.6.1 Parental Concerns Toward Children’s Physical Activity

Rhodes and colleagues (2020) emphasize the crucial role of parents in promoting PA among children through their support, facilitation, and encouragement. However, parental concerns regarding their children’s PA may serve as a major potential barrier (Norman et al., 2015), as they can affect the level of support, facilitation, and encouragement provided by parents. The existing literature suggests that parental concerns for their child’s PA are also specific to the context and may include, but not limited to, concerns about neighbourhood/road safety, stranger danger, and the child’s health and safety while engaging in PA (Carver et al., 2008; Rodríguez-Oliveros et al., 2011; Timperio et al., 2004).

Parental concerns regarding the safety of their children have been shown to have a negative association with children’s PA (Carver et al., 2008). Additionally, the safety concerns related to traffic can also hinder children’s engagement in active transportation (Timperio et al., 2004). A qualitative study examining parental perceptions and practices related to children’s PA found that one of the barriers to PA among children was the parental concern that their child may become ill when interacting with other children in spaces commonly used for PA, such as parks and sporting centres (Rodríguez-Oliveros et al., 2011). Furthermore, Jackson and colleagues (2008) examined parental concerns related to the amount of their child’s PA and whether these concerns affect their children’s PA levels (MVPA min/day). The results indicated that parents who expressed concerns about their child’s PA levels had children who engaged in less PA compared to parents who did not have such concerns.
The COVID-19 pandemic has likely exacerbated parental concerns toward children’s PA. McCormack and colleagues (2020) examined the association between parental anxiety related to COVID-19 and their children’s PA during the pandemic. The results indicated that parents who reported high anxiety levels, in comparison to those with low anxiety levels, reported that their children engaged in less PA both at home and outdoors. (McCormick et al., 2020). Furthermore, children with parents who reported high anxiety levels visited parks fewer days in a month than children with parents who reported low anxiety levels (McCormick et al., 2020). The researchers also noted that heightened anxiety among parents is likely to result in increased adherence to COVID-19 guidelines and restrictions, leading to the restriction of their children’s PA out of fear for their family’s health (McCormick et al., 2020).

2.6.2 Potential Links Between Parental Sociodemographic Characteristics, Parental Concerns, and Children’s Physical Activity

Parents play a substantial role in providing opportunities for children’s PA (Rhodes, et al., 2019). In particular, sociodemographic characteristics of parents, such as gender, race/ethnicity, and socioeconomic status (e.g., education, occupation, income) have known to be strongly associated with children’s PA potentially via parental concerns toward children’s PA.

Parental gender is one of the major characteristics that is associated with parental PA, and it is also a factor that is associated with children’s PA. Generally, both father’s (Craig et al. 2013; Fuemmeler et al., 2011; Isgor et al. 2013; Jago et al., 2014; Vollemer et al., 2015) and mother’s PA levels (Craig et al., 2013; Fuemmeler et al., 2011; Jacobi et al., 2011) are known to be positively associated with children’s PA. Studies have found that mothers are
generally more involved in promoting PA for their children than fathers while fathers are known to influence children’s PA via modelling (Lloyd et al., 2014). This may be due to societal expectations and gender roles that assign primary responsibility for childcare to mothers. Specifically, parental gender roles may have a significant impact on the child's PA levels (Solomon-Moore et al., 2018). In traditional gender roles, men are often seen as the primary breadwinners and may spend more time at work, leaving less time at home with their children. Women, on the other hand, are often responsible for the majority of child-rearing duties (Tilly, 1978). This division of labor can lead to differences in the way they support their children’s PA.

Mothers are also more likely to be concerned about their children’s weight and physical health and may therefore be more motivated to encourage PA for children (Lloyd et al., 2014). Amidst the COVID-19 pandemic, mothers transitioned from being primary caretakers to becoming full-time caregivers for their children (Parlak et al., 2020; Rosenfeld & Tomiyama, 2021). Along with school/childcare closures, mothers were primarily responsible for fulfilling their children’s daily needs including children’s PA. This shift in responsibility can be attributed to several factors, including a lack of changes in the spouse's work life, spouse’s disengagement from family responsibilities, and women taking on sole responsibility for household chores and child-rearing due to a lack of initiative from their partners (Parlak et al., 2020).

Parental visible minority and immigration statuses are also potential sociodemographic characteristics that can influence children's engagement in PA (Sallis & Owen, 1997). Studies have consistently found that children of parents who are visible minorities are less active compared to those of non-visible minorities (Brewer & Kimbro, 2014; Carsley et al., 2016;
Similarly, children of immigrant parents are less active compared to their native-born counterparts (Brewer & Kimbro, 2014; Imhof et al., 2016). Furthermore, recent and visible minority immigrants exhibit lower levels of PA compared to established and non-visible minority immigrants (Mahmood et al., 2019). There are several potential explanations for the lower engagement in PA among individuals who are visible minorities and/or immigrants. These may include cultural attitudes towards PA, lack of access to safe and affordable PA options, and language barriers (Brewer & Kimbro, 2014; Buijs et al., 2009; Caperchione et al., 2009; Hylton, 2010; Kloek et al., 2013). For example, some cultures may prioritize academic achievement over PA (Oh et al., 2019; Song et al., 2016), or may have limited options for safe outdoor play areas (Trigwell et al., 2015). Additionally, racial/ethnic disparities in healthcare and SES may also impact parental concerns about their children's PA levels (Lau et al., 2012; Patel et al., 2020).

The COVID-19 pandemic has further highlighted the PA disparities among visible minority and immigrant populations. Adolescents belonging to a racial/ethnic minority were less likely to meet the (MVPA) recommendation during the pandemic (Nagata et al., 2022) and immigrant youth engaged in less weekly PA during the pandemic than they did prior to the pandemic compared to non-immigrant youth (Colley and Watt, 2022). The underlying mechanisms that could explain these differences in PA could be attributed to the disproportionate impact of the pandemic on these communities (Nagata et al., 2022). Factors such as higher unemployment rates, higher likelihood of being front line workers, COVID-19 related morbidity and mortality, racism, classism, neighbourhood designs, and school closures have contributed to the unequal impact of the pandemic on these communities (Nagata et al., 2022).
These factors, either individually or combined, may have impacted the visible minority and/or immigrant parents’ ability to find opportunities for their children to engage in PA during the pandemic with heightened concerns (Nagata et al., 2022).

Parental education levels have also shown associations with children’s PA. In general, the literature suggests that parents with high education levels were positively associated with children’s PA, by recognizing the health benefits of PA and being able to afford quality PA and sport programs (Jiménez-Pavón et al., 2012). However, it is important to note that some research has shown negative or null associations between parental education and children’s PA (Glozah & Pevalin, 2015). For instance, time constraints faced by parents with higher education levels are found to limit parents’ ability to role model or co-engage in PA for their children (Glozah & Pevalin, 2015).

Research on the relationship between parental education and children’s PA during the COVID-19 pandemic is limited. However, Gilic and colleagues (2020) found that adolescents were more likely to engage in more PA if their father had a higher level of education (Gilic et al., 2020). This association may be explained by the fact that fathers with higher education levels have a better understanding of the health benefits of PA and may therefore be more motivated to encourage their children to be physically active (Gilic et al., 2020). Additionally, parents with higher education levels, who possess a better understanding of the benefits of PA, may also exhibit concerns regarding their child’s PA levels (Gilic et al., 2020; Trost & Loprinzi, 2011). Furthermore, higher education may lead to better-paying jobs, which can provide families with the financial means to enroll their children in afterschool sports or PA programs (Datar et al., 2014).
Studies have shown that parental employment status can be another contributing factor to children's engagement in PA. However, gender interactions may play a role in this relationship. For example, research has found that fathers working full-time or part-time may be negatively associated with children's light intensity physical activity (LIPA), while maternal full-time employment may be positively associated with their MVPA (Hesketh et al., 2006). One possible explanation for the negative association between parental employment and children’s PA could be the lack of time and energy due to employment constraints (Dwyer et al., 2008). On the other hand, positive associations between parental employment and children’s PA could be explained by the ability to afford afterschool sport or PA programs (Datar et al., 2014).

More research is needed to fully understand the complex relationship between parental employment and children's PA, especially in the context of the COVID-19 pandemic. Many parents work settings were altered during the COVID-19 pandemic from commuting to work to working from home full-time. (Dey et al., 2020). Early research indicated that when all adults were working from home, lower levels of PA among their children were observed (Pombo et al., 2020). However, when only one adult was working from home, it showed a positive association with children’s PA (Pombo et al., 2020). Factors that can contribute to the relationship between parent’s work arrangements and PA among children may be contributed to the increase in responsibilities and workplace needs. These needs included increased household and childcare tasks, the need for a quiet workplace in the home, and more responsibility for their child’s schooling (Pombo et al., 2020).

Overall, parental sociodemographic factors can influence children’s PA and parental concerns toward their children's PA levels, which may impact children's PA habits and overall
health outcomes. It is crucial to clarify this potential mechanism in order to identify a strategic intervention window for promoting PA among children. This can be done through testing a mediation role of parental concerns toward children’s PA in the relationship between parental sociodemographic characteristics and children’s PA. In the following section, different mediation techniques are discussed.

2.7 Mediation Analysis

Mediation is a statistical analysis widely used in psychology and other fields to examine the relationship between an independent variable (X) and a dependant variable (Y), and to determine the mediating variable (M) that explains the relationship between them (VanderWeele, 2016). Mediation analysis utilizes a series of linear regressions to determine the mediating effect allowing researchers to understand the underlying causal pathways and the ‘why’ behind the relationship between X and Y. As this thesis utilizes a mediation analysis, a brief review of different mediation analysis techniques is provided in this section.

This thesis delves into two widely used mediation techniques, the first being Baron and Kenny’s traditional method (1986) and the second being Preacher and Hayes’ method (2004). Baron and Kenny’s approach to mediation analysis involves several steps, which require conducting multiple linear regressions (Baron & Kenny, 1986). Briefly, a linear regression is first performed to establish statistical significance between the independent and dependent variables (path c). Second, a statistically significant linear regression must be demonstrated between the independent variable and the mediating variable (path a). Third, a statistically significant linear regression between the mediating variable and dependent variable must exist (path b). Finally, the linear regression on direct effect needs to be examined after controlling for the mediating variable (path c’). If the mediator nullifies the
direct relationship, full mediation is observed, while if a reduction occurs in the direct relationship, then partial mediation can be concluded (Baron & Kenny, 1986).

Baron and Kenny approach to testing the significance of mediators, despite being popularized, has faced criticism. In response, Baron and Kenny proposed alternative methods, such as the Sobel test (Pardo & Roman, 2013), which calculates the significance of a mediator by finding the product of coefficients (Sobel, 1982). If the Sobel test draws statistical significance, the product coefficients are compared to the direct path of Baron and Kenny’s model (Baron & Kenny, 1986). However, the Sobel test has limitations, such as depending on distributional assumptions. To address limitations, researchers have suggested to use a bootstrapping approach (Preacher & Hayes, 2004), which is more appropriate for smaller sample sizes and provides a more accurate estimate of the true $p$-value (Hair et al., 2019).

Recognizing the limitations associated with Baron and Kenny’s mediation and the Sobel test, the Preacher and Haynes’ bootstrapping approach has become the most commonly used approach in the test of mediation in recent years. Haynes (2017) developed plug-ins for various statistical software called the PROCESS macro, which enables high-level bootstrapping and simultaneous linear regressions, thereby increasing the robustness of results and providing highly accurate significance levels (Haynes, 2017).

2.8 Summary and Conclusion

In this section, the literature on the benefits of PA among children is summarized, along with studies on children’s PA levels before and after the COVID-19 pandemic. Furthermore, potential correlates of children’s PA are reviewed within the SEM framework (Sallis et al., 2006). Previous literature identified that parental concerns toward children's PA may be influenced by parental sociodemographic characteristics such as gender,
race/ethnicity, and socioeconomic status (SES). Moreover, the literature on the impact of the COVID-19 pandemic on children’s PA suggested that parental concerns toward children’s PA has exacerbated due to public health restrictions imposed by the pandemic. For instance, as schools and daycare centres closed and public spaces became restricted, parents and children were forced to spend more time together at home, creating challenges for parents to positively influence and support their children’s PA during the difficult time of disaster, particularly among those from vulnerable communities.

Within this context, it is largely unknown if there is an underlying mechanism linking parental sociodemographic characteristics and concerns toward PA that co-influences children’s PA. Specifically, whether parental concerns during the COVID-19 pandemic mediated the relationship between parental sociodemographic correlates and children’s PA is unknown.
2.9 References


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Chapter 3
Parental Sociodemographic Characteristics, Parental Concerns, and Children’s Physical Activity During the COVID-19 Pandemic

3.1 Abstract

INTRODUCTION: Physical activity (PA) is key to children's health, but nearly half of Canadian children do not meet the recommended levels, which has been exacerbated by the COVID-19 pandemic. Identifying correlates and mechanisms influencing PA can inform public health policies and interventions, especially during health crises.

OBJECTIVES: To examine the associations between parental sociodemographic characteristics, parental concerns for the amount of PA among their children, and children's PA and if parental concerns for the amount of PA among their children mediated the relationship between parental sociodemographic characteristics and children's PA.

METHODS: Proxy-reported data from the 2020 Statistics Canada survey, Impacts of COVID-19 on Canadians - Parenting during the Pandemic collected from 5,863 parents of children aged 6-14 years were used. Multiple logistic regressions, Spearman correlations, and mediation analyses were utilized.

RESULTS: The study's respondents consisted mainly of women (91.2%), with most respondents having a university education (74.3%). A majority (89.3%) were Canadian-born and identified themselves as not a visible minority (91.9%). More than half of the parents were employed, either working from home (53.4%), outside the home (15.7%), or a combination (30.9%), with 87.9% maintaining their job throughout the pandemic. Almost half of parents expressed high
concerns for the amount of PA among their children (47.7%) and reported their children had low-moderate PA levels during the pandemic (46.7%). Parents without a university education (OR 1.38, 95% CI 1.18,1.62) and with high level of concerns for the amount of PA among their children (OR 3.91 95% CI 3.44, 4.46) were associated with low-moderate PA among their children. Parental concerns for the amount of PA among their children also partially mediated the relationship between parental visible minority status and children’s PA (47%) and parental immigration status and children's PA (33%), respectively.

**CONCLUSIONS:** Parents, particularly their concerns and education levels, may play an important role in shaping children’s PA. Also, parents and children from marginalized groups including visible minority and immigrants, may require more support and resources to increase their opportunities and access to PA participation. Future intervention strategies for PA promotion efforts ma focus on children within these communities as we recover from the pandemic.

### 3.2 Introduction

Health benefits of engaging in regular physical activity (PA) among children are well established (Carson et al., 2017). In 2016, the 24-Hour Movement Guidelines were developed, spearheaded by Canadian researchers (Tremblay et al., 2016). Within these guidelines, behavioural recommendations are ascribed to children and youth aged 5-17 years for PA, sedentary behaviour, and sleep (Tremblay et al., 2016). In particular, the PA recommendation suggests children and youth to participate in moderate- to vigorous-intensity PA (MVPA) for at least 60 minutes daily (Tremblay et al., 2016). Despite these efforts, almost half (49%) of Canadian children and youth are failing to meet the recommended level of PA (ParticipACTION, 2022).
The COVID-19 pandemic, which was announced in early 2020, may have negatively contributed to already low levels of PA among Canadian children (Guerrero et al., 2020; Moore et al., 2020). This may be because of community-wide lockdowns and stay-home orders implemented to minimize the transmission of COVID-19 infections. Subsequently, parks, schools, and afterschool programs were completely or partially closed (Guerrero et al., 2020; Moore et al., 2020). According to a report from ParticipACTION (2022), only 37% of children and youth aged 5-17 years met the PA recommendations in the fall of 2020. This represents a 14% decrease from the pre-COVID-19 era (51%). Reviews conducted during the pandemic on children’s PA revealed that, just one year into the pandemic, a substantial decrease in children’s PA was observed (Caputo & Reichert, 2020; Kharel et al., 2021; Paterson et al., 2021; Rossi et al., 2021). It is also noted that changes in health behaviours due to the pandemic, such as lowered PA among children, may persist even after the pandemic is over (Kovacs et al., 2022). This highlights the importance of promoting and fostering PA participation among children as we move forward in the post-COVID-19 era.

To promote PA among children, identifying important correlates and mechanisms among the correlates that explain the lowered level of PA during the COVID-19 pandemic is required. The socioecological model (SEM) outlines that health behaviour can be influenced by multiple levels of correlates (Spence & Lee, 2003). Among different layers of influence, interpersonal level correlates are known to be important for children. Specifically, parents may play an important role in facilitating their children’s PA (Rhodes et al., 2020). Parental sociodemographic characteristics, such as age, sex/gender (Rosenfeld & Tomiyama, 2021; Solomon-Moore et al., 2018), race/ethnicity (Colley & Watt, 2022), and socioeconomic status (SES) (Dwyer et al., 2008; Gilic et al., 2020; Hesketh et al., 2006; Jiménez-Pavón et al., 2012;
Pombo et al., 2020) are known to be important in influencing children’s PA (Gustafson & Rhodes, 2006).

Research suggests that in addition to parental sociodemographic characteristics, parental concerns about their children’s PA may also be a key factor influencing their children’s PA levels. (Boufous & Bauman, 2004; Datar et al., 2013; Heitzler et al., 2006; Jackson et al., 2008; Loprinzi et al., 2012; Romero et al., 2001). For example, parents who are more concerned about their children’s PA levels were shown to have a child who is less physically active than those with parents who are not as concerned (Jackson, et al., 2008). Parental concerns about their children’s PA have also shown to vary by parental sociodemographic characteristics. For example, Lack of knowledge about supporting and promoting PA for children and absence or lack of PA facilities were identified as main concerns among ethnically diverse parents in the UK (Rawlins et al., 2013).

The COVID-19 pandemic may have further exacerbated already low levels of PA among children from vulnerable groups, including those from racial/ethnic minority communities who were less likely to meet the recommended level of PA during this period (Nagata et al., 2022). Preliminary research indicated that the pandemic has led to an increase in parental concerns about their children’s PA, which may have contributed to the opportunities for PA among children (McCormack et al., 2020). It is important to understand how parental sociodemographic characteristics and concerns were related to children’s PA during public health crises, such as the COVID-19 pandemic. Moreover, examining the underlying mechanisms that explain the complex relationships between different correlates of PA, utilizing a mediation analytic technique, instead of treating as co-exposures, can provide valuable insights into disparities in children's PA.
Parental concerns about children's PA may be influenced by factors such as sociocultural factors that are relevant to parental sociodemographic characteristics. For instance, ethnically diverse parents in the UK were reported to have heightened concerns about their children's engagement in PA due to concerns for safety, adverse weather events, lack of resources, and lack of access (Trigwell et al., 2015). Parental concerns may also be shown differently by sociocultural factors. For instance, one study reported that British Pakistani girls face more barriers to PA than their White British counterparts, one of the reasons being heightened parental concerns around safety (Hornby-Turner et al., 2014).

Understanding the complex relationships between the correlates of PA during the COVID-19 pandemic can help better inform interventions and policies aimed at promoting children's PA during times of public health crises. Therefore, the objectives of the study were to examine 1) the associations between parental sociodemographic characteristics, parental concerns, and children’s PA and 2) whether parental concerns about children’s PA mediates the association between parental sociodemographic characteristics and children’s PA.

3.3 Study Design and Methods

3.3.1 Data Source and Study Participants

The present study utilized data from the *Impacts of COVID-19 on Canadians - Parenting during the Pandemic 2020*, which is a cross-sectional crowdsourcing survey consisting of parents with children aged less than 15 years old from various regions of Canada (Statistics Canada, 2020). The aim of the survey was to explore the impact of the COVID-19 pandemic on parental concerns and experiences related to their children's health and social life. Data were collected online from June 9th to 22nd in 2020, using a self-administered, proxy-reported questionnaire available at [http://www.statcan.gc.ca/COVIDparenting-questionnaire](http://www.statcan.gc.ca/COVIDparenting-questionnaire). Participation
for the survey was voluntary and facilitated through diverse platforms such as social media, agencies, public/private organizations, and news channels. Participants were required to meet the following two inclusion criteria to participate in the survey: 1) residing in one of the 10 eligible provinces of Canada and 2) being able to read in either English or French. A non-probabilistic approach was employed for recruitment, and the questionnaire included various items related to family composition, health and social impacts, labor market impacts, and sociodemographic characteristics. A total of 32,228 parents completed the questionnaire, and only parents of children aged 6-14 years (n = 5,863) were included in the analysis. Furthermore, variables indicating parental sociodemographic characteristics, parental concerns, and their children’s PA were included. Implicit consent was obtained when participants chose to complete the questionnaire. Ethics approval was not deemed necessary as the study relied solely on anonymized secondary data, thereby ensuring the protection of the privacy and confidentiality of study participants.

3.3.2 Exposure Variables

3.3.2.1 Parental Visible Minority Status

Visible minority status is a term that pertains to an individual's racial and ethnic identity (Ma, 2022). Race and ethnicity are complex concepts that have distinct meanings within research, and their definitions can vary depending on the context and the social, cultural, and historical factors that shape them (Suyemoto et al., 2020). While race is often colloquially understood as referring to biological differences, research recognizes that race is a socially constructed category that reflects historical and cultural contexts and is shaped by power relations and social hierarchies (Suyemoto et al., 2020). Similarly, ethnicity is not simply a matter of cultural differences, such as language and religion, but also reflects complex social,
historical, and political processes that shape identity and belonging (Suyemoto et al., 2020). In
d official use, Statistics Canada employs the term ‘visible minority’ to refer to individuals who do
not identify as White or Indigenous Canadians1.

Parents were asked to indicate their visible minority status using the “select all that
apply” question format. The response options included "White," "South Asian," "Chinese,"
"Japanese," or "Other." These were subsequently grouped into two categories: visible minority
"West Asian," "Korean," "Japanese," "Other") and non-visible minority ("White"). “Not Stated”
responses were recoded as missing and were excluded from the analysis.

3.3.2.2 Parental Immigration Status

Immigration status refers to an individual's legal status as a foreign-born or non-national
entity (Urquia & Gagnon, 2011). A foreign-born individual is someone who was born in a
country or state other than their current country of residence, regardless of their citizenship or
legal status (Urquia & Gagnon, 2011). On the other hand, a non-national or foreigner is someone
who does not have citizenship or permanent residency in the country they reside in, regardless of
their country of birth (Urquia & Gagnon, 2011).

To obtain the immigration status of parents, the following three questions were asked:
“Where were you born?”, with response options including “Born in Canada” or “Born outside
Canada”, “Are you a Canadian citizen?” with response options including “Yes, a Canadian
citizen”, “Yes, a Canadian citizen by naturalization” and “No, not a Canadian citizen”, and

1 The terms racialized people/groups instead of visible minority group/population have increasingly been utilized by
academia and media however Stats Canada continue to use the term visible minority as it is currently utilized in the
Employment Equity Act (Statistics Canada, 2022).
finally, “Are you a landed immigrant or permanent resident?” with response options including “Yes” (landed immigrant or permanent resident) or “No”. Together, these responses informed the recoding of categorizing participants as immigrants or Canadians. “Not Stated” responses were recoded as missing and were excluded from the analysis.

3.3.2.3 Parental Gender

Gender is a social construct that encompasses societal expectations, behaviours, and roles associated with being a woman or man or girl or boy (World Health Organization, 2023). The term gender has been used interchangeably with sex; however, sex refers to biological characteristics assigned at birth as either male or female (Canadian Institutes of Health Research, 2020).

The survey asked parents to indicate their ‘gender’ with the following response options: “Male”, “Female”, and “Please specify”. In this study, the term ‘gender’ and gender-related terms (i.e., men, women) were used consistently as PA behaviour is largely gendered (Irvine et al., 2022).

3.3.2.4 Parental Education

Education is typically measured by the attainment of institutional credentials, including certificates, grades, diplomas, and degrees. The survey asked parents “What is the highest certificate, diploma or degree that you have completed?” The response options included: “Less than high school diploma or its equivalent”, “High school diploma or a high school equivalency certificate”, “Trade certificate or diploma”, “College/CEGEP/other non-university certificate or diploma”, “University certificate or diploma below the bachelor’s”, “Bachelor’s degree university certificate”, “Diploma”, or “Degree above the BA level”. The first five response options were reclassified into the dichotomous variable: < University education
(College/CEGEP/other non-university certificate or diploma” and lower) and ≥ University education (“University certificate or diploma below the bachelor’s,” “Bachelor’s degree university certificate,” “Diploma,” and “Degree above the BA level”). “Not Stated” responses were recoded as missing and were excluded from the analysis.

3.3.2.5 Parental Employment Status

The term ‘employment status’ refers to whether an individual is currently employed, unemployed, or not in the labor force. In the context of the COVID-19 pandemic, it may also refer to changes in the duration or number of hours worked due to job loss, furloughs, or reduced working hours due to the pandemic.

The survey asked parents “During the COVID-19 pandemic, which of the following statements apply to family members living in your home?” with the following statement, “Someone in my family lost their job, was laid off, or has reduced work hours due to COVID-19” with the following response options: “Yes” or “No”. “Not Stated” responses were recoded as missing and were excluded from the analysis.

3.3.2.6 Parental Working Arrangement

Dey and colleagues (2020) classified working arrangements as modifications in work settings from public spaces to private spaces, specifically within individuals' homes, to mitigate the transmission of COVID-19. The survey asked parents to indicate their working arrangements with the following three questions: “During the COVID-19 pandemic, which of the following statements apply to family members living in your home? 1) Someone in my family is working at a fixed location outside the home; 2) someone in my family is working outside the home with no fixed location, and 3) someone in my family is working from home” with the following response options: “Yes” or “No”. For statistical purposes, the responses were reclassified as
working from home, working outside, and mixed. “Not Stated” responses were recoded as missing and were excluded from the analysis.

3.3.3 Exposure/Mediating Variable

3.3.3.1 Parental Concerns of Children’s Physical Activity

Parental concerns were operationalised as the concerns the parent’s had for the amount of PA their child was obtaining during the COVID-19 pandemic.

The survey asked parents “Due to the COVID-19 pandemic, how concerned are you about the following for your child or children aged 0 to 14 years? – Amount of physical activity”. Response options included “Not at all”, “Somewhat”, “Very”, or “Extremely”. Parental concerns of children’s PA were categorized into two groups: low concern (“Not at all or Somewhat”) or high concern (“Very or Extremely”). “Not Stated” responses were recoded as missing and were excluded from the analysis.

3.3.4 Outcome Variable

3.3.4.1 Children’s Physical Activity

The survey asked parents “On average, during the COVID-19 pandemic, how often has your child or have your children engaged in any of the following activities at home? - Physical activities”. Response options included “Never”, “1 to 2 times per week”, “3 to 5 times per week”, “Daily or almost every day”. Children’s PA was categorized into two groups: low to moderate PA (“Never, 1-2 times per week, or 3 to 5 times per week”) and high PA (“Almost every day or Daily”). “Not Stated” and “Valid skip” responses were recoded as missing and were excluded from the analysis.
3.3.5 Covariates

Key variables examined in this study were also used as covariates due to their established association with children’s PA. These covariates included parental visible minority status (visible minority or non-visible minority) (Hornby-Turner et al., 2014), parental immigration status (immigrant or non-immigrant) (Imhof et al., 2016), parental gender (man or woman) (Lloyd et al., 2014), parental education (less than university or greater/equal to university) (Jiménez-Pavón et al., 2012), parental employment status (unemployed/reduced hours or employed) (Datar et al., 2014), and parental working arrangements (work from home, work outside of home, or mixed) (Pombo et al., 2020).

3.3.6 Statistical Analysis

IBM SPSS Version 28.0 (IBM Corp) was employed for all statistical analyses. A complex samples (CS) plan procedure was utilized to account for sample weights, as recommended by Zou and colleagues (2019). CS frequency statistics and corresponding 95% confidence intervals (95% CI) were calculated to describe the sample characteristics. CS multiple logistic regressions were utilized to explore the odds of children engaging in low to moderate PA/week according to parental sociodemographic characteristics and parental concerns for the amount of PA among their children.

To explore the potential mediation effect of parental concerns for the amount of PA among their children on the relationship between parental sociodemographic characteristics and children’s PA, correlations among parental sociodemographic characteristics, parental concerns for the amount of PA among their children and children’s PA were examined using Spearman correlations to first test which variables to use for mediation analysis. To qualify for mediation analysis, each parental sociodemographic variable must show a statistically significant ($p < .001$)
correlation to both parental concerns for the amount of PA among their children and children’s PA. If no correlations ($r = 0.00$) or high correlations ($r > 0.90$) are observed, those variables must be excluded from the mediation analyses (Tabachnick et al., 2007). If there was a variable that qualified for further mediation analysis, a mediation analysis was performed using the PROCESS macro for SPSS, employing the bootstrap method to test the indirect effects of parental sociodemographic characteristics on children’s PA through parental concerns about the amount of PA among their children. Total effect ($c$), direct effect ($c’$) and indirect effect ($ab$) were examined based on unstandardized beta coefficients and 95% CIs for indirect effect only. According to Hayes (2017), interpreting the results based only on standardized coefficients when using binary variables because they are affected by the number of cases in each category and by differences between the averages of the two groups (Hayes, 2017). Also, standardized beta coefficients do not make it easy to compare average values and the relative indirect effects between groups (Hayes, 2017). Therefore, unstandardized coefficients were reported ($B$). These unstandardized coefficients indicate the mean difference between each path in mediation models (Hayes, 2017). Finally, to determine the size of effect of mediation, Hair and colleagues (2019) suggested using Variance Accounted For (VAF) values obtained by dividing the indirect effect by the total effect. VAF value surpassing 80% denotes complete mediation, while a value between 20% and 80% suggests partial mediation, and a VAF value below 20% implies that no mediation is present (Hair et al., 2019). Assumptions for multiple logistical regression and mediation analysis were examined to ensure no violation. Statistical significance was set at $p < .001$ for all analyses.
3.4 Results

Table 1 describes the sample characteristics consisting of 5,863 parents. A majority of parents who completed the survey identified as woman (91.2%), and a significant proportion of them had an education level greater than or equal to the university education (74.3%). Among a member of the family who has been in the labour force before the pandemic, 67.9% did not experience job loss or reduced hours, 53.4% reported working from home, while 30.9% reported a mixed working arrangement. In terms of parental demographic characteristics, 91.9% of parents identified as White and 89.3% reported that they are a Canadian citizen. In relation to parental concerns about the amount of PA among their children during the COVID-19 pandemic, 53.3% of parents reported high levels of concerns for the amount of PA among their children. As for the children's PA levels during the pandemic, it was observed that 53.6% of children engaged in high levels of PA.
### Table 1

**Sample Characteristics**

<table>
<thead>
<tr>
<th>Key Variables</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>5,863</td>
</tr>
<tr>
<td><strong>Parental Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Women: 91.2 (90.2-92.0)</td>
</tr>
<tr>
<td></td>
<td>Men: 8.8 (8.0-9.8)</td>
</tr>
<tr>
<td>Education levels</td>
<td></td>
</tr>
<tr>
<td>&lt; University degree</td>
<td>25.7 (24.4-7.1)</td>
</tr>
<tr>
<td>≥ University degree</td>
<td>74.3 (72.9-75.6)</td>
</tr>
<tr>
<td>Work arrangement of family members</td>
<td></td>
</tr>
<tr>
<td>Working from home</td>
<td>53.4 (51.9-54.9)</td>
</tr>
<tr>
<td>Working outside</td>
<td>15.7 (14.6-16.8)</td>
</tr>
<tr>
<td>Mixed</td>
<td>30.9 (29.5-32.3)</td>
</tr>
<tr>
<td>Employment status (Lost job/reduced hours)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32.1 (30.7-33.6)</td>
</tr>
<tr>
<td>No</td>
<td>67.9 (66.4-69.3)</td>
</tr>
<tr>
<td>Visible minority status</td>
<td></td>
</tr>
<tr>
<td>Visible minority</td>
<td>8.1 (7.4-9.0)</td>
</tr>
<tr>
<td>Non-visible minority (White)</td>
<td>91.9 (91.0-92.6)</td>
</tr>
<tr>
<td>Immigration status</td>
<td></td>
</tr>
<tr>
<td>Immigrant or non-permanent resident</td>
<td>10.7 (9.8-11.7)</td>
</tr>
<tr>
<td>Canadian</td>
<td>89.3 (88.3-90.2)</td>
</tr>
<tr>
<td>Concerns for the amount of PA among children</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>53.3 (50.8-53.9)</td>
</tr>
<tr>
<td>High</td>
<td>47.7 (46.1-49.2)</td>
</tr>
<tr>
<td><strong>Children’s Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
</tr>
<tr>
<td>Low to moderate PA (0-5 times a week)</td>
<td>46.4 (44.9-48.0)</td>
</tr>
<tr>
<td>High PA (6-7 times per week)</td>
<td>53.6 (52.0-55.1)</td>
</tr>
</tbody>
</table>

*Note* 95% CI= 95% Confidence Interval.
Table 2 presents the results of the associations between parental sociodemographic characteristics, parental concerns for the amount of PA among their children, and children’s PA. Parents without a university education were more likely to have children engaged in low to moderate PA/week compared to those with a university education or higher (OR 1.38, 95% CI 1.18, 1.62). Additionally, parents who expressed high concerns for the amount of PA among children during the COVID-19 pandemic were more likely to report their children participating in low to moderate PA/week compared to parents with low concerns (OR 3.91, 95% CI 3.44, 4.46).
Table 2

Multiple Logistic Regression between Parental Sociodemographic Characteristics, Parental Concerns, and Low to Moderate Levels of Children’s Physical Activity

<table>
<thead>
<tr>
<th>Parental Sociodemographic Characteristics/Concerns</th>
<th>Children’s PA Low to moderate PA OR (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Woman</td>
<td>Woman Ref.</td>
</tr>
<tr>
<td>Man</td>
<td>0.78 (0.62-0.98)</td>
</tr>
<tr>
<td>Education levels</td>
<td></td>
</tr>
<tr>
<td>&lt; University</td>
<td>1.38 (1.18-1.62)</td>
</tr>
<tr>
<td>≥ University</td>
<td>Ref.</td>
</tr>
<tr>
<td>Work arrangement of family members</td>
<td></td>
</tr>
<tr>
<td>Work from home</td>
<td>Work from home Ref.</td>
</tr>
<tr>
<td>Not working from home</td>
<td>1.04 (0.90-1.21)</td>
</tr>
<tr>
<td>Mixed</td>
<td>1.13 (0.92-1.38)</td>
</tr>
<tr>
<td>Employment status (Lost job/reduced hours)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Yes Ref.</td>
</tr>
<tr>
<td>No</td>
<td>0.90 (0.78-1.04)</td>
</tr>
<tr>
<td>Visible minority status</td>
<td></td>
</tr>
<tr>
<td>Visible minority</td>
<td>Visible minority Ref.</td>
</tr>
<tr>
<td>Non-visible minority (White)</td>
<td>1.19 (0.93-1.53)</td>
</tr>
<tr>
<td>Immigrant status</td>
<td></td>
</tr>
<tr>
<td>Immigrant or non-permanent resident Canadian</td>
<td>Immigrant or non-permanent resident Canadian Ref.</td>
</tr>
<tr>
<td>1.15 (0.92-1.45)</td>
<td></td>
</tr>
<tr>
<td>Concerns for the amount of PA among children</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>High Ref.</td>
</tr>
<tr>
<td>Low</td>
<td>3.91 (3.44-4.46)</td>
</tr>
</tbody>
</table>

Note. Statistically significant associations are in **bold** (*p* < .001); PA = Physical activity; Ref. = Reference category; Outcome reference category for low to moderate PA = high PA.
Spearman correlation analysis was conducted to examine the correlations between parental sociodemographic characteristics, parental concerns for the amount of PA among their children, and children’s PA and to determine which variables to use in the subsequent mediation models. The results presented in Table 3 indicated that parental immigration and visible minority statuses were the only parental sociodemographic characteristics that demonstrated a statistically significant correlation with parental concerns for the amount of PA among their children and their children’s PA. Specifically, parental visible minority status \((\rho = -0.09, n = 5863, p < .001)\) and parental immigration status \((\rho = -0.07, n = 5863, p < .001)\) were found to be negatively correlated with concerns related to the amount of PA among their children. Moreover, parental visible minority status \((\rho = 0.06, n = 5863, p < .001)\) and parental immigration status \((\rho = 0.05, n = 5863, p < .001)\) were positively correlated with children’s PA. Therefore, two separate mediation models were examined in this study. The first model explored the mediating effects of parental concerns for the amount of PA among their children on the relationship between parental visible minority status and children’s PA. The second model explored the mediating role of parental concerns for the amount of PA among children in the relationship between parental immigration status and children's PA.

In Figure 3, the results of a mediation analysis between parental visible minority status, parental concerns for the amount of PA among their children, and children’s PA are presented. In the analysis, path \(a\), representing the relationship between parental visible minority status (1 = visible minority status; 2 = non-visible minority) and parental concerns for the amount of PA among their children, suggested that there is a negative association between parental visible minority status and parental concerns for their children’s PA (path \(a\): \(B = -0.25, p < .001\)). This indicates that parents of visible minority status reported higher concerns for the amount of PA
among their children. Path $b$ shows the relationship between parental concerns for the amount of PA among their children and children's PA. It indicates that with higher parental concerns for the amount of PA among their children, lower PA among children is observed (path $b$: $B = -0.30, p < .001$). Path $c$ revealed a statistically significant total effect (path $c$: $B = 0.15, p < .001$) between parental visible minority status and children’s PA. Path $c'$ indicated a direct effect (path $c'$: $B = 0.08, p = .03$). The decrease in the direct effect from the total effect suggests partial mediation. Specifically, parental concerns for the amount of PA among their children demonstrated a statistically significant indirect effect (path $ab$: $B = 0.07$, CI: 0.05, 0.10) on the relationship between parental visible minority status and children's PA, which partially mediated the total effect (path $c$) by 47%.

In Figure 4, the results of a mediation analysis between parental immigration status, parental concerns for the amount of PA among their children, and children’s PA are presented. Path $a$ representing the relationship between parental immigration status (1 = immigrant, 2 = Canadian-born) and parental concerns for the amount of PA among their children, suggested that parents have the immigrant status is associated with low levels of PA among their children (path $a$: $B = -0.11, p < .001$). Path $b$ showed the relationship between parental concerns for the amount of PA among their children and children's PA, indicating that with higher parental concerns for the amount of PA among their children, lower PA among children is observed (path $b$: $B = -0.30, p < .001$). Path $c$ revealed a total effect (path $c$: $\beta = 0.09, p = .007$) between parental immigrant status and children’s PA and path $c'$ indicated the direct effect (path $c'$: $B = 0.06, p = .06$). The decrease in the direct effect from the total effect suggests partial mediation. Specifically, parental concerns for the amount of PA among their children showed a statistically significant indirect
effect (path $ab$: $B = 0.03$, CI 0.01, 0.06) on the relationship between parental immigration status and their children’s PA, which partially mediated the total effect (path $c$) by 33%.
### Table 3

*Spearman Correlations between the Key Variables*

<table>
<thead>
<tr>
<th>Key Variables</th>
<th>Gender</th>
<th>Education levels</th>
<th>Work arrangement of family members</th>
<th>Employment status</th>
<th>Visible minority status</th>
<th>Immigration status</th>
<th>Concern for the amount of physical activity</th>
<th>Children’s physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-</td>
<td><strong>0.04</strong></td>
<td>-0.07</td>
<td><strong>0.05</strong></td>
<td>0.00</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.03</td>
</tr>
<tr>
<td>Education levels</td>
<td><strong>0.04</strong></td>
<td>-</td>
<td><strong>-0.17</strong></td>
<td><strong>0.15</strong></td>
<td><strong>-0.09</strong></td>
<td><strong>-0.10</strong></td>
<td>-0.01</td>
<td><strong>0.06</strong></td>
</tr>
<tr>
<td>Work arrangement of family members</td>
<td>-0.07</td>
<td><strong>-0.17</strong></td>
<td>-</td>
<td><strong>-0.09</strong></td>
<td>0.03</td>
<td>0.06</td>
<td>-0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Employment status</td>
<td><strong>0.05</strong></td>
<td><strong>0.15</strong></td>
<td>-0.09</td>
<td>-</td>
<td>0.02</td>
<td>0.03</td>
<td>-0.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>Visible minority status</td>
<td>0.00</td>
<td><strong>-0.09</strong></td>
<td>0.03</td>
<td>0.02</td>
<td>-</td>
<td><strong>0.40</strong></td>
<td><strong>0.08</strong></td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td>Immigration status</td>
<td>-0.02</td>
<td><strong>-0.10</strong></td>
<td>0.06</td>
<td>0.03</td>
<td><strong>0.40</strong></td>
<td>-</td>
<td><strong>0.06</strong></td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td>Concern for the amount of physical activity</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.02</td>
<td>-0.02</td>
<td><strong>0.08</strong></td>
<td><strong>0.06</strong></td>
<td>-</td>
<td><strong>0.32</strong></td>
</tr>
<tr>
<td>Children’s physical activity</td>
<td>-0.03</td>
<td><strong>0.06</strong></td>
<td>0.00</td>
<td>-0.01</td>
<td><strong>0.04</strong></td>
<td><strong>0.04</strong></td>
<td><strong>0.32</strong></td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Statistically significant correlations are in **bold** ($p < .001$).
Figure 3
A Mediation Model Explaining the Relationship Between Parental Visible Minority Status, Parental Concerns for the Amount of Children’s Physical Activity, and Children’s Physical Activity (PA)

Parental visible minority status

-0.25

Parental concerns for PA

0.15

Children’s PA

Indirect effect = 0.07

-0.30

Children’s PA

Note. *Unstandardized coefficients (b) are reported for each path.

Parental visible minority status: 1 = visible minority, 2 = White; parental concerns for the amount of PA: 1 = low concerns, 2 = high concerns; Children’s PA: 1 = low PA, 2 = high PA.

Statistically significant associations are in **bold** \( p < .001 \).
**Figure 4**

*A Mediation Model Explaining the Relationship Between Parental Immigration Status, Parental Concerns for the Amount of Children’s Physical Activity, and Children’s Physical Activity (PA)*

Note. *Unstandardized coefficients (b) are reported for each path.

Parental immigration status: 1 = immigrant, 2= Canadian-born; parental concerns for the amount of PA: 1 = low concerns, 2 = high concerns; Children’s PA: 1 = low PA, 2 = high PA. Statistically significant associations are in **bold** (*p* < .001).
3.5 Discussion

This study explored the relationships among parental sociodemographic characteristics, parental concerns for the amount of PA among their children, and children's PA during the early phase of the COVID-19 pandemic. Moreover, the potential mediating role of parental concerns for the amount of PA among their children in the association between parental sociodemographic characteristics and children's PA was examined using the same data. The results indicated having a parent who did not have university education was more likely to have children who engaged in low to moderate PA/week during the time that stay-home public health restrictions were imposed. Furthermore, it was observed that parents who expressed heightened concerns for the amount of PA among their children during the initial stages of COVID-19 pandemic displayed a higher likelihood of their children's participating in low to moderate PA/week. Additionally, parental concerns for the amount of PA among their children showed a partial mediating effect on the relationship of parental visible minority status and children’s PA as well as on the relationship of parental immigration status and children’s PA.

A key finding of this study is that parental education may be an important correlate of children’s PA during the COVID-19 pandemic. This finding is consistent with previous research suggesting that parents with higher educational attainment may possess greater knowledge about the health benefits of PA and may have more resources to provide support and encouragement for their children to engage in more PA (Davis-Kean, 2005; Dubow et al., 2009).

The present study also highlighted that parental concerns are related to children’s PA during the COVID-19 pandemic, with more concerns among parents being associated with low to moderate PA/week among children. This finding is consistent with previous research
conducted by Jackson and colleagues (2008), who noted that greater parental concerns for their children’s PA levels are associated with low PA participation among children. Recent research by McCormack and colleagues (2022) revealed that parental anxiety related to the COVID-19 pandemic was linked to reduced PA engagement and fewer park visits by children compared to those with parents who reported lower levels of anxiety. These findings, combined with the finding of this study, suggests that parental concerns heightened during the COVID-19 pandemic due to the possibility that infection may prevent children from engaging in adequate levels of PA throughout the week. This downward trend of PA participation among children during the COVID-19 pandemic was observed in several systematic and scoping reviews conducted based on data during the pandemic (Caputo & Reichert, 2020; Kharel et al., 2021; Paterson et al., 2021; Rossi et al., 2021).

Parental concerns showed a partial mediating effect on the relationships between parental visible minority and immigration status, respectively, and their children’s PA during the COVID-19 pandemic. These findings are similar to the observation made in samples from the UK before the pandemic. Specifically, parents with diverse ethnic backgrounds in the UK have reported difficulties and obstacles in their attempts to promote and sustain a healthy diet and PA for their children (Rawlins et al., 2013). The observed mediating role of parental concerns in relation to parental visible minority and immigrant statuses could also be linked to the vulnerability these individuals may have faced during the COVID-19 pandemic (Gopalan & Misra, 2020; Patel et al., 2020). With already low levels of PA observed among children from minority backgrounds (ParticipACTION, 2022), the COVID-19 pandemic may have contributed to further lowering the engagement of PA in this population group, with higher levels of parental concerns exhibited in this population group serving as a major barrier.
Another important thing to note is that parental visible minority status and immigration status may not have been mutually exclusive as it was shown in the moderate strength correlation coefficient between the two variables (\(\rho = 0.40, n = 5863, p < .001\)).

The results of this work can offer valuable insights that could inform future research and intervention strategies targeting these specific characteristics during a public health crisis like the COVID-19 pandemic. First and foremost, in our post-pandemic recovery phase, it is essential to prioritize PA promotion efforts targeting children from visible minority and immigration backgrounds. Combined with our results, previous research indicated that parents from diverse ethnic backgrounds often express barriers and obstacles to PA. These barriers and obstacles include lack of knowledge for the recommended amount of PA for their children, cost of PA, safety concerns which hinder PA engagement, and higher value in academic activities rather than physical activities (Rawlins et al., 2013). To address these concerns, greater promotion of the benefits and recommendations of PA (Efrat, 2011) and enhancing the accessibility and quality of environments where children live to increase their PA (Molnar et al., 2004) may prove beneficial within these communities. Such measures have the potential to alleviate parental concerns and facilitate increased PA participation among children from visible minority and immigration backgrounds. This research also underscores the crucial need to emphasize the value and advantages of PA to help foster more PA engagement.

Additionally, public health initiatives and polices should develop resources and support systems that could better facilitate PA among children, which may could ease parental concerns for children’s PA during times of future public health crises. For example, virtual physical education classes, virtual play dates, and detailed outdoor PA guidelines with safety measures in place. It is essential to ensure that these resources and support systems are accessible to
everyone. Finally, future studies should continue to investigate the intricate connections among multiple levels of factors that impact children’s PA within the SEM framework to better understand the pathways and mechanisms through which children’s PA behaviours are shaped. This will help to develop comprehensive and effective intervention strategies that address multiple focal points for promoting PA among children.

This study has some strengths. First and foremost, this study was conducted during the COVID-19 pandemic to investigate potential mechanisms between parental characteristics and children's PA utilizing a mediation analysis technique, highlighting the role of parental concerns in children’s PA. The findings also suggest that the risk of COVID-19 infection may have been equal, but opportunities for social participation such as PA were impacted differently by parental sociodemographic characteristics. Despite its strengths, the study has several limitations inherent to the study design. Its cross-sectional design prevents making causal inferences even with the use of mediation analysis. Therefore, temporality cannot be established. This study had a large sample size, but respondents were recruited based on a convenience sampling; thus, its generalizability to the broader Canadian population is limited. This study relied on proxy-reported data and potential recall and social desirability biases cannot be diminished. Children’s PA question was only applicable to a home setting given the nation-wide lockdowns during the data collection period. Finally, the findings from mediation analyses should be interpreted with caution due to the weak correlations observed among the key variables.

3.6 Conclusion

This study investigated the associations and mechanisms between parental sociodemographic characteristics, parental concerns, and children’s PA during the COVID-19
pandemic. The results of this study highlight the influence parents have on their children’s participation in PA. The study also highlights that children from marginalized families and communities may require more support and resources for equitable opportunities and access to PA. As we continue to navigate the process of recovery from the pandemic, future strategies promoting PA should prioritize these disadvantaged communities. To confirm and build on these findings, investigations using more robust methodologies (e.g., longitudinal, objective measures) are needed.
3.7 References


spinal posture and retinal vessel parameters in first graders in urban Switzerland. *Journal of Sports Sciences, 34*(13), 1271-1280.


Chapter 4

General Discussion

4.1 Study Summary

This thesis aimed to address two objectives. Firstly, it aimed to examine the associations among parental sociodemographic characteristics, parental concerns for the amount of PA among their children, and children's PA during the early stage of the COVID-19 pandemic. Secondly, it aimed to investigate whether parental concerns for the amount of PA among their children mediated the relationship between parental sociodemographic characteristics and their children's PA. The data utilized in this study was sourced from the 2020 Impacts of COVID-19 on Canadians - Parenting during the Pandemic survey conducted by Statistics Canada. This survey gathered responses from 5,863 parents with children aged 6-14 years. In order to achieve the study's objectives, multiple logistic regressions, Spearman’s correlations, and mediation analytic techniques were employed.

4.2 Summary of Key Findings

In summary, during the early stage of the COVID-19 pandemic, parents who did not have university education were more likely to have children engaging in low to moderate PA compared to those with a university education. Furthermore, higher parental concerns for the amount for PA among their children during the early stage of the COVID-19 pandemic corresponded with low to moderate PA among their children in comparison to parents with lower concerns for the amount of PA among their children during the time when stay-home restrictions were imposed. Parental concerns about their children’s PA levels also showed a partially mediating effect on the relationships between parental visible minority and parental
immigrant status, respectively, and children's PA during the early stage of the COVID-19 pandemic.

4.3 Strengths

This study possesses a few notable strengths. Firstly, though limited, this study provided evidence on potential mechanisms between parental characteristics and children’s PA, utilizing a mediation approach. We found that parental concerns for the amount of PA among their children may play a role in children’s PA during the early stage of the COVID-19 pandemic, particularly among children with parents of visible minority and immigrant communities. The importance of identifying mechanisms between different layers of influence has been highlighted as an area for further exploration in future PA research (Lee et al., 2021) and this study partially addressed such need. Another strength of this study is that data was collected during the recent public health crisis, the COVID-19 pandemic. The pandemic exacerbated already existing disparities in children’s PA with different backgrounds (Patel et al., 2020). Our study's findings reinforce the notion that while the risk of infection may be uniform across individuals irrespective of their backgrounds, the availability of opportunities and resources for social participation, such as engaging in PA, may have been unevenly affected.

4.4 Limitations

The present study has several limitations inherent to the cross-sectional, proxy-reported, convenience sampling data. Firstly, its cross-sectional design prevents making causal inferences (Webb et al., 2017) and, thus, it is important to acknowledge that the associations and mediations found in our study could very well be bi-directional. Therefore, future work
should use longitudinal data to build on our findings. Secondly, the data were collected using convenience sampling, which limits the generalizability of the findings to the broader Canadian population. For example, parental education levels were higher than the Canadian average (Statistics Canada, 2017). Given that Canada is becoming more and more diverse (Statistics Canada, 2022) and that our results point to the need for PA promotion among visible minority and immigrant communities, it may be important to study this population group to promote PA among all children living in Canada. Proxy-reported data on children’s PA may also introduced the risk of recall bias. Such bias may have been exacerbated by the tendency for parents to over-report their children's PA levels, influenced by social desirability (Adams et al., 2005). While objective measures such as accelerometers may minimize these biases (Trost, 2001), using an objective measure is often not feasible for a large-scale survey. Furthermore, given that this study was conducted during the COVID-19 pandemic, in-person administration would not have been feasible.

Limitations of this study extend beyond the study design and sampling, mainly specific to the COVID-19 pandemic-related constraints. Specifically, children's PA levels were solely assessed in a home setting, which does not account for PA engaged in other environments. Although the COVID-19 pandemic forced most, if not all, children to engage in PA at home (Guerrero et al., 2020; Moore et al., 2020; Paterson et al., 2021; Reese et al., 2021), it cannot be ruled out that children within this study may have engaged in PA in settings other than home (e.g., nearby parks, backyards). Furthermore, measuring only the frequency of children's PA (times/week) lacked precision as it did not provide information on the intensity, duration, and/or type of activity. Another limitation of this work, related to the variables used, was the ambiguity of parental concerns. Specifically, the survey asked parents to indicate their concerns
toward their children’s PA but did not ask the specific concerns they have (e.g., concerns for infection, concerns for breaking COVID-19 rules and regulations), which may have provided important contextual information that allows for more insightful interpretation to develop more effective interventions and preparedness for future public health crises that may come.

Finally, the findings of mediation analyses should be interpreted with caution due to the extremely weak strength of correlations observed among parental visible minority status, parental immigration status, parental concerns for PA, and children’s PA. These weak correlations, which informed the mediation analysis, can be attributed to the relatively large sample size (Faber & Fonseca, 2014). While the results suggest that there may be statistically significant correlations between these variables, the strength of correlations were small and may not reflect the associations in real-world settings. In addition, it is important to note that the mediation analytic technique relies on the assumption of a temporal sequence, which requires that the cause (X) must precede the effect (Y), and the mediating variable (M) should be on the pathway between the cause (X) and effect (Y) (MacKinnon, 2012). Given the cross-sectional nature of our data, temporality cannot be established (Webb et al., 2017); therefore, the results of mediation should be interpreted with caution.

In summary, this study presents several limitations, and the results should be interpreted with caution. Future research should aim to address these limitations to provide a more comprehensive understanding of the impact of parental sociodemographic characteristics and concerns on children’s PA levels during public health crises like the COVID-19 pandemic.

4.5 Public Health Implications

While acknowledging the limitations inherent to study design and procedure, lack of specificity in survey questions, and statistical findings showing weak correlations, the present
thesis offers a few public health implications. By uncovering the associations between parental sociodemographic characteristics, parental concerns on their children's PA, and children’s PA during the COVID-19 pandemic, this study sheds light on the potential intervention points to target population sub-groups. Specifically, parental education levels lower than a university degree and parents with heightened concerns for the amount of children’s PA may require additional support and resources to help them to support their children to engage in PA during the time of public health emergency such as the COVID-19 pandemic.

Furthermore, parents with visible minority and immigrant statuses reported low levels of PA among their children via heightened concerns for the amount of PA during the pandemic. These findings indicate that the focus of PA promotion efforts should focus on removing barriers to and providing better support for PA among parents and their children within these communities. Monitoring levels and identifying important barriers to and opportunities for PA among these groups are crucial first steps in addressing physical inactivity among these groups. Furthermore, it is crucial for public health policies and initiatives to create resources and guidelines that encourage children's PA, which, in turn, could mitigate parental concerns about their children's PA levels, even during public health emergencies. A few examples from the COVID-19 pandemic include offering virtual physical education classes, online play sessions, and guidelines for outdoor PA emphasizing safety and physical distancing. More importantly, these resources must be made easily accessible to those who typically have limited access to such support.

4.6 Future Research Directions

To build on the findings of this work, future research should consider using the longitudinal research design to examine the causal relationships between the variables under
investigation. A longitudinal study would allow for the collection of data over time, providing insights into the temporal nature of different variables and the identification of causality (Webb et al., 2017). Moreover, future research could use probabilistic sampling techniques if feasible to ensure the generalizability of the findings to a broader population. Furthermore, to ensure that the data collection process is inclusive and representative of all members of the population, it is important to develop data collection methods that cater to the distinctive needs of visible minority, immigrant, and low SES groups. These groups may face several barriers in participating in data collection activities, such as language difficulties or limited access to technology, which could result in their perspectives being underrepresented (Khan et al. 2015). Therefore, it is crucial to design data collection methods that are tailored to the needs of these groups. Providing language assistance or translation services, conducting interviews in community centers or other accessible locations, or using mobile devices to collect data could help ensure that these groups are able to participate in the data collection process. To improve the measurement of children's PA, future research should consider using device-based measures such as accelerometers or global positioning systems (GPS), which can provide more detailed information on the intensity, duration, and type of PA (Trost, 2001). GPS can be used to examine PA in a variety of settings, such as schools, parks, and community centers, to gain a more thorough understanding of children's PA engagement.

Several variables used in this study lacked in sensitivity and accuracy. For instance, parental visible minority status was used in this study; however, it does not allow researchers to capture the current landscape of racialized experiences due to the binary measure used in this study (visible minority vs non-visible minority). Future research should use more precise terminology and classification to capture the unique experiences of different racial and ethnic
groups as Canada becomes more and more diverse (Statistics Canada, 2022). Additionally, future research should examine the association between parental immigration status and children's PA separately for recent and established immigrants given previous evidence that these two groups present different PA levels (Mahmood et al., 2019). Lastly, future research should improve the conceptualization and operationalization of parental concerns by providing more specific and contextual information. This would allow for a better understanding of the different contexts of parental concerns and their potential impact on children's PA engagement.

In conclusion, the current study highlighted several limitations that future research should consider when investigating the relationships between parental sociodemographic characteristics, parental concerns, and children's PA. To address these limitations, future research should employ a longitudinal research design, foster more inclusively in data collection methods, use objective measures to assess children's PA, use more precise terminology and classification when examining visible minority and immigrant groups, and provide more specific and contextual information when assessing parental concerns. Addressing these limitations will lead to a more comprehensive understanding of the factors that influence children's PA engagement, and ultimately inform interventions and policies aimed at promoting PA among children, particularly in the context of a public health crisis like the COVID-19 pandemic.

4.7 Conclusions

This study examined the associations and potential mechanisms between parental sociodemographic characteristics, parental concerns, and children’s PA. It was determined that parental education levels and parental concerns were both key correlates of children’s PA. Additionally, parental concerns partially mediated the relationships between parental visible
minority status and children’s PA and the relationship between parental immigration status and children’s PA, respectively. These findings collectively suggest that parents play an important role in shaping children’s PA engagement and that children from marginalized families and communities may require more support and resources to level their opportunities and access to PA participation to the overall Canadian children. Future intervention strategies for PA promotion efforts should focus on children within these communities as we recover from the pandemic. More studies are needed with robust methodologies to confirm and build on the findings of this thesis.
4.8 References


Statistics Canada. (2017). *Education in Canada. Key result from the 2016 Census*  
[https://www150.statcan.gc.ca/n1/daily-quotidien/171129/dq171129a-eng.htm](https://www150.statcan.gc.ca/n1/daily-quotidien/171129/dq171129a-eng.htm)

Statistics Canada. (2017). *Immigrants make up the largest share of the population in over 150 years and continue to shape who we are as Canadians*  
[https://www150.statcan.gc.ca/n1/daily-quotidien/221026/dq221026a-eng.htm](https://www150.statcan.gc.ca/n1/daily-quotidien/221026/dq221026a-eng.htm)


Appendix A

*Ethics Letter of Exemption*

Dear Mr. Bains,

Thank you for submitting the secondary use application: "GSKHS-390-21 Parental Sociodemographic Correlates of Parental Concerns and Children’s Physical Activity and Screen Time During COVID-19"/TRAQ File # 6033249

Given that your study relies exclusively on Statistics Canada data, this application is exempt from REB review in that it meets condition (a) of TCPS2 2018 Article 2.2:

*Research does not require REB review when it relies exclusively on information that is:*

- a. publicly available through a mechanism set out by legislation or regulation and that is protected by law; or
- b. in the public domain and the individuals to whom the information refers have no reasonable expectation of privacy.

Based on this exemption from the TCPS2, you will not be required to seek ethics review or clearance from the General Research Ethics Board (GREB) at Queen’s University for this study.

Good luck with your research.

Regards,

[Signature]

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