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Context Matters: Examining children's perceived barriers to physical activity across varying Canadian environments

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ABSTRACT

Children's perceptions of their environment have been associated with their physical activity (PA) levels, however a better understanding of the formation of perceptions within different contexts is needed. This will help to inform decision making related to physical inactivity trends in Canadian children. We examined socio-ecological factors influencing children's perceptions of barriers to PA in Ontario, Canada. Binary logistic regression models measured the relationship between perceptions of barriers and PA for 892 children in Ontario. At the intrapersonal level, girls reported the most barriers to PA. Interpersonally, children whose mother was employed reported the most barriers. At the physical environment level, children in urban and suburban neighbourhoods of large cities, and rural areas reported the most barriers, differing relative to population size. The major contribution of this paper is a new perspective of environmental influences on children's perceptions of PA, using an urbanicity spectrum, and highlighting place specific needs of Canadian children.

1. Introduction

Recent research suggests less than 10% of Canadian children and youth (age 6–17 years) are meeting the daily recommendation of 60 min of moderate to vigorous physical activity (Colley et al., 2017; ParticipACTION, 2016). It has been well established that these low levels of physical activity (PA) among children is of serious concern because inactivity in childhood creates long-lasting health risks which track into adulthood (Bauman, 2003; Pate et al., 1999; Warburton et al., 2006). It is widely accepted that an individual's PA behaviour is shaped by their interactions with their physical and social environments of daily life. This is the major tenet of the socio-ecological perspective; health is an outcome of the quality of the individual-environment fit (Grzywacz and Fuqua, 2000). It emphasizes that the intrapersonal and interpersonal factors, which form environmental perceptions of barriers to PA, may be as important for predicting behaviour as the objectively measured physical environment (Giles-Corti and Donovan, 2002; Hume et al., 2016). This paper will examine how children's perceptions of barriers to PA differ by factors at different levels of the socio-ecological model, including intrapersonal, interpersonal, and physical environment.

Giles-Corti and Donovan (2002) have suggested a socio-ecological model of recreational PA which considers intrapersonal, interpersonal, and physical environment level determinants of PA behaviour. These different levels of environment operate through reciprocal relationship whereby the individual's PA behaviour is affected by multiple levels of environmental influences, and PA behaviour shapes the surrounding social environment (Townsend and Foster, 2013). The intrapersonal environment is shaped by the influence of intrapersonal forces such as psychological and demographic factors, personal preferences and choices (Townsend and Foster, 2013). Factors within this level include gender, ethnicity, and age (Townsend and Foster, 2013). The interpersonal environment includes social networks, norms, supports, and standards, among groups, individuals, and organizations (Townsend and Foster, 2013). Main themes discussed in the literature as mechanisms of influence are socio-economic status, parental influence, and relationships with peers. These dimensions influence what an individual perceives as a barrier to PA in their environment, a key contributor to children's activity levels (Hume et al., 2016).

In order to understand how children engage in PA across Canada, there is a need to understand geographic variation in the determinants of activity (Orton et al., 2017). One approach which can be

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conceptualized is the use of children's daily contexts of living. Regarding health, context has been described as the circumstantial environment in which something takes place, and includes the interplay of the physical, social, cultural and structural environments coming together to shape the individual's experience (Orton et al., 2017; Williams, 2003). When considering the health and PA of children across varying environments, whether they experienced at the intrapersonal, interpersonal, or physical environment level, we must consider the interplay of the variety of factors which shape how behaviour is formed within interactions of daily life.

When considering issues or opportunities that hinder physical activity, one way to consider the environmental influences on children's perceptions is through recognition of barriers to physical activity in different urbanicities. By recognizing the value in understanding the personal and situational influences on physical activity engagement (Loebach and Gilliland, 2010), there is an opportunity to better target future interventions for mitigating barriers (Sherar et al., 2009). The physical activity literature has widely examined barriers of the environment and the potential influence on children's behaviour (Aarts et al., 2010; Grow et al., 2008; Hume et al., 2005; Katapally et al., 2015; Loebach and Gilliland, 2016; Sandercock et al., 2010; Walia and Leipert, 2012; Yousefian et al., 2009). Despite the threats to population health in Canada presented by physical inactivity, there is a paucity of research on the opportunities for physical activity and aspects of the built environment across the spectrum of urbanicity (Yousefian et al., 2009).

Urbanicity, or the degree to which a geographical area is urban, has been identified as an important determinant of population health and well-being (Vlahov and Galea, 2002). According to Vlahov and Galea (2002), the health impacts of living in areas of different levels of urbanicity relates to the fact that certain conditions are present in urban environments to a greater extent than nonurban environments (e.g., access to health services). It is important to examine urbanicity using a spectrum because research has indicated much of the current environment-PA literature oversimplifies environments into a dichotomy of rural-urban (Sandercock et al., 2010). This traditional dichotomy disguises the heterogeneity of Canadian communities and therefore limits our understanding of how different contexts influence children's PA (Walia and Leipert, 2012).

There is little research surrounding children's perceptions of PA barriers focusing on children in the diverse rural communities of Canada. This is important because evidence suggests there is an elevated risk for health concerns related to physical inactivity in rural versus urban Canadian communities due to differences in built environment and social factors (Moore et al., 2013). However, in a systematic review conducted by Sandercock et al. (2010) most studies indicated either no differences, or that urban children were less likely to be active than rural children. This is a problematic conclusion because a dichotomous division between urban and rural populations neglects to highlight heterogeneity of land uses. For example, when using a spectrum approach (i.e., considering more than a dichotomous rural versus urban relationship) to explaining the built environment, which includes suburban or small city populations, many researchers found rural *and* urban children were less active than children in suburban areas or small cities (Joens-Matre et al., 2008; Springer et al., 2009, 2006). This highlights the value of considering barriers to PA with a geographical classification system (Sandercock et al., 2010), such as a spectrum from rural to urban.

The rationale of this research was to gain a better understanding of how children's perceptions are formed within different geographical contexts, especially related to urbanicity. This research addresses gaps in the literature related to a paucity of work outside of urban areas. By demonstrating the differing impacts of the integrated social and environmental contexts in relation to the varying intrapersonal environments for different groups of children, we can better prioritize areas for mitigating barriers to PA. This will help to inform future research and decision making related to physical inactivity trends in Canadian children. This study will address two key objectives that will fill these identified gaps in the literature: (1) To demonstrate how intrapersonal, interpersonal, and physical environment factors influence children's perceptions of barriers to PA; and (2) To utilize an expanded definition of urbanicity to determine the similarities and differences in children's perceptions in relation to the level of urbanicity of their home location.

2. Methods

2.1. Data sources and population

This cross-sectional study uses data from a larger population-based project investigating environmental influences on children's health and well-being, including PA and perceptions of barriers to PA. Study design has been described in detail elsewhere [reference withheld for blinding]. Participants resided in areas of Southwestern Ontario (Southwest Region) and Northwestern Ontario (Thunder Bay Region). This study drew on surveys of youth and their parents, including responses to questions about socio-demographics, socio-economic status, and perceptions of the barriers for PA participation. This study was conducted in accordance with the Declaration of Helsinki and the Canadian Tri-Council Policy Statement; Ethical Conduct for Research Involving Humans and the protocol was approved by the University Non-Medical Research Ethics Board and the respective research officers and/or committees of the participating school boards. Participants in this study provided assent and were given parental consent.

Data were collected between 2010 and 2013 in 33 Southwestern Ontario schools, including 932 children in grades 5–8 (aged 9–14 years) (66.9% recruitment rate). Schools were randomly selected and stratified by geographical context and neighbourhood socio-economic status to ensure the participating sample was representative of the population in the region. In 2016, the study was replicated in four rural Northwestern Ontario schools (100% response rate), including 136 students in grades 4–8 (aged 8–14 years) (70.1% participation rate).

Participants' data was included in this study if it met three criteria: 1) completion of survey by the child participant; 2) completion of a corresponding survey by the child's parent/guardian; and 3) identified postal code of their home location. Data for 892 (out of 1068) children met the inclusion criteria and were retained for analysis.

2.2. Dependent variables

The dependent variables in this study were dimensions of children's perceptions of barriers to PA. The measures of children's perceptions of barriers were based on child survey questions assessing barriers to activity in the respondents' neighbourhood parks/playgrounds, trees in their neighbourhood and safety in their neighbourhood. A full list of the questions can be found in Table 1. Responses were provided on a 4-point Likert scale (strongly disagree, somewhat disagree, somewhat agree, strongly agree), but the 4-point data were coded to binary variables (i.e., 0 for disagree, 1 for agree) to enhance validity of inference for this analysis (Harwell and Gatti, 2001). No neutral response option was provided, to encourage respondents to decide whether they agreed or disagreed with each question (Bishop, 1987). Four questions asked about the presence of facilitators and were reverse coded to maintain consistency in this study (i.e., *do not* know people, *not* enough sidewalks, *not* enough bike lanes, *not* enough trees).

2.3. Independent variables

The independent variables were identified in the PA literature and organized into levels of the social-ecological model: intrapersonal, interpersonal, and physical environment (Giles-Corti and Donovan, 2002). The intrapersonal variables included demographic data from the child survey. Gender was based on child self-identification and coded as

Table 1
Survey questions measuring barriers, and sample distribution of responses.

Question measuring barrier	Representing code in Tables 3–5	Sample size (N)	% Agreed
Perception of Safety			
There is so much traffic on streets near my home that it's difficult/unpleasant to bike or play on the street	*Too much traffic*	852	21.7
Most drivers go too fast while driving in our neighbourhood	*Drive too Fast*	848	37.4
I am worried about being or walking by myself in my neighbourhood and local streets because I am worried about being taken or hurt by a stranger	*Worried about Strangers*	851	18.9
There is a lot of crime in my neighbourhood (ex: strangers, gangs, drugs)	*Crime*	850	9.1
Perception of Social Factors			
There are no other kids to play with at parks/playgrounds in my neighbourhood	*No one to play with*	850	35.3
I get bullied or teased when I go to parks/playgrounds in my neighbourhood	*Bullied at park*	847	7.2
I have nobody to go with to parks/playgrounds in my neighbourhood	*No one to go with*	840	25.2
I [do not] know a lot of people in my neighbourhood	*Do not know people*	853	21.8
There are too many people/it feels too crowded at parks/playgrounds in my neighbourhood	*Too crowded at park*	849	15.1
Perception of Neighbourhood Environment			
Parks/playgrounds in my neighbourhood are too far from my house/takes too much time to get there	*Too Far from Home*	850	17.9
There is not enough room at parks/playgrounds in my neighbourhood for the activities I like	*Not enough room*	848	20.87
There is too much garbage/graffiti at parks/playgrounds in my neighbourhood	*Garbage/Graffiti*	850	13.9
There are [not] enough sidewalks on the street in my neighbourhood	*Not enough sidewalks*	847	37.5
There are [no] bicycle lanes or trails in or near my neighbourhood that are easy to get to	*Not enough bike lanes*	851	48.4
There are [not] a lot of trees along the streets in my neighbourhood	*Not enough trees*	852	23.9
There is no or not enough equipment or activities I like	*Not enough equipment*	848	32.2

a binary variable: girl (0) or boy (1). Age was a continuous variable measured in years. Visible minority was based on reported ethnicity and was coded as a binary variable: Caucasian (0) or non-Caucasian ethnicity (1).

Six variables were used to measure a child's interpersonal environment. Lone parent household was a binary variable defined as a child living with two parents (0) or one parent (1). Household arrangement was dichotomized into a child living in one home (0) or more than one home (1). Parental employment status was measured for both mother and father, with unemployed parents (including self-identified as unemployed, at home with children, students, or on disability/sick leave) as (0) and employed parents (defined as employed for pay outside of home/caregiving, including self-employed, full-time employed, or part-time employed) as (1). Median Family Income (CAD) was the median family income from the 2011 National Household Survey measured at the census dissemination area in which the home was located and categorized as Under $60,000 (0); between $60,000 and $99,999 (1); and $100,000 and more (2) (Statistics Canada, 2017a, 2017b).

The physical environment variable included in this study was the level of urbanicity in which the primary home of each child was located (Tillmann et al., 2018). We categorized urbanicity into five classes: (1) Urban large-city, which includes areas that are characterized by grid-like road networks, high population density, and high land use mix within settlements greater than 100,000 people; (2) Suburban large-city, which include areas that are characterized by irregular, looping and cul-de-sac road networks, lower population density, and low land use mix within settlements greater than 100,000 people; (3) Urban small-town, which include settlement areas with a population between 10,000 and 100,000 people; (4) Rural small-town, which include settlements with a population between 1000 and 10,000; and (5) Rural areas, which are all other areas of our study area, with a population less than 1000, low population density and mostly characterized by agricultural land and natural areas. Home location was compared to this categorization of built form and population density spectrum to determine level of urbanicity, allowing for greater insight into location-based presence of environmental PA barriers.

2.4. Data analysis

A series of logistic regression models with robust standard errors in STATA IC 15 (StataCorp., 2015) were used to compare what children consider to be barriers to their PA at varying levels of the socio-ecological model. Logistic regression is appropriate to use in this analysis as the model is robust, where variables are not required to be normally distributed or have equal variance, and it does not assume a linear relationship between dependent and independent variables (Hosmer et al., 2013). Odds ratios (OR) were calculated to examine associations between a variety of barriers and levels of the socio-ecological model. They were interpreted as the odds of agreeing with a barrier having influence on PA over disagreeing (Hilbe, 2011), and included robust standard error accounts for the observations biased due to clustering (such as within schools). Barriers children reported as influential were significant if $p \leq 0.05$.

3. Results

Descriptive statistics of the survey response distributions are presented in Table 1 and the sample distribution of independent variables is presented in Table 2. To better categorize barriers, results were organized by themed barrier groups: barriers to safety (Table 3); social relationships (Table 4); and neighbourhood environment (Table 5).

Table 2
Descriptive characteristics of independent variables.

Independent variable	N	% of Total (N = 892)
Intrapersonal Environment		
Gender		
Boy	396	44%
Age, mean years (Std. Err.)	11.1 (0.03)	
Visible minority	240	28%
Interpersonal Environment		
# of parents in main home		
Living with one parent	200	22%
Household Arrangement		
Live in more than one home	144	16%
Mother Employment Status		
Unemployed	138	16%
Father Employment Status		
Unemployed	54	6%
Median Family Income, CAD		
Middle Family Income, $60,000–$99,9999	128	14%
High Family Income, $100,000 and more	224	25%
Physical Environment		
Urbanicity		
Suburban Large-City	399	45%
Urban Large-City	83	9%
Urban Small-Town	80	9%
Rural Small-Town	147	16%
Rural	183	21%

Table 3
Logistic regression models examining factors related to children perceiving safety barriers to physical activity.

	Too much traffic		*Drive too fast*		*Worried about strangers*		*Crime*	
	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	p
Intrapersonal Environment								
Boys	0.79 (0.14)	0.167	0.66 (0.11)	0.013*	0.45 (0.08)	0.000*	1.40 (0.38)	0.208
Age	0.84 (0.07)	0.050*	0.92 (0.06)	0.209	0.79 (0.07)	0.014*	0.96 (0.13)	0.735
Visible Minority	0.92 (0.16)	0.630	0.68 (0.14)	0.070	1.45 (0.31)	0.085	1.41 (0.37)	0.182
Interpersonal Environment								
Lone Parent Household	1.24 (0.36)	0.470	1.28 (0.28)	0.247	1.21 (0.29)	0.422	1.17 (0.24)	0.441
Live in one home	1.04 (0.25)	0.870	1.05 (0.24)	0.820	0.95 (0.26)	0.851	1.39 (0.45)	0.309
Mother Employed	0.60 (0.16)	0.052	0.61 (0.14)	0.028*	1.08 (0.25)	0.734	0.62 (0.24)	0.215
Father Employed	0.92 (0.19)	0.703	0.72 (0.19)	0.229	0.64 (0.21)	0.171	1.58 (1.00)	0.474
Family Income (ref: Low Family Income)								
Middle Family Income	0.58 (0.21)	0.134	1.11 (0.28)	0.667	0.92 (0.34)	0.812	2.48 (1.31)	0.082
High Family Income	0.64 (0.18)	0.102	0.80 (0.17)	0.300	0.55 (0.20)	0.099	1.34 (0.77)	0.607
Physical Environment								
Urbanicity (*ref: Suburban Large City*)								
Urban Large City	1.82 (0.46)	0.017*	1.67 (0.50)	0.086	2.01 (0.43)	0.001*	1.46 (0.40)	0.167
Urban Small-town	1.25 (0.28)	0.318	1.51 (0.35)	0.077	1.07 (0.32)	0.800	0.41 (0.40)	0.059
Rural Small-town	0.28 (0.75)	0.000*	1.21 (0.22)	0.301	0.82 (0.23)	0.464	0.29 (0.08)	0.000*
Rural	1.04 (0.28)	0.889	1.29 (0.30)	0.279	1.25 (0.43)	0.525	0.17 (0.07)	0.000*
Constant	2.41 (2.47)	0.4390	1.86 (1.36)	0.399	3.70 (4.13)	0.242	0.07 (0.12)	0.116
Pseudo R2	0.0537		0.026		0.0542		0.0856	

* indicates significance level $p < 0.05$.

While there was some variety in the patterning of results, all independent variables demonstrated a relationship with children's perceptions of barriers except paternal employment status. Full model results are presented in Tables 3–5.

3.1. Intrapersonal factors

At the intrapersonal level, each independent variable demonstrated statistically significant influence on reporting perception of at least one barrier. Girls and visible minorities were more likely to report social barriers than their counterparts (Table 4). Girls were more likely to report *no one to go with (OR* = 0.71, $p = 0.044$*)* than boys. Children who are visible minorities were more likely to report *do not know people* (*OR* = 1.64, $p = 0.016$) as a barrier to PA than Caucasian children. Neighbourhood barriers (Table 5) were reported in two cases. With each increase in age by one year, children were more likely to report *not enough room* as a barrier (*OR* = 0.90, $p = 0.047$). As well, children who are visible minorities were more likely to report *not enough room* (*OR* = 1.51, $p = 0.006$) compared to their counterparts. Two of three groups of children were more likely to report lack of safety as a barrier to their PA compared to their counterparts (Table 3). With each increased year in age, older children reported *worried*

about strangers (*OR* = 0.79, $p = 0.014$) and *too much traffic* (*OR* = 0.84, $p = 0.050$). Girls were also more likely indicate *worried about strangers* (*OR* = 0.45, $p < 0.01$), and *drive too fast* (*OR* = 0.66, $p = 0$ 0.013) as significant barriers compared to boys.

3.2. Interpersonal factors

The interpersonal variables were found to have some significant relationships with reporting safety, social and neighbourhood barriers. The children who reported the most significant barriers were those

Table 4
Logistic regression models examining factors related to children perceiving social barriers to physical activity.

	No one to play with		*Bullied at park*		*No one to go with*		*Do not know people*		*Too crowded at park*	
	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	P	OR (Std Err)	p	OR (Std Err)	p
Intrapersonal Environment										
Boys	0.77 (0.11)	0.080	1.17 (0.30)	0.533	0.71 (0.12)	0.044*	1.00 (0.20)	0.990	1.42 (0.26)	0.062
Age	0.94 (0.08)	0.501	0.81 (0.11)	0.120	1.01 (0.10)	0.903	0.90 (0.07)	0.169	1.03 (0.08)	0.696
Visible Minority	1.08 (0.16)	0.582	1.14 (0.39)	0.705	1.37 (0.23)	0.061	1.64 (0.33)	0.016*	1.44 (0.38)	0.160
Interpersonal Environment										
Lone Parent Household	1.19 (0.21)	0.296	0.88 (0.53)	0.471	1.11 (0.26)	0.640	1.03 (0.22)	0.875	1.31 (0.37)	0.338
Live in one home	1.17 (0.21)	0.715	0.31 (0.35)	0.743	1.19 (0.26)	0.415	0.89 (0.21)	0.606	1.84 (0.55)	0.042*
Mother Employed	0.62 (0.16)	0.070	0.68 (0.20)	0.063	0.78 (0.19)	0.313	1.10 (0.37)	0.772	0.37 (0.16)	0.019*
Father Employed	0.71 (0.24)	0.302	0.67 (0.30)	0.373	1.20 (0.38)	0.564	1.37 (0.54)	0.419	0.75 (0.40)	0.580
Family Income (*ref: Low Family Income*)										
Middle Family Income	0.50 (0.14)	0.013*	0.59 (0.41)	0.447	0.93 (0.30)	0.822	1.13 (0.37)	0.708	0.84 (0.36)	0.691
High Family Income	0.90 (0.22)	0.435	0.62 (0.36)	0.419	1.50 (0.55)	0.272	1.04 (0.35)	0.904	0.78 (0.30)	0.514
Physical Environment										
Urbanicity (*ref: Suburban Large City*)										
Urban Large City	1.32 (0.33)	0.272	0.55 (0.26)	0.213	1.92 (0.65)	0.052	2.71 (0.85)	0.002*	0.98 (0.54)	0.974
Urban Small-town	0.71 (0.27)	0.366	1.15 (0.64)	0.802	0.83 (0.22)	0.479	1.53 (0.38)	0.086	0.82 (0.30)	0.599
Rural Small-town	0.83 (0.29)	0.584	1.47 (0.43)	0.186	1.32 (0.32)	0.255	0.53 (0.16)	0.039*	0.98 (0.23)	0.926
Rural	1.22 (0.28)	0.372	0.72 (0.26)	0.363	1.54 (0.49)	0.175	0.95 (0.29)	0.876	1.14 (0.34)	0.699
Constant	1.50 (1.52)	0.687	1.03 (1.74)	0.987	0.17 (0.18)	0.104	0.60 (0.50)	0.541	0.06 (0.06)	0.007
Pseudo R2	0.020		0.055		0.030		0.047		0.035	

* indicates significance level $p < 0.05$.

Table 5
Logistic regression models examining factors related to children perceiving neighbourhood environment barriers to physical activity.

	Too Far from Home		*Not enough room*		*Garbage/Graffiti*		*Not enough sidewalks*		*Not enough bike lanes*		*Not enough trees*		*Not enough equipment*	
	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	P	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	p	OR (Std Err)	p
Intrapersonal Environment														
Boys	0.70 (0.13)	0.057	1.07 (0.19)	0.695	0.99 (0.24)	0.975	0.99 (0.12)	0.926	0.87 (0.12)	0.297	1.11 (0.19)	0.565	1.01 (0.14)	0.967
Age	0.83 (0.09)	0.070	0.90 (0.05)	0.047*	0.89 (0.06)	0.094	1.04 (0.06)	0.501	0.93 (0.09)	0.438	0.99 (0.07)	0.927	1.08 (0.07)	0.204
Visible Minority	0.97 (0.21)	0.882	1.51 (0.23)	0.006*	1.06 (0.22)	0.795	1.22 (0.24)	0.308	1.08 (0.14)	0.585	1.22 (0.26)	0.349	1.31 (0.23)	0.127
Interpersonal Environment														
Lone Parent Household	0.67 (0.16)	0.090	0.95 (0.27)	0.857	1.37 (0.41)	0.293	1.46 (0.26)	0.039*	1.48 (0.29)	0.047*	1.51 (0.35)	0.078	0.87 (0.19)	0.521
Live in one home	0.69 (0.20)	0.212	1.07 (0.28)	0.793	2.33 (0.68)	0.004*	1.25 (0.24)	0.237	1.24 (0.26)	0.305	1.80 (0.43)	0.014 *	1.00 (0.21)	0.984
Mother employed	0.91 (0.27)	0.757	0.62 (0.16)	0.070	0.35 (0.13)	0.005*	0.92 (0.23)	0.724	0.79 (0.17)	0.293	0.76 (0.17)	0.215	0.61 (0.15)	0.047*
Father employed	1.12 (0.49)	0.804	0.98 (0.31)	0.938	1.88 (0.90)	0.188	0.86 (0.30)	0.674	1.07 (0.31)	0.816	1.45 (0.53)	0.308	0.79 (0.23)	0.408
Family Income (ref: Low Family Income)														
Middle Family Income	1.64 (0.75)	0.280	0.30 (0.13)	0.004*	0.82 (0.29)	0.583	1.27 (0.44)	0.497	0.80 (0.18)	0.328	1.52 (0.52)	0.222	0.73 (0.23)	0.315
High Family Income	1.62 (0.68)	0.249	0.57 (0.20)	0.115	0.68 (0.27)	0.340	0.93 (0.20)	0.751	1.04 (0.20)	0.858	0.99 (0.26)	0.968	0.75 (0.22)	0.333
Physical Environment														
Urbanicity (*ref: Suburban Large City*)														
Urban Large City	1.18 (0.39)	0.606	1.97 (0.61)	0.028*	1.39 (0.44)	0.305	1.06 (0.20)	0.751	0.85 (0.22)	0.523	0.86 (0.31)	0.662	1.68 (0.43)	0.040*
Urban Small-town	1.73 (0.63)	0.131	1.61 (0.50)	0.123	1.26 (0.47)	0.530	1.37 (0.38)	0.256	1.64 (0.65)	0.210	2.47 (0.92)	0.016*	0.92 (0.29)	0.795
Rural Small-town	1.49 (0.73)	0.413	0.82 (0.23)	0.472	0.63 (0.16)	0.067	2.05 (0.76)	0.053	1.18 (0.18)	0.267	1.49 (0.22)	0.007*	0.78 (0.20)	0.321
Rural	4.32 (1.67)	0.000*	1.50 (0.35)	0.077	0.36 (0.13)	0.008*	3.91 (1.30)	0.000*	2.06 (0.34)	0.000*	1.46 (0.47)	0.239	1.09 (0.29)	0.743
Constant	1.12 (1.40)	0.926	0.83 (0.62)	0.803	0.39 (0.34)	0.286	0.16 (0.12)	0.016	1.62 (1.87)	0.677	0.11 (0.09)	0.008	0.23 (0.17)	0.048
Pseudo R2	0.085		0.041		0.057		0.052		0.024		0.030		0.015	

* indicates significance level $p < 0.05$.

whose mother was unemployed. These children reported experiencing the safety-related barrier of *drive too fast* ($OR = 0.61$, $p = 0.028$) (Table 3), the social barrier of *too crowded at park* ($OR = 0.37$, $p = 0.019$) (Table 4), and neighbourhood barriers of *garbage/graffiti* ($OR = 0.35$, $p = 0.005$) and *not enough equipment* ($OR = 0.61$, $p = 0.047$) (Table 5). A child's father being employed was not related to significantly reporting barriers to PA. Children in lone-parent households reported two significant neighbourhood barriers (Table 5) to PA, including not enough sidewalks ($OR = 1.46$, $p = 0.039$) and not enough bike lanes ($OR = 1.48$, $p = 0.047$) when compared to children in single-parent household. Children who lived in one home (versus multiple) also reported three significant barriers to PA, including *too crowded at parks* ($OR = 1.84$, $p = 0.042$), *not enough trees* ($OR = 1.80$, $p = 0.014$), and *garbage/graffiti* ($OR = 2.33$, $p = 0.004$) (Table 5). Three barriers were significantly related to parental income, where children in low income families were more likely to report perceiving barriers than those from middle income families. This included being more likely to report *not enough room* ($OR = 0.30$, $p = 0.004$) (Table 5) and more likely to report *no one to play with* ($OR = 0.50$, $p = 0.013$) (Table 4) than children from middle income families. There were no significant differences in reporting barriers between children in low- and high-income families.

3.3. Physical environment

Children in the rural areas experienced significant barriers related to their neighbourhood environment and local infrastructure for PA when compared to children in suburban areas (Table 5). This was represented in three barriers, *too far from home* ($OR = 4.32$, $p < 0.000$), *not enough sidewalks* ($OR = 3.91$, $p < 0.001$) and *not enough bike lanes* ($OR = 2.06$, $p < 0.001$). On the other hand, suburban children were more likely to perceive barriers related to safety than the rural groups (Table 3). This group of children was more likely to report *crime* compared to rural ($OR = 0.17$, $p < 0.001$) and rural small-town ($OR = 0.29$, $p < 0.001$) children. They were also more likely to report *garbage/graffiti* compared to rural children ($OR = 0.36$, $p = 0.008$) (Table 5), *too much traffic* ($OR = 0.28$, $p < 0.001$) (Table 3) and *do not know people* ($OR = 0.53$, $p = 0.039$) (Table 3) compared to rural small-town children. Comparing urban and suburban children, urban children were more likely to report *too much traffic* ($OR = 1.82$, $p = 0.017$), *worried about strangers* ($OR = 2.01$, $p = 0.001$) (Table 3), do *not know people* ($OR = 2.71$, $p = 0.002$) (Table 4), *not enough room* ($OR = 1.97$, $p = 0.028$), and *not enough equipment* ($OR = 1.68$, $p = 0.040$) (Table 5). The only reported barrier to PA which remained significant for urban small-town and rural small-town children was *not enough trees* (see Table 5).

4. Discussion

This study employed a series of logistic regression models to examine associations between children's perceptions of barriers to PA and different intrapersonal, interpersonal, and physical environmental factors. This study contributed to the literature on children's physical activity by examining and interpreting how children from a wide range of environmental contexts perceive barriers to PA. To our knowledge, this is the first Canadian study which considers PA barriers for a full range of geographic contexts (i.e., five levels of “urbanicity”). By demonstrating the differing impacts of the integrated social and environmental contexts in relation to the varying intrapersonal environments for different groups of children, we can better prioritize areas for mitigating barriers to PA, by targeting variation in the experience of place to most effectively address the issue.

There are several key findings in this study. First, girls perceived more barriers than boys and children who are visible minorities perceived more barriers than Caucasian children. Second, maternal employment status had a significant effect on children's perceptions of barriers while paternal employment status did not, and children in low-income families were more likely to report barriers than those in middle- or high-income families. Finally, children from every level of urbanicity reported different significant barriers. These results demonstrated variations in how barriers to activity were experienced based on a child's context of place. While there were some commonalities across environments, there were striking differences in the way that context influences what children perceived as barriers to their PA.

Previous research has reported mixed results on the importance of children's perceived safety in their community as a barrier to PA (Davison and Lawson, 2006). Although the present study did not link perceptions to actual PA, the findings support other studies which reported perceived lack of safety has a negative association with PA levels (e.g., Gómez et al., 2004). By considering different sub-themes of safety (i.e., traffic, crime, and strangers), the present study offers insight into how perceptions of safety may act as a barrier to children's PA.

The present study found various aspects of traffic safety in the neighbourhood were significant barriers to PA for girls, older children, and children whose mother was employed. This aligned with trends highlighted within a systematic review by Lee et al. (2015) who reported traffic safety was considered a barrier which decreases activity levels in studies they analysed. A finding unique to this study, however, is that children from suburban areas were more likely to report traffic related issues as a barrier to PA than rural small town children. Previous research related to active travel suggests policy initiatives should focus on strategies for traffic calming methods to reduce the threat of traffic speed in neighbourhoods (Larouche et al., 2014; Larsen et al., 2012; Timperio et al., 2018), a strategy which may prove beneficial for practitioners in these areas.

Perception of crime was considered a significant barrier to PA for children in suburban large cities compared to rural small towns and rural areas. Additionally, children in urban areas were more likely to report being worried about being taken or hurt by a stranger in their neighbourhood than their suburban counterparts. Beets and Foley (2008) suggested that it may not be the actual measure of crime, but rather the perceived measure of safety in the environment which is important to children. This example shows how children's experience of place may be misaligned with the reality of their situation. By identifying the variety of perceptions children feel are important to their physical activity, this could provide insight into how children view opportunities or barriers in their communities. This may be an opportunity for local officials and health promoters to draw on strengths of the community, such as social cohesion, as an opportunity to change perceptions and further promote physical activity (Loebach and Gilliland, 2010). Research must further investigate the factors that influence children's perceptions of crime (such as their parents' perceptions). This should include the ways children feel crime is present in their communities in addition to objective crime rates, to understand strategies for mitigating this as a barrier to PA.

In children whose mothers were employed, five of sixteen barriers were reported to significantly influence their PA (see Table 2). On the other hand, none of the examined barriers were statistically significant for children whose mothers were unemployed; likewise, paternal employment status did not have a significant influence on children's responses to reporting barriers. These findings raise several new questions. How and why do the gendered patterns of parental employment status influence children's perception of barriers to PA? Furthermore, how is a child's experience of place influenced by their parent's employment? Future research may use qualitative methods to investigate more deeply why maternal employment status seems to matter more for children's PA perceptions than paternal employment.

In response to objective two, this study used an expanded definition of urbanicity to determine the similarities and differences of children's perceptions in different geographical contexts. The investigation of context was related to categorization of physical environments by level ‘urbanicity’ taking into consideration dimensions of built form and

population density. It was determined that children in the largest areas (urban large-city and suburban large-city) and the smallest areas (rural) reported the most barriers, however these differed relative to urbanicity. While children in urban and suburban areas reported issues related to safety and social barriers, children from the less populated areas consistently reported experiencing physical environment barriers to being physically active. Children in the rural areas reported absence of infrastructure and distance as the major barriers, while children in rural small towns and urban small towns reported these resources were present, but other forces such as neighbourhood aesthetics are perceived to influence their PA behaviour. This makes an important distinction of the differing needs of Canadian children in different contexts, highlighting the importance of considering rural children's variation in the experience of place, rather than one homogenous "*not urban*" population.

This study demonstrated the need for a place-specific approach to understanding the barriers children perceive as influential to their PA. By separating a dichotomous rural-urban definition into five levels in a spectrum, a distinction in the way children experience their environment demonstrates the importance of considering context specific definitions of both urban and rural spaces. In areas with characteristics similar to the urban and suburban areas of study, policy should focus on improving perceptions of safety and interventions should focus on drawing on social connections in the community to alleviate barriers of crime, garbage/graffiti and strangers.

The results of this study suggest policymakers in rural and urban small-towns should seek to engage children as stakeholders for improvements to the current infrastructure and improve the variety of available activities. Policy interventions for rural areas need to focus on opportunities for mitigating perceived distance through transportation opportunities, including active travel (i.e. sidewalks, bike trails) to improve independent mobility, promoting efficacy for children to access resources that currently exist (i.e. school playgrounds out of school time). This could be a beneficial starting point for health promoters. While the influence of accessible parks and playgrounds on physical activity behaviour has been well established in the literature (Davison and Lawson, 2006; Ding et al., 2011; McGrath et al., 2015), the present findings suggest safe, adequate, and age appropriate accessible activities or equipment are other aspects of availability that must be considered (Tucker et al., 2009).

As with any research, this study presents several limitations which must be considered. First, there may have been other confounders at all levels of the socio-ecological model which were not accounted for in the models. This could include indicators for which we did not have specific measures or adequate data, such as household-level socio-economic status, or additional variables which could have been considered at the built environment level, such as access to recreation facilities and parks. This research focused on a more general environment level to build on the gaps of previous research; however, future work will look for significance with more specific built environment factors and identify their impact on PA levels. The second limitation was there was no consideration of facilitators to activity. While previous research has shown environmental facilitators are important for promoting physical activity in children (Mitchell et al., 2016; Tucker et al., 2009, 2008), we chose to focus our modelling on the presence of barriers, which have garnered less attention in the literature. Future research might explore the relative weights of barriers and facilitators together. This study did not include the influence of parental perceptions of the environment. Previous research has demonstrated a link between the perceptions of parents and children (Timperio et al., 2004). Examining this relationship further in the context of environmental perceptions may be a useful area for overcoming barriers. Both perceptions of facilitators and the influence parental perceptions are two potential areas for future research. Additionally, the present study did not link the perception of barriers with a measurement of PA. Nevertheless, the aim of this study was to thoroughly examine children's perceptions of barriers, to provide a basis for future research that may examine how these factors represent actual barriers to children's PA. Future research should focus on examining how these perceived barriers relate to actual PA behaviour.

Despite the limitations mentioned above, it is important to note that the current study assessed how the perceptions of barriers to PA for a large sample of children (almost 900) varied in relation to multiple intrapersonal, interpersonal and physical environment factors across a wide variety of geographical contexts within Ontario. Additionally, this is the first study to assess differences in perceptions of barriers to PA by place, at a five level urbanicity spectrum, demonstrating the value of this approach for future research especially in the Canadian context. This research highlighted not only the heterogeneity of children's physical environments, but also the variety in how children experience barriers based on their intrapersonal and interpersonal environment. While results may be limited in generalizability due to the particular geographic context of Southwestern and Northwestern Ontario, they provided an important new perspective on understanding children's physical activity behaviour in practice. A criticism of Canadian health policy and practice is the one-size-fits-all approach to targeting health issues, especially in rural areas (Canadian Rural Revitalization Foundation, 2015). The present research provided evidence to suggest the variation in experiences of children in different places, highlighting the need for context-specific investigation and interventions. This work emphasized the importance of gaining children's perspective as stakeholders in practice and policy, in order to effectively impact their environment for promoting health.

5. Conclusions and implications

By focusing on context specific needs related to children's physical activity levels, there may be an opportunity to improve the efficiency of policy and practice for changing activity behaviour. This research demonstrated how the socio-ecological environments of each child affect how they perceive and engage with their environments in pursuit of physical activity. By examining the effects of perceptions and environments on children's PA levels, we can begin to suggest strategies for future research, policy, and practice to help alleviate what children consider barriers to their activity. This research highlighted multiple factors at different levels of the socio-ecological model that impact how children perceive environmental barriers to PA. Furthermore, there is a need for context specific, and tailored approaches to increasing physical activity when attempting to address disparities in children's behaviour. Future work must consider targeting barriers for specific groups in the formation of policy and practice to improve effectiveness of programs.

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