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Examining the Impact of a Population-Based Intervention on Children's Physical Activity Levels: The Grade 5 ACT-i-Pass Program in London, Ontario

Christine E. Smith, *The University of Western Ontario*

Supervisor: Dr. Jason Gilliland, *The University of Western Ontario*

A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Geography

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Abstract

Childhood obesity is a major public health concern caused in part by decreasing levels of physical activity (PA). Identification of effective population level strategies for increasing children's PA levels is critical for improving overall health. This thesis is comprised of two studies. **Study 1** examines how naturally-occurring population-level PA interventions with children have been evaluated in previous studies by conducting a systematic review. A total of 15 papers were included for review and results suggest that naturally-occurring population-based PA interventions are generally effective in improving PA levels of children in a variety of PA domains. Eleven studies included additional evaluation components to help justify results and provide important contextual information. Using an ecological framework, **Study 2** investigates how the provision of a naturally-occurring population-based PA intervention in London, Ontario impacted children's PA levels. A total of 643 children completed baseline and post-intervention surveys. Results showed a significant increase in PA over time, with significant increases for girls, visible minorities, children born outside of Canada, children with low parental support, and children from all neighbourhood SES groups. Sex and parental support were the only significant predictors of change in PA. Examining naturally-occurring population-based PA interventions is a beneficial opportunity that should be used by researchers to provide real-world evidence of effective strategies to assess and increase children's levels of PA.

Keywords

Children; physical activity; population-based interventions; natural experiment

Co-Authorship Statement

Both integrated articles within this thesis will be submitted for publication in peer-reviewed journals. Chapter 2 and Chapter 3 are my original work, with Dr. Jason Gilliland, Dr. Andrew Clark and Dr. Piotr Wilk as co-authors on Chapter 3. I am the primary author and performed all data collection, analysis, and writing of each article. Dr. Jason Gilliland designed the evaluation of the ACT-i-Pass study, and Dr. Gilliland, Dr. Clark, and Dr. Wilk were involved in the development of procedures for the analysis of Chapter 3.

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Chapter 1: Introduction

1.1. Research Context

Over the last 25 years, the dramatic increase in obesity rates among children and adolescents has become a major public health concern in Canada (Chaput et al., 2012; Colley et al., 2011; Janssen et al., 2005). According to Statistics Canada (2015), almost one third of children and youth ages 5 to 17 years are classified as overweight or obese. While epidemiological studies show a steady trend in the rate of overweight and obesity in youth (Allison et al., 2015; Roberts et al., 2012), disparities between socioeconomic and ethnic groups are growing (Singh et al., 2010).

Obesity is the result of a sustained energy imbalance from an increase in energy intake and/or decrease in energy expenditure (Hill et al., 2012); however, understanding the complexity of this energy imbalance is a continued challenge. Childhood obesity is problematic for a number of reasons, primarily the several negative consequences related to physical health, mental health, quality of life and longevity (Gurvinder et al., 2012; Halfon et al., 2013; Jansen et al., 2013; Must et al., 1999; Schwimmer et al., 2003). Numerous clinical studies have confirmed a link between childhood obesity and cardiovascular disease, hypertension, type II diabetes mellitus, metabolic syndrome, orthopaedic issues, asthma, fatty liver disease and gastrointestinal diseases issues (Must et al., 1999; Reilly et al., 2011; Pulgarón et al., 2013). In addition to the health-related outcomes, obesity is associated with a plethora of negative psychological outcomes including low self-esteem, body dissatisfaction, social isolation, anxiety, and depressive symptoms (Puder & Munsch, 2010; Pulgarón et al., 2013; Wardle & Cooke, 2005).

Given the detrimental consequences associated with childhood obesity, it is critical to examine the mechanisms that contribute to obesity and research factors that are modifiable to

address this health issue. Physical activity (PA) is one such lifestyle factor that can directly impact the obesity levels of children by increasing energy expenditure. Engaging in regular PA during childhood protects against the risk factors associated with obesity (Janssen & LeBlanc, 2010; Shaibi et al., 2008). PA is also associated with psychological and social benefits such as improved academic performance, higher self-esteem, enhanced social support and reduced depressive symptoms (Trudeau & Shephard, 2010; Piko et al., 2006). Despite the benefits, a majority of children do not engage in enough PA, as only 9% of Canadian children (age 5-17) meet Canada's recommended guidelines of 60 minutes of moderate-to-vigorous intensity on most days of the week (ParticipACTION, 2016).

The overarching purpose of this thesis is to contribute to our understanding of the determinants of children's PA levels. More specifically, this thesis focuses on population-level interventions designed to increase children's PA. The aim is to provide a comprehensive understanding of factors that may impact children's PA, in addition to contributing research to develop more effective intervention strategies based on the findings.

Reasons for not engaging in physical activity are complex, as the behaviour is highly variable and influenced by multiple factors at different levels (Sallis et al., 2006). A number of socio-demographic factors (age, ethnicity, sex, SES and immigrant status) have been identified as underlying determinants of PA in children (Brodersen et al., 2007; Bryan et al., 2006; Colley et al., 2011; Mitchell et al., 2016; Sallis et al., 2000; Singh et al., 2008). Patterns of decline in PA show that age is a critical factor (Sallis et al., 2000), as many studies suggest that PA declines rapidly from childhood to adolescence, with more dramatic decreases for females (Brodersen et al., 2007; Canadian Fitness & Lifestyle Research Institute [CFLRI], 2010; Colley et al., 2011; Trost et al., 2002). Although research has generally found boys to be more active than girls, both

genders showed a reduction in PA levels and an increase in sedentary behaviours beginning at age 11 (Brodersen et al., 2007). Intervening during this stage of development and establishing active lifestyles early is crucial in order for PA habits to persist into adulthood (Telama et al., 2005). While PA levels have been shown to be low for Canadian children in general (Colley et al., 2011), certain sub-groups of children and recent immigrants face an increased risk for insufficient activity levels (Brodersen et al., 2007; Bryan et al., 2006; Gordon-Larsen et al., 1999; Singh et al., 2008)

In addition, several social factors are suggested to influence children's PA. Social support from parents and peers demonstrate positive effects on children's PA (Beets et al., 2006; Barkley et al., 2014; Duncan et al., 2005). Several studies suggest that parents positively influence their children's PA through supportive actions, such as encouraging children to play, providing transportation to PA opportunities, watching children participate in activities and actively engaging with children (Beets et al., 2006; Duncan et al., 2005; Sallis et al., 2000; Trost & Loprinzi, 2011; Welk, Wood, & Morss, 2003). Similarly, research on peer support suggests that the presence and supportive actions from friends improves physical levels (Duncan et al., 2005; Salvy et al., 2009). Although the presence of social support positively impacts children's activity levels, inconsistencies exist in terms of methods used to assess social support and what types of supportive actions are related to increased PA levels (Beets et al., 2010; Sallis et al., 2000)

On a broader scale, numerous studies have linked supportive neighbourhood environments (e.g., parks and recreational facility proximity) to increased PA behaviour (Davison & Lawson, 2006; Giles-Corti & Donovan, 2002; Mitchell et al., 2016; Norman et al., 2006; Powell et al., 2007; Roemmich et al., 2006). Research indicates that levels of PA are higher when recreation facilities are more available within a neighbourhood (Ding et al., 2011; Estabrooks, Lee et al.,

2003; Gordon-Larsen et al., 2006; Mitchell et al., 2016; Roemmich et al., 2006; Tucker et al., 2009; Powell et al., 2007). Gordon-Larsen and colleagues (2006) found that youth who lived in a neighbourhood with one recreational facility were more likely to engage in 5 or more bouts of moderate-to-vigorous PA per week. The presence of recreational facilities may depend on the socio-economic status (SES) of the neighbourhood, as research suggests that individuals who live in low and medium SES neighbourhoods had fewer PA resources (i.e., areas used for PA such as parks, community centers, dance studios) available and fewer free PA opportunities, compared to high SES neighbourhoods (Estabrooks et al., 2003; Gordon-Larsen et al., 2006).

1.2. Intervention Studies

The multiple factors that influence children's PA underscore the need to develop effective interventions to modify these factors. Interventions are an effective tool for testing current understandings and learning from the action taken in order to identify effective strategies that improve children's PA (Hawe & Potvin, 2009).

A growing number of studies are examining the effectiveness of community-based interventions to promote children's PA. Children spend a considerable amount of time outside of school and community-based interventions provide an opportunity to research children in their natural environment by increasing PA opportunities within the community (Brand et al., 2014; van Sluijs et al., 2011; Perry et al., 2012; Sallis et al., 2008). Community-based interventions are desirable as they allow for a greater reach of the targeted population, pooled resources to enhance interventions (Bopp & Fallon, 2008), and have the potential to achieve population-level change in PA levels (Sallis et al., 2008). Current research suggests that the most effective and sustainable PA interventions involve large-scale collaboration among multiple sectors of the community, such as academics, service providers, schools, and policy-makers (Pate et al., 2000;

Sallis et al., 2008). While large-scale collaborations are effective, they can be challenging to organize, as it requires the coordination of many different groups in order to develop, implement and evaluate an intervention (Bopp & Fallon, 2008).

Most researchers are not in a position to develop community-level interventions independently, partly due to the resources (i.e., time, cost, administration, staff) needed to conduct an intervention at the population-level. To bypass this issue, researchers can take advantage of already occurring community-based interventions and evaluate them as a ‘natural experiment.’ A natural experiment can be used to evaluate interventions where individuals in experimental conditions are determined by nature or other factors outside the control of the researchers (Craig et al., 2012; Petticrew et al., 2005). Natural experiments can also be referred to as ‘naturally-occurring’ interventions. The terms ‘natural experiment’ and ‘naturally-occurring’ are used interchangeably throughout the thesis, as the terms both represent interventions that are initiated by an external agency and are not under the direct control of researchers.

Natural experiments allow researchers to evaluate population-level PA interventions that may not be possible as a controlled experiment and provide evidence of real-world effectiveness (Petticrew et al., 2005). Although natural experiments have potential to evaluate population-level change, they are not frequently used in PA interventions with children (Petticrew et al., 2005).

1.3. Theoretical Framework

In the past, theories and frameworks largely focused on the social influences and psychological mechanism that impact PA behaviour. PA research and practice has been guided by four prominent theories: Social Cognitive Theory, Theory of Planned Behaviour, Self-

Determination Theory, and Transtheoretical Model (Buchan, Ollis, Thomas, Baker, 2012). A brief description of each theory can be found in Table 1.1.

Table 1.1 Prominent theories in physical activity research provided by Buchan et al. (2012) & Glantz et al. (2008).

Name of Theory or Framework	Description
Social Cognitive Theory	Social Cognitive Theory suggests that behaviour, cognition, and other personal features have reciprocal relationships with environments. When predicting behaviour, self-efficacy has been found as the most powerful factor to consider.
Theory of Planned Behaviour	Theory of Planned Behaviour builds upon the Theory of Reasoned Action and posits that the most important predictor of behaviour is behavioural intention. Intention is a determinant of one's attitude, subjective norms and perceived control over performing the behaviour
Self-Determination Theory	Self-Determination Theory focuses on how a person attains the motivation for starting new health behaviours and maintaining them. This theory states that human behaviour is driven to meet three basic needs: competence, autonomy, and relatedness. Behavioural outcomes will occur when these three basic needs are met.
Transtheoretical Model	Behaviour change has been characterized as a five-stage process or continuum related to a person's readiness to change: pre-contemplation, contemplation, preparation, action and maintenance. Each stage is characterized by different psychosocial and behaviour changes.

Although these theories and frameworks present different features, the core purpose is focused on changing individual behaviour. The application of these theories has greatly enhanced our understanding of key psychological influences and processes related to PA behaviour (Buchan et al., 2012). A number of effective PA interventions have used these theories, though little has changed in terms of PA outcomes for children (Buchan et al., 2012). The focus on individual change limits the long-term maintenance of the behaviour (Bock et al., 2001; Owen, Glantz, Sallis, & Kelder, 2006) and also lacks the ability to achieve population-

wide impact, as other sources of influence (i.e., social support, community, built environment) are not considered (Sallis et al., 2008).

Recently, there has been a growing interest towards the application of ecological models in PA research and practice, due to their ability to guide comprehensive population-wide approaches to changing PA behaviours (Sallis et al., 2008). Ecological models of health address a behaviour using a range of factors across multiple levels of influence including intrapersonal (i.e., sex, age, attitudes), interpersonal (i.e., social support, household income), community, physical environment, and policy (Sallis et al., 2008) (see Figure 1.1).

When developing comprehensive interventions to target PA, ecological models provide a useful approach as they systematically assess mechanisms of change at the multiple levels of influence. While this approach is relevant for population-level interventions, it is also useful for addressing how place interacts with behaviour. PA occurs in specific places and the ecological model provides a framework to identifying the characteristics of places that facilitate or hinder PA (Sallis et al., 2006; Sallis et al., 2008). For these reasons, an ecological model of health guides this thesis in order to develop a more thorough understanding of the multiple levels of influence that impact change in PA behaviour.

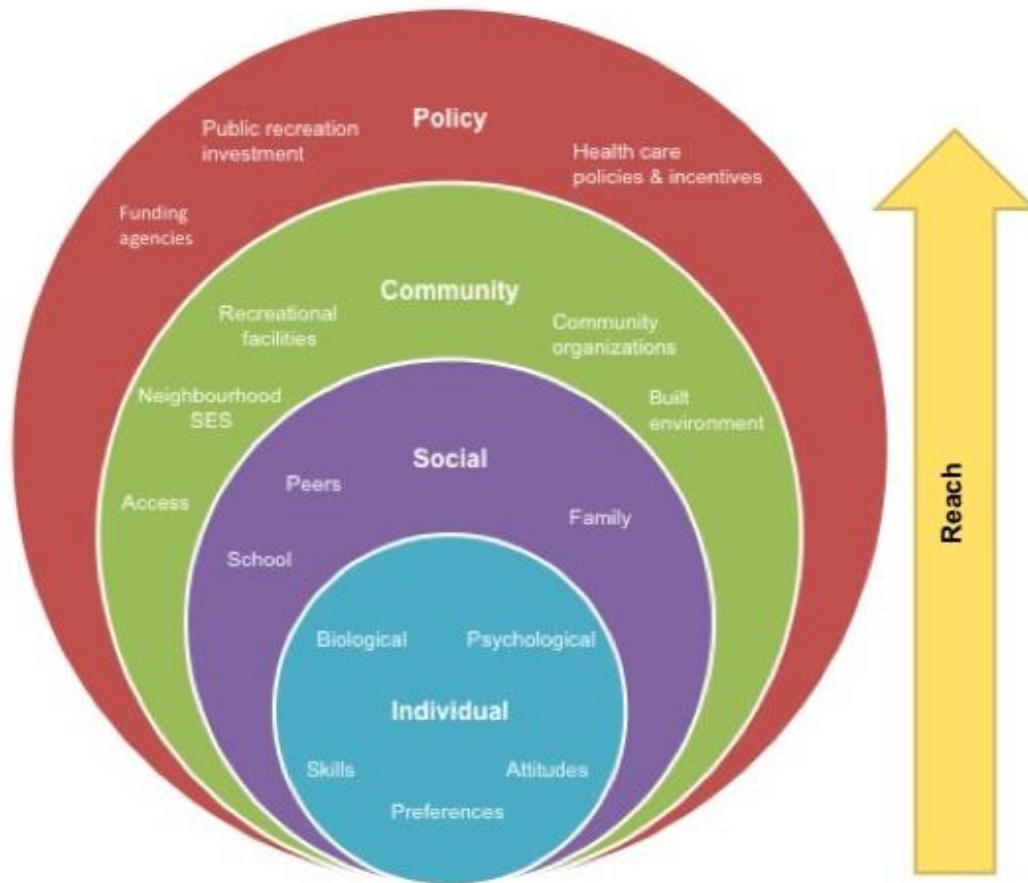


Figure 1.1 Ecological model adapted from Mitchell et al. (2016) & Sallis et al. (2006)

1.4. Research Objectives

The overarching objective of this research is to contribute to a growing body of literature assessing the effectiveness of population-based PA interventions with children. This research aims to better understand how naturally-occurring population-based interventions influence children’s PA and what other factors promote or hinder children’s PA. This understanding is necessary to develop effective strategies, guide future intervention and inform policy-makers with highly relevant evidence in order to improve children’s PA.

To achieve these objectives, this research uses both primary and secondary data. First, secondary literature will be used to conduct an integrative review to address the following research question:

- (1) How have naturally-occurring population-based PA interventions with children been evaluated in previous studies?

Primary data will then be used to evaluate a population-level PA intervention to address the following research question:

- (2) How does the provision of a naturally-occurring population-level intervention change children's level of PA over time in London, ON?

To answer the first research question, this study draws data from existing literature to identify articles that examine naturally-occurring population-level PA interventions with children to determine how these studies are being evaluated and what methods and measures are used. This review aims to summarize and evaluate previous literature by identifying gaps in current research, identifying prominent issues in the studies, and exploring which methods and measures have been used successfully.

To address the second research question, this study draws data from a city-wide initiative launched by London's *Child and Youth Network* (CYN) called the Grade 5 ACT-i-Pass project (ACT-i-Pass). London, Ontario is a mid-sized Canadian city located in Southwestern Ontario with approximately 366,151 inhabitants, 23% of whom (84,080) were 19 years of age or younger according to the 2011 Census of Canada (Statistics Canada, 2012). The ACT-i-Pass program developed by the CYN (www.londoncyn.ca) provided all grade five children in the City of London a free recreational access pass to use at facilities (i.e., YMCA, Boys and Girls Club, and the City of London/Spectrum) across the city for the duration of the school year. The ACT-i-Pass

study used a longitudinal cohort design to evaluate the impact of a naturally-occurring intervention on children's PA levels (Gilliland et al., 2015). During the study period, participants were recruited to register for the program and parental consent was provided to those students who took part in the research portion. Data collection comprised of four measurement periods over an 18-month period in which children and parents completed self-report questionnaires about their socio-demographics (i.e., sex, age, race, family composition), postal code, leisure time activity, PA levels, barriers to PA, perceived accessibility to and use of recreational facilities in their neighbourhood, and perceived parental and peer support. This thesis focuses specifically on two measurement periods (baseline and post-intervention), approximately a 12-month period between each questionnaire. Methods are explained in greater detail in each integrated article (Chapter 2 and Chapter 3).

PA remains a complex health behaviour influenced by a range of factors across multiple levels (i.e., intrapersonal, interpersonal, community, environment). Accordingly, this thesis hypothesizes that factors at each of these levels may impact the success of interventions and therefore seeks to understand the factors that are associated with change in children's PA. This research accounts for several variables known to influence PA occurring at the individual-, social- and neighbourhood-level.

1.5. Thesis Format

This thesis follows an integrated article format, comprised of two independent but related studies. Both studies examine how naturally-occurring population-based PA interventions influence children's PA levels. While each study has the same overarching objective, the specific objectives are met using different approaches. The first study aims to provide insight on how previous PA interventions have been evaluated, whereas the second study evaluates a local PA

intervention in London, Ontario. In doing so, this thesis aims to provide more knowledge of effective population-level PA interventions with children. Brief descriptions of each thesis chapter are provided below.

Chapter 2 reviews existing literature examining naturally-occurring population-level PA interventions with children by conducting a systematic review. This review identifies the current methods and measures used to evaluate PA, identifies successful and unsuccessful components of the studies, and what external factors influence PA outcomes.

Chapter 3 examines how the provision of a naturally-occurring population-level PA intervention changes children's level of PA over time in London, Ontario. This study addresses whether the intervention was successful in improving children's PA levels, examines differences in pre- and post-intervention PA in subgroups of children, and investigates individual, social and neighbourhood characteristics that predict PA change.

Chapter 4 summarizes and connects the findings from each integrated article. This chapter provides research limitations, discusses opportunities for future research and policy implications.

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Chapter 2: Using Natural Experiments to Evaluate Population-level PA Interventions with Children: A Systematic Review

2.1. Introduction

Engaging in regular PA during childhood is associated with numerous health benefits and protects against risk factors associated with obesity (Janssen & LeBlanc, 2010; Shaibi et al., 2008). According to Canadian recommendations (Janssen & LeBlanc, 2010; Tremblay et al., 2010), to obtain the health benefits associated with PA, children should have at least 60 minutes of moderate to vigorous activity (MVPA) every day. Unfortunately, only 9% of Canadian children (age 5-17) meet Canada's recommended guidelines of 60 minutes of MVPA on most days of the week (Shields, 2006; Tremblay et al., 2010; ParticipACTION, 2016).

The decline in children's PA has generated considerable interest in assessing and promoting PA among children, as obesity rates have almost tripled among Canadian children in the last three decades (Colley et al., 2011; Chaput et al., 2012; Janssen et al., 2005). Reasons for the decline in children's PA is complex, as this behaviour is influenced by a range of factors at multiple levels of influence from intrapersonal and interpersonal, to community and policy (Bauman et al., 2012; Sallis et al., 2000; Van Der Horst et al., 2007). A number of socio-demographic factors such as age, sex, ethnicity, socio-economic status (SES), and immigrant status have been identified as underlying determinants of PA in children (Brodersen et al., 2007; Bryan et al., 2006; Colley et al., 2011; Sallis et al., 2000; Singh et al., 2008). Children's interpersonal networks have also been found to influence PA behaviour, as several studies suggest that social support from parents and peers positively influence PA in children (Beets et al., 2006; Duncan et al., 2005; Trost & Loprinzi, 2011; Welk, Wood, & Morss, 2003). On a broader level, supportive neighbourhood environments have also been linked with increased

levels of PA. As a number of correlates of PA in children have been identified, it becomes crucial to assess the effectiveness of interventions aimed at increasing PA.

This paper aims to establish the current state of evidence related to naturally-occurring population-based PA interventions with children by conducting a systematic review. This study addresses the following objectives: 1) to summarize and evaluate previous literature by exploring the methods and measures that have been used in evaluations, 2) to examine the associated PA outcomes, and 3) to identify factors that influence the success of PA interventions. The information generated in this review will inform researchers and policy-makers about relevant evidence-based strategies to modify PA at a population-level.

2.1.1. Measuring Physical Activity

Due to the unique nature of children's PA, there are a variety of different measures that have been used to assess PA in children, with each measure possessing distinct advantages and disadvantages (Troost, 2007; Warren et al., 2010). Measures used to assess PA can be characterized as either objective measures (i.e., heart-rate monitor, accelerometers, pedometers) or subjective measures (i.e., self-report, direct observation). In recent years, the use of accelerometers has increased dramatically, as it is an attractive device due to its small size, modest cost and is a viable measure to use with children and adolescents (Sylvia et al., 2015; Trost, 2007). Accelerometers provide an objective measure of PA by assessing the body during movement by capturing the frequency, duration and intensity of movement (Strath et al., 2013; Trost, 2007). In terms of subjective measures, self-reports continue to be the most widely used due to the ease of administration, low cost, and convenience for large sample sizes (Troost, 2007). Self-report measures often capture information about the type, frequency and length of time spent in various activities using self-administered questionnaires, interviews or activity logs.

Determining the most appropriate measure to quantify PA in children presents a number of challenges for researchers, as there is usually a trade off between the accuracy and practicality of a measure (Welk et al., 2000). Understanding this trade off is particularly important for developing and testing PA interventions.

2.1.2. Community-Based Interventions

Interventions are often used to test different theories, strategies and methods in hopes of achieving positive PA outcomes. Over the last 20 years there has been a dramatic increase in the number of PA interventions on children (van Sluijs et al., 2016). Despite the large scope of research, reviews on the effectiveness of PA interventions have demonstrated limited efficacy for changing children's overall PA levels (Kahn et al., 2002; Metcalf et al., 2012; van Sluijs et al., 2007). Community-based PA interventions are suggested to be the most effective approach with the greatest potential to achieve population-level change in children's PA levels (Pate et al., 2000; Sallis et al., 2008). Considering the amount of time children spend outside of school, the community setting can promote leisure time PA by increasing opportunities for PA within the community (Brand et al., 2014; van Sluijs et al., 2011; Perry et al., 2012). A number of community-based interventions involve cross-sector collaborations with community groups, academic institutions, organizations, recreation facilities, schools and policy-makers (Pate et al., 2000; Sallis et al., 2008). This collaborative approach towards developing and implementing community-based interventions also allow for greater reach of target groups, pooled resources, and a more secure foundation for long-term sustainability (Bopp & Fallon 2008).

2.1.3. Natural Experiments

Community-based PA interventions have the potential to achieve population-level change, however, most researchers are not able to develop such large-scale interventions

independently. To overcome this issue, researchers can evaluate already occurring interventions as a ‘natural experiment,’ where individuals in experimental conditions are determined by nature or factors outside the control of the researchers (Craig et al., 2012; Petticrew et al., 2005). For instance, outcomes of interest can be examined between populations newly exposed to policies or environmental changes with those unexposed (intervention and comparison groups), or compare changes within the same population before and after a program or policy is initiated (pre-post observations) (Mayne et al., 2015). To illustrate, Fuller et al. (2013) used a natural experiment to determine if a bicycle share program increases the likelihood of biking in Montreal, Quebec based on residential exposure. This approach is often a useful way of understanding the impact of large-scale interventions on health outcomes that may not be possible to study as a controlled experiment (Craig et al., 2012). As a result, natural experiments produce good external validity that other research designs are unable to achieve, as they provide evidence for the direct impact of an intervention in real-world settings (Craig et al., 2012; Giles-Corti et al., 2015; Glasgow et al., 2004; Hunter et al., 2014; Petticrew et al., 2005; Ramanathan et al., 2008). There are inherent limitations that exist with this approach, notably, the many sources of potential bias such as confounding and threats to causal inference that should be taken into consideration when measuring study outcomes (Craig et al., 2012).

While it is still a relatively underused tool in PA interventions with children, an increasing number of studies have utilized a natural experimental approach, particularly in environmental interventions that target active travel or built environment changes (Benton et al., 2016; Carlin et al., 2016; Sallis et al., 2006). However, the utility of a natural experimental approach for evaluating population-level PA interventions is not well understood, as there are no known reviews to date that have assessed children’s PA outcomes using this approach. There is

a need to not only assess PA outcomes, but also gather evidence on the methodologies currently used to better understand how natural experiments can be effectively used to evaluate population-based PA intervention with children.

2.2. Methods

2.2.1. Eligibility Criteria

A systematic review was conducted to identify articles published since 2000 that examine naturally-occurring population-level PA interventions with children to determine the current methods and measures used to evaluate PA, assess PA outcomes, and identify successful and unsuccessful components of the studies and what external factors influence PA outcomes.

Eligible studies were selected by searching electronic databases (as of March 2016) and reference lists of relevant articles. Various combinations of several search terms were used in order to capture relevant articles (i.e., physical activity, play, children, youth, intervention, natural experiment, evaluation, community, population). Search terms were inputted into four electronic databases: PubMed, Web of Science, Sport Discus, and Engineering Village (GEOBASE, Inspec, and Compendex). The selected databases cover a range of fields from social science, health, engineering, and applied science.

2.2.2. Search Strategy and Selection of Studies

Articles were included if they met the following criteria: published between 2000-2016; focused on children or adolescents (between 6-18 years); conducted community- or population-based interventions; the intervention or program was naturally-occurring; PA was the primary outcome variable (i.e., objective or subjective measure); and articles were written in English. For the purpose of this review, the terms community- and population-based interventions are interchangeable and are defined as interventions that are provided to an entire community or

population of children. For example, a community or population for an intervention could be a single school or neighbourhood, or as large as a city. This allowed for a greater spectrum of articles that used a natural experimental approach. Similarly, the age range used for inclusion of articles was broad in order to capture all relevant interventions that targeted school-aged children that used a natural experimental approach. Interventions were considered to be naturally-occurring if the article stated that the program or intervention was initiated by an external agency and it was not under the direct control of the researchers.

Articles were excluded based on the following criteria: focused on pre-school ages, adults, or a clinical population (i.e., obese children); examined the general population with no distinct analyses for children, or a subset of population (i.e., only girls); were family-based, school-based, or primary care interventions; and studies that primarily focused on nutrition. Some school-based interventions were included if it was clear that PA was taking place outside of school hours or if schools were used as the method of recruitment and data collection.

The initial search returned 9,496 articles (see Figure 2.1). The titles of all the articles were screened and a total of 3,556 potentially relevant articles were identified. The title screening resulted in 6,140 articles being excluded, of which 510 were duplicates. Abstract screening resulted in the exclusion of 2998 articles. Of the remaining 558 articles, the full text was reviewed and 458 were deemed not to satisfy inclusion criteria. Of the remaining 100 articles, 88 were removed, as they did not meet the definition of a natural experiment. Finally, reviewing the reference lists of the relevant articles identified an additional 3 articles. A total of 15 articles satisfied the inclusion criteria and were examined in detail.

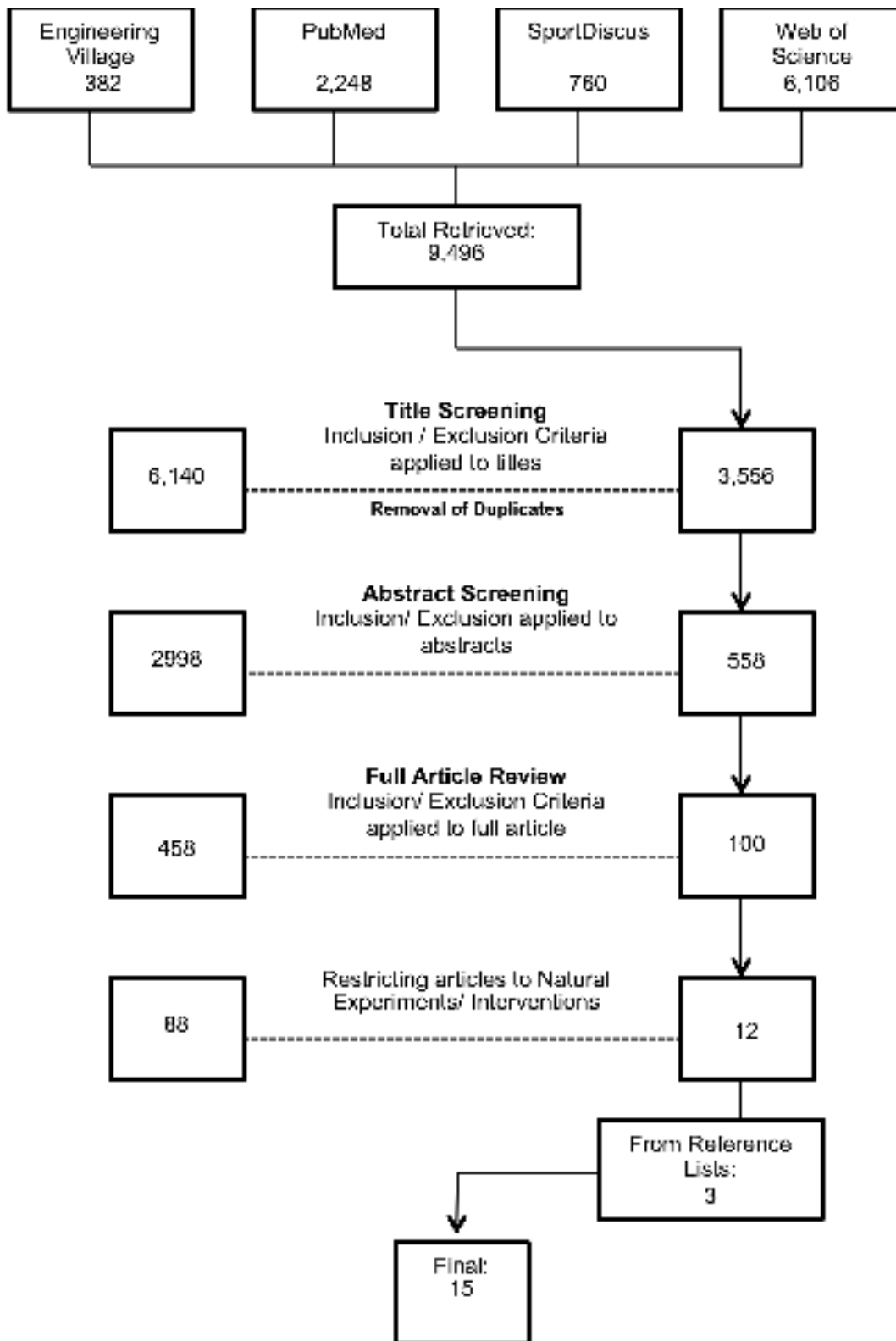


Figure 2.1 Systematic Review Flow Chart

2.2.3. Data Extraction

Data on the study design, study location, total sample size, sample age, year of publication, PA domain, PA measures, intervention components, evaluation components and findings were extracted for each article that met the inclusion criteria and tabulated (see Appendix A at the end of the chapter). Since the purpose of this review is to determine how naturally-occurring population-based PA interventions have been evaluated, outcomes associated with PA, physical fitness, or anthropometric measures related to PA (i.e., body composition, BMI) were reviewed. Additional outcomes related to evaluation components and external factors were also reviewed.

2.3. Evidence Synthesis

2.3.1. General Characteristics of the Reviewed Studies

A total of 15 papers were reviewed. A majority of the studies were conducted in the United States (11/15), while Australia, New Zealand, United Kingdom and Canada had one study each. Sample sizes ranged from 55 to 7455. Nine of the studies were conducted with children (ages 6-12 years), five studies included both children and adolescents, and only one study targeted only adolescents (ages 13-18 years). Among the reviewed studies, duration of the study period varied from 5 weeks to 3 years. Only five of the studies reported the use of a theoretical framework or approach for the intervention that included social cognitive theory, social ecological framework, social marketing principles and an infrastructure/capacity building approach. In terms of the types of PA examined, five studies focused on active travel, five studies targeted built environment, three studies conducted interventions aimed at general PA, and two studies focused on PA in an after-school setting.

Active travel interventions typically focused on promoting walking or biking to and from school either through walking school bus programs or safe routes to school programs. Of the built environment studies, three involved park renovations and two included more comprehensive changes throughout the community such as the creation of sidewalks, crosswalks, walking trails, and bike racks. All three studies targeting general PA were part of the same intervention (VERB), a mass media campaign based on social marketing principles that promoted PA as cool, fun, and easy. One of these studies adapted VERB into a summer program and partnered with community-based organizations to offer PA opportunities. The two studies that used after-school settings both involved adapting programming to include a new PA component in local community organizations; one study partnered with the YMCA, and the other study included the YMCA and Boys and Girls Club in delivering the intervention.

PA was generally measured using subjective measures as eight of the studies used only subjective measures and seven studies used a combination of subjective and objective measures. Eleven studies included an additional evaluation component in tandem with evaluating the primary PA outcomes.

Table 2.1 General characteristics of the papers reviewed.

General Characteristics of the Papers Reviewed	
Characteristics of Paper	Number of Articles
Study Design	
Quasi-experimental	
Repeated cross-sectional (control group)	6
Longitudinal (control group)	4
Longitudinal (no control group) ^a	1
Cross-sectional (control group)	1
Non-experimental	
Longitudinal (no control group)	2
Repeated cross-sectional (no control group)	1
Total Sample Size	
1-100	3
101-500	6
500+	6
Geographic Origin	
Australia	1
Canada	1
New Zealand	1
UK	1
United States	11
Theory or Framework Used	
Social cognitive theory	2
Social ecological framework	1
Alternative approaches	2
Not reported	10
Age Group	
Children (6-12)	10
Adolescent (13-18)	1
Both	5
PA Domain	
Active travel	5
After school	2
Built environment	5
General PA	3
PA Measures	
Objective	1
Subjective	9
Both	5
Evaluation Measures	
PA only	4
Other evaluation component	11

Note: ^aOne study created control group based on participants exposure level to the intervention using propensity scoring matching technique.

2.3.2. Types of Methods and Measures Used

The studies identified in the literature search used several types of research designs. Of the 15 studies, the most frequently used was a quasi-experimental research design with pre/post measures (12/15). Of these 12, a majority of the studies included a control group for except one study that used a statistical technique to create a control group based on participant's exposure to the intervention (Huhman et al. 2005). Three of the studies used a non-experimental research design that included pre/post measures (but no control group). Eight of the studies used a cross-sectional study design where different individuals were assessed at pre/post measurement periods, and the other seven studies used longitudinal study design to assess the same individuals at pre/post measurement periods.

Common among population-based PA interventions, almost half of the studies used only self-report measures to obtain PA outcomes (7/15) (see Table 2.2). Self-reports included child surveys such as the national Youth Risk Behaviour Survey (YRSB) and the Youth Media Campaign Longitudinal Survey (YMCLS). The YRBS is a biennial survey conducted by the Center for Disease Control and Prevention (CDC) to monitor priority health risk behaviours of adolescents nationwide (CDC, 2016), whereas the YMCLS is an interviewer-administered telephone survey designed to evaluate the effects of the CDC VERB campaign. Both measures have been found to have acceptable reliability (Brener et al., 2004; Welk et al., 2007). Other studies that used self-report measures developed intervention specific questionnaires or used classroom tallies. Five of the studies used accelerometers in combination with self-report measures, four of which also included anthropometric measures. The only anthropometric measure used in the reviewed studies was BMI.

Less frequently used was direct observation, as only three studies used this measure, two of which used direct observation in combination with self-report. The direct observation measures included System for Observing Fitness Instruction Time (SOFIT) and System for Observing Play and Recreation (SOPARC). SOFIT is used to measure participants PA levels and lesson context, whereas SOPARC is used to measure park user characteristics and PA behavior.

Table 2.2 Measurement characteristics of the reviewed papers

PA Measure	Number of Papers
Subjective	
Self-report	7
Direct observation	1
Objective	
Anthropometry	-
Accelerometer	-
Combination	
Self-report; Direct observation	2
Self-report; Accelerometer	1
Self-report; Accelerometer; Anthropometry	4

2.3.3. Physical Activity Outcomes

Given the range of measures used, outcome measures for PA were highly varied between the studies and included MVPA, total daily PA, self-report of PA, direct observation of PA, proportion of students who walked to school, and change in BMI. Overall, the studies showed positive changes in PA outcomes. Based on the type of PA, the majority of positive outcomes were for active travel studies followed by general PA interventions (see Table 2.3).

Table 2.3 Results of the reviewed papers by physical activity domain

Authors	Intervention	PA Measure	PA Outcome	Results
Active Travel				
Heelan (2005)	Walking School Bus program: included 8 routes for the intervention schools	Self-report (School Index)	Prevalence of walking	↑
		Accelerometer (ActiGraph)	MVPA	↑
		BMI (kg/m ² , age adjusted BMI percentiles, Lange skinfold calipers, % body fat ^a)	Changes in BMI, BMI percentile, skinfold thickness, and % body fat	↔
McKee (2016)	Travelling Green: a school-based active travel project that included interactive tools	Mapping software (MapIt) Self-report survey	Distance travelled to school by walking	↑
Mendoza (2009)	Walking School Bus program: included 3 routes for the intervention school	Self-report survey	Proportion of students who walked to school	↑
Sayers (2012)	Walking School Bus program: community volunteers meet and walk with children to school along scheduled routes five mornings per week before the beginning of the school day.	Accelerometer (ActiGraph)	MVPA	↔
Stewart (2014)	Safe Routes to School (SRTS) program: provides grants to projects in school-based communities that directly support walking and biking through: engineering, education, encouragement, and evaluation.	SRTS project tracking database	% of active travel	↑
After School				
Gortemarker (2012)	YMCA After-school Food and Fitness Project: focused on program practice changes in the areas of physical activity and offered daily inclusive PA and promoted high levels of staff participation	Accelerometer (ActiGraph)	MVPA, MPA, VPA	↑
Sharpe (2011)	CATCH Kids Club: provided students with opportunities to participate and practice skills in a variety of enjoyable physical activities	Direct Observation (SOFIT)	MVPA	↔

Authors	Intervention	PA Measure	PA Outcome	Results
Built Environment				
Benjamin-Neelon (2015)	Mebane on the Move: consisted of walking and running clubs, cross walks, walking trails, and portable play equipment.	Accelerometer (ActiGraph)	MVPA BMI	↑ ↓
Bohn-Goldbaum (2013)	Park renovations that included upgrading paths, adding greenery, lighting and facilities.	Direct Observation (SOPARC) Sydney Parks User Interview (Survey)	MVPA Park Usage	↔ (↓ for girls) ↔
Chomitz (2012)	Somerville Active Living by Design Project: included installing cross walks, renovating parks, providing bike racks, and walking trail.	Self-report survey (YRBS)	Meeting PA guidelines	↑ (high school) ↔ (middle school)
Cohen (2015)	Park renovations that included new play equipment, landscaping, and ground surfaces.	Direct Observation (SOPARC)	Level of PA observed (MET-hours)	↑
Quigg (2012)	Park renovation that included new play equipment, seating, safety surfacing and waste facilities	Parent Interviews Accelerometer (ActiGraph) Age- and sex-standardized BMI	Park Use Total daily PA BMI	↑ ↔ (↑low BMI score)
General PA				
Alfonso (2011)	VERB Summer Score Card: participants received a score card that introduces them to various activities at community “action outlets.”	Self-report survey (YRBS-MS)	Self-report VPA	↑
Huhman (2005)	VERB Campaign: uses commercial marketing methods to advertise being physically active as cool, fun, and a chance to have a good time with friends.	Self-report survey (YMCLS)	Self-report of free-time and organized PA (non-school hrs)	↑
Huhman (2007)	VERB Campaign: expanded commercial marketing methods to include community- and school-focused efforts.	Self-report survey (YMCLS)	Self-report of free-time and organized PA (non-school hrs)	↑

Note: ↑Significant positive, ↓ Significant negative, ↔ No change

BMI: Body mass index; MVPA: Moderate to vigorous physical activity; MPA: Moderate Physical Activity; VPA: Vigorous physical activity; SOFIT: System for Observing Fitness Instruction Time; SOPARC: System for Observing Play and Recreation in Communities; YRBS: Youth Risk Behavior Survey; YRBS-MS: middle school version of Youth Risk Behaviour Survey; YMCLS: Youth Media Campaign Longitudinal Survey; ^a % body fat equation from Slaughter et al. 1988

Of the five active travel studies reviewed, three evaluated a “walking school bus” program, one assessed a “safe routes to school program” and one used a local active travel intervention. Active travel studies with positive outcomes all used varying research designs (quasi-experimental, non-experimental, cross-sectional and longitudinal), varied in duration from 5-weeks to 2 years, and used self-report or combination of self-report with objective measures. One active travel study found no change in PA and, when compared with the more successful active travel studies, this study used MVPA as the only PA outcome measure, used cross-sectional data (post only), had a small sample size, and a short duration in study period with participants being sampled for a 7-day period.

Of the five built environment studies reviewed, two studies included multiple built environment features and three evaluated park renovations; however, results were mixed. Of the two studies that found positive outcomes, one used a comprehensive approach that changed multiple features of the environment (i.e., sidewalks, crosswalks, walking trails), while the other completed a park renovation. For instance, Benjamin-Neelon et al. (2015) evaluated Mebane on the Move, an intervention developed by community residence to promote PA through walking and running clubs in schools and in the community, portable play equipment, and the installation of sidewalks, crosswalks, and waling trails. Using a combination of measures (i.e., self-report, accelerometers, and BMI), intervention children increased their MVPA and VPA more than comparison. Despite the similarities, the three other studies that evaluated park renovations found no change or mixed results. For instance, Bohn-Goldbaum et al., (2013) used a cross-sectional design, collecting direct observation and self-report data on PA and park usage. One park was renovated while the other park served as a control and no change in MVPA was found

between the parks. Similarly, Quigg et al., (2012) assessed park renovations using self-report and accelerometers and found no change between intervention and control group, while PA increased only for those with lower BMI.

General PA interventions all reported positive outcomes. All three studies were based on the same PA program (VERB), with one study adapting the program as a summer program. The CDC launched VERB as a national campaign to encourage 9-13 year-olds to be physically active every day and used paid advertising with school and community promotions to deliver the health-promotion messages. Using the same promotion strategy, Alfonso et al. (2011) adapted the program to deliver VERB Summer Score Card, a local program in which participants are introduced to new activities at community-based agencies and track their PA on scorecards to receive prizes. All three studies used only self-report measures to obtain PA outcomes. Two of the studies were linked, such that one paper presented results from the 1st year of the program, and the following study presented 2nd year results using a longitudinal, cohort design. None of the general PA studies in this review used a control group; rather, statistical techniques were used to create groups who had no knowledge of the program to serve as a control group.

Two of the studies targeted PA in afterschool settings. Gortmaker et al. (2012) evaluated a YMCA-driven environmental change intervention to enhance PA in after-school programs by offering daily inclusive PA for 30 minutes, vigorous activity offerings at least 3 times per week, and promoting high levels of staff participation in PA. Using self-report and accelerometers, greater PA increases were found for children in the intervention sites compared to control. Similarly, Sharpe et al. (2011) evaluated the CATCH Kids Club, a large-scale community-driven initiative through the YMCA and Boys and Girls Club that introduced new PA opportunities for children to participate and engage in a variety of enjoyable physical activities. Despite the

similarities in the program and setting between these two studies, Sharpe et al. (2011) used only direct observation to measure PA and found no differences in MVPA between the intervention and control sites.

2.3.4. Other Factors that Influenced PA Outcomes

Of the 15 studies, 11 included additional evaluation components to assess external factors of the intervention (see Table 2.4 at the end of the chapter). The focus of the evaluation components used in the studies varied and was dependent upon the type of PA domain being studied.

Of the five active travel studies, three completed evaluation measures. One active travel studies that used a ‘Walking School Bus’ program included a process evaluation to capture weekly attendance of children, the routes that were established, and interviews with parents and volunteers that supported the programs (Mendoza et al., 2009). The other two studies used evaluation measures to identify benefits, motivators and barriers to active travel or characteristics that were associated with greater increases in rates of active school travel (McKee et al., 2016; Stewart et al., 2014).

Both of the after-school PA interventions completed comprehensive process evaluations to assess implementation of the program. Gortmaker et al. (2012) included program and process change measures such as meeting agendas, attendance lists for learning sessions, bimonthly surveys, tracking program usage and PA offerings, self-assessments and interviews. Similarly, Sharpe et al. (2011) conducted structured interviews with 18 program leaders focused on the implementation process of the CATCH Kids Club.

Out of the five the built environment studies, three included evaluation measures. Two of the studies that focused on park renovations used interviews to obtain data on park usage,

perceptions of park features, perceptions of safety, frequency and location of exercise (Bohn-Goldbaum et al., 2013; Cohen et al., 2015). Chomitz et al. (2012) used parent and child surveys to examine encouragement, awareness, and use of recreational space as part of the Active Living by Design program that included bike racks, walking paths, cross walks, and renovated parks in the community.

All three general PA studies used evaluation components. Given the social marketing approach of these studies, the focus of these measures targeted the awareness of the VERB campaign, understanding of the messaging, and self-reported frequency of exposure to the campaign.

Whether or not an additional evaluation component was included, most studies reported external factors that could have impacted the internal or external validity of the intervention and PA outcomes. Some of the reported factors include: characteristics of the sample (i.e., small sample size, subgroup analyses), research design used (i.e., lack of randomization), additional measures used (i.e., sociodemographic, perceptions of neighbourhood safety) and intervention specific characteristics (i.e., community partnerships, recruitment issues). A majority of the studies also included detailed information about the intervention components.

2.4. Discussion

This integrated review was conducted to identify articles that examined naturally-occurring population-level PA interventions with children to determine how these studies are being evaluated. The objective was threefold: (1) summarize and evaluate the current methods and types of measures used; (2) examine PA outcomes; and (3) identify successful aspects of the interventions.

Although the number of studies conducted to date is limited, the results of this review suggest that naturally-occurring population-based interventions are generally effective in improving PA levels of children and adolescents. The positive findings for a majority of the studies reinforce the utility of natural experimental approaches and the potential to develop effective strategies that are applicable in real-world situations. While this review aimed to assess PA overall, it is apparent that natural experiments have been used in multiple PA domains. As a result, there was a high degree of heterogeneity in the methods, measures, and settings, as each study characterized their assessments of PA to account for desired research goals and the specific aspects of the intervention or setting. While this limited the ability to compare studies, the review provided evidence of the methods and measures that are currently being used in population-based natural experiments.

Previous research notes that population-based studies present different challenges in assessing PA (Maddock, 2006). Self-report measures have been suggested as the most commonly used in population-based studies, as they are cost effective and easy to administer for large sample sizes (Trost, 2007). However, this review has found both objective and subjective measures used to assess PA and tend to be dependent upon the type of intervention. For instance, the VERB intervention used a social marketing approach to promote general PA levels among children and, with the large reach of this intervention, only self-report measures were used to assess PA. Conversely, CATCH Kids Club implemented a new PA component in the after school environment (i.e., YMCA and Boys & Girls Club) and used direct observation to obtain data on both the levels of PA observed (MVPA) and lesson context. Given the evidence, it is clear that understanding both the dimensions of PA (i.e., type, frequency, duration and intensity) and the

domains in which PA occurs (i.e., school, leisure, active travel) are essential to understanding the assessment of PA when the goal is behavior change (Strath et al., 2013).

While there is no single method or measure that is perfect, carefully selecting measurement tools are critical for properly evaluating PA in any intervention. Natural experiments at the population-level present different advantages and disadvantages than experimental designs and may require more careful consideration when selecting measures to minimize or control for bias. Many of the studies included in this review used a quasi-experimental design with control group, and despite the lack of randomization, it provided a useful alternative to experimental design when assessing the interventions outcomes. On a broader level, Strath et al., (2013) recommend that decisions be guided by the desired outcomes, the practicality of the measure, available resources, and administration.

Even if recommendations are followed, the characteristics of children's PA patterns can limit the ability to accurately assess the behaviour. Children tend to have short and sporadic bursts of PA and engage in various types of activities and free-play, whereas adolescents tend to engage in more structured activities (Welk et al., 2000). Based on the methods and measures used in this review, it is important to not only choosing the best available research design, but use measures that are focused for the age group, the setting, and the type of PA.

While the success of an intervention may be dictated by physical activity outcomes, developing a better understanding of how and why interventions are successful or unsuccessful provides valuable information to improve and guide future interventions (van Sluijs et al., 2016). By evaluating different elements of PA interventions, important knowledge is generated that is otherwise missed, as such measures offer a more complete understanding of the effectiveness of an intervention (McGoey et al., 2015; Pate et al., 2000). In this review 11 out of the 15 studies

included additional evaluation components such as process evaluations and assessing specific intervention elements. While the studies use diverse methodologies, the inclusion of additional evaluation components help to justify results and offer reasoning behind the outcomes. For instance, Gortmaker et al. (2012) used a variety of program and process measures (i.e., attendance list, bi-monthly surveys, usage, self-assessments, interviews) to assess the implementation of a YMCA-driven PA component in after-school programs and found a number of factors that influenced the success of the intervention (i.e., staff turnover, low dose of intervention). Above all, evaluations can provide important contextual information and emphasize the importance of place in relation to the success of a PA intervention.

The role of place is important in shaping and understanding health outcomes and may be a factor in the effectiveness of population-based PA interventions that use a natural experimental approach (Macintyre et al., 2002). Previous research shows a geographical patterning of health, as area of residence can impact health behaviours based on the characteristics of the individuals in certain places and/or aspects of the physical and social environment (Bernard et al., 2007; Macintyre et al., 2002). Apart from methodological considerations, place may explain some of the differences in PA outcomes among the reviewed studies. The major benefit of natural experiments is their ability to evaluate place-based interventions designed to promote physical activity (Astell-Burt et al., 2015). Findings from the studies suggest that interventions were potentially affected by factors such as: other health-based initiatives taking place, safety of the neighbourhood, self-selection, SES, and systematic differences between the intervention and control groups.

2.4.1. Strengths and Limitations

The strength of this systematic review is in the robust review method used, as several databases were systematically searched using a comprehensive list of search terms to identify a broad collection of potential studies. The same level of rigour was used during the screening and data extraction. Furthermore, the use of natural experiments in population-based PA research is still relatively new and no known review of this nature exists, therefore this review can contribute evidence to help guide future research interventions that use a natural experimental approach.

This review is subject to several limitations. First, the number of studies included was rather low and limited the ability to compare effectiveness of the interventions more fully. Secondly, when assessing PA outcomes, effect sizes were not considered, only statistical significance and the direction. Interventions were included for both children and adolescents, however, PA patterns and method of assessment may be different between the two developmental stages and therefore future research should focus on one age group. In addition, no grey literature was reviewed and therefore other potential natural interventions were missed. Finally, there were no assessment of quality was conducted for the studies in this review.

2.4.2. Suggestions for Future Research

There is need for more research on population-based PA interventions evaluated as a natural experiment, as this approach can provide policy relevant evidence. Children's PA continues to be a major public health concern and when developing interventions to improve PA behaviour, it is not always possible to conduct randomized experiments for practical and ethical reasons (i.e., challenges of experimental design with large sample sizes, withholding a beneficial intervention). Natural interventions can assist in the identification of effective interventions,

provide good external validity and provide opportunities to determine the potential impacts of interventions on health inequalities (Petticrew et al., 2005). While the benefits of conducting natural experiments are promising, they are highly variable as this review confirmed. Many sources of potential bias can occur as well, therefore it is important for future interventions to include a comparison group or groups with varying levels of exposure to the intervention, an estimate of effect size, multiple pre/post measures, an accurate measurement of potential confounders and a variety of methods to address different sources of bias (Craig et al., 2012).

2.5. Conclusions

Together this evidence reinforces the effectiveness of using natural experimental approaches to evaluate population-based PA interventions. While the findings indicate positive changes in children's PA, they also highlight the importance of conducting more comprehensive evaluation measures to provide contextual information to help interpret results and guide future research. Overall, there are currently not enough studies to fully determine the impact of naturally-occurring population-based PA interventions for children.

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Table 2.4 Systematic review table with data extracted from articles examining naturally-occurring population-level PA interventions with children

Authors, Year, Country	Age Group, Sample Size	Type of Physical Activity	Physical Activity Measure & Outcome	Description of Intervention, Evaluation Component ^E	Main Findings
Alfonso, McDermott, Thompson (2011) USA	n= 3,428 (2004) n= 1,976 (2006) n= 2,051 (2007)	General PA	Measures -Child Survey Outcomes -Vigorous PA	VERB Summer Score Card (VSS) ^E Participants received a “scorecard” that introduced them to various new activities at community “action outlets” hosted by businesses. The scorecard was wallet-sized and designed to be carried by youth to enable them to track their PA. When youth had been active for at least 60 minutes at an action outlet (or at home), an adult stamped or signed 1 of the scorecard’s 24 squares. When all squares were filled, the card could be redeemed for prizes	Significant - Positive The proportion of youth who reported frequent vigorous physical activity increased over time. The proportion of VSS participants with moderate or high levels of vigorous physical activity increased more than twice the proportion of nonparticipants Compared to those who had never heard of VSS, VSS participants were more likely to be active across all levels of VPA
Benjamin-Neelon, Brouwer, Ostby (2015) USA	Baseline INT n=64 CON n= 40 Follow-up INT n=34 CON= 18	Built Environment	Measures - Parent/ Child Survey - Accelerometer - BMI Outcomes -MVPA, BMI	Mebane on the Move The Mebane on the Move volunteers promoted physical activity through walking and running clubs in the elementary schools for children and in the community for families, portable play equipment provided to low-income families through home delivery food assistance programs, and sidewalks, crosswalks, and walking trails installed throughout town. Additionally, free community exercise programs were offered to children and adults at the local recreation center.	Significant - Positive Intervention children increased MVPA and VPA more than comparison children For intervention children, BMI decreased compared to children in the comparison community

Bohn-Goldbaum, Phongsavan, Merom (2013) Australia	Follow-up Interviews: n=140	Built Environment	Measures -Direct Observation -Parent interviews Outcomes -MVPA, Park Usage	^E Park renovation included upgrading paths and adding new greenery, lighting, and facilities (e.g., park furniture). More green space was created by opening the adjacent sports field to public use, thus increasing the accessible park size The new children's playgrounds are three unfenced areas dispersed throughout the park. The playgrounds incorporate the city of Sydney's design to mandate include public art, an aboriginal theme, and, following community consultation, a water play feature.	Mixed No change in park use at follow-up No change between parks in the number of children engaged in MVPA Significant decline in girls engaging in MVPA at follow-up
Chomitz, McDonald, Aske (2012) USA	Baseline n= 2,480 Follow-up n= 2,015 Control: n= 2,489	Built Environment	Measures: -Child Survey Outcomes -Self-reported achievement of either moderate or vigorous physical activity guidelines	Somerville Active Living by Design Project ^E Enhanced opportunities for active transportation, walking, and biking through advocacy to paint crosswalks, install pedestrian crossing signs, open and renovate parks, and provide bike racks. Extension of the walking path in conjunction with a subway expansion project connecting Somerville to Boston. School-based and community active living activities for children and families, including walk-to-school efforts, school-based gardens, and physical education.	Mixed Within intervention community, high school-aged students and adults were more likely to meet physical activity recommendations at follow-up after adjusting for demographic, health, and behavioural variables No significant city effects in reporting meeting physical activity guidelines among middle- or high-school students For all age groups and in both communities, use of recreational spaces was associated with reported physical activity.
Cohen, Han, Isacoff (2015) USA	(6 parks: 2 renovated, 2 partially-renovated, 2 not renovated)	Built Environment	Measures -Direct observation -Interviews Outcomes -Levels of physical activity observed into MET- hours, park use	^E Park renovations included the installation of completely new play equipment, landscaping, and ground surfaces. Added adult outdoor fitness equipment and a new 2500 square foot recreation center.	Significant - Positive Compared with parks that had not yet been renovated, improved parks saw more than a doubling in the number of visitors Renovated parks had increase in energy expended Increased park use was pronounced in adults and children

Gortmaker, Lee, Mozaffarian (2012) USA	INT (16 sites) n=114 CON (16 sites) n=98	After school program	Measures - Accelerometer - BMI - Family workbook Outcomes - MVPA, MPA, VPA, Change in physical activity levels among children.	YMCA After-school Food and Fitness Project ^E Activities were developed to capitalize on staff role modeling and practice of healthy behavior. The intervention focused on program practice changes in the areas of physical activity and offered daily inclusive physical activity for at least 30 min, offered vigorous activity at least three times per week, and promoted high levels of staff participation in physical activity	Significant - Positive Greater physical activity increases in children in intervention versus control sites (after modest intervention implementation) Children in intervention sites showed greater increases in average physical activity level than in control sites and more minutes of moderate and vigorous physical activity, minutes of moderate physical activity, and minutes of vigorous physical activity
Heelan, Abbey, Donnelly (2009) USA	INT n= 201 CON n= 123	Active Travel	Measures - Child Survey - Accelerometers - BMI, skinfold thickness, percent body fat Outcomes - Prevalence of walking to/from school, MVPA, BMI	Walking School Bus (WSB) Neighborhood walk-stops were designated within a 1-mile radius of the WSB schools. An adult WSB leader (a paid college student) met the neighborhood children at these designated walk-stops at specified times each morning and walked the group of children to their school and back to the walk stop in the afternoon. Eight routes were created for the 2 WSB schools.	Significant - Positive Prevalence of walking to school frequently was higher in WSB schools than in control school WSB schools obtained significantly more daily PA than control school Frequent Walkers obtained more PA, gained less body fat, and attenuated BMI, compared with passive commuters
Huhman, Potter, Duke (2007) USA	Baseline Year 1 n=2729 Year 2 n=2257 *Dyads of parent and child	General PA	Measures - Child Survey Outcome - Self-reports of free-time and organized physical activity during non-school hours	VERB Campaign ^E VERB is a health marketing campaign that combines national paid advertising with school and community promotions and Internet activities to encourage the nation's 21 million 9- to 13-year-olds to be physically active every day. Television advertising, placed mainly on cable networks popular with children, was the primary delivery vehicle for the intervention. Community-focused and school-directed efforts supplemented the advertising in Year 1 and expanded in Year 2; activity promotion kits were delivered to numerous community-based organizations and schools across the nation.	Significant - Positive Children exposed to VERB messaging reported more PA and more positive attitudes about PA Children aware of VERB- engaged in significantly more PA, than those unaware

<p>Huhman, Potter, Wong (2005)</p> <p>USA</p>	<p>Baseline: n= 3084 adults n= 3120 children</p> <p>Follow-up n= 2732 of the same dyads</p>	<p>General PA</p>	<p>Measures -Child Survey</p> <p>Outcomes -Self-reported estimates of free-time and organized physical activity sessions during non- school hours</p>	<p>VERB Campaign^E</p> <p>VERB is a health marketing campaign that combines national paid advertising with school and community promotions and Internet activities to encourage the nation's 21 million 9- to 13-year-olds to be physically active every day. Uses commercial marketing methods to advertise being physically active as cool, fun, and a chance to have a good time with friends. Television advertising, mainly on cable channels that children watch (eg, Nickelodeon and Disney), was the primary message vehicle</p>	<p>Significant - Positive</p> <p>As children' awareness of VERB increased, PA increased</p> <p>Within subgroups, this relationship between awareness and increased PA was found for age 9-10, girls, white children, parents with < high school education, low income households, children from urban and rural areas, low and high active at baseline</p> <p>Within subgroups, a relationship between awareness of VERB and organized activity was observed for parental education of less than high school and classification as low active at baseline</p>
<p>McKee, Mutrie, Crawford (2016)</p> <p>UK</p>	<p>Baseline INT n=31 CON n=29</p> <p>Follow-up INT= 29 CON=26</p>	<p>Active Travel</p>	<p>Measures - Mapping program to record school travel behaviour - Child Survey</p> <p>Outcomes -Distances travelled from home to school, to school by walking and the distances travelled to school by car</p>	<p>Travelling Green^E</p> <p>Classroom teachers and school children, and their families used a set of written interactive resources during the project (curriculum materials, children and family resources) containing a number of interactive tools (customized maps, distance and time chart, goal setting activities, activity diary, road safety)</p>	<p>Difference between the schools was significant</p> <p>Mean distance travelled to school by walking by intervention children increased significantly from baseline from 198 to 772m</p> <p>Mean distance travelled to school by car by intervention children reduced significantly</p> <p>Mean distance travelled to school by car by control children increased from baseline</p> <p>The difference in the change between schools was significant</p>

Mendoza, Levinger, Johnson (2009) USA	Baseline n= 653 1 month n= 738 6-month n= 729 1 year n= 643	Active Travel	Measures - Child Surveys Outcomes -Proportions of students who walked or were driven to school	Walking School Bus (WSB) ^E Three WSBs were developed and maintained throughout the study period and each "bus" had its own set route to school from different locations in the surrounding neighbourhoods.	Significant - Positive WSB program was associated with significantly higher proportions of students who walked to school at short and long-term follow-up, as compared to the control schools
Quigg, Reeder, Gray (2012) New Zealand	Baseline n=184 Follow-up n=156	Built Environment	Measures -Accelerometer - Parent Survey - BMI Outcomes -Total daily PA, BMI	Park renovations included play equipment, seating, additional safety surfacing, and waste facilities were installed.	Mixed No evidence that participants in the intervention community had a statistically significant difference in their mean TDPA, compared to those living in the control community. Children in intervention community increased in PA levels, only for children with low BMI z-scores
Sayers, Lemaster, Thomas (2012) USA	N= 77	Active Travel	Measures - Accelerometers - Parent surveys Outcomes - MVPA	Walking School Bus (WSB) Community volunteers met and walked with children to school along scheduled routes five mornings per week before the beginning of the school day.	No change No change in objective 7-day PA measures between WSB participants and nonparticipants Negative association between age and physical activity, for WSB participants and non-participants

<p>Sharpe, Forrester, Mandigo (2011)</p> <p>Canada</p>	<p>Baseline- N= 247</p> <p>Follow-up N= 108</p>	<p>After school program</p>	<p>Measures - Direct observation</p> <p>Outcomes - MVPA</p>	<p>CATCH Kids Club (CKC)^E</p> <p>CKC provided students with opportunities to participate and practice skills in a variety of enjoyable physical activities. The CKC PA component consists of following a format that includes a warm-up, fitness time, game play, and a cool down. CATCH Kids Club was introduced into the programming of the community agencies (330 sites, 280 were YMCA and 50 were BGC programs) At the YMCA, the majority of the sites in which CKC was introduced were in schools. The CKC program model was introduced to replace the current structure for the PA component. The BGC sites followed a program structure more akin to a ‘drop in style’ recreation program.</p>	<p>Mixed</p> <p>All sites (except for BGC) achieved greater than 50% of time spent in MVPA</p> <p>No difference between levels of MVPA at CKC and comparison sites or at CKC sites at baseline vs postintervention</p> <p>BGC sites had significantly higher levels of MVPA in CKC programs than in regular sport programs.</p>
<p>Stewart, Moudon, Claybrooke (2014)</p> <p>USA</p>	<p>4 states in study</p> <p>48 SRTS projects with pre/post project time points</p> <p>53 schools with pre/post school-level data</p>	<p>Active Travel</p>	<p>Measures - Self-report</p> <p>Outcomes - Percentage of students walking, bicycling, or using any AST mode.</p>	<p>Safe Routes to School Program (SRTS)^E</p> <p>State SRTS programs provide grants to projects in school-based communities that directly support walking and bicycling through: engineering, education, encouragement, enforcement, and/or evaluation.</p> <p>Specific activities were identified from project descriptions and classified into infrastructure (i.e., sidewalk or crosswalk construction, installation of permanent signage, curb cuts, bicycle rack installation, traffic calming/control such as speed bumps) and non-infrastructure (i.e., media campaigns or promotions to the general public; increased police patrol with emphasis on pedestrian and bicycle safety; walk or ride to school day events; walking school buses; mileage clubs or pedometer programs)</p>	<p>Significant - Positive</p> <p>Significant increases in active school travel were observed across projects in all four states</p> <p>All active school travel modes increased (walking, and biking)</p> <p>Increases in rates of bicycling were negatively correlated with baseline rates of bicycling</p>

Chapter 3: Impact Evaluation of the ACT-i-Pass Program: Assessing the Effectiveness of a Naturally-Occurring Population-Level PA Intervention for Children

3.1. Background

Childhood obesity is a major public health concern, caused in part by increasingly sedentary lifestyles and decreasing engagement in physical activities (Chaput et al., 2012; Janssen et al., 2005). Regular participation in physical activity (PA) is associated with numerous health benefits and is protective against several risk factors related to obesity (Janssen & LeBlanc, 2010; Shaibi et al., 2008). A physically active lifestyle during childhood also has psychological and social benefits, such as improved academic performance, higher self-esteem, and reduced depressive symptoms (Trudeau & Shephard, 2010; Piko et al., 2006). Despite these positive health outcomes, many children fail to achieve sufficient levels of PA. Currently, only 9% of Canadian children (age 5-17) meet Canada's recommended guidelines of 60 minutes of moderate-to-vigorous intensity on most days of the week (ParticipACTION, 2016). Over the last three decades, obesity rates among Canadian children have risen dramatically and has driven the need to identify effective strategies for increasing children's PA at the population-level (Colley et al., 2011; Chaput et al., 2012; Janssen et al., 2005).

The purpose of this study is to evaluate how children's participation in a naturally-occurring population-level intervention in the city of London, Ontario - that offers free access to PA opportunities (facilities and programs) across the city - has an impact on their overall PA levels.

3.1.1. Factors Associated with Children's PA

Physical activity is a complex behaviour, as research indicates that children's PA is influenced by multiple factors at different levels: individual (i.e., age, sex, SES, immigrant status); intrapersonal (i.e., parental and peer support); and community (i.e., availability of PA opportunities) (Pan et al., 2009; Sallis et al., 2008; Sallis et al., 2006). Broadly these factors may act as barriers to or facilitators of PA, however, they might also explain the variation in PA levels among different subgroups of children within the same intervention.

At the individual level, a number of socio-demographic factors have been identified as underlying determinants of children's PA behaviour (Brodersen et al., 2007; Bryan et al., 2006; Colley et al., 2011; Sallis et al., 2000; Singh et al., 2008). A negative association between age and PA has consistently been noted in the literature (Sallis et al., 2000), as PA tends to decline in early adolescence (age 13-18), with more drastic declines among girls (Brodersen et al., 2007; Canadian Fitness & Lifestyle Research Institute [CFLRI], 2010; Colley et al., 2011). While boys tend to be more active than girls, Brodersen et al. (2007) found a reduction in PA levels for both genders as early as age 11. Research also found that there are growing disparities among subgroups of children, as certain ethnic groups and recent immigrants face a greater risk of physical inactivity (Brodersen et al., 2007; Bryan et al., 2006; Gordon-Larsen et al., 1999; Singh et al., 2008). Studies have found that new or recent immigrant children generally have lower PA levels and lower participation in organized sports than do their counterparts who were born or have lived longer in a location (Bryan et al., 2006; Singh et al., 2008). It is frequently reported that children's PA is influenced by socio-economic status (SES), specifically family income and education level, as both of these SES indicators have a strong positive association with children's participation in structured PA (Estabrooks et al., 2003; O'Loughlin et al., 1999). When examining SES as a whole, a number of reviews have found mixed results for the association

between SES and children's PA, which is in part explained by the different measures used (Beauchamp et al., 2014; Stalsberg et al., 2010; Van Der Horst et al., 2007). Family structure, specifically lone-parenthood, has been investigated as a possible factor negatively associated with children's PA, but more research is needed as results are varied (Quarmby et al., 2010; Singhammer et al., 2015).

A number of studies suggest that social support from parents is positively linked with children's PA levels (Beets et al., 2006; Duncan et al., 2005). Parents influence their children's PA through supportive actions, such as: providing encouragement, providing transportation to PA opportunities, watching children participate in activities and actively engaging with children in activity (Beets et al., 2006; Duncan et al., 2005; Sallis et al., 2000; Trost & Loprinzi, 2011; Welk, Wood, & Morss, 2003). Some reviews have found mixed results due to the varying types of social support and different methods used assess the behaviour in relation to PA (Beets et al., 2010; Gustafson et al., 2006; Sallis et al., 2000). Research also indicates that children are generally more physically active when they have supportive friends and peers (Beets et al., 2006; Duncan et al., 2005; Fitzgerald et al., 2012; Salvy et al., 2009), whereas negative peer interactions can decrease children's PA levels (Faith et al., 2002; Gray et al., 2008; Salvy et al., 2012).

Recently, there has been a growing interest in the role of environmental factors, as many studies suggest a link between supportive neighbourhood environments (e.g., parks and recreational facility) and increased PA (Davison & Lawson, 2006; Giles-Corti & Donovan, 2002; Mitchell et al., 2016; Norman et al., 2006; Powell et al., 2007; Roemmich et al., 2006). Efforts to understand the influence of environmental factors have focused on the relationship between PA and the proximity and accessibility of recreational opportunities within a child's neighbourhood.

Studies show that PA levels are higher when more recreation facilities are available within a neighbourhood (Ding et al., 2011; Estabrooks, Lee et al., 2003; Gordon-Larsen et al., 2006; Roemmich et al., 2006; Tucker et al., 2009; Powell et al., 2007). The presence of recreational facilities may depend on the socio-economic status (SES) of the neighbourhood, as studies have found fewer PA resources and opportunities in low and medium SES neighbourhoods compared to high SES neighbourhoods (Estabrooks et al., 2003; Gordon-Larsen et al., 2006). While the presence of PA opportunities is important, it is not enough to facilitate their use, as these facilities need to also be accessible (Estabrooks et al., 2003). Limited access to PA opportunities is not only due to geography, but also due to economic reasons such as whether a child's family can afford to pay to admission fees to access a facility or the cost to register in different PA programs (Humbert et al., 2008; Sallis et al., 1998).

3.1.2. Intervention Studies

Given the range of factors that are associated with PA, intervention studies are a tool for testing these factors, learning from different approaches, and ultimately improving PA behaviours (Hawe & Potvin, 2009). Various types of PA interventions with children and youth have been tried in practice and evaluated in previous studies, such as coaching, educational, policy and environmental, however, the effectiveness of these strategies remains unclear (Metcalf et al., 2012). Reviews examining the effectiveness of PA interventions have found limited efficacy for changing children's overall PA levels (Metcalf et al., 2012; Russ et al., 2015; van Sluijs et al., 2007). Community-based PA interventions are suggested to be the most effective approach, partly due to the potential to achieve population-level change in children's PA levels (Pate et al., 2000; Sallis et al., 2008). It has been suggested that community-based interventions are a promising setting for promoting leisure time PA by increasing access to

opportunities for PA within an individual's community (Brand et al., 2014; van Sluijs et al., 2011; Perry et al., 2012). Results of evaluation studies suggest that community-based interventions are most effective and sustainable when they involve cross-sector collaborations with community groups, academic institutions, organizations, recreation facilities, schools and policy-makers (Pate et al., 2000; Sallis et al., 2008). Furthermore, it is extremely difficult for a researcher to initiate an evaluation study of a population-level community intervention without cross-sector collaboration. Cross-sector collaboration increases the likelihood that a researcher or research team is able to identify a new program or policy that is occurring naturally (without researcher control) in the community with enough time to adequately design, fund, and conduct the 'pre-test' or baseline evaluation before the intervention, to compare with a post-intervention evaluation.

Given the focus on population-level change, a number of community-based PA interventions have used an ecological framework to account for a range of factors that contribute to PA (Haggis et al., 2013; Sallis et al., 2008). Ecological models of health propose that a range of factors influence behaviours, including intrapersonal (i.e., sex, age, attitudes), interpersonal (i.e., social support, household income), community, physical environment, and policy (Sallis et al., 2008). Ecological models are also useful for addressing how place interacts with behaviour by identifying the characteristics of places that facilitate or hinder PA (Sallis et al., 2006; Sallis et al., 2008).

3.1.3. Details of the Grade 5 ACT-i-Pass Intervention

This study examines a city-wide initiative launched by London's *Child and Youth Network* (CYN) called the Grade 5 ACT-i-Pass (ACT-i-Pass) program. The CYN is a collaboration of over 170 organizations in London dedicated to aspects of children's health and

well-being (www.cynlondon.ca). The ACT-i-Pass offers all children in grade 5 who live or attend school in London, Ontario, Canada a free recreational access pass to use at facilities and programs across the city for the duration of the school year (see Figure 3.1). The ACT-i-Pass was designed to reduce financial barriers to accessing PA opportunities and increase parents' awareness of the resources that exist in London. Community-partners include YMCA of Western Ontario, London Boys & Girls Club, and City of London Parks and Recreation Department. The participating recreational organizations offered a number of physical activity program opportunities outside of school-time such as drop-in programs, floor hockey, skating, swimming, hip-hop dance, basketball, soccer, cheerleading, and volleyball (see Appendix B). The ACT-i-Pass also grants each child a "plus one" (i.e., parent, sibling or friend) to attend recreational programs for no additional cost. A full description of the Act-i-Pass intervention and evaluation can be found in Gilliland et al. (2015).

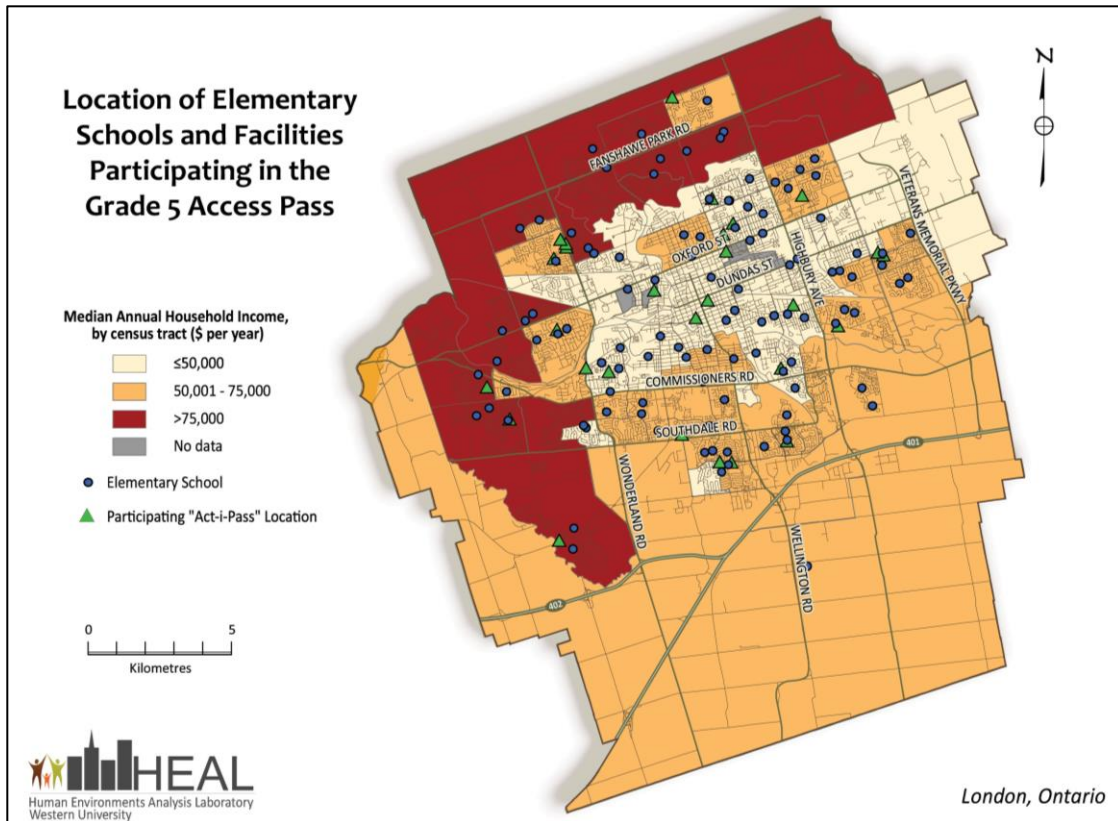


Figure 3.1 Location of elementary schools and facilities participating in the ACT-i-Pass Program from Gilliland et al. (2015)

3.1.4. Study Objectives

The purpose of this study is to assess how the ACT-i-Pass program – a naturally-occurring population-level PA intervention that offers free access to PA opportunities – can impact the PA levels of children from London, Ontario. There are three main research objectives: 1) to determine whether there was a change in PA between baseline and post-intervention; 2) to examine change in PA across different subgroups of children; and to 3) use an ecological framework to investigate how individual, social and neighbourhood characteristics predict change in children’s PA. Based on the literature, we hypothesize that the intervention will have the most positive impact on PA levels among children who are: female, new immigrants to

Canada, from low SES neighbourhoods, and live in close proximity to one or more participating recreation facilities.

3.2. Methods

3.2.1. Study Design

This research uses a longitudinal study design to evaluate how a population-based physical activity intervention targeting grade 5 children living or attending school in the city of London, Ontario, Canada influences general PA levels. Ethical approval for this study was obtained from the Western's Non-Medical Research Ethics Board (File#103954) and the participating local school boards (i.e., 2 publicly funded English school boards, 2 publicly funded French first-language school boards, and 1 private school) (see Appendix F).

3.2.2. Study Population and Recruitment

In May 2014, all students in grade 4 from every elementary school (n=99 [93 English-speaking schools, 5 French-speaking schools, and 1 private school]) within the city limits of London, Ontario were recruited to participate in the ACT-i-Pass program. Schools were invited to participate, and if their principal agreed, students were given packages to bring home to their parents that included information outlining the details of the ACT-i-Pass program, the research project, and a parental consent form. Children were advised to return signed consent forms by the end of May in order for the research team to collect baseline data. In September 2014, children who returned a parental consent form were mailed an ACT-i-Pass along with information on how to use the pass, a schedule of programming and facility locations. Passes were valid for the duration of the school year (Sept-June). Students were informed that participation in the research project was entirely optional and not a requirement for receiving the ACT-i-Pass.

The total sample of students registered for the ACT-i-Pass program included 1,709 out of 3,677 eligible students across 99 schools. Of the 1,709 who registered, 957 participants completed baseline surveys and 896 participants completed post-intervention surveys. Participants were excluded from analysis if they did not have completed PA outcome data at both time points, resulting in a final sample size of 643 participants with matched pairs of data between baseline and post-intervention.

3.2.3. Data Collection

For this study, data was collected from surveys that were administered to children and parents over the study period (2014 to 2016) (see Appendix C for child survey and Appendix D for parent survey). The **child survey** is a self-administered questionnaire that was completed 4 times by participating children over an 18-month period: baseline collected in Spring 2014; within-intervention collected Fall 2014; post-intervention collected Spring 2015; and follow-up collected Fall 2015. This study used data from baseline and post-intervention (12-month period) to examine the change in PA.

The survey was completed in the schools with a representative from Western University's Human Environments Analysis Lab administering the survey. Questions obtain information on socio-demographics (i.e., age, sex, ethnicity, immigrant status, and family composition), postal code, sedentary behaviours, PA behaviours, barriers to PA, and perceived accessibility and use of recreational facilities. Additional questions capture information on perceived social support from parents and peers.

PA was measured using the Physical Activity Questionnaire for Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997 [see Appendix E]). The PAQ-C is a self-administered 7-day recall and consists of 9 items, which are scored on a 5-point Likert scale,

with higher values indicating greater levels of PA. Items assessed different aspects of PA such as spare time activity, average level of PA throughout the week and context specific activity. For example, four of the items assessing context specific PA use memory cues such as “recess”, “gym class,” “after school” (i.e., In the last 7 days, on how many days right after school, did you do sports, dance, or play games in which you were very active?). Similarly, the item measuring spare time activity assessed what activities children engaged in and the frequency of engagement (i.e., “Have you done any of the following activities in the past 7 days? If yes, how many times?”). Previous studies indicate that the PAQ-C is a reliable and valid self-report measure for elementary school-aged children (grade 4-8) (Crocker et al., 1997; Janz et al., 2008). The PAQ-C is also low cost and easy to administer for large-scale studies such as the ACT-i-Pass (Kowalski et al., 2004).

The **parent survey** was a self-administered questionnaire that was completed three times: baseline (Spring 2014), within-intervention (Spring 2015), and post-intervention (Fall 2015). Parent surveys collected additional information on socio-demographic characteristics that children may be unaware of such as ethnicity, parental education level, household income, and current employment status. Similar to the child surveys, parents answered questions regarding their perceptions of barriers to PA, accessibility and use of recreation facilities, and perceptions of social support. Questions also assessed parental PA levels using the International Physical Activity Questionnaire (IPAQ), a validated 7-day recall questionnaire used to describe levels of PA in adults (Craig et al., 2003).

3.2.4. Measures

3.2.4.1. Outcome Measure: General PA Levels

For this study, the primary outcome measure was children’s general PA levels using the PAQ-C scores. Data from the nine PAQ-C items were scored to obtain an activity score between

1 and 5 for each item. For item 1 (spare time activity) and item 9 (weekly activity level), a composite mean was calculated for each item. For items 2-8, the selected response corresponds with values from 1 through 5. Recoding responses and eliminating participants based on a cut-off of items answered accounted for missing data. For item 1, missing responses were recoded to 1-None. For item 8, only participants with less than 5 missing responses were included. To calculate the final PAQ-C activity summary score, the mean of the nine items is taken to form the final score. Only participants with less than 3 missing responses for all items were included in the final PAQ-C activity summary score.

3.2.4.2. **Independent Variables**

Using the ecological model as a guiding framework, multiple levels of independent variables were included to examine the change in PA: individual-level; social-level; and neighbourhood-level variables. **Individual-level variables** are used to control for the differences in demographic characteristics that are known in the literature to influence PA levels. These individual-level variables include (reference category has been italicized) sex (*boy* or girl), visible minority (*no* or yes), immigrant status (*born in Canada* or born elsewhere), lone-parent (*two parents* or lone-parent), parental education level for both mother and father (*high school or less* or at least college/university), and full-time employment status for both mother and father (*not full-time* or full-time). Immigrant status was defined based on whether the family moved to Canada less than 10 years ago (parent survey), if ‘yes,’ children were considered to be born outside of Canada. The individual-level variables used in this study were collected from the baseline child and parent surveys.

Social-level variables were used to determine how a child’s perceived level of social support impacts change in PA. The questions used to characterize social support include four

items related to parental support and four items measuring peer support. All social support questions elicit responses about the frequency of support during a typical week and were scored on a 5-point scale (i.e., [0] Never, [1] 1-2 Days, [2] 3-4 Days, [3] 5-6 Days, [4] Daily) (Sallis, Taylor, Dowda, Freedson, & Pate, 2002). Parental support items include encouraging children to play, providing transportation to PA opportunities, watching children participate in activities, and actively engaging with children. Similarly, peer support items included: encouragement from friends, playing with friends, teasing, and praise. Both parental and peer support variables used in this study were collected from the child surveys at baseline.

For parental support, the responses from each child for the 4 items were averaged to obtain a score between 1 and 5 (i.e., 1=low support, 5=high support) (Prochaska, Rodgers & Sallis, 2002). This same procedure was used to generate a combined score for peer support, with the exception of reverse coding the item related to teasing.

Geographic Accessibility is used to provide evidence as to how the proximity to ACT-i-Pass recreation facilities influenced the change in children's PA between baseline and post-intervention. These measures included distance to the Boys & Girls Club, distance to the nearest YMCA, distance to the nearest arena, and distance to the nearest indoor pool. These four measures of geographic accessibility have been created using a Geographic Information System (ArcGIS 10.1) to calculate the shortest network distance (along a street network) between a child's home postal code and the closest recreation facility by type that are part of the ACT-i-Pass program.

Median household income (CAD) was used as a proxy measure of the neighbourhood SES. Data was obtained from the 2011 Census of Canada data and measured for the census dissemination area (DA) that each child's postal code resides within. A dissemination area

covers one or more blocks with an approximate population between 400–700 people (Statistics Canada, 2015). While parent surveys provided data for multiple socio-demographic variables, the response rate for questions related to income and occupational status was low, making it necessary to use neighbourhood SES to act as a proxy. Prior research indicates that neighbourhood level income is a valid proxy for household income in population studies which do not have access to such data (Mustard et al., 1999).

3.2.5. Statistical Analyses

Statistical analyses were performed with STATA SE 14 (StataCorp, 2015). Difference in self-reported PA levels from baseline to post-intervention and difference between subgroups of children were examined using paired t-tests. Analysis also included a series of linear regression models to assess associations between multiple variables and change in PA (see Table 3.3). Model 1 included the entire sample (n=643) with robust standard errors. Additional models were stratified by sex (Model 2- Boys, Model 3 - Girls), given the evidence on the relationship between sex and PA.

All variables, regardless of bivariate significance levels, were included into the final model to follow an ecological framework. The outcome variable, PAQ-C score, was deemed normally distributed based on tests of the skewness and kurtosis (i.e., indicated values below 1.00) and the large sample size (n=643). Variables in the model were also assessed for multicollinearity and no variables were found to be collinear, with a maximum variance inflation factor of 2.87 (Model 1), 4.15 (Model 2 & Model 3).

3.3. Results

3.3.1. Characteristics of the Sample

Characteristics of the sample can be found in Table 3.1. There were no significant differences between the 643 participants and the total sample of 957 who completed baseline surveys. Of the 643 participants, 48.7% were boys and 51.3% were girls. The mean age of participants was 9.8 years ($SD= 0.57$) as our sample was restricted to only grade 5 students. A majority of the children in the sample were born in Canada (90.1%) and were not a visible minority (68.7%). Most participants had a sibling (92.2%), lived in a two-parent household (80.9%), and had at least one car at home (93.4%). In terms of parental education level, 70.6% of fathers and 81.5% of mothers have achieved at least college or university level of education. For full-time employment status, 77.6% of fathers and 53.8% of mothers work full-time.

Perceived social support was relatively high for both parental ($M=3.62$, $SD=1.94$) and peer support ($M=4.41$, $SD=1.56$) (i.e., a score of 1 indicates low support and a score of 5 indicates high support). The average distance to the closest ACT-i-Pass recreation facility was 2.54 km and the median household income for the sample was \$67,599 (CAD).

Table 3.1 Characteristics of the Study Participants (n=643)

Variable	n	%
Sex		
Boy	313	48.7
Girl	330	51.3
Visible Minority		
Not a visible minority	442	68.7
Visible minority	201	31.3
Immigrant Status		
Born in Canada	579	90.1
Born elsewhere	64	10.0
Siblings		
Only child	44	6.8
Has sibling(s)	593	92.2
Parents at primary home		
Lone parent	120	18.7
Two parents	520	80.9
Missing	3	0.5
Maternal Education		
High school or less	107	16.6
At least College/University	524	81.5
Missing	12	1.9
Paternal Education		
High school or less	152	23.6
At least College/University	454	70.6
Missing	37	5.8
Maternal Work Status (Full-time)		
No	269	41.8
Yes	346	53.8
Paternal Work Status (Full-time)		
No	79	12.3
Yes	499	77.6
Car Ownership		
No car	34	5.3
1 car	192	29.9
2 or more	408	63.5
	Mean	SD
Median Household Income (CAN \$10,000) ^a	6.75	2.55
Social Support		
Parental Support	3.62	1.94
Peer Support	4.41	1.56
Closest Recreation Facility (km)	2.54	2.44
YMCA Facility (km)	5.45	3.29
Boys & Girls Club (km)	6.81	3.22
Arena (km)	3.08	2.60
Pool (km)	4.97	2.96

Note: ^a obtained from the 2011 Census of Canada data and measured for the census DA

3.3.2. Average Differences in Self-Reported PA

Baseline and post-intervention assessments of self-reported PA are presented in Table 3.2. Overall, PA increased significantly from baseline ($M=3.28$, $SD=0.72$) to post-intervention ($M=3.42$, $SD=0.68$, $p=0.00$). Boys and girls both increased PA from baseline to post-intervention; however, this difference was only significant for girls ($M=3.42$, $SD=0.66$, $p=0.00$). Participants that identified as visible minorities significantly increased their level of PA from baseline ($M=3.24$, $SD=0.70$) to post-intervention ($M=3.46$, $SD=0.62$, $p=0.00$), more so than non-visible minorities from baseline ($M=3.30$, $SD=0.73$) to post-intervention ($M=3.40$, $SD=0.71$, $p=0.00$). Significant increases in PA were also found for children that were not born in Canada ($p=0.00$). Participants that reported low parental support at baseline significantly increased PA from baseline ($M=2.83$, $SD=0.74$) to post-intervention ($M=3.09$, $SD=0.67$, $p=0.01$). No significant differences in PA were found for children from lone-parent households, those with less educated or underemployed fathers, and those with high parental and peer support.

Table 3.2 Average differences in self-reported PA from baseline to post-intervention by subgroups (n=643)

	Baseline	Post- Intervention	Average Difference	<i>t</i>	<i>p</i>
	<i>M</i> (SD)	<i>M</i> (SD)			
Total Sample	3.28 (0.72)	3.42 (0.68)	0.14	-5.12	0.00***
Sex					
Boys (n=313)	3.36 (0.72)	3.42 (0.71)	0.06	-1.41	0.16
Girls (n=330)	3.21 (0.72)	3.42 (0.66)	0.22	-5.96	0.00***
Visible Minority					
No (n=442)	3.30 (0.73)	3.40 (0.71)	0.10	-3.14	0.00***
Yes (n=201)	3.24 (0.70)	3.46 (0.62)	0.22	-4.60	0.00***
Born in Canada					
No (n=64)	3.25 (0.65)	3.49 (0.61)	0.25	-2.85	0.00***
Yes (n=579)	3.29 (0.73)	3.41 (0.69)	0.13	-4.45	0.00***
Lone Parent					
No (n=520)	3.29 (0.70)	3.43 (0.67)	0.15	-5.00	0.00***
Yes (n=120)	3.26 (0.82)	3.35 (0.74)	0.08	-1.22	0.23
Mother's Education					
High school or less (n=107)	3.20 (0.77)	3.37 (0.79)	0.17	-2.44	0.01**
College/university (n=524)	3.29 (0.71)	3.42 (0.66)	0.13	-4.44	0.00***
Father's education					
High school or less (n=152)	3.37 (0.79)	3.47 (0.72)	0.11	-1.74	0.08
College/university (n=454)	3.25 (0.69)	3.41 (0.67)	0.16	-5.50	0.00***
Mother's work status (full-time)					
No (n=269)	3.32 (0.70)	3.49 (0.68)	0.18	-4.12	0.00***
Yes (n=346)	3.24 (0.73)	3.36 (0.66)	0.11	-3.13	0.00***
Father's work status (full-time)					
No (n=79)	3.29 (0.73)	3.43 (0.66)	0.15	-1.91	0.06
Yes (n=499)	3.28 (0.71)	3.41 (0.68)	0.13	-4.38	0.00***
Parental Support					
Low (n=158)	2.82 (0.74)	3.09 (0.67)	0.27	-4.72	0.00***
Average (n=317)	3.27 (0.63)	3.43 (0.67)	0.16	-4.15	0.00***
High (n=168)	3.72 (0.61)	3.70 (0.58)	-0.02	0.33	0.75
Peer Support					
Low (n=32)	2.74 (0.86)	2.94 (0.74)	0.20	-1.60	0.12
Average (n=375)	3.12 (0.70)	3.29 (0.68)	0.17	-4.66	0.00***
High (236)	3.61 (0.60)	3.69 (0.59)	0.08	-1.90	0.06
Neighbourhood SES					
Low-SES (n=170)	3.29 (0.77)	3.43 (0.72)	0.14	-2.46	0.02*
Medium-SES (n=192)	3.29 (0.70)	3.39 (0.68)	0.10	-2.02	0.05*
High-SES (n=281)	3.26 (0.72)	3.43 (0.66)	0.17	-4.21	0.00***

	Baseline	Post- Intervention	Average Difference		
	<i>M</i> (SD)	<i>M</i> (SD)		<i>t</i>	<i>p</i>
Closest Recreation Facility					
<1.6km (n= 208)	3.29 (0.75)	3.40 (0.69)	0.11	-2.46	0.01*
>= 1.6km (n=435)	3.27 (0.71)	3.43 (0.68)	0.15	-4.51	0.00***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

3.3.3. Regression Analyses

Multiple regression analysis was used to test the association between individual-, social-, and neighbourhood-level variables and change in PA. To perform this analysis, a series of models were specified that assessed the entire sample and then stratified according to sex (see Table 3.3).

For the entire sample, results indicate that two predictors explained 5.8% of the variance in change in PA ($R^2 = .05$, $F(21, 67) = 4.04$, $p = 0.00$). Sex ($\beta = 0.14$, $p = 0.01$) and parental support ($\beta = -0.05$, $p = 0.00$) significantly predicted change in PA. Sex had a positive association with change in PA, as girls had a significantly higher change in PA than boys. Parental support was negatively associated with change in PA, such that high parental support decreased change in PA. Additionally, results from sex-stratified models indicate that only parental support significantly predicted change in PA for boys ($\beta = -0.06$, $p = 0.01$), however, this was found to be a negative association. There were no significant predictors of change in PA for girls.

Table 3.3 Results of full model and sex-stratified models assessing all variables and change in general PA

Variables	Regression Coefficients					
	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	Total (n=643)		Boys (n=313)		Girls (n=330)	
	$\beta \pm SE$	<i>p</i>	$\beta \pm SE$	<i>p</i>	$\beta \pm SE$	<i>p</i>
Socio-demographic						
Sex (base: boy)						
Girl	0.14±0.05	0.01**				
Visible Minority (base: no)						
Yes	0.05±0.07	0.46	0.04±0.10	0.68	0.05±0.08	0.53
Born in Canada (base: yes)						
No	0.06±0.10	0.55	-0.16±0.15	0.30	0.25±0.14	0.08
Lone-Parent (base: two parent)						
Lone-parent	-0.04±0.07	0.56	-0.07±0.11	0.56	-0.01±0.10	0.89
Missing	0.63± 0.40	0.11	0.17±0.71	0.82	0.84±0.48	0.08
Mother's Education (base: high school or less)						
At least college or university	-0.04±0.08	0.61	-0.20±0.12	0.12	-0.10±0.11	0.35
Missing	0.01±0.22	0.96	-0.62±0.44	0.16	0.27±0.25	0.29
Father's Education (base: high school or less)						
At least college or university	0.02±0.07	0.78	0.08±0.10	0.45	-0.08±0.10	0.47
Missing	-0.17±0.14	0.22	0.07±0.23	0.77	-0.32±0.18	0.09
Mother's Full-time Employment status (base: not full-time)						
Full-time	-0.05±0.06	0.39	-0.14±0.09	0.09	0.02±0.08	0.75
Missing	-0.07±0.14	0.65	0.23±0.25	0.35	-0.17±0.18	0.36
Father's Full-time Employment status (base: not full-time)						
Full-time	-0.00±0.09	0.98	0.09±0.13	0.46	0.00±0.13	0.98
Missing	0.09±0.13	0.50	0.14±0.21	0.49	-0.04±0.17	0.82
Social Support						
Parental support	-0.05±0.02	0.00***	-0.06±0.03	0.01*	-0.04±0.02	0.09
Peer support	-0.01±0.02	0.58	-0.00±0.03	0.90	-0.03±0.03	0.36
Neighbourhood Economic Status						
Median Household income (CAD 10,000)	0.00±0.01	0.65	0.01±0.02	0.47	0.01±0.02	0.51

Variables	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	Total (n=643)		Boys (n=313)		Girls (n=330)	
	$\beta \pm SE$	<i>p</i>	$\beta \pm SE$	<i>p</i>	$\beta \pm SE$	<i>p</i>
Closest Recreational Facility (km)	-0.04±0.04	0.31	0.01±0.06	0.86	-0.10±0.06	0.08
YMCA Facility (km)	0.02±0.02	0.28	-0.00±0.03	0.92	0.04±0.02	0.11
Boys & Girls Club (km)	-0.01±0.02	0.75	-0.01±0.03	0.62	-0.03±0.03	0.24
Arena (km)	0.05±0.03	0.15	0.03±0.05	0.56	0.06±0.05	0.22
Pools (km)	-0.01±0.02	0.56	-0.03±0.03	0.18	0.01±0.02	0.75

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; Table expressed as B values (unstandardized regression coefficients); ^a $R^2 = 0.0613$; ^b $R^2 = 0.1112$; ^c $R^2 = 0.0822$

3.4. Discussion and Conclusion

The primary objective of this study was to determine whether children's participation in a naturally-occurring population-level intervention resulted in an increase in their level of PA over time. For this study, the ACT-i-Pass intervention was evaluated by: (1) assessing the differences in PA between baseline and post-intervention; (2) examining associations among different subgroups of children; and (3) using an ecological framework to investigate how multiple factors at different levels predicted change in children's PA. By using this novel approach, the current study contributes evidence-based research to guide future research and develop effective intervention strategies.

The ACT-i-Pass sought to increase children's general PA levels by providing free access to PA opportunities within the community. Overall, the findings indicate that the ACT-i-Pass significantly increased PA levels over time and demonstrate the effectiveness of this strategy as a way to improve children's PA at the population-level. While the positive change in PA is encouraging, the increment of the increase should be carefully considered, as the sample of children already had an above average score for physical activity at baseline ($M=3.28$, $SD=0.72$) (Crocker et al., 1997). Compared with several other studies that used the PAQ-C, our sample achieved a higher baseline score, however, none of these studies used the tool in an intervention setting (Benitez-Porres et al., 2016; Crocker et al., 1997; Voss et al., 2013). This suggests that selection bias may play a factor in the results, as children who were already physically active may have been more likely seek out additional opportunities to be active. That said, even though children were already very active before the intervention, it is encouraging that we still saw a statistically significant increase in overall PA levels over the course of the intervention (baseline to post-intervention, approximately 12 month period), particularly as this is an age at when

children's participation in PA tends to sharply decline (Brodersen et al., 2007; Canadian Fitness & Lifestyle Research Institute [CFLRI], 2010; Colley et al., 2011; Trost et al., 2002).

Promising results were also found for certain subgroups of children. Previous research consistently shows that girls achieve lower levels of PA than boys (Brodersen et al., 2007; Colley et al., 2011; Sallis et al., 2000; Trost et al., 2002), thus, it is encouraging that girls in the ACT-i-Pass program achieved significantly higher levels of PA over time, compared to boys. Baseline assessments indicate that girls had slightly lower PA scores than boys before the intervention and therefore had more room to increase. This increase may be linked to the types of activities and programs that were offered, as the ACT-i-Pass included a variety of activities comprised of unstructured (i.e, drop in programs, free swim, free skate) and structured activities (i.e., basketball skills, cheerleading, hip-hop dance, soccer, volleyball) that may have appealed to girls. Other intervention studies that consisted of play-based and non-competitive activities found improvements in PA outcomes for girls (de Meij et al., 2011; Martinez-Vizcaino et al., 2014). These findings emphasize the importance of sex differences in PA, as research shows that girls prefer different types of PA than boys and have different motivations for engaging in PA (Mota et al., 2012).

The impact of the ACT-i-Pass among visible minority children and those born outside of Canada is important to note. Research examining children's organized PA found that immigrants were less likely to participate than those who were born or have lived longer in a location (Singh et al., 2008). We also found this to be the case based on our baseline data; however, our study also found that visible minorities and children born outside of Canada both achieved greater improvements in PA over the course of the intervention than non-visible minority and children born in Canada. Many population-based PA interventions have been found to increase health-

inequalities due to the lack of targeted components (Lornec, Petticrew & Welch, 2013), however, the ACT-i-Pass program was able to achieve significant increases in PA for these subgroups of children.

The ACT-i-Pass served to remove financial barriers to participating in community-based PA opportunities. Studies show that compared to children from two-parent households, children in lone-parent families experience additional barriers to PA besides economic barriers, as more competing family demands are placed on a lone-parent (Azar et al., 2009; Quarmby & Dagkas, 2010). Nevertheless, a recent meta-analysis that examined whether children's PA was lower in lone-parent families compared to two-parent families found no differences in PA (Singhammer et al., 2015). Our baseline assessments indicate that children from lone-parent households had slightly lower PA scores than children from two-parent households before the intervention. Additionally, assessments after the ACT-i-Pass intervention revealed that children from two-parent households experienced statistically significant increases in PA levels, whereas children from lone-parent households did not.

Children with low levels of perceived parental support for PA at baseline, achieved significantly higher PA over the course of the intervention than those children with average and high levels of parental support. The ACT-i-Pass program included a number of program offerings, multiple locations and the ability to bring another guest for free. These additional program features may have increased parent's capacity to provide support for their child's PA.

Contrary to expectations based on previous research, our study found parental support to be negatively associated with change in PA in regression analyses. That is, children who reported higher levels of parental support for their PA actually experienced statistically significant declines in their predicted change in PA between baseline and follow-up. Numerous studies have

found a positive association between parental support and children's PA levels (Beets et al., 2006; Duncan et al., 2005; Sallis et al., 2000; Trost & Loprinzi, 2011; Welk, Wood, & Morss, 2003). As the data indicates, children with higher levels of parental support reported higher levels of PA at baseline, and it is possible that these well-supported children are already participating in enough organized PA activities that the ACT-i-Pass would not have a positive impact on PA levels. The negative association could be a result of the measure used, as this study used a summative scale to obtain a score for parental support. While this provides a generic outcome, research has found unique associations between specific types of support and PA and suggest that these be considered as distinct behaviours (Beets et al., 2006). Moreover, generic scores of parental support limit the ability to address which actions or behaviours impact children's PA the most (Beets et al., 2006). Children's perception of parental support for the sample was above average (3.62) suggesting that a majority of participants felt supported by their parents in terms of PA. However, the score for parental support used a limited range (i.e., 5-point scale, 1 low support, 5- high support) and therefore the variable could be subject to ceiling effects, as there is little room for change.

This finding is opposite to what was anticipated and will require further research to examine why this association occurred. For the full model, possible reasons for the lack of significant findings could be an indication of the variables used to assess change in PA. A study by Sallis et al. (1999) assessed predictors of change in children's PA using a number of demographic variables and psychological variables reported by children and parents. Results showed that children's preferences for PA and frequency of parents transporting children to PA opportunities were associated with change in PA. In a similar study, Neumark-Sztainer et al. (2003) found that the two strongest predictors of PA change were time constraints and support

for PA from parents, peers, and teachers. Based on these findings, it is difficult to determine whether the variables used in the present study had no influence on children's PA, or if important variables were left out, or whether the measures used were not precise enough to detect associations. It is evident that more research is needed to clarify the relationships between factors at different levels of influence to better understand the association with change in PA.

3.4.1. Strengths and Limitations

The strength of this study is the contribution to evidence-based research and the novel approach used to improve PA. The ACT-i-Pass was designed to reduce financial barriers by offering free recreational opportunities to all grade 5 children in London, Ontario. Using a longitudinal design comparing PA levels before and after the intervention, this study found that children's PA significantly improved over time. Evidence from this research suggests that eliminating financial barriers to accessing PA opportunities is an effective strategy and should be considered for future interventions. Furthermore, policy-makers have advocated for the use of natural experimental approaches, as they can provide direct evidence for the effectiveness of PA interventions in real-world settings.

While the use of a natural experiment approach is a strength of this study, there are also several limitations that should be addressed. The study is limited by the use of self-report measures, which are subject to recall and social desirability bias. In addition, median household income of the child's neighbourhood (DA) is an ecological measure or proxy for individual SES and therefore precise conclusions cannot be made as to whether the ACT-i-Pass program improved PA outcomes for the most vulnerable children. The high level of PA at baseline emphasizes the need to assess pass usage, to determine which students were using the pass compared to those who did not in order to develop a better understanding of other barriers that

may influence a child's use of the program. To improve the ACT-i-Pass identifying barriers could help to develop more targeted approaches to reach children at greater risk for physical inactivity.

3.5. Conclusion

As a large-scale study, the short-term findings from the ACT-i-Pass study offer greater insight into the potential role of population-based interventions to promote PA. The findings from this study reinforce the value of using natural experiments and a collaborative approach to assess population-based PA interventions. The findings also emphasize the need for additional research to determine what factors affect change in PA level to inform and guide future interventions. Above all, this study has direct implications for policy, as the evidence is based on effectiveness in a real-world setting rather than conditions of a closed experiment. The results show the translation of PA research into practice and thus enable community stakeholders to make informed decisions about the effectiveness of the intervention.

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Chapter 4: Synthesis

4.1. Summary of the Findings

The two studies included in this thesis examined the effectiveness of naturally-occurring population-based PA interventions with children. While the main objective of both studies was similar, different approaches were used to understand what strategies effectively improved children's PA.

Chapter 2 examined the existing literature to determine how population-level PA interventions using a natural experimental approach have been evaluated. Previous studies were reviewed to investigate what methods and measures have been used, what interventions were successful or unsuccessful, and what external factors impacted results. Overall, a majority of the studies successfully improved children's PA and supports the use of natural experiments as a way to evaluate population-level change. There was a high degree of heterogeneity in the methods and measures used, as the studies assessed natural experiments in a variety of PA domains. While this limited the ability to compare effectiveness between the studies, it provided an overview of the settings, methods and measures currently used in this field. A majority of the studies included additional evaluation components and detailed information about intervention components. The inclusion of additional evaluation components contributed important contextual information to better understand why certain aspects of the intervention were successful or unsuccessful. In addition, such information helped to justify results, offer reasoning behind the outcomes, and highlighted the importance of place when assessing PA interventions. Currently, there are not enough studies to fully determine the effectiveness of naturally-occurring population-based PA intervention for children.

Building off of these findings, Chapter 3 investigated how the provision of a naturally-occurring population-level PA intervention (ACT-i-Pass) changed children's level of PA over time. The ACT-i-Pass program provided all grade five children living in London, Ontario a free recreational access pass to use at facilities (i.e., YMCA, Boys and Girls Club, city owned swimming pools and skating arenas, and City of London/Spectrum) across the city for the duration of the school year. This study evaluated the impact of the ACT-i-Pass by: (1) assessing whether the intervention was successful in improving children's PA levels, (2) examining the differences in PA across different subgroups, and (3) investigating the individual, social and neighbourhood characteristics that predict change in PA over time. Physical activity was assessed at baseline and post-intervention using self-report measures (PAQ-C) and results showed an increase in PA over time. Statistically significant increases in PA were found for girls, visible minorities, children born outside of Canada, and children with low parental support. When examining variables associated with change in PA, parental support was the only significant predictor; however, parental support was negatively associated with change in PA. Overall, results from this study provide supporting evidence that community-based interventions such as the ACT-i-Pass can have a positive influence on children's PA levels; however, more research is needed to understanding the factors that predict change in PA.

4.2. Research Contributions

While the chapters are distinct, comparing the results between the two chapters reveal similar findings. Both found positive results for improving PA outcomes in children, reinforcing the value of using natural experiments to evaluate community-based and population-level PA interventions.

Chapter 2 contributed important evidence to help guide future PA interventions, as the use of natural experiments in PA interventions research is still relatively new. Although there was a high degree of heterogeneity in the reviewed studies, positive change in children's PA was achieved in diverse settings that targeted different types of PA behaviour. Showcasing the diverse application of natural experiments help to advance the methodology of this approach by identifying useful tools, measures, and settings to guide and inform future PA interventions. Recently, there has been a call for researchers to consider natural experiments, as they can provide highly relevant data on intervention effectiveness in real world settings and directly inform policy and practice (Craig et al., 2012; Ramanathan et al., 2008). Furthermore, evidence from the review highlighted the importance of including additional evaluation components to justify and contextualize results. Apart from direct PA analyses, additional evaluations highlighted elements of the intervention or implementation process and how it contributed to the results, allowing for greater understanding of successful strategies that should be considered for future interventions.

While Chapter 2 assessed previous studies, Chapter 3 evaluated the effectiveness of a naturally-occurring population-level PA intervention (ACT-i-Pass). The ACT-i-Pass provided children with free access to PA opportunities across London, Ontario and successfully increased children's PA levels over time. Although the change in PA was small, at the population-level, these changes can amount to significant improvements with regard to physical activity (Task Force on Community Preventative Services, 2002). While encouraging, the results indicated that a majority of the children in the study were already sufficiently active at baseline, thus emphasizing the need to design intervention components that are targeted in order to reach children at greater risk of physical inactivity.

The results may not be generalizable to other communities as the ACT-i-Pass program is the product of cross-collaboration among multiple sectors in the community that work together as part of the CYN in order to address children's health. While a collaborative structure such as this may not be present in other communities, the positive outcomes and the novel approach used in the ACT-i-Pass should be adapted and replicated in other cities to better understand its impact.

With regards to assessing PA, the goal of the ACT-i-Pass was to increase general physical activity levels over time. To achieve this, the PAQ-C was well suited to the research objectives and a feasible measure both in cost and administration. A recent review supported the use of the PAQ-C in assessing PA levels at the population-level (Biddle et al., 2011; Crocker et al., 1997; Voss et al., 2013). While self-report measures should be interpreted with a degree of caution, research shows the PAQ-C to be a valid and reliable measure of PA (Kowalski et al., 2004). Future use of the PAQ-C in similar intervention studies will allow for more cross-study comparisons to be made, which is lacking in present literature based on the findings of Chapter 2.

The use of the ecological model to assess how multiple predictors can influence change in PA was beneficial towards enhancing our understanding of PA behaviour. Although only a limited number of predictors were significant, this should not discredit the value of using such a framework. Rather, it suggests the need to further clarify the relationships between multiple factors and children's PA, some of which may not be easily assessed using self-report measures and may require different methods.

Together, this study was necessary as it provided a greater understanding of the factors associated with changing PA among children. New knowledge generated from this research may be used to: (1) inform future interventions aimed at increasing PA involvement through a natural

experimental approach; (2) develop interventions aimed at increasing PA levels among youth who are at-risk for inactivity; and (3) to inform policy decisions about future PA initiatives for children.

4.3. Limitations

While both studies had similar objectives, they presented different limitations based on the methods used to evaluate each study. For Chapter 2, the review is subject to several limitations. First, the number of studies included was rather low and limited the ability to compare effectiveness of the interventions more fully. Secondly, the study did not differentiate between different types of PA domains (i.e., active travel, built environment, afterschool, media campaigns) because the primary objective was to examine population-level PA interventions overall. When assessing PA outcomes, effect sizes were not considered, only statistical significance and the direction. More often, the reporting of effect size is important to determine the practical significance of outcomes (Rosen et al., 2012) and should be investigated in future reviews. The review included interventions that targeted both children and adolescents (age 6-18), however, PA patterns are known to be different between these age groups. In addition, no grey literature was reviewed and therefore other potential natural interventions were missed. Finally, no assessment of quality was conducted for the studies in this review.

Chapter 3 was limited by the self-report measures used; as such measures are subject to recall bias and social desirability bias. Despite these limitations, the PAQ-C was selected due to its acceptable reliability and validity and is appropriate for population-based research as objective measures were not feasible for this study. Another limitation of this study was the use of proxy measures, such as neighbourhood median household income to represent SES. Although neighbourhood or DA level income is often used in Canadian studies to represent SES

(Gilliland & Healy, 2012), improper interpretations of such proxy measures can lead to errors related to the ecological fallacy (Hanley & Morgan, 2008). Self-selection is another limitation, as it is possible that physically active children were more likely to enroll in the intervention, however, we do not have PA data on the non-study participants to test this. Finally, this study may not be generalizable to other populations or communities. Given the local context of this PA program, it is possible that results would differ if the study were to be replicated in other cities or communities. Finally, this study did not include a control group, therefore actual changes in PA cannot be directly attributed to the ACT-i-Pass intervention.

4.4. Implications for Policy and Practice

This research aimed to explore how naturally-occurring population-level PA interventions influence children's PA levels. Specifically, this thesis aimed to clarify how a) this type of intervention has been evaluated in previous studies, and b) how the provision of a naturally-occurring population-level intervention impacted children's PA. The use of natural experiments is an emerging approach that has been encouraged by policy-makers due to the affordability and highly relevant evidence-based findings (Craig et al., 2012; Petticrew et al., 2005). Findings from both studies in this thesis provide supporting evidence that natural experimental approaches evaluating population-based PA intervention can be used to effectively determine intervention impacts on children at the population-level.

A number of systematic reviews that have examined the effectiveness of PA interventions have found limited to modest change in PA (Bleich et al., 2013; Metcalf et al., 2012; van Sluijs et al., 2007). Many of these reviews suggest the need for more evidence-based research to understand the effectiveness of interventions in real world settings. This research has contributed

to this gap in knowledge by exploring how natural experiments have been used in population-based PA interventions targeting children PA.

Twelve out of the 15 studies reviewed in Chapter 2 found positive outcomes in PA. While the studies were highly variable in terms of methodology, the review emphasized the importance of place when conducting a natural experiment and the need to perform additional evaluations to better understand the context of such interventions and how it impacts effectiveness. Comprehensive evaluations of PA interventions were rarely conducted until recently and have generated important knowledge that was otherwise lacking in PA intervention studies (McGoey et al., 2015; Pate et al., 2000). Performing evaluations offer a more complete understanding of how effective an intervention is at improving PA levels of children, identification of barriers and facilitators, and whether the intervention is impacting subgroups of the population who are in the most need (e.g., children from low income neighbourhoods, recent immigrants) (McGoey et al., 2015). These evaluation components, coupled with the evidence provided from natural experiments, provide policy-makers with highly relevant evidence to base decisions regarding PA policies.

While Chapter 2 provided a foundation of evidence on the use of natural experiments in PA interventions, Chapter 3 conducted an evaluation of a novel population-based intervention to further contribute to this growing knowledge base. The ACT-i-Pass provided all grade 5 students in London, Ontario free access to participating recreational facilities for the duration of their school year. The program offerings provided a range of unstructured and structured programs multiple times a week and children were allowed to bring one friend, sibling, or parent with them for free. Results from Chapter 3 indicate that the intervention was successful in increasing children's PA levels over time. The goal of this research was not only to improve PA,

but to provide all grade 5 students access to free PA opportunities. Research has shown that it is critical to expose pre-adolescents to various activities at a young age to improve the likelihood that they will maintain participation in some of these activities in the future (Aaron et al., 2015). The ACT-i-Pass was delivered to children at a critical age with the aim of minimizing the downward trend in PA, as there is substantial evidence of PA declines as children progress into adolescents (Brodersen et al., 2007; Sallis et al., 2000). Introducing children to new PA opportunities at this age and eliminating the financial barrier to accessing these PA opportunities are strategies that should be considered more widely to have a larger impact on PA for children.

When considering the larger scope of this intervention, an interdisciplinary team has guided its development, implementation and evaluation. The nature of this intervention is based upon cross-collaborative efforts among a number of community groups, academics, municipal departments and policy-makers. Through this cross-collaboration, the ACT-i-Pass was successfully implemented across the city and a comprehensive evaluation was completed. Evaluation results were consistently presented to members of the CYN to obtain insights from various sectors, troubleshoot issues, and develop plans for the continuation of the program. Research indicates that interventions developed in partnership with policy-makers and practitioners are more likely to influence policy, as researchers can directly communicate and discuss findings (Giles-Corti et al., 2015). The ability to communicate with multiple sectors of the community allows for researchers to better understand the issues confronting policy-makers and practitioners and as a result increase the likelihood that research is policy-relevant (Giles-Corti et al., 2015).

Cross-sector collaboration also increases the likelihood that a researcher or research team is able to identify a new program or policy that is occurring naturally (without researcher

control) in the community with sufficient time to properly design, fund, and conduct baseline evaluation before the intervention, to compare with a post-intervention evaluation. Without cross-sector collaboration, it is extremely difficult for a researcher to initiate an evaluation study of a population-level community intervention.

The results from the ACT-i-Pass program enable community stakeholders to make informed decisions about the effectiveness of the intervention, as results are based on a real-world setting. Although the findings may not be generalizable to every city, the success of the ACT-i-Pass program in London, Ontario has the potential to influence other municipalities and local community organizations to consider implementing a similar type of program. On a broader scale, the positive impact of this intervention on children's PA should encourage policymakers at all levels of government to consider adopting the program more widely across Canada.

4.5. Future Research

The findings from both studies emphasize the need for more research on the utility of natural experiments in population-based interventions. Chapter 2 provided an informative foundation regarding the use of natural experiments in PA interventions; however, the review highlights the need to consider specific types of PA domains. A main finding from this review was the high degree of heterogeneity among the studies. Future reviews should analyze studies that focus on one type of PA domain (i.e., active travel) in order to draw better conclusions about the use of natural experiments in specific settings. A majority of the articles in the review did not use a theoretical framework and ones that did focused on components related to individual behaviour change. When considering population-level change, more studies are needed that use an ecological framework in order to consider factors at multiple levels that can impact behaviour change. The ecological framework is beneficial to use to develop intervention components that

can target different levels (i.e., intrapersonal, interpersonal, community, environment) but also as a way to evaluate an intervention to see what factors across these levels has an impact on the PA outcomes. Overall, there were a limited number of studies in this review and therefore more interventions need to be conducted in order to fully realize the potential of this approach for population-based PA interventions.

The findings from Chapter 3 illustrates that, despite using the ecological model as a guide, the complexity of PA behaviour is difficult to separate and more consideration should be given to the measures selected. For instance, only a small number of items addressed social support and used a summative scale to produce a score for the construct, which can miss the more distinct and subtle aspects of social support. In addition, the measure used for neighbourhood level SES (i.e., median household income) is a proxy measure and might not accurately depict the SES of participants in the sample. Future research using an ecological model should evaluate the reliability and validity of different measures and develop clear objectives for the research and seek measures that will satisfy those objectives.

In addition, future studies should determine the barriers and facilitators of using the pass and include a control group to draw more comparisons on the effect of this intervention. Numerous studies have also suggested that assessing the implementation of interventions is highly relevant to determining overall effectiveness of interventions. Aspects of the intervention such as the reach, dose delivered, fidelity, adaptation, differentiation, responsiveness, quality, and monitoring of control/ comparison groups have all been cited as important characteristics related to overall effectiveness of interventions (Durlak & DuPre, 2008; Naylor et al., 2015). The ACT-i-Pass documented the implementation process throughout the intervention; however, this was not formally evaluated in the present study. Future research should incorporate more

comprehensive evaluations to add important contextual information to understand the outcomes of these interventions.

Finally, future research should seek to triangulate data by including qualitative methods. Qualitative research can provide a more detailed understanding about the effectiveness of the intervention, provide insight into the process, and highlight the barriers and facilitators that contributed to the use of an intervention. Future research that assesses population-level PA interventions should consider a qualitative component when developing and evaluating intervention to capture data that quantitative analyses might not show.

4.6. Conclusions

The purpose of this research was to examine how a naturally-occurring population-based PA intervention such as the ACT-i-Pass can impact children's PA levels. When reviewing previous studies that used natural experiments to evaluate population-based interventions, several important considerations were found. First, the findings suggest that population-based interventions may be effective in improving children's PA levels, as a majority of the studies found positive results. Second, there were a number of studies that assessed different domains of PA, illustrating the wide application of a natural experimental approach. Thirdly, the inclusion of evaluation components provided useful information to not only assess the impact of the intervention, but also inform future interventions as they provided important contextual information.

To contribute to this area of research, the ACT-i-Pass was a novel intervention that was naturally-occurring in the community and offered a unique opportunity to assess PA. The ACT-i-Pass successfully improved PA levels over time, however, determining its impact for at-risk children may be difficult as a majority of the sample were already sufficiently active. In addition,

factors associated with change in PA over time had limited results and emphasize the need for continued research to understand the multiple factors that contribute to or detract from the intervention's success and ultimately children's PA.

4.7. References

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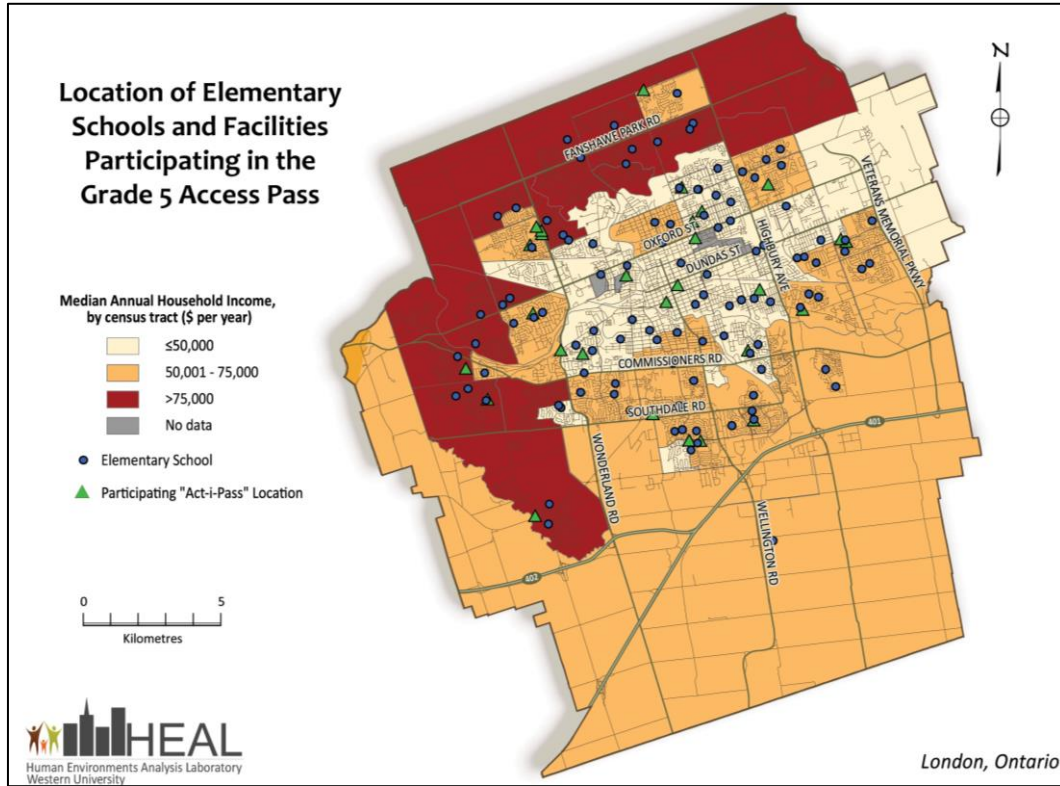
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APPENDICES

Appendix A Location of Schools and Facilities Participating in the ACT-i-Pass Program



Appendix B Recruitment Letter



Dear Grade 4 Parents/Guardians,

You and your grade 4 child are invited to participate in the Child and Youth Network's *ACT-i-Pass Program*. The ACT-i-Pass is a card that grants your child (plus one friend, family member, or chaperone) **FREE** access to many of London's recreation centres and programs from September 2014 until June 2015.

The purpose of the program is to increase a child's ability to participate in physical activity, which can improve health, lengthen life, decrease illness, reduce screen time, and increase play in their lives! This program also provides an important chance for your child to be active at an early age, as active children become active, healthy adults. This project has been endorsed by, and has passed the ethical standards of, your child's school board and Western University.

If your child registers for the *ACT-i-Pass Program*, he/she will receive a pass in September that will allow them to access free physical activity opportunities offered through our partners: the City of London/Spectrum, The Boys and Girls Club of London, and The YMCA of Western Ontario. These opportunities include programs like swimming and skating, drop-in sports programs (i.e. basketball, soccer), and select Spectrum classes.

To register your child for the *ACT-i-Pass*:

- Fill out the *ACT-i-Pass Registration* section on the *registration form*, including your mailing address so we can mail the card directly to you.
- Return the *registration form* to your child's teacher.
- Receive the *ACT-i-Pass* by mail in September 2014.
- Use your pass to access recreational facilities and programs throughout London between September 2014 and June 2015. Program schedules are updated seasonally, and can be found at www.inmotion4life.ca. A sample schedule can be found on the back of this letter.

The CYN is also working with researchers at Western University to evaluate the ACT-i-Pass program. This evaluation involves you and your child filling out surveys. For more details regarding the evaluation process please see the attached *Research Project Letter* or visit www.playeveryday.ca. Please note that this is optional and does not determine whether or not your child receives the pass. However, we do encourage you to be involved to help us better understand how the *ACT-i-Pass program* benefits children in the City of London. Please note that this evaluation has passed the ethical standards of your child's school board and Western University.

To participate in the *Western Research Study*:

- Read the *Research Project Letter* found in this package.
- Fill out the *Research Registration* section of the *registration form*.
- Return the *completed registration form and optional parent survey* included in this package to your child's teacher.
- Complete *surveys* throughout the project to help us better understand how this project benefits our community.

Thank you for your interest in the program. If you have any questions about the ACT-i-Pass program or the related research, check out the project websites at www.inmotion4life.ca or www.playeveryday.ca.

Kindly,

London's Child & Youth Network



SAMPLE ACT-I-PASS SCHEDULE

ACT-i-Pass Winter 2014

Dates may be subject to change. For the most up-to-date schedules and times, including Spectrum sessions dates and specific times, please visit mmotbn4life.ca.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Hip Hop 10/12 Wildcury PS 7:15-8:15pm 247997 Soccer 10/12 Wildcury PS 7:15-8:15pm 249954 Basketball 10/12 Knottwood HS 7:00-8:00pm 249028 Floor Hockey 10/12 Lord Nelson PS 7:00-8:00pm 249035 Glee 10/12 Lord Nelson HS 7:00-8:00pm 249037 Soccer 10/12 (Girls) Northtree HS 7:00-8:00pm 249041	Hip Hop 10/12 Lambeth CC 7:15-8:15pm 247996 Football 10/12 South London CC 7:00-8:00pm 248891 Volleyball 10/12 Wildcury PS 7:00-8:00pm 249025 Soccer 10/12 Glen Oliver PS 7:00-8:00pm 249052	Glee 10/12 Berksire Club 7:30-8:30pm 247931 Skipping 10/12 White Oaks HS 7:00-8:00pm 248930 Soccer 10/12 Dixon Somerset HS 7:30-8:30pm 248957 Basketball 10/12 Knottwood PS 6:00-7:00pm 249105 Floor Hockey 10/12 Hyerson HS 7:00-8:00pm 249092 Cheerleading 10/12 Lord Nelson PS 7:00pm-8:00pm 249110	Volleyball 10/12 White Oaks HS 7:00-8:00pm 248930 Skipping 10/12 Medway CC 7:00-8:00pm 248932 Basketball 10/12 Wilton Grove HS 7:30-8:30pm 249122		Cardio Funk 10/12 South London CC 10:45am-11:45am 247977 Basketball 10/12 Hyson Rec Centre 11:45am-12:45pm 248726	
GOLF - History 9 hole - use the pass on one occasion and bring a friend/parent for free. Closed until March 2014						
SKATING - Free entry to all public skating/family skating September through to the end of December at all City facilities						
Swimming 7:30pm-9:30pm Carlton Heights Pool			Swimming 3:30pm-5:00pm South London Community Pool		Swimming 3:00pm-5:00pm Aquatic Centre	
					Drop-In Program 1:00pm-4:00pm Roya & Girls Club	Drop-In Program 1:00pm-4:00pm Roya & Girls Club
YMCA Drop-In Program (Centre Branch, Tracey Creek or The Bob Hayward) 4:30pm-6:00pm			YMCA Drop-In Program (Centre Branch, Tracey Creek or The Bob Hayward) 4:30pm-6:00pm			

Only these specific Spectrum programs are offered as part of the pass. Please preregister by phone at 519.001.5575 or in person before attending.

PLEASE NOTE: Not all Spectrum programs run the full winter period. Specific session dates and times, as well as new spring schedules, can be found at mmotbn4life.ca.

Appendix C ACT-i-Pass Child Survey



ACT-i-Pass Survey for Youth

We need your help to make the **ACT-i-Pass** program a success. Your honest answers to the questions are very important to us. This will not take too long to complete.

A. General Information

1. I am female male
 - a. My current age is _____ years old.
 - b. Please circle the month in which you were born:
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2. My ethnicity (*please circle the appropriate response(s)*):

<input type="checkbox"/> Aboriginal (Inuit, Metis)	<input type="checkbox"/> Arab/West Asian (Armenian, Moroccan)
<input type="checkbox"/> Black (e.g., African, Jamaican)	<input type="checkbox"/> Chinese
<input type="checkbox"/> Filipino	<input type="checkbox"/> Japanese
<input type="checkbox"/> Korean	<input type="checkbox"/> Latin American
<input type="checkbox"/> South Asian	<input type="checkbox"/> South East Asian
<input type="checkbox"/> White (Caucasian)	<input type="checkbox"/> Other
3. Were you born in Canada? Yes No
 - a. If no, how many years have you lived in Canada? _____
4. My primary home (where you sleep most or all nights) is a:

<input type="checkbox"/> single-parent household
<input type="checkbox"/> two-parent household
<input type="checkbox"/> other : _____
5. My home:

<input type="checkbox"/> I live in one home (sleep all nights in the same home)
<input type="checkbox"/> I split my time equally between 2 homes / parents
<input type="checkbox"/> I live in mostly one home but regularly visit/live in a second home / parent
<input type="checkbox"/> I have another home arrangement: _____
6. How many people live (including yourself AND other children) in your primary household?

<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6 or more
----------------------------	----------------------------	----------------------------	----------------------------	------------------------------------
7. How many other children (NOT including yourself) live in your primary household?

<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 or more
----------------------------	----------------------------	----------------------------	----------------------------	----------------------------	------------------------------------

8. Postal code at your primary home: _____ - _____

9. How many days a week do you live at this address?

1 2 3 4 5 6 7

10. If you have a secondary home (where you sleep some nights), what is the postal code:

_____ - _____

11. How many cars are owned by your household? None 1 2 3 or more

12. Do you or your family members have a London Transit Bus Pass? Yes No

B. Leisure-Time Activities

Tell us how much time on a typical SCHOOL DAY (week day) you spend doing the following activities. Please think about the time from when you wake up until you go to bed outside of school.

Please circle the best answer for you.	No time	Less than 30 min	30 min to 1hr	1 to 2hr	More than 2hr	I do not have a
1. Watching television/videos/DVDs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TV...
2. Playing video or computer games (Playstation / Xbox / Wii)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	system
3. Playing hand held game player (Nintendo DS / Sony PSP / iPod Touch)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	player
4. Using the internet or emailing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Access to internet
5. Talking or texting on cell phone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cell phone

C. Physical Activity & Active Recreation

Physical activity is any activity that increases your heart rate and/or their breathing. Please tell us a little about your physical activity behaviours.

1. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?

I don't do PE Quite Often
 Hardly Ever Always
 Sometimes

2. In the last 7 days, what did you do most of the time at recess?
- Sat down (talking, reading, doing schoolwork)
 - Stood around or walked around
 - Ran or played a little bit
 - Ran around and played quite a bit
 - Ran and played hard most of the time
3. In the last 7 days, what did you normally do at lunch (besides eating lunch)?
- Sat down (talking, reading, doing schoolwork)
 - Stood around or walked around
 - Ran or played a little bit
 - Ran around and played quite a bit
 - Ran and played hard most of the time
4. In the last 7 days, on how many days right after school, did you do sports, dance, or play games in which you were very active?
- None
 - 1 time last week
 - 2-3 times last week
 - 4 times last week
 - 5 times last week
5. In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active?
- None
 - 1 time last week
 - 2 or 3 times last week
 - 4 or 5 times last week
 - 6 or 7 times last week
6. On the last weekend, how many times did you do sports, dance, or play games in which you were very active?
- None
 - 1 time
 - 2 or 3 times
 - 4 or 5 times
 - 6 or more times
7. Which one of the following describes you best for the last 7 days? Read all five statements before deciding on the one answer that describes you.
- All or most of my free time was spent doing things that involve little physical effort
 - I sometimes (1-2 times last week) did physical things in my free time.
 - I often (3-4 times last week) did physical things in my free time
 - I quite often (5-6 times last week) did physical things in my free time
 - I very often (7 or more times last week) did physical things in my free time

8. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

Day of the Week	None	Little Bit	Medium	Often	Very Often
Monday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tuesday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wednesday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thursday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Friday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Saturday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sunday	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times?

Physical Activities	No	1-2	3-4	5-6	7 times or more
a. Bicycling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Walking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Ice Skating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Rollerblading	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Skateboarding / Scootering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Skipping / Tag / Running Games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Play Catch (Ball, Frisbee)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Dance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Soccer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Hockey / Ringette	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Swimming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Basketball	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Baseball / Softball	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Martial Arts (Karate, Judo)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o. Volleyball	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p. Football / Rugby	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Physical Activities	No	1-2	3-4	5-6	7 times or more
q. Skiing / Snowboarding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
r. Racquet Sports (Tennis, Badminton)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
s. Run / Jogging / Track & Field	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
t. Gymnastics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
u. Trampoline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
v. Other? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
w. Other? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D. Barriers to Physical Activity

Please tell us whether you agree or disagree with the following.

It is difficult for me to be active more often because...	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. My parents are too busy to take me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I am too busy doing other activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I am involved in other non-active programs (e.g., Voice Lessons, Boy Scouts, Girl Guides)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I get too much homework.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. My parents do not have a car to take me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The nearest recreation centre (arena, pool, gym) is too far away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The nearest park is too far away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I don't have any energy after school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I find physical activity boring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I don't understand the rules of sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I am no good at sports and other physical activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I don't want to get hurt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I don't like to be active.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. I don't like sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I am already active enough.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Programs are not available in my neighbourhood that I am interested in.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

It is difficult for me to be active more often because...	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
17. The programs I am interested in are always full.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. It costs too much money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I have no one to be active with.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. It is embarrassing to play sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. I have a physical disability that makes it difficult for me to play (<i>specify</i>): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. I have a health problem (i.e., asthma, cold, flu) (<i>specify</i>) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E. Recreation places and sports facilities where you live

For the following places / facilities, please tell us whether	Are there any located in your neighborhood?		Do you typically use or visit these places?	
	Yes	No	Yes	No
a. <u>Indoor</u> recreation centre	Yes	No	Yes	No
b. Arena	Yes	No	Yes	No
c. River, pond, or creek	Yes	No	Yes	No
d. Natural Area (e.g., Forest, Field)	Yes	No	Yes	No
e. Sports field (soccer, football)	Yes	No	Yes	No
f. Basketball court	Yes	No	Yes	No
g. Tennis court	Yes	No	Yes	No
h. Skate park	Yes	No	Yes	No
i. Baseball diamond	Yes	No	Yes	No
j. Swimming pool	Yes	No	Yes	No
k. Splash Pad or wading pool	Yes	No	Yes	No
l. Public playground with play equipment (e.g., climber, swings)	Yes	No	Yes	No
m. Physical Activity Programs (e.g., swimming lessons, basketball teams)	Yes	No	Yes	No
n. YMCA	Yes	No	Yes	No
o. Boys and Girls Club	Yes	No	Yes	No

F. Parental Support for Physical Activity

During a typical week, how often has a member of your household: (For example, your father, mother, brother, sister, grandparent, or other relatives):	Never	1 - 2 Days	3 - 4 Days	5 - 6 Days	Daily
1. Watched you participate in physical activity or play sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Encouraged you to do sports or physical activity?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Provided transportation to a place where you can do physical activity or sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Done a physical activity or played sports with you?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

G. Peer Support for Physical Activity

During a typical week, how often	Never	1 - 2 Days	3 - 4 Days	5 - 6 Days	Daily
1. Do your friends encourage you to do sports or physical activities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do your friends do physical activity or play sports with you?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Do your friends or classmates tease you about not being good at physical activities or sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Do your friends tell you that you are doing well in physical activities or sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix D ACT-i-Pass Parent Survey



ACT-i-Pass Survey for Parents

We need your help to make the **ACT-i-Pass** project a success. Your honest answers to the questions are very important. This will not take too long to complete. If you have more than one child bringing home a survey – we would appreciate you filling out a survey for each child since some answers will be specific to each child.

A. General Information

1. Postal code of your child's primary home: ____ - ____
 - a. How many days a week do they live at this address? 1 2 3 4 5 6 7
2. Postal code of your child's secondary home (if applicable): ____ - ____
3. Please **check and circle** the highest level of education the child's mother has completed.
 - Grade: 1 2 3 4 5 6 7 8 9 10 11 12 13
 - College/University
 - Graduate School
 - N/A
4. Please **check and circle** the highest level of education the **child's father** has completed.
 - Grade: 1 2 3 4 5 6 7 8 9 10 11 12 13
 - College/University
 - Graduate School
 - N/A
5. Which of the following best describes the current work status of the **child's mother**?

<input type="checkbox"/> Employed full-time	<input type="checkbox"/> Employed part-time
<input type="checkbox"/> At home with children	<input type="checkbox"/> Unemployed
<input type="checkbox"/> Student	<input type="checkbox"/> other _____
<input type="checkbox"/> I prefer not to answer	<input type="checkbox"/> not applicable
6. Which of the following best describes the current work status of the **child's father**?

<input type="checkbox"/> Employed full-time	<input type="checkbox"/> Employed part-time
<input type="checkbox"/> At home with children	<input type="checkbox"/> Unemployed
<input type="checkbox"/> Student	<input type="checkbox"/> other _____
<input type="checkbox"/> I prefer not to answer	<input type="checkbox"/> not applicable
7. Which of the following best describes the current work status of the **child's primary caregiver/guardian if different than above**?

<input type="checkbox"/> Employed full-time	<input type="checkbox"/> Employed part-time
<input type="checkbox"/> At home with children	<input type="checkbox"/> Unemployed
<input type="checkbox"/> Student	<input type="checkbox"/> other _____
<input type="checkbox"/> I prefer not to answer	<input type="checkbox"/> not applicable

8. Please indicate the total income from all sources that you and other members of your household received in the last year (Jan-Dec) before taxes. The total income from all sources was:

- | | | |
|--|---|--|
| <input type="checkbox"/> Less than \$20,000 | <input type="checkbox"/> \$20,000 - \$29,999 | <input type="checkbox"/> \$30,000 - \$39,999 |
| <input type="checkbox"/> \$40,000 - \$49,999 | <input type="checkbox"/> \$50,000 - \$59,999 | <input type="checkbox"/> \$60,000 - \$69,999 |
| <input type="checkbox"/> \$70,000 - \$79,999 | <input type="checkbox"/> \$80,000 - \$89,999 | <input type="checkbox"/> \$90,000 - \$99,999 |
| <input type="checkbox"/> \$100,000 - \$109,999 | <input type="checkbox"/> \$110,000 - \$119,999 | <input type="checkbox"/> \$120,000 - \$129,999 |
| <input type="checkbox"/> \$130,000 - \$139,999 | <input type="checkbox"/> \$140,000 - \$149,999 | <input type="checkbox"/> \$150,000 or more |
| <input type="checkbox"/> I don't know | <input type="checkbox"/> I prefer not to answer | |

9. Please indicate your child's race (please circle the appropriate response(s)):

- | | |
|--|---|
| <input type="checkbox"/> Aboriginal (Inuit, Metis) | <input type="checkbox"/> Arab/West Asian (Armenian, Moroccan) |
| <input type="checkbox"/> Black (e.g., African, Jamaican) | <input type="checkbox"/> Chinese |
| <input type="checkbox"/> Filipino | <input type="checkbox"/> Japanese |
| <input type="checkbox"/> Korean | <input type="checkbox"/> Latin American |
| <input type="checkbox"/> South Asian | <input type="checkbox"/> South East Asian |
| <input type="checkbox"/> White (Caucasian) | <input type="checkbox"/> Other |

10. Are you and your family immigrants to Canada? If so, how long have you lived in Canada?

- | | |
|--|---|
| <input type="checkbox"/> No | <input type="checkbox"/> 5 years or less |
| <input type="checkbox"/> 6 to 10 years | <input type="checkbox"/> More than 10 years |

11. My child's current height is: _____ cm OR _____ ft _____ in

12. My child's current weight is: _____ kg OR _____ pounds

B. Barriers to activity in neighbourhood parks and recreational facilities

Please tell us whether you agree or disagree with the following by checking the answer that best applies.

It is difficult for my child to be active more often because...	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
1. I am too busy to take them.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. They are too busy doing other activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. They are involved in other non-active programs (e.g., Voice Lessons, Boy Scouts, Girl Guides).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. They get too much homework.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I do not have a car to take them.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The nearest recreation centre (arena, pool, gym) is too far away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

It is difficult for my child to be active more often because...	I strongly disagree	I disagree a little bit	I agree a little bit	I strongly agree
7. The nearest park is too far away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. They don't have any energy after school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. They find physical activity boring.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. They don't understand the rules of sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. They are no good at sports and other physical activity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. They don't want to get hurt.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. They don't like to be active.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. They don't like sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. They are already active enough.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Programs are not available in our neighbourhood that they are interested in.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. The programs they are interested in are always full.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. It costs too much money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. They have no one to be active with.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. They are embarrassed by playing sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. They have a physical disability that makes it difficult for them to play (<i>specify</i>): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. They have a health problem (i.e., asthma) (<i>specify</i>)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

C. Your Physical Activity

We are interested in finding out about the kinds of physical activities that parents do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

No vigorous physical activities



Skip to question 3

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ hours per day

_____ minutes per day

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

No moderate physical activities



Skip to question 5

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ hours per day

_____ minutes per day

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking → *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day** _____ **minutes per day**

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day** _____ **minutes per day**

D. Parental Support for Physical Activity

During a typical week, how often have you...	None	Once	Sometimes	Almost Daily	Daily
1. Encouraged your child to do physical activities or play sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Done a physical activity or played sports with your child?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Provided transportation so your child can go to a place where he or she can do can do physical activities or play sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Watched your child participate in physical activities or sports?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E. Recreation places and sports facilities where you live

For the following questions, please circle the answer that best applies to your child and your neighbourhood.	Are there any located in your neighbourhood?		Does your child typically use or visit these places?	
	Yes	No	Yes	No
1. <u>Indoor</u> recreation centre	Yes	No	Yes	No
2. Arena	Yes	No	Yes	No
3. River, pond, or creek	Yes	No	Yes	No
4. Natural Area (e.g., Forest, Field)	Yes	No	Yes	No
5. Sports field (e.g., soccer, football)	Yes	No	Yes	No
6. Basketball court	Yes	No	Yes	No
7. Tennis court	Yes	No	Yes	No
8. Skate park	Yes	No	Yes	No
9. Baseball diamond	Yes	No	Yes	No
10. Swimming pool	Yes	No	Yes	No
11. Splash Pad or wading pool	Yes	No	Yes	No
12. Public playground with play equipment (e.g., climber, swings)	Yes	No	Yes	No
13. Physical Activity Programs (e.g., swimming lessons, basketball teams)	Yes	No	Yes	No
14. YMCA	Yes	No	Yes	No
15. Boys and Girls Club	Yes	No	Yes	No

Appendix E Physical Activity Questionnaire for Children (PAQ-C)

Physical Activity Questionnaire (Elementary School)

Name: _____

Age: _____

Sex: M _____ F _____

Grade: _____

Teacher: _____

We are trying to find out about your level of physical activity from *the last 7 days* (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rowing/canoeing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In-line skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baseball, softball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skateboarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soccer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Street hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Floor hockey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice skating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-country skiing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice hockey/ringette	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other:					
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

- I don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

3. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 or 5 last week
- 6 or 7 times last week

7. On the last weekend, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

- A. All or most of my free time was spent doing things that involve little physical effort
- B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- C. I often (3 — 4 times last week) did physical things in my free time
- D. I quite often (5 — 6 times last week) did physical things in my free time
- E. I very often (7 or more times last week) did physical things in my free time

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wednesday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thursday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saturday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sunday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

- Yes
- No

If Yes, what prevented you? _____

Reference: The Physical Activity Questionnaire for Older Children (PAQ-C)

Kowalski, K., Crocker, P., & Donen, R. The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual. College of Kinesiology, University of Saskatchewan.

Appendix F Research Ethics Approval Forms for Use of Human Participants



**Western
Research**

Research Ethics

Use of Human Participants - Revision Ethics Approval Notice

Principal Investigator: Jason Gilliland
 File Number: 103954
 Review Level: Delegated
 Protocol Title: Evaluation of a Physical Activity Intervention for Elementary School Children in London, Ontario
 Department & Institution: Social Science/Geography,
 Sponsor:
 Ethics Approval Date: May 07, 2014 Expiry Date: December 31, 2016
 Documents Reviewed & Approved & Documents Received for Information:

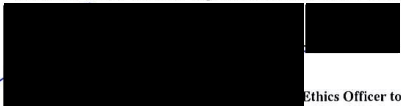
Document Name	Comments	Version Date
Revised Western University Protocol	Western NM REB Protocol	
Instruments	Parent Survey	
Instruments	Youth Survey	
Revised Letter of Information & Consent	Parental LOI/Consent	
Assent	Child Assent	
Other	Registration Form	

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.



Ethics Officer to Contact for Further Information

<input type="checkbox"/> Erika Basile	<input checked="" type="checkbox"/> Grace Kelly	<input type="checkbox"/> Mina Mekhail	<input type="checkbox"/> Vikki Tran
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This is an official document. Please retain the original in your files.

Curriculum Vitae

Christine E. Smith, M. Sc.

EDUCATION

- 2014 - Present M.Sc. Geography, Western University, London, Ontario
- 2009 - 2013 B.A. in Psychology and Studio Arts with distinction (Honours),
University of Guelph, Guelph, Ontario

AWARDS AND SCHOLARSHIPS

- 2015 - 2016 Social Science and Humanities Research Council (SSHRC),
Canadian Graduate Scholarship- Masters
- 2015 - 2016 Ontario Graduate Scholarship (OGS), declined in lieu of SSHRC
scholarship

RELATED WORK

- 2014 - 2016 Research Associate, Human Environments Analysis Laboratory,
London, Ontario
- 2014 - 2016 Teaching Assistant, Western University, London, Ontario
- 2013 Research Assistant, Discourse Science and Publics Lab, University
of Guelph, Guelph, Ontario

PUBLICATIONS

- Clark, A.F., P. Wilk, C.A. Mitchell, **C. Smith**, J. Archer, & J.A. Gilliland. (*Submitted*).
Examining how Economic, Geographic and Informational Accessibility Influences
the Uptake of a Free Population-Level Physical Activity Intervention for Youth.
American Journal of Health Promotion
- O'Doherty, K. C., **Smith, C.**, & McMurtry, C. M. (forthcoming). Vaccine Hesitancy:
Ethical Considerations from Multiple Perspectives. In Paul Bramadat, Julie
Bettinger, & Maryse Guay (eds.). *Cultural and Religious Roots of Vaccine
Hesitancy: Explanations and Implications for Canadian Healthcare*. University of
Toronto Press: Toronto