Healthy Food Zones Around Schools: Evaluating Projected Impacts of a Restrictive Food Planning Policy on Junk Food Availability after 10 years: An Equity- focused Simulation Study

by

Lindsey Marie Ramos Soon

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Arts
in
Planning

Waterloo, Ontario, Canada, 2021

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.
I understand that my thesis may be made electronically available to the public.

Abstract

Healthy diets are important for public health and health equity, given that globally, dietary risks currently comprise the largest burden of morbidity and mortality (Afshin et al., 2019). In Canada, diet quality is the poorest among youth ages 14-18 (Garriguet, 2009), which is concerning given that youth quickly develop eating patterns that track throughout their lives (Lien et al., 2001). Similarly, our understanding of the relationship between the built environment and population health outcomes as situated within a social equity lens has grown. Both planning and public health organizations and researchers have recommended restrictive food planning policies that regulate unhealthy food outlets' distribution, density, and proximity around secondary schools (ASPQ, 2011; Einstoss et al., 2015; OPPI, 2011; Robitaille et al., 2016). Several municipalities and cities in Canada and the US have explored and implemented such restrictive urban planning policies in certain public areas, including around schools; however, these policies have not been evaluated, nor have the ethical implications been considered (ASPQ, 2011; Díez et al., 2019; Luan et al., 2016).

This cross-sectional, quantitative, ecological thesis examines how food environments are projected to change under different restrictive food planning policies over 10 years in the Region of Waterloo (Ontario, Canada) by buffer type, buffer distance and various markers of equity. This manuscript-based thesis uses popular demographic modelling projections and discusses the potential ethical implications of this policy on equity-deserving youth from a health equity perspective to answer the following three research questions: 1) How would high school students' food environment accessibility be projected to change during the school day if restrictive food planning policies (restricting fast food and convenience stores from opening around schools) were implemented in the Region of Waterloo, Ontario?", 2) "How does current food environment accessibility differ by the proportion of students at schools identifying as low-income, EAL and newcomer status in secondary schools in the Region of Waterloo, Ontario?", and 3) "How would projected changes in food environment accessibility after 10 years of restrictive policy implementation differ by these social identity groups?"

Findings suggest that Euclidean distance policies showed a larger decline in the number of unhealthy outlets at 10 years relative to their network distance counterparts and low- and medium- equity schools (those with high proportions of equity-deserving students across multiple marks of equity) currently have higher accessibility to unhealthy retailers compared to high-equity schools (those with low proportions of equity-deserving students) in the Region of Waterloo, Ontario. Even after 10 years of implementation, low- and medium- equity schools still have higher projected access to unhealthy food retailers relative to high-equity schools.

This research provides planners, public health practitioners, and policymakers with an understanding of how recommended policies may impact food environments around schools in different contexts to inform decision-making regarding food policy interventions and contributes to the ongoing conversation of social inequities across food systems and highlight ethical implications of restrictive food planning policies. Future public health research should evaluate the effectiveness of existing restrictive food policies and examine the impacts restrictive food planning policies may have across communities, especially equity-deserving communities, through an intersectional and equity lens.

Acknowledgements

First and foremost, I would like to thank my supervisor Dr. Leia Minaker for her endless guidance and support throughout my time at the School of Planning, without whom my success and accomplishments would not have been possible. Thank you for actively creating a warm and welcoming lab environment where graduate students can feel heard and supported and for always encouraging us to explore our interests, gain new skills and to apply for every opportunity. Your advice and wisdom regarding the research process and everyday life has had a profound impact and the community you've created among your graduate students is unparalleled. It has been an incredible privilege to have worked alongside you for the past two years, thank you for being an amazing supervisor but also a wonderful friend.

Thank you to my committee members, Dr. Mark Seasons and Dr. Jennifer Dean, for your guidance in shaping this thesis. Your comments and feedback throughout the research process are greatly appreciated and pivotal to the final draft of this thesis. I'm grateful to have has your perspectives and expertise in your respective fields and for your support for other academic endeavours during my time at the School of Planning that has helped shape my graduate experience.

Thank you to my incredible peers and colleagues that I've had the pleasure of meeting and working with on shared academic endeavours. I especially want to thank the planning gals for their endless support and encouragement over the past two years. I feel very fortunate to have met you all and to have had the opportunity to create lasting friendships.

Thank you to my friends for their continuous support and encouragement throughout the last two year. Thank you for letting me talk your ears off about health and the built environment and never failing to ask me how things were going and for always being there to celebrate my achievements.

Lastly, I’d like to thank Markus Wieland from the University of Waterloo’s Geospatial Centre for your never-ending patience and willingness to troubleshoot GIS and ArcMap remotely. I also want to thank the various organizations such as the University of Waterloo, OPPI and CIP for supporting this research through financial scholarships.

Table of Contents

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Problem Context

Healthy diets are important for public health and health equity, given that globally, dietary risks currently comprise the largest burden of morbidity and mortality (Afshin et al., 2019). In Canada, diet quality is the poorest among youth ages 14-18 (Garriguet, 2009), which is concerning given that youth quickly develop eating patterns that track throughout their lives (Lien et al., 2001). Similarly, our understanding of the relationship between the built environment and population health outcomes as situated within a social equity lens has grown. Historically, food issues have been conceptualized as agricultural and rural issues, with the urban food system being less visible compared to other predominant urban systems such as transportation, housing and employment (Pothukuchi & Kaufman, 1999). However, research on food issues within the urban context concludes that despite its low visibility, urban food systems are a significant contributor to not only community health and welfare but is inherently connected to other urban systems such as land use and economic development (Pothukuchi & Kaufman, 1999).

In 2017, the Government of Canada's Chief Public Health Officer released a report on the current state of public health in Canada, emphasizing the need to raise awareness about how our built environment contributes to a foundation for healthy living and population health (Tam, 2017). Furthermore, the Canadian Institute of Planners report on "Policy on Healthy Communities Planning" emphasizes the direct impact of the built environment on dietary intake and eating habits (CIP, 2018), with food systems being identified as a key pillar of the Healthy Built Environment Framework, specifically equitable access to and affordability of healthy food options (BCCDC, 2018).

Current food literature suggests food environments and food availability may differ systematically by neighbourhood-level characteristics (i.e., income), affecting neighbourhood access to food retailers and potentially perpetuating disparities in health outcomes (Gordon-Larsen, 2014; Larson et al., 2009). At the intersection of equity and the built environment, planners and researchers consider the unique needs of vulnerable and equity-deserving populations, such as

low-income and racialized youth, when considering how to effectively and equitably intervene on the built environment to promote well-being. The majority of current research on food environment and youth diet focuses on organizational (i.e., home, in-school program), and informational food environments (i.e., menus, advertising while few studies examine community food environments frequented by children and youth, such as school-neighbourhood food environments (Gebremariam et al., 2017). Research suggests that the availability and accessibility of unhealthy retailers (e.g., fast food and convenience stores) around schools may be directly associated with overweight and obesity in children and adolescents (da Costa Peres et al., 2020). Although vastly understudied, extant research on the impacts of the food environments around schools on diet and health outcomes for subgroups of equity-deserving children and youth suggests that equity-deserving youth (e.g., lower-income and racialized youth) are exposed to poorer quality food environments around schools (Fleischhacker et al., 2011; Kestens & Daniel, 2010; Zenk & Powell, 2008).

The use of planning tools such as zoning, as a solution to a pressing public health issue. Public health organizations and researchers have recommended restrictive food planning policies that regulate unhealthy food outlets' distribution, density, and proximity around secondary schools (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016). Several municipalities and cities in Canada and the US have explored and implemented restrictive urban planning policies in certain public areas, including around schools. Although public health has recommended such policies, no research has evaluated these non-traditional interventions, nor have the ethical implications been considered (ASPQ, 2011; Díez et al., 2019; Luan et al., 2016).

1.2 Study Area Context: Waterloo Region, Ontario

Although food systems planning is a relatively new subfield, there is increasing interest in improving diets and community health by linking food system policies and land use planning practices. Several municipalities in both Ontario and Québec, including Peel Region, Ontario, Waterloo Region, Ontario and Québec City, Québec have explored and, in some cases, implemented food planning policies for the purpose of improving community health (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016; Wegener et al., 2012; Wegener et al., 2012). The Region of Waterloo has been the topic of case studies for existing food systems planning

research on the Government's role in food systems policy making and addressing key facilitators and barriers to food system policy making (Wegener et al., 2012; Wegener et al., 2012). In 2009, The Region of Waterloo adopted a new Regional Official Plan (ROP) that included commitments to support the regional food system through actions to facilitate access to healthy, local food and is currently in the process of undertaking a Regional Official Plan Review (Region of Waterloo, 2021). According to Wegener et al., (2012), Waterloo Region planning staff began exploring issues related to hunger and food insecurity as early as 1999, identifying several factors affecting agriculture and urban food access within the Region. Over the past two decades, there has been an increase in collaboration between public health staff and policy planners to explore how supporting the regional food systems can improve community food security and help protect against sprawl (Wegener et al., 2012).

The upcoming Region of Waterloo ROP Review has been recognized by Public Health as an opportunity to solicit greater government buy-in when adopting supportive food policies within the Region. Furthermore, communities at the local level have begun advocating on behalf of food systems issues through the creation of non-profit organizations such as the Food System Roundtable of Waterloo Region with the objective to identify and prioritize food system needs while raising awareness of food system issues (University of Waterloo, 2020)

The local environments around schools are important to understanding the context of food environments and food accessibility around individual schools. Within the Region of Waterloo, schools are situated in both urban and rural contexts, impacting school-level accessibility. Schools located in urban contexts may be adjacent to institutional or commercial land uses which are likely to have increased presence of food retailers, while other schools located in residential neighbourhoods may be located further away from commercial land use. Schools located in rural contexts experiencing differing local contexts compared to urban schools, making it vital to understand the local context around schools.

1.3 Study Purpose, Significance and Objectives

The purpose of this study is to examine how access to unhealthy food retailers (i.e., fast food and convenience stores) in school-neighbourhood food environments may change in a mid-sized municipality in the Region of Waterloo, Ontario over 10 years under various food planning policies that prohibit new fast food retailers and convenience stores from opening around schools. Furthermore, this simulation study examines how current and long-term accessibility might differ by school-level markers of inequity based on students' household income, whether they speak English as a additional language (EAL), and newcomer (immigrant) status. It opposes the mainstream assumption that individuals are solely responsible for their health and provides considerations for the impact of the built environments and population health outcomes as it relates to social and economic impact on food access. This study is the first to project impacts of an often-proposed restrictive zoning policy, and raises awareness of the potential unintended consequences of such policies from a health equity lens. This study aims to address these gaps through the following four research objectives:

1. To examine the extent to which the food environment around schools would change under various policy types and distances after 10 years in the Region of Waterloo.
2. To examine how the current and projected state of school-neighbourhood food environments may differ based on various markers of equity at the school-level in the Region of Waterloo.
3. To explore the equity implications and potential unintended consequences for the implementation of restrictive planning policies around schools.
4. To conceptualize and recommend how planning can continue to support health equity initiatives and considerations for planners and municipalities interested in exploring and implementing similar food planning policies.

1.4 Thesis Overview

This thesis will follow the format of a manuscript-based thesis consisting of two stand-along manuscripts (Chapter 4 and Chapter 5). It contains six chapters, including the introductory chapter comprised of the problem context, study purpose and significance. Chapter 2 consists of a review of current literature on dietary health and the built environment, the relationship between food environments around schools and youth diet and evidence suggesting youth may experience

food environments differently based on socio-economic characteristics. I also examine non-traditional food environment policy options to support healthy dietary practices and identify gaps in extant research. Chapter 3 highlights the philosophical worldviews that contributed to the structure of this study and high-level overview of the methods and methodology undertaken in this research. Chapter 4, I examine the overall impacts of restrictive "junk food policies," using four different policy options that vary by buffer distance (800m vs. 1km) and by type of buffer (Euclidean vs. Network), using data visualization and demographic population projection modelling to examine how neighbourhood-school food environments may change under these policy options after 10 years. In Chapter 5, I examine the current and potential long-term changes to food environments around schools through a social equity lens using school-level markers of inequity such as student's household income, English as a additional language speakers (EAL) and newcomer (immigrant) status. I use the proportion of students with these markers of inequity to operationalize school-level equity to examine food environments across populations of equity-deserving youth and discuss potential equity implications of these policies on equity-deserving subgroups. In Chapter 6, I summarize key findings from each manuscript, how these findings apply to both planning and public health practice and recommendations for future research.

Chapter 2
Literature Review

Healthy diets are essential for public health and health equity. Both public health and planning researchers and practitioners are increasingly proposing built environment solutions to the problem of poor dietary practices, particularly for youth, whose diet quality is worse than any other age group and given that eating habits track through adulthood. To date, very little research examines the impacts of proposed policies, so little is known about the overall impacts of such policies and the potential impacts on equity-deserving sub-groups. This chapter will describe the process for which the literature review was conducted, the current state of research and policy in this area and justify the research presented in this thesis.

2.1 Literature Review Methodology

The methodology for this literature review is based on the framework outlined by Pham et al. (2014). The review includes the following five key phases: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) analyzing, summarizing and reporting the results.

2.1.1 Literature Review Question

This literature review is in response for the need to update the 2014 Engler-Stringer review on community and consumer food environments, it is guided by the similar question "How do community and consumer food environments influence children's diet?" For the purpose of this review, community and consumer food environments are defined as food environments outside of Organizational Nutrition Environments (i.e., home or school) and the Information Environment (i.e., media and advertising) (Glanz, et al. 2005).

2.1.2 Data Sources and Search Strategy

The initial search was implemented February 15th, 2021, on SCOPUS. Within the search, there were limits to date and language. No limits were place on year published and articles in which English versions were obtainable were included. The search query used was the identical to the query used in Engler-Stringer's (2014) review in order to allow for proper replication and consisted of terms including but not limited to: food environment, food outlet, food availability, nutrition

environment, fast food, adolescent behaviour, food habit, youth. Additionally, 2-3 key articles were identified, and the sources cited in these key articles, along with articles that had cited the key articles were included in the search strategy. The complete search strategy can be found in the Table 1.

Table 1: Search Strategy

Search Strategy
(TITLE-ABS-KEY ("nutrition environment*") OR TITLE-ABS-KEY ("food environment*") OR TITLE-ABS-KEY ("food desert*") OR TITLE-ABS-KEY ("foodscape*") OR TITLE-ABS-KEY (supermarket*) OR TITLE-ABS-KEY ("grocery store*") OR TITLE-ABS-KEY ("convenience store*") OR TITLE-ABS-KEY ("food outlet*") OR TITLE-ABS-KEY ("food industry") OR TITLE-ABS-KEY ("food services") OR TITLE-ABS-KEY ("food accessibility") OR TITLE-ABS-KEY ("portion size*") OR TITLE-ABS-KEY ("food price*") OR TITLE-ABS-KEY ("food option*") OR TITLE-ABS-KEY ("food availability") OR TITLE-ABS-KEY ("food marketing") OR TITLE-ABS-KEY ("food advistis*") OR TITLE-ABS-KEY ("neighbourhood food*") OR TITLE-ABS-KEY ("neighborhood food*") OR TITLE-ABS-KEY ("corner store*") OR TITLE-ABS-KEY ("food retail*") OR TITLE-ABS-KEY ("vending machine*") OR TITLE-ABS-KEY ("food security") OR TITLE-ABS-KEY ("food insecurity") OR TITLE-ABS-KEY (restaurant*) OR TITLE-ABS-KEY ("food supply") OR TITLE-ABS-KEY ("food packaging") OR TITLE-ABS-KEY ("food labelling") OR TITLE-ABS-KEY ("fast food*") AND TITLE-ABS-KEY (adolescen*) OR TITLE-ABS-KEY (child*) OR TITLE-ABS-KEY (infant*) OR TITLE-ABS-KEY ("adolescent behavio*") OR TITLE-ABS-KEY ("child behavio*") OR TITLE-ABS-KEY (parent*) OR TITLE-ABS-KEY (teen*) OR TITLE-ABS-KEY (youth) OR TITLE-ABS-KEY ("young people") AND TITLE-ABS-KEY (diet) OR TITLE-ABS-KEY (nutrition) OR TITLE-ABS-KEY (eating) OR TITLE-ABS-KEY ("nutritive value") OR TITLE-ABS-KEY ("feeding behavio*") OR TITLE-ABS-KEY ("food habit*") OR TITLE-ABS-KEY ("food preference*") OR TITLE-ABS-KEY ("food choice*") OR TITLE-ABS-KEY (beverage*)

2.1.3 Eligibility Criteria

A two-stage screening process was used to assess the relevance of studies identified in the search. Studies were eligible for inclusion if they met the following eligibility criteria:

2.1.3.1 Participants

Studies examining children and youth aged 11- 18 years were included in the eligibility criteria of this literature review. These ages correspond to students in middle and high schools and were selected due to the likelihood of these schools having off-campus policies that allow students to seek lunch from a retailer within the immediate school area. Studies examining primary students or toddler and infants were excluded as most elementary schools do not allow students to leave school property for lunch. Furthermore, it is during the child and adolescent years (i.e., ages 11-18) that youth begin to have more freedom over the foods they eat, and their dietary habits begin

to track into adulthood. The language for this criterion is flexible as this population may be identified in various ways and can include but are not limited to; adolescent*, youth, child*, teen*.

2.1.3.2 Exposure and Accessibility

Studies examining youth exposure to community and consumer food environments, as defined by Glanz et al., (2005), were included in this scoping review. Community Nutrition Environments consist of the type & location of food outlets (i.e stores and restaurants), and the accessibility of these outlets to individuals (Glanz, et al. 2005). Comparatively, the Consumer Nutrition Environment comsists of the availability of healthy options, the price, promotion and placement and nutrition information (Glanz, et al. 2005). Studies examining grocery stores were excluded given that the policy would exclude grocery stores. Language for this criterion is flexible as food environments are sometimes referred to differently within literature, appropriate language includes, school food environments (not within schools), neighbourhood food environment, school neighborhood food environment. Studies examining organizational food environments (i.e., school and home), for example, school lunch programs or parental food purchasing behaviours, will be excluded. Studies examining the school food environment within schools, including cafeteria and vending machines will also be excluded. Furthermore, studies examining informational environments (i.e., TV or advertising), for example, children's menus were also excluded. Studies examining food environment exposure between home and school may be considered for inclusion provided that data on food environment exposure around schools are reported separately. Geographical eligibility extends beyond Canada, and will include the United States, and Europe. Other geographical locations may be considered and included provided there is some relevance to the North American context such as New Zealand and the UK.

2.1.3.3 Outcomes

As this scoping review is focused on the association of the consumer and community food environments on diet, studies examining dietary outcomes (i.e., eating behaviour and dietary intake), and health outcome (i.e., obesity and poverty) will be considered for eligibility. These potential outcomes are important determinants of health and therefore should be considered. Other potential outcomes include but are not limited to junk food consumption, eating frequency, and food purchasing.

2.1.3.4 Variables

Other variables of interest in this scoping review reflect individual and community-level variables including socioeconomic status, urban vs. rural, deprivation, spatial clustering, race/ethnicity, and land use.

2.1.4 Screening Process and Literature Review Matrix

During the selection process, only the title and abstract of citations were reviewed during the first phase of screening. Due to the large initial search and time restraints, only 250 articles from the initial search were screened. Information from the top 250 articles were downloaded and compiled into a form for screening. The titles and abstract were examined against the eligibility criteria discussed above and those that met the criteria were included in the second phase of screening. Additionally, 2-3 key articles were identified, and relevant articles cited in the key articles as well as articles that had previously cited the key articles were also compared again eligibility criteria. All journal articles that met the eligibility criteria during the title and abstract screening were then reviewed in full, and additional studies were identified using the snow-ball method through in-text citation and reference lists. Additional screenings were conducted throughout the study process to identify newly published journal articles and emerging findings within the literature.

2.2 Key Findings from Literature

2.2.1 Dietary Health and the Built Environment

Dietary risks currently comprise the largest burden of morbidity and mortality globally (Afshin et al., 2019). In Canada, diet quality is the poorest among youth ages 14-18 (Garriguet, 2009). Furthermore, youth quickly develop eating patterns that can track into adulthood and throughout their lives (Lien et al., 2001; Nelson et al., 2008). At the same time, our understanding of the built environment and population health outcomes as situated within economic and physical contexts has grown, along with the recognition of the importance of these environmental determinants.

Public health and planning practitioners are interested in the impacts of the built environment on population health outcomes. In 2018, the Public Health Service Authority of British Columbia, Canada, highlighted the importance of built environments that promote wellbeing and improve quality of life by linking design, planning, and health through a healthy

built environment framework (PHSA, 2018). Healthy communities are comprised of the built, natural, and social environments and include healthy food systems as a foundational aspect of healthy built environments (HBE) (Mui et al., 2021; PHSA, 2018). Food systems planning lies at the intersection of planning and public health, with awareness for this subfield growing along with the understanding of how built environments can promote and sustain healthy lifestyle patterns and, alternatively, contribute to unhealthy behaviours resulting in chronic health problems such as obesity (Hilmers et al., 2012).

A demonstrated predictor of healthy behaviours, including dietary behaviours, are factors influencing eating behaviours such as the availability and accessibility of foods within the built environment (Gebremariam et al., 2017). A 2019 scoping review examining urban form and health in Canada identified food environment features such as proximity to, and density of healthy and unhealthy food retailers to be significantly associated with various health outcomes (McCormack et al., 2019). The review also found that proximity and access to fast food were associated with a range of adverse health outcomes, including mortality, depression, cardiovascular conditions and weight status (McCormack et al., 2019). Another systematic review examining the link between retail food environment, BMI and diet quality in Canada noted modest evidence of a food environment -BMI relationship and little evidence of a food environment – diet quality relationship (Stevenson et al., 2019). Overall, the use of proxy methods to measure food access using geographic information systems is more strongly associated with diet-related health outcomes; however, there is no consensus on a ‘best practice’ food outlet database or classification system nor method of validation of these databases (Stevenson et al., 2019).

2.2.2 Equity and Food

There has been increased emphasis by both planning and public health professionals to recognize the importance of healthy food systems and healthy food environments (e.g., food access and availability) when planning healthy communities and promoting equity (Mui et al., 2021). Current literature suggests food environments and food availability may differ systematically by neighbourhood income, affecting neighbourhood access to food retailers and may perpetuate disparities in health outcomes (Gordon-Larsen, 2014; Larson et al., 2009). Two trends have been

identified: 1) an oversaturation of unhealthy food retailers within equity-deserving (e.g. low-income, racialized and Indigenous, immigrant or newcomer) communities compared to other groups (Fleischhacker et al., 2011; Jang & Kim, 2018; Kwate & Loh, 2010) and 2) a lack of healthy food options in these same equity-deserving communities (Bower et al., 2014; Hilmers et al., 2012; Jeong & Liu, 2020; Luan et al., 2016; Ohri-Vachaspati et al., 2019; Powell et al., 2021). Furthermore, a growing body of research examines whether access to food and adverse health outcomes in equity-deserving subgroups indicates inequitable access to food (Drewnowski, 2009; Kraft et al., 2020; Matsuzaki et al., 2020).

Planners have sought to increase potential social benefits and food equity through the use of planning strategies such as urban agriculture to increase access to food, positive health impacts and community development (Horst et al., 2017). Research suggests strategies for planners better orient their efforts to support food justice, including developing mutually respectful relationships with food justice organization with diverse backgrounds and incorporating food equity into plans' vision, goals and objectives (Horst et al., 2017; Mui et al., 2021). Although local and regional governments have developed and implemented a variety of plans to evaluate and address inequities in the food system, most assessments of plans fall short in understanding how plans address structural problems that lead to poor food access (Mui et al., 2021). Planners can also leverage strengths of other urban systems, and regional plans to advance food equity by connecting decisions regarding transportation and development infrastructures to support access to healthy food (Mui et al., 2021). Aspects of the built environment and public health contribute to issues of food insecurity, including food mirages and food sovereignty, merging two traditionally siloed sectors. Examining food inequity from an interdisciplinary lens of both urban planning and public health allows for a unique opportunity to explore non-traditional solutions to improve community development and community health through the lens of food justice and equity.

2.2.3 Food Environments Around Schools and Youth Diet

The majority of current food environment research examines associations between organizational food environments (e.g., home, in-school food, and lunch programs) or information food environments (e.g., menus, food marketing and advertisements) and youth diet and health

outcome, while few focus on community food environments frequented by youth such as residential- and school-neighbourhood food environments (Gebremariam et al., 2017). The most recent scoping review exploring food environment interventions targeting children and adolescents examined interventions ranging from organizational (in-school interventions) to external informational food environment interventions within community settings such as menu labelling or in-store interventions (Downs & Demmler, 2020). Down & Demmler (2020) concluded that most food environment interventions to date had been in-school rather than community settings. Given that students spend at least 6 hours at school and typically eat at least one meal outside their home, community food environments such as school-neighbourhood food environments around schools may impact youth eating behaviours and health outcomes and should be considered for potential interventions.

A systematic review in 2013 by Engler-Stringer et al. explored literature on community, and consumer food environments and children's diet found of the 26 eligible studies, 22 showed at least one positive association between food environment exposure and diet outcomes, while four studies noted null associations (Engler-Stringer et al., 2014). Another more recent systematic review exploring the association between retail food establishments around schools and overweight in students concluding of the 31 eligible articles, 18 found a direct association between proximity or density of establishments (mainly fast-food restaurants, convenience stores and grocery stores) around schools and overweight and obesity in children and adolescents (da Costa Peres et al., 2020). The review also suggests inconsistencies among findings, as noted by fourteen papers that found no association, and four papers presented inverse associations (da Costa Peres et al., 2020). One Canadian study sparked policy action explored the relationship between junk food consumption at lunchtime and fast-food outlet access near school among secondary-school adolescents in Québec, Canada (Cutumisu et al., 2017). This study dichotomized school access to a fast-food retailer as 'low access' (0 or 1 food outlet) and 'high access' (2 or more food outlets), and findings suggest a high level of exposure to fast food outlets, with 41.2% of secondary schools has access to two or more fast-food retailers within 750m (Cutumisu et al., 2017). Further, Cutumisu et al. (2017) concluded that exposure to two or more fast-food retailers within a radius of 750m around schools was associated with a higher likelihood of consuming junk food at lunch

after accounting for student, family and school characteristics (Cutumisu et al., 2017). Many studies have identified positive associations between food environment exposures and diet outcome; however, findings between studies remain inconsistent. One possible reason may be inconsistencies in measuring and categorizing food environments and retailers, prompting difficulties when comparing studies.

2.2.4 Measuring Food Access

As noted, the lack of consistency of methodology when measuring food access has been identified as a gap in current literature and contributes to challenges faced when conducting new studies or comparing existing research. Two methods of measuring food access have been identified in existing literature: 1) proxy measures that provide an approximate measure based on the geographic area and/or other factors and 2) true or exact measures used to determine the precise measure of food access using GPS. For example, Sadler et al. (2016) examined the actual exposure youth had to unhealthy food retailers using GPS to track the exact routes youth took between school and home, before and after school.

Inconsistencies, including differences in the type of retail food definitions, distance and type of buffer, and the method of measuring food access, contribute to challenges that limit our understanding of the impacts of food access and health outcomes for children and youth. For example, some studies did not include local or non-chain retailers in their proxy measure of harmful exposure and only identified fast-food chain outlets, potentially inaccurately capturing actual exposure (L. Seliske et al., 2013). In addition, there are inconsistencies in terms of both the type of buffer considered (i.e., circular vs. network buffer) (Day & Pearce, 2011; He et al., 2012; L. M. Seliske et al., 2008; Shareck et al., 2018) and buffer size (400m-5km) (Day & Pearce, 2011; L. M. Seliske et al., 2008). Lastly, overall, it can be challenging to ensure the accuracy of food retailer location data due to two reasons: 1) the food environment when the data was collected versus when the article is published or read may have changed due to the volatility of the food retail industry and 2) GIS in datasets and human error may occur contributing to inaccuracies.

2.2.5 Youth Experience Food Environments Differently Based on Socio-economic Characteristics

Research on the impacts of the food environments around schools and diet and health outcomes for vulnerable populations such as youth are still vastly understudied, especially for equity-deserving youth subgroups. Extant research examines two main streams: 1) Equity: the relationship between area-level socio-demographic characteristics and food environment around schools, and 2) Impact: the extent to which school-neighbourhood food environments are linked to diet-related outcomes. Furthermore, equity-focused research suggests that equity-deserving youth (e.g., lower-income, racialized, newcomer, and Indigenous youth) are exposed to poorer quality food environments. Less healthy food environments have been documented in school neighbourhoods with lower neighbourhood income (Bower et al., 2014; Díez et al., 2019; Elbel et al., 2019; Fleischhacker et al., 2011; Ohri-Vachaspati et al., 2019; Powell et al., 2021), density related to land use (i.e. commercialization) (Kraft et al., 2020; Zenk & Powell, 2008), or a higher proportion of racialized youth (Bower et al., 2014; Elbel et al., 2019; Fleischhacker et al., 2011; Jang & Kim, 2018; Jeong & Liu, 2020; Kwate & Loh, 2010; Ohri-Vachaspati et al., 2019; Powell et al., 2021). For example, a study in Montreal, Québec, Canada, found that schools in the lowest income quartile have ten times more food retailers within 750m than those in the highest income quartile, after controlling for commercial density (Kestens & Daniel, 2010). Furthermore, Zenk & Powell (2008) found the availability of fast food and convenience stores within walking distance of US public secondary schools is higher in the lowest-income neighbourhoods relative to the highest-income neighbourhood while schools in predominantly African-American has overall fewer food retailers relative to predominantly white neighbourhoods (Zenk & Powell, 2008). However, a similar cross-Canada study countered these findings and found that access to food retailers was generally not associated with the neighbourhood SES in the immediate proximity of schools, although within the broader neighbourhood, lower SES neighbourhoods had access to fewer food retailers of all types, suggesting that researchers should consider the boundaries of what is considered the school-neighbourhood food environment (L. M. Seliske et al., 2009).

Regarding impact-focused research, our understanding of the extent to which food purchasing, dietary and health outcomes for children and youth are linked to the types of food environments around schools is also growing (An & Sturm, 2012; Cutumisu et al., 2017; Engler-

Stringer et al., 2014; Matsuzaki et al., 2020; Williams et al., 2014). In addition to area-level socio-demographics, food environments may also be experienced differently by children and youth based on individual-level social identities related to income, gender, age, and race. A recent systematic review explored associations between food environments around schools and body weight by race/ethnicity and socio-economic found greater consistent evidence for associations among racialized students compared to non-racialized students (Matsuzaki et al., 2020). Given that only two studies examining differences by socio-economic advantage were included in the review, evidence of these relationships by socio-economic status are less certain. Kraft et al.'s (2020) recent systematic study exploring associations between neighbourhood food environments and health outcomes in populations with the highest obesity rates in the US noted modest evidence that adverse health outcomes are more strongly associated with convenience store access for Black and Hispanic youth (vs. non-racialized youth) and with fast food access for Black and Hispanic adults and youth (vs. Non-racialized individuals) (Kraft et al., 2020).

2.2.6 Food Environment Policy Options to Support Healthy Dietary Practices

Given the importance of healthy food systems to healthy communities, both planning and public health organizations emphasized the importance of planning for food systems by prioritizing the development of healthy communities (ASPQ, 2011; Einstoss et al., 2015, OPPI, 2011). Furthermore, despite inconsistent findings, both planning and public health researchers have proposed non-traditional interventions that aim to improve the healthfulness of community food environments for children and youth (Cutumisu et al., 2017; Davis & Carpenter, 2009; Day & Pearce, 2011; DuBreck et al., 2018; He et al., 2012; Minaker et al., 2016; L. Seliske et al., 2013). Two types of food planning policy interventions are suggested: 1) those that increase access to sources of healthy food that aim to encourage or enable healthy eating and 2) those that restrict opportunities for unhealthy eating through proxy methods of categorizing unhealthy outlets (i.e., fast food and convenience store) (Ashe et al., 2011; Davis & Carpenter, 2009; He et al., 2012; Minaker et al., 2016; NPLAN, 2011; Sadler et al., 2016).

One example of policies that restrict unhealthy eating includes recommendations for the regulation of the distribution and density of unhealthy food outlets. For example, one restrictive

food planning policy aims to create food environments termed “Healthy Food Zones” through zoning policies that limit fast-food retailers and convenience stores by prohibiting new unhealthy food retailers from opening within a certain distance of schools (NPLAN, 2009). It is important to note that existing restrictive zoning policies include a legacy clause that excludes existing retailers within the intervention area to be exempt from such policies. Héroux et al. (2012) also suggest that youth may benefit from adopting municipal or regional policies that regulate the number of food retailers located within proximity to schools. To date, two public health authorities in two Canadian provinces (York Region, Ontario and Québec City, Québec) have explored and implemented restrictions on new food retailers near secondary schools (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016). Several US cities have also implemented zoning restrictions limiting or restricting fast food outlets in some areas of the city or regulating the proximity between fast food outlets and other sites such as schools or hospitals, including Arden Hills, Minnesota, Detroit, Michigan and Los Angeles, California (Einstoss et al., 2015). In Québec, Canada, several municipalities have adopted by-laws restricting fast-food restaurants in public areas, including around schools (ASPQ, 2011), as was the case in the municipality of Lavaltrie that adopted the motion prohibiting new fast-food restaurants within a 500m radius around schools (Robitaille et al., 2016).

To date, only one analysis of a restrictive food planning policy such as zoning regulation has been evaluated. Sturm & Cohen (2009) evaluated the impact of a fast food retailer (FFR) zoning restriction in an equity-deserving community (racially diverse and low-income) and found no impact on population health outcomes such as obesity and BMI. However, this may be due to the short one-year implementation length of the ordinance and that the ordinance only applied to new free-standing food retailers and excluded restaurants located within a shared space (Sturm & Cohen, 2009). Given this, it was unsurprising that the policy failed to change population-level exposure to FFR (Sturm & Cohen, 2009). To our knowledge to date, no studies have specifically examined such restrictive zoning policies around schools (Downs & Demmler, 2020) or focus on the potential impacts of these policies on equity-deserving communities. A health equity perspective would dictate that impacts of such policies on equity-deserving groups should be prioritized. However, these limitations impede our understanding of the potential impacts of the

proposed food planning policies in school areas for children and youth, and especially those belonging to equity-deserving subgroups.

Food interventions require a high degree of consideration for social equity due to the vulnerable (i.e., youth) or equity-deserving communities (i.e., low-income and racialized) they serve. While both public health and planning are very concerned with health equity, and both have recommended non-traditional interventions to reduce access to junk food, especially for children and youth, the effectiveness of these policies for reducing population-level availability along with the equity implications have not been fully considered.

2.3 Remaining Gaps in Knowledge

The subfield of food systems research is still largely understudied, bringing a set of challenges when conducting new studies. There is a lack of consistency and standardization in the way that food environment exposure is measured which makes it challenging when comparing multiple studies. These inconsistencies include differences in type of food retail exposure, distance and type of buffer, differences in the limits and types of environments as seen in the methodological characteristics presented in this scoping review. For example, some studies only identified chain fast-food outlets as the unhealthy exposure and did not include local or non-chain retailers potentially skewing actual exposure (Seliske et al., 2013). Additionally, studies presented challenges regarding the type of buffer used (i.e., circular vs. network buffer), indicating that road network buffers provide a more accurate representation of the food environment compared to circular buffers (Seliske et al., 2009; Strum, 2008), although a greater percentage of studies included in this review used circular buffers.

Further limitations were presented regarding the lack of true or actual measures used to measure food access. Many of the articles used surveys to collect self-reported data on behaviour or GIS to create proxy environments, however there can be bias associated with these methods that may differ from actual exposure (Forsyth et al., 2012; He et al., 2012). Additionally, use of purchasing behaviour may be less reliable than consumption or dietary intake to determine actual exposure. Lastly, it can be difficult to ensure accuracy of data such as food retailer locations for

two reasons: 1) due to the volatility of the food retail industry, the food environment when the data was collected versus when the article is published or read may have changed and 2) human errors and GIS in datasets can occur resulting in inaccuracies.

Strengths reported in the studies include those that take a cross-national perspective (Hêroux et al., 2012), or examine various types of food environments (i.e., home neighbourhood environments vs. school food environments) (Forsyth et al., 2012). These studies aim to identify differences in associations to food environment exposure among different communities or countries. This is important as there are innate differences among populations, which may need to address the issue in other ways. Additionally, extant research on food environments and health often lacks a large diverse population sample size (i.e., race/ethnicity, SES) as this provides a greater accuracy with findings as well as provide the opportunity to identify potential social inequities that need to be addressed. Existing literature does not address or provide considerations for the ethical implications associated with the proposed restrictive planning policies and is warranted. Lastly, studies presented a preference for GPS technologies to be used to obtain a more accurate measure of food access, as there are biases associated with self-reporting.

2.4 Recommendation for Future Research

The results of this literature review have identified recommendations for future research examining associations between community and consumer food environments and youth's diet. While this research varies among methodology and measured outcomes, some key recommendations for improving consistencies between studies or best practice have been identified including the use of sidewalk or road network buffer analysis over circular (i.e., radius) buffers as network buffers provide a more accurate representation of the environment (Seliske et al., 2009). In addition, future research should examine actual measures of food access within food environments rather than proxy measures such as self-reporting or purchasing behaviour (Shearer et al., 2015). Furthermore, as suggested by Davis & Carpenter (2009), future research should focus on the impact of these restrictive zoning policies provided in the recommendations for planning practice on vulnerable or marginalized communities and populations. Prior to the implementation of any of these policies, additional research, and analysis (i.e., gender-based analysis+) is required to understand the

potential unintended impacts of such policies on low SES or high deprivation communities. Lastly, planning research must identify whether such a policy would reduce exposure to unhealthy food environments and if not, question whether this policy should be reconsidered.

2.5 Research Objectives and Questions

As noted in Chapter 1, this study is driven by the following four research objectives that will address existing gaps identified in the literature review to positively contribute to food planning literature and expand planning practice within the context of the Region of Waterloo, ON:

1. To examine the extent to which the food environment around schools would change under various policy types and distances after 10 years in the Region of Waterloo.
2. To examine how the current and projected state of school-neighbourhood food environments may differ based on various markers of equity at the school-level in the Region of Waterloo.
3. To explore the health equity considerations and potential unintended consequences for the implementation of restrictive planning policies around schools.
4. To conceptualize and recommend how planning can continue to support healthy equity initiatives and considerations for planners and municipalities interested in exploring and implementing similar food planning policies.

These research objectives will be realized through specific sub-questions that are addressed through the following two manuscripts:

- **Manuscript 1, Chapter 4: Healthy Food Zones Around Schools: Evaluating Projected Impacts of a Restrictive Food Planning Policy**
    1. How would high school students' food environment availability be projected to change during the school day if restrictive food planning policies (restricting fast food and convenience stores from opening around schools) were implemented in the Region of Waterloo, Ontario?"
- **Manuscript 2: Chapter 5: Junk Food Availability after 10 years of a Restrictive Food Environment Zoning Policy around Schools: An Equity-focused Simulation Study**

2. “How does current food environment availability differ by the proportion of students at schools identifying as low-income, EAL and newcomer status in secondary schools in the Region of Waterloo, Ontario?”
3. “How would projected changes in food environment availability after 10 years of restrictive policy implementation differ by these social identity groups?”

Chapter 3
Research Method Overview

3.1 Introduction

This chapter describes the research approach undertaken in this study to examine how food environments around schools may change based on various policy types and across markers of equity in the Region of Waterloo, Ontario. A postpositivist and transformative quantitative approach was used to guide the research and methodological approach through the duration of this study, with the aim of this thesis to contribute a health equity perspective to the extant body of literature. An overview of research design and data collection are presented in the research method section along with discussion on methods of analysis used to address the research objectives and subsequent research questions in each manuscript. Next, strengths and limitations, including ethical implications of the research are provided, backed with discussion of the efforts taken to address personal biases, and my position as a racialized women of colour conducting this research and concludes with highlights of the strengths of this study.

As previously mentioned, the research objectives are: 1) To examine the extent to which the food environment around schools would change under various policy types and distances after 10 years in the Region of Waterloo; 2) To examine how the current and projected state of school-neighbourhood food environments may differ based on various markers of equity at the school-level in the Region of Waterloo; 3) To explore the equity implications and potential unintended consequences for the implementation of restrictive planning policies around schools, and 4) To conceptualize and recommend how planning can continue to support health equity initiatives and considerations for planners and municipalities interested in exploring and implementing similar food planning policies

3.2 Philosophical Paradigms and Perspectives

3.2.1 Guiding Philosophical Paradigms

Philosophical worldviews, also known as paradigms, epistemologies and ontologies, in this instance refers to “a basic set of belief that guide action” (Creswell & Creswell, 2018). These worldviews are developed based on different sources that provide a general philosophical

orientation of the world including discipline orientations and research communities, advisors and mentors and past research experiences (Creswell & Creswell, 2018). Further, Farthing (2016) describes the need to make assumptions of what the social world is, often based on the sources mentioned above, before you begin to conduct the research. In recent year, planning academic has shifted outcome priorities to "achieving certain environmental and social goals rather than on research and theory building" (Farthing, 2016, p.16), evidenced by this study and complementary existing literature.

3.2.2 The Post-positivism Worldview

Creswell & Creswell (2018) describes the post-positivism worldview as one that "challenges the traditional notion of the absolute truth of knowledge and recognizes that we cannot be absolutely positive about our claims of knowledge when studying the behaviour and actions of humans" (p.44). Positivists are interested in which causes may determine effects or outcomes; thus, research reflects the need to identify and assess causes that impact outcomes, often reduced into a small, discrete set to test such as research questions. This is reflected in this research through the examination of the Region of Waterloo, Ontario as a case study of a mid-sized city. Postpositivist perspectives assume that "research is the process of making claims and then refining or abandoning some of them for other claims more strongly warranted" (p.45), in this case, interpreted as the understanding that research always imperfect and fallible (Creswell & Creswell, 2018). This is appropriate given the paradigm shift behind the role and impact of planning on cities from an activity undertaken to re-design ideal cities to a universal process in which urban planners were only one aspect (Farthing, 2016).

Another key idea associated with the postpositivist worldview is the need for the awareness of values upheld by the researcher, as these values drive and shape the research process and ultimately the use made of research findings (Farthing, 2016). The broad research topic, and identification of a precise problem are identified by the researcher in the early stages largely derived from values, and other external sources of interest. Given this, planning research is inherently political in the sense that there are different ways of framing or conceptualising research

(Farthing, 2016), shaping the anticipated outcomes, and how research outcomes may impact the problem.

Often quantitative research follows a positivist worldview due to the use of numerical data while qualitative research is seen as post-positivist as it is more interpretive. Although this research employs a quantitative research approach, this thesis is large driven by a post-positivist view recognizing that as a researcher, assumptions have been made throughout this research process that directly impacts the findings and outcomes of this thesis. Furthermore, this research takes a post-positivist view given that while this research took a quantitative methods approach, the findings and outcomes are not the absolute truth and findings are largely dependent on the context of the research and research methods taken to carry out this thesis and that as the context and assumptions change around this topic, so will the outcomes. This is especially true given that existing food environments may vary greatly at a national, provincial, and local level and that the research conducted within the context of the Region of Waterloo may not be indicative of the reality across other geographies.

3.2.3 The Transformative Worldview

The transformative worldview arose during the 1980s, challenging the postpositivist assumptions imposing structural laws and theories that excluded marginalized individuals or issues of power and social justice that should be addressed (Creswell & Creswell, 2018). This worldview consists of a groups of researchers who are likely to be impacted by systemic discrimination and oppression and those who felt that existing worldviews did not go far enough in advocating for actions that positively impact marginalized peoples including but not limited to feminists; racial and ethnic minorities; Indigenous and postcolonial peoples and members of the LGBTQ+ community (Creswell & Creswell, 2018). A transformative worldview asserts that research inquiry must account for politics and a political change agenda a as means of confronting social oppression and inequality (Creswell & Creswell, 2018), and therefore focuses predominantly on the needs of equity-deserving groups and individuals in our society. Key features of the transformative worldviews includes the central importance places on the study of lives of diverse equity-deserving groups that have traditionally been marginalized, focusing on inequities based on but not limited

to gender, race/ethnicity and socioeconomic class that result in power imbalances among relationships (Creswell & Creswell, 2018).

This research takes a transformative worldview as it directly focuses on equity-deserving groups by examining how different school-level markers of equity (i.e., income, English as a additional language and newcomer status) are differently associated outcomes in accessibility from this policy. This research challenges the assumption that individuals are solely responsible for their health and presents the built environments as a contribute to social injustice with the understanding that factors of systemic oppression present barriers to access of healthy food options for equity-deserving youth. This research directly focuses on the inequity in access to unhealthy food options experience by equity-deserving groups, highlighting the potential perpetuation of this inequity through the implementation of planning policy.

3.2.4 Health Equity Perspective and Adapted Harm Reduction Model

As noted in Chapter 2, health equity is of the utmost important for public health practitioners, requiring the reduction of unnecessary and avoidable differences among populations that are unfair and unjust (Public Health Ontario, 2020). As Farthing (2016) noted, some researchers argue that practicing planners have not spent sufficient time conducting research on the impacts of their policies or using research-based evidence "to develop or justify their policies though they ought to do so" (p. 15). Further, there is often a knowledge gap between what is produced by research in universities and the needs of practicing professionals, and there is more to professional planning practice beyond scientific results (Farthing, 2016). In the case of this study, public health practitioners and health researchers have recommended the use of restrictive food planning policies such as zoning by-laws to limit to availability, density, and proximity of unhealthy food outlets around secondary schools as a solution to the growing rate of adverse health outcomes (i.e., obesity) in youth, however, little planning related research has been conducted on the feasibility of implementing such policies, the potential unintended impact on communities or whether this recommendation would be effective at improving health outcomes among youth. This study embodies the transformative worldview, as a woman of colour myself, placing emphasis on equity-deserving youth and choosing to take a different approach than the traditional cause and effect

relationship for one to give attention to the social meanings and interpretations of the world (Farthing, 2016).

This study aims to simulate the potential effects of the implementation of restrictive food planning policies around secondary schools in a mid-sized city as an extension of the harm reduction model, often used in social work as an evidence-based client-centered approach to reduce the health and social harms of individuals (Pires et al., 2007). While advocacy planning theory is described as a progressive planning theory, beyond advocacy there is the need to conduct due diligence on the impacts of planning plans and policies on communities with the deep understanding that communities may experience planning decisions differently based on systemic oppressors and demographic characteristics. It is critical that planners consider the potential unintended consequences planning decisions may have on those that have been traditionally and historically disenfranchised such as equity-deserving communities. Adapting a harm reduction model to urban planning provides a framework in which planners examine a particular issue from different perspectives, for example, public health and urban planning while explicitly considering the potential impacts of equity-deserving communities from a social equity perspective.

3.3 Research Design: A Cross-Sectional Quantitative Ecological Simulation Design Approach

This thesis was undertaken using a quantitative, ecological, simulation study approach to provide projected simulations of food environments around schools after the implementation of various restrictive food planning policies. This study examines food environments around schools over time, so although the available data presents a cross-sectional observation of the current food environment, the research described in this thesis uses the popular demography model of population projection to simulate the potential impacts of restrictive food planning policies on food environments around schools over time. This research design approach includes popular demography models and school-level equity data to explore more complex relationships. Therefore, while this study relies on cross-sectional data, through the analysis it provides a longitudinal perspective of the impact of food planning policies after 10 years. In addition, this research provides a model for which municipalities can replicate using their unique restaurant, key

business statistics, and demographic data to project how food environments may change within their communities.

This research approach does have limitations given that municipalities across Ontario and within Canada are not homogenous, and characteristics of food environments and student demographic characteristics may not apply to the general population. Therefore, although this research presents key insights to potential changes in food environments after the implementation of restrictive food planning policies, modeling these potential changes is limited to the type and quality of the data available. Furthermore, discussions of ethical implications in this study are based on inferences based on academic knowledge and personal experience rather than concerns that have been voiced by members of the public and should be acknowledged as assumptions. Additional research is warranted to better understand how these policies will impact equity-deserving communities and those who already experience poorer food environments. Sections 3.4.1 and 3.4.2 will provide an overview and justification of the research methods employed for each manuscript and includes a summary of data collection, data analysis and assumptions made while undertaking this research. The following Section 3.4 provides a high-level overview while Chapter 4 and 5 provide a more detailed description of methods used to answer research objective and questions.

3.3.1 Strengths and Limitations

This study is the first to my knowledge utilize a quantitative approach and popular demography projection models to simulate changes within food environments after a restrictive zoning policy. To date, no studies to date have explored how such food planning policies may change availability for an intervention period of longer than one year. This study is one of few that simulates the potential impacts of implementing such food planning policy options within and across policy type and distance, addressing gaps due to a lack of research examining various types of food planning policy interventions. The model created for this study is one that can be replicated using unique municipal data on food retailers to provide a projection of how food environments may change between different areas, communities, or municipalities. Given the quantitative nature of this research, this study can be replicated across other Regions or municipalities to test for

generalizability of these findings and outcomes. Further, standard spatial analysis methods and road network analysis were used, providing consistency with previously used socio-spatial analysis techniques in ArcGIS.

Another limitation of this study was the timing and the impact of COVID-19 on the retail food industry. Due to the timing of this research and when the food retailer data was collected and cleaned (prior to the COVID-19 pandemic), the possible economic impacts of COVID-19 on the retail food industry that may have resulted in retailers closing permanently are not captured in this study. Further research on food environments around school's post-pandemic is warranted, as the data collected before COVID-19 may not reflect current food environments. As previously mentioned in the literature review, there is little consistency with the categorization of food retailers and subsequent datasets, bringing challenges when comparing methods and outcomes across studies.

3.4 Research Methods

3.4.1 Manuscript 1: Chapter 4: Healthy Food Zones Around Schools: Evaluating Projected Impacts of a Restrictive Food Planning Policy

This manuscript used secondary data from the Human Environments Analysis Laboratory at the University of Western Ontario on retailer type and location in the Region of Waterloo and other secondary sources including school-level data and key business data from Government of Ontario and Statistics Canada respectively, to examine how food environments around schools may change under various types and distances of restrictive food planning policies over 10 years in the Region of Waterloo, Ontario.

3.4.1.1 Data Sources

School Type and geocoded *Location* data were retrieved from the Government on Ontario School Information and Student Demographics (Gov. on Ontario, 2019). For this study, *School Type* included public and Catholic secondary schools, consisting of grades 9 – 12 (approximately ages 14 – 18 years). There were 25 secondary schools within the Region of Waterloo, 18 were from the Waterloo Region District School Board, five from the Waterloo Catholic District School Board, and two private catholic schools. At the time of this research, of the 25 schools, 22 had

data on all variables of interest and were included in the current study. *Retail Food Type* and geocoded *Location* data were retrieved from the Human Environments Analysis Lab (HEAL) at the University of Western Ontario from public health inspection data that were cleaned and compiled before the COVID-19 pandemic (therefore, not accounting for retail food closures related to the COVID-19 pandemic in the current study). *Retail Food Type* included: Fast Food Retailers, Convenience Store, Restaurants and Grocery Stores. This study included only Fast-Food Retailers (FFR) and Convenience Stores (CS) as "less healthy food retail outlets" following Ontario Public Health Standards' report on calculating access to different food sources (Gov. of Ontario, 2019), and as evidenced by existing research further justified in Chapter 4. Business survival rates used for the population projection model were derived from key business statistics from Statistics Canada (Statistics Canada, 2019). Lastly, The Region of Waterloo Road Network (v2019.3) was retrieved from DMTI Spatial Inc. (2019).

3.4.1.2 Methodological Approach

3.4.1.2.1 Planning Policy Scenarios

This study compares various food planning policy scenarios that have been explored and recommended within existing literature to examine how availability to fast-food retailers and convenience stores may change around schools over 10 years. Unhealthy food availability (defined as the number of outlets within each buffer) was calculated for two different policy features: buffer type (Euclidean vs. Network) and buffer distance (800m vs 1km), given the fact that most proposed restrictive food retail policies focus on these two types of buffers and distances as proxies when measuring food environments (Austin et al., 2005; Cutumisu et al., 2017; Davis & Carpenter, 2009; Day & Pearce, 2011; DuBreck et al., 2018; Forsyth et al., 2012; He et al., 2012; Héroux et al., 2012; Sadler et al., 2016; L. Seliske et al., 2013). Each policy examined various Retail Food Environment (RFE) Community Contexts: specifically, a "Young" RFE, an "Average" RFE, and an "Old" RFE (described in detail below), given that (like human death rates), business death rates are linked to their age. For example, a recently opened establishment has approximately a 95% survival rate for the year (5% death rate), while a business that has been open for seven years has approximately a 53% survival rate (47% death rate) for the

year (Government of Canada, 2019). As noted above, all policy scenarios assume any new policy contains a legacy clause for existing food retailers.

3.4.1.3 Methods of Analysis

3.4.1.3.1 Geographic Information Systems

Geographic Information Systems (GIS) is a typical method of measuring density and proximity to characterize attributes of food environments (Charreire et al., 2010). The majority of studies examining food environments are cross-sectional and use GIS as part of their methodology (Cutumisu et al., 2017; Day & Pearce, 2011; He et al., 2012; Sadler et al., 2016; L. M. Seliske et al., 2009; Shareck et al., 2018). Spatial analysis tools on ArcMap (version 10.8.1) were used to identify all fast-food restaurants and convenience stores on or within the buffer areas for both the Euclidean and Network buffer.

3.4.1.3.2 Community Population Projection Using Life Tables

Life tables (a popular demographic projection method) and population projection models were created for each RFE age-composition scenario (Young, Average, Old) to project the total number of unhealthy food outlets within the intervention area (identified by Euclidean and Network buffers) in potential policy scenarios over 10 years given average business survival rates by age. In no-policy scenarios, a standard population projection model was conducted, calculated using the average business death rates and birth date by year over 10 years of the service-producing sector in Canada (Gov. of Canada, 2019). Calculations of all policy scenarios used a modified population projection model excluding birth rate to account for the implementation of the policy (including the legacy clause). Further, assuming a 1km Euclidean distance as the threshold of the school-neighbourhood environment and a distance students could walk during their lunch period, the total FFR/CS at 10 years under each policy scenario was calculated within a 1km Euclidean distance. This study uses availability as an appropriate measurement over time as a key performance indicator, defined by the Ontario Public Health Standards (OPHS) as the presence, count and density of food retailers within a defined geographical space (i.e., 800m buffer) around secondary schools (Butler et al., 2019; Engler-Stringer et al., 2014; Mahendra et al., 2017)

3.4.2 Manuscript 2: Chapter 5: Junk Food Accessibility after 10 years of a Restrictive Food Environment Zoning Policy Around Schools: An Equity Focused Simulation Study

This manuscript used data from Chapter 4 with the addition of secondary school-level demographic data to examine the current and projected state of food environments around schools based on proportions of equity-deserving students over 10 years in the Region of Waterloo, Ontario.

3.4.2.1 Data Sources

This study utilized the existing data used in Chapter 4 with the addition of school-level demographic data on the proportions of equity-deserving students attending each school from the Government of Ontario School Information and Student Demographics (Gov. of Ontario, 2019). For this study, *school-level demographic* data included the percentage of students: 1) living in low-income households, 2) whose first language is not English (EAL), and 3) who are new to Canada from a non-English speaking country (Non-English Immigrant) within each school. Of the 25 Public and Catholic secondary schools in the Waterloo Region, 22 had data on the proportion of low-income households and EAL students, while 17 had data on all variables of interest and were included in the current study based on data availability. The analyses of school-level equity, therefore, rely on the 17 schools with complete data. It is important to note at the time of this study, descriptive demographic data is presented at the school or area-level, therefore, limiting our understanding of the composition of students (i.e., students that may overlap between multiple markers of equity).

3.4.2.2 Methodological Approach

3.4.2.2.1 Equity-Deserving Subgroups

Given the importance of understanding how new policies may negatively impact equity-deserving communities and the current literature on inequities in food access, we examine how the current potential food environment exposures differ based on the proportion of students: 1) living in low-income households, 2) whose first language is not English (EAL) and 3) who are newcomers to Canada. These variables are measures of demographic characteristics in the existing literature and are often associated with equity-deserving populations. Data on equity-deserving groups was very limited, and therefore the subgroups were chosen due to the demographic data that was available,

as most of available data was regarding education. EAL is distinguished from newcomers due to the differences in lived experience between these two groups. Newcomers to Canada represents a group that is first generation immigrants, and their unique experience with the healthy immigrant effect as they (Lu & Ng, 2019), whereas EAL learners might be second generation immigrant, the children of the newcomers. It must be noted that demographic research in schools is predominantly presented at the school or area-level, limiting our understanding of the intersectionality of youth at the individual-level, for example, the percentage of students that may fall into one or more of the equity-deserving markers accounted for.

3.4.2.2.2 School-Level Equity Categories

Schools were categorized for the purpose of two different analyses: 1) into low and high equity groups for each individual variable (income, EAL, and newcomer) by dichotomizing each variable at the median. Low Equity schools were those with an above the median proportion of low income, EAL, or newcomer students, whereas High Equity schools were those with a below the median proportion of students in each category. Schools were further categorized into low-equity, medium-equity and high-equity categorized based on the proportion of high equity-deserving students within each marker of equity in each school (i.e., above the median within each variable). For example, low-equity schools were above the median on all three variables, medium- equity school has 1-2 variables above the median and high-equity schools had all three variables below the median. This second categorization was created with the consideration that some students may identify with more than one marker of equity, however the current method of data collection and analysis fails to consider the potential intersecting identities of equity-deserving youth.

3.4.2.3 Methods of Analysis

3.4.2.3.1 Spatial Analysis of Food Environments

Similar to other studies examining food environments with Geographic Information Systems (GIS) (Charreire et al., 2010; Cutumisu et al., 2017; Seliske et al., 2009), this study used spatial analysis to determine the availability of unhealthy food outlets that characterize food environments. All FFR and CS on or within the Euclidean buffer area were identified, indicating “unhealthy” food

retailers within the buffer at both 800m and 1km. A road network analysis was conducted to determine the road network distance of 800m and 1km to identify FFR and CS on or within the road network buffer. The total FFR and CS within each buffer type and distance represent the current number of unhealthy food retailers around each school.

3.4.2.3.2 Policy Projection by School Equity Level

Similar to Section 3.3.1.3.2, this manuscript uses population projection models to examine how the community population of unhealthy food outlets around schools differing by markers of equity may change with the implementation of a restrictive food planning policy over 10 years. In our policy scenarios, calculations used a modified population projection model that excludes birth rate to account for the fact that no new FFR or CS would open within the policy area, recognizing that existing business would continue operating (given the legacy clause). These projections were separated by school equity level to determine how the proposed restrictive food planning policies would impact food environments around schools of different perceived levels of equity, providing insights whether this policy would be effective at improving equity among food environments centered around equity-deserving youth.

3.5 Ethical Considerations, Limitations and Strengths of Study

3.5.1 Ethical Considerations

Ethics approval from the University of Waterloo was not necessary for this study given that secondary data was used, however, ethical implications of this study were considered from the onset with the understanding that the outcomes from this research may be provided as evidence in a future use case. This thesis was designed with intent to provide insights into the future of an emerging food planning policy as a solution to a "real world problem" (i.e., poor food environments for students) that has the potential to impact communities at a local and national scale (Farthing, 2016). This research is also meant to emphasize the importance of actively considering the potential unintended consequences of recommended restrictive food planning policies, including how it may impact equity-deserving communities with the hopes of highlighting Flyvbjerg's (2004) questions of *phronetic planning research*: "Where are we going with planning? Who gains and loses, and by which mechanisms of power? Is this development desirable? What, if anything, should we do about it?" (Farthing, 2016, p.186). Urban planners

would be remiss to ignore the inequitable distributions of power within society and the impacts of systemic oppressors as it relates to planning research potentially limiting our understanding of reality. This research seeks to provide insight to these questions through a

3.5.2 Limitations of Study

At the same time, it is important to address the limitations of the research and of this study. The food retail landscape is rather volatile, making it difficult to assume to failure rate of food outlets. Moreover, there were no local data on food retailer failure rates, so we used the national industry averages. The food retailer data was collected before the COVID-19 pandemic, which severely impacted the food retail industry due to the ongoing lockdowns, resulting in potential undocumented changes to the food landscape.

Another notable limitation to this study was the current data available and the method of which it is presented at the school-level. While this data focuses on a health equity perspective, it does not provide a true intersectional perspective on this issue. Current school-level demographic data fails to demonstrate the intersectionality of students as individuals, and specifically in the case of this study, provide insights regarding the proportion of students that overlap between equity variables. This limits our understanding of the individual-level impacts of such policies and fails to address the intersectionality of individuals who may experience various types of oppression.

3.5.3 Strengths of Study

This study is among the first to examine the potential impacts of these types of recommended food planning policies, and to incorporate a public health recommendation from a planning and health equity perspective. This study aims to demonstrate how planning research can support professional practice and help to mitigate the knowledge gap between research and practice. Furthermore, this study discusses the ethical implications of a restrictive food planning policy as part of the potential unintended consequences of these policies on equity-deserving youth and communities and discusses the implications for both urban planning and public health. Lastly, this study addresses the knowledge gap between public health and planning research and practice by increasing the research-based evidence on the use of food planning policies as a solution for adverse health outcomes among youth.

Chapter 4
Healthy Food Zones Around Schools: Evaluating Projected impacts of a Restrictive Food Planning Policy

4.1 Introduction

Dietary risks currently comprise the largest global burden of morbidity and mortality (Afshin et al., 2019). In Canada, diet quality is the poorest among youth ages 14 – 18 (Garriguet, 2009). Furthermore, youth quickly develop eating patterns that can track into adulthood and throughout their lives (Lien et al., 2001; Nelson et al., 2008). At the same time, our understanding of dietary behaviours as situated within economic and physical contexts has grown, and recognition of the importance of these environmental determinants of diet has similarly grown, particularly around health and the built environment. The availability and accessibility of foods within the built environment influencing eating behaviours have been a demonstrated predictor of healthy behaviours, including dietary behaviours (Gebremariam et al., 2017). In 2019, a scoping review conducted on the relations between urban form and health in Canada found that food environment features, such as proximity to and density of healthy and unhealthy food retailers, were significantly associated with a range of health outcomes (McCormack et al., 2019).

Furthermore, the review found that proximity and access to fast food were associated with mortality, depression, cardiovascular conditions, and weight status (McCormack et al., 2019). Another systematic review assessing the evidence for the link between retail food environment, diet quality and BMI in Canada found little evidence of a food environment – diet quality relationship and modest evidence of a food environment-BMI relationship (Stevenson et al., 2019). Overall, relative measures of the food environment derived in geographic information systems are more strongly associated with diet-related health outcomes. However, there is no consensus on the 'best practice' food outlet database or method of validating these databases (Stevenson et al., 2019).

Of the studies conducted on associations between organizational food environments (i.e., home, in-school, lunch programs) or informational food environments (i.e., menus, food advertising) and youth diet and health outcomes, few have focused on community food

environments that children and youth often frequent including residential- and school-neighbourhood food environments (Gebremariam et al., 2017). Students spend at least 6 hours at school and typically eat at least one meal a day outside of their home. Therefore, community food environments around schools have the potential to impact youth eating behaviours and health outcomes. In 2013, Engler-Stringer et al. conducted a systematic review of literature on community and consumer food environment and children's diet due to the lack of a published comprehensive review to date that evaluated food environments outside of home and school and the relationship with diet in children. Of the 26 eligible studies, 22 showed at least one positive association between the food environment exposure and diet outcome, while four studies reported only null associations (Engler-Stringer, Le, Gerrard, & Muhajarine, 2014).

A more recent systematic review on the presence of retail food establishments around schools and overweight in students concluded of 31 articles, 18 found a direct association between proximity or density of establishments (mainly fast-food restaurants, convenience stores and grocery stores) around schools and overweight and obesity in children and adolescents (da Costa Peres et al., 2020). Fourteen papers found no association, and four papers presented inverse association suggesting inconsistencies among findings (da Costa Peres et al., 2020). One study that has spurred policy action investigated the association between junk food consumption at lunchtime and fast-food outlet access near school among secondary-school children in Quebec, Canada (Cutumisu et al., 2017). Cutumisu et al. (2017) dichotomized school access to a fast-food outlet as 'low access' (0 or 1 food outlet) and 'high access' (2 or more food outlets) and found 41.2% of schools had access to two or more fast-food outlets within 750m, suggesting a high level of exposure (Cutumisu et al., 2017). Further, this study concluded that exposure to two or more fast-food outlets within a radius of 750m around schools was associated with a higher likelihood of consuming junk food at lunch after controlling for student, family, and school characteristics (Cutumisu et al., 2017). Although many studies have identified positive associations between food environment exposures and diet outcome, findings between studies remain inconsistent. One possible reason may be the lack of consistency of how food environments are measured and categorized, leading to difficulties when comparing studies.

Despite inconsistent findings, several researchers recommend that municipalities consider "non-traditional dietary interventions" to improve community food environments for children and youth (Cutumisu et al., 2017; Davis & Carpenter, 2009; Day & Pearce, 2011; DuBreck et al., 2018; He et al., 2012; Héroux et al., 2012; L. Seliske et al., 2013; L. M. Seliske et al., 2008; Shareck et al., 2018; Shearer et al., 2015). Among the non-traditional dietary interventions, urban planning strategies to improve food environments have emerged as a popular idea, especially among public health scholars (DuBreck et al., 2018; Minaker et al., 2016; Forsyth et al., 2012). Two different types of food planning policy interventions are suggested: those that encourage or enable healthy eating by increasing access to sources of healthy food and those that restrict opportunities for unhealthy eating (for example, in fast food outlets and convenience stores) (Minaker et al., 2016; Ashe, Graff & Spector, 2011; NPLAN, 2009; Davis & Carpenter, 2009; Sadler et al., 2016; He et al., 2012). Examples of policies that restrict unhealthy eating include recommendations to improve community food environments for children and youth by regulating the distribution and density of unhealthy food retailers.

One such restrictive policy describes the use of zoning policies to limit fast-food retailers and convenience stores by prohibiting new unhealthy food retailers from opening within a certain distance of schools to create food environments termed "Healthy Food Zones" (NPLAN, 2009). Héroux et al. (2012) suggest that youth may benefit from adopting municipal or regional policies that regulate the number of food retailers located within proximity of schools. Public health authorities in two Canadian provinces (York Region, Ontario and Québec City, Québec) have explored and have implemented restrictions on new food outlets near secondary schools (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016). Furthermore, there are several examples of US cities that have implemented zoning restrictions to limit or ban fast food outlets in some regions of a city or regulate the distance between fast food outlets and other sites such as schools or hospitals, including Arden Hills, Minnesota, Detroit, Michigan and Los Angeles, California (Einstoss et al., 2015). In 2010, several municipalities in Québec adopted a bylaw restricting fast-food restaurants in public areas, including around schools (ASPQ, 2011). Shortly after, the municipality of Lavaltrie adopted the motion prohibiting the establishment of fast-food restaurants

within a 500m radius around schools (Robitaille et al., 2016). Since then, other Québec municipalities have sought to limit students' access to unhealthy food.

To date, no studies have examined the impacts of restrictive food environment policy around schools or whether such a policy would be effective, and only one study (Strum & Cohen, 2009) evaluated the impact of a fast-food (FF) ban. Although not focused on youth, this well-cited study evaluated the impact of an FF outlet zoning restriction and found no impact on population health outcomes (including obesity and BMI). This was likely due (at least in part) to the fact that the policy did not change population-level exposures to fast food outlets due to the short implementation length of the one-year ordinance, which only limited new drive-through windows, new stand-alone fast-food restaurants or expanding floor space (Strum & Cohen, 2009). Notably not subject to regulation were restaurants located within existing buildings (i.e., strip malls) (Strum & Cohen, 2009).

Research on the impacts of the built environment on diet and health outcomes is still vastly understudied, especially for vulnerable populations such as children and youth. As noted, a lack of consistency of methodology when measuring food availability contributes to challenges when conducting new studies or comparing existing literature. These inconsistencies include differences in the type of retail food definitions, distance and type of buffer, and the method of measuring access to less healthy food retail outlets (Gov. of Ontario, 2019). First, some studies only identified fast-food chain outlets as harmful exposure and did not include local or non-chain retailers, potentially skewing actual exposure (Seliske et al., 2013). Second, studies were inconsistent in terms of both the type of buffer considered (i.e., circular vs. network buffer) (Day & Pearce, 2011; He et al., 2012; Seliske et al., 2008; Shareck et al., 2018) and buffer size (400m-5km) (Day & Pearce, 2011; Seliske et al., 2008). Third, it can be difficult to ensure accuracy of data such as food retailer locations for two reasons: 1) due to the volatility of the food retail industry, the food environment when the data was collected versus when the article is published or read may have changed and 2) human errors and GIS in datasets can occur resulting in inaccuracies.

In the most recent scoping review examining food environment interventions targeting children and adolescents, Down & Demmler (2020) examine interventions ranging from organizational (in-school interventions) to external food environment interventions in community settings (menu labelling or in-store interventions) and conclude that the majority of food environment interventions to date have been in school rather than community settings. Further, this scoping review fails to identify any studies examining the potential impacts of food planning policies such as zoning restrictions or a fast-food ban on reducing the availability of unhealthy food retailers to youth. No studies to date have explored the anticipated effects of different types of restrictive food environment policies around schools over an extended period (more than one year). This is important, given the recent and increasing number of proposals by governments and public health organizations to limit youth access to unhealthy food sources (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016; NPLAN, 2009). This study aims to address these gaps by answering the question: "How would high school students' food environment availability be projected to change during the school day if restrictive food planning policies (restricting fast food and convenience stores from opening around schools) were implemented?" We use standard demographic projection methods (life tables) to examine differences in projected food environment availability by different policy options such as type of buffer and distance (an 800m vs. 1km buffer policy; a network-distance vs. Euclidean distance buffer policy) and different community contexts (reflecting different age compositions of the food retailers) over ten years.

4.2 Methodology

4.2.1 Study Area

This Region of Waterloo, Ontario, Canada, is used as a case study. The Region of Waterloo is an upper-tier municipality with a population of 617,870 as of 2019 (RoW, 2020) and is comprised of three urban (Waterloo, Kitchener, Cambridge) and four rural (North Dumfries, Woolwich, WellEALey and Wilmot) second-tier municipalities. There are 25 high schools in the Region of Waterloo (23 urban high schools and two rural high schools), and approximately 27,535 students in the Region of Waterloo attended high school in 2019- 2020 (Government of Ontario, 2020). The Region of Waterloo has been the subject of other food systems planning research and has identified the government's role in food system policymaking to improve access to healthy foods

(Wegener, Raine & Hanning, 2012), offering the potential for synergies with the proposed food planning policies.

4.2.2 Data Sources

4.2.2.1 School-level Data

School Type and geocoded *Location* data were retrieved from the Government on Ontario School Information and Student Demographics (Gov. on Ontario, 2019). For this study, *School Type* included public and Catholic secondary schools, consisting of grades 9 – 12 (approximately ages 14 – 18 years). We selected secondary school selection due to the likelihood that these schools would have policies that allow students to leave school property during lunchtimes, while this policy is less likely in Middle or Elementary schools. There were 25 secondary schools within the Region of Waterloo, 18 were from the Waterloo Region District School Board, five from the Waterloo Catholic District School Board, and two private catholic schools. Of the 25 schools, 22 had data on all variables of interest and were included in the current study.

4.2.2.2 Food Retailer-level Data

Retail Food Type and geocoded *Location* data were retrieved from the Human Environments Analysis Lab (HEAL) at the University of Western Ontario from public health inspection data that were cleaned and compiled before the COVID-19 pandemic (therefore, not accounting for retail food closures related to the COVID-19 pandemic in the current study). *Retail Food Type* included: Fast Food Retailers, Convenience Store, Restaurants and Grocery Stores. This study included only Fast-Food Retailers and Convenience Stores as "less healthy food retail outlets" following Ontario Public Health Standards' report on calculating access to different food sources (Gov. of Ontario, 2019), and given the fact that most proposed restrictive food retail policies focus on these two types of retailers (Austin et al., 2005; Cutumisu et al., 2017; Davis & Carpenter, 2009; Day & Pearce, 2011; DuBreck et al., 2018; Forsyth et al., 2012; He et al., 2012; Héroux et al., 2012; Sadler et al., 2016; L. Seliske et al., 2013). While imperfect in terms of accurately assessing availability to non-nutritious foods, these categorizations are standard practice in the food environment literature to date (Moudon et al., 2013; Lind et al., 2016). According to the North American Industry Classification System (NAICS) Canada 2012, fast-food restaurants (FFR) are establishments primarily engaged in providing over-the-counter food services to patrons who pay

before eating (StatsCan, 2018). These establishments may offer a variety of food items, specialty snacks and non-alcoholic beverages. Alternatively, convenience stores (CS) are defined as establishments primarily engaged in retailing a limited line of items, including soft drinks, snacks, and limited general food items such as bread and milk (StatsCan, 2018). This study excluded full-service restaurants due to the lack of time students would have to purchase and consume lunch from a full-service restaurant during relatively brief lunch periods.

4.2.2.3 Business Survival Rates

We assumed that any new food planning policy would contain a legacy clause for existing food businesses (similar to existing policies) (NPLAN, 2009). This legacy clause would exempt existing FFR and CS from the policy and prohibit new FFR and CS from opening within the designated policy area.

Every year, the *national average of new restaurants for the service-producing sector* was retrieved from Statistics Canada to determine restaurants' "birth rate" by year over 10 years (Government of Canada, 2019). This study assumed the average birth rate of 8.9% for enterprises with more than one employee within the service-producing sector from 2005 to 2015 (Statistics Canada, 2019).

This study uses *Business survival rates year over year* to develop the restaurant "death rate" over 10 years and retrieved from Statistics Canada (Government of Canada, 2019). Like human death rates, business death rates are linked to age. For example, a recently opened establishment has approximately a 95% survival rate for the year (5% death rate), while a business that has been open for seven years has approximately a 53% survival rate (47% death rate) for the year (Government of Canada, 2019). Therefore, the age distribution of food retailers within a community would be expected to affect policy impacts. Survival rates of businesses with one or more employees within the service-producing sector are used in a demographic population model that simulates how food environments might be impacted over time by the suggested food planning policies. For scenarios where the policy was implemented, the birth rate was omitted in the projection each year after the policy was implemented to demonstrate the impact of prohibiting new retailers from locating within designated areas.

4.2.2.4 Community-level Network Data

The Region of Waterloo Road Network (v2019.3) was retrieved from DMTI Spatial Inc. (2019). This road network was used to determine how many unhealthy retailers are within 800m and 1km walking distance from the school. This road network does not take into consideration possible short-cuts known to students.

4.2.3 Methodological Approach

4.2.3.1 Planning Policy Scenarios

This study compares various food planning policy scenarios that have been explored and recommended within existing literature to examine how availability to fast-food retailers and convenience stores may change around schools over 10 years. Unhealthy food availability (defined as the number of outlets within each buffer) was calculated for two different policy features: buffer type (Euclidean Buffer vs. Network) and buffer distance (800m vs 1km). Finally, each policy examined various Retail Food Environment (RFE) Community Contexts: specifically, a "Young" retail food environment, an "Average" RFE, and an "Old" RFE (described in detail below). As noted above, all policy scenarios assume any new policy contains a legacy clause for existing food retailers.

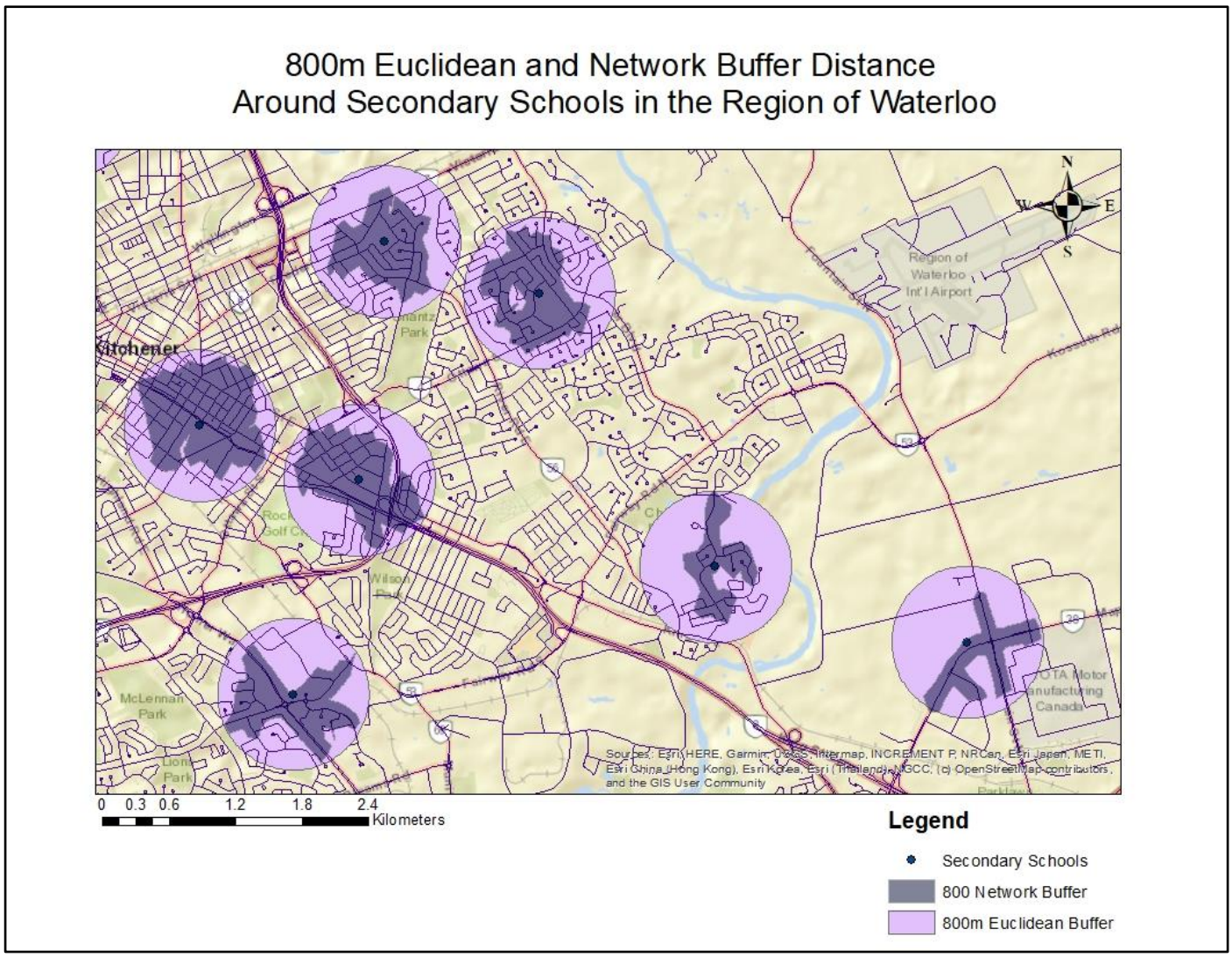
4.2.3.2 Retail Food Environment (RFE) Community Context

Restaurant survival rates differ by the restaurant's age, indicating that the age composition of the establishments in a community may influence how the policies affect projected availability. This study looked at three possible community demographic compositions of retail food environments around schools: A Young RFE, an Average RFE and an Old RFE. A Young RFE scenario represents a retail food environment where 70% of establishments are 0-5 years old, and the rest (30%) are old (6-10 years). An Old RFE demonstrates the scenario where 70% of the establishments are 6-10 years, and 30% are young (0-5 years). Last, an Average RFE represents a retail food environment where the ages of establishments are evenly distributed between 0-10 years. Due to the lack of data on average annual failure rates and survival rates of retail food establishments at the Regional or Municipal level, the RFE age compositions were included to provide context for how these potential policies would impact RFE's of various age compositions.

4.2.3.3 Buffer Type (Euclidean vs. Network)

The type of buffer included in the policy may impact the number of unhealthy food retailers included or excluded from the policy. This study compares two potential types of buffers: Euclidean and Network. Existing studies utilize Euclidean and Network buffers when measuring food environment availability (Héroux et al., 2012; Shearer et al., 2015). A *Euclidean buffer* is a circular buffer often used to analyze distance around a feature and is often represented as a circle around the point of interest with a radius equal to the distance of the buffer (ArcGIS, 2021). A Network buffer, also referred to as a Network Service Area in Geographic Information Science (GIS), refers to a line-based road network calculated based on the average travel distance from one location to a prescribed distance. Euclidean distance buffers are typically larger than network distance buffers of the same distance, especially when street networks are curvilinear and not well-connected. One study reported that the use of radii might not reflect actual access to food retailers due to the lack of consideration for street connectivity and carriers to travel (L. M. Seliske et al., 2009). Figure 1 shows the difference between an 800m Euclidean buffer and an 800m network distance buffer around two secondary schools (a rural and an urban school) in the study region.

Figure 1: Map comparing 800m Euclidean and Network buffer distances around secondary schools in various areas of the study region.



4.2.3.4 Buffer Distance (800m vs. 1km)

The buffer distance refers to the distance from the school in which the policy would be effective. Buffer distances used to measure access to food differ among existing studies and range from 400m (Day & Pearce, 2011) to 1600m (Forsyth et al., 2012). Many studies utilize the distance that the average adult could walk in 10-15 minutes, as this would likely be the furthest distance students could go within their 45 minutes to a one-hour lunch break (L. Seliske et al., 2013). The 800m and 1km buffer distance evaluated in this study remains consistent with existing literature for suggested buffer distance, and the average distance youth would be willing to walk to purchase food during

their lunchtime. Moreover, one study concluded that proximity (less than 1km) to fast food retailers increased the likelihood of students purchasing food from these retailers (He et al., 2012).

4.2.4 Methods of Analysis

4.2.4.1 Geographic Information Systems

Geographic Information Systems (GIS) is a typical method of measuring density and proximity to characterize attributes of food environments (Charreire et al., 2010). The majority of studies examining food environments are cross-sectional and use GIS as part of their methodology (Cutumisu et al., 2017; Day & Pearce, 2011; He et al., 2012; Sadler et al., 2016; L. M. Seliske et al., 2009; Shareck et al., 2018). For this study, two spatial analysis of retail food environments around secondary schools was conducted using ArcMap (10.8.1): a spatial buffer analysis (ex. Euclidean) and a network analysis using the Road Network Extension. The buffer analysis identified all fast-food restaurants and convenience stores on or within the buffer area serving as the Euclidean buffer, indicating "unhealthy" food retailers within the buffer at both 800m and 1km. We conducted a road network analysis to determine the road network distance of 800 m and 1km, identifying FFR and CS on or within the road network buffer. The total FFR and CS within each buffer type and distance represent the current number of unhealthy food retailers around each school (as of March 2020).

4.2.4.2 Community Population Projection using Life Tables

Life tables (a popular demographic projection method) and population projection models were created for each RFE age-composition scenario (Young, Average, Old) to project the total number of unhealthy food outlets within the intervention area (identified by Euclidean and Network buffers) in potential policy scenarios over 10 years given average business survival rates by age. For the no-policy scenarios, a standard population projection model was conducted, calculated using the average business death rates and birth date by year over 10 years of the service-producing sector in Canada (Gov. of Canada, 2019). Calculations of all policy scenarios used a modified population projection model excluding birth rate to account for the implementation of the policy (including the legacy clause). Due to the marginal difference in outcomes between RFE community contexts, subsequent analysis was conducted using the Average RFE community context. Assuming a 1km Euclidean distance as the threshold of the school-neighbourhood

environment and a distance students could walk during their lunch period, the total FFR/CS at 10 years under each policy scenario was calculated within a 1km Euclidean distance. This study uses availability as an appropriate measurement over time as a key performance indicator, defined by the Ontario Public Health Standards (OPHS) as the presence, count and density of food retailers within a defined geographical space (i.e., 800m buffer) around a secondary school (Engler-Stringer et al., 2014; Butler et al., 2019).

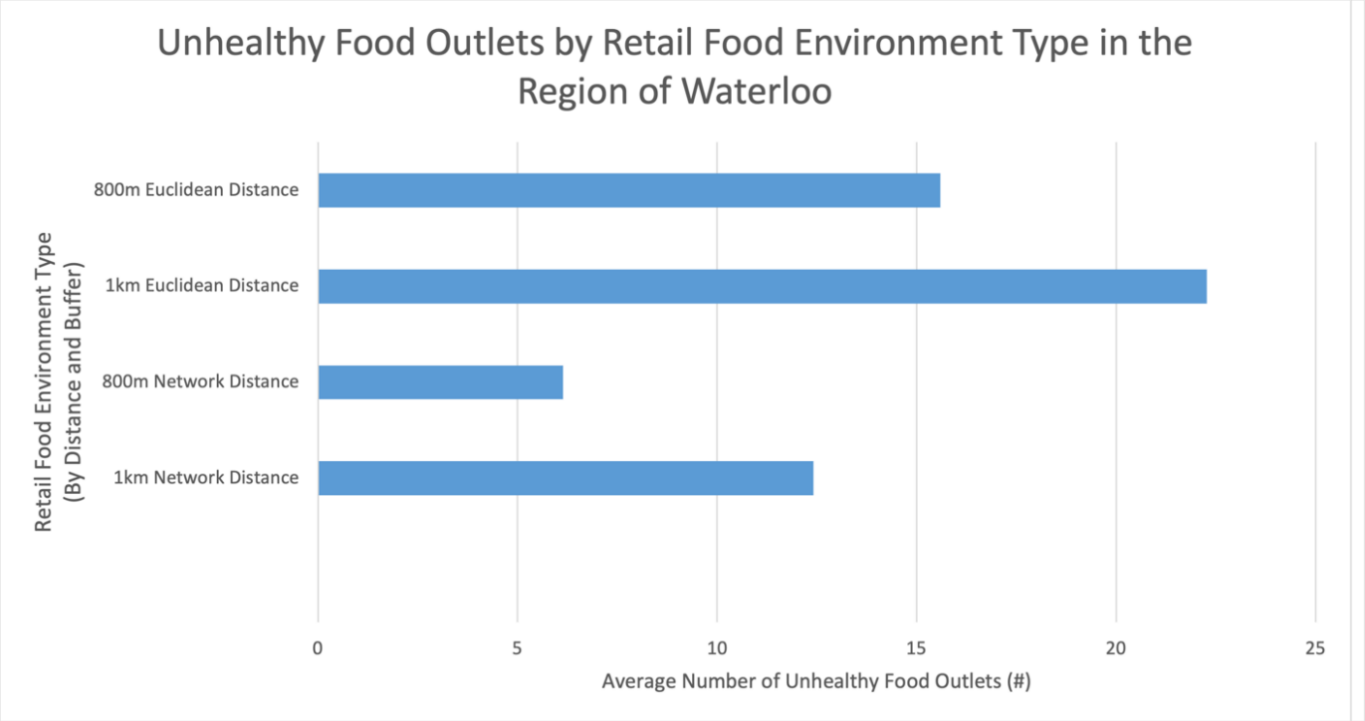
4.3 Results

4.3.1 Current State of Food Environments Around Schools

Overall, we examined school-neighbourhood RFE's within four buffers; these include an 800m Euclidean buffer, a 1km Euclidean buffer, an 800m Network buffer and a 1km Network buffer. Of these four, the 1km Euclidean RFE unsurprisingly has the highest FFR and CS within the buffer. In total, there were 356 FFR and 134 CS within 1km (Euclidean distance) of the 22 secondary schools in Waterloo Region in 2020. The mean number of unhealthy food retailers within 800m and 1km Euclidean RFE distances of schools is 15.6 and 22.3, respectively. Comparatively, the mean number of unhealthy food retailers within 800m and 1km (network distance) of secondary schools in Waterloo Region were 6.1 and 12.4, respectively. Almost all (91.3%) of schools have at least two or more retailers within an 800m Euclidean distance of the schools, and 95% of schools have at least two or more retailers within a 1km Euclidean distance, whereas over two-thirds (68%) have at least two FFR or CS within 800m Network distance, and 91% have at least two FFR or CS within 1km Network Distance.

For both Euclidean and Network distances, at 1km, the average total number of retailers was approximately 6.5 higher than at 800m. Figure 2 represents the average number of FFR and CS around secondary schools by distance in 2020 by retail food environment distance. The average number of FFR was higher than the average number of CS at both 800m and 1km, with an average of 11.0 FFR and 3.7 CS within the 800m Euclidean distance and 15.2 FFR and 5.7 CS within the 1km Euclidean distance. Alternatively, there are 4.2 FFR and 3.2 CS and 8.6 FFR and 3.2 CS within the 800m Network distance and the 1km Network distance.

Figure 2: Total average number of fast-food restaurants and convenience stores around secondary schools in the Region of Waterloo (as of March 2020).



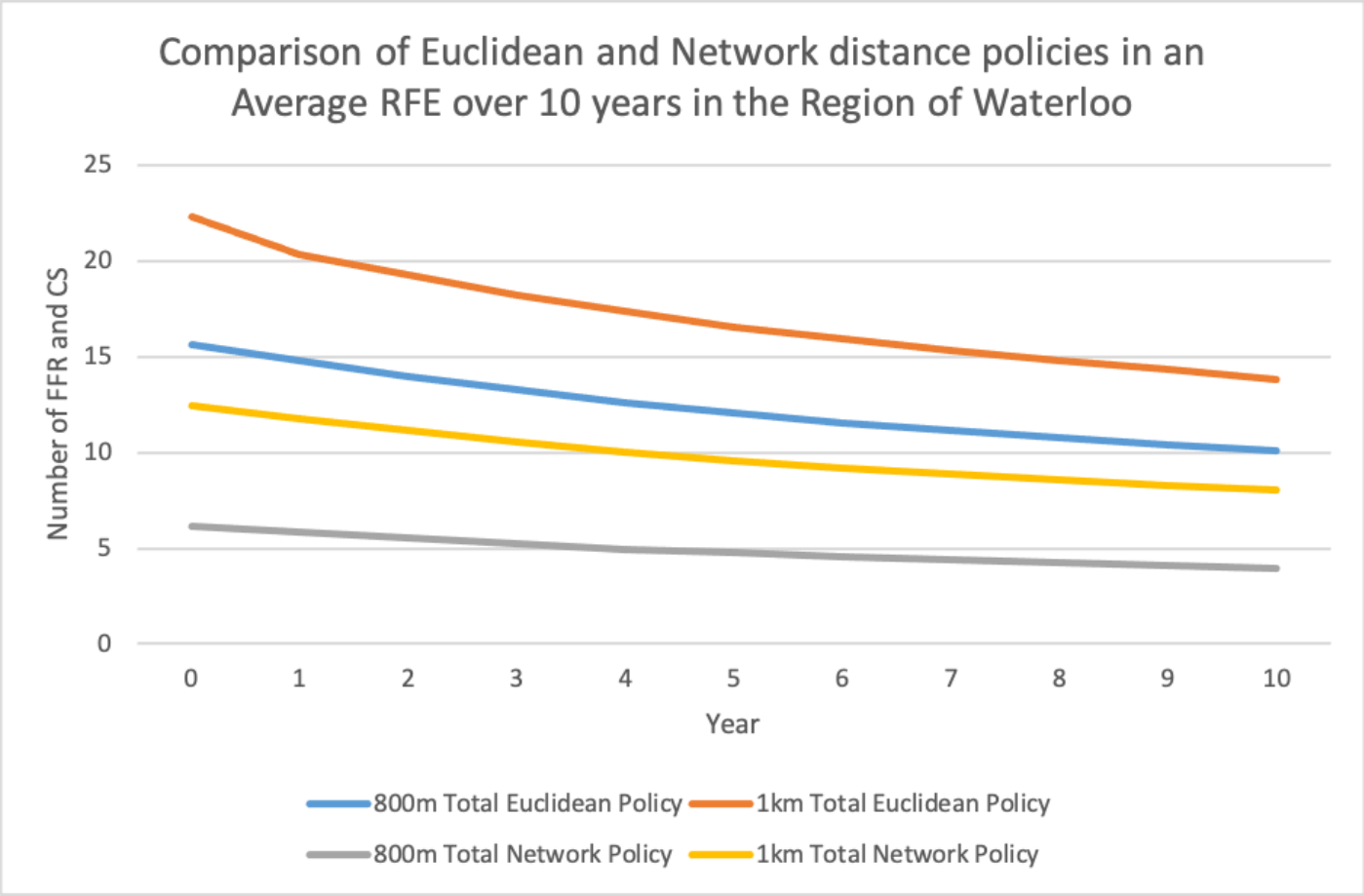
4.3.2 Secondary School RFE Availability Projections

Four potential policy scenarios to reduce youth availability to unhealthy food retailers around schools were examined, and all four policies successfully decreased the number of FFR and CS around schools over 10 years. Across all RFE community contexts (old, young, average), availability projections showed little difference in the average number of FFR/CS after 10 years, with a difference of approximately 1.25 retailers. As shown in Table 2, after 10 years, 91.3% of secondary schools still had at least 2 FFR/CS within the 800m Euclidean policy intervention area. Similarly, 91.3% of schools in a 1km Network policy had two or more FFR/CS within the policy intervention area, although the percentage of schools with two or more unhealthy retailers within a 1km Network policy area decreased to 82.6% after 10 years. Furthermore, in every policy scenario, the average number of FFR/CS remaining within the policy areas after 10 years of policy implementation was greater than 3. Figure 3 represents a comparison between the reduction in the number of FFR and CS within both Euclidean and Network policy distances over 10 years.

Table 2: Percentage (%) of schools with two or more FFR and/or CS at Year 0 and Year 10 by Policy Type

Policy Type	Percentage (%) of schools with two or more FFR and/or CS at Year 0	Percentage (%) of schools with two or more FFR and/or CS at Year 10	Percentage (%) decrease between Year 0 and Year 10
800m Euclidean Policy	91%	91%	0%
800m Network Policy	68%	61%	10%
1km Euclidean Policy	95%	91%	4%
1km Network Policy	91%	83%	9%

Figure 3: Comparison of policy types over 10 years in the Region of Waterloo



4.3.3 School-Neighbourhood Environment Availability Projections

This study explored the projected impact of FFR/CS availability within 1km (Euclidean distance) of schools based on different policies over 10 years. After 10 years, the 1km Euclidean policy resulted in an average of 13.8 unhealthy retailers within 1km (Euclidean distance) of schools. Comparatively, an 800m Euclidean policy resulted in an average of 20.1 unhealthy retailers within 1km (Euclidean distance), a 1km Network policy resulted in an average of 23 unhealthy retailers, and an 800m Network policy resulted in an average of 28.3 unhealthy retailers within 1km (Euclidean distance) of schools.

4.4 Discussion

This study sought to examine how projected availability to FFR/CS in the school neighbourhood would change for secondary students in Waterloo Region over 10 years if various "junk food ban" zoning policies were implemented. I examined the impact of a Network vs. Euclidean distance policy, an 800m vs. 1km policy, and examined differences by retail food community demographic characteristics (e.g., "young," "average," and "old"). We found that of all the policy scenarios and in each community context (young, average, and old), the lowest mean number of unhealthy retailers within 1km (Euclidean distance) of schools was about 14 retailers after 10 years of policy implementation, which still provides youth with ample opportunity to access FFR and CS. This overarching finding brings the potential effectiveness of restrictive zoning policies around schools into question, given that exposure to two or more fast-food outlets within 750m of schools is associated with an increased higher likelihood of excess junk food consumption at lunchtime (Cutumisu et al., 2017).

Two other key findings emerged from this study and will be discussed in detail below. First, because of the typically larger size of Euclidean vs. Network policies, especially in neighbourhoods with curvilinear street patterns and fewer intersections, Euclidean distance policies showed a larger decline in the number of unhealthy outlets at 10 years relative to their Network distance counterparts. For example, within 1km (Euclidean) distance of high schools in Waterloo Region, both the 1km and 800m Euclidean distance policies had a lower mean number of unhealthy food outlets (14 and 20, respectively) compared to the 1km and 800m network

distance policies (23 and 28, respectively). Therefore, if a municipality were interested in reducing high school students access to FFR and CS by implementing a restrictive zoning policy, it would be important to specify a Euclidean distance policy, especially in suburban or rural school-neighbourhoods. Specifically, as shown in Figure 1, the difference between the Euclidean policy and the Network policy at the same distance can vary significantly between schools, with rural or suburban Euclidean distance buffers far larger than network distance buffers of the same radius. Euclidean policies do not consider street connectivity or barriers to travel (L. Seliske et al., 2013), potentially including retailers outside of where youth could walk during their lunch period within the policy. While network buffers may better capture the geographic boundaries used to assess food environment exposures compared to Euclidean buffers (L. Seliske et al., 2013), policymakers should consider how large the school neighbourhood environment (i.e., what distance students walk) before implementing such policies (DuBreck, 2018).

Although during lunch period is the foremost opportunity to purchase junk food, it is not the only opportunity for youth to access unhealthy food retailers. High school students often use active or public transportation to travel to and from school and may be exposed to unhealthy food retailers within home-neighbourhood and school-neighbourhood food environments. For example, a higher density of fast-food outlets in the neighbourhood surrounding the home and school is associated with adolescents purchasing fast food when a parent or guardian is absent (He et al., 2012). Another study of Ontario adolescents found that nearly 1 in 20 trips made to and from school involved purchasing unhealthy junk food (Sadler et al., 2016). The same study found a significant, positive relationship between adolescents' duration of exposure to unhealthy food outlets between home and school and the likelihood of junk food purchasing (Sadler et al., 2016). Therefore, implementing a Euclidean policy intervention covering a broader absolute area may be more effective in reducing the availability of unhealthy food retailers within the greater school neighbourhood.

Second, for these types of policies, the buffer distance (800m vs. 1km) seems to be important in determining availability after 10 years, given that the number of junk foods increases as the

school zone threshold increases (DuBreck, 2018). The current study found that on average, within a 1km Euclidean distance of high schools in Waterloo Region after 10 years of policy implementation, there were about 6 fewer outlets within the 1km Euclidean distance policy scenario vs. the 800m Euclidean distance policy scenario and about 5 fewer outlets within the 1km network distance policy scenario vs. the 800m network distance policy scenario. Although one US study demonstrated that the median distance of fast-food restaurant was only 440m from participants schools (Forsyth et al., 2012), both distances included in this study are consistent with existing literature conceptualizing food environments around schools (Cutumisu et al.,2016; DuBreck et al.,2018; Seliske, 2012). Of note, 800m reflects the distance the average individual can travel in approximately 10 minutes, and 1km in approximately 12 minutes, providing sufficient time for students to walk away from school during lunch. 272

4.5 Strengths and Limitations

This study incorporates diverse perspectives on a newly emerging subfield of planning on a vulnerable and understudied population. While studies have examined the relationship between unhealthy food availability and population health outcomes, no studies to date have explored how such food planning policies may change availability for an intervention period of longer than one year. This study is one of few that simulates the potential impacts of implementing such food planning policy options within and across policy type and distance, addressing gaps surrounding lack of research examining various types of food planning policy interventions. This study furthers the discussion surrounding the increased emphasis on Regional, and Municipal Official Plans are placing on healthy communities, and food systems planning (Einstoss et al., 2015; OPPI, 2011), and public health authorities are placing on Healthy Food Zones (ASPQ, 2011; Butler et al., 2019; Robitaille et al., 2016). Standard spatial analysis methods and road network analysis were used, consistent with previously used socio-spatial analysis techniques in ArcGIS.

Another limitation of this study was the timing and the impact of COVID-19 on the retail food industry. This study does not consider the possible economic impacts of COVID-19 on the retail food industry that may have resulted in retailers closing permanently, as data collection was completed before the pandemic. Further research on food environments around school's post-

pandemic is warranted, as the data collected before COVID-19 may not reflect current food environments. Additionally, this study did not account for sidewalks and trails/paths in the road network analysis and that such alternative networks can impact the distance travelled (Canada Public Health, 2019). Lastly, we did provide considerations that would result in the indicators reflecting institutional (secondary school) access to unhealthy food outlets rather than potential student availability. Future studies should consider standardizing the analysis based on student density (e.g., the number of students enrolled in secondary schools with at least one fast-food restaurant within 750m or 1km walking distance over the total number of students enrolled in secondary schools in the geographic area of interest) (Canada Public Health, 2009).

4.6 Conclusions and Future Research

Even under the strictest policy scenario (1km Euclidean distance), the proportion of schools with 2 or more outlets within the intervention area was still 91% after 10 years. If such food planning policies do not substantially reduce adolescents' access to sources of inexpensive, highly palatable, and unhealthy foods, there is little reason to expect that they will impact population health outcomes. Planners and practitioners may consider prioritizing other intervention methods, although future research should consider whether such a policy would effectively reduce access to unhealthy food outlets to the point where results indicate changes in population health outcomes among youth.

Ultimately, the preferred policy buffer depends on the overall goal of the policy, key performance indicators and the effectiveness of decreased access on improving eating behaviours. Studies indicate that Network buffers are the preferred method of assessing access to retail food environments and land use; however other perspectives suggest the need to assess the boundaries of the school-neighbourhood environment in relation to access to unhealthy FFRs and CS retailers and consider all opportunities students have to purchase from unhealthy food outlets. Understanding potential challenges with implementing such a large buffer, municipalities may consider beginning with implementing smaller intervention areas (similarly to existing policies of 500m) or consider alternative in-store interventions to regulate what is sold in retailers within intervention areas. More research on food policy interventions comparing various policy buffer

options and their effectiveness in changing youth eating behaviour is warranted. If the area of meaningful access extends beyond existing zoning restrictions, a more significant policy area will provide better coverage of the school neighbourhood environment with the potential to reduce further access for students walking to and from school. However, further research should consider the unintended consequences concerning areas that might overlap with business improvement areas and other economic priorities. Additionally, this study did not consider the distance youth with access to vehicles would be able to travel from the school as it was out of the scope of the study.

There is a growing need and desire for the intersectoral collaboration of public health and planning professionals to support healthy communities' policies and improve dietary health outcomes. This simulation study aimed to provide public health practitioners and policymakers with an understanding of how recommended policies might play out in different contexts to inform decision-making regarding food policy interventions. This research also contributes to the understudied subfield of impacts of the built environment and youth/adolescent population health outcomes. Future research should evaluate the effectiveness of existing food planning policies around schools on reducing availability and improving population health outcomes, for example, in Québec (where such policies have been implemented). Such research is necessary to determine whether this non-traditional public health intervention should be presented as an option or whether public health practitioners should prioritize other intervention options such as in-store interventions if there are remaining unhealthy food retailers around school after an implementation period of 10 years. Additional research is necessary to examine the impacts restrictive food planning policies may have across communities through an intersectional and equity lens. Municipalities should encourage collaboration between planning and public health professionals to tackle issues and further discuss the relationship between the built environment and population health outcomes.

Chapter 5
Junk Food Availability after 10 years of a Restrictive Food Environment Zoning Policy Around Schools: An Equity Focused Simulation Study

(Submitted to Journal of the American Planning Association. Status: Revisions Requested)

5.1 Introduction

Healthy communities are comprised of built, natural and social environments, with healthy food systems being one aspect of the foundational framework of healthy built environments (HBEs) (Mui et al., 2021). HBEs can promote and sustain beneficial lifestyle patterns which contribute to chronic disease prevention (Hilmers et al., 2012). Planning and public health professionals increasingly recognize the importance of healthy food systems and healthy food environments (e.g., food access and availability) in planning healthy communities and promoting equity (Mui et al., 2021). Food environments and food availability seem to differ systematically by neighbourhood income, affecting neighbourhoods' access to food retailers and may perpetuate disparities in health outcomes (Gordon-Larsen, 2014; Larson et al., 2009). In particular, there may be an oversaturation of unhealthy food retailers within equity-deserving (e.g., low-income, racialized and Indigenous, immigrant or newcomer) communities compared to other groups (Fleischhacker et al., 2011; Jang & Kim, 2018; Kwate & Loh, 2010), in parallel with the lack of healthy food options in these same communities (Bower et al., 2014; Hilmers et al., 2012; Jeong & Liu, 2020; Luan et al., 2016; Ohri-Vachaspati et al., 2019; P. K. Powell et al., 2021). In addition, a growing body of research explores associations between access to food and adverse health outcomes in equity-deserving subgroups that indicate inequitable access to food (Drewnowski, 2009; Kraft et al., 2020; Matsuzaki et al., 2020).

Children may be especially vulnerable to built and food environments, given that they are typically less mobile than adults (Pitt et al., 2021). A recent scoping review investigating the relationship between urban form and children and adolescent health outcomes suggested that urban form is associated with health outcomes among Canadian youth, although there is an over-reliance on cross-sectional studies in the literature (Pitt et al., 2021). Both home and school neighbourhood food environments were frequently examined in relation to weight status in children, although

results were inconsistent (Pitt et al., 2021). Another scoping review on healthy equity issues related to childhood obesity found that most food environment elements (i.e. food choices and availability) were associated with children's weight status, although there was no agreement regarding the association of childhood obesity and both food deserts and food insecurity (Vargas et al., 2017).

Food environments deemed particularly relevant to children and youth are those around schools (often operationalized as fast food restaurants (FFR) and convenience stores (CS) within walking distance), which explains the relatively large body of research that examines the extent to which children's and youths' food environments support healthy eating. Two main streams of extant research examine 1) Equity: how area-level socio-demographic characteristics are associated with food environment characteristics around schools, and 2) Impact: the extent to which school food environments are linked to diet-related outcomes. Equity-focused research on area-level socio-demographic characteristics typically shows food access varies systematically based on school neighbourhood income (Bower et al., 2014; Díez et al., 2019; Elbel et al., 2019; Fleischhacker et al., 2011; Jang & Kim, 2018; Jeong & Liu, 2020; Kestens & Daniel, 2010; Luan et al., 2016; Ohri-Vachaspati et al., 2019; P. K. Powell et al., 2021), land use (Kraft et al., 2020; Zenk & Powell, 2008), or racial composition (Bower et al., 2014; Elbel et al., 2019; Fleischhacker et al., 2011; Jang & Kim, 2018; Jeong & Liu, 2020; Kwate & Loh, 2010; Ohri-Vachaspati et al., 2019; P. K. Powell et al., 2021). For example, the availability of FFR and CS within walking distance of US public secondary schools is higher in the lowest-income neighbourhoods relative to the highest-income neighbourhood, and schools in predominantly African-American neighbourhoods had fewer food outlets than predominantly white neighbourhoods (Zenk & Powell, 2008). Another study in Montréal, Canada, found that schools in the lowest income quartile had ten times more food retailers within 740m than schools in the highest income quartile, even after accounting for commercial density (Kestens & Daniel, 2010). These findings are countered by a similar cross-Canada study that found access to food retailers were generally not associated with the neighbourhood SES in the immediate proximity of schools, although within the broader neighbourhood, lower SES neighbourhoods had access to fewer food retailers of all types (Seliske et al., 2009).

Second, in terms of impact-focused research, our understanding of the extent to which food environments around schools are linked to food purchasing and dietary and health outcomes for children and youth is also growing (An & Sturm, 2012; Cutumisu et al., 2017; Engler-Stringer et al., 2014; Gilliland et al., 2012; He, Tucker, Gilliland, et al., 2012; He, Tucker, Irwin, et al., 2012; Matsuzaki et al., 2020; Williams et al., 2014). Studies typically use two methods of measuring exposure: 1) using buffers around schools to measure *potential* exposure and 2) using activity spaces and GPS to measure *true* exposure (Sadler et al., 2016; Sadler & Gilliland, 2015). It is important to note the bias in geospatial proxies when measuring exposure, given that proxy measures are not true exposure (Sadler & Gilliland, 2015). Therefore, accessibility may be a more appropriate term when measuring potential exposure within retail food environments. In a recent systematic review on associations between the presence of retail food outlets around schools and prevalence of overweight among students, 18 of 31 total articles found direct associations between proximity or density of establishments (mainly FFR, CS, and grocery stores) around schools, and overweight and obesity in children and adolescents (da Costa Peres et al., 2020). However, inconsistent research findings were noted: 14 reviewed papers found no association, and four presented inverse associations (da Costa Peres et al., 2020).

It is also important to note that food environments may be experienced differently by children and youth based on individual-level social identities related to income, gender, age and race. Matsuzaki et al.'s (2020) recent systematic review exploring associations between food environments near schools and body weight by race/ethnicity and socio-economic factors found more consistent evidence for associations among racialized students vs. non-racialized students. Evidence on these relationships by socio-economic status was less certain, given that only two studies examining differences by socio-economic advantage were included in the review. Another systemic review examining associations between neighbourhood food environments and health outcomes in populations with the highest obesity rates in the US found modest evidence that adverse health outcomes are more strongly associated with CS access for Black and Hispanic youth (compared to non-racialized youth) and with FFR access for Black and Hispanic adults and youth (compared to non-racialized individuals) (Kraft et al., 2020).

Given the importance of healthy food systems to healthy communities, planning and public health organizations have suggested that zoning regulations might improve food access by restricting access to sources of unhealthy food such as FFR and CS(Einstoss et al., 2015; Minaker et al., 2016). In 2011, for example, the Ontario Professional Planners Institute released a call to action to prioritize the creation of healthy communities and emphasize the importance of planning for food systems. In municipalities in two Canadian provinces (York Region, Ontario and Québec City, Québec), public health authorities have examined and implemented zoning regulations prohibiting new food outlets near secondary schools (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016). Several municipalities in Québec have adopted bylaws restricting FFR in public areas, including around schools (ASPQ, 2011). For example, the municipality of Lavaltrie adopted the motion prohibiting new FFR within a 500m radius around schools (Robitaille et al., 2016). In the United States, several major cities, including Detroit, Michigan and Los Angeles, California, have also implemented zoning restrictions to limit or ban FFR in some areas or regulate the proximity of FFR around other sites such as schools or hospitals (ASPQ, 2011).

Unfortunately, to date, only one example of such a restrictive zoning regulation has been evaluated. Sturm & Cohen (2009) evaluated the impact of a free-standing FFR zoning restriction in an equity-deserving community (racially diverse and low-income) and found no impact on population health outcomes (including obesity and BMI). However, this was unsurprising, given the short implementation length of the ordinance (one year) and the documented failure of the policy to change population-level FFR access (Sturm & Cohen, 2009). Notably, restaurants within shared space were excluded from the policy and not subject to regulation (Sturm & Cohen, 2009). To date, no studies have specifically examined zoning restrictions in school areas. These limitations stymie our understanding of the potential impacts of these restrictive food planning policies in school areas. A health equity lens would dictate that impacts of such a policy on equity-deserving groups should be prioritized.

As noted, zoning policies meant to restrict youth access to sources of unhealthy foods have been suggested by both planning and public health organizations as a way of improving health and health equity. However, these policies have not yet been evaluated, nor have equity implications

been fully considered. Therefore, the objective of this simulation study was to examine accessibility to sources of unhealthy foods (FFR and CS, in line with some recommendations (ASPQ, 2011)) around secondary schools in a mid-sized municipality in Canada over 10 years of implementing a restrictive "junk food ban." In particular, we focus on how long-term accessibility might differ by school-level markers of inequity based on students' household income, whether they speak English as a additional language (EAL), and newcomer (immigrant) status. We ask, "How does current food environment availability differ by the proportion of students at schools identifying as low-income, EAL and newcomer status in secondary schools in the Region of Waterloo, Ontario?" and "How would projected changes in food environment availability after 10 years of restrictive policy implementation differ by these social identity groups?"

5.2 Methodology

5.2.1 Study Area

This study uses the Region of Waterloo, Ontario, as a case study. The Region of Waterloo is an upper-tier municipality with a population of 617,870 as of 2019 (RoW, 2020). It comprises second-tier municipalities of three urban (Waterloo, Kitchener, Cambridge) and four rural (North Dumfries, Woolwich, WellEALey and Wilmot). There are 25 high schools in the Region of Waterloo (23 urban high schools and two rural high schools), and approximately 27,535 students in the Region of Waterloo attended high school in 2019-2020 (Government of Ontario, 2020). The Region of Waterloo has been the subject of other food systems planning research and has identified the government's role in food system policymaking to improve access to healthy foods (Wegener, Raine & Hanning, 2012), offering the potential for synergies with the proposed food planning policies. About a third (35%) of households in the Waterloo Region have an annual household income of less than $60,000 (Region of Waterloo, 2016). For context, to receive the Low-Income Workers Tax Credit from the Government of Ontario, the annual family net income must be below $68,500 (Government of Ontario, 2020). The number of permanent residents landing in Waterloo Region has remained consistent from 2008- 2015, and immigrant population growth has increased from 2016-2018 (Folkema & Vandebelt, 2019).

5.2.2 Policy Description

This study examined restrictive food planning policies aimed at improving the healthfulness of food environments around schools by reducing accessibility to unhealthy retailers by prohibiting new FFR and CS from opening within intervention areas (ASPQ, 2011). Like other policies (NPLAN, 2009), we assume that any new food planning policy would include a legacy clause that would exempt existing FFR and CS from the policy. We examine various policies by distance and buffer type. Four policies examined include an 800m Euclidean policy, 1km Euclidean policy, 800m Network policy and 1km Network buffer.

5.2.3 Data Sources

5.2.3.1 School-Level Data

School Type and geocoded *Location data* were retrieved from the Government of Ontario School Information and Student Demographics (Gov. of Ontario, 2019). Public and Catholic secondary schools, consisting of grades 9-12 (approximately ages 14-18 years), were included in School Type. Secondary schools were selected due to the likelihood that Middle or Elementary schools would be subject to "closed campus" policies, whereas secondary schools are more likely to have policies that allow students to leave school property during lunchtimes. In the Region of Waterloo, there were 25 secondary schools: 18 from the Waterloo Region District School Board, five from the Waterloo Catholic District School Board and two private Catholic schools.

5.2.3.2 Food Retailer-Level Data

Retail Food Type and geocoded *Location* data from March 2020 were retrieved from the Human Environment Analysis Laboratory (HEAL) at the University of Western Ontario. Four *Retail Food Type* included: FFR, CS, Restaurants and Grocery Stores. This study focuses on "less healthy food retail outlet" accessibility such as FFR and CS as described in the Ontario Public Health Standard's report on calculating access to different food sources (Gov. of Ontario, 2019). Additionally, most suggested restrictive food retail policies target these two types of retailers (Cutumisu et al., 2017; Sturm & Cohen, 2009). Moreover, while grocery stores and restaurants also sell unhealthy food, standard practice in the current literature to date defines these retailers as a proxy for healthy food outlets (Lind et al., 2016; Moudon et al., 2013). As described in the North American Industry Classification System (NAICS) Canada 2012, FFR consists of establishments that primarily

provide over-the-counter food services, and customers pay before eating (StatsCan, 2018). FFR may offer a variety of food items, including specialty snacks and non-alcoholic beverages. Alternatively, CS are establishments primarily retailing a limited line of items such as soft drinks, snacks and some general food items such as bread and milk (StatsCan, 2018). Full-service restaurants were excluded from this study due to the lack of time students would have to sit down, order, consume and pay for lunch at these establishments during relatively brief lunch periods.

5.2.3.3 Business Survival Rates

This study assumes a legacy clause for existing food businesses for any new food planning policy (similar to existing policies), exempting existing targeted food outlets from the policy (NPLAN, 2009). Under this legacy clause, only *new* FFR and CS would be prohibited from opening within the designated policy area.

The *national average of new restaurants for the service-producing sector* was retrieved from Statistics Canada to determine the restaurants' "birth rate" by year over 10 years (Government of Canada, 2019). We assumed the average birth rate of 8.9% for enterprises with more than one employee within the service-producing sector from 2005 to 2015 (Government of Canada, 2019).

Business survival rates year over year were used to develop the restaurant "death rate" over 10 years and were retrieved from Statistics Canada (Government of Canada, 2019). Similar to human death rates, business death rates are linked to age. For example, a business that has been open for seven years has approximately a 53% survival rate (47% death rate) for the year while a recently opened establishment has approximately a 95% survival rate (5% death rate) for the year (Government of Canada, 2019). Therefore, policy impacts may be affected by the age distribution of food retailers within a community.

5.2.3.4 Community-Level Network Data

The Region of Waterloo Road Network (v2019.3) was retrieved from DMTI Spatial Inc. (2019). The road network was used to determine how many unhealthy retailers are within the designated policy areas (800m and 1km walking distance) around schools; however, it does not consider possible short-cuts known to students.

5.2.3.5 School-Level Demographic Data

School-level demographic data were retrieved from the Government of Ontario School Information and Student Demographics (Gov. of Ontario, 2019). For this study, *school-level demographic* data included the percentage of students: 1) living in low-income households, 2) whose first language is not English (EAL), and 3) who are new to Canada from a non-English speaking country (Non-English Immigrant) within each school. Of the 25 Public and Catholic secondary schools in the Waterloo Region, 22 had data on the proportion of low-income households and EAL students, while 17 had data on all variables of interest and were included in the current study based on data availability. The analyses, therefore, rely on the 17 schools with complete data.

5.2.4 Methodological Approach

5.2.4.1 Current School-Neighbourhood Food Environment

Unhealthy food accessibility (defined as the number of FFR and CS within each buffer) was calculated for four different policy scenarios based on two different policy features: buffer type (Euclidean Buffer vs. Network) and buffer distance (800m vs. 1km). Specifically, we examined policies at the following four buffers sizes: an 800m Euclidean buffer, a 1km Euclidean buffer, an 800m Network buffer and a 1km Network buffer. We explored the current state of unhealthy food accessibility around secondary schools within four buffers by each school-level variable individually to examine how access to FFR and CS varies by demographic characteristic.

5.2.4.2 Equity-Deserving Subgroups

Given the importance of understanding how new policies may negatively impact equity-deserving communities and the current literature on inequities in food access, we examine how the current potential food environment exposures differ based on the proportion of students: 1) living in low-income households, 2) English as an additional language (EAL) and 3) who are newcomers to

Canada. These variables are measures of demographic characteristics in the existing literature and are often associated with equity-deserving populations. The equity-deserving subgroups were chosen based on the demographic data available at the school- or area-level. While there was little information on the justification for methods of data collection, I assume that these two groups are distinguished by the unique experiences of these subgroups. This follows the assumption that newcomers to Canada refers to first generation immigrants, who uniquely experience the healthy immigrant effect (Lu & Ng, 2019), while EAL may refer to second generation immigrant, including the children of newcomers born in Canada. Demographic data on students was limited and mostly captured educational data.

5.2.4.3 School-Level Equity Categories

Schools were categorized into low and high equity groups within each variable (income, EAL, and newcomer) by dichotomizing each variable at the median. Low Equity schools were those with an above the median proportion of low income, EAL, or newcomer students, whereas High Equity schools were those with a below the median proportion of students in each category. For ease of reference, the dichotomous Low/High Equity variables are described as Low Equity – Income; Low Equity – EAL; Low Equity – Newcomer; High Equity – Income; High Equity – EAL, and High Equity – Newcomer.

We then categorized schools further using all three original variables. In this further categorization, Low Equity schools were those that ranked above the median in at least two of the variables; Medium Equity schools ranked above the median in only one of the variables and; High Equity schools ranked below the median in all three variables.

5.3 Analysis

5.3.1 Spatial Analysis of Food Environments

Most studies examining food environments use Geographic Information Systems (GIS) are cross-sectional and used as a typical method to measure density and proximity as characterizing attributes of food environments (Charreire et al., 2010; Cutumisu et al., 2017; Seliske et al., 2009). We conducted two types of spatial analysis of retail food environments around secondary schools using ArcMap (10.8.1): a spatial buffer analysis (ex. Euclidean) and a network analysis using the

Road Network Extension. All FFR and CS on or within the Euclidean buffer area were identified, indicating “unhealthy” food retailers within the buffer at both 800m and 1km. A road network analysis was conducted to determine the road network distance of 800m and 1km to identify FFR and CS on or within the road network buffer. The total FFR and CS within each buffer type and distance represent the current number of unhealthy food retailers around each school.

5.3.2 Community Population Projections

This study uses population projection models to provide the total number of unhealthy food outlets identified within Euclidean and Network intervention areas for potential policy scenarios over 10 years according to average business survival rates by age. In our policy scenarios, calculations used a modified population projection model that excludes birth rate to account for the fact that no new FFR or CS would open within the policy area, recognizing that existing business would continue operating (given the legacy clause).

5.3.3 Policy Projections by School Equity Level

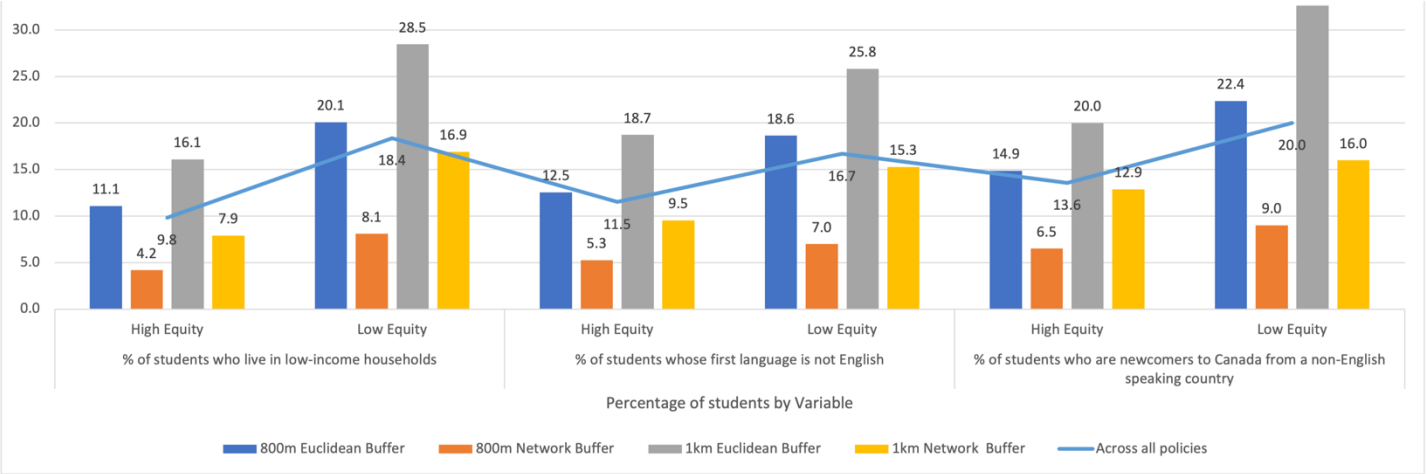
This study uses demographic population modelling data of food environments around schools to examine how projected changes would differ over 10 years by school-level equity across all policies. All policy scenarios assume all policies contain a legacy clause that excludes existing FFR and CS from the policy and prohibits new FFR and CS from opening within the policy area. We examined the projected changes both within the policy area and the greater school-neighbourhood environment. The total number of FFR and CS at 10 years across all policy scenarios under each school risk level was calculated.

5.4 Results

5.4.1 Current State of Food Environments Around Schools by Each Variable

Across each variable, Low Equity schools had the highest number of FFR and CS within a 1km Euclidean buffer (the largest buffer), with 28.5 retailers around Low Equity- Income schools, 25.8 retailers around Low Equity – EAL schools, and 32.6 retailers around Low Equity - Newcomer schools. Across all buffers, Low Equity – Newcomer schools had a mean of 20 unhealthy retailers, while Low Equity- Income schools and Low Equity – EAL schools had a mean of 18.4 and 16.7 unhealthy retailers, respectively. In contrast, High Equity – Newcomer schools had a mean of 13.6 unhealthy retailers across all buffers. High Equity - Income schools and High Equity – EAL schools had a mean of 9.8 and 11.5 unhealthy retailers around schools, respectively. There was a mean difference of 6.7 unhealthy retailers more around Low Equity schools relative to High Equity schools. Figure 4 represents the current number of unhealthy retails around secondary schools in the Region of Waterloo by individual variable.

Figure 4: The current mean number of unhealthy retailers around secondary schools in the Waterloo Region by individual variable.

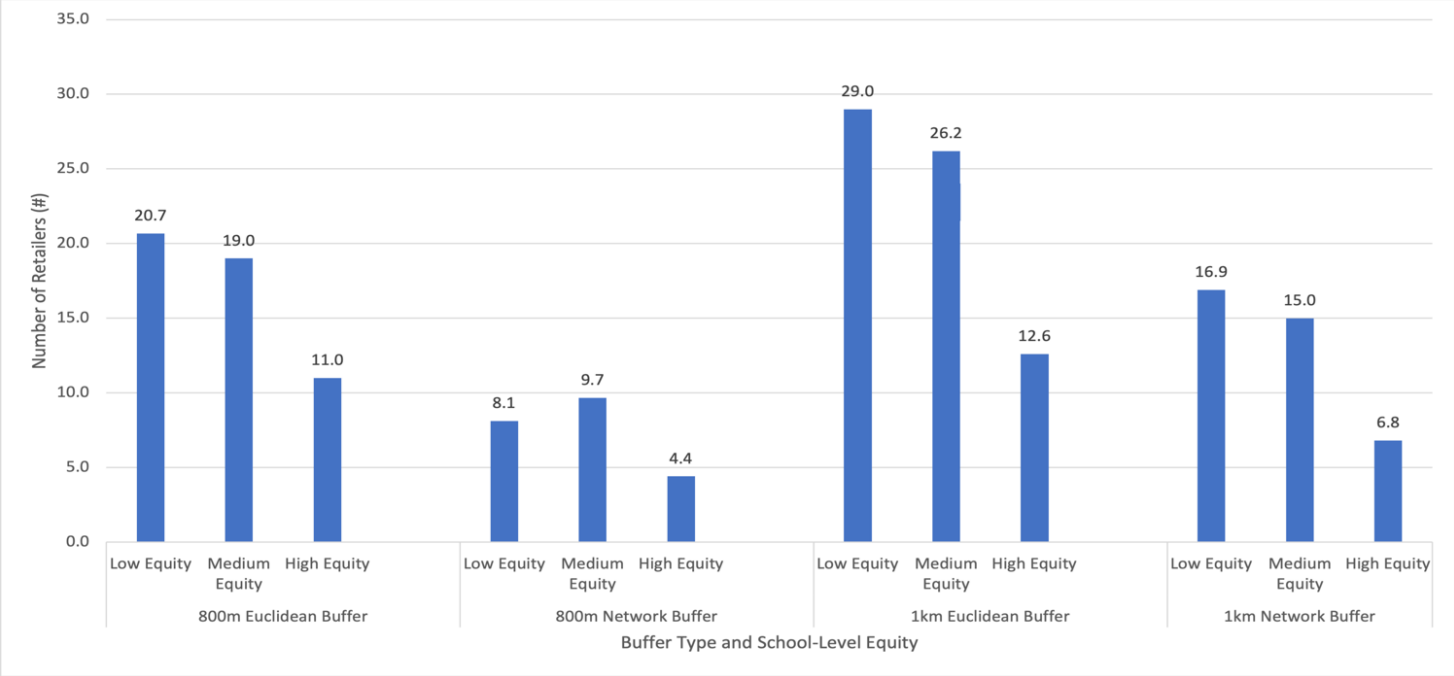


5.4.2 Current State of Food Environments Around Schools by School-Level Equity

In total, nine schools were "Low Equity," three were "Medium Equity," and five schools were considered "High Equity." In three of the four buffer type scenarios, low-equity schools had more unhealthy retailers than medium and high-equity schools. For example, Low Equity schools with a 1km Euclidean buffer had access to 29 unhealthy retailers than High Equity schools, which had

access to 12.6 retailers, with the largest difference of 16.4 retailers across all policies. In only one scenario, the 800m Network buffer, the Medium Equity schools have a higher number of unhealthy retailers than Low or High Equity schools. Figure 5 shows the current mean number of unhealthy food retailers around schools by equity level and buffer type.

Figure 5: The current mean number of unhealthy food retailers around secondary schools by school-level equity (i.e., low, medium, and high equity) and buffer type.

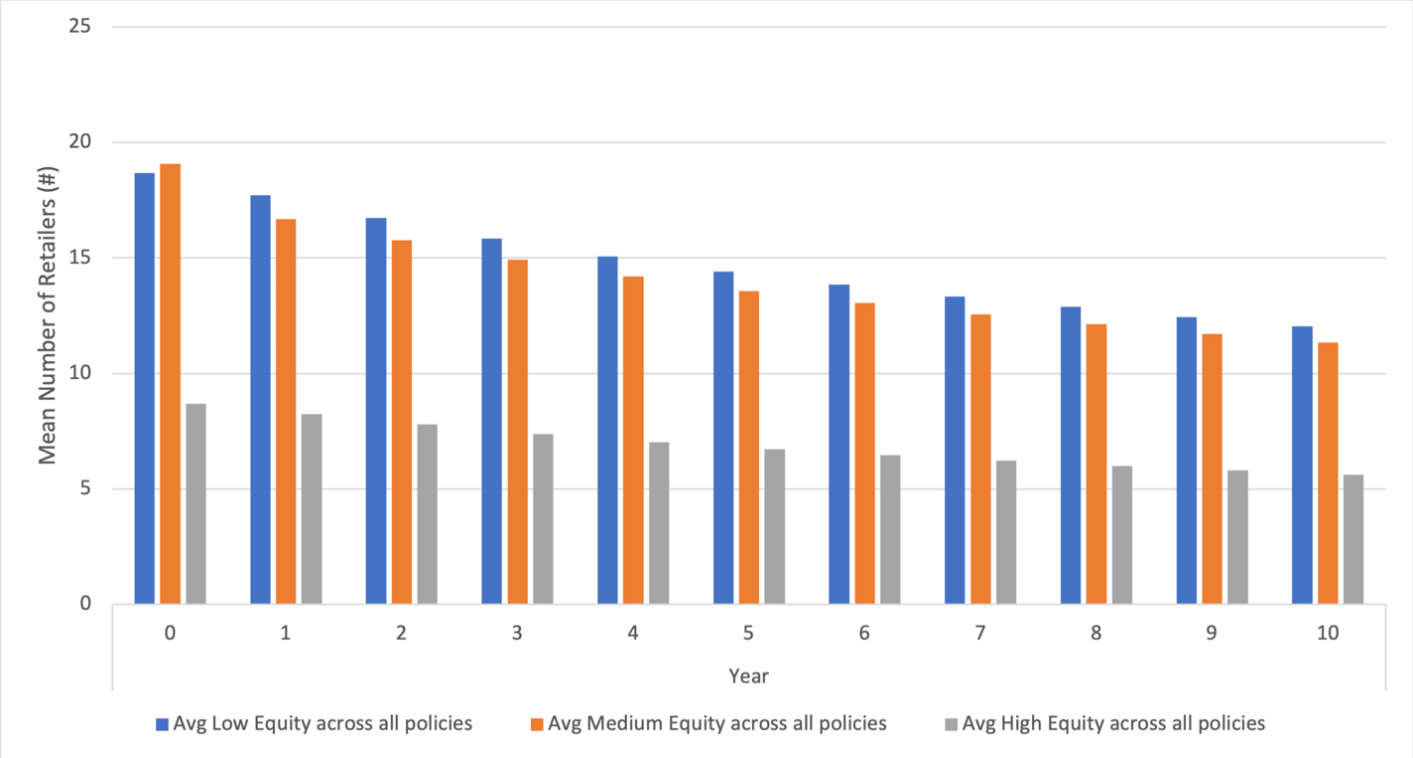


5.4.3 Food Environment Projections by Equity Level

Finally, we examined how food environments would change across all school equity levels over 10 years if our proposed restrictive food planning policy were implemented around Waterloo Region secondary schools. Across every policy scenario and equity level, the mean number of unhealthy retailers around schools was greater than 5 retailers at the end of 10 years. Low Equity schools across all policy scenarios had a mean of 12 unhealthy retailers, Medium Equity schools had a mean number of 11.3 retailers, and High Equity schools had a mean number of 5.6 unhealthy retailers within their buffers after 10 years. Assuming a 1km Euclidean distance as the threshold for the school-neighbourhood environment and a distance students could walk during their lunch period, Low Equity schools had an average of 27.6 unhealthy retailers within a 1km Euclidean

distance of schools, Medium and High Equity schools had 31.9 and 23.5 unhealthy retailers respectively within the same threshold. Figure 6 shows the number of unhealthy retailers by equity level for all policy types over 10 years.

Figure 6: The projected mean number of unhealthy retailers across all policy types by school-equity level over 10 years.



5.5 Discussion

This study examined how current food environment accessibility around secondary schools differs by the proportion of various equity-deserving students and how projected changes caused by potential restrictive food planning policies after 10 years vary by school-level equity in a mid-sized Canadian municipality. Three key findings emerged. First, at the end of the 10 years, despite mean overall reductions in the number of unhealthy retailers in school zones from nine to six, all schools had at least two unhealthy retailers within the school zone. Second, current food environment accessibility to unhealthy retailers is higher among low-equity schools than high-equity schools. Third, at the end of 10 years, Low Equity schools still have higher projected

accessibility to unhealthy food retailers than Medium Equity or High Equity schools. Each of these findings will be described in greater detail below.

First, while differences emerged between projected High-Equity school food environment accessibility and Low/Medium Equity food environment accessibility over time, even High Equity schools had a mean of six unhealthy food retailers within walking distance (e.g., 1km Euclidean distance) after 10 years. Despite differences between Low and High Equity schools, ultimately, all schools maintain ample access to unhealthy retailers even after 10 years. This is important given that Cutumisu et al., 2017 found that, after accounting for student, family, and school characteristics, potential exposure to two or more fast-food outlets within a radius of 750m was associated with a higher likelihood of junk food consumption at lunch. Therefore, even in the best-case scenario with such food planning policies, more than two retailers still exist within walking distance of each school. This overarching finding brings into question the potential effectiveness of these restrictive zoning policies in meaningfully reducing accessibility to unhealthy food outlets at the population level and whether other interventions should be considered if these policies do not meaningfully decrease access to unhealthy food outlets.

Second, Low and Medium Equity schools currently have higher accessibility to unhealthy food retailers than High-Equity schools. For example, within a 1km Euclidean buffer distance, the Low and Medium Equity schools had a higher mean number of unhealthy food outlets (29 and 26, respectively) than High Equity schools (13). Given that proximity and density of retailers around schools may impact purchasing choices and health outcomes among youth/adolescents (Davis & Carpenter, 2009), it appears that students attending Low and Medium Equity schools may be exposed to school food environments that are less supportive of their health. These findings mirror those of studies examining food environments around schools and equity-deserving communities (Bower et al., 2014; Hilmers et al., 2012; Kestens & Daniel, 2010; Powell et al., 2007; Zenk & Powell, 2008). For example, in Montreal, Canada, schools in the lowest income quartile had ten times more stores within 750m than schools in the highest income quartile even after accounting for commercial density (Kestens & Daniel, 2010). Given the adverse health outcomes for equity-

deserving communities, municipalities and public health practitioners may want to tailor intervention research to promote more healthful food environments around schools with large populations of equity-deserving communities.

Third, after 10 years of policy implementation, Low and Medium Equity schools still have higher projected access to unhealthy food retailers (12 and 11, respectively) relative to or High Equity schools (6 retailers). Given the objective of these restrictive planning policies to improve the healthfulness of food environments around schools for equity-deserving youth, it seems that such policies may be further unwarranted if there is no decrease in inequitable access. Several studies, along with our results, highlight the current oversaturation of unhealthy food outlets in equity-deserving communities with the criticism that restricting new outlets would have little impact on school-neighbourhood food environments (Diez et al., 2019; Green et al., 2018). Some authors have thus suggested that planning and zoning policies should include existing retailers (Diez et al., 2019) or a more robust intervention strategy that spans spatial and informational landscapes should be considered. Health equity is an important dimension of retail food environment interventions as they are often tailored to communities where inadequate household income is likely to amplify the effects of spatial disparities in food access (Minaker et al., 2016). This is equally true for interventions aimed at supporting healthy environments for youth.

From an equity perspective, physical environmental factors (i.e. healthy food availability) are explicitly connected to and shaped by social environmental factors (i.e. socioeconomic status) (Díez et al., 2019). For example, FFR and CS primarily sell energy-dense foods are typically cost less than nutritious foods, making unhealthy foods more financially accessible for people with low incomes (Drewnowski, 2009). Therefore, the question remains: is equity upheld if restrictive policies reduce geographic access to financially accessible food access for low-income youth and their families? Is no food better than unhealthy food? This may be a particularly important question in areas characterized as “food deserts” (areas with low access to sources of nutritious foods) or “food mirages” (areas with adequate access to sources of nutritious foods that are economically inaccessible to lower-income populations living there (Breyer & Voss-Andreae, 2013; Jang &

Kim, 2018). At the same time, children and youth, especially equity-deserving youth, are targeted explicitly by food marketing within unhealthy food outlets (Cairns et al., 2013; Hastings et al., 2003; Kumanyika & Grier, 2006). Therefore, reducing access to "unhealthy" food outlets may prove to be a suitable intervention to mitigate youths' exposure to powerful, point-of-sale marketing and, ultimately, support equity. When exploring the implementation of a policy restricting certain types of food retailers within communities, it is important to consider the potential unintended consequences or impacts, especially for equity-deserving communities. This is an important area for future research, and multiple perspectives should be considered. For both planning and public health, better understanding whether these policies will improve the quality of life for equity-deserving youth or perpetuate systemic issues that contribute to social inequities is important for moving forward with these policies. Given that access to food is associated with other social inequities, planners and public health practitioners should consider the impacts of restricting access to food retailers without providing additional supports to improve availability and financial accessibility to healthier food options (Díez et al., 2019). Cost-neutral interventions that increase access to healthful and culturally acceptable food and improve residents' financial opportunities to purchase and consume foods that meet dietary recommendations are also recommended (Luan et al., 2016).

5.6 Strengths and Limitations

This study examines the projected impacts of proposed restrictive food planning policies on various equity-deserving groups. While some studies have discussed the use of zoning restrictions on "non-nutritious food" (Davis & Carpenter, 2009; Mah et al., 2016; Minaker et al., 2016), no extant research has explored how such policies around schools may impact equity-deserving subgroups. Further, while this study looked at two buffer types (800m and 1km) that appear most often in the literature, this study did not examine smaller intervention areas similar to existing policies, which may be more feasible for municipalities to implement. There are several limitations to this study. First, this study only considers the school-neighbourhood retail food environment and does not include other food sources such as in-school food environments (e.g., cafeterias), which may also be significant food sources for students. Second, in keeping with existing literature and some policy recommendations (ASPQ, 2011), we categorize FFR and CS as "unhealthy food

outlets" proxies and exclude grocery stores, although unhealthy foods are available for purchase in these locations. Third, this study did not consider land use, given that food retailers are only permitted on land that is zoned for commercial uses. Therefore, more food retailers would be expected in central urban core areas and along suburban arteries. Finally, this study is limited by the availability of school-level data and resulted in a relatively small sample size covering most secondary schools in the Waterloo Region.

While proximity is key, there are other factors that are important when measuring and understanding access to food. For example, urbanicity has a large impact of access to food, therefore demonstrating differences in food environments between schools located in urban and rural areas (DuBreck et al., 2018). This study did not include external factors such as urbanicity, whether schools had a school lunch program for students, or the percentage of students who drive. Further, this study did not examine the average cost of food in neighbourhoods surrounding the schools. This may have provided insight into the economic cost and accessibility of both healthy and unhealthy foods, nor did this study consider the food advertisements being marketed to students (i.e value meals, specials).

5.7 Conclusions and future Research

Under all policy scenarios, after 10 years of implementation, Low and Medium Equity schools still have higher accessibility to unhealthy retailers than High Equity schools. Planners and practitioners may consider prioritizing interventions to improve the healthfulness of food environments around schools with large proportions of equity-deserving students but consider other or additional intervention methods. Future research should consider whether such a policy effectively reduces accessibility to the point where results indicate changes to population health outcomes for equity-deserving youth, such as Québec (where policies have already been implemented).

Ultimately, the objective of restrictive food planning policies is to reduce access to unhealthy foods and, in so doing, improve youth diets and long-term health. However, there may be unintended consequences on equity-deserving youth whose families may rely on more financially accessible food options. Using restrictive zoning policies in areas already oversaturated

with FFR and CS may have little impact on changing accessibility to unhealthy food retailers in school neighbourhoods. More research on the impact of food policy interventions on equity-deserving communities is warranted.

With a growing need and desire for intersectoral collaboration of planning professionals and public health, this simulation study aimed to contribute to the ongoing conversation of social inequities across food environments and highlight equity considerations of restrictive food planning policies.

Chapter 6
Conclusion

This thesis examines how recommended restrictive food planning policies may impact food environments around schools by buffer type, buffer distance and across different groups of equity-deserving youth. This thesis was presented as two distinct manuscripts, and aimed to answer the following questions in each manuscript:

- **Manuscript 1, Chapter 4: Healthy Food Zones Around Schools: Evaluating Projected Impacts of a Restrictive Food Planning Policy**

    1. How would high school students' food environment availability be projected to change if restrictive food planning policies (restricting fast food and convenience stores from opening around schools) were implemented in the Region of Waterloo, Ontario?"

- **Manuscript 2: Chapter 5: Junk Food Availability after 10 years of a Restrictive Food Environment Zoning Policy around Schools: An Equity-focused Simulation Study**

    2. "How does current food environment availability differ by the proportion of students at schools identifying as low-income, EAL and newcomer status in secondary schools in the Region of Waterloo, Ontario?"
    3. "How would projected changes in food environment availability after 10 years of restrictive policy implementation differ by these social identity groups?"

Given our growing understanding of the importance of the built environments and population health outcomes and how access to food outlets in school-neighbourhood food environments may vary across equity-deserving populations, both planning and public health have provided suggestions on how to improve the healthfulness of food environments for youth through restrictive food planning policies such as those examined in this research (ASPQ, 2011; Einstoss et al., 2015; Robitaille et al., 2016). However, little research has examined the potential impacts of these policies on accessibility to unhealthy retailers in food environments around schools over

time, and even less has used a health equity lens across equity-deserving subgroups of youth (Díez et al., 2019; Luan et al., 2016)

6.1 Summary of Findings

The following section will discuss how the research questions have been addressed and provide a summary of findings. This thesis focused on two main areas of research: 1) examining the potential impacts of food planning policies by buffer type and distance over 10 years and 2) how current and future food environments around schools vary across various markers of equity. The research questions were addressed through the use of life tables and simulated population projection model of unhealthy retailers within the food environment. Overall, the policies reduced the availability of unhealthy food retailers within the intervention areas, however, due to the legacy clause, there were remaining unhealthy retailers around schools, bringing into question whether this policy would reduce actual exposure as opposed to availability to unhealthy food outlets and improve youth dietary and health outcomes. Current food environments around secondary schools present a gradient of availability of unhealthy food environments between schools with high proportions of equity-deserving students compared to schools with low proportions of equity-deserving students, and this gradient remains after 10 years of policy implementation further perpetuating inequities among food access for equity-deserving communities.

Manuscript 1, Chapter 4 found that both buffer types (Euclidean vs. Network) and distance (800m and 1km) are important in the effectiveness of restrictive food planning policies reducing accessibility to unhealthy food retailers in the school-neighbourhood food environment after 10 years. Of the different policy types examined, Euclidean distance policies showed a larger decline in the number of unhealthy outlets at 10 years relative to their network distance counterparts. Although these restrictive food planning policies reduced availability to unhealthy outlets around schools, the majority of schools still had two or more outlets within the intervention area even after 10 years of implementations, suggesting high exposure according to Cutumisu et al., 2017. These findings bring into question whether the recommended food planning policies with the inclusion of the legacy clause would be effective at reducing availability of unhealthy food outlets to the

point where measurable improvements to health outcomes were observed. Further research is warranted for municipalities that have already implemented restrictive food planning policies to evaluate the effectiveness and other related impacts of a fast food ban around secondary schools.

Furthermore, findings from Manuscript 2, Chapter 5 support extant findings of gradients of inequity in access to food across communities (Bower et al., 2014; Elbel et al., 2019; Fleischhacker et al., 2011; Kraft et al., 2020; Zenk & Powell, 2008), with low- and medium- equity schools (those with high proportions of equity-deserving students across multiple marks of equity) currently have higher accessibility to unhealthy retailers compared to high-equity schools (those with low proportions of equity-deserving students) in the Region of Waterloo, Ontario. Similar to findings from Manuscript 1, Chapter 4, the recommended restrictive food planning policies reduced availability of unhealthy food retailers across all school-level equity categories. However, even after 10 years of implementation, low- and medium- equity schools still have higher projected access to unhealthy food retailers relative to high-equity schools. Therefore, recommended food planning policies appear to fail to consider the current inequitable gradient to the availability of unhealthy food retailers across equity-deserving communities and maintains inequitable access to unhealthy outlets after 10 years, highlighting potential equity implications. Given that such policies may have little impact on reducing access to less healthy food outlets in oversaturated communities, there is a need to consider the potential unintended consequences of such policies on equity-deserving communities who may already experience poorer food environments. For example, is it ethical to restrict food outlets that may be more financially accessible to equity-deserving communities such as low-income families? Is there a risk of perpetuating food insecurity if there are not also additional and tangential interventions to provide access to financially accessible fresh and healthy food options? These questions deserve attention in any assessment of a real-world policy implementation.

It is important to note the explicit connection to how physical environmental factors (i.e., healthy food availability) are shaped by social environmental factors (i.e., socioeconomic status) (Díez et al., 2019). Therefore, youth may experience the impacts of these restrictive food planning policies differently based on individual-level markers of equity (i.e., low household income,

racialized or immigrant), however data is currently presented at the school- or neighbourhood-level, limiting our understanding of the markers of equity at an individual-level. Given that health equity is a vital consideration when proposing interventions, especially for youth, a greater understanding of how such policies would impact communities who may already experience poorer food environments such as areas characterized as food deserts or food mirages is warranted. Although further research is required to gain a better understanding of the effectiveness of restrictive food planning policies proposed on improving population health outcomes, findings suggest that planners and practitioners should consider prioritizing interventions to improve the healthfulness of food environments around schools, especially where there are large proportions of equity-deserving students but may consider other or additional intervention methods.

6.2 Recommendations

6.2.1 Recommendation Area #1: Integration of Healthy Built Environment Framework and Food Systems Policies in Official Plans

6.2.1.1 Policies Supporting Healthy Built Environments

A healthy built environment is a key determinant of health, including social and emotional well-being. A previously mentioned, the understudied subfield of food systems planning is less visible than other urban planning related issues such as transportation, housing and employment however, it is a key pillar within the Healthy Built Environment (HBE) Framework Linkages Toolkit created by British Colombia's Provincial Health Services Authority. To ensure that food systems planning issues are considered and addressed within the planning process, a Healthy Built Environment Framework and specifically food systems planning policies into Official Plans in support of strengthening food systems. Lower-tier municipalities should consider both zoning that decreases access to unhealthy food while increasing access to healthy retailers, while the Region of Waterloo should consider integrating food justice and food equity principles into their vision, goals and objectives which will serve as guidance and direction for lower-tier municipalities.

The integration of an HBE Framework and food planning policies should be done in a way that emphasizes the connection between food access and other urban systems such as housing, and with food justice and food equity be implemented as an integral theme for policy plans and all

levels as food insecurity is an issues felt at provincial, municipal and community levels. These policies and objectives should support the increase of healthy financially accessible food access while other methods, such as zoning, are used to make it more difficult to access unhealthy foods. Consideration for access to healthy food should be addressed as an integral theme within all policy and development plans including subdivision plans and master plans given that food systems issues impact each community and individual.

6.2.1.2 Planning Policies for Healthy Food Outlets

Assessments of current food systems policies suggest that Regional plans lack attention to the affordability of food and social equity within the food system, in addition to the lack of language surrounding food equity, namely in the vision, goals and objectives (Mui et al., 2021), which has left communities to tackle these issues independent of and with little support from OP policies. For example, the Region of Waterloo's Food System Round Table and Toronto FoodShare. Food systems planning policies from a social equity lens should include those that encourage and incentivize the creation and implementation of healthy food initiatives that improve physical and financial access to healthy food in urban areas. Supportive food systems policies may impact various areas of the food system including food retailers, farmer's markets and community gardens.

Official plans, zoning by-laws and land-use planning provide opportunities for local governments to influence food environments and according to Vanderlee et al.'s 2017 report on creating healthier food environments in Ontario had a score of "None or Very Little" or "Low" for their lack of implementation of provincial government policy areas relevant to this researching including:

- Planning policies for unhealthy food outlets
- Planning policies for healthy food outlets
- Priorities for inequalities related to nutrition
- Increase taxes on unhealthy foods
- Monitoring food environments

Therefore, Regions and Municipalities in Ontario should implement actionable steps to support healthy food systems including but not limited to:

1. Planning policies encouraging the availability of outlets selling fresh fruit and vegetables
2. Integrate healthy food access into city and regional land use policies and community planning to establish healthy food environments
3. Provide incentives and regulations for stores to locate in underserved neighbourhoods (e.g increasing access to grocery stores)
4. Create healthy food zones via zoning or land-use bylaws
5. Planning policies to increase access to grocery stores and other healthy food outlets

Though a well-rounded and holistic approach to creating healthy food systems by meaningfully integrating food systems planning and policies that support the increase of access of healthy food options, planners can mitigate the ethical implications of the restrictive food planning policies examined in this thesis to ensure that equity-deserving communities have access to financially-accessible healthy food options.

6.2.2 Recommendation Area #2: Collaboration Between Public/ Community Health Practitioners and Planners

As presented in this thesis, the issue of food systems planning lies at the intersection of public health and urban planning. There is currently a disconnect between public health and planning as they work separately to achieve similar goals and solutions. Further, public health practitioners and researchers have recommended planning related solutions to public health problems (i.e restrictive food planning policies) however, there is little movement on the planning side to determine whether such a recommendation should continue to be explored, while there is ample evidence that urban planning decisions impact health. Moving forward, public health and planning departments should collaborate to explore and address issues related to health and the built environment with the objective of building healthy built environments. Research on the government's role in food systems planning suggest that when planning departments and public health departments are well-connected, health and chronic disease prevention are more easily implemented into ROP's (Wegener et al., 2012; Wegener et al., 2012). Planning departments should include public and community health colleagues in the plan-making process to create a robust and holistic framework to integrate public health solutions into the built environment and

planning policies. The goal of this collaboration would be to bridge the gap between public health and planning to ensure public health recommendations and planning decisions are aligned. As found in this thesis, however, sometimes public health recommendations have unintended impacts and may exacerbate inequities. Therefore, as much as possible, decisions need to be made within the framework of promoting health equity and with an understanding of existing evidence.

In many communities, organizations committed to addressing food systems issues already exist and have likely already taken steps to improve various food systems issues within their communities. Planning departments should seek guidance and insight from those doing on the ground work on how planning policy might best support the solutions that have already been implemented, rather than trying to reinvent the wheel. When reflecting on the importance of collaborating with and seeking expertise from existing knowledge-keepers, it is critical to understand how planners would work with equity-deserving and food justice organizations to improve access to healthy food. Rather than attempting to improve health outcomes as an external source, planners must figure out how to integrate food systems solutions to maintain food sovereignty among these equity-deserving groups and ask ourselves whether equity-deserving people want these kinds of interventions. Currently, it is researchers and governing authorities that have provided recommendations for improving access to health food and subsequently, health outcomes, however it is unclear whether public consultation has been conducted to determine whether this is something equity-deserving groups are concerned about or if they've been consulted regarding the implementation of restrictive food planning policies. Public participation from food justice and equity-deserving groups should be included in the policy making process as it relates to the inclusion of food equity goals and objectives in Regional and Municipal Official Plans.

6.2.3 Food Systems Planning Education and Planning Equity Training for Planners

In urban planning, what planners decide to build and where is important and similarly what planners are taught during their education is important, shaping the types of planners they will be. While current planning education provides the basis of urban planning theories, plans and

processes, planning education should include issues that go beyond and are less visible such as food systems or the impact of climate change, and educate planners on the relationships and connections between these issues that will have to be addressed in the very near future. Current planning education touches on visible urban systems such as infrastructure, transportation, and housing, all which impact access to food. Planners need to have an understanding of how more well-known systems impact and affect less visible systems such as access to food. Food systems issues have been largely siloed from transportation and housing issues, although they are intertwined. Planners need to have an understanding of these interrelationships and connections, in order to better address food systems issues through improvements to transportation and housing. By integrating lesser-known issues, such as food systems, that are interrelated with more prominent issues, planners can strive to improve community development and community health. By integrating food systems issues into the course materials already taught, planners will gain a more thorough understanding of the interrelations, and interconnectedness of urban systems, providing a more holistic perspective of planning and ensure lesser-known issues are still addressed. Further, planning education should present planning issues from an intersectional and equity perspectives that can be applied across various interests with the understanding that individual identities may result in individuals experiencing issues differently. This understanding and perspective is provide the necessary knowledge and insights for future planners to emphasize considerations for how issues, and the solutions to those issues may impact less visible equity-deserving communities differently.

The events of the past year such as the COVID-19 pandemic and the Black Lives Matter movement, have emphasizes societal inequities and propelled the paradigm shift within society and within the planning profession to challenge planners in being more intentional and aware of unconscious biases within research, planning practice and policy. It is important that planners understand where they may be falling short in truly considering the unintended consequences planning decisions and policy and the role that planners may play within cycles of systemic oppression.

6.3 Implications of Planning and Public Health

This research contributes to the understudied subfield of impacts of the built environment and youth/adolescent population health outcomes, especially within equity-deserving subgroups. This simulation study aimed to 1) provide planners, public health practitioners, and policymakers with an understanding of how recommended policies may impact food environments around schools in different contexts to inform decision-making regarding food policy interventions, and 2) contribute to the ongoing conversation of social inequities across food systems and highlight ethical implications of restrictive food planning policies.

This research adds valuable insights to the current body of knowledge of the topic of restrictive food planning policies by providing a look into the future of how these recommended food planning policies may impact food environments around schools and discusses the potential impact to schools with large proportions of equity-deserving students from a health equity perspective. This study is among the first to provide projected impacts of various restrictive food planning policies and their ability to reduce the availability of unhealthy food outlets around secondary schools. To date, this research is the first to examine the current state of food environments around secondary schools in the Region of Waterloo by markers of equity and increases awareness to less visible inequities such as food systems in regards to the built environment and population health outcomes for youth within a region with an existing interest in improving and strengthening regional food systems. It also provides municipalities with simulation model that can be replicated using unique data and examines different policies that municipalities can further explore based on their objectives, bridging the gap between planning research and practice.

6.3.1 So What?

Findings from this study brings into question whether the recommendation from public health practitioners to implement food planning policies such as zoning by-laws to restrict the location of unhealthy food outlets around secondary schools would be effective in reducing youth accessibility to sources of unhealthy foods. Although it is public health practitioners and researchers who recommend this restrictive food planning policy, no known research has evaluated the impacts of this policy. While public health units have substantial experience with evaluation,

they have yet to evaluate this recommendation. This may be because of the inconsistent findings among food access, or the challenges with measuring food environments. With many priorities within a municipality, evaluating food policies not widely implemented may not be feasible due to financial, and public relation challenges (i.e. seen as a waste of money). Further, while the Ontario Public Health Standards contain guidelines for chronic health, health equity and school health, none of these guidelines contains language surrounding evaluating restrictive food planning policies (Government of Ontario, Ministry of Health and Long-Term Care, 2018), leading to the assumption that this is not a priority for the province.

Findings show that due to the legacy clause that would exclude existing food retailers from the policy, the availability of unhealth retailers is reduced but not below the threshold of 'high exposure' (two or more food outlets) presented by Cutumisu et al., (2017) to indicate low exposure (less than one retailer). If the implementation of food planning policies does not improve population health outcomes, perhaps other interventions should be considered alongside or to replace these policies. Although out of the scope of this research, there is an inherent relationship between the density and proximity of food retailers and land use that will likely impact the effectiveness of such policies, especially in urban areas.

Furthermore, it is the role of urban planners to provide recommendations that best align with public interest; however, the public interest is often made up of various communities and perspectives, including equity-deserving groups that are likely to experience barriers to public participation including financial barriers (i.e., hourly shiftwork), or lack of childcare opportunities. In planning, there are multiple, competing interests and priorities among stakeholders and it is the role of urban planners to not only consider the interests that have been presented but also any unintended consequences that may result from a recommendation. For example, from the sole public health perspective of reducing availability to unhealthy food outlets around secondary schools, a 1km Euclidean restrictive food planning policy would be most effective however, from a health equity perspective, such as policy may have unintended consequences for communities that already experience food insecurity. Planners must consider the trade-offs of the implementation of restrictive food planning policies beyond the benefits from a public health

perspective including the impacts of land use, economic development and what this precedence would mean for future policy development. Furthermore, there is the question of what the permissible power of municipalities is to establish zoning on the basis of citizen's personal nutritional choices, and whether they should be allowed to regulate the specific types, density and proximity of food retailers.

6.3.2 Now What?

Given that both urban planning and public health are concerned with the built environment and population health outcomes, municipalities should encourage collaboration between planning and public health professionals to explore the relationship between the built environment and population health outcomes. Municipalities should consider implementing supportive healthy food policies to improve the access to healthy food options for equity-deserving communities to be addressed through both planning policy and practices as part of municipalities framework to building healthy built environments. Greater consideration and awareness to the unintended consequences of planning and policy decisions, especially on vulnerable (youth) and equity-deserving communities is warranted on behalf of urban planners when conducting due diligence and during the development of planning recommendations.

Based on the findings presented, for municipalities interested in implementing a restrictive food planning policy similar to those examined, policy planners should introduce planning policy that supports the strengthening of rural and urban food systems, and planning policy that supports healthy food systems. Planners interested in exploring restrictive food planning policies should conduct research on the current state of their food environments to identify potential areas of interest that may benefit from such a policy and include considerations for the collection of intersectional demographic data to examine the potential impacts of these restrictive food planning policies on communities.

Furthermore, planners should consider a range of distances from 200m-1km when conducting research on potential restrictive food planning policies that include explicit considerations for the potential impacts to equity-deserving communities from an individual-level

and how the implementation of such policies may impact future land use and economic development through additional technical reports. Lastly, planners should collaborate with public health professionals to tackles food system and health equity issues related to the built environment from a social equity lens. For example, the addition of additional programs and interventions in parallel to a restrictive food planning policy that would improve access to financially accessible healthy food options is warranted.

Schools boards have a significant opportunity in contributing to the improvement community health through creating school environments and policies that promote healthy eating and physical activity (Story et al., 2009). This includes educating youth on healthy eating habits through providing healthy food options in the in-school environment. Given that youth quickly develop eating patterns that track throughout their lives (Lien et al., 2001), providing knowledge of healthy eating behaviours, and the importance of a proper nutrition for youths ages 14-18 would be appropriate. Moveover, the availability of foods in-school impacts dietary behaviours. Studies have related the availability of unhealthy foods such as snacks and soft drinks sold in schools to students' high intake of total calories, and a lower intake of fruits and vegetables, reducing the availability of snacks and soft drinks sold in schools would support the goal of improving in-school food environments.

6.4 Recommendations for Future Research

The relationship between the built environment and population health outcomes for youth and equity-deserving communities is vastly understudied. Findings from this paper suggest that restrictive food planning policies aiming to reduce access to unhealthy food environments may be less effective and equitable than expected. Future public health research should evaluate the effectiveness of existing restrictive food policies, for example, in Lavaltrie, Quebec at reducing population-level access to unhealthy food retailers around secondary schools, while planning research should evaluate the policy development process for the implementation of policies that regulate or restrict the location of businesses, and/or marketing and advertisements in communities. In addition, planning research should examine how the regulation and restriction of

unhealthy food outlets would impact overall food access in communities using a gender-based analysis to consider the intersectional identities of individuals and the various systemic oppressors they may face. Taking into consideration potential challenges for municipalities to implement a policy with such a large intervention area, future research should consider smaller buffers or intervention areas (e.g., 500m), comparing the effectiveness of the various buffers on reducing exposure and access to unhealthy food retailers around schools. Given that these policies may have little impact on changing availability of unhealthy food outlets in areas that are already oversaturated, additional research is required on the impacts restrictive food planning policies may have across communities, especially equity-deserving communities, through an intersectional and equity lens.

Future research on health and the built environment should focus on qualitative research with grassroots organizations that focus on food justice, food equity and improving access to food. While this research was quantitative, it did not explore perspectives of this restrictive food planning policy from those that it would impact most, equity-deserving groups. Do they want this policy? How do they think it might impact them? This is a perspective that must be considered, in order to promote food sovereignty and food justice. Future research must seek to understand the impact of this policy would have from a social, economic and food equity perspective. If the food planning policy is not wanted by the public and would have negative economic impacts due to the restricting new food retailer establishments around schools, even in commercial or mixed-use areas. Lastly, if this policy does not support food equity, food justice or increased health equity, perhaps public health and planning practitioners and researchers should turn their attention to other public health interventions such as in-store interventions, or planning interventions such as improvements to mobility.

References

Afshin, A., Sur, P. J., Fay, K. A., Cornaby, L., Ferrara, G., Salama, J. S., Mullany, E. C., Abate, K. H., Abbafati, C., Abebe, Z., Afarideh, M., Aggarwal, A., Agrawal, S., Akinyemiju, T., Alahdab, F., Bacha, U., Bachman, V. F., Badali, H., Badawi, A., … Murray, C. J. L. (2019). Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. The Lancet, 393(10184), 1958–1972. https://doi.org/10.1016/S0140-6736(19)30041-8

An, R., & Sturm, R. (2012). School and Residential Neighborhood Food Environment and Diet Among California Youth. American Journal of Preventive Medicine, 42(2), 129–135. https://doi.org/10.1016/j.amepre.2011.10.01z

ArcGIS. (2021). Buffer (Analysis). Buffer (Analysis)-ArcGIS Pro | Documentation. https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/buffer.htm.

Ashe, M., Graff, S., & Spector, C. (2011). Changing places: Policies to make a healthy choice the easy choice. Public Health, 125(12), 889–895. https://doi.org/10.1016/j.puhe.2011.04.010

ASPQ (Association Pour La Sante publique Du Quebec). (2011). (rep.). The School Zone and nutrition: Courses of Action for the Municipal Sector. Quebec: ASPQ (Association Pour La Sante publique Du Quebec). Retrieved from https://www.aspq.org/nos-outils/the-school-zone-and-nutrition-a-guide-for-the-municipal-sector/

Austin, S. B., Melly, S. J., Sanchez, B. N., Patel, A., Buka, S., & Gortmaker, S. L. (2005). Clustering of Fast-Food Restaurants Around Schools: A Novel Application of Spatial Statistics to the Study of Food Environments. American Journal of Public Health, 95(9), 1575–1581. https://doi.org/10.2105/AJPH.2004.056341

BC Centre for Disease Control. Healthy Built Environment Linkages Toolkit: making the links between design, planning and health, Version 2.0. Vancouver, B.C. Provincial Health Services Authority, 2018.

Bower, K. M., Thorpe, R. J., Rohde, C., & Gaskin, D. J. (2014). The intersection of neighborhood racial segregation, poverty, and urbanicity and its impact on food store availability in the United States. Preventive Medicine, 58, 33–39. https://doi.org/10.1016/j.ypmed.2013.10.010

Butler, A., Mahendra, A., Robitaille, E., Polsky, J., Riou, M., Lefebvre, M., Prowse, R., Johnson, S., & McBrien, T., Access to Less Healthy Food Retail Outlets Relative to Secondary schools (2019). Ontario; OPHS (Ontario Public Health Standards).

Cairns, G., Angus, K., Hastings, G., & Caraher, M. (2013). Systematic reviews of the evidence on the nature, extent and effects of food marketing to children. A retrospective summary. Appetite, 62, 209–215. https://doi.org/10.1016/j.appet.2012.04.017

Canadian Institute of Planners. (2018). Policy on Healthy Communities Planning.

Charreire, H., Casey, R., Salze, P., Simon, C., Chaix, B., Banos, A., Badariotti, D., Weber, C., & Oppert, J.-M. (2010). Measuring the food environment using geographical information systems: A methodological review. Public Health Nutrition, 13(11), 1773–1785. https://doi.org/10.1017/S1368980010000753

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches. SAGE Publications, Inc.

Cutumisu, N., Traoré, I., Paquette, M.-C., Cazale, L., Camirand, H., Lalonde, B., & Robitaille, E. (2017). Association between junk food consumption and fast-food outlet access near school among Quebec secondary-school children: Findings from the Quebec Health Survey of High School Students (QHSHSS) 2010–11. Public Health Nutrition, 20(5), 927–937. https://doi.org/10.1017/S136898001600286X

da Costa Peres, C. M., Gardone, D. S., Costa, B. V. de L., Duarte, C. K., Pessoa, M. C., & Mendes, L. L. (2020). Retail food environment around schools and overweight: A

systematic review. Nutrition Reviews, 78(10), 841–856. https://doi.org/10.1093/nutrit/nuz110

Davis, B., & Carpenter, C. (2009). Proximity of Fast-Food Restaurants to Schools and Adolescent Obesity. American Journal of Public Health, 99(3), 505–510. https://doi.org/10.2105/AJPH.2008.137638

Day, P. L., & Pearce, J. (2011). Obesity-Promoting Food Environments and the Spatial Clustering of Food Outlets Around Schools. American Journal of Preventive Medicine, 40(2), 113–121. https://doi.org/10.1016/j.amepre.2010.10.018

Díez, J., Cebrecos, A., Rapela, A., Borrell, L. N., Bilal, U., & Franco, M. (2019). Socioeconomic Inequalities in the Retail Food Environment around Schools in a Southern European Context. Nutrients, 11(7), 1511. https://doi.org/10.3390/nu11071511

DMTI Spatial. (2019). CanMap Content Suite, v2019.3. Abacus Data Network. https://abacus.library.ubc.ca/dataset.xhtml;jsessionid=3335293e5978953f76ebd6caaa3c?persistentId=hdl%3A11272.1%2FAB2%2FPCTBFN&version=1.0&q=&fileTypeGroupFacet=&fileAccess=Restricted&fileTag=%22Delta%2BLayers%22&fileSortField=&fileSortOrder=.

Downs, S., & Demmler, K. M. (2020). Food environment interventions targeting children and adolescents: A scoping review. Global Food Security, 27, 100403. https://doi.org/10.1016/j.gfs.2020.100403

Drewnowski, A. (2009). Obesity, diets, and social inequalities. Nutrition Reviews, 67, S36–S39. https://doi.org/10.1111/j.1753-4887.2009.00157.x

DuBreck, C. M., Sadler, R. C., Arku, G., & Gilliland, J. A. (2018). Examining community and consumer food environments for children: An urban-suburban-rural comparison in Southwestern Ontario. Social Science & Medicine, 209, 33–42. https://doi.org/10.1016/j.socscimed.2018.05.004

Einstoss, C., Finkelstein, S., & Pimbert, H. (2015). Healthy Food Zones: Assessing Food Outlet Density and Purchasing Behaviours of Students. 42.

Elbel, B., Tamura, K., McDermott, Z. T., Duncan, D. T., Athens, J. K., Wu, E., Mijanovich, T., & Schwartz, A. E. (2019). Disparities in food access around homes and schools for New York City children. PLOS ONE, 14(6), e0217341. https://doi.org/10.1371/journal.pone.0217341

Engler-Stringer, R., Le, H., Gerrard, A., & Muhajarine, N. (2014). The community and consumer food environment and children's diet: A systematic review. BMC Public Health, 14(1), 522. https://doi.org/10.1186/1471-2458-14-522

Farthing, S. M. (2016). Research design in urban planning: A student's guide. SAGE.

Fleischhacker, S. E., Evenson, K. R., Rodriguez, D. A., & Ammerman, A. S. (2011). A systematic review of fast food access studies: Fast food access review. Obesity Reviews, 12(5), e460–e471. https://doi.org/10.1111/j.1467-789X.2010.00715.x

Forsyth, A., Wall, M., Larson, N., Story, M., & Neumark-Sztainer, D. (2012). Do adolescents who live or go to school near fast-food restaurants eat more frequently from fast-food restaurants? Health & Place, 18(6), 1261–1269. https://doi.org/10.1016/j.healthplace.2012.09.005

Garriguet, D. (2009). Diet quality in Canada. Health Reports, 20(3), 41–52.

Gebremariam, M. K., Vaqué-Crusellas, C., Andersen, L. F., Stok, F. M., Stelmach-Mardas, M., Brug, J., & Lien, N. (2017). Measurement of availability and accessibility of food among youth: A systematic review of methodological studies. International Journal of Behavioral Nutrition and Physical Activity, 14(1), 22. https://doi.org/10.1186/s12966-017-0477-z

Gilliland, J. A., Rangel, C. Y., Healy, M. A., Tucker, P., Loebach, J. E., Hess, P. M., He, M., Irwin, J. D., & Wilk, P. (2012). Linking Childhood Obesity to the Built Environment: A Multi-level Analysis of Home and School Neighbourhood Factors Associated With Body Mass Index. Canadian Journal of Public Health / Revue Canadienne de Santé Publique, 103, S15–S21.

Gordon-Larsen, P. (2014). Food Availability/Convenience and Obesity12345. Advances in Nutrition, 5(6), 809–817. https://doi.org/10.3945/an.114.007070

Government of Canada. (2019, December 6). Key Small Business Statistics - January 2019. Key Small Business Statistics . https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03090.html#point1-2.

Government of Ontario. (2020). School board and school authority contact information - Ontario Data Catalogue. School board and school authority contact information - Datasets - Ontario Data Catalogue. https://data.ontario.ca/dataset/school-board-and-school-authority-contact-information.

Government of Ontario. (2020). School enrolment by gender - Ontario Data Catalogue. School enrolment by gender - Datasets - Ontario Data Catalogue. https://data.ontario.ca/dataset/school-enrolment-by-gender.

Government of Ontario, Ministry of Health and Long-Term Care. (2018). *Ontario public health standards - programs and services - health care professionals - MOHLTC*. Ontario Public Health Standards - Programs and Services - Health Care Professionals - MOH. Retrieved November 2, 2021, from https://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/protocolsguidelines.aspx.

Hastings, G., Stead, M., Mcdermott, L., Forsyth, A., Mackintosh, A., Rayner, M., Godfrey, C., Caraher, M., & Angus, K. (2003). Children? A Systematic Review Of The Evidence.

He, M., Tucker, P., Gilliland, J., Irwin, J. D., Larsen, K., & Hess, P. (2012). The Influence of Local Food Environments on Adolescents' Food Purchasing Behaviors. International Journal of Environmental Research and Public Health, 9(4), 1458–1471. https://doi.org/10.3390/ijerph9041458

He, M., Tucker, P., Irwin, J. D., Gilliland, J., Larsen, K., & Hess, P. (2012). Obesogenic neighbourhoods: The impact of neighbourhood restaurants and convenience stores on adolescents' food consumption behaviours. Public Health Nutrition, 15(12), 2331–2339. https://doi.org/10.1017/S1368980012000584

Héroux, M., Iannotti, R. J., Currie, D., Pickett, W., & Janssen, I. (2012). The food retail environment in school neighborhoods and its relation to lunchtime eating behaviors in youth from three countries. Health & Place, 18(6), 1240–1247. https://doi.org/10.1016/j.healthplace.2012.09.004

Hilmers, A., Hilmers, D. C., & Dave, J. (2012). Neighborhood Disparities in Access to Healthy Foods and Their Effects on Environmental Justice. American Journal of Public Health, 102(9), 1644–1654. https://doi.org/10.2105/AJPH.2012.300865

Horst, M., McClintock, N., & Hoey, L. (2017). The Intersection of Planning, Urban Agriculture, and Food Justice: A Review of the Literature. *Journal of the American Planning Association*, *83*(3), 277–295. https://doi.org/10.1080/01944363.2017.1322914

Jang, S., & Kim, J. (2018). Remedying Food Policy Invisibility with Spatial Intersectionality: A Case Study in the Detroit Metropolitan Area. Journal of Public Policy & Marketing, 37(1), 167–187. https://doi.org/10.1509/jppm.16.194

Jeong, J., & Liu, C. Y. (2020). Neighborhood Diversity and Food Access in a Changing Urban Spatial Structure. City & Community, 19(4), 963–986. https://doi.org/10.1111/cico.12426

Kestens, Y., & Daniel, M. (2010). Social Inequalities in Food Exposure Around Schools in an Urban Area. American Journal of Preventive Medicine, 39(1), 33–40. https://doi.org/10.1016/j.amepre.2010.03.014

Kraft, A. N., Thatcher, E. J., & Zenk, S. N. (2020). Neighborhood Food Environment and Health Outcomes in U.S. Low-Socioeconomic Status, Racial/Ethnic Minority, and Rural Populations: A Systematic Review. 38.

Kumanyika, S., & Grier, S. (2006). Targeting Interventions for Ethnic Minority and Low-Income Populations. The Future of Children, 16(1), 187–207.

Kwate, N. O. A., & Loh, J. M. (2010). Separate and unequal: The influence of neighborhood and school characteristics on spatial proximity between fast food and schools. Preventive Medicine, 51(2), 153–156. https://doi.org/10.1016/j.ypmed.2010.04.020

Larson, N. I., Story, M. T., & Nelson, M. C. (2009). Neighborhood Environments. American Journal of Preventive Medicine, 36(1), 74-81.e10. https://doi.org/10.1016/j.amepre.2008.09.025

Lien, N., Lytle, L. A., & Klepp, K.-I. (2001). Stability in Consumption of Fruit, Vegetables, and Sugary Foods in a Cohort from Age 14 to Age 21. Preventive Medicine, 33(3), 217–226. https://doi.org/10.1006/pmed.2001.0874

Lind, P. L., Jensen, P. V., Glümer, C., & Toft, U. (2016). The association between accessibility of local convenience stores and unhealthy diet. European Journal of Public Health, 26(4), 634–639. https://doi.org/10.1093/eurpub/ckv242

Lu, C., & Ng, E. (2019). Healthy immigrant effect by immigrant category in Canada. *Health Reports*, *Volume 30*, Issue 4 April 2019 Pages 3-11. https://doi.org/10.25318/82-003-X201900400001-ENG

Luan, H., Minaker, L. M., & Law, J. (2016). Do marginalized neighbourhoods have less healthy retail food environments? An analysis using Bayesian spatial latent factor and hurdle models. International Journal of Health Geographics, 15(1), 29. https://doi.org/10.1186/s12942-016-0060-x

Mah, C. L., Cook, B., Rideout, K., & Minaker, L. M. (2016). Policy options for healthier retail food environments in city-regions. Canadian Journal of Public Health, 107(1), eS64–eS64. https://doi.org/10.17269/CJPH.107.5343

Mahendra, A., Polsky, J., Robitaille, É., Lefebvre, M., Mcbrien, T., & Minaker, L. (2017). Status report – Geographic retail food environment measures for use in public health. *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice*, *37*(10), 357–362.

Matsuzaki, M., Sánchez, B. N., Acosta, M. E., Botkin, J., & Sanchez-Vaznaugh, E. V. (2020). Food environment near schools and body weight—A systematic review of associations by race/ethnicity, gender, grade, and socio-economic factors. Obesity Reviews, 21(4). https://doi.org/10.1111/obr.12997

McCormack, G. R., Cabaj, J., Orpana, H., Lukic, R., Blackstaffe, A., Goopy, S., Hagel, B., Keough, N., Martinson, R., Chapman, J., Lee, C., Tang, J., & Fabreau, G. (2019). Evidence synthesis A scoping review on the relations between urban form and health: A focus on Canadian quantitative evidence. Health Promotion and Chronic Disease Prevention in Canada : Research, Policy and Practice, 39(5), 187–200.

Minaker, L. M., Shuh, A., Olstad, D. L., Engler-Stringer, R., Black, J. L., & Mah, C. L. (2016). Retail food environments research in Canada: A scoping review. Canadian Journal of Public Health, 107(1), eS4–eS4. https://doi.org/10.17269/CJPH.107.5344

Moudon, A. V., Drewnowski, A., Duncan, G. E., Hurvitz, P. M., Saelens, B. E., & Scharnhorst, E. (2013). Characterizing the food environment: Pitfalls and future directions. Public Health Nutrition, 16(7), 1238–1243. https://doi.org/10.1017/S1368980013000773

Mui, Y., Khojasteh, M., Judelsohn, A., Sirwatka, A., Kelly, S., Gooch, P., & Raja, S. (2021). Planning for Regional Food Equity. Journal of the American Planning Association, 87(3), 354–369. https://doi.org/10.1080/01944363.2020.1845781

Nelson, M. C., Story, M., Larson, N. I., Neumark-Sztainer, D., & Lytle, L. A. (2008). Emerging Adulthood and College-aged Youth: An Overlooked Age for Weight-related Behavior Change. Obesity, 16(10), 2205–2211. https://doi.org/10.1038/oby.2008.365

NPLAN (National Policy & Law Analysis Network to Prevent Childhood Obesity). (2009). (rep.). Creating a Healthy Food Zone Around Schools. ChangeLab Solutions. Retrieved from http://www.changelabsolutions.org/sites/default/files/HealthyFoodZone_FactSht_FINAL_091008.pdf

Ohri-Vachaspati, P., DeWeese, R. S., Acciai, F., DeLia, D., Tulloch, D., Tong, D., Lorts, C., & Yedidia, M. J. (2019). Healthy Food Access in Low-Income High-Minority Communities: A Longitudinal Assessment—2009–2017. International Journal of Environmental Research and Public Health, 16(13), 2354. https://doi.org/10.3390/ijerph16132354

Ontario Professional Planners Institute (OPPI). (2011). Healthy Communities and Planning for Food Planning for Food Systems in Ontario A Call to Action from the Ontario Professional Planners Institute. Ontario.

Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods, 5*(4), 371-385. doi:10.1002/jrsm.1123

Pitt, T. M., Aucoin, J., HubkaRao, T., Goopy, S., Cabaj, J., Hagel, B., & McCormack, G. R. (2021). The Relationship of Urban Form on Children and Adolescent Health Outcomes: A Scoping Review of Canadian Evidence. International Journal of Environmental Research and Public Health, 18(8), 4180. https://doi.org/10.3390/ijerph18084180

Pothukuchi, K., & Kaufman, J. L. (1999). Placing the Food System on the Urban Agenda: The Role of Municipal Institutions in Food Systems Planning. *Agriculture and Human Values*, *16*(2), 213–224.

Powell, L. M., Slater, S., Mirtcheva, D., Bao, Y., & Chaloupka, F. J. (2007). Food store availability and neighborhood characteristics in the United States. Preventive Medicine, 44(3), 189–195. https://doi.org/10.1016/j.ypmed.2006.08.008

Powell, P. K., Lawler, S., Durham, J., & Cullerton, K. (2021). The food choices of US university students during COVID-19. Appetite, 161, 105130. https://doi.org/10.1016/j.appet.2021.105130

Region of Waterloo. Regional Official Plan. Available online: http://www.regionofwaterloo.ca/en/regionalGovernment/PreviousROP.asp

Robitaille, E., Paquette, M.-C., Cutumisu, N., Lalonde, B., Cazale, L., Traoré, I., & Camirand, H. (2016). (rep.). The Food Environment Around Public Schools and the Consumption of Junk Food for Lunch by Quebec Secondary School Students. Quebec: INSPQ (Institut National De Sante Publique Du Quebec. Retrieved from https://www.inspq.qc.ca/pdf/publications/2143_food_environment_public_schools.pdf

RoW (Region of Waterloo). (2020). Region of Waterloo: Population. Region of Waterloo. https://www.regionofwaterloo.ca/en/regional-government/population.aspx#.

Sadler, R. C., Clark, A. F., Wilk, P., O'Connor, C., & Gilliland, J. A. (2016). Using gps and activity tracking to reveal the influence of adolescents' food environment exposure on junk food purchasing. Canadian Journal of Public Health, 107(S1). https://doi.org/10.17269/cjph.107.5346

Sadler, R. C., & Gilliland, J. A. (2015). Comparing children's GPS tracks with geospatial proxies for exposure to junk food. Spatial and Spatio-Temporal Epidemiology, 14–15, 55–61. https://doi.org/10.1016/j.sste.2015.09.001

Seliske, L. M., Pickett, W., Boyce, W. F., & Janssen, I. (2008). Association between the food retail environment surrounding schools and overweight in Canadian youth. Public Health Nutrition, 12(9), 1384–1391. https://doi.org/10.1017/S1368980008004084

Seliske, L. M., Pickett, W., Boyce, W. F., & Janssen, I. (2009). Density and type of food retailers surrounding Canadian schools: Variations across socioeconomic status. Health and Place, 15(3), 903–907. https://doi.org/10.1016/j.healthplace.2008.11.001

Seliske, L., Pickett, W., Rosu, A., & Janssen, I. (2013). The number and type of food retailers surrounding schools and their association with lunchtime eating behaviours in students. International Journal of Behavioral Nutrition and Physical Activity, 10(1), 19. https://doi.org/10.1186/1479-5868-10-19

Shareck, M., Lewis, D., Smith, N. R., Clary, C., & Cummins, S. (2018). Associations between home and school neighbourhood food environments and adolescents' fast-food and sugar-sweetened beverage intakes: Findings from the Olympic Regeneration in East London (ORiEL) Study. Public Health Nutrition, 21(15), 2842–2851. https://doi.org/10.1017/S1368980018001477

Shearer, C., Rainham, D., Blanchard, C., Dummer, T., Lyons, R., & Kirk, S. (2015). Measuring food availability and accessibility among adolescents: Moving beyond the neighbourhood boundary. Social Science & Medicine, 133, 322–330. https://doi.org/10.1016/j.socscimed.2014.11.019

Statistics Canada. (2018, March 23). North American Industry Classification System (NAICS) Canada 2012. Government of Canada, Statistics Canada. https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=118464.

Stevenson, A. C., Brazeau, A.-S., Dasgupta, K., & Ross, N. A. (2019). Evidence synthesis - Neighbourhood retail food outlet access, diet and body mass index in Canada: A systematic review. Health Promotion and Chronic Disease Prevention in Canada : Research, Policy and Practice, 39(10), 261–280.

Story, M., Nanney, M. S., & Schwartz, M. B. (2009). Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity. *Milbank Quarterly*, *87*(1), 71–100. https://doi.org/10.1111/j.1468-0009.2009.00548.x

Sturm, R., & Cohen, D. A. (2009). Zoning For Health? The Year-Old Ban On New Fast-Food Restaurants In South LA. Health Affairs, 28(6), W1088–W1097. http://dx.doi.org.proxy.lib.uwaterloo.ca/10.1377/hlthaff.28.6.w1088

Tam, T. The Chief Public Health Officer's Report on the State of Public Health in Canada 2017– Designing Healthy Living, The Chief Public Health Officer's Report on the State of Public Health in Canada 2017 – Designing Healthy Living (2017).

University of Waterloo. (2020, July 22). *Food system roundtable*. Our Food Future – Waterloo Region. https://uwaterloo.ca/food-future-waterloo-region/about/food-system-roundtable.

Vanderlee, L., Goorang, S., Karbasy, K., Schermel, A., & L'Abbé, M. (2017). (rep.). *Creating Healthier Food Environments in Canada: Current Policies and Priority Actions*. Food EPI Canada. Retrieved September 15, 2021, from https://labbelab.utoronto.ca/wp-content/uploads/2017/12/FoodEPI_Summary_Report_WEB-Final.pdf.

Vargas, C. M., Stines, E. M., & Granado, H. S. (2017). Health-equity issues related to childhood obesity: A scoping review. Journal of Public Health Dentistry, 77(S1), S32–S42. https://doi.org/10.1111/jphd.12233

Wegener, J., Hanning, R. M., & Raine, K. D. (2012). Generating Change: Multisectoral Perspectives of Key Facilitators and Barriers to Food System Policy Making. *Journal of Hunger & Environmental Nutrition*, *7*(2–3), 137–148. https://doi.org/10.1080/19320248.2012.707115

Wegener, J., Raine, K. D., & Hanning, R. M. (2012). Insights into the Government's Role in Food System Policy Making: Improving Access to Healthy, Local Food Alongside Other Priorities. International Journal of Environmental Research and Public Health, 9(11), 4103–4121. https://doi.org/10.3390/ijerph9114103

Williams, J., Scarborough, P., Matthews, A., Cowburn, G., Foster, C., Roberts, N., & Rayner, M. (2014). A systematic review of the influence of the retail food environment around schools on obesity-related outcomes. Obesity Reviews, 15(5), 359–374. https://doi.org/10.1111/obr.12142

Zenk, S. N., & Powell, L. M. (2008). US secondary schools and food outlets. Health & Place, 14(2), 336–346. https://doi.org/10.1016/j.healthplace.2007.08.003