

**Hot Weather in a Cold Land: Hot weather planning
and vulnerable populations in Toronto, Canada.**

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**A thesis submitted in partial fulfilment of the
requirements for the degree of Doctor of Philosophy.
The candidate has already achieved 180 credits for
assessment of taught modules within the blended
learning PhD programme**

July 2019

Faculty of Health and Medicine

Lancaster University

**I declare that this thesis is my own work and has not been submitted for
the award of a higher degree elsewhere**

Acknowledgements

I dedicate this thesis to my wife Laurel, who has been with me every step of the way through this journey. Your love, support and encouragement are the reasons that I have been able to get so far in life. I also dedicate this to my daughters Alexandra and Emma, my mother and sisters. I could not have asked for a better group of ladies in my life.

I would also like to express my sincere gratitude to my two supervisors for their unwavering support and direction throughout these past few years. These two people selflessly dedicated years of their time to my work and for that I admire and respect them. Firstly, Dr. Paula Holland, who always believed in my work and challenged me to continue to do better. Her guidance, attention to detail and constant encouragement made this journey easier. I also must thank Professor Gordon Walker, a true professional. As I progressed through this thesis his role unexpectedly expanded, he devoted countless hours to my work and practically carried me over the finish line. Without you two, I would not be here today.

I also want to recognise the 2011 cohort of the PhD Public Health programme. I have never met a finer group of people. We all instantly formed a bond and encouraged each other throughout our journey. Thank you for all the never-ending support.

Finally, I want to thank my father and aunt who, unfortunately, are no longer with us. They were and continue to be my inspiration. You both wanted to see the word "Doctor" before my name, I hope I made you proud.

Abstract

Background

Climate change has resulted in changes to weather patterns and to the intensity of extreme atmospheric phenomena. One of the most significant of these changes is manifested as increased intensity and frequency of hot weather events. To mitigate the effects of extreme heat, many cities have implemented 'hot weather', or 'heat wave' response programmes. However, the effectiveness of these, and how well they protect vulnerable populations remain under-researched issues.

Objective

This thesis examined whether the people of Toronto who are most vulnerable to extreme heat, have been properly identified and served by Toronto's Hot Weather Response Programme.

Design

This thesis utilised qualitative techniques in the form of a thematic critique of documentary sources and semi-structured interviews. Documents pertaining to Toronto's Hot Weather Response Programme were analysed to gain an understanding of the evolution of the programme. Interviews were also conducted with vulnerable residents to understand their perceptions and experiences with hot weather and Toronto's programme.

Findings

The thematic critique determined that over the time period 1999 to 2019, there were multiple changes to the criteria used for calling alerts/warnings, repeated revisions to the definition of vulnerability, shifts in communication techniques and drastic reductions in budget and services. The interviews indicated that recipients had limited knowledge of the negative consequences of hot weather, lived in conditions that were detrimental to their health, did not have mitigation plans, and the amenities that were available to them were insufficient to be protective.

Discussion

The findings indicate that the vulnerable populations of Toronto have been inadequately identified by health officials and the methods used to reach them have been poorly selected. These populations demonstrated a lack of knowledge of Toronto's hot weather programme and of protective measures necessary during oppressive heat. Toronto's once 'cutting edge' hot weather response program has been greatly diminished due to a lack of proper evaluations and budgetary cuts which underestimate the value of elements of the programme.

Conclusions and recommendations

This thesis demonstrated the benefits of proper planning and evaluation for public health programmes. It also illustrated how political or economic pressure can alter the delivery of services and can attenuate the potency of mitigation activities, such that they can instead increase vulnerability.

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Chapter 1: Introduction

1.1 Introduction

In recent years, climate change has resulted in alterations of global weather patterns and has increased and intensified the severity of atmospheric phenomena (Ward & Shively, 2012). This is of greatest concern when it comes to heat-related events, as heat is regarded as the deadliest atmospheric phenomena worldwide (Sheridan *et al.*, 2012, Huang *et al.*, 2011) and as one of the 21st Century's greatest threats to health (Ford, *et al.*, 2010). Over the past half-century, there has been a steady net increase in the earth's surface temperature with each successive year being, on average, hotter than its preceding year (Simmons *et al.*, 2017). There has also been an increase in the average temperature of the summer months and in the frequency of extreme heat events, particularly in the Northern Hemisphere (Kamae, Shiogama, Watanabe, & Kimoto, 2014). Climatologists generally agree that due to human influence, the risk of the occurrence of a heatwave such as the deadly 2003 European heat wave have more than doubled (Haines *et al.*, 2006). Since the 1970s, there has been a rapid increase in the world's temperature by 0.5°C, and it is predicted that by the year 2100 there will be an average temperature increase globally of between 1.4 to 5.8 °C (Mcmichael *et al.*, 2005).

The impact of unusually hot weather is most obvious in temperate countries that have previously been unaccustomed to such conditions (Harlan *et al.*, 2006). In the United States of America, hot weather has been estimated to account for

more deaths annually than any other weather related event (Hartz *et al.*, 2012). In Toronto, Canada it has been estimated that an additional 120 deaths occur each year as a result of hot weather (Rinner *et al.*, 2010) and with the North American summer of 2018 producing some of the continent's hottest recorded temperatures (Samenow, 2018), it is evident that more attention must be paid to heat by public health officials.

As a result of these temperature increases and deadly heat waves, in recent decades many cities have implemented Heat Warning and Response Programmes (Ebi, Teisberg, Kalkstein, Robinson, & Weiher, 2004; Hartz, Golden, Sister, Chuang, & Brazel, 2012; Alberini, Gans, & Alhassan, 2011). These programmes are typically intended to alert the public that dangerous heat conditions exist or are forecast and provide an appropriate response once those conditions prevail.

One of the first such programmes introduced was in Philadelphia, USA, as a result of deadly heat waves in 1985 (Ebi *et al.*, 2004; Kalkstein, Jamason, Greene, Libby, & Robinson, 1996; Kalkstein, Greene, Mills, & Samenow, 2010). This was followed by similar programmes throughout the United States, Asia, Europe and Canada (Kirtsaeng & Kirtsaeng, 2015; Hajat *et al.*, 2010). The first such programme introduced in Canada was in Toronto. At its inception, the Toronto programme, was a two-stage venture which aimed to alert the citizens of Toronto to the presence of oppressive heat conditions and then provide response services such as drinking water and education on health protection practices (Basrur, 2002). The programme has evolved over time and there have been changes to both the alerting phase and the response activities. The changes to the programme are so substantial that the current iteration of the

programme bears only cursory resemblance to the one first implemented (Benny, 2017). The programme which was intended to provide adequate relief services for the citizens of Toronto most vulnerable to heat, may not be doing so and hence this is the major target of inquiry for this thesis.

1.2 Statement of problem

The effects of climate change on public health are most likely to be manifested as increased levels of mortality due to ambient temperatures. As such, health protection from hot weather is becoming increasingly necessary (Hajat, Vardoulakis, Heaviside, & Eggen, 2014). At the same time, officials at the local public health levels are well positioned to create programmes and policies aimed at mitigating those effects (Araos, Austin, Berrang-Ford, & Ford, 2016). Most public health interventions target the general population (Mayrhuber *et al.*, 2018), as the discipline of public health is rooted in the improvement of health of communities rather than individuals (Kass, 2001). However, because vulnerability to hazards is differentiated across the population, with disadvantaged groups being more vulnerable, general, non-targeted interventions can create further health inequities.

Diderichsen, Hallqvist, & Whitehead (2018) suggest that this uneven distribution of vulnerability across socioeconomic groups results from what they term differential exposure, differential effects and differential consequences. Differential exposure refers to the range of exposure factors that people in society are subject to, due to their types of work, economic and residential conditions. Differential effects refer to situations where different effects are

observed across different groups and differential consequences refers to situations where the same illness or injury can have different consequences within and among different groups (Diderichsen *et al.*, 2012). In Toronto, many residents fall into socioeconomic categories that may be considered as being vulnerable to heat, those being elderly (Åström, Forsberg, & Rocklöv, 2011), low income (Declét-Barreto, 2013), recent immigrants (Chen, 2010), having English as a second language (Hansen *et al.*, 2014), racialised minority (O'Neill, Zanobetti, & Schwartz, 2005a), socially isolated (Semenza *et al.*, 1996), living in substandard housing (Chestnut, Breffle, Smith, & Kalkstein, 1998), or a combination of one or more of those categories.

Toronto's Hot Weather Response Programme initially started off as a pilot project and was then instituted as a seasonal program to be delivered on an annual basis (Toronto City Council, 2000). Upon its implementation, a substantial budget was allocated to the programme, staff were assigned, and duties and responsibilities were designated for various departments, divisions and organisations. As will be shown, over the past 20 years the programme gradually morphed into what exists today with multiple changes, often without empirical evidence to support those changes. This directly contrasts with the generally accepted approach of 'evidence based public health' a term which describes decisions about the care of communities in terms of health protection, health promotion and disease prevention being made on the best available evidence (Janicek, 1997).

1.3 Research focus

This study examines the relationship between vulnerability to, and responses to, the potential impacts on health of hot weather and considers Toronto's Hot Weather Response Programme as a means of doing so. Using a thematic critique of programme documents over a 20-year period, the Toronto programme was examined to draw out and analyse why it was initially implemented, the intended target audience, what services were initially offered, the allocation of resources, the current provision of services and the reasons for the changes made to the programme over time. As a second part of the research, interviews were conducted with members of Toronto's vulnerable communities, to explore their experiences with heat, their perceptions of its impact on their health, their coping strategies and to gauge their awareness of the programme and its activities.

1.4 Aim and objectives of the study

1.4.1 Aim of study

The aim of this study is to determine if people defined as vulnerable to the effects of hot weather receive the appropriate level of protection and response by public health officials in Toronto, Canada. To accomplish this aim, several objectives were pursued.

1.4.2 Objectives of the study

1. To identify population types most vulnerable to hot weather.
2. To identify the various heat-related health issues faced by vulnerable individuals.
3. To gain an understanding of the elements of Toronto's Hot Weather Response Programme and how and why these have changed over time.
4. To determine how members of Toronto's vulnerable communities experience heat and their coping strategies for dealing with that heat.
5. To determine if the intended recipients are aware of the Hot Weather Response Programme and its response activities and if so, to understand how they perceive the benefits of the programme.
6. To identify barriers that prevent potential recipients of the programme from utilising hot weather relief facilities and resources.
7. To identify barriers and gaps in programme delivery and uptake that would allow the programme to be better received.

1.4.3 Research question

Does Toronto's response to hot weather address the needs of population groups most vulnerable to heat?

1.5 Overview of methodology

This study was conducted from an interpretivist viewpoint and employed qualitative techniques. Qualitative inquiry is usually used when the aim of research is to gain an in-depth understanding of a situation (Holloway & Biley, 2011). The qualitative techniques used in this study were a thematic critique of historical and current programme documents and qualitative semi-structured interviews with a cross-section of vulnerable residents of Toronto.

A thematic critique is a form of document analysis, a method of examining current and historical documents and extracting data which can then be interpreted in the context of the phenomena being studied (Caulley, 1983). The qualitative interviews utilised semi-structured questions to gain detailed, in-depth perspectives from the population of interest. The data extracted from both the thematic critique and the interviews were analysed using thematic analysis (Petty, Thomson, & Stew, 2012). Through thematic analysis, themes and sub-themes emerged which were further analysed within the context of the theoretical framework and used to answer the research question.

1.6 Study setting

This study was set in Toronto, located along the shorelines of Lake Ontario, in the southern portion of Canada. Toronto is approximately 641 km² in area and has a perimeter of approximately 180 km (City of Toronto, 2017b). The annual average daily temperature in Toronto is 9.4 °C and the summer average daily temperature is approximately 21°C (The Weather Network, 2018). However,

temperatures have ranged from -32.8 °C in January to over 40°C in August (Government of Canada, 2016). These very high summer time temperatures have accounted for many deaths (Gower, Campbell, *et al.*, 2010).

1.6.1 Demographics of Toronto

Toronto is the largest city in Canada and the fourth largest in North America. Its population is estimated at 2,790,000 (City of Toronto, 2016), an 11% percent increase since 2006 (City of Toronto, City Planning, Social Policy Analysis & Research, 2012). Even though Toronto has approximately 8% of the total population of Canada, it is home to 20% of all immigrants who have settled in Canada and 30% of the most recent immigrants (City of Toronto, 2016).

Due to the large immigrant population, it is not surprising that approximately 49% of Toronto residents have reported that English was not their mother tongue (Figure 1.1) (Statistics Canada, 2013) and 5% of the city's population have no knowledge of either of official language, English or French (City of Toronto, 2012).

This large immigration has also influenced the ethnic diversity of Toronto, with 49% of the population reporting that they were not born in Canada (City of Toronto, 2016). This is more than double the national average of 21%. Around half (49%) of Toronto's residents also identified themselves as a visible minority, that is being non-Caucasian in race. Although the largest ethnic group identified as being of British origin, it was similar in proportion to those of Chinese origin (City of Toronto, 2013a).

Employment conditions are also different than in other parts of Canada. Toronto has a higher unemployment rate (9.3%) than the Canadian average (7.8%), and unemployment rates are even higher for residents with lower levels of education (City of Toronto, 2013b). The high unemployment rate is partially explained by the fact that one sixth of recent immigrants to Canada settled in Toronto and one in twelve residents of Toronto moved to the city from outside Canada in the past 5 years. Often without previous Canadian work experience, obtaining formal employment is extremely difficult.

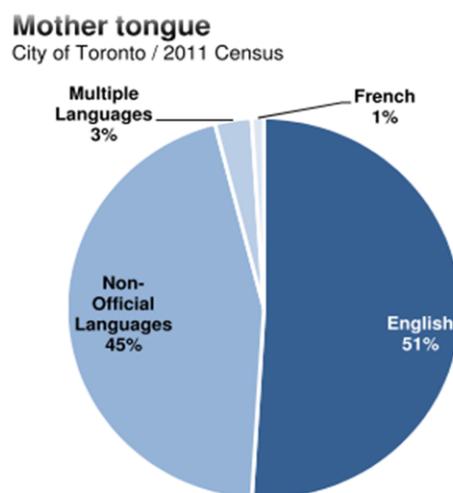


Figure 1. 1 Mother tongue of population of Toronto
(City of Toronto, 2013d)

Toronto is ranked ninth out of 15 major Canadian cities in household income (City of Toronto, 2013c) . As an example, Toronto's median household income is \$58,380, compared to Calgary which is highest in the country at \$81,256. Edmonton, with a population of 730,000, has a median household income of \$72,248 (City of Toronto, 2013c). According to Statistics Canada (2015),19%

of the population of Toronto was living with an after-tax income below the low-income measurement level.

Home-ownership in Toronto is below the national average, with approximately 45% of residents renting their place of accommodation compared with those in the cities surrounding Toronto (19%) or in the rest of Canada (31%) (City of Toronto, 2013c). Rental units in Toronto vary from single family homes to much older multi-residential, high-rise buildings, often lacking many modern amenities such as air-conditioning or proper insulation.

More than a quarter of the population of Toronto (26%) is over 55 years old and this percentage has grown steadily from 22.6% in 2001 (City of Toronto, City Planning, Social Policy Analysis & Research, 2012). This is further illustrated by the fact that between 2006 and 2011, the population groups in Toronto with the fastest rates of growth were seniors between the age of 60-65 and 85 plus (City of Toronto, City Planning, Social Policy Analysis & Research, 2012).

The very diverse population of Toronto, prominently made up of recent immigrants with multiple languages, lower employment rates than the rest of Canada, a rapidly growing senior population and lower income levels than the national average, makes it an ideal subject for the study of vulnerability to heat, as these factors contribute significantly to this phenomena (Kosatsky, Henderson, & Pollock, 2012; Kazmierczak, 2012; Berko & Ingram, 2014).

1.7 Hot weather in Toronto

1.7.1 Heat Waves and mortality in Toronto

Each year in Toronto, there are, on average, at least 15 days where temperatures are 30°C or higher (Gower, Mee, & Sabanadesan, 2011). As shown in Figure 1.2, these numbers are expected to rise due to the effects of climate change, such that by the period 2080-2100, it is predicted that, annually, the city will experience over 65 days with such temperatures (Hengeveld, Whitewood, & Fergusson, 2005).

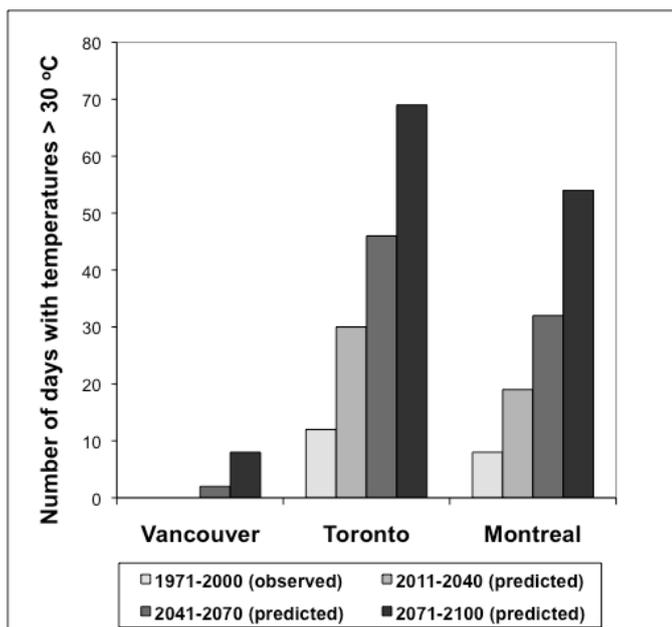


Figure 1. 2 Number of days with temperatures above 30°C in various Canadian cities.

Source: (Medical Officer of Health, 2011)

Pengelly *et al.* (2007), examined the number of all non-traumatic deaths in Toronto for the period 1954-2000, adjusted for non-environmental factors, performed regression analysis and estimated that on average, there are 120 deaths per year in Toronto that can be attributed to extreme heat. With the number of hot days continuing to rise, it is assumed that the number of annual deaths due to heat should also rise.

1.7.2 Toronto's response to heat waves

Toronto's Hot Weather Response Programme is a multi-agency, inter-department venture which is led by the Public Health Department. The programme is two-staged and involves an alerting phase and a subsequent response phase and has evolved significantly since it was first implemented. With Toronto being the largest city in Canada and having the largest health department, it is generally seen as serving as a model for other municipalities who are in the process of establishing their own.

In Toronto, the programme runs from May 15th to September 30th of each year (City of Toronto, 2015). Every morning, during this period, a determination is made by Toronto's Medical Officer of Health, in consultation with the manager of the programme, of whether to call a heat warning and trigger its subsequent response activities. Once these warnings are called, information is released to the media and the City of Toronto's website is updated with information on the warning. Response activities also commence. However, due to the demographic makeup of the city, not everyone may have easy access to the city's website or the relevant media.

As such there is a distinct possibility that people in need of help with the oppressive heat may not be aware or benefit from the available resources. Gaining greater insights into these topics is at the heart of this study.

1.8 Preview of chapters

The following is a summary of the overall structure of this thesis, including a brief preview of the contents of each chapter.

Chapter two critically examines the available literature on social vulnerability, enabling understanding of what makes individuals vulnerable to extreme heat so that the appropriate individuals could be selected for interviews. There is also a focus on risk perception, as it pertains to natural hazards and in particular hot weather, as risk perception forms an integral part in the understanding of vulnerability. Finally, models of vulnerability are reviewed and the theoretical framework underpinning the study, the Hazards of Place Model of vulnerability, is discussed.

Chapter three describes the methodology and methods employed in this study, including discussion of the documents used in the thematic critique, the sampling methods and recruitment strategy used in the primary research, and data analysis. It should be noted that I am the manager of Toronto's Hot Weather Response Programme and over the years I have had many conversations with programme officials which has shaped my understanding of the programme. As such I will be occasionally drawing from those conversations

to frame some of the findings in this study and to help bridge gaps where they may exist.

Chapters four and five present the results of the study, with chapter four describing the themes that emerged from the thematic critique of programme documents and chapter five describing the findings from the qualitative interviews, conducted with a cross-section of Toronto's heat vulnerable population.

Chapter six synthesises and discusses the study findings in relation to previous work on social vulnerability, climate change and extreme heat and answers the research questions.

Chapter 7 discusses the limitations and strengths of the study, makes relevant recommendations for similar programmes and future research, and concludes the thesis.

1.9 Summary

This chapter has emphasised the rising threat to health of heat wave events due to climate change. It has laid out the problem the thesis is focused on and the specific aim and objectives that have directed the investigation. It has also introduced the hot weather response programme at the City of Toronto and has identified why it is the subject of this inquiry. As made clear, while it is viewed as a ground-breaking programme, particularly in Canada, the programme has changed significantly since it was first implemented and may not properly serve its intended recipients. The core question is therefore to establish whether

Toronto's programme, as it is currently exists. is built on a solid understanding of vulnerability, and if the resulting response activities are ideally suited to provide the best services to the vulnerable populations of Toronto. In the next chapter, existing knowledge on social vulnerability and vulnerability to heat will be reviewed to underpin and set the scene for the remainder of this thesis.

Chapter 2- What is known and what is to be determined. A literature review on heat vulnerability and a theoretical framework to underpin the research

2.1 Introduction

This chapter presents a review of literature on vulnerability to heat and of perceptions of risk from natural hazards, with a focus on heat waves. As well as underpinning the thesis, the review is focused on determining the segments of the population that are the most likely to be affected by heat, both to provide information on the groups from which participants should be drawn for the interviews, and to determine if Toronto's Hot Weather Program is targeted at the correct population groups. The chapter then presents a theoretical framework which underpins the thesis by reviewing various models of vulnerability and presenting the model that was most applicable to this study.

2.2 Which population groups are most vulnerable to heat?

The following sections describe the literature review that was conducted to gain an understanding of which populations are most vulnerable to the effects of excessive heat.

2.2.1 Search strategy

In order to identify gaps in the existing literature and to answer several of the research objectives posed in section 1.4.2, a systematic approach was used to search the literature (Webster & Watson, 2002). This began with the search of several electronic databases, Google Scholar, government websites as well as a search of grey literature. Jackson & Waters (2005) indicate that since public health literature is likely to be widely dispersed, such an approach is necessary.

2.2.2 Databases

The Lancaster University Library website has recommendations for searching literature, including subject guides and lists of databases relevant to various topics. Using the recommendations for health-related literature, the electronic databases PubMed, Web of Science and MEDLINE Complete were used as they were identified as most likely to produce literature relevant to the topic of interest.

2.2.3 Key terms

This study was related to hot weather and social vulnerability and with my prior experience in the subject and in reading literature on the topic, I was aware that the terms "hot weather" or "heat" were both regularly used interchangeably, and they were often used in reference to both "social vulnerability" and

"vulnerability". Therefore, the following terms with the Boolean operator "AND" were used to search the databases:

- a. Heat AND social vulnerability
- b. Heat AND vulnerability
- c. Hot Weather AND social vulnerability
- d. Hot Weather AND vulnerability.

2.2.4 Inclusion and exclusion criteria

Many of the more devastating and deadly heat waves in the developed world, have been observed since the 1990s and various heat response programmes have been implemented in response to them. One of the earliest heat response programme was that of Chicago and it proved to be effective at mitigating the effects of extreme heat during the 1995 heat wave (O'Neill, Carter, Kish, Gronlund, White-Newsome, Manarolla, Zanobetti, Schwartz, et al., 2009). Since then more programmes have been implemented across the world, utilising lessons learned from Chicago's experience. Considering this, I decided to exclude studies that were published prior to 1995.

I also decided to include only studies that were published in English, as I am unilingual and would be unable to understand any study published in any language other than English. Even though this thesis is a qualitative study, I included both quantitative and qualitative studies in the review, as the subject of heat and social vulnerability is still relatively new, and I wanted to ensure that

I could gain as comprehensive an understanding of the subject as possible and that necessitated using studies with both methodological approaches. The inclusion and exclusion criteria used in the literature review are presented in Table 2.1 and the search strategy is illustrated in Figure 2.1

Table 2. 1 Inclusion and exclusion criteria used in search strategy

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Studies published after 1995 | Studies published before 1995 |
| Studies published in English | Studies published in languages other than English |
| Quantitative, qualitative and mixed methods studies | |
| Studies involving human subjects | Studies involving non-human subjects |
| Studies involving participants 18 years and older | Studies involving participants less than 18 years old |

| | |
|--|--|
| Studies involving non-occupational heat exposure | Studies involving occupational heat exposure |
| Studies involving exposure to heat indoors | Studies involving exposure to heat outdoors |

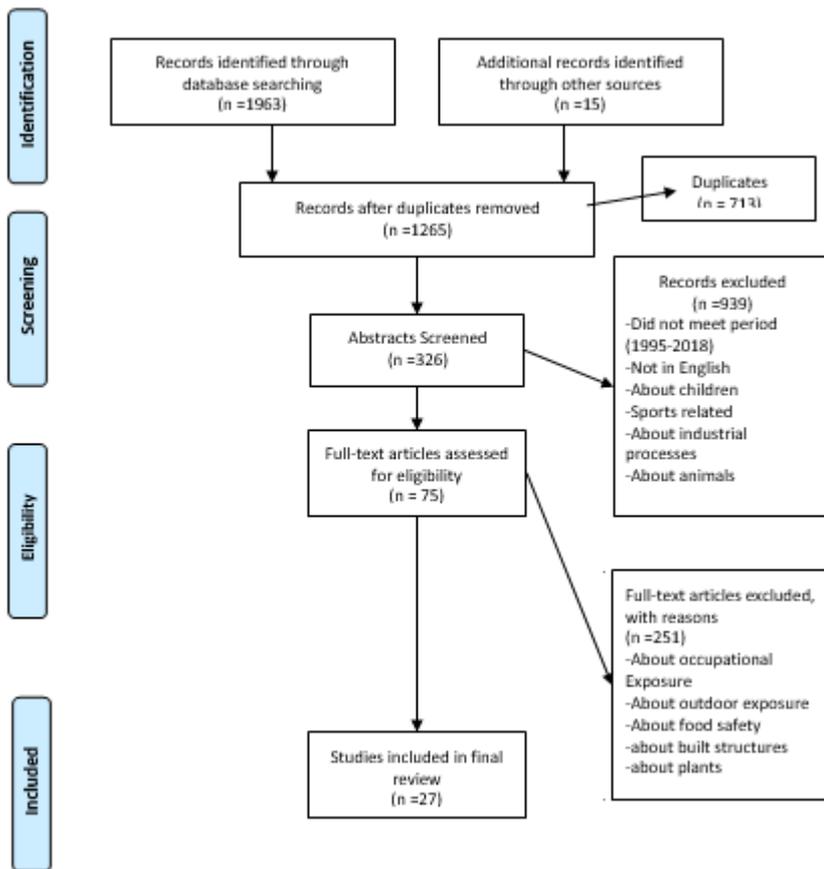


Figure 2. 1 PRISMA diagram illustrating search strategy.

2.2.5 Elderly people.

Elderly individuals are the most susceptible group to heat-related mortality (Tan, 2008). Following the 2003 heat wave in which thousands perished across Western Europe, the Italian Ministry of Health conducted an epidemiological study and deduced that of the heat-related deaths in Italy, 92% occurred in people 75 years or older (Conti et al., 2005). There are multiple reasons for this, including elderly people's reduced ability to thermoregulate, the use of medication that interferes with homeostasis and their bodies inability to physiologically adapt to heat (Luber & Mcgeehin, 2008). Thermoregulation refers to the ability to effectively dissipate heat that was either gained from the environment or through metabolic processes (Loughnan, Nicholls, & Tapper, 2012) and homeostasis is the ability of a person's body to maintain a steady state. Elderly persons, those 65 years and older, have a reduced capacity to lose heat compared to younger individuals (Huang *et al.*, 2011) and with an ageing population it is likely that, in the future, the collective population will be more susceptible to heat (Sheridan *et al.*, 2012). In fact, the elderly population of the USA is expected to increase by more than double from 40 million to over 88 million by 2050 (Sheridan *et al.*, 2012) and in Europe, by 2070, the population over the age of 65 is expected to increase from being 19% of the overall population to 29%. Similarly, the proportion of seniors over the age of 80 is projected to increase from 5% to 13% during the same time period (European Commission, 2018).

There is also an increased incidence of diabetes, respiratory and cardiovascular illnesses among older populations (Huang *et al.*, 2011). Studies have demonstrated that elderly individuals suffering with these pre-existing medical

conditions have a greater vulnerability to heat (Bell *et al.*, 2008) due to the apparent overexertion of systems such as the respiratory and cardiovascular system during times of excessive heat (Lissner *et al.*, 2012). In a study conducted in Madrid, it was estimated that for every degree that exceeded the heat wave threshold, mortality due to cardiovascular illness increased by 23% (Tobías, Díaz, & Linares, 2012). In relation to this, hospital admissions of elderly individuals are known to increase during periods of extreme heat (Knowlton *et al.*, 2009), especially among those who live on their own or who are socially isolated, as discussed further in Section 2.2.3.

Individuals who have a history of diseases such as Chronic Obstructive Pulmonary Disease (COPD) have also been shown to be vulnerable to heat (Wolf *et al.*, 2010) and older individuals have a greater incidence of COPD than younger people (Brown & Walker, 2008).

Cassti *et al.*, (2013) noted that for senior citizens, when there are extreme heat events that occur during the day without any relief over the night-time, there is a much greater risk of negative health effects. This indicates that the effects of extreme heat may not always be immediate and could be increased by consecutive days of hot conditions.

Elderly people typically spend more time indoors compared to the overall population, approximately 90% of their time (White-Newsome *et al.*, 2012). However, this time indoors does not appear to be a physiological problem when the ambient temperature is between 18°C and 24°C (Ormandy & Ezratty, 2012), but at higher temperatures thermal comfort is reduced and there can be significant health concerns. Gower, Mee, Pacheco, & Campbell (2010),

conducted a study involving agencies who provide services to vulnerable clients during extreme heat events to gain insight into what protective activities were taken by both the agencies and their clients. Most of the population examined (68%) was elderly and of that, 30% chose to stay indoor during extreme heat, an action which instead of being protective actually increased their vulnerability (Gower, *et al.*, 2010).

Elderly persons have also been shown to be susceptible to heat due to the support systems they keep and the self-reliance that many of them maintain. Wolf *et al.* (2010) studied the social networks of seniors and found that many older individuals relied on persons their own age to help shape their perception of risk. When the significance of hot weather and heat-related illnesses were downplayed by elderly people, that perception was substantiated and perpetuated by their social contacts. In addition, those who chose to maintain a level of independence often ignored and declined any advice or assistance provided by people external to their circle.

Another factor that can be linked to heat vulnerability of elderly people is the lack of preparation for the onset of extreme heat. In a UK study with elderly individuals (Wolf *et al.*, 2010), there was an overwhelming belief that heat waves could not be predicted and should be addressed only after the event had started. The majority of people interviewed also held the belief that heat was just another aspect of weather and, if and when extreme heat arrived, they would adjust their activities to suit the conditions. Similarly, Hansen *et al.*(2011) found that many older individuals had experienced summers before the common use of air-conditioning and as a result considered themselves able to cope with the heat, when in fact due to their age and declining health, they were

not. Occurrences like these may have resulted in even greater heat vulnerability.

2.2.6 Social isolation

People who are socially isolated tend to have a much greater risk of being affected by hot weather than those with a good social network, regardless of age. Neighbourhoods that have a community network and a good social support system tend to have a much lower mortality rate during times of extreme heat (Harlan *et al.*, 2006). A study conducted in Phoenix, USA, (Harlan *et al.*, 2006) suggested that communities with lower levels of social integration and less access to material resources were at greater risk of being affected by heat. This was also the case in the 1995 Chicago heat wave; those who had few social contacts also had a much higher mortality rate (Reid *et al.*, 2009). A study of heat-related deaths which occurred in New York in 2000-2011 (Madrigano, Ito, Johnson, Kinney, & Matte, 2015), determined that comparing heat waves to regular weather conditions, the proportions of deaths which occurred at the residents' home was greater than the proportions of deaths which occurred at the hospital. In the cases of residents who died at home, they were usually found to be living alone. These findings were similar to those of Semenza *et al.* (1996), who examined the American heat wave of 1995 where more than 700 people perished. In that study, the authors suggested that having social contacts was heat protective, whilst those who were socially isolated and who had limited mobility were at a greater risk of dying from exposure to heat. Those with social contacts were more likely to leave the home, have friends locally or

be involved in group activities. Similarly, Vandentorren *et al.*(2006) examined the 2003 European heat wave and found that in France, many of the elderly deaths which occurred were directly linked to their lack of mobility and social isolation.

Klinenberg, (2001) suggested that many older people are socially isolated because of their frailty, deaths in their friend and family circle or because they become estranged from their social network.

These findings, together with those discussed in section 2.2.2, make clear why seniors who are socially isolated are often identified as being the most vulnerable to the ill effects of extreme heat (Rinner *et al.*, 2010).

2.2.7 Language

Associations have also been found between non-native language speakers and vulnerability to heat. In Phoenix, USA, due to migration patterns in that city, with more Caucasian residents moving to retirement homes and Mexican born residents filling that void, there was a substantially higher mortality rate to heat-related events among Spanish-speaking individuals compared to the remainder of the English-speaking public (Gober *et al.*, 2012). An Australian study found similar results, where heat-related vulnerability was also more pronounced among non-English speakers (Loughnan *et al.*, 2012). One of the explanations for this vulnerability is that non-native language individuals experience greater difficulties trying to receive and interpret protective messages about heat and follow recommended mitigation strategies,

particularly if those messages are provided solely in a language that is foreign to those individuals (Uejio *et al.*, 2011). This has led to recommendations that messages aimed at protecting vulnerable residents should be delivered in multiple languages (Gober *et al.*, 2012). Rinner *et al.* (2010) also noted that even when vulnerable residents may have had some awareness of heat and its effects, language barriers have prevented them from being able to access available protective services.

Hansen *et al.* (2014) indicated that the increase in vulnerability due to heat was not limited to new immigrants who did not speak the local language, but also included older migrants who, despite spending many years in another country, occasionally revert to their original language and cultural behaviour. This type of behaviour may be linked to age related neuro-cognitive disorders (Hansen *et al.*, 2014). This has led to 'linguistic isolation', a term used to describe living situations where few person speaks the native language, which has in turn increased heat vulnerability (Hansen, Bi, Saniotis, & Nitschke, 2013)

2.2.8 Race and ethnicity

Race and ethnicity have been shown to have an association with vulnerability to heat. In studies conducted in Chicago, black Americans were found to have a much greater vulnerability to heat-related events than white Americans (Gober *et al.*, 2012). Even in situations where black Americans earned as much as white Americans, they still tended to live in more impoverished neighbourhoods, and thus suffered from the disadvantages of

those areas, such as substandard housing, higher indoor temperatures and thus greater vulnerability to heat (Gober *et al.*, 2012). Another American study which examined deaths from 2006 - 2010, found that non-Hispanic blacks had a heat-related mortality rate that was 2.5 times that of non-Hispanic whites (Berko & Ingram, 2014). (O'Neill *et al.* (2005) concluded that black people tended to live in communities that did not have air-conditioning, and this could have been a contributing factor to their higher heat-related mortality rates. Another example of race and ethnicity being a contributing factor to heat vulnerability was demonstrated during the 2006 heat wave in California, USA. Hospital records indicated that there were significant increases in Emergency Department visits by most of the non-white ethnic groups of that area compared to white communities (Knowlton *et al.*, 2009).

2.2.9 Income and cost of living

Poverty and income have been shown to influence people's vulnerability to heat. In the 1999 Chicago heat wave, individuals with an annual income of less than \$10,000 had an increased risk of death relative to those with an income over \$10,000 (Reid *et al.*, 2009). Similar findings were also seen among individuals who lived on a low fixed-income (Luber & Mcgeehin, 2008). In a Taiwanese study it was found that individuals who lived on a lower income had a 1.3-1.7 times greater mortality rate than their more affluent counterparts (Sung *et al.*, 2013). However, despite these findings of a negative relationship between incomes and heat-related morbidity and mortality, Smoyer *et al.* (2000) observed a slightly different relationship. In a

study of cities in Southern Ontario, Canada, they observed that cost of living had a more significant relationship with heat-related mortality than income itself. The cities of Toronto and Hamilton were found to have the highest incidences of low-income individuals and the highest incidences of heat vulnerability. However, these two cities also had the highest costs of living among all the Southern Ontario cities studied. Windsor, on the other hand, also had a high proportion of low income individuals but had a moderate cost of living and there was no relationship between heat mortality and low income (Smoyer *et al.*, 2000). Income may not have a clear-cut association with vulnerability to heat, however it may have a synergistic effect when combined with other vulnerability factors.

2.2.10 Education

More highly educated people are less likely to be exposed to the effects of extreme heat. This was the case in a study on education levels and vulnerability to heat in Italy (Loughnan *et al.*, 2012). In that study, populations in Milan and Rome with lower levels of education showed a greater heat-related mortality rate (18%) than those who were better educated (6%). The authors postulated that the levels of education may have been related to types of employment, with the least educated persons occupying blue-collared occupations, which may have exposed them to more direct occupational heat (Loughnan *et al.*, 2012). Ma *et al.*, (2015) reported similar results in their examination of heat mortality as it related to education levels. In their study, the authors examined populations in China and stratified them

by education level. The authors determined that during heat waves mortality among the least educated individuals were 5 times greater than the most educated individuals and deaths among those with a medium education level were twice as high as that of the most educated people (Ma *et al.*, 2015).

However, despite similarities in the results of these two cases a study by Bell *et al* (2008), had conflicting results. In that study, the association between education level and heat vulnerability varied by city, with persons in Sao Paulo, Brazil showing a negative relationship between lower levels of education and increased vulnerability to heat whereas persons in other cities, such as Mexico City and Santiago, Chile did not show any such relationship (Bell *et al.*, 2008). In such a situation, further factors may have had an impact on vulnerability to heat, such as low income and substandard housing. Therefore, it is necessary to look at as many factors as possible that could contribute to vulnerability to heat.

2.2.11 Urban Heat Island and housing quality

One of the factors that affect a person's ability to respond physiologically to extreme heat is their home environment. Of concern to heat vulnerability are artificially created micro-climates called Urban Heat Islands, with temperature increases of up to 6°C (Gober *et al.*, 2012), and this can further exacerbate existing vulnerabilities. More heat-related deaths have been identified in these areas compared to suburban environments (Stone *et al.*, 2010).

Urban heat islands are built environments where the energy balance is altered due to the use of the land, as well as the anthropogenic use and release of heat from daily activities (Tomlinson, Chapman, Thornes, & Baker, 2011). Urban heat islands have resulted because of city densification, an unfortunate consequence of land use planning aimed at addressing the housing needs of growing populations (Lemonsu, Viguié, Daniel, & Masson, 2015). Asphalt-concrete, one of the most common paving materials, has been identified as a major contributor to the urban heat island effect, with a low albedo and a high heat capacity, often reaching temperatures above 60 °C during summertime (Mohajerani, Bakaric, & Jeffrey-Bailey, 2017). Reduced convective cooling and lower water evaporation rates are also contributing factors as these urban areas typically contain reduced bodies of water and vegetation (Gunawardena, Wells, & Kershaw, 2017).

Housing quality is also a significant factor in terms of heat vulnerability, as the type of building material used, the amenities and facilities available as well as the age of the structure all factor in. Mavrogianni, Taylor, Davies, Thoua, & Kolm-Murray (2015), examined three types of social housing and looked at their resilience to excessive heat. The authors found that among low-rise, mid-rise and high-rise buildings, the tenants in the high-rise buildings experienced more incidents of overheating. Similar results were found by Taylor *et al.* (2018) and Tomlinson *et al.* (2011) who found that people who lived on south-facing flats that received higher sun exposure had higher rates of overheating.

Air-conditioning is known to reduce the detrimental health effects of heat, as was demonstrated in a study by Ostro, Rauch, Green, Malig, & Basu (2010). In

that study, the authors observed that air-conditioning reduced hospital admissions due to extreme heat. These results were similar to those reported by Hajat, O'Connor, & Kosatsky (2010), in which they identified that there is a strong protective effect against heat for people who live in homes where air-conditioning is present. Unfortunately, in many low-income and substandard housing areas, air-conditioning is neither present nor affordable.

2.3 Discussion of heat vulnerability literature

The above sections illustrate that vulnerability to heat is a complex concept. While individuals who work outdoors or who spend a substantial amount of time outdoors are expected to be susceptible to heat (Kovats & Kristie, 2006), the literature demonstrates that people who have living circumstances that may be less obvious, may also be severely impacted by extreme heat.

The evidence examined above also tends to indicate that in order to properly study individuals' vulnerability to heat, the various factors have to be examined not only individually, but rather as a whole, as there appears to be synergistic effects (Wolf and McGregor, 2013). For example, the discussion above in section 2.2.2, on elderly individuals, indicated that due to medication, physiological changes to an ageing body and a pre-existing health conditions, these people are particularly vulnerable to heat. Very often, though, elderly individuals are also socially isolated. Tomaka, Thompson, & Palacios (2006), examined the negative health effects due to social isolation, loneliness and lower social support among elderly residents. The researchers found that there

was a health damaging effect among socially isolated seniors and a health promoting effect when there was a good, stable support system.

As discussed in section 2.2.5, there are also disparities in the vulnerability to heat between Caucasian and non-Caucasian people, and as indicated in section 2.2.8 people who live in substandard housing also tend to be disproportionately negatively affected by heat. Both of these socioeconomic conditions are associated with poor living conditions (Madrigano *et al.*, 2018), less access to goods and services and lower purchasing power due to the elevated costs of items in minority communities (Williams, Mohammed, Leavell, & Collins, 2010). In a New York study, the authors found that blacks and Hispanics inhabited homes that were less likely to contain air-conditioning or the infrastructure necessary to support the installation of air-conditioning (Madrigano *et al.*, 2018). The combination of minority race with older age also appears to have an impact on vulnerability to heat (Schwartz, 2005)..

The literature indicates that in addition to individual socioeconomic characteristics affecting vulnerability to heat, a combination of one or more of those characteristics can further increase a person's vulnerability to heat. This synergy can create additional implications as far as identifying vulnerable populations who should be targeted in heat wave planning and response strategies.

2.4 Risk perception

Social vulnerability to heat can result in incidents of morbidity and mortality. Furthermore, the extent of harm can be exacerbated by an individual's perception of how likely they are to be affected by heat, and therefore the extent to which they prepare for or act to protect themselves during hot weather periods. As such, this section will briefly discuss the concept of risk perception as it relates to social vulnerability.

There is a difference between what experts call objective risk and what lay people perceive as being a risk. Objective risks are based on calculations and statistics and are usually expressed as the likelihood of an event occurring. However, perceived risks are related to a person's beliefs and are not always based on facts but rather on experience, knowledge and feelings. For example, the risk of someone dying in a plane crash is relatively low, but many people are afraid to fly and perceive that there is a much higher risk than what actually exists (Oltedal, Moen, Klempe, & Rundmo, 2004). Perception of risk is a complex concept, one that differs among individuals and is a by-product of years of engrained knowledge, anecdotal information and messages delivered by trusted individuals. Risk concerns are also affected by perceptions of the probability of an event occurring and the potential consequences of that action happening. If either of these variables are viewed as minimal, then there is very little perception of risk (Knuth, Kehl, Hulse, & Schmidt, 2014).

Renn (2008) makes the argument that a person's perception of risk is framed by four levels of factors. These levels include experience-based knowledge, which is supplemented by knowledge and emotion-based factors, which are

further enhanced by social and political values and finally cultural norms. Each of these factors are interdependent and together help shape an individual's perception of risk.

Risk perception can also be explained by three main theories: Bounded Rationality, Cognitive and Cultural theories (Bang, 2008). These theories are complementary to the factors described by Renn. Bounded rationality refers to the concept whereby people make decisions based on the limited information that they have on hand, the limited capacity of their mind to analyse and process that information and the limited time that is often allotted to making those decisions. Cognitive theory centres around how people make decisions when there is uncertainty about risk (Otway, 1992) while Cultural theory focuses on how risk is socially and culturally constructed (Douglas and Wildavsky, 1982) and explains why research on disasters indicates that people of a similar background and living in similar circumstances tend to have similar perceptions about risks (Cutter, 1996).

In addition to these theories, a person's perception of risk may also be influenced by multiple factors that are personal, contextual and situational (Novelo-casanova *et al.*, 2012). Often an individual's perception of risk is filtered through their own lens of experience and perception (Chen, 2010).

Studies have also shown that people tend to overestimate rare events that have the potential for catastrophic consequences and underestimate the probability of common events with less severe consequences. It is suggested that this is an evolutionary quality that once was necessary to ensure the survival of the species, however, is less applicable to modern situations. Yet it seems to be

something that people still maintain and subconsciously rely upon (Haimes, 1993).

Risk perception also varies depending on whether a hazard is natural or anthropogenic. Natural hazards are generally viewed as having much lower risks than technological/ anthropogenic hazards (Wachinger *et al.*, 2010). This could be in part due to the view that natural hazards are relatively well-known events, such as hurricanes and earthquakes and as such have a history with the population. Sometimes, when people experience hazardous events without significant adversity, there tends to be a complacent attitude when similar events reoccur. People in such circumstances are less likely to follow advice and warnings and may not take effective mitigation measures (Halpern-Felsher *et al.*, 2001). Many individuals co-exist with these natural hazards, such as those that live on a flood plain or along an area known to experience tornados, and while they are aware of a potential hazard, it is often not viewed as being very risky.

However, this is not always the case as people's experiences with hazardous events may also have a significant impact on their perception of subsequent risks both at the individual and at the community levels. In areas where people have experiences of hazardous events, there generally are much higher levels of concern for those events reoccurring (Prelog & Miller, 2013).

2.4.1 Risk perception of hot weather

Abrahamson *et al.* (2008) conducted a UK study in which they examined the heat perception risks in older people. The persons interviewed, all over 70 years old, would be vulnerable to heat based on age (Public Health England, 2018), but 73% of them also met the criteria of having one or more of medical conditions which increased their susceptibility to heat. The authors found that even though the respondents identified that elderly people were vulnerable to heat, most of them did not consider themselves as being elderly nor vulnerable to heat and many indicated that a lifetime of exposure to heat made them resistant to it (Abrahamson *et al.*, 2008). These findings were similar to those of Åström, Forsberg, & Rocklöv (2011), who performed a systematic review on risk perception of elderly residents.

Another complication of risk perception of heat is that in temperate and cooler climates, residents usually view hot weather positively and the risks are downplayed or even ignored entirely. Both Abrahamson *et al.* (2009) and Wolf *et al.* (2010), examined the perception of UK residents to heat and found that overwhelmingly they viewed hot weather as a welcome event. Lefevre *et al.* (2015) further suggested that experiences that evoke positive feelings are less likely to result in heightened perceptions of risks and, therefore, less likely to result in protective actions.

People tend to gain knowledge of heat waves by actually experiencing them and only then does it leave an indelible impression on them and lead to perceptions of increased risk (Rauf *et al.*, 2017). Risk perception can be either attenuated or exacerbated by social factors. People who are married and have

a wider social circle tend to have a lower risk perception of heat than people who are single, otherwise live alone or are socially isolated. The wider social network can act as a protective mechanism to assist during times of extreme heat and as a result these individuals have a reduced perception of risk to heat (Lo & Chan, 2017). Akompab *et al.* (2012) also found that individuals who had greater access to information and were therefore, better informed about heat and its risks, tended to have lowered perceptions of risk compared to those people who were not as well informed.

Like social vulnerability, risk perception is also a complex concept. Understanding the nuances of how these are created and how they interact with one another is essential to proper heat wave planning.

2.5 Theoretical framework.

A theoretical framework is a guide with which to build and support a study and is analogous to a 'blueprint', used when building a house (Grant & Osanloo, 2014). The theoretical framework helps guide the formulation of the research question, the objectives, the chosen methodology, data collection and analysis. Lederman & Lederman (2017), suggest that theoretical frameworks are critically important to quantitative, qualitative and mixed-methods research.

This thesis examines socially vulnerable populations and as such various models that have been used to describe vulnerability will be briefly described in a chronological manner, illustrating the evolution of the understanding of social

vulnerability. The review will culminate with the model that will underpin this research.

2.5.1 The evolution of theories of social vulnerability

O'Keefe *et al.* (1976) described vulnerability to natural hazards as not being a "natural" event, as it was due to the growing social vulnerability of the population to physical elements rather than occurrences in nature. The authors examined various disasters that had occurred in 1976, including droughts in Africa, floodings in Venezuela and Indonesia and an earthquake in Guatemala. One of the most common themes that emerged, was that the greatest loss of life and economy occurred in the most underdeveloped countries and the individuals who suffered the most losses were those who had a lower standard of living. According to O'Keefe *et al.* (1976), the Guatemalan survivors referred to the earthquake as a "class quake", indicating that there were differential impacts on different classes of society. To alleviate the impacts of natural disasters, the authors suggested that it would be necessary to raise the standards of living among those most vulnerable to the disaster, recognising that the impacts of natural disasters came not from the environmental event but modifiable socio-economic conditions of the population.

Timmerman (1981), later explored vulnerability as it pertained to climate change. He suggested that the word vulnerability was so broadly used that it was almost meaningless for careful description. He offered his own definition which described vulnerability as being the degree to which a system would react

to a hazardous event. His theory considered resilience and the ability to recover from the negative effects of the event (Timmerman, 1981).

Chambers (1989) identified that vulnerability was a misunderstood term and was often, incorrectly used synonymously with poverty. He emphasised that poverty referred to a “lack of” or a “want of”, whilst vulnerability indicated a sense of defencelessness, insecurity and exposure to risks. Chambers proposed the Model of Stresses and Contingencies (Chambers, 1989). The model viewed vulnerability as being a dynamic interaction between two subsets of vulnerability, external vulnerability which resulted from exposure to external shocks, and internal vulnerability, which featured stresses such as the inability to cope with those external stresses. Chambers advocated for the development of general vulnerability indicators, akin to poverty indicators, to allow a vulnerable population to be identified and described. Although the model is frequently mentioned in vulnerability literature as a succinct definition of vulnerability, it also has its detractors. Pfefferle (2014) referred to the Stress and Contingencies Model as being too broad to properly describe vulnerability to climatic events. He cited the fact that in such a model there is little indication as to who may be vulnerable and under what conditions.

Watts and Bohle (1993) expanded on Chambers’ model by adding additional layers of internal and external processes. In the “Space of Vulnerability Model”, they saw the external side of vulnerability as consisting of the risk of exposure to hazards and the internal side of vulnerability as being composed of capacity (the ability to deal with stressors) and potentiality (the risk of significant consequences from the stressors).

Liverman (1990) is one of the earliest researchers who focused on socio-economic conditions as they contribute to vulnerability due to climate change. Liverman examined drought and heatwaves in Mexico and described how many impoverished children in Northern Mexico died due to oppressive heat. Liverman suggested that even though events such as climate change affected everybody, some members of society were better equipped to deal with the hazardous conditions than others. Wealthy individuals could afford air-conditioning, bottled water or retreat to locations with more favourable environmental conditions, whereas less affluent people had to endure conditions such as the oppressive heat, bad air quality and lack of drinking water. Vulnerability analysis, as viewed by Liverman, considers equity and the resultant negative and positive impacts over time and space. It also considers factors beyond the obvious class differences and recognises that elements such as age and gender should also be considered. Liverman's efforts to include other socio-economic determinants besides income in a theory of vulnerability demonstrate that she had an understanding that financial resources were not the most important factor in determining whether people were vulnerable to natural hazards like climate change. This was a departure from most of the previous models that were used to describe vulnerability (Liverman, 1990).

2.5.2 The Hazards of Place Model

While O'Keefe and Liverman presented models, which emphasised the effects of socio-economic status on vulnerability, neither identified that vulnerability could be place specific. They did not consider that people of similar socio-

economic status could have differences in vulnerability due to the geographic area that they inhabited and vice versa, that people in a geographic area have differences in vulnerability due to their socio-economic status. Cutter (1996), however, did and developed a model which will be used to underpin this research. In the Hazards of Place (HOP) Model, the various elements that contribute to vulnerability interact and produce vulnerability within a specific place. The development of this conceptual framework was seen by Cutter as a means of clarifying the confusion that existed over the different meanings ascribed to vulnerability, which were often contradictory (Cutter, 1996).

The model proposed a combination of biophysical and social stimuli acting within a particular geographical area to produce vulnerability (Cutter, 1996). Even though it was introduced more than two decades ago, Cutter's model still resonates with researchers as an explanation of vulnerability (Joakim, 2008; Olatundun, 2011; Schmidlin, 2009) and thus provides a forum for policy interventions.

The HOP Model is applicable to describing vulnerability due to almost any hazard, from natural hazards such as hurricanes, floods and tornadoes to anthropogenic hazards such as industrial accidents and creates avenues for intervention and therefore, mitigation of vulnerability, or conversely, exacerbation of vulnerability as a result of inaction (Zakour & Gillespie, 2012). Other models described previously pay very little attention to the amplification or attenuation of hazards.

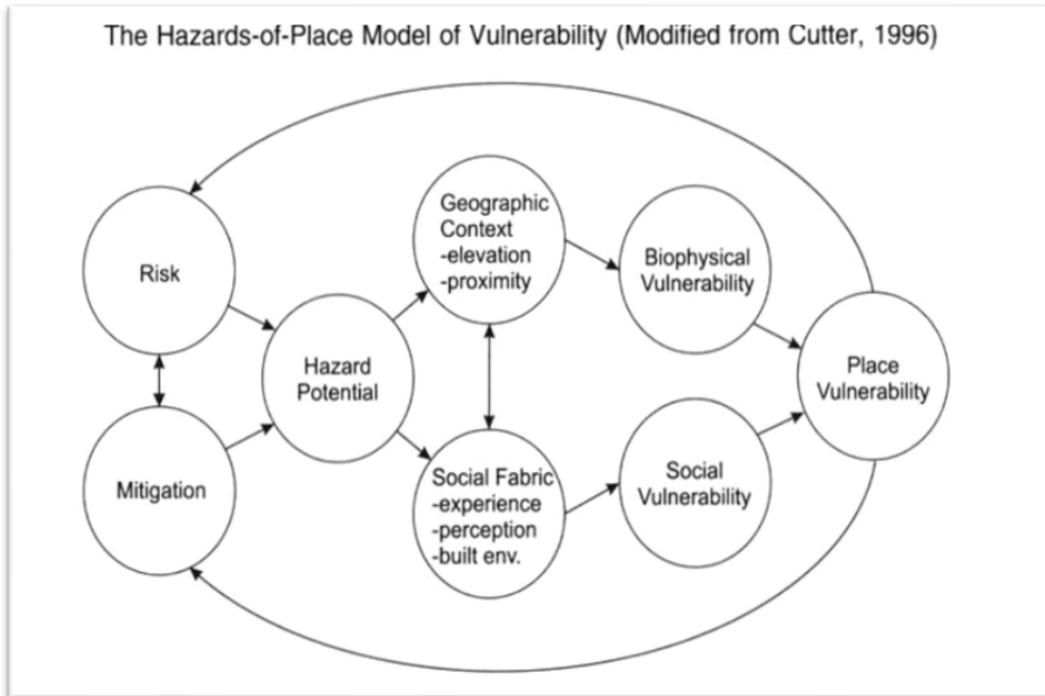


Figure 2. 2 Cutter's Hazard of Place Model of Vulnerability.

Risk, as envisioned in the model, is made up of the nature of the risk (flooding, heat, hurricanes), the consequence of the risk (severe or not) and the likelihood of the risk occurring (every hundred years, seasonally). Risk when combined with mitigation, which can take the form of proper planning, prior experience or any methods that reduce the risk, result in the overall hazard potential.

Hazard potential is then influenced by the social fabric of that area to produce social vulnerability. The social fabric in this model refers to the socioeconomic determinants of health, such as income, race, ethnicity and age, as well as factors such as the built environment, for instance housing quality. These social factors vary depending on the community under consideration, and as such, so too does the degree of social vulnerability.

At the same time, hazard potential is also influenced by the geographical context, that being the proximity to the hazard as well as the actual site and situation under consideration. Together this manifests itself as biophysical vulnerability. The interaction between biophysical vulnerability and social vulnerability results in what is known as Place Vulnerability, a particular geographic area that can be identified as being socially vulnerable to whatever hazard is being considered. Place vulnerability then feeds back into the system and either enhances mitigation or increases risk which will either reduce or increase overall vulnerability.

The simplicity of the model is an asset, as it can easily be applied to different societies, with various socio-economic makeups and prone to varied hazards. However, it is important to note that in any given context the various elements represented in the model are in a constant state of change and so too are the levels of vulnerability.

The HOP model was used in Khunwishit and McEntire's (2012) analysis of the effects of Hurricane Katrina on the vulnerable population of New Orleans. The authors conducted a quantitative study to explore whether social vulnerability was predictive of disaster impact. The HOP model allowed the researchers to demonstrate that places that were vulnerable to natural hazards resulted in greater and more frequent impacts to their residents. The model also provided the opportunity for the authors to show that a mitigation factor such as having insurance, reduced vulnerability and overall disaster impact (Khunwishit & McEntire, 2012) .

Myers et al. (2008) explored how migration patterns were influenced by social vulnerability in the wake of disasters by examining American Gulf Coast populations in the aftermath of Hurricanes Rita and Katrina. They retrospectively employed the HOP model and revealed that the areas that were most affected by the storms and which therefore had the most migration out, were indeed the areas that the model suggested would have the most vulnerable populations such as those that predominantly housed elderly and dependent populations (Myers *et al.*, 2008).

Schmidlin (2009) applied the HOP model to his research in Bangladesh, an area which has the highest frequency of severe storms in the world. He demonstrated that the disaster impact of such storms was heightened due to the poor socio-economic conditions that exist in that society. Bangladesh has a very high population density, high levels of poverty, and the living conditions of many citizens are below acceptable standards (Bai *et al.*, 2013). The model provided an explanation of how the hazard potential of the storm interacts with the social fabric of the society to increase social vulnerability. More importantly, the model graphically laid out avenues where interventions could be introduced to decrease vulnerability (Schmidlin, 2009).

Joakim (2008) examined natural disasters in Canada and determined that during 1900-2005 the highest number of deaths due to natural disasters occurred because of extreme heat events. Joakim applied the model to Waterloo, a mid-sized city west of Toronto. The findings of the study indicated that vulnerability of a population was best demonstrated when there was consideration of both social and environmental elements. Her findings emphasised that reducing the human and economic losses associated with heat

could be accomplished by strengthening community resilience and thereby reducing social vulnerability.

2.6 Gaps in knowledge- Examining risk perception and social vulnerability within the Hazards of Place Model

The literature review presented above illustrates many of the factors that contribute to social vulnerability to heat. However, missing is examination of mitigation activities and how they influence changes in vulnerability. Mitigation activities such as social and health programmes, are viewed as means of reducing vulnerability. However, there may be external forces that are not represented in the model that could potentially influence these mitigation activities and instead of decreasing vulnerability, increase them. This study will attempt to provide some information on this rather unexplored phenomenon and help fill that knowledge gap.

With the focus of the study being on social vulnerability and risk perception, as highlighted in sections 2.2, 2.3 and 2.4 above, the bottom portion of the Hazards of Place Model is of interest and will be used to explore how these mitigation factors could increase vulnerability. Figure 2.2 illustrates the 'social fabric' elements of the model and will focus on the interaction between people's experiences, risk perception, and their built environment. In Figure 2.2 the question mark in blue represents those elements, previously undescribed in the literature, that feed into and influence mitigation activity, potentially exacerbating vulnerability rather than attenuating it. The examination of these influences will later in the thesis provide an addition to the HOP model that will

help to explain how the link between place vulnerability and mitigation can play out in practice.

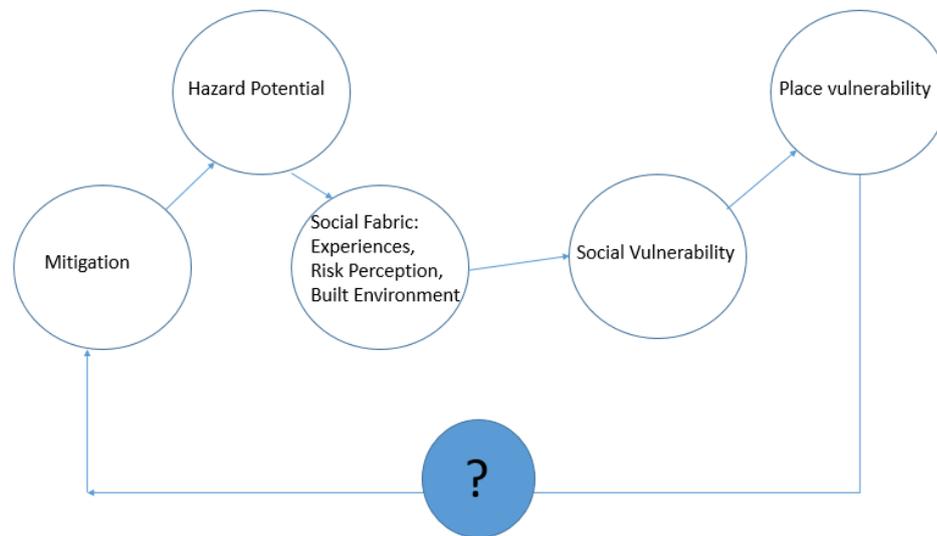


Figure 2. 3 Portion of Hazards of Place model focussed upon in this study.

2.7 Conclusion

This chapter presented a review of the available literature on heat vulnerability and perception of risk to heat. Vulnerability to heat is a complex subject that appears to be influenced by several different factors, both socioeconomic and location specific. The various factors appear to act synergistically as a combination of more than one factor tends to increase vulnerability. This was an important consideration in recruitment of participants for this study. The synergistic effect described in the literature meant that in order to properly study vulnerability, the participants chosen would have to belong to several of the vulnerability criteria previously stated.

A theoretical framework based on the understanding of social vulnerability, was also presented and the Hazards of Place Model of vulnerability was chosen as the model of vulnerability that will underpin this study. The HOP Model illustrates how a person's vulnerability to heat can be influenced by both their socioeconomic status and their geographic location. This is important to this study as specific geographic areas within Toronto, with populations that meet many of the vulnerability criteria described in this chapter, were chosen. In subsequent chapters, the HOP model will be used to put into context the data obtained in this research project. However, despite its value in describing vulnerability, an addition to the HOP Model will also be presented to consider influences, such as political and economic ones, which are missing from the model, but which can have substantial impacts on vulnerability.

Chapter 3 will describe the methodology and methods used to in this thesis and will set the stage for the two chapters of results which follow.

Chapter 3: Finding answers to the questions: The methodology and methods used

3.1 Introduction

This chapter describes the research design of this study as well as the justification and use of its methodology. The study setting was Toronto and Toronto's Hot Weather Response Programme served as a case study for this research. The sampling strategy involved selecting individuals from three neighbourhoods in Toronto whose demographics, based on the information obtained from the literature review, represented the subset of the population who were of interest to this study. This was a two-stage study which focused on both the Hot Weather Response Programme, ranging from its inception through to its current evolution, as well as the recipients of the programme, their perceptions of the programme, the phenomena of extreme hot weather and their perceptions of their vulnerability to it.

3.2 Research question and objectives

This study set out to answer the question of whether Toronto's response to hot weather properly addresses the needs of those most vulnerable to heat. To accomplish this several research objectives were explored, and they are as follows:

1. To identify population types most vulnerable to hot weather.
2. To identify the various heat-related health issues faced by vulnerable individuals.
3. To gain an understanding of the elements of Toronto's Hot Weather Response Programme and how and why these have changed over time.
4. To determine how members of Toronto's vulnerable communities experience heat and their coping strategies for dealing with that heat.
5. To determine if the intended recipients are aware of the current Hot Weather Response Programme and its response activities and if so to understand how they perceive the benefits of Toronto's current Hot Weather Response programme.
6. To identify barriers that prevent potential recipients of the programme from utilising hot weather relief facilities and resources.
7. To identify barriers and gaps in programme delivery and uptake that would allow the programme to be better received.

This chapter will provide an in-depth discussion of the research question and objectives and an explanation of why the chosen methodology was used to obtain answers to these.

3.3 Research paradigm

This study utilised qualitative techniques and was conducted from an interpretivist viewpoint. Qualitative research has been described as any form of social research which utilises and analyses data in a textual format rather than converting it to numerical data, and seeks to gain an understanding of human behaviour (Carter & Little, 2007). There usually is no statistical or other quantifiable means of expressing findings (Strauss & Corbin, 1990). Interpretivist researchers are of the view that the world is socially constructed and interpreted, thus the world is composed of multiple realities which are formed through people's culture, experiences, space and time (Mengshoel, 2012). In studies that adopt this philosophy, there is heavy reliance on the view points of the participants of the study and there is the understanding that through interactions between the participants and the researcher, interpretations of the data and their findings are co-constructed (Chronister, Marsiglio, Linville, & Lantrip, 2014). The researcher, in studies such as these, is considered an instrument in the research and plays an active role. However, at the same time the researcher has to be aware of his/her own preconceived assumptions and must take steps to ensure that results are interpreted on their own merit and not adulterated (Dawson & Heinecke, 2004).

Qualitative research and an interpretivist paradigm contrast with quantitative methodology and its positivist/post-positivist paradigm, which views the world as naturally constructed and studies it objectively through a highly controlled setting, and through traditional empirical, scientific methods. Such an approach emerged from the biological and physical sciences (Savenye & Robinson, 2005) and typically utilises methods that test hypotheses and theories. Positivist

research detaches the researcher from the subject and participants being studied. The environment of the study is carefully controlled and there is an aim to obtain results that are reproducible in such a way that either the researcher, the subjects or both could be replaced and the study would produce the same results (Parsell, Ambler, & Jacenyik-Trawogger, 2012). Positivist/post-positivist researchers view human beings in the same way as matter, and their actions and behaviours as mechanical reactions to external stimuli.

Westbrook (1994) suggests that the research problem should dictate the research method chosen. He further suggests that if theories are already known and hypothesis testing is the goal of the research, then quantitative methods should be chosen. In a study such as this one, where the primary intentions were to gain deeper insight into people's experiences and understandings of hot weather, the use of qualitative methods is more applicable.

3.4 Stages of research

The study was conducted in two separate but overlapping phases. The first phase involved conducting analysis of documents pertaining to Toronto's Hot Weather Response Programme, its annual plan and reports that the programme produced. This analysis included the review of historical documents which give evidence as to why the programme was initially proposed, what it originally comprised, the various official bodies that contributed to its formation and the reasons they were included. The findings of this phase of the study were necessary to obtain information on how well the operational elements of the

programme are being employed and if those activities are reaching the vulnerable individuals previously identified.

The second, and perhaps more important, portion of the study was the interviews with the recipients or potential recipients of the programme. Hot Weather Response Programmes are designed to protect and provide services to the general public, but should be targeted to those most vulnerable to heat (Ebi & Schmier, 2005). The perceptions of the programme from those most vulnerable are important, as it is they who would be most affected by excessive heat.

The literature review on vulnerability unequivocally identified the various population groups who were vulnerable to the effects of extreme heat and as such fulfilled objective 1, stated in section 3.2. The first phase of the study, the thematic critique, provides historical information on the Hot Weather Response Programme and similar programs which influenced it and was used to help fulfill objectives 2, 3 and 6. The second phase of the study, the qualitative interviews, provided more information to help fulfill objectives 2, 3 and 6 but also was able to accomplish objectives 4 and 5 and 7. The totality of the information above helped to answer the research question of whether Toronto's Response to Hot Weather properly addressed the needs of those most vulnerable to heat.

3.5 Methodology utilised in this study

3.5.1 Case study

A case study is generally considered as a particular person, event, subject, policy, system, or as in this research, a programme that is examined intensively and in-depth (Savenye & Robinson, 2005). Their use is most effective when phenomena are studied in a real-world context and it is not possible to separate the phenomena under consideration from the environment in which it is occurring (Macneil & Pauly, 2010). Case studies are typically utilised when there is the need to answer questions that relate to how or why something is done, the conditions of the study cannot be manipulated and the context of the study is important (Baxter, Susan Jack, & Jack, 2008). Case study research is predicated on the notion that in order to examine and properly understand a phenomena, protensive and detailed examination of the case is needed (Dawson & Heinecke, 2004).

Case studies are particularly useful to policymakers who are often at a distance from the actual execution of their policy. The in-depth information provided by such studies have served to provide “bottom-up” insights and can complement other forms of data that the policymaker may have on their case, creating a more functional policy (Abma & Stake, 2014).

Case studies tend to draw upon multiple sources of data (Carolan, Forbat, & Smith, 2015) and allow for flexible research designs which can study an issue from various perspectives. They give more comprehensive views of the issue, while still studying it within its naturalistic environment (Abma & Stake, 2014;

Walshe, Caress, Chew-Graham, & Todd, 2004). Since case studies explore topics from multiple angles, they allow for multiple facets of phenomena to be revealed and studied further (Baxter *et al.*, 2008). According to Stake (2000), with case studies becoming more readily accepted as a rigorous means of conducting research, they are becoming a more common. In this thesis, Toronto's Hot Weather Response Programme provided an ideal case to study utilising the methods of a thematic critique and qualitative interviews.

3.5.2 Thematic critique

The first phase of the research, the thematic critique, utilised the methods of document analysis and a document review. Document analysis is a methodical approach to locating and analysing information from both printed and electronic documents (Bowen, 2009) such as policies, procedures, meeting minutes, reports, surveys, public and private records. This type of analysis usually involves the examination of documents that were prepared without the input of the researcher and which are, usually, already in use prior to the commencement of the study. Relevant excerpts of the document are commonly analysed by content analysis or thematic analysis (Labuschagne, 2003). Thematic analysis involves a comprehensive and thorough examination of data so that salient and pertinent themes emerge. These themes are brought to light using coding and categorizing of data.

A document review is a method typically used in programme evaluations whereby a summary of each document analysed is made noting relevant points

of interest to create an overall picture of topic of interest (Centre for Disease Control and Prevention, 2009).

3.5.3 Advantages and limitations of document analysis and document review

Document analysis is popular in public health research, particularly when exploring and evaluating programmes. It is often the only means of retrospectively obtaining information about a programme (Caulley, 1983). Document analysis also assists in *methods triangulation*, a process whereby several types of data are obtained and used to cross-validate each other and verify consistencies in findings (Patton, 1999).

Document analysis is a particularly effective means of research when issues such as cost, and efficiency are under consideration. As the information contained within documents has already been obtained, there usually is no need to conduct additional research and analyses can be started from the inception of the study. However, even though the information is present, its quality and usefulness still needs to be determined by the researcher in terms of its value and in the context that in which it will be used (Bowen , 2009).

Stability of the information included within documents also make this means of research advantageous. Added to these, the extensive coverage that documents can provide on a topic, including the ability to highlight historical information, that could otherwise not be accessed, makes it an ideal method of obtaining both broad and specific information over an extended period of time (Bowen, 2009).

According to Bowen (2009), the benefits of analysing documents go beyond obtaining historical information. As was the case in this study, document analysis also suggests additional questions that may need to be asked about the topic at hand, it provides supplementary research data that would otherwise not be found in current documents and it also allows a researcher to track changes and development over time.

Document reviews are typically used to gather background information, to help determine if programmes have been implemented as intended and to help develop other tools for data collection. Some advantages of document reviews include that they are a very inexpensive method of inquiry, they provide insight into programmes that may not be overt, and they are unobtrusive. At the same time, the method does have its limitations as carrying it out can be extremely time consuming, information can be incomplete, biased and disorganized. However, when used in conjunction with other methods, a document review can provide good supporting information (Centers for Disease Control and Prevention, 2009).

3.5.4 Qualitative interviews

Interviews and focus groups are the two most common qualitative methods used to gather in-depth information and these methods are particularly useful when they are used to explore issues of race, class and gender (Rakow, 2011). While both methods have their relevant merits, focus groups are more appropriately used when the goal is to obtain data that results from interaction and dialogue among a group (Lambert & Loiselle, 2008). Focus groups also

highlight similarities and differences of opinions within groups, however, the depth of detail and information is usually confined to the topic being discussed and individual participation is usually unequal and is dependent on how dominant individual participants are (Kaplowitz & Hoehn, 2001). Interviews are superior to focus groups when they are used to probe deep into the responses of participants. Individual interviews allow for more focused attention on the part of both interviewer and participant. Semi-structured interviews are usually chosen as a means of guiding the subjects in the appropriate direction, so that relevant information could be obtained, while at the same time still allowing them to express themselves as fully as they would choose to. Semi-structured interviews usually consist of open-ended questions that do not restrict the amount of detail in an answer (Pope & Mays, 2008).

3.6 Methods used in this study

3.6.1 Part I: Document analysis and document review

In this study, several types of documents were examined, including budgets, meeting minutes, technical reports and documents containing background information on the programme. The technical reports and background documents were analysed using thematic analysis whilst the other documents were analysed using a document review. Thematic analysis positioned the themes revealed in their social context and provided a different level of meaning, not possible with content analysis (Rasmussen, Muir-Cochrane, & Henderson, 2012).

Atlas.ti qualitative software was used to assist in this process. Documents were coded based on pre-determined *a priori* codes, which were developed from information gathered through the literature review. Later, additional codes that were generated from the semi-structured interviews were also applied to the already coded documents, in an iterative process.

3.6.1.1 Documents for analysis

The official files for the Hot Weather Response programme are categorised, filed by year and stored in an electronic database at Toronto's Health Department. In addition to these, statistics and other analytical data are made available to the public through Toronto's Open Data website. Documents related to policies and procedures, budgets and changes in the Hot Weather Response programme activity and direction were obtained. These documents included City council documents, meeting minutes, internal memos and department reports. The documents were primarily historical in context and were explored to illustrate the origins and development of relevant policies, procedures, programmes and events. Every version of the Hot Weather Response Plan was examined to determine how services changed, and what precipitated those changes. The documents that were analysed were either publicly available or were obtained by making a request under the Municipal Freedom of Information and Protection of Privacy Act. In total 585 documents were obtained, ranging in dates from 1999 to 2018.

Figure 3.0 illustrates how the documents were filtered and categorised. The 585 documents were scanned for content and any duplicates identified, as the

database often contained many different draft versions of the same document. After removing the duplicates, 463 documents remained, and they were organised in one of the following 6 different categories:

- Background information- which included documents pertaining to the need for a hot weather programme in Toronto such as historical weather data, demographic information and information about American hot weather programmes.
- Committee Meeting Minutes- which detailed what was discussed at each semi-annual Hot Weather Response Committee meeting.
- Budgets- which detailed the annual budget for the Hot Weather Response Programme
- Hot Weather Response Plans- the annual plan of activities for the programme
- Programme/Technical Reports- produced by programme staff, summarised programme activity as well as other documents from experts in the subject matter, policies and procedures.
- Others- these included documents that did not add any additional relevance to this study and included human resources and personnel information, invoices and receipts for purchases, presentations and promotional material.

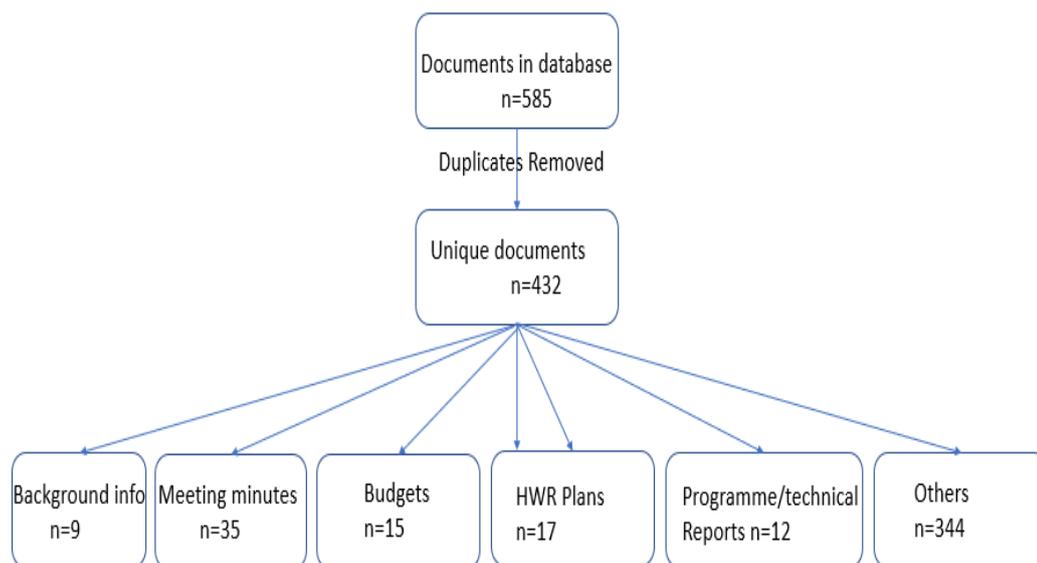


Figure 3. 1 Illustrating how the programme documents were categorised for analysis.

Of the original 585 documents only 87 documents were included in the analysis as the others did not add any relevance to this study. Of the 87 documents selected, the background documents and the technical and programme reports, a total of 21 documents, were coded with the assistance of Atlas ti. The budget documents contained financial information which did not have to be interpreted and the other documents were analysed using the document review methodology (Centers for Disease Control and Prevention, 2009), whereby each document was examined to determine who wrote the document, when and in what context it was written, the audience for whom it was written, the reason

why the document was written and finally what was written in the document. Utilising this approach, a summary was created for each document.

3.6.2 Part II: Semi-structured interviews

Semi-structured interviews were conducted with 25 individuals selected in relation to the range of criteria for heat vulnerability. Those 25 individuals all came from neighbourhoods whose demographics indicated that they were likely to be vulnerable to hot weather.

3.6.2.1 Participant selection

Participants for this study were selected using purposive sampling. The literature review indicated particular groups within the population who would be more vulnerable to heat. Some of the groups identified included recent immigrants, racialised minorities, people whose first language was not English, elderly people, unemployed people and people with lower levels of formal education. Demographic census data were used to select three neighbourhoods within Toronto which had high populations of people who fit in the vulnerable categories. The three neighbourhoods chosen were Parkdale in the south, Jane and Finch in the north and Scarborough in the east. The neighbourhoods are circled in yellow in Figure 3.1.

Average Individual Income, City of Toronto, 2015

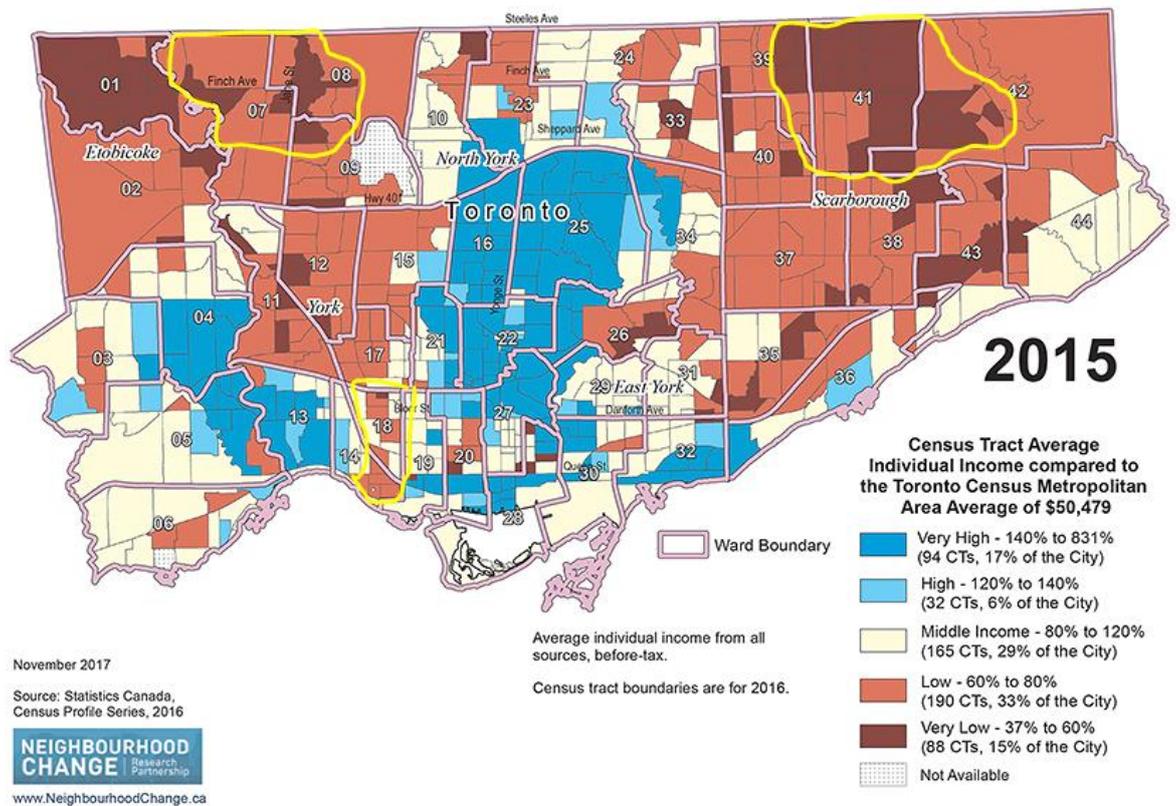


Figure 3. 2 Areas from where recruitment took place, circled in yellow (Lorinc, 2017)

In late March to early April 2014, the study was advertised by placing flyers on community bulletin boards located throughout each of these three neighbourhoods, in lobbies of high-rise buildings and rooming houses known to be home to many of these vulnerable people. An incentive of a \$50.00 gift card was used as means of generating interest in the study. The offering of an incentive for participation has been shown to increase participation rates, whilst reducing sampling bias, as it encourages participation by individuals who would normally be less likely to participate in research studies (Guyll, Spoth, & Redmond, 2003). On the flyer there was an explicit statement that participants

would be entered in a random draw, there was no other promises of incentives or rewards, either implied or stated, beyond this gift card or potential benefits to the community as a result of the findings.

Every individual who volunteered for the study was contacted by either email or telephone, based on the method that they chose to contact the researcher. A brief preliminary discussion was conducted with the volunteer to verify whether they met the selection for this study. The volunteers who were selected, were informed via phone call or email, depending on their preference, of that selection and that they would be eligible for the lottery draw. Those who did not meet the selection criteria, as described in section 3.6.2.2 below, were similarly informed and advised that they were excluded from the lottery draw. When the willing participants were selected, a meeting with them was arranged or email contact was made, whereby they were once again made aware of the intention of the study and what type of commitment would have been required of them. They were provided with a document describing the study, the "Participant Information Sheet", and were allowed time to read it. A follow-up date was arranged at which the participants were again asked about their willingness to continue with the study, their questions and concerns addressed, they were provided with a consent form and asked to sign it if they still chose to participate. Confidentiality and anonymity at all times was emphasised. After all these processes, only those who were still willing to continue became part of the study.

After enrolment in the study, the participants were advised that once their data were anonymised and incorporated into themes it might not be possible for it to

be withdrawn. However, if they chose to withdraw, every attempt would be made to extract their data, up to the point of publication.

Potential interviewees at government run cooling centres, air-conditioned buildings where food, drink and resting facilities are provided, were treated the same as those who responded to the flyer. They were provided with an information sheet describing the study as well as a copy of the flyer advertising the study. They were told of their inclusion in the lottery for the \$50.00 gift card if they were selected to participate. Any questions that they had, were answered and those who agreed to participate were given a consent form to sign. Those individuals at the cooling centre, however, were also given the opportunity to delay their participation to a later date and were provided with the researcher's contact information. This additional time allowed the participants to carefully consider their participation in the study and to ensure that their consent would be well informed.

3.6.2.2 Selection criteria

It was initially anticipated that 20-30 respondents would be sufficient to interview for this study, depending on saturation of the data. In total there were 51 responses to the advertisement, but those who were selected to participate had to meet many of the vulnerability criteria that were highlighted in the literature review. To accomplish this, a matrix was constructed, and the various vulnerability criteria were used as a basis for selection. Respondents whose socioeconomic conditions met the majority of the conditions sought were selected to participate, those who did not were declined.

Of the 51 who responded to the advertisement, 22 were selected to be interviewed, in addition, three more people were interviewed at cooling centres. During Heat Warnings, seven designated cooling centres are opened to provide a respite. Since there had been an average of more than 9 of these days, each year, over the past 12 years in Toronto, it was intended that additional interviews would have been conducted at several of the Cooling Centres. Ten people were approached at the cooling centre, but only three participated in the study because they met both the selection criteria and had also agreed to participate in the study.

3.6.2.3 Interview questions

The semi-structured interviews were designed to gain an understanding of the experiences and familiarity of the subjects with the phenomena of extreme hot weather. The interviews probed into how well the participants were coping with those conditions, if they were aware of Toronto's Hot Weather Response Programme, if they were, how many of the services they were utilising and whether they felt those services were beneficial.

The questions were mostly consistent throughout the interviews, with an interview guide (Appendix D) used to keep the flow of information continuous. The participants were encouraged to provide as much detail as they chose, when they were responding to questions, and the guide was used as a means of keeping the interview on the appropriate course. After each interview, the responses were reviewed, and these helped to refine the interviewing techniques for the following interview.

3.6.2.4 Conducting the interviews

Qualitative research studies phenomena in its natural setting, therefore the ideal time to interview the participants would have been in the height of the summer season. However, because of the unpredictable nature of weather this was not always possible. Interviews began in May of 2014, however, 2014 was one of the mildest summers on record in Toronto. Therefore, the interviews continued throughout the summer and the autumn of 2014 and again through the spring and summer of 2015 and 2016.

To maintain the natural setting of the study, participants were given the choice of being interviewed in their own homes, in meeting rooms at the Health Department or at local libraries. Of the 25 persons who participated in the study, 15 were interviewed in their own homes, 7 in meeting rooms at the Health Department and 3 at the cooling centres.

At both the beginning and the conclusion of each interview, the participants were reminded that the interviews were confidential and that any of their information used would be anonymised. They were also given a two-week period in which they could contact me should they have any concerns at all about the interview process or the information they provided. Notwithstanding this two-week period, the participants were also advised that if at any point, up to publication, they wanted to withdraw their information, they would be able to unconditionally do so.

3.6.3 Interview transcripts

Transcription is a process whereby recorded audio is transformed into written text. This transformation is particularly important in qualitative research as it prepares recorded interviews to be appropriately understood, analysed and interpreted (Mero-Jaffe, 2011). There are two main methods of transcription utilised by researchers, naturalised and denaturalised transcription. Naturalised transcription is the technique whereby audio is transcribed in as natural a state, with as much detail as possible. All pauses in conversation, changes in body language, laughter, unrelated audio etcetera are recorded. Denaturalised transcription filters and refines the audio and includes only the information and content related to the subject at hand, while still producing an accurate transcript (Davidson, 2009). Some researchers argue that naturalised transcription produces a more accurate representation of the interview (Forbat & Henderson, 2005). Others suggest that the content of an interview is more important than the actual nuances of the conversation, and as such, denaturalised transcription produces a more appropriate product for analysis (Oliver, Serovich, & Mason, 2005). While each method has its own merits, Mero-Jaffe (2011), suggests that the majority of researchers actually utilise a combination of both techniques.

The audio of each of the interviews for this study was recorded only after permission was granted by the participants and transcription utilised a denaturalised approach. There were times when interviews were carried out in the homes of participants and they were occasionally interrupted by conversations between the participants and parties unrelated to the study. Those conversations and interjections were eliminated from the transcripts as

they were unrelated to the topic at hand. Changes in tone, body language, and hand gestures were also not captured. However, after each interview, field notes were made, and many of those observations were noted.

Transcription is a time-consuming process, one that is essential but has often been relegated to a by-product of a research process, simply a task that must be done to facilitate analysis. However, transcription plays a vital role and is not simply a transitional task between interviews and analysis, it is, in fact, a centralised feature that shapes the words, feelings and perceptions of the participants of the study (Oliver *et al.*, 2005). Transcription for this study was conducted both by me and by a third-party transcription service. I transcribed the first four interviews as familiarising myself with transcription was an essential component of the overall process. Due to time constraints, the remainder of the interviews were transcribed by a professional transcription company. An American company was selected, one that has provided transcription services to the Toronto Public Library, several Canadian Universities and several departments of the United States Government. The transcription service advertised 98% accuracy, three layers of accuracy confirmation and complete confidentiality of the transcripts. After the transcripts had been produced, they were read once, and then they were read in concert with the audio of each transcript. Overall, the error rate among the transcripts was very low, with some transcripts having no errors at all. Any errors that were present were corrected and then the transcripts were read for a third time to confirm that they matched the corresponding audio.

3.7 Data analysis

Analysis of the data began at the conclusion of each interview, with observations and items of interest noted in a journal. In addition to the field notes being written and reread, the recording of each interview was listened to. This action was necessary as it helped refine the technique for each successive interview, but in so doing, initial impressions of each interview and the information they yielded were made.

Qualitative Data Analysis Software, ATLAS ti, was used to analyse the data. Each transcript was read several times from beginning to end, before it was read line by line and codes ascribed to each relevant individual word, statement, parts of a sentence or paragraph. Codes were determined *a priori* based on information obtained from the literature review. After each transcript was coded, they were re-read and re-coded. Some codes were combined, others were removed, and new codes were generated based on the reading of the transcripts. After all the transcripts were coded, codes were arranged in code families and relationships established among codes, code families and individual transcript. Several themes were generated from this process and each theme was further explored and related to literature previously reviewed. Thematic analysis was used to extract the main themes from the data and a thematic network was used to structure these themes in a web like fashion. Basic Themes were extracted from the data, these were then clustered into Organising Themes and finally sets of organising themes were grouped into Global Themes. The global themes summarise the main findings of the data and provide a succinct interpretation of the entire text (Attridge-Stirling, 2001).

3.8 Positionality

This research project was carried out from a unique perspective, as I am the Chair of Toronto's Hot Weather Response Committee, the Manager of the Hot Weather Response Programme and the person who is ultimately responsible for the coordination and delivery of the Hot Weather Response Plan. This responsibility, however, is limited as decisions about budgets, programme components and cuts are made at a higher level and passed down to me to execute. Also, in the past I have also been actively involved as a member of staff who was carrying out the ground level activities of hot weather response. At one point in the past, I was also a member of the target population of this programme. Therefore, I bring to this study personal and professional experiences that are not only a motivation to see the programme succeed but also, to ultimately bring positive changes to the programme.

One of the limitations though was being an 'insider researcher', a person who conducts research on the same organisation to which they are attached (Workman, 2007). Insider research can present multiple problems for the researcher, including conflicts of interest, moral and professional conflicts which may occur during and after the research (Floyd & Arthur, 2012), clouded judgements when dealing with familiar issues (Dwyer & Buckle, 2009), inherent bias and too much subjectivity (Greene, 2014).

Being an insider made it impractical to conduct research with other officials, who are responsible for either the planning or the delivery of elements of the programme. There existed the possibility of bias, with each official attempting to justify and defend their contribution to the programme. There was also the

possibility that during interviews, programme officials could alter their contribution to suit what they believed I would be expecting them to say. As Floyd & Arthur (2012) indicate, this is not uncommon and is seen when there is an attempt to display a façade of team unity. Therefore, as best as I could, I assumed the position of an external observer and did not conduct any of the research in any official capacity, rather as a PhD student from Lancaster University. However, as previously stated in Chapter 1, I did reflect on personal conversations with senior programme officials to explain some of the actions taken.

3.9 Ethical considerations

This study involved direct interaction with human subjects therefore, there were several ethical issues that had to be considered, primarily to ensure that all participants were protected from harm and that appropriate channels were used when obtaining information on the programme. Also researchers who conducts research ethically often succeed in the recruitment and retention of volunteers (Ross *et al.*, 2010) . Prior to beginning this study, ethical approval was sought and granted by Lancaster University's Faculty of Health and Medicine Research Ethics Committee (Appendix A).

3.9.1 Recruitment

Whenever human subjects participate in research activities, one of the major considerations is the risks to the participants due to process or outcome (Ross

et al., 2010). The recipients of the programme typically comprised individuals from one or more vulnerable groups and every precaution was taken to ensure that they were not put at any disadvantage or in any danger because of participating. The individuals were assured that their participation would be completely confidential and any information that they provided that could result in a reprisal, either from their landlord, building management or government official would either be anonymised or would not be disclosed.

A random draw for a \$50.00 gift card was used as a means of encouraging participation in the study. However, as this study involved vulnerable individuals every effort was made to ensure that the participants understood that they were not guaranteed to receive any compensation. Only one gift card would be awarded, and this would be done randomly. At the conclusion of the study, the gift card was awarded by assigning each participant a number from 1 to 25 and having a random number generator select a number within that range.

3.9.2 Potential sensitive issues

There was also the possibility that the participants, relatives or friends may have in the past, been not only negatively affected by hot weather, but also may have experienced other forms of disadvantage, such as the effects of poor housing, low income or isolation. To assist with the possibility of any sensitive issues that may have arisen, the contact information of professionals who could assist were made available to the participants. Toronto Public Health has a team of Public Health Nurses that aids in cases such as these. This information was included as a source of information on the Participation Information Sheet (Appendix E).

3.9.3 Ethical issues during dissemination

To ensure that anonymity was kept, when the results of the study were written up, presented and published, all participants interviewed for the research were given a pseudonym. Identifiable characteristics were removed, such as name and address as well as those of any persons mentioned during the interviews, such as landlords. The two main reasons for anonymisation were to ensure confidentiality and also to ensure protection of the subjects from reprisal (Ross et al., 2010). As the individuals described living conditions and use of government programmes, every effort was made to keep them anonymous, so that their protection from undue harm was maintained.

3.10 Data management and storage

All electronic data were securely stored on the password protected H drive at Lancaster University. In addition to being password protected and available to only the researcher, the files were also regularly backed up. All paper files, notes, consent forms, interview guides and any other documents pertaining to this research were stored in a locked filing cabinet, located within the locked office of the researcher. To ensure confidentiality of all involved in the study, these documents were accessible by the researcher and the two supervisors attached to the project. This ensured that the personal information included in the files could not be used for any other purpose.

Any permission granted by the subjects to use their information, was exclusively for this study, this was a condition of their informed consent. The information

obtained was to be kept for 5 years from the date of collection and destroyed thereafter. This complied with the UK Data Protection Act (1998).

3.11 Successes and challenges faced

The methods that were employed for this study worked well for what was required. The document critique method was well suited to the task of analysing existing programme documents. There was enough information available to trace the history of the Hot Weather Response Programme and to identify activities that changed over time. Very importantly to this study on social vulnerability was programme officials' definition of vulnerability. The documents contained enough information to be able to see the fluctuations in those definitions.

What was missing from the thematic critique was explanation for the myriad decisions to alter vulnerability, to add and remove response activities. There was some information available on the many changes to the budget, but the majority of that information I gleaned, over the years, from personal communications with senior management officials.

With the interviews, there were issues trying to schedule meetings during hot weather. It was assumed that if people were interviewed during periods of extreme heat, they would likely provide more accurate information about their interpretations and response to it. However, during the first summer when the interviews began, Toronto experienced an atypically mild summer and there was a lack of response to the request for participation. As a result of this, the

interviews continued into the next two summers and caused a delay in the entire process.

3.12 Conclusion

This chapter examined the methodology and methods employed in this study. A qualitative study of Toronto's Hot Weather Response Programme was conducted. It utilised both a thematic critique of existing historical documents that pertained to the programme and current documents which detail response activities, as well as semi-structured interviews with members of the public who were identified as potential users of the programme. The documents examined, traced the history of Toronto's programme from its planning stages, implementation through to its current state. Budgets, annual reports, meeting minutes and documents produced for public consumption were reviewed. These provided insight into how the programme has changed from year to year and provided some explanations as to why certain changes were made. The twenty-five semi-structured interviews explored the vulnerable populations' experiences of coping during periods of hot weather, their perceptions of how it affected them, the resources they drew on, as well as their familiarity and use of Toronto's hot weather programme. The following chapter will present the results obtained from this study and will set up the discussion of those results in subsequent chapters.

Chapter 4- What did the documents say? The results of the thematic critique of programme documents

4.1 Introduction

This chapter presents the findings from the thematic critique of Toronto's Hot Weather Response Programme documents. The aim of this critique was to trace the evolution of the programme and to gain an understanding of why changes were made to the programme. The critique involved examination of programme budgets, annual reports, meeting minutes, documents produced for public consumption, as well as response activity logs.

The four main themes which emerged were:

- the criteria used by programme officials for issuing heat alerts/warnings;
- programme officials' changing interpretation of vulnerability due to heat;
- changes to the programme budget and corresponding changes to services provided by the City of Toronto;
- changes in communication techniques to intended recipients.

In addition to these four major themes which emerged from the analysis, examination of the documents also provided succinct background information into the justification and need for a Hot Weather Programme in Toronto.

4.2 Justification and need for a Hot Weather Response Programme

The thematic critique began with the examination of documents that pertain to the inception of the programme and the justifications for implementing it. This was an important step because it demonstrated the reasons why public health officials initially felt that a programme to address oppressive heat was necessary.

Toronto's Hot Weather Response programme is a direct result of some of the responses to hot weather that were taking place in the United States in the late 1990s and the similarities of Toronto to cities such as Chicago. Located at similar latitudes, Toronto and Chicago have similar climates, including average daily temperatures and average summer maximum temperatures. There are also parallels in their population sizes, with Toronto having approximately 90,000 more residents than Chicago (Melanson, 2013). The cities are the fourth and fifth largest cities in North America respectively (Scowen, 2013), and showed similar employment rates and male to female gender ratios (United States Census Bureau, 2016; City of Toronto, 2016).

According to research conducted by Toronto Public Health, historical data on air-pollution, weather patterns and mortality between 1954-2000 indicated that on average there were over 120 additional deaths per year in Toronto, attributable to extreme heat (Gower, Campbell, *et al.*, 2010). Due to climate change, these numbers were expected to increase as the number of days per year in Toronto with temperatures above 30°C was also expected to gradually increase from the then 12 days per year to over 45 days per year by 2070 (Campbell, 2011).

A July 1999 report from the then Medical Officer of Health, recommended that Toronto implement an annual Hot Weather Response Plan (City of Toronto Council and Committees, 1999). The report referenced the 1995 Heat Waves in Chicago in which there was more than 600 deaths attributable to heat exposure. The report further identified some of the actions that were taken in Chicago in response to the heat:

Chicago established a heat emergency protocol that is used to co-ordinate the city's response to hot weather. It includes the establishment of cooling centres in city controlled buildings, increased surveillance of heat-related illness by emergency health services and expansion of hours at recreation facilities(City of Toronto Council and Committees, 1999).

The Chicago programme was again cited in other early Toronto City Council and Staff Reports on hot weather (Basrur, 2002 ; City of Toronto, 2000) and illustrated that the impetus for the development and implementation of a hot weather response programme was the similarity of Toronto to Chicago and the fact that Chicago had a well-established programme.

4.3 Theme I: Development of criteria for calling heat alerts/warnings

Over the twenty years that Toronto's Hot Weather Response Programme has been in effect, there have been different criteria used for calling alerts. Some of these criteria have been based on actual temperatures, some based on local climatic and health data, some on apparent temperature or humidex, and some have been based on a combination of all of these. Humidex is the Canadian equivalent of apparent temperature and is defined as the temperature that a

person would theoretically experience, considering humidity (Mekis, Vincent, Shephard, & Zhang, 2015). One of the documents analysed indicated that the myriad changes to the criteria used for calling heat alerts have at times led to confusion among the public as to what the terminology meant and when alerts would be called (Gower, Campbell, *et al.*, 2010). The following section provides information on the changing criteria used for calling alerts/warnings. The implications of these changes, particularly on the intended recipients of the programme, are briefly mentioned in this chapter, but are fully developed and discussed in Chapter 6.

4.3.1 One-day humidex forecast

In 1999, Toronto Public Health piloted a Hot Weather Response programme during the summer months (Toronto City Council, 2000). Heat alerts were called if there was a forecast of oppressive heat and the threshold was a humidex of 40:

[Toronto Public Health] selected humidex as the Alert trigger in part because humidex forecasts were readily available from Environment Canada, and the measure was familiar to the public as a result of widespread use by Canadian media and weather reports (Gower, Campbell, *et al.*, 2010).

A humidex value of 40 was used, because Environment Canada, Canada's department responsible for weather related services, defined humidex values above 40 as causing great discomfort (Gower, Campbell, *et al.*, 2010). During that first year of implementation, only one heat alert was called (July 31, 1999), in response to the predicted humidex forecast for the following day. The

humidex value was forecast to be at least 40 and the warning system was seen as a positive step as that date coincided with the annual Caribbean Carnival parade (City of Toronto, 2000) which attracts over 1,000,000 people to Toronto. On August 1st, Toronto was hit by a huge thunder storm which quickly cooled the city and as such, the humidex value plummeted and never reached the threshold (City of Toronto, 2000). The warning that was proactively issued was without merit as the maximum temperature in Toronto that day only rose to 27.9°C, and the humidex did not get to the predicted level. In fact, there were 20 days that year hotter than August 1st. On none of them, though, was humidex predicted to be 40, so no other alerts were issued (Government of Canada, 2000a). According to a City Council report, the change in humidex on August 1st, 1999 necessitated cancellation of the alert and presented unforeseen logistical challenges:

...urgent mobilization of the staff response proved extremely difficult, given the short advance notice of adverse weather conditions in conjunction with the long weekend. Cancellation of the response also proved to be difficult as it was hard to communicate with community agency personnel who were already in the field. This experience highlighted the difficulties in mobilizing the Hot Weather Response protocol on weekends and in accurately predicting Humidex levels, which can change rapidly (City of Toronto, 2000).

The one-day humidex threshold therefore, proved to be inappropriate as a criterion for calling an alert.

4.3.2 Two or more days humidex forecast

The following year, 2000, there was an adjustment to the criteria for calling alerts and new nomenclature was also introduced. A 'Heat Warning' would be called if the forecasted humidex was to be 40 or greater for two consecutive days. A 'Heat Emergency' would be issued if the forecasted humidex was greater than 45 for two consecutive days (City of Toronto, 2000). City Council felt that there were too many logistical challenges trying to mobilise resources for a single day response and secondly, they believed that the effects of extreme heat would be amplified if a person experienced two days of heat exposure:

Morbidity and mortality increase after 2 days of heat stress. A heat threshold of at least two days duration also allows for the roll-out of the hot weather response (e.g. notifying the media, contacting community agencies, and conducting outreach to clients at risk for heat-related illness) (City of Toronto, 2000).

The document cited a 1999 workshop which featured American experts from Chicago and Philadelphia who had experience with heat waves, as the source of evidence for these two claims. No other empirical evidence was used in this assessment and no explanation was found for the change in terminology.

During the summer of 2000, the two-day threshold was implemented, however, there were there were no Heat Warnings or Emergencies issued, as none of the days met the criteria. The two-day threshold may have given the impression that there was no hot weather during that summer. However, during the months of June and August 2000, Toronto experienced multiple hot days where temperatures climbed above 30 °C (Government of Canada, 2000b) . This

finding suggests that there were times when the residents may have benefitted from a warning, but because of the criteria used, none were issued.

4.3.3 Synoptic Model

A report by Toronto's Medical Officer of Health in 2006, indicated that in the summer of 2001, there was recognition that the system was not well suited to issue heat alerts (Mckeown, 2006a). There is no evidence that a formal evaluation was performed on the system, rather a decision was made to alter the system based on the fact that the threshold for issuing warnings did not seem to reflect the weather conditions.

It became evident that it is very difficult to accurately predict Humidex levels, since they change rapidly. Subsequently, in 2000 and 2001, Toronto Public Health partnered with the Toronto Atmospheric Fund and the University of Delaware to develop a heat health alert system specifically for Toronto (Mckeown, 2006a).

This partnership led to the development of a Spatial Synoptic Classification method, which considered the relationship between different types of air masses, climate conditions and mortality (Alberini *et al.*, 2011). 46 years of climate data and 17 years of mortality data for Toronto were used in the model, which predicted that on average, there should have been 4 days of either heat warnings or emergencies each year. With this newly developed system, there was another change in terminology, with heat alerts replacing heat warnings. The system was used to call 9 days of either alerts or emergencies in 2001 (City of Toronto, 2017a). Heat Alerts were issued when the model predicted the likelihood of excess mortality would exceed 65% and Heat Emergencies were

issued when it was predicted that there was greater than 90% chance of weather-related mortality. According to the Medical Officer of Health:

The thresholds of 65 percent (for a Heat Alert) and 90 percent (for a Heat Emergency) ensure that Toronto takes action at a point where health is most likely to be adversely affected (Basrur, 2002).

In 2011 updated health and climatic data were used and new criteria developed for issuing alert:

In general, a Heat Alert is when forecast weather conditions suggest that the likelihood of a high level of mortality is between 25 and 50 percent greater than what would be expected on a typical day. An Extreme Heat Alert is when forecast weather conditions suggest that the likelihood of a high level of mortality is at least 50 percent greater than what would be expected on a typical day (Gower *et al.*, 2011).

The criteria appeared to be more protective, but no explanation was found in any of the available documents as to why there was a reduction in the threshold for excess mortality. The new criteria also featured another change in terminology from Heat Emergency to Extreme Heat Alert.

4.3.4 Harmonised System

In 2012, cities that bordered Toronto, often reported that their residents confused their own programmes with Toronto's, particularly due to the ubiquitous Toronto media and 'news bleed' (Behan, 2013). Several of the cities without programmes, indicated that their residents were confused by what they were seeing on television. There was a need for a harmonised system with

similar thresholds for alerts and similar messaging to the public. According to Behan (2013):

[There] is the realization that all levels of government need to work together on heat; and more specifically, to create a harmonised heat alert and response system. To date, health units and other orders of government have had a disaggregated approach to dealing with heat in the province, resulting in inconsistency and duplication of efforts. (Behan, 2013).

Despite the identification of the need for a harmonised system, the synoptic system with the revised thresholds continued to be in place until 2015, when a new system was piloted across Ontario during the 2015 Pan American Games. No evaluation of the system was formally performed, but the subsequent year the system was adopted. The harmonised system resulted in another change of terminology with 'Heat Alerts' being changed to 'Heat Warnings' and 'Extreme Heat Alerts' being changed to 'Extended Heat Warnings'. Heat warnings were thereafter issued if there was a forecast of two consecutive days with daytime high temperatures $\geq 31^{\circ}\text{C}$, together with overnight low temperatures $\geq 20^{\circ}\text{C}$, or Humidex values ≥ 40 . Extended Heat Warnings were called if those conditions extended beyond 2 days (Benny, 2017). The new criteria were developed as a result of updated research on heat-related mortality and temperatures (Ontario Ministry of Health and Long-Term Care, 2018) .

The act of issuing warnings based on time periods of two or more days directly contradicted the findings of a Masters of Public Health study conducted by Murti (2011) based on data from Toronto Public Health. Murti (2011) indicted that despite the implementation of hot weather response activities, heat-related mortality continued to occur and that activation of the hot weather response programme 24-48 hours in advance of heat events was necessary. She further

suggested that issuing alerts and initiating response activities on the same day of the heat event was often too late to alter the effects of that day (Murti, 2011). With the new criteria requiring at least two consecutive days to meet the threshold before a warning could be issued, any single day above 30°C that would have previously resulted in warnings under the synoptic system, would be devoid of response activities. Since 2015, no formal evaluations have been done on the new system, the criteria used for issuing alerts or the successes of the programme. Despite this, the harmonised system continues to be the programme of choice across the province.

The above section illustrates the changes in criteria for issuing heat alerts/warnings and the changes in terminology that have occurred since the inception of the programme. Even though the current threshold for issuing heat warnings is based on scientific studies conducted by both meteorologists and health officials, as will be seen in the next chapter, the constant changes in criteria and terminology has made it difficult for members of the public to fully understand when and under what conditions warnings are issued and as such when protective measures should be taken.

4.4 Theme II: Programme officials' changing interpretations of vulnerability

One of the most noteworthy findings from the thematic critique was the continual revision of the definition of vulnerability. A proper definition of vulnerability was essential because it should have underpinned the focus, content and communication strategy of the programme. Despite many changes, however,

the definition of vulnerability has never been as inclusive as the heat vulnerability literature discussed in sections 2.2 and 2.3 indicate. This was significant because all iterations of Toronto’s Hot Weather Response Plans have listed their purposes as, “to reduce the impacts of excessive heat by alerting those most vulnerable of the existence or soon to be presence of oppressive heat” (Toronto Public Health, 2016); a task that would be ineffective without a proper definition of vulnerability.

City Council reports indicate that the original request for a hot weather response programme came from the Seniors Task Force and the Advisory Committee on Homeless and Socially Isolated Persons (City of Toronto Council and Committees, 1999). As homeless and socially isolated people were the groups that this body represented, these two groups comprised the initial definition of a people vulnerable to heat under Toronto’s programme. However, changes soon occurred to the definition of vulnerability.

Table 4. 1 Changing definitions of vulnerability by Toronto officials

| Year | Population defined as being vulnerable to heat |
|-------------|--|
| 1998 | Homeless and socially isolated people |
| 1999 | Persons very young, very old, homeless, outdoor workers and urban poor individuals |

| | |
|--------------|---|
| 2000 | Seniors and medically-at-risk populations |
| 2002 | Seniors |
| 2006 | Socially isolated seniors, people with chronic and pre-existing illnesses including mental illness, children, people who have low incomes or are homeless |
| 2007 | Socially isolated seniors, people with chronic and pre-existing illnesses including mental illness, children, people who have low incomes or are homeless or live in inadequate housing |
| 2008 | Seniors, people with chronic and pre-existing illnesses, infants and young children, people on certain medications, people who are marginally housed or homeless |
| 2009 onwards | Socially isolated seniors, people with chronic and pre-existing illnesses including mental illness, children, and people who are marginally housed or homeless |

Toronto's 1999 Hot Weather Response Plan was the very first iteration of the annual plan and included a definition of what it considered to be the people vulnerable to heat. According to available documents, members of this identified population included persons who were very young, homeless, outdoor workers, urban poor individuals and very old persons (City of Toronto Council and Committees, 1999). The identification of vulnerable groups, while not complete, expanded from that proposed the previous year, was very comprehensive and provided good information on who should have been targeted during extreme heat events. However, at the conclusion of that summer, revisions had already begun on the plan. A Toronto City Council report from July 2000, provided the first indication of how quickly the definition of vulnerability was altered by authorities. The report referred to a workshop that was hosted by the City of Toronto on December 3rd, 1999, which brought together experts on heat from Philadelphia and Chicago. According to the report:

Seniors and medically-at-risk populations were identified as groups that need to be targeted. (City of Toronto, 2000)

This changed the focus on vulnerability and for the years that followed more services were focused on senior citizens. This came at the expense of services for other vulnerable groups. On March 21st, 2002, a Staff Report by the then Medical Officer of Health further illustrated the emphasis on seniors:

The experience of 2001 further highlighted that frail seniors are a population group which require additional outreach during extreme hot weather. Toronto Public Health and its partners are exploring options to reach seniors who are isolated. (Basrur, 2002).

In 2006 the definition of vulnerability was expanded, with young children and homeless people once again included. A staff report indicated that evidence suggested that the populations vulnerable to heat should be expanded:

Research studies show that socially isolated seniors are at highest risk of heat-related morbidity and mortality. Other at-risk groups include people with chronic and pre-existing illnesses including mental illness, children and people who have low incomes or are homeless (Mckeown, 2006a)

In 2007, the definition of vulnerability was further expanded to include people who lived in inadequate housing (Toronto Public Health, 2007). In a report, the Medical Officer of Health indicated that the organization would increase its focus on those who lived in inadequate housing:

In 2007, Toronto Public Health will again follow up with the rooming houses and boarding homes on its registry and will provide telephone calls and home visits to vulnerable clients as needed. In addition, Toronto Public Health will intensify its public education campaign about hot weather and heat-related illness, continue to use media releases to advise the public of heat alerts and precautions to take during hot weather, and work collaboratively with community agencies and organizations serving vulnerable populations (Mckeown, 2007a).

The next year 2008, a more comprehensive definition of vulnerability, similar to that currently identified in the literature was proposed:

At-risk populations includes the following groups: elderly, socially isolated, chronically or acutely ill, people living in poverty, the people living on the street, in shelters or in poor housing condition, infants and children, people living in rooming and boarding houses, vulnerable people living in upper floors of buildings without air conditioning, people working outdoors, and people engaging in high levels of physical activity outdoors" (Gower, Campbell, *et al.*, 2010).

Although the list was initially identified, it was never adopted into the Hot Weather Response Plan. Instead, the definition of vulnerability continued to look very similar to that of 2007 and remains the current definition of vulnerability used by the programme. There still is no mention of the wider group of people on the lower end of the socioeconomic scale, new immigrants or people whose first language is not English.

The above section illustrates the multiple changes in the interpretation of vulnerability by programme officials since the inception of the programme. While the definition started out very narrow and has expanded to include more groups of people, it still does not include many of the vulnerable groups identified in the literature.

4.5 Theme III: Changes to the budget and corresponding changes to services

A review of the available financial documents indicated that the budget allocated to Toronto's Hot Weather Response Programme has fluctuated since the programme's inception. While there have been several increases to the budget, overall the budget has been reduced significantly over the life of the programme. Along with the changes to the budget has been changes to the services provided.

4.5.1 The early years 2000-2002

The first year when Toronto's City Council dedicated funding to the Hot Weather Programme was in 2000. Financial documents show that even though there was a recommendation for \$150,000 only \$40,000 was allocated (Basrur, 2002). The funding meant that whenever a heat alert was issued, response activities could be delivered. These activities included phone calls, emails or facsimiles to relevant partners responsible for delivering elements of the response phase of the programme and to local television, radio and newspaper outlets (City of Toronto, 2000). For the first two years of the programme, these media notifications were confined to non-statutory holiday weekdays. This was a deficiency in the system as the providers of the programme would be informed of the alerts on weekends and holidays. However, the general public received no information and advice on these days (Mckeown, 2007b).

During the first year of the programme information was also available to the general public about heat mitigation activities, if people phoned the health department during the hours of 8:30am to 4:30 pm, Monday to Friday. For 2001, a 24 hour, 7 days a week Red Cross Information line funded by the Toronto Public Health Department, was added to the list of response activities. During the summer of 2001, there were approximately 500 calls made to this Heat Information Line; of those 51 were redirected to the Emergency services and as a result of those calls 21 people were transported to the hospitals for emergency medical attention (Basrur, 2002). Staff reports also indicate that calls were also received from parents requesting information about participation in sports activities during extreme hot weather (Toronto City Clerk, 2002). This volume of these calls and the fact that some resulted in emergency treatments

demonstrated the value of this service. Although this additional service was available, there was no addition to the 2001 budget. As indicated in section 4.3.2, no alerts/warnings were issued in 2000, therefore there were no response activities provided. As such the same budget of \$40,000 was kept.

A 2002 staff report by the then Medical Officer of Health estimated that there should be less than 5 alert days each year, based on historical data. As such, the budget of \$40,000 was again deemed sufficient to handle all activities. Those response activities during the first four years of the programme mostly included the distribution of educational material and outreach activities from a number of contracted community groups (Basrur, 2002).

4.5.1.1 Community agencies

The Out of the Cold group, a local community agency which aids homeless people was contracted to deliver bottled water to facilities such as community centres and local libraries, locations where homeless people were likely to frequent on hot days.

Another organization, Community Information Toronto, phoned and faxed shelters and community agencies that were responsible for dealing with homeless and vulnerable individuals. They would call and advise these agencies of the issuance of a Warning or Emergency and would be available as a resource for heat-related information.

Table 4. 2 Changes to program activities and budgets since the inception of the programme.

| Activities | Year | | | | | | | | | | | | | | | | | | | |
|---|-----------|----------|----------|----------|------|-----------|-----------|-----------|------|------|-----------|-----------|-----------|------|----------|----------|----------|------|------|------|
| | 1999/2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Budget(\$) | \$ 40,000 | \$40,000 | \$40,000 | \$78,920 | | \$108,826 | \$171,800 | \$350,900 | N/A | N/A | \$428,236 | \$196,998 | \$186,000 | | \$67,527 | \$57,176 | \$39,474 | | | |
| Proactive literature distribution through larger pharmacy chains | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Bottled water distribution to libraries and community centres | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Information Line | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Proactive literature distribution to vulnerable resident buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Inspections/Outreach during Heat Alerts | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Red Cross transport of vulnerable resident to cooling centres | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Printed literature availability and distribution | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Presentations to public upon request | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Dedicated cooling centre for seniors | | | | | | | | | | | | | | | | | | | | |
| Hot Weather messages for pets | | | | | | | | | | | | | | | | | | | | |
| Outdoor bottled water distribution | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Alert Notification on Phone | | | | | | | | | | | | | | | | | | | | |
| Alert Notification via Fax | | | | | | | | | | | | | | | | | | | | |
| Cooling centres for general public | | | | 4 | 4 | 4 | 4 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Alert Notification via email | | | | | | | | | | | | | | | | | | | | |
| Web based material | | | | | | | | | | | | | | | | | | | | |
| Libraries display heat messages and available for cooling off | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Extended swimming pool hours | | | | | | | | | | | | | | | | | | | | |
| Street Outreach for homeless by Red Cross | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Heat literature to ER Hospitals | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Subsidised housing communication with tenants re: heat/ precautions | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Public Health Nurse contact vulnerable residents during alerts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Visit senior and vulnerable population | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Community Agency outreach | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| EMS staff on Duty at Cooling Centre | | | | | | | | | | | | | | | | | | | | |
| Public education on heat | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Proactive inspections of vulnerable resident buildings | | | | | | | | | | | | | | | | | | | | |

Anishnawbe Health Toronto, a local Aboriginal Community health Centre, ran street patrols to identify individuals who were suffering ill effects from heat. They also provided tokens for the local transportation system, so that the affected individuals could find themselves to cooler locations (Basrur, 2002).

The Ontario Community Support Association, a group that serves frail and isolated seniors, also provided information to vulnerable clients on ways to combat heat. They visited clients on days when warnings/emergencies were issued to verify that the clients were able to cope with the heat. To facilitate this, they were provided with training, at a cost to Toronto Public Health, on how to recognize signs and symptoms of heat illness as well as CPR and First Aid Training (Basrur, 2002). Local pharmacies also agreed to distribute Hot Weather-related information to clients, particularly seniors who would be among the most vulnerable to hot weather.

The Toronto Emergency Medical Services (EMS) in partnership with the Canadian Red Cross staffed a mobile medical and environmental vehicle that would conduct assessments of people in private homes who were at risk of experiencing negative effects due to the weather. If any of those people needed transportation to a cool location, this vehicle would also be used for such situations. As a part of running the Heat Information line, the Red Cross also took the information of any persons who needed assistance during hot weather and visited them with EMS whenever necessary.

4.5.1.2 Implications

The above demonstrates that during the early years of the programme there was a significant onus placed on outreach and education. Community groups were engaged and contracted to provide services to their respective communities. The regular use of the information line demonstrated its importance to the dissemination of information to residents. While there were limited services available, the value that those services produced, particularly the personal outreach was extremely important.

4.5.2 2003 to 2006: Services grow, and cooling centres are introduced

In 2003 the budget increased from \$40,000 to \$79,000. With the increase, came the addition of two additional response activities, the opening of four dedicated cooling centres and a contract with the Red Cross to do street patrols and transport heat-affected people to the nearest cooling centre. A 2002 Board of Health report, highlighted the ongoing need for better protection of frail and vulnerable seniors (Toronto City Clerk, 2002). This recommendation was not realised until 2006 though, when Toronto Homes for the Aged was included as a partner. This organisation introduced a seniors' cooling centre, a facility with short-term beds for vulnerable adults and frail seniors who sought a respite from oppressive hot weather.

The actual cost of services from 1999 to 2005 is unknown. But a 2006 report from the Medical Officer of Health gave an indication of what the services cost and made a request for a substantial increase to improve services:

In 2005, there were 26 Heat Alert days resulting in a total expenditure of \$108,826 for related services. Toronto Public Health has requested \$171.8 thousand gross, \$60.1 thousand net, in the 2006 Operating Budget to hire Public Health Inspection students to provide outreach and education to landlords and vulnerable residents of rooming houses and boarding homes, and to cover services for additional Heat Alert/Heat Emergency days. (Mckeown, 2006a).

4.5.2.1 Implications

The above subsections indicate that during the early years of the programme, there were increases to the budget followed by increases in services. One of the most significant was the opening of four cooling centres available for use by the general public and the one dedicated centre for seniors. Cooling centres are recognised as an effective option to deal with excessive heat (Widerynski et al., 2016). The cooling centre model demonstrated a recognition of the benefits of access to air-conditioning to those who may have otherwise not had that option.

4.5.3 2007 and beyond- A new department and a new direction

Meeting minutes show that there was a request for an even larger budget increase for the summer of 2007:

The Medical Officer of Health recommends that the General Manager of Shelter, Support and Housing Administration be authorized to allocate up to \$200,000 gross (\$50,000 net) to implement the 2007 extended summer hours drop-in program (Toronto Board of Health, 2007).

In addition to the approval of \$200,000 for the additional services, the Healthy Environments division of Toronto Public Health assumed responsibility for the

programme from the Emergency Planning and Preparedness division. (City of Toronto, 2007). Healthy Environments is the section of Toronto Public Health with expertise in environmental health and not emergency planning. The directorate is primarily responsible for law enforcement and does not employ any emergency planners or health promotion specialists and therefore, no one with detailed knowledge on how to develop and deliver public health programmes to vulnerable residents

With this transition there was an increase in the budget to \$350,900. This figure represented the cost of staffing and administering the programme, by hiring 6 part time Student Public Health Inspectors, and Emergency Coordinator and a Manager for a 6-month period.

In 2007, the Healthy Environments directorate also assumed many of the tasks previously carried out by other groups, including having the overall responsibility for revising, coordinating and administering the activities of the plan. These activities included the development and distribution of educational literature, delivery of health protection educational material to landlords of low-cost housing and outreach activities during prolonged periods of extended heat. There was also distribution of transit tokens to vulnerable and homeless people during hot weather events (City of Toronto, 2007).

Another activity that was undertaken by Healthy Environments, and one that was previously absent from the plan, was a pre-season visit by Public Health Inspectors to all known rooming, lodging, boarding homes and shelters. The inspectors distributed Hot Weather Protection Plan Packages to landlords and provided information and advice to those landlords as to when and how to

implement their own hot weather plan. While this promised to be an expansion of services, these visits only lasted for one season. No explanation was found for the termination of this activity.

Review of the 2008 Hot Weather Response Plan also illustrated that a number of other response activities ended in 2007. These included the proactive literature distribution through larger pharmacy chains, nurse contacts and visits with vulnerable residents during alerts, community agencies outreach, bottled water distribution to libraries and community centres, public education on heat as well as paramedic staff on duty at cooling centres (City of Toronto, 2008). One contradictory note, though, was that the elimination of these services coincided with a broader definition of vulnerability being used. This was counterintuitive as the documents seemed to indicate that the provision of services was not tied to vulnerability.

In 2010, there was a Municipal election and the new Mayor emphasised finding efficiencies in all Toronto departments. In the Health department, there was a request to cut budgets by 10%. This was an overall sum and it was not evenly distributed across all programmes. The Hot Weather budget at that time was \$428,298, however, to meet the 10% overall reduction, senior management decided to eliminate all the staff from the programme except the manager. This promised a savings of \$231,300. This dollar value meant that the budget for the Hot Weather Response Programme was reduced from 2010 to 2011 by over 55% to \$196,998. There was no information available which indicated that these cuts were a part of an evaluation of services, rather it appeared that the cuts were done primarily to save money.

For the calendar year of 2012, the approved budget was decreased further, down to \$186,000. This reduction of \$10,000 meant that an information line run by the Canadian Red Cross providing information and advice to members of the public, most notably those responsible for the care of vulnerable individuals, was eliminated. Also, a contracted service that would provide phone notification of alerts to vulnerable individuals was eliminated. Again, there was no indication that the cuts were because of any evaluation into the effectiveness or value of those elements, rather their cuts were just mentioned in meeting minutes as changes to the programme (Hot Weather Committee Meeting Minutes, 2013)

At the conclusion of the 2013 season, proactive literature distribution to vulnerable resident buildings, communication with tenants of subsidised housing about precautions to take during periods of extreme heat, inspections and outreach during heat events and transportation of vulnerable resident to cooling centres all ended (Hot Weather Committee, 2013). The cuts to services continued the following season with the end of printed literature distribution to the public and to hospital Emergency Rooms, hot weather presentations to the public and alert notification on phone and fax. In 2014, distribution of information packages to the approximately 300 landlords of low-cost housing buildings were eliminated. These packages had included advice on setting up a hot weather plan for each building, as well as information on how residents should deal with excessive heat. The packages also provided the locations of the nearest cooling centre as well as addresses, phone numbers and opening hours of nearby air-conditioned public places, such as libraries and community centres. Senior management felt that these packages had been distributed to these residences

for the previous 5 years and was not needed (Personal communication, 2014). Little attention was paid to the fact that the residents of these homes are transient and there for a limited period. Many of the residents stay in one of these homes for less than a year, therefore there is little reason to believe that the current residents are aware of anything that took place the previous year.

In addition, more health-related activities such as a dedicated cooling centre for seniors, outdoor bottled water distribution and street outreach for homeless by the Red Cross were also cut. Personal communication with senior management officials at Toronto Public Health (2014) indicated that these potentially lifesaving activities were all eliminated for budgetary reasons. These cuts were made without any evaluation of their effectiveness despite the fact that public health practice should be underpinned by evidence (Brownson, Fielding, & Maylahn, 2009). Very few of the reviewed documents provided any information as to why services were discontinued and those that did, referred to budgetary constraints (Mckeown, 2007a, Gower *et al.*, 2010).

With all these cuts, the budget for 2014 amounted to just \$67,527 and the 2015 budget showed a further decrease down to \$57,176. That same year there was also elimination of the water distribution contract that was in place with the Canadian Red Cross. Without any empirical evidence, it was suggested that there was no tangible benefit to distributing water. According to a senior official, water was available everywhere and the elimination of this element could save over \$30,000 (Personal Communication, 2015).

4.5.3.1 Implications

The above subsection describes two major shifts to Toronto's Hot Weather Programme, both of which fundamentally altered the direction of the programme and its activities. The transfer of the programme from the emergency planning division to the healthy environments division meant that the officials in charge of the programme no longer had the background in emergency planning and were ill equipped to properly administer the response activities. The healthy environments division also took on the outreach activities that were previously performed by various contracted groups and this severed most of the community-based activities and limited the natural feedback and learning activities that would have occurred with community partners.

4.6 Theme IV: Changing communication techniques

When Toronto's Hot Weather Response Programme was first proposed, its target group was seniors and homeless people. Twenty years later, the programme has morphed into one where the communication techniques utilised would probably preclude most members of those two vulnerable groups, especially the latter.

A review of programme documents indicated that there was a transition from physical outreach, written and personal communication to more electronic forms of communication. This change started around 2007, the same year that responsibility for the programme was transitioned to Healthy Environments.

Around that time, the internet started to be used to notify the public of Heat Alerts and Extreme Heat Alerts. Whenever an alert was called, upgraded, downgraded or terminated, the Healthy Environments directorate updated several City of Toronto webpages. With this new method of notification, some of the previous elements of the plan were deemed obsolete. The majority of community outreach services were eliminated from the plan. While the outreach groups played an important role in notification of alerts, they also served their vulnerable clientele in other ways such as personally connecting with and providing them with other supportive services. Senior management at Toronto Public Health were of the view that more effective communication could be achieved by utilizing electronic means such as email, websites and social media such as Facebook and Twitter (Senior Official, Personal Communication). However, there was no provision for the replacement of the other periphery response activities that the outreach groups delivered.

Extensive use of the internet also removed and replaced many of the printed resources that agencies and departments involved in the programme could distribute to their clients. In 2014, there was no further printing of information and according to the opinion of one senior programme individual, any information that was needed could easily be accessed online (Personal communication, 2014).

4.7 Conclusion

This chapter presented the results of the thematic critique which was performed on documents which pertain to Toronto's Hot Weather Response Programme.

The critique identified four main themes which demonstrated how the programme has evolved since its inception. The first theme examined the changes in the criteria for issuing alerts/warnings. The alert criteria varied from being based solely on temperatures and humidex, to including the number of days of hot weather in sequence, then to include mortality and then back to temperature and humidex based. These changes happened regularly and with very little explanation to the public. The implication of this is that there could be confusion among the public as to what the terms meant and when protective actions should have been taken.

The second theme examined the changing understanding of vulnerability by programme officials. Programme officials have never had as comprehensive a definition of vulnerability as indicated in the literature. The constant changes to the understanding of vulnerability may have resulted in a lack of attention being focussed on the vulnerable groups who needed it.

The third theme which emerged from the documents was changes over time to the budget and services provided. Many of the services which were available in the earlier years of the programme have since been eliminated and it appears that this was a direct result of a reduction in the programme budget. The documents indicate that many of the changes to the programme were based on assumptions of what elements were necessary and what were redundant, and many were made as a means of cost-cutting.

The fourth theme identified changes to communication techniques. This was a significant shift and demonstrated a transition away from personal communication to electronic forms of communication and a very heavy reliance

on technology. The early years of the programme was centred around connecting with vulnerable communities and serving them on a personal level, while the latter years has been geared towards residents' self-management and self-responsibility for their health outcomes. These types of actions are becoming more prevalent due to austerity measures. Such actions, though, can also create social and economic disadvantage, particularly among those unfamiliar with the technology and can exacerbate health outcomes rather than improving them (Lupton, 2015). One of the most notable findings from this document critique was the absence of any evidence of formal evaluations by the programme management to justify these changes. This change in philosophy and its implications for the programme and the residents will be explored further in Chapter 6.

Chapter 5- In their own words: the findings of the semi-structured interviews

5.1 Introduction

This chapter describes the results obtained from the qualitative interviews conducted with participants selected from a cross-section of Toronto's vulnerable populations. Twenty-five semi-structured interviews were conducted with participants who met several of the heat vulnerability criteria, previously discussed in the methodology chapter. Questions were asked about the participants' perception of oppressive heat, their understandings of how heat may affect health, their strategies for coping with heat, their knowledge of Toronto's Hot Weather Response Programme and their suggestions for improvements to the programme. Using thematic analysis, the twenty-five interviews were analysed for consistent themes, which helped to create an understanding of the way in which vulnerable people perceive heat and its risks as well as the way that Toronto's Hot Weather Response Programme is viewed and utilised, if at all, by its target population.

5.2 Sample population

The selection process previously described in Chapter 3 provided a means of obtaining participants, who based on information obtained from the literature review in Chapter 2, were identified as being vulnerable to the effects of hot

weather. 25 people, 10 men and 15 women, were chosen for the study. As illustrated in Table 5.1, the participants ranged in age from 23 to 77 years, only one had attained a post-secondary education, with the remainder having achieved secondary school levels or less. Of the 25 participants, 16 were identified as belonging to a racialised minority group, 16 had English as their second language and 20 were foreign born. None of the participants owned their home; they all rented, either from a private sector company or from government subsidised social housing, and they all identified as being low-income residents.

5.3 Findings from qualitative interviews

In analysing the responses from the interviews, three major themes emerged. These themes captured the overall results of the interviews and identified the major topics that were recurring. Each of the themes were further defined by several underlying sub-themes. The three themes which emerged were: Perceptions and understandings of heat and its risks, Agency, and Understandings and interpretations of the Hot Weather Response Programme. These themes and sub-themes are presented in the thematic map in figure 5.1

Table 5. 1 Characteristics of the participants interviewed

| Participant | Age | Gender | Racialised Minority | Secondary School or Lower | Low Income | Rent | No Air Conditioning | No Cooling Room | English 2nd Language | Interview Location |
|-------------|-----|--------|---------------------|---------------------------|------------|------|---------------------|-----------------|----------------------|--------------------|
| 1 | 27 | M | X | X | X | X | X | X | X | Home |
| 2 | 63 | F | X | X | X | X | X | X | X | Home |
| 3 | 60 | F | X | X | X | X | X | X | X | Home |
| 4 | 60 | F | X | X | X | X | X | X | X | Home |
| 5 | 63 | F | X | X | X | X | X | X | X | Meeting Room |
| 6 | 36 | F | X | X | X | X | X | X | X | Home |
| 7 | 63 | F | X | X | X | X | X | X | X | Home |
| 8 | 35 | F | | X | X | X | X | X | | Home |
| 9 | 48 | M | X | X | X | X | X | X | X | Home |
| 10 | 23 | F | X | | X | X | X | X | X | Meeting Room |
| 11 | 36 | F | X | X | X | X | X | X | X | Home |
| 12 | 42 | F | X | X | X | X | X | X | | Home |
| 13 | 30 | M | X | X | X | X | X | X | | Meeting Room |
| 14 | 26 | M | | X | X | X | X | X | | Meeting Room |
| 15 | 38 | F | | X | X | X | X | X | | Home |
| 16 | 63 | F | X | X | X | X | X | X | | Home |
| 17 | 38 | M | | X | X | X | X | X | X | Cooling Centre |
| 18 | 62 | F | X | X | X | X | X | X | X | Cooling Centre |
| 19 | 55 | F | | X | X | X | X | X | X | Cooling Centre |
| 20 | 58 | F | X | X | X | X | X | X | X | Meeting Room |
| 21 | 66 | M | X | X | X | X | X | X | | Meeting Room |
| 22 | 68 | M | | X | X | X | X | X | | Meeting Room |
| 23 | 67 | M | | X | X | X | X | X | | Home |
| 24 | 75 | M | | X | X | X | X | X | x | Home |
| 25 | 77 | M | | X | X | X | X | X | x | Home |

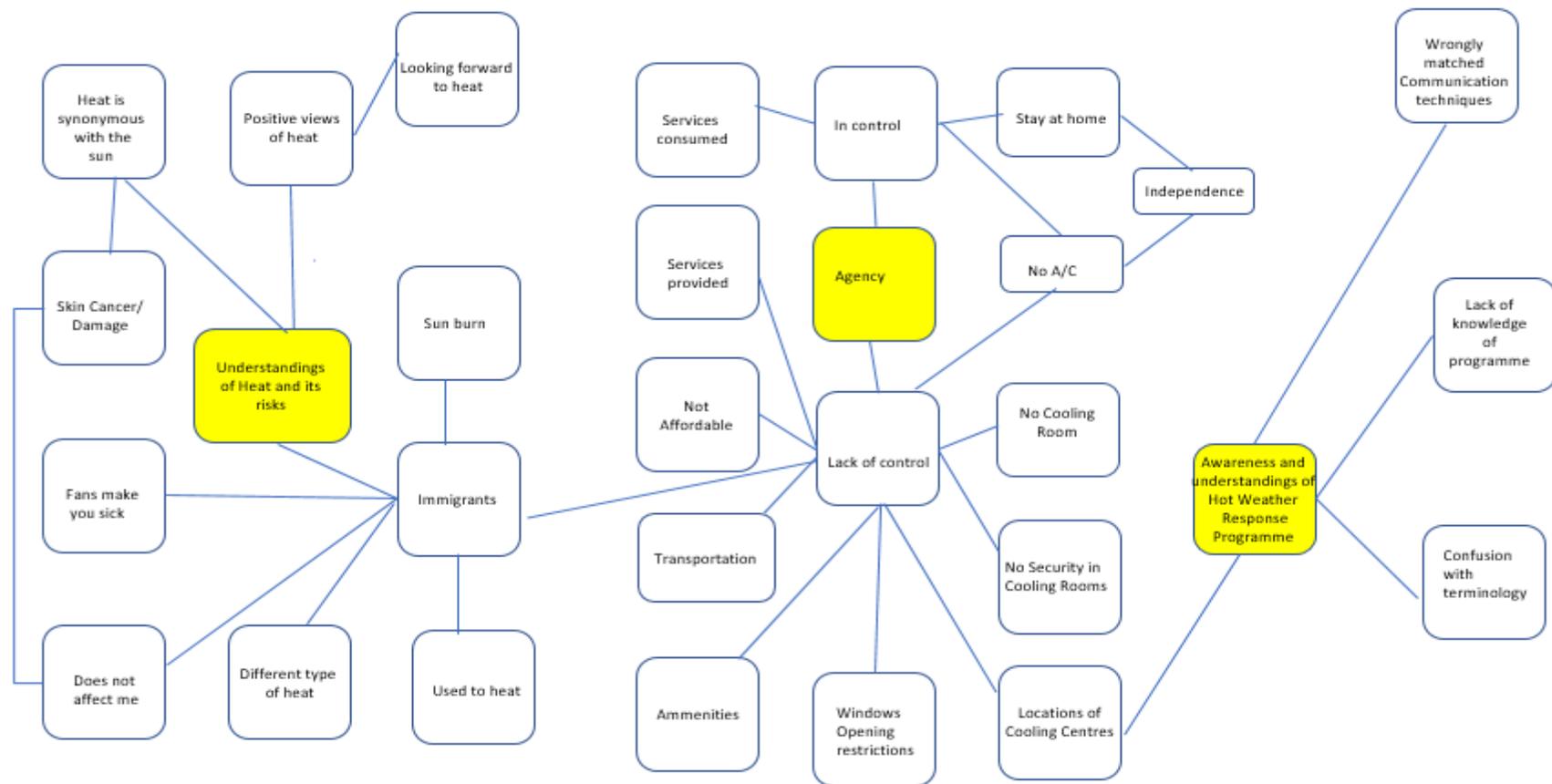


Figure 5. 1 Thematic Map

5.4 Theme 1: Perceptions and understandings of heat and its risks

One of the goals of this study was to explore vulnerable people's perceptions, experiences and understandings of heat and whether they believed that it had negative effects on their health. Thematic analysis of the interviews demonstrated that the participants had clearly defined perceptions of hot weather and the potential for that weather to affect their health.

5.4.1. Health effects due to sun exposure rather than heat exposure.

While skin damage and cancer are associated with exposure to ultra-violet radiation from the sun, the negative impact that heat can have on health can occur even in the absence of the sun (White-Newsome *et al.*, 2012). The health effects posed by exposure to sunlight and ultraviolet rays differ from those associated with exposure to oppressive heat. When asked about their understanding of the health effects of hot weather, the initial perceptions of many of the participants focused on the negative effects of sun exposure and very few made a connection with other negative health effects such as cardiovascular and respiratory issues, which can be exacerbated by heat.

A 63-year-old female who had migrated to Toronto from South America, when asked about her perceptions of the health effects of hot weather spoke at length about sun burns and skin cancer:

I think that with the sunshine here people can get sick, they get burn, there is cancer and of skin and you need to cover up otherwise you get bad burns. Most people get red and burn, they do not cover enough, they wear little bit of clothes, but they can get really bad burns, You see it all the time, little children playing outside it is too hot , there is no trees, no

shade but you know, it is like, they are small, they want to play outside so they parents let them play outside, and they are in the sun, and sun is out until 10 o'clock, so it is dangerous to them.(Participant 2)

Another female who had recently emigrated from India provided a similar response:

I get burned very quickly in the sun, so that's my primary problem, being exposed to the sun. Particularly my hand, so any exposure, skin burns. (Participant 6)

Similar responses were also obtained from other participants as sunburns and skin cancer were mentioned on multiple occasions. This predominant focus on skin cancer and sunburn as a result of exposure to hot weather was not confined to elderly participants or recent immigrants. Participant 10, the youngest participant and the only university educated female, spoke exclusively about sunburn and melanoma and Participant 8, a 35-year-old Caucasian female who was born and grew up in Toronto, mentioned sunburns and cancer when asked about the health effects of heat. When probed further and asked if she could separate the concepts of exposure to ultraviolet rays and heat, she indicated that she could not:

Oh! No, I've always thought of them as connected, but when it comes to things like melanoma and stuff, I don't see that as being a heat or humidity-related thing specifically, because I know that prolonged exposure to sunshine, even when it's pretty cool or pretty mild, and if you don't wear sun block or anything, you're susceptible to getting skin cancer. (Participant 8)

Another 36-year-old female of mixed ethnic background, who was born and grew up in the Toronto area, when asked about what she thought the health

effects of hot weather were, instantly spoke of sunburns affecting herself and her elderly mother:

I guess for me, sunburn is an issue, but because it's not my number one issue, like I've had trouble with other stuff, it's not on the forefront but I know I do have to pay attention to that, too. Someone like my mom who's very pale and that's probably her number one concern. (Participant 11)

A 66-year-old long time Canadian resident, originally from Grenada, also had similar views of the effects of hot weather. He spoke about children and animals dying in hot cars, but when pressed further his description was similar to the others:

I think it is just what I said, the tiredness and the sunburn for some people. (Participant 21)

Most interviewees' accounts therefore focussed on skin damage and cancer, which result from chronic exposure to ultra-violet rays, rather than the detrimental health impacts that could result from acute exposure to extreme heat. This finding is important because there seems to be little awareness of the dangers of heat among a sample of individuals who, according to the literature, are vulnerable to the effects of heat due to their socio-economic circumstances. This will be further explored in the discussion chapter which follows.

5.4.2 Unaffected by heat

As many of the interviewees focused on skin damage and cancer, some of the possible detrimental health effects due to heat exposure were discussed with them. Respiratory and cardiovascular effects due to heat were emphasised, but most participants who had originally come from hot climates were of the view that they were immune to the effects of oppressive heat. A 66-year-old, originally from Grenada, West Indies, but who had come to Canada to work in the agricultural industry, reported that hot weather could not affect him because of his background and the conditions that he endured as a young man. When asked directly if he had ever suffered any negative health effects due to heat, his response was that he had not. The tone and emphasis of his response also seemed to indicate that he believed that he could not be affected by the heat and demonstrated that there was a lack of understanding of how vulnerability of the body changes with age:

No man, I am from Grenada man, no problem there. I used to work in the apple fields, all day, the most we used to get was hot and thirsty, but we used to enjoy it. (Participant 21)

This response was not unique, as a participant from India, who had previously identified sunburns as a problem, did not initially think that there could be additional health affects due to heat. Only when probed further and the concept of people becoming sick due to heat exposure was directly mentioned to her, did it seem to resonate:

I'm used to the heat coming from India. It's quite hot, hotter than it's in Canada, so heat is something you constantly deal with. I'm not certain being sick has ever been... If I have ever considered being sick due to

the heat, but I can see that you do get overheated and you can't really cool off that quickly. Yeah, yeah, you can attribute feeling sick to the heat as well. (Participant 3)

This presumption of being immune to the effects of heat was not based solely on country of origin, it also seemed to be based on assumptions about how vulnerability to heat related to colour of skin.

Participant 13, a 30-year-old Black male, believed that almost exclusively Caucasian people were the only ones who could be affected by extreme heat. When asked who he thought were most likely affected by hot weather and prompted with choices such as young, old and outdoor workers he chose a different option:

I think Caucasian people, that's about it. What I heard is because the melanin in their skin... I heard that's why. (Participant 13)

Later in the interview when he was asked if he had ever personally experienced any ill effects due to heat, he stated that he was not Caucasian.

Participant 15, a 38-year-old Caucasian female also expressed similar views. When asked which segment of society would most likely be affected by oppressive heat, she chose to speak about race and ethnicity:

People that quickly burn like people of Irish descent, they're Caucasian, they're Asian, they burn really easily, so that might be a concern. (Participant 15)

Several of the participants were more concerned about their current health conditions than health risks from heat. A 62-year-old woman originally from

India, demonstrated this when she was asked directly if she was concerned about the negative effects that hot weather could have on her:

I am 62 years old; I don't worry about things like that, and I worry about if my blood pressure will be high in the morning. (Participant 18)

Having never had ill effects due to heat in the past, it seemed she did not believe that it was something she needed to prioritise in the future.

Participant 24 spoke about his hip and mobility issues and Participant 25 spoke about feeling cold due to his diabetes. Even though they were both over 75 years old, and heat is known to be particularly detrimental to the health of older individuals, neither of them expressed any concern for the effect that heat could have on them.

5.4.3 Toronto's heat as a 'different type of heat'

A common term that was repeated by some of the participants, particularly those who were not born in Canada, was that Toronto's heat was a "different type of heat". The participants often referred to Toronto's heat as being stifling and emphasised that there was a lack of wind. This is a feature that is quite common in urban heat islands, which was characteristic of the areas in which all the participants lived.

Participant 1, a 27-year-old Venezuelan, who indicated that he was healthy, stated:

No, it's different because in Venezuela, we have wind and it refreshes to us, but this kind of hot two weeks ago, it's like you feel a pressure onto you. And again, it's like the breathing, it's difficult in that moment than other time. (Participant 1)

A 60-year-old Somali immigrant perceived that the summer-time temperatures in Toronto were substantially greater than in Somalia:

[Somalia] is not as excruciating hot, it's not as humid. Yes, there are the hot months, and there's sometimes even drought, but I realise that summer months in Toronto is just really hot, and I feel like that's part of global warming or something, but especially over the last past years, recent years. (Participant 4)

The average temperatures in Toronto are, in fact, much lower than those in Somalia. Somali summer temperatures can get above 38 °C and relative humidity readings are usually above 65% (Kennedy, 2018). Toronto, between 1981 and 2010, has had an average daily temperature of 20.2 °C during the summer months and has averaged only 0.25 days with temperatures in excess of 35°C (Environment and Climate Change Canada, 2017).

Another participant from India also suggested that the heat in Toronto was different to the heat in New Delhi:

The heat here is... I find it very different compared to the heat back home. Heat here feels a lot more direct, and that sounds odd I know coming from a very hot country, but it's harder to stay out longer I find here, than being in India. So, in an odd kind of way it's more tolerable in India than in Toronto, or maybe because I'm used to that there, than here (Participant 18).

This reference to “a different type of heat” is important as it indicated that the participants were likely experiencing health effects due to the heat, but they did not readily recognize it. This will be discussed in relation to other studies with similar findings in Chapter 6.

5.4.4 Air-conditioning, windows and fan use

A further complication to the lack of recognition of the dangers of extreme heat, was that common, potentially lifesaving coping strategies were not well understood by study participants. In some cases, they were feared and avoided. As such, the participants may have inadvertently been putting themselves at even greater risk. There seemed to be a lack of understanding of the benefits of air-conditioning during periods of extreme heat. Air-conditioning has been shown to be one of the most effective ways to prevent heat exhaustion or to aid in recovery from heat exposure (Knowlton et al., 2009). Instead of seeing air-conditioning as a benefit, many participants viewed it as a detriment to their health.

This is a very old building, people use fans, and air [conditioning] makes you sick so I don't want to catch the flu. (Participant 2)

Another participant indicated that he did not think air-conditioning was natural:

No, like I told you before, I'm European and I like the heat and I try to really like stay away from air-conditioning, it just isn't natural, not healthy. (Participant16)

Fan use was also not well understood. Most participants used fans to cool off. Many, however, used fans under conditions where it could have had led to overheating and dehydration, while others failed to use them when they could have assisted cooling. In either situation, the residents unwittingly may have placed their health in jeopardy.

Participants were asked about the proper use of fans. One participant felt that if she felt hot, she should turn the fan on, except when she was sleeping:

I would say as long as it is hot, I would use the fan, if there is, for example electricity and it can be used I would use it. The only time, like I said is at night and in bed (Participant 5)

Another participant also refused to use the fans at night because she feared that it would make her sick:

During the day, but never at night and never aim the fan at your face or chest because you can get sick from that, especially if you have shower and hair is wet that can get you sick and you can get the cold...flu from it (Participant 7)

One of the only participants who indicated that she would use fans throughout the day and into the night also misunderstood the way colds and flu are transmitted. Like the others before, she too felt that she could get sick from the fan breeze:

I have no idea that there were proper ways to use a fan, just keep the fan running throughout the day, literally, 24 hours if need be, just don't aim it at your face, that I know. Well it is already hot outside, so you don't want to catch a cold on top of that (Participant 11)

Other participants who indicated that they did use fans did not seem to be aware that there were temperatures at which fans should not be used. One participant was asked directly about this indiscriminate fan use and whether there were days when the fan did not seem to provide any relief:

I never really thought of that, but yes sometimes it seems that it is so hot the fan doesn't really help out so much, but I still have to use it otherwise it gets too hot (Participant 4)

Participant 12 also expressed concerns about catching the cold from having the fan blow air on her face, but she also indicated that she would always keep her windows closed when she was using the fans; she appeared unaware that keeping the windows closed could lead to rapid warming of the apartment.

Participant 8 when asked about opening her windows when using the fan responded:

See, you're not supposed to because the [cool] air will escape out. That's what I learned as a kid. But the thing is as I told you, our unit facing south, it's hot all year round, right? So, I often want some fresh air to come in, to breeze through, especially after cooking and stuff, right? So sometimes if I'm in the mood for fresh air, I will open the window a crack. But I wouldn't open it all the way, if the fan's on. I just open it a crack and then... But then other days I'll close it completely if the fan is on 'cause you want to keep the air in.... (Participant 8)

Participant 17 described why he would keep his windows closed during his fan use:

Yeah. The windows would be closed, you don't want the cool air from the fan going out and you have to keep the heat from going in, it's like the busses and those office buildings. They keep the windows closed year-round (Participant 17).

Another interviewee seemed to have some prior knowledge of proper fan use, but with limited information on the topic available, she too was confused:

I don't know. I've heard that, because at night when you're sleeping and if the fan is constantly blowing on you, that somehow it causes dehydration and you can die. I don't know, it's... I guess maybe it's a superstition, even. I don't know. But I don't do it. Also, I know that you can catch a cold if the fan is directly on your face, so I wouldn't do it (Participant 10).

The majority of responses indicated a high level of confusion concerning the use of fans in conjunction with windows. Often participants restricted the use of fans to the daytime while keeping their windows closed. Their responses emphasised this confusion and their actions may have led to them creating environments that could have had severe physiological consequences. The avoidance of direct contact with their face and body, because they felt it could make them sick, demonstrated a lack of knowledge of how the cold and flu viruses were spread and may have led to them not using fans to cool themselves when they should have.

5.4.5 Positive perceptions of heat

Some participants had positive perceptions of heat. Several participants indicated that when they saw the advertisement for this study, they immediately thought that it would be about the benefits of summer and what they liked most about it. They did not think of hot weather in a negative light.

A 63-year-old female originally from Guatemala, was asked what her immediate thoughts were when she heard the words 'hot weather', her response was all positive:

Well I thought it would be something like the opposite of SAD, you know the disease that people get during the wintertime when they are in the home all the time. I imagined it was something about how the sun makes you perk up, makes you happy. (Participant 2)

When asked specifically if she only ever associated positive thoughts with hot weather, she responded that she had:

Yes, I only thought about the sun affecting your health positively, you know brightening your mood, now that we are talking, I realise that you are probably going to start asking me about the negative aspects of hot weather. (Participant 2)

Despite having said that, she followed up her statement with another that again represented hot weather positively:

Yeah, probably there are more positive than negative aspects, but I imagine the biggest negative effect is probably skin cancer and sunburn (Participant 2).

Participant 10, a 23-year-old, university educated female also had a similar response to the same question:

Generally, people feel a bit more positive during the summer because the sun is out. It's not like winter, where it's constantly cloudy, and so, I would say the prevalence of depression would be less. Okay. That is so true, especially after being in the house for 6 months with the cold, getting outside in the summer is something people crave. (Participant 10)

Another individual, when asked if he ever thought negatively about hot weather, compared Toronto's weather to that of the much colder Winnipeg. In his view, referring to hot weather in a negative light was akin to complaining and was something that should not be done:

Never, to tell you the truth up until you contacted me it never entered my mind that summer and heat could be something bad, and still I don't think of it that way. Yes, I know some children die when they are left in cars, but really that is the parents' irresponsibility and has nothing to do with the weather. Look we really are lucky here in Toronto, imagine people in Winnipeg, even their summers are cold, so I don't think we should ever complain. (Participant 17)

Overall, the participants seemed to have a lack of awareness of the potential health effects of hot weather, other than those related to sun exposure. Many did not think that they could or would be personally affected either because of their ethnicity or a perception that they were resilient to heat due to their prior exposure in their country of origin. Others viewed hot weather only positively. The consequences of these types of views and the implications for the government's plans for hot weather response are explored in the discussion chapter.

5.5 Theme 2: Agency

The second major theme which emerged from the interviews was one of agency. Agency refers to an individual's ability to make decisions guided by their own choices. It is an expression of autonomy and a sense of mastery over that individual's environment (Becker, 2017). Agency is also viewed as an

individual's control over their actions and through them, over external events (Beck, Di Costa, & Haggard, 2017). Many of the aspects explored seemed to indicate the participants experienced a lack of agency, in terms of their living conditions as well as the choice of services and amenities available to them. There was also a sense of desire to maintain their personal independence and of the need to make decisions on their own terms.

5.5.1 Lack of agency

The majority of participants in this study appeared to have very limited control over various aspects of their living conditions, especially in terms of heat mitigation strategies. Most of the participants exhibited feelings of helplessness when they described their living situations. Most spoke of the lack of amenities in their accommodation and of having very little choice in improving their living standards with respect to heat mitigation.

5.5.1.1 Unable to open windows

All the participants in this study lived in rented accommodations and one of the most repeated concerns by participants was their inability to open their windows. In Toronto, all rental building with units on the third floor or above, have their window openings restricted. This is a safety feature to prevent small children from falling out of them. Unfortunately, this solution to a very serious problem also has unintended consequences and in environments such as the

ones where many of the participants lived, may worsen living conditions during the summer.

Several of the interviewees had removed the opening restriction device on their apartment windows. One stated:

My grandson took that thing out a long time ago, we put it back in for the yearly inspection, but with that in you can't really open the windows, and really it is a joke with those on. (Participant 4)

A 77-year-old who lived on the sixth floor of his building also spoke unfavourably about his windows being unable to be opened fully:

Yes, they only open a little, and I tell you that is useless sometimes. (Participant 25)

Participant 18, when asked about her windows, how wide they open and if she opened them when it was hot, spoke about the futility of such actions:

I noticed that if I do open the window, it doesn't do anything. It maybe even makes it hotter inside, so I don't think I'd open the windows. (Participant 18)

These three participants used words that indicated that they felt the restrictions imposed on them were without merit, particularly because all of them were older and had no small children. The words "useless", "does nothing" and "is a joke" illustrate that the participants disagreed with the restrictions. Even the tenant who had her grandson remove the device, recognised that it was not a permanent solution and that she would have to replace it or face severe fines at the next annual inspection.

In total, out of the 25 participants interviewed, seven lived on floors three or above in their buildings. None of these seven spoke favourably about the window restrictions and most of them seem resigned to the fact that there was very little they could do about it.

Many participants also spoke of the inability to have any cooling due to the lack of proper air flow from the outside. Some individuals spoke about the orientation of their buildings and their positions among other high-rise buildings. Participant 25 mentioned that his apartment became extremely hot in the summer with no air exchange:

Yeah, it is really hot here too and you don't get the wind passing through, but it is better than out there, I mean if you need a glass of water or something, at least you have it right here. (Participant 25)

Another participant identified the surrounding high-rise buildings as blocking the wind from cooling her unit:

... too many big buildings around here, no breeze, so we have two fans one for living room and one for bedroom. (Participant 14)

Another echoed those sentiments and identified that the windows were secondary to the overall lack of air flow in the neighbourhood:

There's like no air even if you have windows open, the way the apartment is structured and where we live, there's no air. (Participant 4)

While another identified both her large windows and her unit's orientation as being problematic:

I know it gets really hot during the night, we face south so with the large windows it really heats up during the day, but that is the price you pay for a good view I suppose (Participant 11).

5.5.1.2 Air-conditioning being not affordable or not available.

One of the questions that was posed to the participants was whether they had air-conditioning, to which none indicated that they did. However, responses from most of the participants indicated that if it was available, it would not be utilised, as air conditioning was generally seen as a luxury and not a necessity.

A/C is for the rich, we have been living for thousands of years like this, no need for such items. (Participant 6)

.. this is not a luxury high-end place, so we don't have any. (Participant 23)

... I'm in a pretty simple part of town, we get by without all those luxuries. (Participant 15)

The majority of participants also spoke about the costs of air-conditioning and their inability to afford it. When the Grenadian senior was asked if air-conditioning would be something that he would be receptive to, he indicated that he would be, however, when asked if he would pay for it, he said that he would not be able to afford it and might have to find a new place to live.

Another participant spoke from personal knowledge about people in her community and the way that both running costs and maintenance cost of air-conditioning factored into their decision-making process:

It's like my personal experience, right? I know that a lot of Asian seniors are very frugal, and they will not turn on their air conditioning, even if they have it, 'cause they wanna first of all save on the bill, and secondly, a lot of them tend to be worried about it breaking down. Like they wanna keep it so that they have it for guests, whenever guests come over, but they don't wanna use it themselves on a regular basis, 'cause the more they use it they fear they might break it down and then they'll have to pay for it to be repaired, right? , "No, I don't wanna waste money on the bill" or "I don't wanna make it susceptible to breaking down, I'll just drink more water" or "I'll just put some ice in my mouth and, or use more fans. (Participant 11)

Some participants also indicated that they were discouraged or even forbidden from installing air-conditioning, even if they were willing to pay the required costs:

Some people have the small window type units, but management does not really like that, they always complain about noise and water dripping and things like that (Participant 3)

Another participant was asked if any resident in her building had air-conditioning and whether the building management prohibited such appliances:

I don't think that's something that they advertise, but I know people have those air-conditioning units on their windows, you can see it when you're walking outside. (Participant 4)

Another interviewee spoke about the situation in her building where such units were prohibited. In defiance, some residents had installed them anyway, but they were asked to remove them:

No, I don't have air-conditioning and we are not allowed to have air-conditioning in this building, I've seen some of those small window units, the new types with the hoses, but if the super knows about it, they make you take them out. (Participant 10)

The Toronto Health Department does recommend that landlords provide an air-conditioned cool space in their buildings for their residents. However, there is no legislation that compels them to do so. In this study, none of the participants identified the presence of such a space in their building. Several of them had never heard of such a feature and others said that even if there was one, they were unaware of it. Two participants mentioned the management office as an air-conditioned space, but not one that they could use:

The rental office that's about it, that's the only thing that is air conditioned in this building. The laundry room is a bit cooler, probably because it is in the basement away from the sun. But there isn't such a room in this building. (Participant 10)

No. There's the lobby and that's like the coolest place in our building, and that's it, but I don't think it's designated, it just is. (Participant 7)

Another mentioned that the superintendent probably had air-conditioning in his unit, emphasising the inequity that existed:

No. Only the office and super apartment (Participant 1)

5.5.2 Being in control and the need to maintain independence

Most of the people interviewed emphasised the actions that they took that were within their control. They spoke openly about what choices they made to

address hot weather and they gave reasons for their decisions. Unfortunately, in making some of those decisions, such as staying at home during times of oppressive heat, they may have possibly exacerbated their situations.

5.5.2.1. Making their own choices

Individuals can take various actions to minimize the effects of extreme heat such as keeping hydrated or minimizing their exposure to heat. The participants were informed about the government-run cooling facilities throughout Toronto. When asked about their willingness to visit such cooling facilities, many indicated that they instead would choose to stay at home.

One interviewee viewed a public cooling facility as being ‘unnatural’ and could not imagine why a person would choose to use such a facility. When she was asked to explain her, she elaborated:

Well I mean, that just sounds like something that nobody would use, I can't see people going there and feeling comfortable, there is the lobby and that is close to outside, but just sitting in a big room with strangers, I don't see the use in that. I think if it was me and my family, I would much rather stay in my apartment and try to stay cool. (Participant 4)

Another when asked about visiting cooling facilities also too insisted that he would stay at home. The tone that he used suggested defiance, and indicated personal choice:

Well like I told you I stay inside. If I have to do something when it's really hot, I just try to stay inside a good bit of time. It is, it's easy, it is easier for me than to go out there if it's too hot. I think it's better if I just stay indoors. (Participant 23)

The other participants who mentioned that they would stay in their homes during times of extreme heat all used a similar tone of voice which connoted choice.

Other participants when asked about visiting the cooling facilities insisted that they would change their routine if it was too hot, avoid doing anything that they had planned and stay in their hot home, rather than go out to a such a cooling facility. Upon further analysis, another subtheme emerged, one related to lack of agency, that of a lack of security. Many participants felt that visiting such a facility would likely compromise their and their family's safety and their refusal to visit such a facility was stated as a personal choice.

...there are no security cameras in this building and as you probably noticed this is not exactly the safest of neighbourhoods. So, I think staying at home would probably be the safest thing to do. Bear the heat until it gets better. I guess there might be some relief at night. (Participant 20)

Another way that participants tried to emphasis their control was by asserting their independence. This was displayed on multiple occasions by many, particularly elderly participants, who did not acknowledge that they were likely to be affected by heat and did not want to be referred to as vulnerable or dependent on outside help. A 77-year-old, when asked about receiving help in times of extreme heat, emphasised that he did not need any assistance:

I'm by myself. I learnt a long time ago not to depend on anybody. My father used to say that if you can do something you don't wait for anybody to do it for you, so I take care of myself. (Participant 25)

Another interviewee, a 67-year-old also spoke at length of his living alone.

Well I have done this for years, my wife is no longer here, my daughter has her family and I maybe see her for Christmas, or sometimes during the year, but other than that, I'm on my own. I've come to accept this, so I, I have no choice it's, it's my way of life. I don't know, later on, when I get old, maybe I might need some people around. (Participant 23)

When asked if he would be amenable to help from community groups or other agencies that could provide help, he declined:

God no I am not interested in that, I have lived like this for a long time and this is fine by me. I have no problems with this. (Participant 23)

Another interviewee was a bit more direct when asked the same question:

I don't need any help, so- I can do it on my own (Participant 22).

Participant 5 indicated that she had family members who she could reach out to if needed, but it wasn't something that she was likely to do:

But I don't need any help with the heat. I have been doing it all my life and I am used to it (Participant 5).

To summarise, many of the participants chose to stay indoors during oppressive heat even though some perceived their living spaces were hotter than the outside. Others refused to use the cooling facilities that were provided. Their refusal to accept help may have reflected a lack of understanding of the dangers of heat. While they maintained their independence, and chose to make decisions on their own, they were increasing their exposure to heat and exacerbating an already dangerous situation. These results are not unlike those of Lane et al. (2013), who performed a study of heat protective behaviour in

New York City and found that many seniors preferred to stay at home rather than visit cooling centres. The seniors in that study indicated that they chose not to socialise and did not want to be around 'old people'.

5.6 Theme 3: Awareness and understanding of the Hot Weather Response Programme

The third major theme which emerged from the thematic analysis of the qualitative interviews was the lack of awareness and understanding of Toronto's Hot Weather Response Programme. The participants were asked questions about their familiarity with Toronto's programme, what amenities they utilised and what the terminology commonly used by the media and programme officials meant. While there appeared to be cursory knowledge by a few participants, there was a general lack of awareness. For most participants this meant that they were unlikely to partake in any of the available services.

5.6.1 Lack of knowledge of the programme.

The first sub-theme which emerged was one of a lack of awareness of Toronto's Hot Weather Response Programme. Participants were asked about what they knew of the programme and whether they were familiar with services such as the distribution of free bottled water or the availability of services at cooling centres. Only one of the participants indicated that she was aware of the services, but even in that case her knowledge was limited:

Like I heard it on the news like while I was doing things. Like I wasn't really paying attention or looking for it... I just overheard it like really quickly. I have, now that you mentioned it, I did hear it last year, that we had some cooling centres, but I didn't really pay attention, but I think that should be advertised a bit more because that's... I mean, especially mothers with kids, or with pets, or people that are homeless or I mean, if they're welcome there. I know how some people are about homeless people, but yeah, I think it is something that is needed by everyone, yes, I think more advertisements and so on. (Participant 11)

Another participant indicated familiarity with some of the buildings the services were provided within, but was unaware that those facilities provided services to people during periods of hot weather:

I mean, I have heard about the civic centres and the libraries, but what do they have to do with when it is hot? (Participant 20)

Even after being informed of the services, there was still a lack of recognition that these services were available free of charge to anyone:

You have to be a member or something? (Participant 25)

One interviewee indicated that she had never heard of the available services:

I really don't think so, I didn't know, and I never heard anybody talk about them until you did today. (Participant 3)

Another expressed her belief that her neighbours were also unaware of the programme and its services:

You have all sorts of people in this building, most of them are immigrants or elderly, and just talking to some of the neighbours that we've gotten to

know, I don't think many people know about any of these services.
(Participant 5)

In terms of the nomenclature used by the Health Department to describe varying degrees of hot weather, such as Heat Alert, Extreme Heat Alert and Heat Warning, most participants expressed familiarity with these terms but could not explain what they meant. Several definitions were provided, but none adequately described these terms. Some respondents freely admitted that they didn't know what the terms meant:

Heat alert? I think I may have heard that, but I don't know what it means, I think it is about heat, so there is high heat of something like that?
(Participant 21)

Without a proper understanding of these terms, it would be unrealistic to expect residents to take the appropriate levels of precautionary responses to them.

5.6.2 Mismatched communication techniques

To gain an understanding of how successful communication from the Hot Weather Response Programme has been, participants were asked about the means by which they obtained information about the weather. Every participant mentioned television as one of their main avenues for information and one news channel was mentioned repeatedly as the choice for weather information:

Well I think like everybody else on the TV, CP24. From the moment I wake up in the morning I check the weather there because you know what it like here in Canada, one day so hot, the next day so cold. You

really have to check the weather before you do anything. I find with CP24 they give you good information, so it helps before I go out to really prepare. (Participant 18)

Oh, how I find out about the weather? I don't know, I guess I would watch TV, maybe channel 24. (Participant 16)

TV, CP24, they are good, they give you that kind of information all the time, so they are good. (Participant 2)

CP24, that's my primary source...sometimes The Weather Network, but news channels are where I get my information from... I think they say it's a general Toronto forecast, what the weather is going to be like in the city of Toronto. On the Weather Network you get it by different cities and sometimes I like to compare, but for me it's every morning waking up, first thing CP24 what the weather is going to be. (Participant 6)

Only one participant mentioned the use of Facebook for information, but she also indicated that television was her primary source of information:

Yeah, usually just the Weather Channel, I know they send reports out for extreme heat alert stuff. My mom has one of those texting for community update things, so it'll tell her that. And, I don't know, it's kind of like word of mouth, someone might know it, or if you're online, they're gonna be like, "Oh my gosh, it's like, blah blah blah," on Facebook and things that are more instant. (Participant 11)

Similarly, two other participants mentioned the use of the internet to obtain information, but at the same time they also indicated that television was a major source of information:

From the minute I get up, I'm constantly on my phone, my smartphone, or my Android, and I watch the news, like I'm watching the news constantly especially when I have my coffee and catch up on emails in the morning. I wake up fairly early, so I just watch that in the morning,

CityTV or CP24 or Global... And newspapers, you know. I would say like social media, the regular TV and newspapers. (Participant 15)

The internet, the radio, the television, CP24 and I have a friend who's a professional dog walker, he keeps me updated on what's happening, he's the first outside. (Participant 9)

Interestingly, the five last participants who were interviewed mentioned the radio as a primary means of obtaining information. All four of these individuals were males, over the age of 65 and they lived alone:

I have the radio on all the time, on 680 news they give you the weather news all the time. So, if there is a storm coming, they tell you. (Participant 25)

During the day, I listen to the radio. Usually you get all the important information there. I don't read much anymore, it is a task to get out and go down to get the newspapers, you know since they removed the box from the front there. (Participant 23).

Participants were also questioned on the best way to get information on weather alerts and protective measures to them; television seemed to be the most preferred method.

Participant 5 also introduced the idea that local ethnically specific media might be beneficial to particular cultural groups:

The TV is the best way, we have our Indian station with our language-we watch everyday, they give us tips that we follow and information on our community. Any information I need I get there. Yes, English news is good too, but we watch it only sometimes. (Participant 5)

Another echoed those views:

I really think TV is best, those community programmes would help. I know we watch the Latin channel 35, it has been that way since we arrived in this country and I know my children and their children also do the same thing. I think all people would do that, they find something that remind them of home, so you can use that. (Participant 16)

These comments about local ethnic groups were also mentioned by Participant 14, although her preferred method of communication was through the distribution of printed flyers:

No, I think it would be good to have a flyer with different languages. Maybe the more important ones. That would be good. Maybe that can reach to more people, it should be interesting. (Participant 14)

Participant 3 also suggested that written information would be beneficial, distributed in an environment where it would be well received together with other health information:

I think at the Doctor's Office, or the clinic. They could put information on the magazines, flyers. (Participant 3)

Despite the emphasis by the health department to use its website to promote warnings, that method of communication did not seem to resonate with the members of the vulnerable groups interviewed for this study. While the Hot Weather Response Programme has been focusing on notifications of warnings through its website, Twitter, Facebook and email, most participants still obtained their information through the television and the older male participants seemed to prefer radio.

5.7 Conclusion

This chapter presented the findings from the thematic analysis of the twenty-five interviews conducted with the participants of this study. Three major themes, each with supporting sub-themes, emerged. These themes highlighted that many of the participants, a cross-section of Toronto's vulnerable population, had limited knowledge of the negative effects of hot weather. Many participants focused on sunburn and skin damage, and there was very little focus on cardiovascular and respiratory effects, the conditions that account for the most common causes of heat-related deaths. In terms of living conditions and available amenities, most participants lived in conditions that were detrimental to their health, particularly when temperatures rose. They did not seem to have mitigation plans and the amenities that were available to them were insufficient to be protective.

All these findings will be explored fully in the following discussion chapter. The results from this chapter will also be assimilated with the findings from Chapter 4, which featured information obtained from the thematic critique, to form an overall picture of whether and how Toronto's vulnerable population is served by its Hot Weather Response Programme.

Chapter 6: Bringing the findings together: discussion of emergent themes

6.1 Introduction

This study explored social vulnerability to heat using Toronto's Hot Weather Response Programme as a case study. The programme has been in place since 1999 and was designed to protect the vulnerable populations of Toronto from the detrimental health effects of oppressive heat. The study examined the evolution of that programme, what services were being offered, how and why they changed over the years and gathered perspectives of the intended recipients regarding their experiences of heat, how they cope and their experiences with the programme.

The study was underpinned by the Hazards of Place Model (1996) which describes how vulnerability can be location specific and influenced by elements such as social fabric and risk perception. This chapter discusses the findings of both the thematic critique of the Hot Weather Response Programme and the qualitative interviews.

6.2 Discussion of findings

6.2.1 Changing understandings of vulnerability by programme officials

As discussed in Chapter 2, most heat-related deaths occur within cities, rather than in rural environments (Harlan, Declet-Barreto, Stefanov, & Petitti, 2013). This trend can be expected to continue as cities become more densely populated. Certain populations within cities, also tend to be disproportionately vulnerable to and affected by heat (O'Neill, Zanobetti, & Schwartz, 2005). Toronto is no different and in 1999, when it was proposed that a hot weather response programme should be implemented, the goal was the protection of the vulnerable population from the effects of excessive heat (Basrur, 2002). Since the inception, though, there has been a continual revision of the definition of vulnerability and most of those revisions seemed to have occurred without any empirical evidence to support them. No models or theories of vulnerability were ever utilised to allocate services and no evaluations were performed to determine if the appropriate populations were benefitting from the services provided.

What initially started off as a programme aimed at homeless and socially isolated people, widened into one that includes more vulnerable groups, such as seniors, children and those who are marginally housed. While this may have been seen as a positive step since it was more inclusive, without a model being employed of the multidimensionality of how vulnerability is produced, like the HOP Model (Cutter, 1996), the selection of some groups as vulnerable and others as not, may be seen as insufficiently justified or even arbitrary. Many

groups of people who have been identified in the literature as disproportionately vulnerable to heat, such as people who are of a racialised minority (Stafoggia *et al.*, 2006; O'Neill *et al.*, 2005), people whose first language is not native to the country, in this case English; (Gober *et al.*, 2012; Loughnan *et al.*, 2012), people with lower standards of education (Bell *et al.*, 2008 ; Loughnan *et al.*, 2012) as well as people who have a low income and a high cost of living (Luber & Mcgeehin, 2008 ; Sung *et al.*, 2013), have not been included in the Toronto definition of vulnerability and have not been targeted with response activities. As a result, even greater health inequalities may be created.

6.2.2 Non-recognition of vulnerability and risks

The participants who were interviewed for this study were all part of groups identified in the literature as being vulnerable to heat (Maller & Strengers, 2011; Cutter *et al.*, 2003; O'Neill *et al.*, 2009) yet none of them so self-identified. Some interviewees who had come from countries that were traditionally hot, felt that they were immune to the effects of heat. They did not take any additional precautions to protect themselves from hot weather and most of them did not partake in any of the response activities that were being provided by the government. The older participants also did not think that they were the ones who would be affected by heat and while some of them recognised that elderly people were at risk, they saw the term 'elderly' as referring to people older than themselves.

The CDC's publication on identifying vulnerable populations during times of environmental emergencies, indicates that often people who are susceptible to

environmental hazards fail to identify themselves as being vulnerable (Centers for Disease Control, 2015). This can be addressed by providing improved messaging and communications with those groups (Centers for Disease Control, 2015). The failure of the programme to use a more comprehensive definition of vulnerability and therefore target information to a wider group may have resulted in reduced participation in the response programme and less people seeking health protective information and services. The Health Belief Model suggests that individuals will take measures to protect themselves based on whether they believe a negative situation exists and that they are capable of taking a recommended action to protect themselves (Murray & Turner, 2010). Akompab *et al.*(2013), suggest that this model could be used as a theoretical framework to explain why individuals take particular actions during heat waves. Many potentially vulnerable people would not have been aware that they were members of groups who would be affected by heat. Having not being targeted by the health department, since they did not fit into the departments working definition of vulnerability, they would not have participated in the elements of the programme designed to protect them.

Therefore, there were two factors that were interacting and producing negative results for both the programme and the intended recipients. On one hand, programme officials had an unclear understanding of who they were trying to reach and adopted varying definitions of vulnerability, which ultimately were too narrow to properly serve the vulnerable population. On the other hand, those deemed vulnerable in the literature did not regard themselves as vulnerable and therefore, did not actively seek out the benefits of the programme activities. This created a gap of service delivery and service uptake, one that potentially could

have improved health or saved lives. These points suggest that there is a tangible benefit to having public health practitioners being engaged with the public and target populations they are intending to serve and co-designing programmes.

6.2.3 Participants' understandings of heat and its risks

People who live in climates that are traditionally cold, such as Toronto's, are more likely to be affected by extreme heat (Mcmichael *et al.*, 2005). This is often due to physiological acclimatisation, the physical structure of living accommodation or lifestyle factors and choices (Keatinge *et al.*, 2000). As indicated in section 5.4.1, many of the interviewees in this study when asked about exposure to heat mentioned sunburn and skin cancer with very few mentions of respiratory and cardiovascular problems. While skin damage, sunburn and skin cancer are health problems that have to be addressed and appropriate precautions taken, as discussed in chapter 2, the majority of deaths during heatwaves are usually attributed to cardiovascular, respiratory and cerebrovascular problems (Haines *et al.*, 2006; Tobías *et al.*, 2012; Luber & Mcgeehin, 2008). With a lack of information on heat-related mortality, it was demonstrated that many residents were taking the wrong precautions and instead of protecting themselves from heat were, in fact, exposing themselves to even greater risk.

Many of the interviewees also stated that they kept their windows closed and used fans to cool themselves, while others stated that they would not use air-conditioning as it was "unnatural" and could get them sick. These actions

conflict with understandings of what can be protective responses. The use of air-conditioning has been shown to be one of the most effective means of decreasing heat related mortality (Bustinza, Lebel, Gosselin, Bélanger, & Chebana, 2013) and the improper use of fans has also been shown to be unhealthy or even deadly (Kovats & Kristie, 2006). By confining themselves to their hot apartments and not utilising appropriate cooling techniques, these residents were exacerbating the extreme conditions. Klinenberg (2003) analysed the aftermath of the 1995 Chicago heat wave and noted that electrical fans were provided for residents to keep themselves cool. Many residents turned the fans on in their hot homes with the windows closed. They ended up circulating the hot air, exacerbated the hot, humid conditions and died of dehydration. To overcome issues like these, a much better targeted communication plan delivered at the community level is needed. The WHO emphasised the need to “re-orient” health services and place greater emphasis on community level health promotion (WHO, 1986). Similarly, de Andrade et al. (2015) suggested communities should play a large role in health promotion. Harlan & Ruddell's (2011) study on climate change and mitigation strategies suggests that “bottom-up”, “grassroots” activities involving community groups and individual citizens are necessary for the development of actions plans to address mitigation activities.

Toronto's annual review and revision of its Hot Weather Response Plan does not involve the community it serves. In fact, there are no public consultations with the recipients of the programme to get their views of the programme. Without the involvement of the wider community, the programme is not

benefiting from the valuable information that they could provide, such as what resources and support the vulnerable communities need.

6.2.4 Personal experience with heat

One of the key themes which emerged from the interviews was that people's perceptions of heat seemed to be shaped by their personal experience. Egan & Mullin (2012) found that isolated days of extreme temperatures left no indelible memories and people's views on climate were often shaped by the weather of the past week. Current cognitive theories indicate that learning that involves abstract information, such as global temperature changes and variations in weather patterns, is more difficult than experiential learning which happens automatically and involves experienced phenomena (Myers et al., 2012). The theory of cognitive dissonance also explains why individuals who have previously experienced particular phenomena, encounter conflicts when trying to adjust to alternatives to those experiences (Whitmarsh, 2011). People who have not had a negative experience with heat would probably be less likely to be worried about the health effects of heat and as a result may not take part in response activities (Myers et al., 2012).

Another way that residents could have been placing themselves at risk, unintentionally, was due to their positive views on hot weather. Canada is typically a cold country and many residents look forward to the warmer weather of spring and summer. As discussed in section 5.4.5, several participants indicated that they never viewed hot weather negatively and instead spoke about its benefits, including the positive aspects it had on their moods. This

attitude was similar to what was found by Lefevre *et al.* (2015) in their study of UK residents and their heat protective behaviour during heat waves. Many subjects held positive perceptions about heat and those perceptions may have resulted in them taking fewer protective behaviours. The authors suggested that government communications about heat should evoke unpleasant feelings, if they were to produce proper heat protective behaviour (Lefevre *et al.*, 2015). Part of the mandate of the Hot Weather Response Programme is to protect the residents of Toronto from the effects of extreme heat and this involves ensuring that they are aware of the dangers that extreme heat presents. The findings from the interviews indicate that there still is not that level of awareness of those dangers. Without that, there is the likelihood that few people will utilise available response activities and amenities and put themselves at even greater risk. Messages that include explanations of why some people are more vulnerable than others as well as the distinction between enjoying safe reasonable heat and the risk that extreme heat brings are necessary. Investing resources to ensure public awareness of these dangers could be beneficial both in terms of the amount of lives potentially saved and in financial savings that would be accrued from not having to treat people suffering from heat-related illnesses (O'Neill, Carter, Kish, Gronlund, White-Newsome, Manarolla, Zanobetti, & Schwartz, 2009b).

6.2.5 Agency, changes to services and communication methods

In sociology there is a constant interplay between agency and structure, with structure, formed by institutions, programs and rules limiting the agent's ability

to act and make choices freely. Many of the aspects explored during this study seemed to indicate that, in general, the participants experienced a lack of agency, such as in terms of their living conditions, as well as the choice of services and amenities available to them. The living conditions of the individuals who were interviewed for this study were all rental accommodation. They usually were older buildings with a lack of air-conditioning and very few amenities apart from the essentials. As discussed in Chapter 5, some of the interviewees lived in apartments that had restrictive rules on installing air conditioning or fully opening windows. The participants emphasised the lack of air flow and the uncomfortable conditions that they experienced, typical of the urban heat island effect. During the 2003 European heat wave, this effect was seen in cities like London, where night-time temperatures were more than 8 °C higher than the nearest rural areas (Wolf & McGregor, 2013). Also, again typical of the areas in Toronto that were studied, the effect is more pronounced in areas with a larger urban sprawl that are more densely populated (Conti *et al.*, 2005). Strategies to mitigate the urban heat island effect include increasing green space and the use of high-albedo materials (O'Malley, Piroozfar, Farr, & Pomponi, 2015). However, these are long term solutions and do not solve the immediate problems faced by affected residents.

The above sections illustrate that even with better communication and understanding of heat risks, there will still be constraints on people's ability to act on that understanding. Therefore, it follows that action and intervention needs to go further than communication and needs to include better enforced standards on buildings, particularly in rented accommodations.

6.2.6 Issues with cooling facilities

In 2003, four cooling centres were opened and eventually expanded to the current seven locations, as discussed in section 4.5.4. Many of the participants who were interviewed did not know the location of their nearest cooling centre. When they were advised of the locations, most indicated that they would not attend them because they were located at too far a distance from where the residents lived. While the locations of the cooling centres were selected because they were dispersed across the city, they were also chosen because they were on the sites of large government owned or run centres. The availability of those buildings, with security and staff already present and no additional costs associated with rent or maintenance may have been a reason those locations were chosen. A 2006 staff report from the Medical Officer of Health did indicate that 3 of the locations were not well attended during extreme heat events, but no changes were made to those locations (Mckeown, 2006b).

In addition to these public facilities, Toronto also encourages landlords of high-rise rental buildings to provide an air-conditioned room for their tenants' use during times of oppressive heat. However, none of the participants indicated that their building housed such a facility and further, many indicated that they would not utilise such a facility, even if it was available. The participants identified safety concerns and cultural barriers, such as some cultures separating men from women, as reasons which would preclude its use.

The neighbourhoods selected for this study were chosen because the residents met the criteria identified as being vulnerable to heat. These neighbourhoods, being some of the poorer areas of Toronto, also have high rates of crime and

ranked 9th, 11th and 28th out of 140 neighbourhoods in terms of rates of murder, assault, sexual assault and other major crimes (CBC, 2018). Studies have demonstrated that women and visible minorities tend to demonstrate greater levels of fear of violence and crime, despite the fact that statistically they are less likely to be victims of crime, a phenomena referred to as “the paradox of fear” (Breetzke & Pearson, 2014). It was, therefore, not surprising that safety was mentioned as a reason to not use a cooling room, which are very often located in the basement of a high-rise building.

While the recommendations for a cooling room in buildings have been made for more than 10 years, consideration needs to be given to the changing demographics of these neighbourhoods and the fact that more cultural and religious sensitivities are necessary when making such recommendations. As an example, the Muslim population has been estimated to be the fastest growing group in Canada (Postmedia Staff, 2013), and this is one of the groups that traditionally separates unrelated members of the opposite sex.

6.2.7 Changes to services provided

A major theme which emerged from the thematic critique was the significant changes that have occurred over the lifespan of the programme, both in terms of the availability of response activities and the way those services are provided. Many changes were made based on criteria unrelated to value of the services to the vulnerable populations, such as for budgetary reasons. The findings from the semi-structured interviews suggested that some of the changes may have

put certain populations at even greater disadvantages and may have increased vulnerability to heat among many of these individuals.

When the Hot Weather Response Programme was originally implemented, the majority of services were geared towards making residents aware of the dangers of hot weather and also ensuring that people kept hydrated. There was a telephone information line, printed material distributed through pharmacies and outreach by various community agencies. In the early years of the programme, there was also distribution of bottled water throughout the city by various organizations. In the years that followed, many of these services were eliminated, however they were never replaced by viable alternatives. Instead the programme changed into one that was dependent on residents being more self-sufficient. Whether recipients became better equipped to handle extreme heat has never been determined as no evaluations on these programme elements were ever performed.

As with any government funded programme there should be a cost-benefit analysis to justify the implementation and continued funding of that programme. Cost-benefit analyses are an important component of evaluations of public health programmes. These analyses translate all of the various costs and benefits associated with the programme into monetary amounts that can be easily understood and can make decision-making transparent (Perkins *et al.*, 2015). Hajat *et al.*(2010) reported very few evaluations into the cost effectiveness of heat warning programmes have been conducted, however in cities where evaluations have been carried out, such as Philadelphia, the benefits far exceed the costs. A systematic review conducted by Masters, Anwar, Collins, Cookson, & Capewell, (2017) suggested that there is a 14:1

return on investment of public health interventions. In Philadelphia, for the period of 1995 to 1998, the cost of the system was estimated to be \$210,000 for which there was an estimated benefit of \$468 million, mostly in terms of lives saved (Ebi, Teisberg, Kalkstein, Robinson, & Weiher, 2004). In Toronto there has never been a cost-benefit analysis conducted to support the continuation of response activities, nor their withdrawal, yet there has been a gradual paring away of funding and services. A report produced by the Greater Toronto Area Clean Air Council (2007) highlighted the overall lack of accountability for the dollars spent and indicated that the indirect costs of Toronto's Hot Weather Response Programme were never well accounted for.

One service that was cut without a proper cost-benefit analysis was the cooling centre, designated for seniors. The cooling centre was set up in a long-term care facility where there was access to physicians, nurses and other medical personnel. Seniors who became sick due to heat were transported by paramedics to that facility, but other seniors could also drop in and benefit from the cooling effect of the air conditioning, as well as the available food and drink. Paradoxically, the division who was responsible for managing the cooling centres did not want it to be advertised, as it would have put a strain on resources and greater costs to the division (Programme Official, Personal Communication, 2013). Without it being advertised, there was very little use of the facility and the service was eliminated.

6.2.7.1 Elimination of outreach activity and literature distribution

The early years of Toronto's Hot Weather Response Programme was dominated by outreach activities aimed at providing health protective information and assessing whether people needed medical assistance. Outreach took place proactively by means of distributing health information to known vulnerable residents. During heat events, outreach activities were conducted by nurses, the Canadian Red Cross, the Toronto Police, public health inspectors and a variety of community and social service agencies. Most of these activities were gradually eliminated with the main reasons being the costs associated. A recurring point that was made by many of the interview participants was their unfamiliarity with Toronto's Hot Weather Response Programme. While the programme is assumed, by government officials, to be one that is well established among the people of Toronto, very few participants indicated that they were aware of what response activities and promotions were offered during periods of excessive heat or knew what to do in times of heat to protect themselves. This lack of awareness could, in part, be linked to the elimination of health protective literature prior to the annual heat season.

As previously discussed in section 4.5.3, Toronto would distribute information on the risks of heat to over 1000 community partners and government agencies and this material allowed individuals to gain information on the health effects of heat and provided contact information for officials at the health department should they have questions. The accumulation of information and handy reference material was meant to make it easier for people to plan for summer weather. Officials believed that many landlords would have literature from the previous years, would be able to recycle them and provide the relevant

information to their residents. However, none of the individuals who were interviewed for the study remembered seeing any of this information. Participants often did not know that the health department had an active programme to aid during times of excessive heat and they also were unaware of what protective measures they themselves could take. The fact that the majority of the individuals interviewed had no knowledge of the Hot Weather Response Programme and were making assumptions about what they should do to protect themselves suggests the need for pre-season visits and other measures to raise awareness.

6.2.7.2 Elimination of bottled water

Heat exhaustion usually occurs when the body's core internal temperature rises to between 37°C and 40°C. It is typified by symptoms of weakness, thirst, malaise and dizziness and left untreated, can easily develop into heat stroke (Glazer, 2005). One of the easiest ways of counteracting the effects of heat exhaustion and prevent the escalation of symptoms, is by hydration (Barrow & Clark, 1998; Glazer, 2005). As described in section 4.5.1.1, since 2000, bottled water distribution constituted a major part of the response activities, but was discontinued in 2015, for budgetary reasons. Since that time there have been calls for renewal of that program by operators of homeless shelters and by partners in the Hot Weather Response Program (Hot Weather Response Committee Meeting, 2017; Hot Weather Response Committee Meeting, 2019). A Parks Ambassador, a member of the Hot Weather Response Committee, recently requested that the bottled water distribution be resumed. According to

him, there were many occasions where homeless people were found living in parks and ravines and those people were unlikely to come into public buildings to seek water (Personal communication, May 08, 2017). Homeless people have reported feeling unwelcome and discriminated against when seeking health care (Wen *et al.*, 2007). The negative feelings associated with the perception of being unwelcome have often created barriers to the access of public health programmes and have prevented people from seeking help in the future (Wen *et al.*, 2007). Mental health issues and addictions are among the most prevalent health concerns with homeless individuals and these conditions also lead to a lack of services uptake (Krausz *et al.*, 2013). Street outreach to homeless people has been identified as one of the most effective means of engaging that population and providing them with assistance (Tsai *et al.*, 2014). Toronto's decision to eliminate the bottled water distribution is likely to have created further health inequities particularly among this group.

6.3 Changes to communication techniques

6.3.1 Heat information line

One of the first activities of Toronto's programme was institution of a "heat information line" where residents could call to receive information about whether a warning or alert had been issued. More importantly, the line provided information about the location of available amenities and precautions people could take to protect themselves from the dangers of extreme heat. The United States Environmental Protection Agency recommends such telephone information lines as a method of keeping people safe during extreme heat

events (USEPA, 2006) as does the WHO Europe who further suggest that coordination between the health department and social services agencies could also allow these lines to help identify vulnerable residents and target services to them (WHO Europe, 2008). Heat information lines like these are typical in communities with established heat warning programmes. Philadelphia and Chicago are two cities whose heat response programmes take advantage of this technology (Bassil *et al.*, 2007) and the Australian state of Victoria benefitted from this technology, to get information to residents over the age of 75 during a prolonged extreme heat event in 2009 (Queensland University of Technology, 2010). The wider health literature also recommends the use of telephone lines as a means of assisting the public with health issues, such as in the United Kingdom, with NHS 111, a service which can connect callers to nurses or dentists, as well as provide information and advice on urgent medical questions (NHS, 2017). Reinius *et al.* (2013) observed that telephone health information lines assisted in reducing the use of emergency departments by providing telephone-based case management interventions. Similarly, Bunn, Byrne, & Kendall (2004) noted that telephone consultation reduced the number of hours that patients needed with their health care provider. In this study, analysis of internal documents did not produce any information that would have justified the elimination of the heat information line. In fact, based on the number of calls that the line was receiving it should have continued. In 2010 there were 16 heat events and 149 calls were made to the line and in 2011 with only 5 heat events there were 144 calls received (Hot Weather Response Programme Report, 2011). There were no evaluations conducted on the benefits of the information line in 2011, yet it was removed from the list of

services being provided in 2012. It should be noted though that there was a cost attached to the information line of \$1270 per heat event day and the elimination of this service may have been seen as a cost savings initiative.

6.3.2 Internet based communications

As discussed in section 4.5.3, in 2015, all printed literature was replaced exclusively by information on the internet. The move to replace outreach activities with electronic communication is a form of e-Government, which is defined as the delivery of government products and services to the public via the use of the internet or other electronic means (Qureshi, 2005). Fountain (2004) suggests that due to the limited resources that public health programs often face, e-Government technology has the potential to present many opportunities, however, the agency has to understand its clients and their ability to participate in the e-Government ventures (Ojo, Janowski, & Estevez, 2007). Although much more health information is currently available online, inequities can be created by relying heavily on the internet as the primary means of communication, as people without internet access or ability, are further disadvantaged with respect to receiving crucial health information (Schmeida, McNeal, Rose-wicz, & Connell, 2007).

Another way that the use of internet technology was failing was in the communication of heat alerts and warnings. In the early years of the programme, these were communicated through phone calls, faxes and personal outreach. News media picked up on those notifications and would occasionally broadcast them as well. Currently, notifications to the public are

communicated through email, the City of Toronto's website is updated with a banner indicating that a warning has been issued and the social media platforms Facebook and Twitter are used to get messages across to the public. While the use of email may seem efficient, such a method of communication assumes that residents first have access to email and secondly have subscribed to the warnings. Similarly, the messages available through social media assumes that the people who should be receiving those messages would be following one of the City's social media accounts. LaCroix *et al.* (2014), performed a meta-analysis of mass media communication and the success of health information campaigns. Their study focused on HIV prevention and found that the method was successful at getting health messages across to the public, however, multiple communication channels were necessary to transmit the messages and a single electronic medium was insufficient. Hieftje *et al.*(2013) noted that although electronic health communication has been found to be successful in changing risky health behaviours, the method's use is limited, as individuals from lower-income environments were less likely to have access to a computer to go online and partake in these health education campaigns. Similarly, Zanchetta's and Poureslami's (2006) study of health literacy among newcomers to Canada, identified a number of barriers to effective communication between health professionals and new immigrants. In particular, they indicated that for persons with language or literacy issues, electronic health information was of little value (Zanchetta & Poureslami, 2006). Similarly research conducted by Kontos, Bennett, & Viswanath (2007), found that while more than 80% of internet users have used it as a means of seeking health information, there is a significant divide in the population, with people who

belong to higher socioeconomic groups demonstrating substantially greater access and use of the media compared to people of lower socioeconomic groups. While the use of digital technology may result in economic savings and may make the process of disseminating information easier, the reception of that information also must be considered. For an e-Government to be effective, the target audience must be regular internet users (Qureshi, 2005). However according to Statistics Canada (2016), more than 50% of Canadians over 70 years of age do not use the internet for periods of up to several months.

In this study, only two of the participants interviewed stated that they used social media to gain information on the weather and one stated that he used email on a regular basis, but none of the participants were aware that the City of Toronto sent out email notifications of warnings and as such none of them were signed up to receive such messages. What was of interest though, was that every person interviewed mentioned television as a viable means of gathering information. Sherman-Morris, (2005) examined the role of local television in relaying weather-related messages and found that people tended to trust the local television weather presenter and would be more likely to heed protective messages if they came from such a person. In a Canadian study of the public perception of severe weather and warnings, the authors found that 98% of the individuals interviewed used the television to gather information of weather and alerts, with the Weather Network television channel and the local news being the major outlets for information (Silver & Conrad, 2010). In the present study, all participants identified the local Toronto news channel CP24 as their source for weather-related information with some participants also mentioning the Weather Network as alternative source. Papathanassopoulos *et al.* (2013,)

examined news media consumption in eleven countries across four continents and found that despite the changing nature of news reporting, television remained the dominant medium for reliable news. Television also appeared to be the method of choice for older, less educated, less affluent people (Kohut et al, 2008). The findings suggest that Toronto's shift to complete electronic communication was probably ill suited to properly communicate risks and coping strategies to its target population. The use of email and social media was not significant among this group and there was much more reliance on television for information.

Greater emphasis should be placed on local television and radio stations. Toronto has several televisions and several radio stations that broadcast in various languages targeting members of different ethnic communities. Utilising approaches such as these would be a much more effective tool for promoting the programme and communicating protective strategies to members of the various local communities

6.4 Understandings and interpretations of the Hot Weather Response Programme.

6.4.1 Development of criteria for calling alerts/warnings

The thematic critique illustrated how the criteria for calling alerts and warnings changed over time and the interviews demonstrated how those changes may have resulted in confusion among the public. As indicated in the critique, the

first two thresholds that were instituted were based on arbitrary criteria. In the years that then followed scientific models and computerised algorithms were employed and currently there is a system that is based on research conducted on mortality data. As evidenced by all the interviews conducted in this study, despite the improvements to the methods and techniques used to call alerts, the lack of public information may have led to misunderstandings and confusion among the public.

Section 4.3 indicated that the programme chose humidex as the first measure of an alert because Toronto officials felt that it was familiar to the Canadian public (Gower *et al.*, 2010). A study by Kosatsky *et al.* (2009) on Montreal residents, however, contradicted that assertion and found that 46% of the respondents confused humidex with pollution indices and believed that the term humidex meant a combination of temperature and air-pollution. Kalkstein (2007) also conducted a study in the Region of Peel, a group of cities bordering Toronto, and similarly found that there was significant confusion with warning messages around smog and heat. These findings paralleled that of the individuals who were interviewed for this study. When the 25 people interviewed were asked about their knowledge of alerts and warnings, none of them mentioned humidex, only one mentioned humidity, while three mentioned smog. One participant, when asked if she had ever heard about heat alerts or warnings indicated that she recalled hearing about smog alerts on television. Probing further, several participants were asked directly if they knew what humidex described but none of them indicated that they did.

As discussed in Section 4.3.2, 4.3.3 and 4.3.4, from 2000 onwards, Toronto officials decided to introduce a second tier of heat severity and they consistently

varied the terminology used to describe both tiers. There never was any public education campaign or media communication issued which explained these changes in terminology or why there were changes in thresholds. As indicated in meeting minutes, the constant change in terminology was even confusing to the members of Toronto Hot Weather Response Committee, the people who were responsible for the implementation of the activities of the programme (Hot Weather Response Committee, 2015).

Ebi & Schmier (2005) indicated that for hot weather, it is essential that stakeholders, such as those who are likely to be affected by the event, be included in the planning and development of those systems. The annual review of the Hot Weather Response Plan presents the opportunity for recipients to be consulted on an ongoing basis and activities be altered to benefit them. However, this never been done, and it represents lost opportunities to enhance the quality of response activities available to residents.

Even if residents are not consulted on their opinions for programme improvements, they should be purposely informed of changes and enhancements to the programme, particularly when those changes could potentially be lifesaving (Few, Brown, & Tompkins, 2007). The thematic critique in Chapter 4 did not produce any evidence of the public being informed of the changes in terminology and the interviews demonstrated the confusion that remains around the terminology used in the programme. As discussed in section 5.6.1, the twenty-five interviewees when asked about their familiarity with terms such as “heat alert” or “heat warning”, could not provide an accurate definition, supporting the need for public education campaigns. This mirrors a study which examined the public’s understanding of extreme weather warnings,

in which 99.4% of participants indicated that they knew what various warning terminology meant, but when probed further, they all only had a basic understanding of those terms (Wong & Yan, 2009). A Nova Scotian study recommended the development of detailed public education campaigns which address not only the warnings but the various facets of vulnerability presented by those extreme weather conditions (Silver & Conrad, 2010). These two referenced studies as well as the information gleaned from this study highlight that there is a need to continually provide public education in order to ensure that there is proper uptake of the programme.

6.5 Budget and its impact

One of the most significant themes to come out of this study was one of the diminishing budgets and the reduction in services for Toronto's Hot Weather Response Programme. As previously detailed in section 4.7, at its onset, a modest budget of \$40,000 was allocated to the programme and this eventually rose to over \$400,000. Today the programme has a budget of less than \$20,000, and many staff and services have been pared away. Despite these reductions, the Toronto programme is still held as an example of what a successful hot weather programme should be. This view was evident in the formulation of the provincially harmonised programme, which relied heavily on Toronto's programme as a template for the development of other cities' programmes. With the other cities' programmes being in the developmental stages, it would be highly unlikely that they would be able to identify the gaps in services and delivery and may themselves develop ineffective programmes.

As highlighted in sections 4.5 and 4.7 there was no evidence in the analysed documents that demonstrated that there were any evaluations performed that would have justified the budget cuts, rather many of the conversations with senior officials indicated the opposite. Much of the budget and the services were reduced or eliminated as a cost savings measure and is a feature that is not uncommon in public health programmes worldwide (Borisch, 2014). In times of economic crisis, governments respond with cuts to sectors such as education, culture and health. Typically of health sector cuts, primary care continues to receive the bulk of funding while public health experiences the deepest cuts (Borisch, 2014). Compounding this is the fact that most public health is delivered at the local municipal level, and additional cuts are likely as the local agencies attempt to deal with their overall budgetary restraints (Stine & Chokshi, 2012).

At the same time that the global financial crisis hit in 2008, the WHO delivered a report in which it indicated that poor social policies and programmes, unfair economic arrangements and bad politics contributed significantly to health inequities (WHO, 2008). This was borne out later in Greece, as deep cuts to public health resulted in an erosion of social services and health protection (Ifanti, Argyriou, Kalofonou, & Kalofonos, 2013). The WHO, therefore, championed greater investments in public health programmes. Toronto's Hot Weather Programme is an example of the opposite. As detailed in section 4.7, in 2010 when there was a requirement to cut Toronto's overall budget, the Hot Weather Programme was an easy target. There was little hesitation to cut the budget as there were no ongoing evaluations to prove the merit of the response activities, and similarly there were none to indicate that they should be cut. Also,

the sporadic temporality of heat events enables them to be easily 'forgotten' or ignored at a time of decision-making more than other areas where consequences are more ongoing and more in mind.

6.6 Implications of findings

The findings of this study suggest that over the course of the programme's existence, the myriad changes to many services and the complete withdrawal of others, which were enforced by a lack of evidence-based decision making, resulted in a hot weather programme that did not adequately address the needs of those most vulnerable to heat. From the very onset, there were changing official interpretations of vulnerability, which meant that there was not any consistency in terms of the population groups served. Therefore, even when a group was correctly identified as being vulnerable, according to evidence from scientific literature, services were not dedicated to this group for any protracted period. Simultaneously, some groups identified in the literature as having increased vulnerability to heat, such as racialised minorities, recent immigrants and people with low incomes, were not recognised as heat-vulnerable by programme officials. Services such as outreach, which provided health protective information to residents, as well as information on the response services available through the programme, were, thus, never available for long periods. This further compounded another problem, one in which vulnerable groups did not self-identify as being vulnerable. As a result of this non-identification, alongside lack of awareness of the service, many of the services that were advertised as being for 'vulnerable individuals' were not well utilised. Cooling centres, which were set up to provide respite for groups identified as vulnerable by programme officials, suffered from a lack of attendance. The

recommendation by the health department that vulnerable groups should sign up for email notifications also was not well received, seemingly because these groups did not recognize that they were the ones being targeted.

However, this non-recognition of vulnerability could have been mitigated had the health department chosen to use a more robust definition of vulnerability and chosen to consistently dedicate services to ensuring that vulnerable groups understood that they were in fact vulnerable to heat and should have been taking advantage of the activities available by the health department. Unfortunately, since this was not the avenue taken by the health department, many of the provided facilities were under-patronised and many of the available services were underutilised. As a result of this, program officials, erroneously, felt justified in paring or completely withdrawing those services.

It should also be noted that there were many cutbacks to programme services and activities, that were made primarily to save public money. However, this was a specious exercise at best. The fact that officials were making changes to public health programmes that were not based on evidence, for example the use of an incomplete definition of vulnerability or a lack of any evaluation of programme reach or efficacy, was itself a waste of public money. Funds should have been better targeted, but only after full programme evaluations were performed to establish their efficacy.

6.7 Conclusion

This chapter discussed and drew together the findings of both the thematic critique of programme documents and the qualitative interviews. The findings

indicate that the populations vulnerable to heat, have been inadequately identified by Toronto health officials and the methods used to reach that population have been poorly selected. As a result of this, the actual vulnerable population has a lack of knowledge of the programme and methods to protect themselves during times of oppressive heat. Toronto's once 'cutting edge' hot weather response program has been greatly diminished due to a lack of proper evaluations and budgetary cuts which underestimate the value of elements of the programme. The implications for policy are substantive as they indicate that the programme is mismatched to its intended goals. The concluding chapter of this thesis will make recommendations to improve the programme and will examine the contribution that this study has made to literature in its field.

Chapter 7: The path forward: conclusions and recommendations

7.1 Introduction

This thesis set out to answer the question of whether Toronto's response to hot weather addresses the needs of population groups most vulnerable to heat. Based on the information obtained through the analysis of programme documents and supplemented by the views of its intended recipients, it can be concluded that the programme does not meet the needs of its target population. Further the programme fails to meet a major goal of public health, that of improved equity by raising public health standards (Ministry of Health and Long-Term Care, 2018). In concluding the thesis, I first provide recommendations for improving hot weather programmes. I then address contributions to the literature and limitations of this study. Finally, I propose future research that could build on the results of this study.

7.2 Recommendations for improvements to hot weather programmes

While it was determined that Toronto's programme does not adequately serve the heat-vulnerable population of Toronto, the results of this study are applicable to other cities contemplating and implementing hot weather response programmes. Climate change is resulting in changing weather patterns which are making more people vulnerable to the effects of extreme heat. Added to this, increasing urbanisation in many cities is also making heat islands larger

and more common. Differential vulnerability also means that some people are affected much more than others. Therefore, it is important that hot weather programmes are designed properly from the outset and continually evaluated and refined to address the needs of the affected populations

All the failures identified in this study are likely to have exacerbated pre-existing social inequalities in heat-related morbidity and mortality. Therefore, based on the findings of the research the following are recommendations to ensure that hot weather programmes provide and deliver appropriate services:

- The utilisation of a model of vulnerability, such as the Hazards of Place Model, combined with a thorough review of literature on heat vulnerability and best practices in the field to identify vulnerable residents and allocate services appropriately. This thesis has demonstrated that throughout the lifetime of Toronto's programme, the changing definitions of vulnerability adopted by programme officials have never adequately identified the populations identified as vulnerable in the scientific literature. Improving on this would help to ensure that services are allocated appropriately, and health inequities are reduced.
- Community involvement in the development and delivery of the programme activities, including information on targeted response and cultural sensitivities. The involvement of community level groups should bring in specialised knowledge that government officials may not necessarily have. With this information, more inclusive and targeted response activities could be devised.

- Inclusion of more personal outreach to connect with the range of vulnerable communities and establish whether current reliance on electronic communication for public education campaigns is an appropriate medium for these vulnerable communities, or if there are other more appropriate means of communication.
- Yearly review and evaluation including cost benefit analysis of programme activities. Milstein & Wetterhall (1999) suggest that effective programme evaluations are essential to improving public health programmes. However, they also identify that these evaluations are either not performed consistently nor well integrated in the day to day management of programmes.
- Dedicated budgets and proper staffing to ensure that services are effectively delivered. This would also promote the programme as an established entity, permanently affixed and integrated into local communities' responses to climate change.
- Awareness of political and economic pressures that could alter the delivery of programmes and services and the development of adaptable programmes that can absorb these pressures and still deliver appropriate levels of services.

While most of these recommendations are meant to assist vulnerable populations when extreme heat presents itself, officials need to also place much greater emphasis on improving structural conditions in which heat-vulnerable populations live. This involves upstream interventions, such as better insulation, air-conditioning, active and passive cooling and its associated infrastructure,

tree planting and green roofs, rather than simply trying to communicate the risks of heat once hot weather conditions are present.

However, these recommendations are not unique to hot weather programmes, as indeed they could be extended to the wider public health field. It is essential that all public health interventions are properly grounded in evidence (Davies, 2012). Before any intervention is designed and implemented, a detailed study of the public health problem should be undertaken and there must be scientific evidence to justify the need for the intervention (Cherney & Head, 2010). Public health interventions, however, cannot be successful unless they are appropriately designed for the target population. Therefore, for all public health interventions there also needs to be proper understanding of who the vulnerable populations are, and this must be determined according to well-founded evidence.

Another applicable finding to wider public health programmes is the need for their full evaluation, taking into account the impacts on their target population and health/social inequalities. Health equity impact studies play a major role in ensuring that these issues are addressed in evaluations. Simpson, Mahoney, Harris, Aldrich, & Stewart-Williams (2005) identified that the public health workforce does not routinely assess the equity impacts of policies and programmes. They suggest that health equity impact assessments could strengthen the value of evaluations and identify equity issues that could go unidentified in routine evaluations. Approaches to evaluations like these are essential before the implementation of any intervention (Harris-Roxas, Haigh, Travaglia, & Kemp, 2014), but even more so before there are any changes to public services, particularly cuts to services aimed at vulnerable groups.

Finally, another important implication from this study is the benefit of co-designing public health interventions with the target population. Co-design of interventions takes into account the target population's perception of the problem, their suggested solutions, services they would use and those that they would not find useful. Co-design of interventions has been demonstrated to produce better health outcomes, greater recipient uptake and has resulted in more cost savings (Palumbo, 2016).

7.3 Contributions to the literature

7.3.1 Empirical contribution

This thesis has added a detailed case study of a major city's hot weather planning to the research base. Such empirical studies are currently limited in number, but are important because they can provide rich, deep, contextual data that better helps us understand the situated practices of hot weather planning and how well these address the needs of vulnerable populations. Habeeb et al. (2015), noted that throughout Europe and many cities in the United States, there is a lack of heat response plans or heat focussed emergency plans. They suggested that cities could lower heat-related mortality by preparing emergency response plans. Bernard & Mcgeehin (2004) also reviewed the heat wave response activities of 18 cities that had a history of heat-related mortality but determined that only 10 of them had heat response plans, and those plans were cursory at best and did not address the disparities in vulnerability among residents. These authors suggested that proper heat response plans should

provide for coordinated action across government authorities and involve private sector participants. While Okwuofu-Thomas, Beggs & MacKenzie (2017) did perform a multijurisdictional study of 23 heat wave plans from cities across Australia, Canada and the United States, the authors only focussed on seniors in aged-care facilities and not on the impacts of heat on other vulnerable groups. By examining, in detail, Toronto's Hot Weather Response plan, this thesis has gone further than the above referenced cases and provided detailed and relevant information about how a seemingly well-crafted and functional heat response plan, according to Toronto City Council (Mckeown, 2007b), can be fraught with errors, misinformation and not deliver its intended results. This type of information is particularly useful for other cities considering their own such plans, in response to the rising threat of climate change.

7.3.2 Expanding the theoretical knowledge on social vulnerability

This study has applied the Hazards of Place model (Cutter, 1996) to help conceptualise the range of factors that come together to shape heat wave risks. This proved particularly useful for stressing the importance of the 'social fabric' in the formation of social and place vulnerability. In other words that it is not just that Toronto experiences heat extremes which threaten health, but that these interact with a place where there is a particular profile of social vulnerability, related variously to population characteristics, migration histories, perceptions of risk, housing characteristics and tenures and other factors.

It was suggested earlier in the thesis, that there was a component missing from the model that captured the various processes that could influence mitigation

either positively, helping to attenuate vulnerability, or negatively thus limiting its impact, or even exacerbating vulnerability. I, therefore, propose an amendment to the model to include political and economic influences on mitigation strategies and actions. In figure 7.1, the blue box represents the new addition to the model. I suggest that political and economic influences may affect mitigation strategies and reduce their effectiveness, even leading to increased vulnerability.

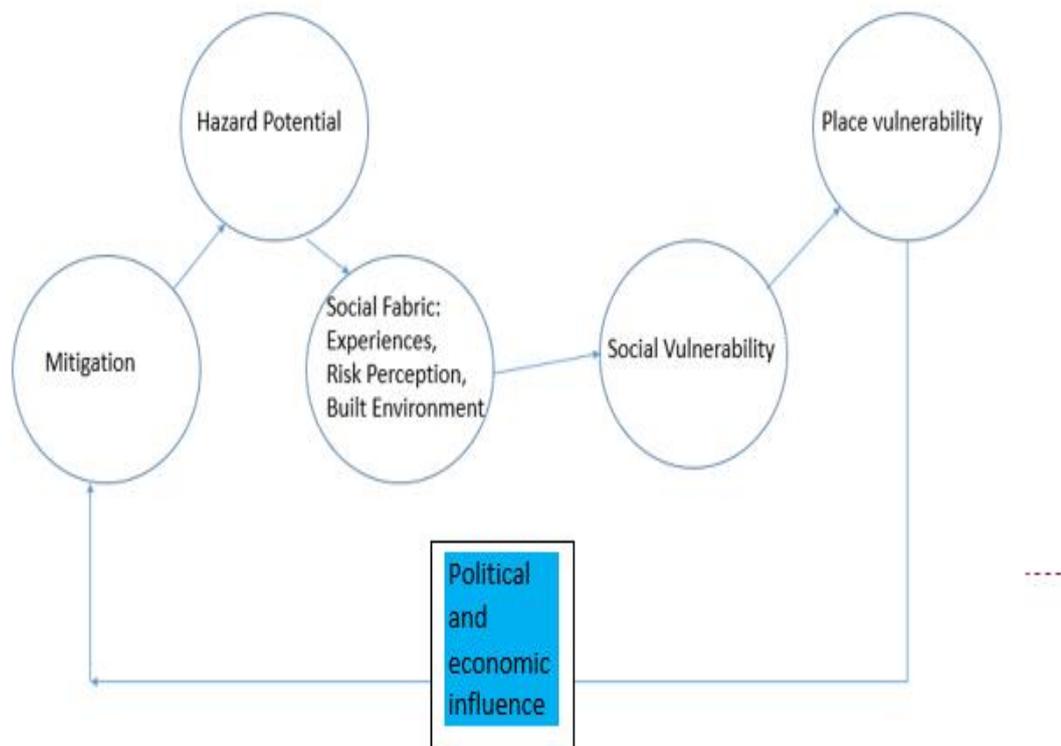


Figure 7. 1 Political and Economic influence added to the Hazards of Place Model

The Hazards of Place Model (Cutter, 1996) has an uninterrupted path from ‘Place Vulnerability’ to ‘Mitigation’ and suggests that this is where interventions could be applied to reduce vulnerability. Figure 7.1, however, illustrates that political and economic influences exerted by those in authority can potentially

affect mitigation. In this study those influences included uninformed decisions made by programme officials, such as cuts to budgets and services, flawed planning and a lack of proper evaluations. They are elements that influenced the impact and efficacy of mitigation services and instead of decreasing overall vulnerability, may have actually increased vulnerability. In this study it was demonstrated that mitigation strategies that were helping vulnerable populations, such as outreach, telephone information and bottled water, were replaced by electronic communication and a move to have residents become more self-reliant and be more personally responsible for their protection from heat. These moves were made due to government and economic pressures. As a result of these changes, many vulnerable people no longer had effective mitigation strategies and their vulnerability may have increased. Understanding the impact that these influences can have on public health programmes is essential and therefore, it should be incorporated into the Hazards of Place Model.

While these political/economic influences may not be overtly obvious, their impacts can be devastating. As an example, in 2008 following the global economic crisis, there was a focus on austerity in public services in many countries. In Europe, countries such as Spain, Greece and Portugal adopted strict fiscal austerity and reduced health sector spending, froze or reduced the salaries of public health professionals and cut back on public health interventions (Karanikolos et al., 2013). In Greece, to meet austerity targets set by the International Monetary Fund, the European Commission and the European Central Bank, the government decided on a reduction of the national health budget by 40%. This resulted in sharp rises in infant mortalities,

mosquito-borne illnesses and HIV infections, among other issues (Stuckler & Basu, 2013). In Canada, recent changes in government have highlighted how politics and economics can interact to affect public health services. Health services, including public health, are delivered at the local level in Canada. Individual cities are funded primarily by the larger provincial government. In 2018, the Conservative provincial party came into power and implemented dramatic changes to public health bodies. The Premier, the leader of the provincial government, had a history of voicing his disapproval of public health interventions and once he was elected, he exercised his views and dramatically reduced public health budgets. For Toronto, this amounted to a budget reduction of \$100 million annually (Global News, 2019).

Another reason that these political/economic influences are so easy to enact is because the effects of public health interventions are often invisible. Interventions, such as those that address chronic diseases, injury preventions, and vaccines, demonstrate their successes when nothing adverse happens to the recipient of the intervention. To an uninformed individual, this could look like the intervention has no value and could make it vulnerable to cuts. This makes public health programmes for sporadic events, such as extreme heat, flooding or foodborne outbreaks, especially vulnerable to cutbacks.

Having examined the impact of these political and economic influences on a selected portion of the HOP model (the pathway from 'Place Vulnerability' to 'Mitigation'), it is important to consider their overall impact on the model and what it means to vulnerability. A political or economic influence that negatively interferes with mitigation could either result in no additional protective impact or could, in fact, reduce mitigation. In this study, the pressures to cut back on

budgets, staff and resources meant that the mitigation activities were specious at best and were actually negatively affecting the vulnerable community. In a case like this, instead of mitigation interacting with risk to temper hazard potential, it could instead exacerbate hazard potential. The end result would be that place vulnerability would be increased and its residents would have their vulnerability to the hazard further increased. It is therefore important that whenever the HOP model is applied to determine the vulnerability of a particular place due to a hazard, that potential covert political and economic influences are considered.

7.3.3 Methodological development

Qualitative studies often utilise several methods in conducting research. In this study I used a thematic critique in the form of a document review and a document analysis to assist in analysis of data and to complement qualitative interviews. Document reviews have been used in programme evaluations, but the combination with document analysis to develop themes, which were further combined with themes from qualitative interviews is uncommon. In this study the methods worked very well together, each method had its specific advantage, but their combination proved to be a powerful tool in information gathering and the use of these combined methods should be beneficial to future studies, particularly those that analyse and evaluate programmes.

7.4 Limitations and strengths of the study

7.4.1 Timing of fieldwork

Davis, Alea, & Bluck, (2015) suggest that a person's recall of incidents is influenced by their age, with older individuals recalling more information about when an incident occurred while younger individuals recalled more information about why an incident occurred. Also a person's memory of incidents can be influenced by the emotional significance of that incident, with accuracy of recall being lessened when there is an emotional attachment (Soleti, Wright, & Curci, 2017). Since this study involved older participants, as well as those who likely had suffered or who knew people who suffered health effects due to heat, I attempted to interview individuals during times that were close to a heat event, to aid with recall. However, as described in section 3.6.2.4, due to unusually coolest weather interviews had to be extended over three years. Reliance on memory was still a key variable as often interviews were conducted a week or two after heat events had concluded. As such, recollections and perceptions of the participants may have still been influenced by circumstances which occurred after the actual heat event.

The major strength of this study was the fact that I could look at the issues through two different lenses, one as a programme official and gain insider's knowledge on why certain actions took place, but also as a researcher who was actively seeking answers to questions that had not been previously answered. While I attempted to carry out this study as an external researcher, my familiarity with the programme allowed me analyse documents and to delve into past

actions and decisions by programme officials at a much deeper level than somebody without that familiarity. This allowed me to gain a more authentic understanding of the reasons for many of the actions of programme officials.

7.5 Future research

It is not known whether the conclusions reached in this study are applicable to similar programmes in other locations. While the basic findings of doing proper planning and evaluations is applicable to public health programmes, Toronto is a large city, with a diverse population and a variety of housing types. It is unlikely that smaller cities will have similar demographic make-ups and thus, social and place vulnerability will be different. Therefore, comparative research should be undertaken to see how well these results fit with those of other cities of different population sizes and demographic makeup.

This study should be also followed up with a longitudinal study, conducted over a period of about 5 years with vulnerable residents of Toronto. As this study has indicated that the populations vulnerable to heat are not all being appropriately targeted by the Hot Weather Response Programme, studies should be conducted with residents who have been made aware of the programme activities and their behaviours followed during times of hot weather. This would be one of the only ways to understand if awareness of the programme has a tangible impact on the health behaviour of the residents and if different strategies are necessary.

Finally, to follow directly from this study and to explore some of the unintended consequences of the programme changes, it would be productive to analyse data on heat-related hospital admissions, clinical diagnoses and mortality, year over year and compare with the programme's evolution and changes.

7.6 Conclusion

Climate change is upon us and the devastating effects are being felt by many people around the world. Although it is probably too late to reverse this phenomenon, we can apply strategies to help mitigate its effects. Hot weather response programmes are such a strategy, but only if they are properly structured and applied appropriately. These and other climate change adaptation initiatives can help cities prepare for the future, particularly those who are most vulnerable to these changes, ensuring that we all have a chance to survive and continue to thrive on this planet.

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Appendix C- Consent Form

Study Title:

Hot Weather in a Temperate Climate and Persons Vulnerable to Heat: Does Toronto's Response to Hot Weather properly address the needs of those most vulnerable to heat

We are asking if you would like to take part in a research project examining perceptions of the hot weather response programme in Toronto by some of its recipients.

Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please speak to the principal investigator, Rajesh Benny.

1. I confirm that I have read the information sheet and fully understand what is expected of me within this study
2. I confirm that I have had the opportunity to ask any questions and to have them answered.
3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.
4. I understand that once my data have been anonymised and incorporated into themes it might not be possible for it to be withdrawn, though every attempt will be made to extract my data, up to the point of publication.
5. I understand that the information from my interview will be pooled with other participants' responses, anonymised and may be published.
6. I consent to information and quotations from my interview being used in reports, conferences and training events.
7. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with his research supervisor.
8. I consent to Lancaster University keeping written transcriptions of the interview for 5 years after the study has finished.
9. I consent to take part in the above study.

Name of Participant _____ **Signature** _____ **Date** _____

Name of Researcher _____ **Signature** _____ **Date** _____

Appendix D- Interview Guide

INTERVIEW GUIDE

Hello, Thank you for agreeing to participate in this study of resources available to assist people during times of Hot Weather.

1. What do you think are some of the health effects of hot weather on people?

2. Have you personally experienced any ill effects due to hot weather and if so can you tell me about them?

3. Where do you get your information about the weather and potentially dangerous conditions?

4. How do you deal with hot weather?

5. Do you have a support structure, friends, family etc that can assist you when the weather becomes hotter than expected?

6. Do you have anyone that depends on you to assist them during times of hot weather?

7. What sort of housing do you currently have (privately owned, rental, shelter) and what is it like indoors during times when it is hot outside?

8. In the building that you live, do you have air conditioning?
 - a. If yes- ask is it included as a part of the accommodation, about being able to afford it, maintain it etc?

 - b. If no- ask if there are fans available for use, are they used, does the interviewee know when to use fans /when not to use fans, how to use fans properly?

9. Is there a dedicated cooling room available in your place of accommodation?

10. If there is, do you use the cooling room?

11. Can you tell me about your experiences using the cooling room-your likes, dislikes, what can be improved, what is appropriate?

12. Are you aware of local facilities that you can visit when the weather is hot?

a. If yes- have you visited these facilities and if so what have been your experiences using them?

b. If no- briefly describe them to interviewee- and ask: Now that you are aware of them will you likely use them?

13. Are you aware of some of the services that the Health Department provides during times of hot weather, such as the Opening of Air-Conditioned Cooling Centres, distribution of bottled water in parks, transportation to cooling centres?

a. If yes- have you used them, and could you describe you experiences using them?

b. If no- now that you are aware of them are you likely to make use of them?

14. Is there anything else you would like to add?

Thank you very much for participating, you can reach me at the number provided if you have any questions or concerns about this interview or if you would like to add more information.

Again, all information here is confidential and if any of your information is used in the published work it will be anonymised so that you cannot be identified.

Appendix E- Participant Information Sheet

Hot Weather in a Temperate Climate and Persons Vulnerable to Heat: Does Toronto's Response to Hot Weather properly address the needs of those most vulnerable to heat?

My name is Rajesh Benny and I am conducting this research as a student in the PhD Public Health programme at Lancaster University, Lancaster, United Kingdom.

What is the study about?

The purpose of this study is to look at Toronto's Hot Weather Response Programme to see if it sufficiently meets the needs of people who are most affected by extremely hot weather. The study is particularly interested in the perceptions of the people who are most likely to be in need of the programme activities.

Why have I been approached?

You have been approached because the study requires information from people who live in your neighbourhood, as it has been identified as an area with a large population of people who are vulnerable to hot weather.

Do I have to take part?

No. It's completely up to you to decide whether or not you take part in this study.

What will I be asked to do if I take part?

If you decide you would like to take part, you would be asked to participate in a one on one interview with myself, the researcher. The interview will last approximately 60 minutes.

Will my data be confidential?

The information you provide is confidential. All topics discussed and all answers that you provide to the questions asked will be kept confidential. The data collected for this study will be stored securely and only the researcher conducting this study will have access to this data:

- Hard copies of questionnaires will be kept in a locked cabinet.
- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.
- At the end of the study, hard copies of questionnaires will be kept securely in a locked cabinet for five years. At the end of this period, they will be destroyed.

- The typed version of your interview will be made anonymous by removing any identifying information including your name. Anonymised direct quotations from your interview may be used in the reports or publications from the study, so your name will not be attached to them.

There are some limits to confidentiality: if what is said in the interview makes me think that you, or someone else, is at significant risk of harm, I will have to break confidentiality and speak to a member of staff about this. If possible, I will tell you if I have to do this.

What will happen to the results?

The results will be summarised and reported in a PhD thesis and may be submitted for publication in an academic or professional journal. It may also be presented at various Environmental Health conferences across Canada.

Are there any risks?

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher and contact the resources provided at the end of this sheet.

Are there any benefits to taking part?

Although you may find participating interesting, the only other direct benefit is the chance to win a \$50.00 gift card. There will be only one winner, there is no guarantee of winning and the odds of winning are dependent on the number of participants and the winner will be randomly selected. You will be eligible for the draw if you are interviewed.

Who has reviewed the project?

This study has been reviewed by the Faculty of Health and Medicine Research Ethics Committee, and approved by the University Research Ethics Committee at Lancaster University.

Where can I obtain further information about the study if I need it?

If you have any questions about the study, please contact the main researcher:

Rajesh Benny

Email: r.benny@lancaster.ac.uk

Telephone: 905-867-5734

Sources of Support

If you experience any distress after participating in this study please contact one of the trained professionals of the Toronto Public Health Vulnerable Adult and Senior Team(VAST) at 416-338-7600 or online at intake@toronto.ca and request the services of a VAST Public Health Nurse.

Complaints

If you wish to make a complaint or raise concerns about any aspect of this study and do not want to speak to the researcher, you can contact:

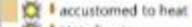
Professor Susan Cartwright Tel: (01524) 592430
Professor of Organizational Psychology and Well being
Director of the Centre for Organizational Health and Well Being
Head of Division of Health Research
Faculty of Health and Medicine
Lancaster University LA1 4YD

If you wish to speak to someone outside of the Public Health Doctorate Programme, you may also contact:

Professor Paul Bates Tel: (01524) 593718
Associate Dean for Research Email: p.bates@lancaster.ac.uk
Faculty of Health and Medicine
(Division of Biomedical and Life Sciences)
Lancaster University
Lancaster
LA1 4YD
Thank you for taking the time to read this information sheet

Appendix F- Excerpts of Coded Interviews

Sample 1

- 018 Well there is always the other problem with diabetes, vision and tiredness, but no not really. I try to do what I have to do. 
- 019 And do you have any family, relatives, etc?
- 020 I have two sons. I didn't get married to their mother, we just lived together, nice Canadian woman I met when I was working in Brampton in the farms, but she went her way and the boys went with them, with her, I don't hear from them, they must be all grown up now, that is how it is. I did get married to a woman from Trinidad, and we had move there for a few years, but we came back and she passed, so this is me. What I have is this, I've made my life, so this is it.  
- 021 Ok, thanks, so in your own words, can you tell me what you believe are the health effects of hot weather?
- 022 Well, when it is hot you sweat a lot and you feel tired, I know some people can't be in the sun, they get like rashes and burns, but that is, and in cars, I know that dogs and children are sometimes left in cars and that is bad, that can cause death.     
- 023 Okay, you mentioned death for people and animals left in cars, but what about people in their day to day activities, so at home or around town, in general, what do you think are some of the health effects of hot weather in general?
- 024 I think it is just what I said, the tiredness and the sun burn for some people.   
- 025 Have you personally, ever experienced any negative effects due to hot weather?
- 026 No man, I am from Grenada man, no problem there. I used to work in the apple fields, all day, the most we used to get was hot and thirsty, but we used to enjoy it. It was different then though, that was an open area, more breeze, yes that was okay, but now, not really, I can't really go too far, I stay at home and I do what I have to, so no real problems now.    
- 027 So you mentioned that you stay at home a lot, is that

Sample 2

- : A: The television
- : R: TV?
- : A: Yes. Every morning before we get off of the house we say, "Oh, today would be raining or too cold, too hot." And then we can, "Oh, I put this," or "I would put that."
- : R: Okay, all right, very good. And if there's dangerous weather condition, same thing TV or do you and your family listen to the radio? The internet?
- : A: No I think it is mostly the weather channel, and in the news.
- : R: In the news, okay. So by the news, how do you get your news? Primarily how do you get your news? Newspapers? TV? Radio?
- : A: The first time, in the TV or in the Metro news.
- : R: Mm-hmm. Okay. Now if it's very hot, like let's say, what, about a week and a half ago, the weather was very hot, and similar to back home, the conditions, did it feel the same? Or...
- : A: No, it's different because in Venezuela, we have wind and it refresh to us, but this kind of hot two weeks ago, it's like you feel a pressure onto you. And again, it's like the breathing, it's difficult in that moment than other time.
- : R: Yeah, yeah, I could imagine. Well, how did you deal with the weather that day? What did you do? Tell me from the beginning. First...
- : A: I tried to stay inside the buildings, in my home, at home, drink a lot of water that day, and stay the minimum time possible outside.
- : R: Okay. So... Okay. Now what about your clothing? Anything different?
- : A: Light clothing, shorts, t-shirts, not jackets, no jeans, try to dress light, it is hot, very so you try to dress light.
- : R: Great. Okay, that's good so far. You have any other family here or friends apart from your wife and children?
- : A: Friends, I have friends.
- : R: You have friends here? Okay.
- : A: My wife here, she too has her girlfriend, they always talking.
- [laughter]

- ☀️ tv
- ☀️ weather information
- ☀️ awareness of weather
- ☀️ tv
- ☀️ weather information
- ☀️ newspaper
- ☀️ tv
- ☀️ weather information
- ☀️ different heat
- ☀️ no wind
- ☀️ stifling
- ☀️ oppressi
- ☀️ uncomfc
- ☀️ remain at home
- ☀️ stay indoors
- ☀️ comfortable
- ☀️ social network

Appendix G- Literature reviewed

| | Author | Title | Description | Methodology |
|---|---|--|--|--------------------|
| 1 | Tan (2008). International Journal of Epidemiology 37:318–320 | People's vulnerability to heat wave | Review of previous studies which examined vulnerability, socioeconomic status and potential interventions. | Both |
| 2 | Conti et al (2005). Environmental Research 98 390–399 | Epidemiologic study of mortality during the Summer 2003 heat wave in Italy | Study on the relationship between mortality and age during heat waves in Italy | Quantitative |
| 3 | Luber and McGeehin (2008). Curr Epidemiol Rep 1:165–173 | Racial and Socioeconomic Disparities in Heat-Related Health Effects and Their Mechanisms: a Review | The article reviews major epidemiologic risk factors associated with mortality from extreme heat exposure and discusses future drivers of heat-related mortality, including a warming climate, the urban heat island effect, and an aging population | Quantitative |
| 4 | Loughnan, Nicholls, & Tapper (2012). International Journal of Population Research | Mapping Heat Health Risks in Urban Areas | Study of heat-related morbidity and mortality in relation to socio- economic status | Quantitative |
| 5 | Huang et al (2011). Journal of Environmental Management 92 (2011) 1753-1759 | Is everyone hot in the city? Spatial pattern of land surface temperatures, land cover and neighbourhood socioeconomic characteristics in Baltimore, MD. | Study which examined land surface temperatures and various communities and identified communities with lower income, more poverty, less education, more ethnic minorities, more elderly people and high crime risk tended to have higher land surface temperatures. The results of the study could be used to identify areas where more funding could be allocated. | Quantitative |

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| 6 | Bell et al (2008) International Journal of Epidemiology 2008; 37:796–804 | Vulnerability to heat-related mortality in Latin America: a case-crossover study in São Paulo, Brazil, Santiago, Chile and Mexico City, Mexico | A case-crossover study of heat-related deaths in Latin America considering confounding factors such as age, education and sex. The authors concluded that elderly individuals were an important group for targeted intervention. | Quantitative |
| 7 | Lissner et al (2012). Climatic Change (2012) 112:687–708 | Towards sectoral and standardised vulnerability assessments: the example of heatwave impacts on human health | The authors examined the impacts of climate change on human health, in a region of Germany, where the urban heat island effect, percentage of elderly population and frequency of heat waves have an impact. They determined that while climate change impacts the larger society as a whole, the smaller segments are further impacted by socio-economic factors. | Quantitative |
| 8 | Tobías, Díaz, & Linares (2012). Science of the Total Environment 439 (2012) 238–239 | A cautionary note to prevent the heat effects on human health. | A Spanish study which examined the adaptation of people to hot weather, the effect of that weather on those 65 years plus and the effectiveness of heat wave plans. The authors concluded that heat warning and prevention plans should place special emphasis on those people who are at greater risk. | Quantitative |
| 9 | Knowlton et al (2009). Environmental Health Perspectives • volume 117 number 1 | The 2006 California heat wave: Impacts on hospitalizations and emergency department visits | This study was conducted in California, USA and examined whether there were increased rates of hospital admissions, based on race and ethnicity. The authors determined that there | Quantitative |

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| | | | were high rates of emergency room visits and hospital admissions among minority ethnic groups, that could in part be related to the exposure to excessive heat as a result of their field of employment. | |
| 10 | Wolf <i>et al.</i> (2010). <i>Global Environmental Change</i> , 20(1), 44–52 | Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities | A UK study which examines the role that social networks play in relation to vulnerability due to heat waves. The authors found that there was a positive relationship with social networks, better health and better adaptation to climate change. | Qualitative |
| 11 | Brown & Walker (2008). <i>Building Research & Information</i> , 36(4), 363–372. | Understanding heat wave vulnerability in nursing and residential homes | A UK study which explored the daily settings in which people experience heat wave conditions and the ways in which factors such as social, cultural and infrastructural could potentially contribute to creating vulnerability and limiting short- or longer-term adaptation. The authors emphasised that the understanding of why people are affected by heat is essential in order to develop effective response activities. | Qualitative |
| 12 | Cassti et al (2013). <i>Journal of Applied Meteorology and Climatology</i> , 52(12), 2669–2698 | Regional Climate Projections of Extreme Heat Events in Nine Pilot Canadian Communities for Public Health Planning | A Canadian study which examined the use of evidence-based information in the planning of programmes in response the climate change. The authors identified extreme temperature indices which were used to characterize heat | Quantitative |

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| | | | events associated with health risks. | |
| 13 | White-Newsome et al (2012). Environmental Research, 112, 20–27 | Climate change and health: indoor heat exposure in vulnerable populations | This study examined the relationship between indoor exposure to extreme heat by elderly people. The authors determined that indoor temperatures exceeded the comfort threshold for elderly people during times of extreme heat. They also identified that indoor temperatures could be predicted by considering the outdoor temperatures in conjunction with the building stock and the surrounding environment. | Quantitative |
| 14 | Ormandy & Ezratty (2012). Energy Policy, 49, 116–121 | Health and thermal comfort: From WHO guidance to housing strategies | A review of the evidence associated with the WHO's guidance for thermal comfort. The authors reviewed both quantitative and qualitative work and concluded that improving the heating and insulation in all the energy inefficient dwellings in England would save t £750 million per year by reducing the demands on the NHS. | Both |
| 15 | Hansen et al (2011). International Journal of Environmental Research and Public Health, 8(12), 4714–4728 | Perceptions of heat-susceptibility in older persons: barriers to adaptation. | This study was conducted in Australia and was designed to gain insight into the factors which contribute to adaptation to heat by older individuals and barriers which may prevent that adaptation. The authors | Qualitative |

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| | | | used interviews and focus groups and found that the factors included physiological and age-related factors, socioeconomic, psychological and adaptive strategies. | |
| 16 | Harlan, et al., (2006). <i>Social Science & Medicine</i> (1982), 63(11), 2847–2863 | Neighbourhood microclimates and vulnerability to heat stress | A study conducted in Phoenix, USA which examined local microclimates in an urban environment as they relate to socio-economic characteristics, thermal environments and resources that people have to cope with the climatic conditions. The authors concluded that lower socioeconomic and ethnic minority groups were more likely to live in areas that were warmer, were more vulnerable to the effects of heat and had fewer resources to cope with those conditions. | Quantitative |
| 17 | Reid et al (2009). <i>Environmental Health Perspectives</i> , 117(11), 1730–1736 | Mapping community determinants of heat vulnerability | An American study which examined heat related factors for morbidity and mortality in the USA. The authors determined that 4 factors accounted for more than three-quarters of all morbidity/mortality. The factors included social vulnerability, social isolation, the use of air-conditioning and old age/diabetes. | Quantitative |
| 18 | Madrigano, Ito, Johnson, Kinney, & Matte (2015). <i>Environmental Health Perspectives</i> , 123(7), 672–678 | A Case-Only Study of Vulnerability to Heat Wave-Related Mortality | A study in which the authors used a case-only analysis, including all deaths of New York City residents from 2000 through 2011, to | Quantitative |

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| | | in New York City (2000-2011) | examine subject and neighbourhood characteristics that modified the association between heat waves and mortality. They determined that deaths during heat waves were more likely to occur to blacks, at home rather than in hospitals, to people on social assistance and in neighbourhoods that had less green space. | |
| 19 | Semenza et al. (1996). <i>New England Journal of Medicine</i> , 335(2), 84–90 | Heat-Related Deaths during the July 1995 Heat Wave in Chicago | An American study which sought to determine who were most at risk of heat related deaths during a Chicago heat wave. The authors used a case-controlled study and determined that those most at risk of heat related deaths were people who were lived alone, lived on the upper floors of buildings and had little or no social network. | Quantitative |
| 20 | Vandentorren et al (2006). <i>European Journal of Public Health</i> , 16(6), 583–591 | August 2003 Heat Wave in France: Risk Factors for Death of Elderly People Living at Home | A study which examined the 2003 heat wave in France and used a case-controlled survey. The authors determined that people with pre-existing medical conditions were at increased risk of dying and suggested that those individuals needed information that would help them to adapt during heat waves. | Quantitative |

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| 21 | Klinenberg (2001). <i>Ethnography</i> , 2(4), 501–531 | Dying Alone | Ethnographic study in which the author examined the 1995 Chicago heat wave in which over 700 people died. The author concluded that conditions such as people living alone, elderly people being socially isolated, crime laden neighbourhoods in which people withdraw from society out of fear, inadequate social services and degradation of segregated neighbourhoods all created conditions that resulted in the excessive deaths. | Qualitative |
| 22 | Rinner et al (2010). <i>Cartography and Geographic Information Science</i> , 37(1), 31–44 | The Role of Maps in Neighbourhood-level Heat Vulnerability Assessment for the City of Toronto | In this study, the authors examined heat vulnerability maps and used maps representing exposure and sensitivity indicators and vulnerability indices. The indices were calculated using the ordered weighted averaging multi-criteria analysis method. The authors suggested that the maps could be used for hot weather response planning. | Quantitative |
| 23 | Gober et al (2012). <i>The Professional Geographer</i> , 64(2), 286–302 | Vulnerability to Extreme Heat in Metropolitan Phoenix: Spatial, Temporal, and Demographic Dimensions | This study which was conducted in Phoenix, USA examined the distribution of vulnerability to extreme heat in 1990 and 2000. The authors used an index of seven equally weighted measures of physical exposure and adaptive capacity. They concluded that Phoenix' elderly and Hispanic | Quantitative |

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| | | | community were most affected by the extreme heat. | |
| 24 | Uejio et al. (2011). <i>Health & Place</i> , 17(2), 498–507 | Intra-urban societal vulnerability to extreme heat: the role of heat exposure and the built environment, socioeconomics, and neighbourhood stability | This Philadelphia study examined the relationship between mortality during excessive heat and the built environment, socioeconomic conditions and neighbourhood stability. The authors concluded that neighbourhoods with higher proportions of Hispanics, blacks, linguistically and socially isolated individuals were at a greater risk of heat related mortality | Quantitative |
| 25 | Hansen, Bi, Saniotis, & Nitschke, 2013). <i>Global Health Action</i> , 6(1) | Vulnerability to extreme heat and climate change: is ethnicity a factor? | An Australian study which investigated the underpinning reasons as to why ethnicity may be associated with susceptibility to extreme heat. | Qualitative |
| 26 | Berko & Ingram, 2014. <i>National Health Statistics Report</i> . 76 | Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006–2010 | An American study which examined heat-related mortality, cold-related mortality, and other weather-related mortality during 2006–2010 among subgroups of U.S. residents. | Quantitative |
| 27 | O’Neill et al. (2005). <i>Maturitas</i> , 64(2), 98–103 | Preventing heat-related morbidity and mortality: New approaches in a changing climate | An American study which examined whether AC prevalence explained differing heat-related mortality effects by race. Study included populations in Chicago, Detroit, Minneapolis, and Pittsburgh. | Quantitative |
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