SINGLE ETHNICITY STUDY OF HIGH BLOOD PRESSURE AND LOCAL NEIGHBORHOOD ENVIRONMENTS IN THE PARSI POPULATION IN MUMBAI

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ABSTRACT

The environment is dynamic and a changeable interface affecting health and disease susceptibility in populations. Environmental factors are of significance in public health because they are modifiable and preventable causes of diseases. Contemporary studies look at the comprehensive impact of the environment on health and recognize that Global Environmental Changes have a potentially larger influence human health and development. Local neighborhoods form a significant component of the general external exposome. Although we live in a globalized world, local neighborhoods, with their natural and built resources, remain influential on human health. The local neighborhood encompasses critical influences on lifestyle by affecting safety, access, physical or social activities, and belonging. High blood pressure is a common complex disease and a metabolic risk factor for morbidity and mortality among adults globally. Common complex diseases affect a large number of the global population, are chronic, can be inherited, are polygenic and involve environmental factors affecting lifestyle. High blood pressure is the single most significant risk factor for cardiovascular mortality. Apart from genetic factors, ageing and physiological effects of gender, the environment is the largest determinant of factors affecting blood pressure. A combination or single effect of a small number of the many environmental risk factors affect high blood pressure. Low- and middle- income countries (LMICs) bear a larger burden of the disease. The relation between local neighborhoods environments and high blood pressure in LMICs have not been studied. This study was directed toward exploring the impact of local neighborhoods in India, a middle-income country (MIC), on susceptibility to high blood

pressure. The study was conducted in the Parsi population in Mumbai. Parsis are a founder population and the genetic stability in this population reduces the confounding actions of diverse genetics. 774 females and 756 males participated in the study. For all neighborhoods, the study had a gender-balanced and representative sample of the Parsi community in the age-group 19-53 years; who live in four distinct neighborhoods. Information on neighborhoods, socio-demographics known risk factors for high blood pressure were collected; height and weight of the participants were taken to calculate the body mass index (BMI); and two readings of their blood pressure were taken. Data were analyzed using SPSS software. Local neighborhood environments had an impact on BMI and blood pressure.

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LIST OF ABBREVIATIONS

BAUG: Gated community housing with amenities

BMI: Body mass index

COSMO: Cosmopolitan apartments

CCD: Common Complex Disease

CVD: Cardiovascular Disease

DALY: Disability Adjusted Life Year

GEC: Global Environmental Changes

GIS: Geographical Information System

HALE: Healthy Life Expectancy at birth

HBP: High blood pressure

HDI: Human Development Index

HICs: High income countries

IRB: Institutional Review Board

LMIC: Low- and middle- income countries

MJDPC: Mancherji Joshi Dadar Parsee Colony

MICs: Middle income countries

NCD: Non-communicable Disease

PARAP: Parsi Apartments

SDG: Sustainable Development Goal

SES: Socioeconomic status

WHO: World Health Organization

CHAPTER ONE

INTRODUCTION AND BACKGROUND

ENVIRONMENTAL EPIDEMIOLOGY

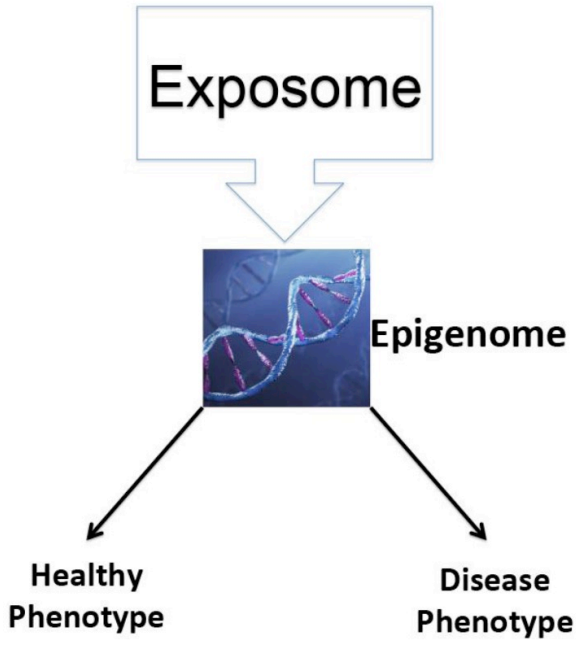
Environmental epidemiology refers to the study of diseases and health conditions occurring in populations that are linked to environmental factors (Pekkanen, 2001). The environment is a modulator of the health-disease spectrum[1]. The environment is dynamic and a changeable interface affecting health and disease susceptibility. Environmental factors are of significance in public health because they are modifiable and preventable causes of diseases (Millis, 2011).

The role of the environment in susceptibility to disease is under-studied. Humans can adapt to environmental changes. The pace and scale of physical, social and cultural shifts in the environment since the industrial revolution has been the most rapid in history. It has been suggested that human activity and its effects on the environment may have evolved too fast for the body to develop immune and repair mechanisms to adapt to these changes (Frumkin, 2019; Olden et al., 2011). The effect of the environment on health and disease has been studied and established. Data indicate that the environment directly affects about 30% of diseases globally (Frumkin, 2003; Jackson, 2003). Contemporary studies look at the comprehensive impact of the environment on health and recognize that

[1] Health spectrum: Health and disease can be visualized on a spectrum as they are not singular but continuous states. They can overpower each other, and one can be more prominent over the other on the spectrum.

Global Environmental Changes (GEC) have a potentially larger influence human health and development. These studies examine GEC as an operating system for the entire global population rather than the effect of specific environmental factors on a disease (Frumkin, 2019). The GEC studies are a step in the right direction because the environment is not restricted to specific exposures from air, water and soil. The environment is everything 'non-genetic' and is addressed as the exposome (Nakamura et al., 2014; Wild, 2012).

Figure 1. The Exposome and Phenotype



The exposome, comprised of all exposures, general and specific surrounds the genome. Neighborhoods are a part of the general external exposome affecting health and disease in the population.

From cellular structures surrounding the nucleus, everything around the gene is its environment and influences how the gene expresses the health or disease phenotype

(Figure 1) (Nakamura et al., 2014; Wild, 2012). Wild divided the exposome into three parts, general external exposome, the internal body exposome and the specific external exposome (Wild, 2012). The general external exposome includes social, cultural, psychological, climatic and the built environment. The internal exposome is comprised of internal body mechanisms acting in and around cellular structures but outside the gene. The specific external exposome refers to specific substances in the general external exposome such as chemical pollutants, infectious agents, alcohol and tobacco. The exposome includes the social environment as one aspect of the pathway to disease (Wild, 2012). Therefore, the paradigm of exposure → physiological change → disease, while still true is more complex than previously thought.

Exposome studies articulate the expanse of environment and a reason to investigate the 'exposome' for public health (Lioy, 2011). Genetic research has led to the discovery of many disease-susceptibility genes and thousands of genetic variants, and yet they do not explain susceptibilities to the most common, complex, and burdensome diseases. Research on metabolic risk factors has generally not considered significant environmental exposures such as social and behavioral factors (Marmot, 2005; Olden et al., 2011; WHO, 2005, 2009). These exposures can affect physiological functions throughout the life cycle, leading to development of metabolic risk factors, which affect HALE and DALYs[2]. As the body adapts in its environment, certain pathologies are known to develop. Epigenetics and genomic plasticity are pathways by which the environment affects health (Bjornsson, 2004). Most studies of the exposome and epigenetic

[2] HALE: Healthy Life Expectancy at birth; DALY: Disability-Adjusted Life Year

expression focus on chemical exposures (Haugen et al., 2014). Modern comprehensive understanding of the exposome presents an opportunity to intervene for better health of populations so that HALEs improve, and DALYs decrease to match up to life expectancy. Non-communicable diseases (NCDs) account for 21 of the 30 leading causes of DALYs. Of concern is also the interaction and co-morbidity of risk-factors. Global public health research indicates the strong role of risk factors in health, quality of life and disease. The World Health Organization (WHO) (2009), identified over 20 risk factors to poor health, including tobacco use, low birth weight, high blood pressure, and diabetes. The WHO compilation of health data and the global burden of disease data, help us understand the importance of risk factors in prevention of morbidity and mortality (Collaborators, 2015; WHO, 2011, 2014).

While there can be a considerable overlap and debate over their classification, exposome risk factors can be divided into four broad categories: a) Environmental, b) Behavioral, c) Nutritional and d) Metabolic (http://www.who.int/healthinfo/indicators/2015/100CoreHealthIndicators_2015_infographic.pdf?ua=1) (accessed April, 2019). Of the risk factors, metabolic risk factors such as high blood pressure (HBP) and high blood sugar also qualify as common complex diseases.

Common complex diseases (CCDs) affect a large number of the global population, are chronic, can be inherited, are polygenic and involve environmental factors affecting lifestyle. The polygenic nature of CCDs makes their occurrence common and has contributed to the high prevalence of these diseases globally. Monogenic diseases are rare and have a rare gene occurrence or disorder (an example is retinoblastoma). Another

challenge is that even if the CCDs are affected by multiple factors they are not necessarily caused by the same set of factors (Bjornsson, 2004; Ehret, 2010; Jackson, 2003; Toscano et al., 2014). Current research and knowledge about CCDs are challenged by epigenetic effects of known and unknown risk factors and the permutations and combinations in which risk factors affect the disease phenotype.

LOCAL NEIGHBORHOOD ENVIRONMENTS

Local neighborhoods form a significant component of the general external exposome. Although we live in a globalized world, local neighborhoods, with their natural and built resources, remain influential on human health. Olden (2011) explains that neighborhoods are not just geographical areas but live intricate environments which can interact in many ways to affect diseases. The local neighborhood in its physical, economical and socio-cultural aspects, is a significant part of the general external exposome and studies have indicated its role in health and disease (Diez Roux, 2010; Gordon-Larsen, 2006; Kondo, 2009). Local neighborhood environment is the link between the individual and the community; the urban and the home (Bonaiuto, 2003). A characteristic of the local neighborhood is that exposures are chronic. Physical, social, cultural, economic, behavioral, psychological and other factors interact over time, so no single element is responsible for the entire human adaptation and response to the neighborhood. Neighborhoods affect health by behavioral contagion or structure (Ross, 2000). Common behaviors become prevalent over time and may be accepted by people in the neighborhood as normal. This is called behavioral contagion. These behaviors may be health or risk behaviors. Alternatively, the design and infrastructure of a neighborhood

can pose constraints or opportunities leading to behaviors, which then become prevalent and affect health or disease. The local neighborhood encompasses critical influences on lifestyle by affecting safety, access, physical or social activities, and belonging (Diez Roux, 2010; Hicken, 2015).

Oldenburg (1997) observed that post World War II construction of residences in the United States seemed more about protecting from the community rather than connecting to the community. He emphasized the need for 'Third Places', their proximity to home, and time to access these places. Third places follow the home, which he defined as the 'first' place and work which he called the 'second' place. At the time he argued that third places were an alternative to television without necessitating getting into an automobile. Oldenburg argued that third places could only be local. While this is debatable, his research stands true today that third places allow mobility and essentially build social capital in a neighborhood. Browning et al. (2003) report that neighborhood affluence affects health beyond individual SES, demographics or health behaviors. Their research indicates that neighborhood affluence is not just the opposite of neighborhood disadvantage in terms of resources, but residents of affluent neighborhoods exhibit better control over local institutions through collective efficacy. This cultivates stronger social environments and promotes health.

HIGH BLOOD PRESSURE

High blood pressure (HBP) is a common complex disease and a metabolic risk factor for morbidity and mortality among adults globally. Thirteen percent of global deaths and four percent of DALYs are attributed to HBP (NIH, 2002; WHO, 2009, 2013).

Blood pressure (BP) is the pressure exerted by the heart each time it pumps blood into the blood vessels. It is measured in two sub-divisions, systolic blood pressure and diastolic blood pressure. Systolic pressure is the maximum pressure on blood vessels as the heart contracts and pushes blood into the arteries. Diastolic pressure is the pressure on the arteries when the heart relaxes (WHO, 2013). Systolic blood pressure gets blood to all parts of the body and diastolic blood pressure keeps the blood flowing through the arteries. High blood pressure occurs when the blood meets with resistance to reach all parts of the body causing the heart to exert more pressure to maintain function (Cushman, 2003). High BP is often asymptomatic and has been nicknamed the "silent killer" but could present as a non-specific headache, dizziness or nose bleeds (WHO, 2013). Persistent raised BP has the potential to harm the heart, blood vessels, kidneys, brain, or eyes. It is associated with thickening of arterial walls and sluggish blood supply to end arteries leading to morbid conditions eventually leading to end organ damage (Blacher, 2016; Cushman, 2003). It is therefore a risk factor for cardio-vascular diseases (CVDs), stroke, dementia, chronic renal failure, and blindness. The effects of HBP are significant even in those who are not diagnosed with clinical hypertension. Thus, average or below average blood pressure but higher than normal is classified as a risk to health (Blacher, 2016; NIH, 2002; Walker, 2013; WHO, 2009, 2013).

Blood pressure is a much-researched topic and has seen many amendments and classifications over the years. A single occurrence of high blood pressure does not qualify as hypertension. Carretero and Oparil (2000) note that though the definition of hypertension is discretionary, it is defined for practicality. The definition is discretionary because there is no set threshold at which it becomes a risk factor for end stage diseases.

A formal diagnosis of clinical hypertension is declared when high blood pressure is recorded on three different occasions, each reading taken at least 48 hours apart and the average of two subsequent readings is more than 140 mmHg, systolic or 90 mmHg diastolic. Isolated systolic or diastolic hypertension is when either but not both pressures are raised.

Key categorizations of BP for adults 18 years or above are (Chobanian, 2003; Cushman, 2003; WHO, 2013) https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

- Normal BP is less than or equal to 120/80 mmHg
- Pre-hypertensive BP is equal to 121-139 mmHg
- Hypertensive BP is more than or equal to 140/90 mmHg
- The risk for CVD can increase at the threshold BP of 115/75 mmHg in the age-group 40-70 years

Chronic high blood pressure or acute episodes of very high blood pressure stress the vascular system and the heart. Stroke and CVDs are the most common and morbid tertiary effects of high blood pressure. Danaei et al. (2009) studied 12 modifiable risk factors of mortality in the United States to find that a combination or single effect of a small number of these risk factors affects larger proportion of disease and death. They found that HBP is the single most significant risk factor for cardiovascular mortality. Essential or idiopathic hypertension is not secondary to a known disease but increasingly connected with known risk factors (Carretero, 2000; WHO, 2013). It may occur secondary to an existing renal disease or a single genetic association when it is termed as

non-essential hypertension. Known risk factors that affect essential hypertension include socio-demographic, behavioral and metabolic factors.

Socio-demographic Factors

Heritability of essential hypertension is high and family history can be a predictor of the disease. Multiple genetic variants are associated with the disease phenotype. Young populations with a family history of hypertension are much more likely to suffer hypertension than those with no family history (Cushman, 2003; Ehret, 2010; Millis, 2011; Pausova, 1999; WHO, 2013). The physiology, pathology and genetic mechanisms indicate that age is an independent risk factor for hypertension. Blood pressure often rises with age (Cushman, 2003; Sun, 2015; WHO, 2013). This is due to decline in physiological function leading to arteriosclerosis. When complicated by other risk factors, mortality in hypertensive patients often occurs before the age of 70 years (Sun, 2015; WHO, 2013; Yano, 2016). Gender is a significant confounder for high blood pressure (Ehret, 2010). Males are more prone to hypertension in younger age groups. Beyond 65 years of age, physiological changes and ageing probably annul this difference (Carretero, 2000; Sandberg, 2012). Gender is not just a demographic but has socio-cultural implications and these factors adversely affect hypertension in women (Stroope, 2015). Research on social factors affecting hypertension in women globally is negligible. Low- and middle- income countries (LMICs) bear a larger burden of the disease (Carretero, 2000; WHO, 2013). Low SES is associated adversely with hypertension. The relation with education and income can change beyond a point but results are mixed (Irazola, 2016; WHO, 2013). Urbanization has a negative relation with high blood pressure mediated through behavioral changes in the population. Stress is an important

factor affecting high blood pressure. Social factors affecting stress and the poor management of stress are both critical to prevention and care of high blood pressure (Matthews, 2004; WHO, 2013). Chronic stress and fatigue lead to pathological changes in the body directly affecting blood pressure (McEwen, 1998).

Behavioral factors

Physical activity, physical inactivity, sedentary lifestyle, high sodium intake, alcohol and tobacco consumption are adversely associated with high blood pressure (WHO, 2013). Physical activity is a protective health behavior documented to reduce the risk of high blood pressure and CVDs (Tong, 2016; Weinberger, 2012; WHO, 2018a, b). Physical inactivity is the fourth outstanding risk factor for NCDs and global mortality (Atkinson, 2016). Physical inactivity is defined as an insufficient physical activity level to meet present physical activity recommendations (Tremblay, 2017). Sedentary behavior is defined as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture" (Tremblay, 2017). Sedentary behaviors lead to a decrease in energy expenditure, increase in weight, and subsequently to metabolic disturbances including high blood pressure. (Thorp, 2011; Wilmot, 2012). Sedentary lifestyle is a cumulative eventuality of poor active behaviors, physical inactivity and sedentary behaviors. It is therefore a serious risk factor for high blood pressure. Regulated salt-intake is recommended as a significant contributor to reduce the risk of high blood pressure and its subsequent effects especially stroke and CVD. The WHO recommends reduced salt consumption in all adults (> 16 years) to less than 2 mg/ day. Harmful use of alcohol has a direct impact on blood pressure and leads to hypertension. Tobacco use is also associated with high blood pressure and its

subsequent cardio-vascular effects. Reduced use of tobacco leads to control of blood pressure in those who have high blood pressure (WHO, 2013).

Metabolic risk factors

All the behavioral factors affecting high blood pressure affect blood flow from the heart and lead to metabolic defects. High blood pressure affects and is affected by other metabolic risk factors to health (Blacher, 2016; Tadvi, 2016; WHO, 2013). Research studies indicate that it is more likely for those with hypertension to present with one or more metabolic risk factors such as obesity or diabetes (Blacher, 2016; Bozkurt, 2016; Danaei, 2009) . While there is co-existence of metabolic risk factors, a high body mass index directly affects high blood pressure (Chobanian, 2003; WHO, 2013; Xie, 2015).

Environmental Epidemiology of High blood Pressure

From the above discussion, it is evident that barring the genetic factors, ageing and physiological effects of gender, the environment is the largest determinant of factors affecting blood pressure (Carretero, 2000; Cushman, 2003). It is well-established that chronic diseases are primarily environmental in origin (Rappaport and Smith, 2010). Environments affect health and disease susceptibility by way of lifestyles. Global Environmental Changes have led to a cascade effect on lifestyles of populations. It is a cascade effect because these are phenomenal effects of urbanization or suburbanization observed globally (Frumkin, 2019). Physical activity is critical from the point of view of sustainable development and related to GEC (SDG goals 3 and 11) (A/RES/70/1, 2015).

Physical inactivity trends are noticeably different within and between countries. It is observed that physical inactivity increases with economic development and is influenced by transportation, technology, urbanization, and socio-cultural environments (Sallis J, 2016; WHO, 2018a). Economic development and urbanization are simultaneously associated with the burden of adverse effects of sedentary behaviors (Atkinson, 2016; Dang, 2019; Koyanagi, 2018; Monda, 2007; O'Donoghue, 2016). Rapidly emerging economies are challenged by dual effects of GEC leading to epidemiologic transition. High burden of diseases in LMICs affects economic output unfavorably (Frumkin, 2019; Koyanagi, 2018).

The question remains as to how local neighborhoods in LMICs affect risk factors and a common complex disease like high blood pressure. This study was directed toward exploring the impact of local neighborhoods in India, a middle-income country (MIC), on susceptibility to a metabolic risk factor, High blood pressure.

LOCAL NEIGHBORHOODS AS EXPOSURES FOR HIGH BLOOD PRESSURE IN MUMBAI

A component of the hypothesis tested in this study is that local neighborhoods with their multiple influences (Diez Roux, 2010; Frumkin, 2003) have the potential to affect blood pressure at many levels of genetic and environmental susceptibility (Wang, 2015). Neighborhood disadvantage affects blood pressure through various structural, physical and socio-cultural influences, which affect health behaviors. Neighborhoods and walkability have been explored to understand whether there are correlations with walking, a form of physical activity and a preventive health exposure of neighborhoods. Walkability refers to the many diverse environmental factors that affect walking in all

forms and is an important determinant of activity in populations (Forsyth, 2015). Walkability contributes to physical activity and social capital and therefore has a protective function towards health of populations in more ways than one (A/RES/70/1, 2015; Bull, 2017; Lawrence, 2006; Morris, 1997; Owen, 2004). Walkability influences lifestyle.

In the context of high blood pressure, physical activity, inactivity and sedentary behaviors affecting lifestyles of populations and consequently their health, walking and walkability become important factors (Hamer, 2008; Min Lee, 2012). Globally, walking is the most common form of physical activity in populations, has protective effects on health, prevents diseases and can potentially break several socio-demographic barriers to physical activity. Walking has been and has the potential to be the most sustained protective health behavior contributing to a physically active lifestyle (Morris, 1994; Morris, 1997). Walking may be done for fitness, utilitarian, leisure or transit purposes. Walking is expected to be the most widely available and oldest mode of transport (Newman, 1989; Weinberger, 2012). Goetzke et al. (2010) have reported that walking is self-reinforcing and walking behavior will encourage others to do the same. Thus, walking can be a prevalent behavior by contagion. Third places in neighborhoods would enhance this behavior by providing a high sense of community within the neighborhood (French, 2014; Oldenburg, 1997). Walkability also promotes walking through structure. Zuniga-Teran (2017) studied nine walkability categories to report that neighborhood infrastructure is related to walking. Neighborhoods play a key role in incorporating the nine factors: connectivity, land-use, density, traffic safety, surveillance, parking, experience, greenspace and community which are related to walking outcomes.

Neighborhoods and effects on blood pressure have been studied mainly in high income countries (HICs). Most studies on urban areas and walkability involve HICs and the global health prescription for slowing the progress of common complex diseases may not be aligned to metropolitan regions in LMICs. Rapidly emerging economies have experienced sudden and large migration to urban areas and data indicate that sedentary behaviors are increasing. With rapid urbanization the world is becoming smaller and more global and local neighborhoods may be affected by this. There exists a research gap in local neighborhoods in LMICs and their influence on the increasing burden of NCDs in these countries.

SINGLE ETHNICITY STUDY ON HIGH BLOOD PRESSURE AND LOCAL NEIGHBORHOOD ENVIRONMENTS (SESHLONE)

The SESHLoNE examined effects of local neighborhood environments on blood pressure in the Parsi population in the Mumbai Metropolitan Region[3]. The rationale behind selecting the Parsi community was two-fold. One was to stabilize the genetic influence. The second was that the community housing and distinct neighborhoods in which they live. This allowed for an exclusive research study to understand any relation with local neighborhoods within the metropolitan region. The Parsi population expresses founder effects[4] (Arcos-Burgos, 2002). The loss of genetic variation stabilizes heritability and

[3] The Mumbai Metropolitan Region includes the cities of Mumbai, Navi Mumbai, Thane, Bhiwandi and Palghar.

[4] Founder Effects: These occur when a few members of a population detach and start a new colony. Founder populations are population isolates or genetic isolates occurring from lack of genetic interchange with other subpopulations. This results in a bottleneck of genetic interchange, and there is reduced genetic variation in the new colony as they procreate.

reduces some complexity of understanding the environmental influence on common complex diseases.

In a diverse population like that of Mumbai, genetic heterogeneity is high and individual susceptibilities are more likely to be reflected in within country studies. This study was exclusively done in a founder population in whom genetic heterogeneity tends to be lower, thus allowing a large sample to reflect the impact of the environment. Parsis are Zoroastrians who follow the teachings of Prophet Zarathustra and originally lived in the region of Persia. A fragment of followers of this faith migrated to India around the 9th century CE (1300 years ago) because of religious persecution and for purposes of trade (Kulke, 1974). They identify themselves as Parsis. Another fragment of followers of the Zoroastrian faith who migrated to India over 200 years ago from Iran, identify themselves as Iranis. Today, both groups intermingle culturally and religiously. For this paper, all Zoroastrians living in Mumbai and participating in this study were referred to as Parsis. Parsis in India have mostly lived together as a community, avoided inter-religion marriages, and disallowed religious conversion of people of other faiths to Zoroastrianism. Thus, they qualify as a founder population. Their population in India is 57,264 (2011 census).

A key feature of the Parsi community has been exclusive subsidized community housing in Mumbai. Parsi community accommodations were first constructed with the idea of providing affordable housing and assistance to members of the community. In the late 1800's, philanthropists of the community responded to the need for housing among Parsis. The philanthropists built the colonies to offer affordable housing. Housing opportunity became a trend with the philanthropists, and it was appropriate for Mumbai

which had relatively high real estate prices. What started as affordable housing then progressed as community living. Given the small numbers of the population, living together was about nurturing the Zoroastrian culture by building social capital and enriching faith. Parsis in Mumbai may live in community housing with amenities, community apartments without amenities or in cosmopolitan housing with the general population. This provided an opportunity to study blood pressure in a genetically restricted population that would allow assessment of local neighborhood environments in a megacity in India, a middle-income country.

This study was the first of its kind in India to determine the actions of macro-essential differences in local neighborhoods within urban areas and their effects on blood pressure.

CHAPTER TWO

RESEARCH METHODS

THE STUDY

The Single Ethnicity Study on High blood pressure and Local Neighborhood Environments (SESHLoNE) was designed as a quantitative cross-sectional epidemiological study. It was a quasi-experimental study assuming that physical-social-cultural environments in local neighborhoods affect health outcomes.

POPULATION COHORTS

For the study, three neighborhood cohorts were created for comparative analysis of local neighborhood resources: Baugs, Parsi apartments and Cosmopolitan apartments

1. The Parsi Baug (BAUG) is a congregation of apartments with amenities such as a playground and gymkhana or community center. The gymkhana is an enclosed space adjacent to a playground. Residents gather there to socialize or spend time. Gymkhana is derived from the combination of the word's gymnasium and food (khana = food, *origin Hindi Language).* Not all gymkhanas in BAUGs serve food but they provide a space for socializing and indoor games. There is a lot of variation within and among housing for Parsis in Mumbai. Every Baug is not similarly constructed and resourced. In a Baug, housing may be owned or leased.

2. Parsi apartments (PARAP) are exclusively for Parsis and are constructed in clusters or individually in neighborhoods of mixed ethnicities. Parsi apartments are different from BAUGs in that they lack a playground and a gymkhana. The apartment may be privately owned or owned by a philanthropic trust providing subsidized housing.
3. Some Parsis living in Mumbai reside outside of community housing for various reasons, including economic opportunities and individual choice. Women who marry outside of the Zoroastrian community are not eligible for housing in a Baug. Many Parsis in Greater Mumbai live in cosmopolitan neighborhoods (COSMO). Thus, the Parsi community is an appropriate community to study a founder population living in three distinct neighborhoods within a megacity.
4. At the time of data collection, an additional cohort was recognized, and the cohort classification was reset to four cohorts. Mancherji Joshi Dadar Parsee Colony (MJDPC), the fourth cohort, is a concentration of over 100 apartments exclusively for Parsis. It has a playground, gymkhana and Agyari (fire temple or place of worship of and for Parsis only). The lack of a boundary wall or a gate distinguishes this housing from BAUGs.

The four cohorts and participants from each cohort are listed in Table i below.

Table i. Summary of Neighborhood and Participants

Cohort	Name	Description	Code	Number of Participants
1	Parsi Baugs	Exclusive gated community housing with amenities	BAUG	505 (33%)
2	Parsi Apartments	Exclusive community housing without any amenities	PARAP	505 (33%)
3	Mancherji Joshi Dadar Parsee Colony	Exclusive community housing with amenities but not gated	MJDPC	214 (14%)
4	Cosmopolitan	Housing anywhere in the city with other ethnicities	COSMO	306 (20%)

The study design is exclusive in its methods because it does not rely solely on geographic limits to define neighborhoods, and it restricts the role of heritability. This methodology complements the need to study the role of local neighborhoods in health and disease in a megacity where genetic diversity would otherwise be the primary confounding factor.

Inclusion and Exclusion criteria

1. The participant must be of exclusive Parsi lineage (defined as both parents and all four grandparents being Parsi)
2. The participant must read and write English
3. The participant must have resided in the current residence for at least three years.

PROCEDURE, TOOLS, APPARATI, IRB APPROVALS

Questionnaire

Data were collected using a self-administered questionnaire uploaded onto a digital device (Samsung Galaxy 4). Qualtrics software (https://it.umn.edu/technology/qualtrics) was used to design the electronic version of the questionnaire.

Informed consent was the first question and the participants could progress to the survey only if they were in agreement (Appendix 1). Participants were given a choice to receive an e-copy, keep a print copy or hear the informed consent.

Self-reporting of behaviors is a common method used in research (Tong, 2016). This type of method focusses on choosing and defining the target group of the independent variable. Parsis were chosen as the target group of local neighborhoods in Mumbai. Most questions had the option of 'refuse to answer'. The questionnaire (Appendix 2) consisted of three sections.

Section One: Residence, Work, Socio-demographics

i. Past and current residences, work location and mode of travel, age, gender, marital status, household income, family size (Questions 2-14)

ii. Risk factors affecting blood pressure: physical activity, sedentary work or habits, salt intake, smoking, alcohol, stress, family history and self-history hypertension (Questions 15-40).

Section Two: Local Neighborhood Resources (Questions 41-71)

The questions on local neighborhoods assessed perceptions of walkable access to fundamental daily needs for urban living within a local neighborhood. Walkable was defined as a radius of one kilometer from their residence (van den Berg, 2015). The nine

walkability factors in the walkability framework suggested by Zuniga-Teran (2017) were modified to study walkability in Mumbai, which is different from cities where the walkability framework is applied. Neighborhood walkability was calculated as a score based on eight known factors affecting walkability: green and open space, third places and opportunities, streetscape and experience, land-use, connectivity, surveillance, pedestrian safety and public transport. The factors of street connectivity, density and parking were not included in this framework but were taken into consideration separately. The survey did not address any questions about parking because people's perceptions about parking are not well understood. Research has examined how poor parking adversely affects walkability (Speck, 2012; Zuniga-Teran, 2017). However, people's perceptions would be affected by their own need to park a vehicle rather than their need to walk. Parking of vehicles and how cars occupied neighborhoods were a better proxy of walkability and therefore photographs were used to assess and analyze parking.

The walkability framework and other walkability studies suggest higher density increases walkability. Mega cities are unique because density in megacities can be inversely related to walkability. The global livability index reports that all except two of the high-ranking cities of the world are mid-size cities (Network, 2018). Density was addressed based on the city and the community population.

Street connectivity examined by the grid of street network providing multiple, short and direct routes to facilitate walking was assessed through satellite images from Google Earth Pro.

The thirty-one questions regarding neighborhood perceptions were categorized in one of these eight factors within the Walkability Framework.

i. Green and open space: access to open space for activity, open space for sports, a community gymnasium, swimming pool, city parks

ii. Third places and opportunities: cultural activities in neighborhood; space for theater, art, cultural engagement; religious facility; library; schools; community organization for social or cultural purposes; knowing and socializing with neighbors, park for children

iii. Streetscape and experience: cleanliness, aesthetics, trees providing shade

iv. Land use: fresh food; fresh meat and fish; groceries; a corner store for basic items such as milk, eggs and bread; department store, health care clinic, a 24-hour pharmacy and a hospital with 24-hour emergency care

v. Connectivity: connectivity by walking was assessed by the perception of a good pedestrian path

vi. Surveillance: means eyes on the street and it was assessed as perceived safety from crime based on gender, age, and socio-economic status

vii. Pedestrian Safety: crosswalks at traffic lights for crossing streets (zebra-crossings) and a good pedestrian path for the elderly and the disabled.

viii. Public transport for access to the larger urban area

These perceptions help to connect with walkability, followed by participants' health or risk behaviors, and the health outcome of blood pressure.

At the end of this section, the questionnaire prompted the participant to return the digital device to the researcher. This was followed by measurement of blood pressure, height, and weight.

The mapping of Parsi residential areas in and around Mumbai City and their neighborhood was performed using Geographical Information System (GIS). The data points for participants' residences and the Agyaris were identified and digitized using Google Earth Pro software. The spatial and attribute data pertaining to these parameters of Parsi residents and their neighborhood were imported into Arc GIS 10.1 software. The data layers were given spatial reference and geo-referencing was done using WGS84 projection. Data were mapped to present spatial distribution of Parsi residents and the Agyaris.

Section Three: Height, Weight, Blood Pressure, Birth Weight

i. Two readings of Blood Pressure were taken at least ten minutes apart. One was taken after the participant had relaxed and gone through the informed consent process. The second reading was taken after the participant had completed the questionnaire. Blood pressure was measured using a manual mercury sphygmomanometer.

ii. Height was recorded in inches using a standard stadiometer. Height recorded in inches was later converted to meters and (meters^2).

iii. Weight was recorded on a digital scale. It was not possible to have a standardized scale at all sites of data collection in the city because it is very bulky and not portable.

iv. The participants' neighborhood was re-confirmed to assign them to the appropriate cohort.

Validity of Questionnaire

The socio-demographic questions did not require validation. Variables for neighborhood locations and resources sections were validated based on research studies (Bonaiuto, 2003; French, 2014; van den Berg, 2015) and repeated auditions among members of the Parsi community and researchers on the study.

VARIABLES

Independent Variable: Local Neighborhood (Categorical variable; four categories)

The common and controlled variable was exclusive housing for Parsis. Participants were asked in which neighborhood they lived, and this was confirmed by the de-identified residential address they provided. Table i summarized the independent variable.

Dependent Variable: Blood Pressure (Categorical variable; three categories)

Average of the two readings were used for analysis. Categorization was done on the basis of global criteria (Table ii) (WHO, 2013).

Table ii. Blood Pressure Measures and Categorizations

Systolic	Diastolic	Category
≤ 120 mmHg	≤80 mmHg	Within Normal Limits
= 121- 139 mmHg	= 81- 89 mmHg	Pre-Hypertensive
≥ 140 mmHg	≥90 mmHg	High Blood Pressure

Control Variables: Socio-Demographics and Known Risk Factors for High Blood Pressure

Information on socio-demographics and known risk factors for high blood pressure were collected. Socio-demographic information included age, gender, income, family size, marital status, and years spent in neighborhood. Factors known to affect blood pressure are body mass index (BMI), family history or self-history of hypertension, socio-

economic status, medication for hypertension, stress, physical activity, and salt intake. See Appendix 3 for a detailed list of all variables collected and derived for analysis.

Age: Month and year of birth were used to calculate age as a continuous variable. Data were distributed into quartiles (Table iii) at the time of analysis and four age-cohorts were created for analysis. Previous studies used five-year periods or deciles based on sample size of their respective studies.

Table iii Age Quartiles

Age Quartiles	
Age-cohort 1	19 - 28 years
Age-cohort 2	29 – 38 years
Age-cohort 3	39 – 44 years
Age-cohort 4	45 – 53 years

Gender: Gender was as a nominal variable. Four participants refused to answer or selected 'other' gender. Their data were not representative and also had the risk of being identified. Therefore, these four points were not included in the analysis.

Socio-economic status: Many participants chose not to provide income information. Only 37% (561) participants answered the question. Over 30% of the reported income data was questionable as participants provided random numbers, probably misinterpreted annual for monthly income figures and many had told me upfront that they were lying. Income data therefore could not be used for analysis.

Family history of, and medication for clinical hypertension: Responses were categorized as dichotomous (yes/no) variables.

Smoking: Smoking habits were assessed as frequency from the past and present. A smoking score was created: 0 = never smokers, 1 = non-daily smokers, 2 = past daily smokers and 3 = current daily smokers.

Alcohol intake: Those who consumed alcohol more than three times per week were considered to be more than social drinkers and at risk of high blood pressure. Responses were dichotomous. Those who consumed alcohol more than three times per week (yes) and those who did not consume alcohol more than three times per week (no).

Stress: Participants were asked whether they had experiences excessive stress in the last six months. Excessive was defined as 'more than usual' or stress for which they needed external help. Responses were categorized as dichotomous (yes/no) variables.

Physical Activity: Participants were asked the following questions to assess their activity behaviors:

i. Active for fitness: Responses were dichotomous (yes/no) variables, and participants were either active for fitness or not.

ii. Recommended activity levels for fitness: The WHO recommends 150 minutes of exercise per week for health benefits of physical activity. This variable was derived from time spent on fitness/day and days/week (WHO, 2018a). Activity per week was calculated based on the number of minutes spent on exercise per day and multiplied by the number of days the exercise regime was followed in a week. The new variable was categorized as a dichotomous variable: yes, sufficiently active / no, not sufficiently active.

iii. Sedentary work or habits: Responses were dichotomous: those who were sedentary or were required to sit for more than 6 hours a day (yes) or not (no). This was categorized as a dichotomous variable for analysis.

iv. Mode of transportation to work was used to identify whether people used active or were automobile dependent. Public transit users were categorized as active (Lachapelle U, 2009) and those who used cabs, auto-rickshaws, motorbikes, drove themselves or were driven in a car were categorized as automobile dependent. A dichotomous variable was created: Automobile Dependent or Active Transit.

v. Details of activities done for fitness were also collected. Participants enumerated whether they chose one or more activities for fitness and named those activities. The activities were classified as:

   a. Simple: activities which could be done without new training or any extra costs within an urban infrastructure.

   b. Special: needed either instruction, equipment, group participation, reserved space outside of home or special infrastructure.

Please see Appendix 4 for a detailed list of all activities.

Salt Intake: Studies measure sodium excretion to estimate sodium intake. It was not possible to measure sodium excretion because the focus of our study was to look at blood pressure based on different neighborhoods within a megacity. We did have to understand and control for the risk factors though. We best collected information on meals and estimated salt content in the meals.

Salt intake was estimated based on skipped, homemade and non-homemade meals. Homemade meals were assessed for use of ready to eat meals, packaged food and condiments, pickles, and fried fritters[5]. Consumption of packaged beverages and the habit of sprinkling extra salt were also taken into account. Each category, homemade, not-homemade and skipped meals, beverages, and extra salt were all assessed for their relationship with blood pressure. Thirteen people reported that all their meals were non-homemade. This sample was not representative or comparable. The last two categories of non-homemade frequency were added and thus it includes all those who reported eating more than four non-homemade meals per day. The sample was 44 people and adequate for comparison.

Neighborhood Perceptions: For analysis, all responses to neighborhood perceptions were scored and given an affirmative perception score. Responses were scored on a scale of 1-5 for each neighborhood. The scoring card is presented in Table iv.

Table iv Affirmative Response Score from Neighborhood Perceptions

Affirmative Responses to a Neighborhood Perception	Score
90%-100% affirmative responses	5
80%-89% affirmative responses	4
70%-79% affirmative responses	3
60%-69% affirmative responses	2
50%-59% affirmative responses	1
Less than 50% affirmative responses	0

Individual response rates and the respective affirmative perception score of each question of the thirty-one questions are shown in Appendix 5a. Appendix 5b is a summary of affirmative and negative responses by participants in each neighborhood. Appendix 5c

[5] Pickles and fried salty fritters are a part of traditional Parsi meals. Questions specified the food items in colloquial terms.

lists the categorization of the 31 questions into the Walkability Framework. The affirmative perception scores were summed to create a cumulative affirmative response score for each category in the Walkability Framework. The cumulative affirmative responses were scored on a scale of 1-10 and this was the walkability score.

Walk-score: A walk-score was calculated for each neighborhood using established methods (https://www.walkscore.com/cities-and-neighborhoods/), which is used globally for walkability research (https://www.walkscore.com/methodology.shtml, 2014; Weinberger, 2012). Published research indicates that walk-score is a good and reliable measure of neighborhood walkability in many countries. The website gives a warning that the results for this research are in an 'unsupported country' because it calculated scores based only on the following categories: groceries, shopping, errands, parks, schools, culture and entertainment and dining. These scores were used because they were relevant for our study. The walk-score website uses GIS mapping to get best information. This provided standardized scores on how all neighborhoods faired on these seven categories even if the website did not map all categories. The interpretations of walk-scores are shown in Table v.

Table v Walk-score Interpretation

Walk-score	Interpretation
90-100: Walkers Paradise	Daily errands do not require a car
70-89: Very Walkable	Most errands can be accomplished on foot
50-69: Somewhat Walkable	Some errands can be accomplished on foot
25-49: Car Dependent	Most errands require a car

Body Mass Index: Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. The BMI outcomes were categorized as shown in Table vi.

Table vi Body Mass Index Categories

Body Mass Index	Categorization
< 18.5	Underweight
18.5-24.99	Healthy
25-29.99	Overweight
> 30	Obese

Source: Centers for Disease Control

Approval was secured for an informed consent from the Institutional Review Board (IRB) at the University of Minnesota (approval number: CR00002207; see Appendix 6). IRB protocols were followed for deidentifying and securing data collection and storage on Qualtrics.

SAMPLE SIZE:

The sample size for the study was calculated as 1500 as it was large enough to determine odds ratios. This allowed for detection of any associations between local neighborhood environments (exposure) and blood pressure (outcome). Given the nature of the study, the sample size was not required to be representative of the Parsi population or of high blood pressure prevalence in that population. It was anticipated that each cohort would have 500 participants. The number of participants in each cohort had to be altered for two reasons:

a. an added cohort of 214 participants from MJDPC, and

b. fewer Parsis reside in COSMO, it was not possible to recruit 500 participants from COSMO.

This did not affect the study design or derivations of odds ratios for testing the hypothesis.

1530 Parsis in the age group 19-53 years from different neighborhoods in Mumbai participated in the study.

RECRUITMENT

1. Process

Plan A for recruiting was to select a random sample from the Bombay Parsi Punchayet (BPP) voter database because it is the largest database of Parsi adults in Mumbai. The BPP shared and provided permission to use their voter database. The database could not be used because it did not provide age of the voters; and the voter list was not up-to-date. The community has a large elderly population not eligible for this study. It would have been culturally inappropriate to call all registered voters and ask them their age; and many members had moved, changed residences within the city, moved out of the city, or had changed phone numbers.

Plan B was developed based on the best option to secure a random and un-biased sample. Volunteers, leaders, professionals, and several members from the community helped in executing data collection successfully. Data were collected in a span of nine months. Participants were recruited in residential areas, cultural events of the community, work places, hospitals, and with referrals from enrolled participants or people from the community known to the researcher.

Participants were recruited at Parsi neighborhoods, schools, hospitals, offices, clinics, socio-cultural events, sport meets, conference, school meetings, and a blood donation camp. All events were exclusive for or by the Parsi community and provided scope for data collection and a random sample. Hospitals and offices had mixed ethnic staff and there were no obstacles to conducting the study exclusively for Parsis.

Within a household, if there were several eligible respondents, all members of the household were included. Husband and wife have different genetic linearity and there is no conflict. Siblings can develop different behavioral patterns as they grow older. Heritability and behavioral influences on blood pressure are extensively researched and show much variation within and outside of families.

2. Tools

Materials used for recruiting (Appendix 7):

a. Flyers: Flyers were posted in neighborhoods prior to visits. They were distributed with the morning newspaper or weekly magazine to all residents.
b. Standee: This was made to display at a central place within a Baug when I was there/ at the entrance of an apartment/ at my table at an event.
c. WhatsApp messages
d. Phone calls
e. Email/ Letter to of request: This was used to get permission from authorities to be in a neighborhood or at an event.

A large part of the recruitment happened using WhatsApp messenger. WhatsApp is a freeware and all data are encrypted. WhatsApp was the most important tool that I found because:

a. most people in the age group of this study used WhatsApp Messenger
b. it allowed me to send reminders without intrusion. A phone call or a knock on the door would have meant direct intrusion
c. it gave me an opportunity to send people a brief about the study
d. people could read it at their convenience
e. repeated reminders could be sent
f. meeting for data collection could be scheduled easily over this portal based on convenience of the participant or the prospective participant was kept informed of where I would be stationed for data collection on a particular day

Statistical Software and Methods for Analysis: After completion of data collection, data were downloaded from Qualtrics. The file was transferred to Microsoft Xcel for calculation. Data were then transferred into a licensed IBM SPSS Statistics 25 software purchased through the University of Minnesota. All variables were checked, coded and categorized for analysis. A separate Microsoft Xcel reference sheet was created with codes.

Frequencies for socio-demographics and age quartiles were done in SPSS. Bivariate analysis, chi-square test, frequency, cross-tab and multinomial regression functions were

used for analysis. Several calculations, graphs and tables were done and created in Microsoft Xcel.

Multinomial Regression Analysis for Blood Pressure and Body Mass Index

The Multinomial logistic regression method was used to test the hypothesis (impact of neighborhoods on blood pressure) because:

a. the nominal dependent variable, blood pressure had more than two categories: within normal limits, pre-hypertension, and blood pressure
b. categories of the dependent variable were mutually exclusive
c. the independent variable was a nominal variable with four categories
d. there was no multicollinearity between the independent and control variables
e. the sample size of each cohort was large

For BMI: Activity behaviors and neighborhoods were studied for their impact on Body Mass Index. The Multinomial logistic regression method was used to study cumulative effect of behaviors and impact of neighborhood on BMI after controlling for activity behaviors because:

a. the nominal dependent variable, BMI had more than two categories: underweight, healthy, overweight and obese BMI
b. the control variables were nominal with mutually exclusive categories
c. the independent variable was a nominal variable with four categories
d. there was no multicollinearity between the independent and control variables
e. the sample size of each cohort was large

Mancherji Joshi Dadar Parsee Colony was used as the reference category and compared other neighborhoods to MJDPC. Each variable was introduced in a stepwise fashion to test the validity of the model, but no variable was excluded. The physical activity variables did not have a hierarchical structure. There is no evidence that recommended physical activity levels, sedentary lifestyle, or active transport have a hierarchical influence on BMI. However, research has indicated that each of these factors influences BMI and hence all factors were included. The neighborhood variable was introduced at the end and a final regression analysis is presented in Chapter Four.

For blood pressure: Data were controlled for gender, age, body mass index, family history of hypertension, use of anti-hypertensives, smoking score, alcohol intake, excessive stress, recommended physical activity (because it included all three representations: those who were inactive, those who achieved recommended levels of activity, and those who were did not achieve recommended levels of activity), and non-homemade meals. Multinomial regression was done in three phases because of the large number of control variables. Control factors were introduced one at a time and tested for fitness and validity.

After individually testing each factors' effect on blood pressure gender, age, body mass index, family history of hypertension, and use of anti-hypertensives were set as factors in Model 1. All factors in Model 1 were significantly associated with pre-hypertension and high blood pressure. For all control variables and for the independent variable, SPSS automatically selected the last group as the reference category. For blood pressure, the first category: within normal limits, was chosen as the reference category and pre-

hypertensive and high blood pressure results were compared with it respectively. Males were the reference category for gender, age cohort-4 was the reference category, obese BMI was the reference category,

The second set of factors were introduced individually after Model 1. Smoking score, alcohol intake, excessive stress, recommended activity level for physical fitness, and non-homemade meals were introduced in a stepwise manner. These were all set as factors in Model 2. Neighborhood was the final variable and it was introduced in Model 3 and this regression analysis is presented in Chapter 5.

The results are separated into three chapters focusing on activity behaviors, urbanization, and local neighborhoods

Chapter Three: Local Neighborhood Environments: Perceptions and Walkability

Chapter Four: Activity Behaviors and Impact on Body Mass Index

Chapter Five: Blood Pressure and Local Neighborhood Environments

Common to all the results are the socio-demographics and neighborhoods summarized in Table vii.

Table vii. Socio-demographics of the Study Population

Socio-Demographics and Risk Factors	**Females N (%)**	**Males N (%)**
	774 (50.6%)	756 (49.4%)
Neighborhood		
Baugs	253	252
Parsi Apartments	263	242
Mancherji Joshi Dadar Parsee Colony	103	111
Cosmopolitan	155	151
Age		
19 - 28 years	181	222
29 – 38 years	212	207
39 – 44 years	190	136
45 – 53 years	191	191

774 females and 756 males participated in the study. For all neighborhoods, the study had a gender-balanced and representative sample of the Parsi community in the age-group 19-53 years. Mean age was 36.5 years; the median 37.5 years.

CHAPTER THREE

LOCAL NEIGHBORHOOD ENVIRONMENTS: PERCEPTIONS AND WALKABILITY

This chapter examines local neighborhood environments for walkable access to fundamental urban resources. Participants' perceptions of their neighborhood, density of neighborhoods, parking and walk-scores were aligned to the walkability framework.

The Mancherji Joshi Dadar Parsee Colony (MJDPC) had the highest number of affirmative responses (80%) to perceptions of walkable access to resources. Residents of Baugs (BAUG) had 20% fewer affirmative responses at 72%. Cosmopolitan (COSMO) and Parsi apartment (PARAP) residents had relatively poorer perceptions of access to daily resources within their neighborhoods and had fewer affirmative responses at 61% and 59%, respectively (Appendix 5b*)*.

NEIGHBORHOOD PERCEPTIONS

Each walkability category was scored on a on a scale of 1-10 to prepare the Walkability Framework for the neighborhoods in this study (Table viii).

Table viii. Walkability Framework: Walkability Score Based on Neighborhood Perception

WALKABILITY FRAMEWORK				
Walkability Factor	**Walkability Score**			
	BAUG	**PARAP**	**COSMO**	**MJDPC**
Green and Open Space	6.4	1.6	2.4	8
Third Places and Opportunities	5.3	2.8	1.8	8.3
Streetscape and Experience	8	2	2.7	9.3
Land Use	7.3	8.5	8.8	9.3
Connectivity	4	2	2	8
Surveillance	10	10	10	8
Pedestrian Safety	2	0	0	5
Public Transport	8	8	8	10

Table ix: Walk-score for Neighborhoods in SESHLoNE (https://www.walkscore.com/methodology.shtml, 2014)

Neighborhood	Score 90-100	Score 70-80	Score 50-69	Score 49-25
BAUG (505)[a]	6[b] (248)	4 (257)	0	0
PARAP (505)	40 (424)	5 (80)	1 (1)	0
MJDPC (214)	1 (214)	0	0	0
COSMO (306)	48 (223)	22 (62)	8 (20)	1 (1)

[a]Number of participants; [b]Number of neighborhoods

NEIGHBORHOOD WALKABILITY

Neighborhood walkability was determined by a comprehensive analysis of the walkability scores (perceptions of participants), walk-scores (Table ix) calculated as described in Methods (Table v), density, parking, and a satellite view of the neighborhood.

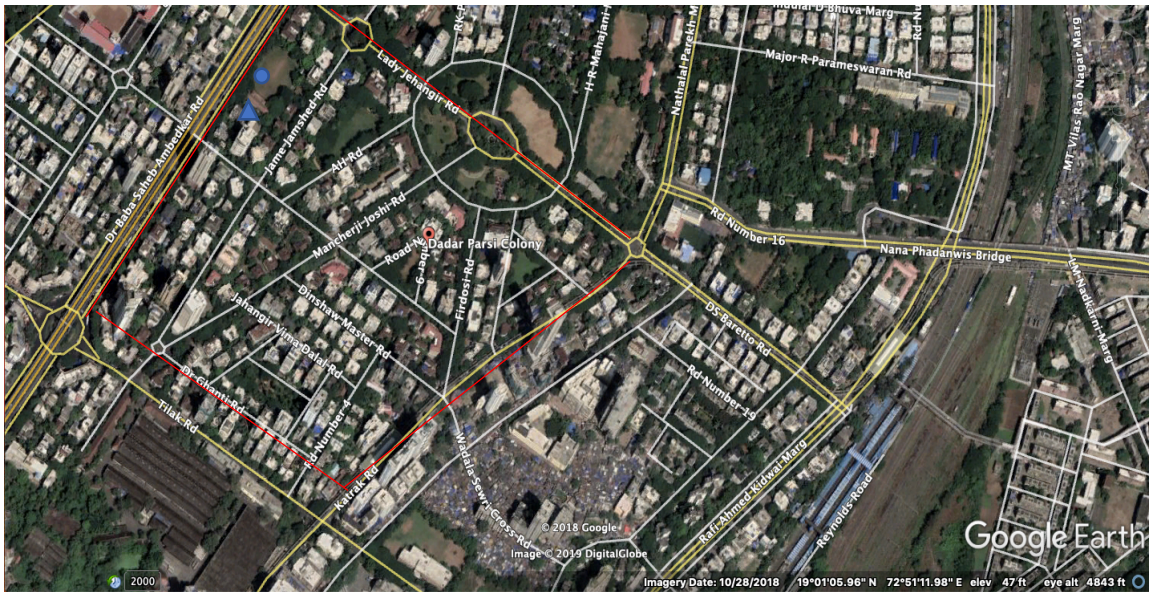
MANCHERJI JOSHI DADAR PARSEE COLONY (MJDPC)

Mancherji Joshi Dadar Parsee Colony is a non-gated community housing with amenities. Figure 2 is a satellite image of the MJDPC. In addition to the playground, several parks are seen in and along the periphery of the colony. The parks along the periphery of the colony are city parks maintained by the municipality of Mumbai. The residents had

access to community as well as city spaces. Participants' perceptions of green and open space were quite accurate, and the walkability score was 8 on a scale of 10. The high score for green and open space meant that the participants were aware of the spaces seen on the map and perceived they could use those spaces for an active lifestyle. The availability of public space translated well into literary, religious, and socio-cultural opportunities. The score (8.3) for third places and opportunities indicated a high sense of community. One of the reasons for high walkability scores was the cleanliness, aesthetics and shade trees along the footpath, all of which formulated to a streetscape and experience score of 9.3, meaning that walking was a pleasurable experience for participants in this neighborhood. The participants perceived easy access to food, supplies and health care (land-use and diversity score: 9.3) within the neighborhood. The walk-score, shown in Table viii, confirmed this and scored MJDPC in the most walkable category. This was because their neighborhood had a mix of commercial and residential dwellings. As seen in Figure 2, the grid network of internal streets provided excellent connectivity within the colony and to the arterial roads of the city. This street connectivity was complemented by the participants' perceptions of a good pedestrian path (score: 8). The residents also perceived walkable access to public transport to be able to connect to the larger urban area (score: 10). However, they did not perceive the streets and pedestrian paths to be safe enough to prevent them from injuries and the score was 5 on a scale of 10 for pedestrian safety. These mixed perceptions can be interpreted from Figures 3 and 4. Figure 3 shows people using the wide pedestrian path in the colony. Figure 4 shows an intersection inside the colony where despite a pedestrian path, people are walking on the street and not using the path.

From surveillance against crime related to gender, age, and socio-economic status (SES), participants perceived their neighborhood to be fairly safe (score: 8). However, this was the only walkability category in which they scored lower than any other neighborhood. All other neighborhoods scored a 10 in this category. There was no obvious reason for this difference. There are two possibilities. First, they were very aware of the question which asked whether the neighborhood was safe for people of any age, gender, and SES to be outside at any time. While Mumbai is among the safest cities in the world people are street-smart and aware of their surroundings taking due precautions for their safety (Phadke, 2011). The MJDPC participants were probably more aware of this sub-conscious effort they had to make for their safety. The second possibility is that because MJDPC is a non-gated community, they perceived this connectivity also made them more vulnerable to crime. It is difficult to say from our data, why there was this difference in perception compared to other gated and non-gated housing within the city.

Figure 2. Mancherji Joshi Dadar Parsee Colony



City arterial roads are shown in yellow; internal small streets are shown in white; the red line demarcates the MJDPC residential area, the blue triangle marks the gymkhana, the blue circle is the playground.

Figure 3. Pedestrian Path in MJDPC

The footpath is wide and there are shade trees, however some pedestrians towards the back are walking on the street and cars are randomly parked.

Figure 4. Intersection in MJDPC

The footpath is narrower in some parts of MJDPC and people are seen walking on the street rather than on the footpath.

PARSI BAUGS (BAUG)

Parsi Baugs are gated communities with amenities. Walkability in BAUGs was high but walkability scores for all factors, except surveillance, were lower than that for MJDPC. Figure 5 is a satellite image of the one of the Baugs in Mumbai. Participants perceived a walkability score of 6.4 for green and open spaces. The Baug in Figure 5 has three playgrounds but that was not true for all Baugs. Most Baugs had only one playground. BAUGs did have an advantage over all neighborhoods in access to open space in that the playgrounds were open for access at all hours. Some had a forested area and others had only two amenities, a playground and gymkhana. The relatively low score was most likely because several BAUG residents relied on the city for other open and green spaces. These may not have been accessible due to various reasons including restricted hours of

access, difficulty in getting to the parks or the absence of green space within a walkable distance. Each BAUG differed in characteristics based on location, size and funding for maintenance and this score represents an average score for all BAUGs. The lack of a swimming pool was reflected in the score for BAUGs as well.

The score for third places and opportunities was 5.3 on a 10-point scale. This was low because although there was a space for socializing, it was not utilized to its potential. This means that the residents were not able to translate the space into socio-cultural opportunities. The score indicated that existence of space does not translate to socio-cultural interaction. In response to the question: "Mine is a close-knit neighborhood where everyone knows each other and socializes", many participants in BAUGs pointed out that they did know each other but did not socialize. They remarked that the neighborhood puts them in proximity to their community, but it is not essentially a close-knit neighborhood. Even though these statements are anecdotal, they help to understand the results. For streetscape and experience, BAUGs had a high score though it was lower than MJDPC. Residents of BAUGs always pointed out that the space inside their BAUG was clean but that their neighborhood outside the BAUG was not clean. Given the lack of commercial dwellings within BAUGs, they must access spaces in their immediate neighborhood and that space cannot be ignored in understanding walkability. The relatively low land use and diversity score (7.3) reflected this lack of commercial dwellings when compared to other neighborhoods. All other neighborhoods had a score of more than 8. Gated communities tend to lack diversity of land use because it is rare to have commercial dwellings within the boundaries. This not only restricts the land use but

also the connectivity factor because they have fewer free and short routes which increase connectivity. Wall boundaries and the gates restrict free access for the residents. This restriction is also why they perceived public transport to be not as accessible as perceived by the residents of MJDPC. This is seen in Figure 5 where the space inside the Baug has a grid street network but eventually it has only two routes to the larger city through the two gates at each end.

Fewer participants perceived they had access to a good pedestrian path. This led to poor scores for connectivity. As is seen in Figure 6 some people tend to walk on the street. Figure 7 shows the barriers on and around the pedestrian path. The pedestrian paths also reflected participants' poor perception of safety (score: 2). This was lower than the score of 5 for MJDPC. The boundary wall and gate definitely led to slow and controlled traffic inside the Baug, but as discussed earlier the immediate neighborhood outside is also relevant and that space was not perceived as safe for pedestrians.

From surveillance against crime related to gender, age, and SES, participants perceived their neighborhood to be very safe (score:10).

While the BAUGs and MJDPC are both community housing with amenities, there are two probable reasons why they recorded different perceptions to walkability in their neighborhood; first, BAUGs are gated and MJDPC is not. In fact, the lack of a boundary and gate allows MJDPC to be very well connected to the adjacent neighborhood and the city through several arterial roads. This leads to more choices and more mobility for residents. The MJDPC seamlessly merges into the adjacent neighborhood and there is no hard and fast rule about what is inside or outside of the colony other than the apartment

buildings. Thus, a grocery store or restaurant outside the colony in walking distance is very much perceived as within the neighborhood. BAUGs on the other hand are restricted in their access first by their perception and then by the actual boundary. This is also the reason MJDPC seems much larger and spacious than BAUGs even though some BAUGs may have more area. Second, MJDPC was only one neighborhood while the ten Baugs studied were spread across the city. All BAUGs had the amenities, but each BAUG differs on the quality and maintenance of amenities, the green cover, SES in terms of funds available for infrastructure.

Figure 5. BAUG

City arterial roads are shown in yellow; small streets are marked in white; the red line demarcates the boundary wall; the Baug has a grid street network within the boundary; white squares locate the gates connecting the Baug to the city, the small white square is only for pedestrians; the blue triangle marks the gymkhana; the three blue circles mark the playgrounds within the Baug

Figure 6. Street and Pedestrian Path in a BAUG

Although there are footpaths, people are walking on the streets

Figure 7. Pedestrian Path in BAUG

There are barriers on the footpath, open windows, cars blocking the egress and the footpath is not smooth making it inconvenient for walking

PARSI APARTMENTS (PARAP)

Parsi apartments in this study were community housing without any amenities. Residents of PARAP had the poorest perceptions of access leading to poor walkability scores in their neighborhoods. They had the lowest number of total affirmative responses (59%) to perceptions of walkable access to resources. They perceived little or no access to green and open space (score: 1.6), streetscape and experience (score: 2), connectivity (score: 2)

and pedestrian safety (score: 0). Figure 8 shows a cluster of six Parsi apartments bound by a wall and a gate, located in southern Mumbai. There is a playground and park in the neighborhood but there are impregnable barriers for the residents to reach the park by foot. There is no grid street network of small streets leading to the park. The block sizes are longer making access more difficult. The gate of the apartments opens into an arterial road of the city. There is a large intersection of arterial roads just outside the apartment. The intersection and the arterial road, both increase the risk of road traffic injuries and decrease walkability. A huge skywalk is seen outside the apartments and one arm of the skywalk also leads to a train station nearby. These skywalks are seen at many locations in the city but access to these skywalks is poor and this leads to many pedestrians continuing to risk walking on the road. The skywalk also disrupts the streetscape and experience of walking. Poor construction of skywalks indicates poor urban planning affecting walkability and pedestrian safety. Figure 9 shows the small space inside the apartment complex which is occupied by cars leaving little space and safety for walking. Residents of PARAP did not perceive themselves as having socio-cultural opportunities although they also reside in community housing. This is because there is a lack of space to create and avail these opportunities. Third places require space to allow mobility, walking and interaction, which would build a sense of community because just belonging to the same ethnicity does not bring a sense of community. The Parsi apartments lacked what one participant described to me in local lingo: *Parsipanoo* (translates loosely to Parsi-ness). This indicated that the neighborhoods did have a sense of community and socio-cultural opportunities in the past, which were fading away. The built environment contributes to the socio-cultural opportunities. For example, residents of PARAP and

BAUGs perceived good access to religious spaces but scored lower than the MJDPC. Figure 10 is a map of Parsi Fire Temples (Agyaris) in Mumbai generated using GIS. All Parsi community housing is located within walking distance to the Fire Temples. Residents of PARAP and BAUGs perceived less walkable access because of the barriers to reach them.

PARAP residents scored high on land-use and diversity (score: 8.5) access to public transport (score: 8), and surveillance (score: 10). Most PARAP were located within the urban area, which has a mix of residential and commercial dwellings. The walk-score validated land-use and diversity. Table ix indicates that 84% of the PARAP residents lived in walkable neighborhoods that did not require a car for daily errands.

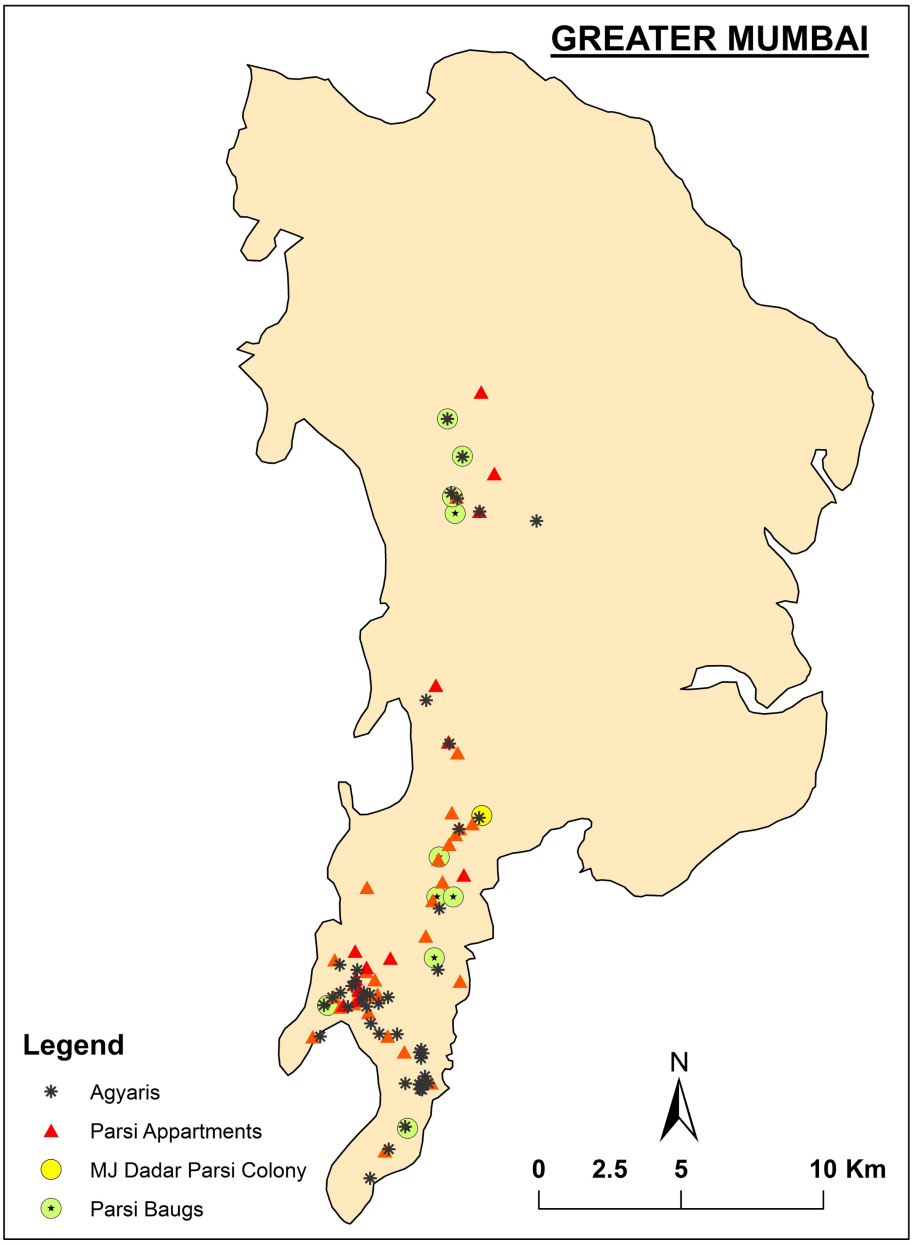
Figure 8. Parsi Apartment

City arterial roads are shown in yellow; small streets are marked in white; the blocks are bigger, the red line is the boundary wall of the apartments, the white square is the gate connecting to a main arterial road; the orange diamond is a small open space in the complex used for parking cars, the oval white structure to the left of the apartment is a skywalk over the main intersection of streets outside the apartment complex.

Figure 9. Pedestrian Path PARAP

The open space in the PARAP is occupied by automobiles restricting pedestrian space.

Figure 10. Parsi Fire Temples in Mumbai (Giara, 2002)



COSMOPOLITAN APARTMENTS (COSMO)

Perceptions of participants from COSMO were not very different from those in PARAP. They had only 2% more affirmative responses than PARAP (total 61% affirmative

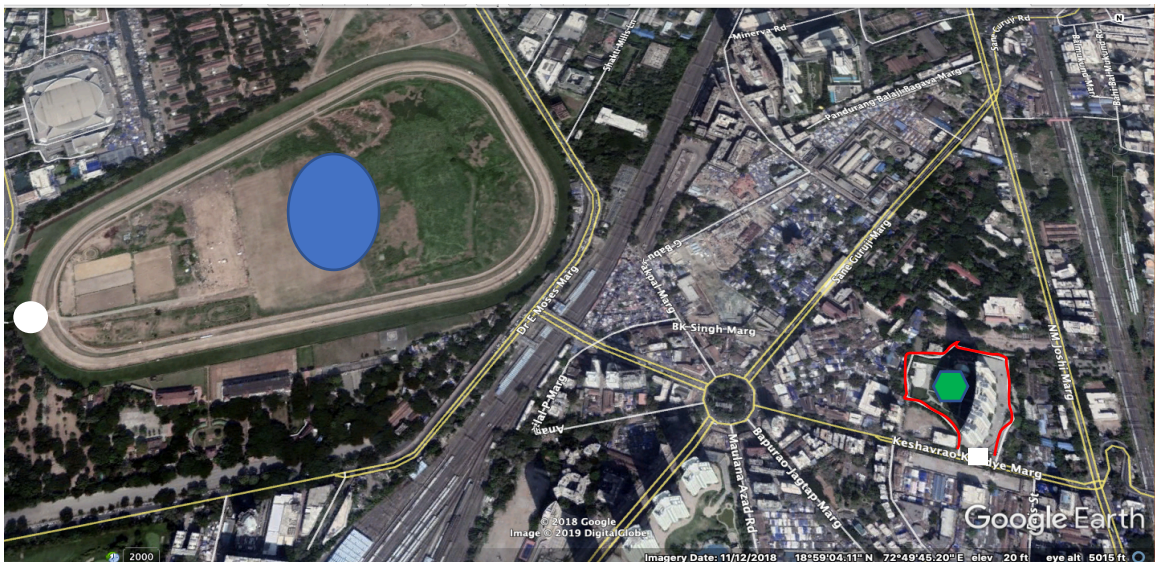
responses) to perceptions of walkable access to resources that led to poor walkability scores. Their perception scores of access to green and open space (score: 2.4), third places and opportunities (score: 1.8), streetscape and experience (score: 2.7), connectivity (score: 2) and pedestrian safety (score: 0) were similar to PARAP. Scores for perceptions of walkability related to land-use and diversity (score: 8.8), surveillance (score: 10) and access to public transport (score: 10) were high and similar to those of PARAP. COSMO residents had the poorest response for access to religious space and it is because they live away from community housing and the Parsi Fire Temples are located within or near Parsi settlements by design. Cosmopolitan residents perceived less access to religious and library space, and poorer experience of a close-knit and social neighborhood. The mean length of residence for cosmopolitan residents in their current neighborhood was 21 years and for those in community housing was 22 years. Thus, the common ethnicity in community housing did create a sense of belonging to the neighborhood. All community housing had a religious place within walking distance. Figure 11 shows a satellite image of a cosmopolitan apartment complex. A large open space with a walking track and parks is on the left of the image. For the residents to access this open space, they must cross a large roundabout of arterial roads with much traffic and diminishing safe pedestrian space as is indicated by the participants perception of connectivity. The small grid street network is absent. This indicates that pedestrians are compelled to walk along arterial roads. The open space has restricted hours (https://portal.mcgm.gov.in/irj/portal/anonymous/qldeptward) and the one access gate to the main park and playground area is located far away from the gate. The apartment does provide some walking space within, but this does not extend into the neighborhood to

allow access to resources and a varied streetscape and experience. A combination of these factors was common to all COSMO apartments and hence the residents perceived low walkability.

This apartment complex had a swimming pool for its residents but that implies an extra cost to access. Overall, fewer COSMO residents had access to a swimming pool.

Figure 12 shows parking and pedestrian space near the cosmopolitan apartment. While the cosmopolitan apartment had underground parking, cars and motorbikes of visitors and residents of other apartments in the neighborhood block the street and pedestrian path. The quality of the pedestrian path seen in Figure 12 indicates the actual and perceived lack of safety for pedestrians from injuries.

Figure 11. Cosmopolitan apartment



City arterial roads are shown in yellow; small streets are marked in white; the blocks are bigger, the small street network is absent, the red line is the boundary wall of the apartment complex, the white square is the gate which opens into main arterial road; the green hexagon is the swimming pool; there is some space around the complex and within the boundary to walk; the blue circle marks the playground and park area, the white circle shows the entrance to the playground

Figure 12. Pedestrian Path and Parking COSMO

The footpath is broken at places making it inconvenient for walking, bikes are parked on the footpath, cars parking is narrowing the street

COMMON FACTORS AMONG NEIGHBORHOODS

All participants felt they could access a health care clinic or a 24-hour pharmacy within their neighborhoods. For urgent care and emergencies, all except the MJDPC reported that there was a hospital in the vicinity. Interestingly, access to emergency care was the worse for MJDPC and best for PARAP. This is a stark reminder of the difference in primary access to resources for better quality of life and health, and primary, secondary or tertiary health care. While both are significant components of the public health spectrum, the clinic, pharmacy and hospital mean access to health care, which is secondary public health and the resources provide a healthy lifestyle which can prevent disease and preserve health, which is primary public health.

None of the neighborhoods had access to a public swimming pool. The Mumbai Metropolitan Region has five public swimming pools that are not sufficient for the entire population of Mumbai (portal.mcgm.gov.in).

Residents of BAUG and MJDPC perceived their neighborhoods to be cleaner, aesthetically pleasing, and greener as compared to the residents of Parsi apartments and cosmopolitan housing.

On the whole, perceptions of access to socio-cultural opportunities were low. All participants perceived less access to art, cultural and theater events. This is of concern because we are increasingly moving towards an individualized society where everyone has their own TV on a digital device. This reduces mobility and interaction within the neighborhood and can lead to people being more sedentary, or automobile dependent if they access these events far away from home. It may also end up being that people do not access these events as much as they would like. The measured impact of socio-

cultural opportunities was out of scope of this study, but the results do help us understand the health outcomes from the perspective of decreasing mobility and poor choices for a healthy lifestyle.

PARKING AND DENSITY

Parking was an impediment to walking in most neighborhoods and only relatively low in MJDPC. Putting cars in their place and getting the parking right (Speck, 2012) is most essential for improving walkability in any neighborhood and city. Figures 4, 6, 7, 9, and 12 indicate that parking across the city has led to narrowing of the street. In and around PARAP as well as COSMO, there was a greater tendency to see cars and motorbikes parked out of place on streets and even on pedestrian paths. This is seen in Figures 9 and 12. Cars and motor bikes are parked in central space, pedestrian space and out of space on streets. Parking out of place was observed in some Baugs and MJDPC as well. This indicated poor walkability in all neighborhoods but more so in COSMO and PARAP. There were no cycling tracks in any neighborhoods and those who cycle were at a high risk for injuries. This was a direct impact of parking on the streets because automobiles occupied much of the street leaving no space for bicycles.

The density of the urban area is more than the density inside community housing. The low and increasingly old population of the community led to fewer people on the streets in their community housing than in non-community housing. The relatively low density makes their community housing more livable and walkable than the larger urban area of Mumbai. The Parsi apartments link directly to the larger urban area and lack community or public space. They do not have the density advantage that exists for MJDPC and BAUG.

WALK-SCORES AND WALKABILITY

The walk-scores, shown in Table ix indicated that over 98% of the participants lived in neighborhoods that had walkable access to groceries, shopping, errands, parks, schools, culture and entertainment and dining. The perceptions of the participants matched the walk-scores for groceries, shopping, and errands. The larger urban area was definitely well equipped for fresh food and other supplies for daily needs as most participants in all neighborhoods reported high perceptions of access. The walk-scores did not match the participants perceptions for parks, schools, culture and entertainment (MJDPC was an exception to the school and they reported there was a school within the colony). This means that the mapping indicates the presence of these resources, but the participants do not perceive access either because of barriers to reach them by walking or because the spaces do not cater to the needs of the participants. All neighborhoods, including MJDPC, had poor responses to the perception of access to theater, art and cultural engagement (see appendix 7). The reasons for this could be that the entertainment places such as theaters in the neighborhoods may not show the kind of entertainment enjoyed by the Parsi Community. Many cultural and movie theaters are generally not within walking distance of residential areas in Mumbai. Parents may prefer to send their children to a school which is not in their neighborhood leading to less walking. Parks and theaters may either be accessed by automobiles or not accessed at all. This affected walkability scores of all neighborhoods including MJDPC.

From all the perceptions of neighborhood, it was evident that local neighborhoods were challenged for space unless provided by community housing. Road traffic and pedestrian

safety was of greatest concern for all neighborhoods. The Walkability Framework was telling of the people's perceptions and cumulative walkability dropped from MJDPC to BAUG, and PAPAP and COSMO had very poor walkability. Thus, PARAP and COSMO were dependent on the city municipality or self-reliant for access to fundamental daily needs within the neighborhood. Community housing cannot provide for all needs. Community housing can also have limitations in how much it can provide, and it can be restrictive if it is gated as in the case of BAUGs. The access to private spaces like gymnasiums and swimming pools means an extra expenditure to access space and also affordability to be able to access this space.

In a mega city walkability means making the walk useful, safe, comfortable and interesting (Speck, 2012). Maintaining local neighborhoods distinct from the urban and simultaneously providing good connectivity is essential. The small-street grid network and how it connects with the essential spaces within the neighborhood and also with the big arterial roads of the city determines walkability. This factor will connect the people to the mixed-land-use in their neighborhood. Good and safe footpaths, crosswalks, and intersections will protect the pedestrian and encourage people of all ages to walk for utilitarian purposes. Planning the neighborhood for aesthetics, maintaining cleanliness, shade trees and green space will improve the experience of walking and make it comfortable. Putting the cars away and getting the parking right will encourage walking and also allow for better visibility and use of footpaths.

The perceptions on pedestrian space encompassed all three aspects of access to space, access to supportive infrastructure and safe access to all resources in neighborhood, and overall were low. A pedestrian path is directly related to activity and can be a supportive

infrastructure to get to places for various purposes and also is important in terms of safety because broken paths can mean injuries and lack of a good pedestrian space can lead to people walking on the streets and being exposed to road traffic injuries. Lack of pedestrian space also leads to not walking and choosing an automobile for getting to places. If a pedestrian path were to be used for simple exercise activities like walking or running, then its absence means having to choose a special activity for exercise or not being physically active. Road traffic and pedestrian injuries are very high in India (Babu, 2019) and the participants perceptions were better aligned with this.

CHAPTER FOUR

ACTIVITY BEHAVIORS AND IMPACT ON BODY MASS INDEX

This chapter presents the results of activity behaviors in the Parsi population and the impact of these behaviors on body mass index (BMI).

ACTIVE AND INACTIVE BEHAVIORS

Active behaviors included activity for fitness and active transit to work. Inactive behaviors included no activity for fitness, sedentary habits or work, and automobile dependence for travel to work. The results for physical activity, recommended physical activity levels and sedentary habits or work by gender are shown in Table x.

Table x. Physical Activity, Recommended Physical Activity, Sedentary Lifestyle for Males and Females

Behavior	**Yes (%)**		**No**		**Total**
Physically Active for Fitness	**856 (55.9)**		**659**	**43.1%**	**N= 1515[a]**
Females	390	51%	376	49%	766
Males	466	62%	283	38%	749
Recommended Activity	**(>150 mins/week) 610 (71.3%)**		**(< 150 mins/ week) 246 (28.7%)**		**N = 856**
Females	264	68%	126	32%	390
Males	346	74%	120	26%	466
Sedentary Habits/Work	**771 (50.4%)**		**759 (49.6%)**		**N= 1530**
Females	393	51%	381	49%	774
Males	378	50%	378	50%	756

[a]15 participants refused to answer about their physical activity behaviors

PHYSICAL ACTIVITY, INACTIVITY AND SEDENTARY LIFESTYLE

The Parsi population was relatively active, 55.9% of the participants said they spent some time on fitness and less than half, 43.1%, reported no time spent on fitness activities. Leisure activity or activity for fitness is low in India and studies indicate less than 8% of the population is active. Globally, physical activity is low in middle-income countries (Anjana, 2014; Atkinson, 2016; Hallal, 2012). Of those who were active for fitness, 71.3% (610) participants spent more than 150 minutes on fitness activity every week and 28.7% were unable to achieve recommended levels of physical activity. Again, this was better compared to any numbers for urban populations in India (Anjana, 2014; Misra, 2019) but global comparisons are debatable. Similar results, better physical activity in the population, have been found in high income countries and attributed to more knowledge of public health, obesity and physical activity (Stamatakis, 2007). These were positive findings of the study. Sedentary habits or sedentary occupations were reported by about half (50.4%) the study population. This is a high risk because the changing economy of India is also leading to the sedentary nature of jobs, which has been related to obesity in the population (Dang, 2019).

ACTIVITY BY GENDER

Males were more physically active for fitness than females. More males were able to follow activity recommendations than females (Table x). Both genders had a high and almost equal prevalence of sedentary habits and work, 50% males and 51% females were sedentary.

ACTIVITY BY AGE

Table xi. Age-Cohorts and Physical Activity Status

Physically Active	Age- Cohort (age group)[a]				Total
	1 (19-28)	2 (29-38)	3 (39-44)	4 (45-53)	
No	35.5%	46.5%	45.8%	46.7%	43.5%
Yes	64.5%	53.5%	54.2%	53.3%	56.5%

[a] Values presented in the table above are percentages

Physical activity is known to decrease with age (WHO, 2018a), and this population reflected that. The youngest age cohort were most active for fitness (64.5%) but among those who were 28 years or older, participation in activity for fitness was about 54%. Physical activity behaviors by gender and age are in line with global and in-country comparisons. Globally, younger age groups are more active although overall physical activity levels in young people are dropping. Females have fewer opportunities for physical activity because of socio-cultural factors. Young females are less active than males and physical activity levels drop further after women have parenting and other household responsibilities which require them to be inside and often sedentary.

ACTIVITY BY TYPE

Of the 856 participants who were physically active for fitness, 337 followed a single activity regime, 302 chose from one of two activities and 217 chose one of three activities. Participants listed a maximum of three activities (primary, secondary, and tertiary activity) and this resulted in 1592 frequencies from a range of 73 activities (Appendix 4). Of the 73 activities, 13 were simple and 60 were special activities. Given the complete lack of bicycle lanes, cycling was categorized as a special activity and only 2.8% active individuals chose cycling as an activity. The frequency of simple activities

was lower. Females were more likely to participate in simple rather than special activities.

Of all activities, walking was the most frequent activity among primary, secondary or tertiary choices for 378 participants. Of the most frequent choices for fitness, three were simple activities and the other 12 activities were special. Walking was chosen by 378 of 856 participants. Although walking was the most frequently listed activity, only 24% indicated that it was their choice of activity for fitness.

The data reveal a shift from simple toward special physical activities. This is a stress on public health because the percent of people involved in any single activity other than walking is less than 15%. This low level of walking is not optimal because it implies more individual motivation and access rather than a population motivation and access. The spread and choice of more special activities implies extra costs and socio-cultural factors as determinants of who can be physically active. Special activities often are not all-inclusive. For example, badminton and tennis are different sports, which need mutually exclusive infrastructure. Those who play one may or may not play the other and playing both is definitely not without extra cost. This adds a layer of complexity for physical activity access. It is difficult to provide infrastructure for all sports and limited infrastructure leaves people out. As alternatives, the people left out will remain inactive, choose a simple activity, or travel somewhere else to participate in the sport they like. If walking is being done for fitness purposes, less walking translates to either no activity and more sedentary habits or more specialized activities, which are costly. As we saw earlier, fewer people are participating in simple activities. So, people are either inactive

or have to make extra effort to be active. This is challenging for sustaining an active lifestyle.

The Parsi population is aware of the need for physical activity for fitness but are more dependent on special activities. Special activities are not sustainable in the long run because people could drop out for various reasons from lack of time to participate and not enough return on investment or if the expenses are a burden at any time. Consistency of special activities is much harder than that of simple activities. More people would take up physical activity if better infrastructure was provided for simple activities. Sherwood et al. (2000) state that exercise can happen in phases and there can be periods of no exercise for various reasons. Dependence on special activities leads to more periods of no exercise.

AUTOMOBILE DEPENDENCE AND ACTIVE TRANSPORT

The results indicated very high automobile dependence (78%). More than half the participants (n=1186, 77.5%) traveled within Mumbai for work. All participants were in the working age group and 335 did not travel locally and worked at home. More males (n=522, 87.6%) traveled for work than females (n=401,70.6%). Males (81.5%) were more dependent on automobiles for traveling to work than females (73.5%) (Table xii).

Table xii. Automobile Dependence and Gender

Automobile Dependent	Yes	No	Total
	923 (77.8%)	263 (22.2%)	1186
Females	401(73.5%)	144 (26.5%)	545
Males	522 (81.5%)	119 (18.5%)	641

Public transport was the most frequently used option for travelling to work (19%); followed by self-driving a car, chauffeur-driven to work, hailing a cab or autorickshaw, riding a motorbike, and walking. Those who solely used public transport also walk because public transport is never door-door (Lachapelle U, 2009). Those who used public transport (19%) or walked (3%) were categorized as using active transport. Others were categorized as automobile dependent (78%).

The Mumbai Metropolitan Region has a projected population of over 22 million inhabitants [Mumbai Population. (2018-11-21). Retrieved 2019-02-15, from http://worldpopulationreview.com/world-cities/mumbai/][6] The public transport system includes a metro, bus, and rail networks. The Western Railway in Mumbai (60 km., 28 stations) ferries over 3.5 million passengers daily http://www.wr.indianrailways.gov.in/view_section.jsp?lang=0&id=0,1 and the Central Railway (>100 km., 76 stations) ferries over 3.8 million passengers daily http://www.cr.indianrailways.gov.in/view_section.jsp?lang=0&id=0,6,1191,1192,1394,1395,1414,1415). The Mumbai Metro and bus services also support the public transport system. There are no official numbers, but through media projections it was estimated that they ferry another 600,000 people daily.

Approximately 14.5 million people living in Mumbai are of working age and of these over 50% use public transport. Only 19% people in the study population used public transport. This shift, from the use of public transit and sustainable modes of commuting such as walking and cycling, to the use of private vehicles, defines the middle-income

[6] The last national census was done in 2011 and is outdated for use in 2019. Hence, we use this website which calculates population based on projected growth.

country (MIC) urban conundrum. While Mumbai is a fast-growing metropolitan region in a MIC, the Parsi population shows more similarities in transit behaviors seen across many high-income countries such as the United States (Hickman, 2019). Even if most people don't use a private car, they do use a vehicle privatized for their use in a transit trip. This vehicle could be their own car, motorbike, a cab or an autorickshaw.

ACTIVITY AND WALKABILITY BY NEIGHBORHOODS

Table xiii. Activity Behaviors and Neighborhoods

	Activity Behaviors[a]					
Neighborhood	**Inactive**	**Physically Active**			**Activity Type (Sum of primary, secondary and tertiary activities)**	
		< 150 mins/week	**> 150 mins/week**	**Total Active**	**Simple**	**Special**
BAUG	41	26	74	59	34	66
PARAP	48	29	71	52	42	58
COSMO	43	31	69	57	39	61
MJDPC	40	31.5	68.5	60	34	66

[a]Values presented in the table above are percent

Participants from Parsi Apartments (PARAP) were the least active for fitness at 48%. Participants from the Mancherji Joshi Dadar Parsee Colony (MJDPC) were the most active at 60%. BAUGs and COSMO participants followed MJDPC at 59% and 57%, respectively. Relatively fewer participants from PARAP and COSMO chose special activities. Walking for fitness was relatively more frequent among PARAP and COSMO residents than in BAUGs and MJDPC. PARAP participants were least dependent on automobiles while all others were about 80% automobile dependent.

BODY MASS INDEX

Results for Body Mass Index are presented in Figure 13. The mean BMI in the study population was 26.7, which was in the overweight category. A BMI greater than 24.99 was recorded for 57.5% of the participants who were designated as overweight or obese. The prevalence of high BMI in this population was more than the urban BMI for the state of Maharashtra. Tables xiv and xv show the BMI results by age, gender and neighborhoods.

Figure 13. Body Mass Index: Results by Categories

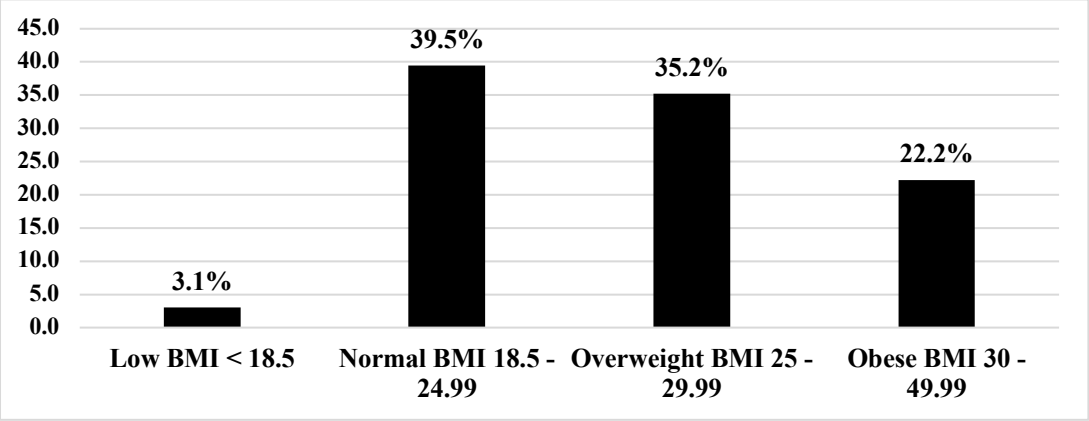


Table xiv. Body Mass Index and Age Cohorts

Body Mass Index	Age Cohorts				
	19-28 y	29-38 y	39-44 y	45-53 y	Total
Low	44.7	29.8	8.5	17.0	3.1
Healthy	37.7	28.3	17.4	16.6	39.5
Overweight	21.2	25.2	22.4	31.2	35.2
Obese	11.8	28.8	28.2	31.2	22.2

[a]Values presented in the table above are percent

Table xv. Body Mass Index, Gender, Neighborhood

Body Mass Index	Females	Males	BAUG	MJDPC	PARAP	COSMO
Low BMI	3.36	2.78	3	1.9	3.6	3.3
Healthy BMI	43.67	35.19	39.2	44.4	39	36.9
Overweight BMI	32.17	38.36	36.2	33.6	31.9	39.2
Obese BMI	20.80	23.68	21	19.6	25.5	20.6

[a]Values presented in the table above are percent

Table xviii. Results of Multinomial Regression for Body Mass Index and Neighborhoods

Variables	β	p	Odds Ratio (OR)	95% CI for Coefficient	
				Lower	Upper
Healthy BMI 18.5 - 24.99					
Intercept	0.867	0.016			
Females	0.615	0.000	1.850	1.331	2.570
Males	0[b]				
Age Cohort 1	1.521	0.000	4.576	2.803	7.471
Age Cohort 2	0.547	0.015	1.728	1.111	2.689
Age Cohort 3	-0.060	0.805	0.942	0.587	1.512
Age Cohort 4	0[b]				
Physically Inactive	-0.893	0.000	0.409	0.283	0.592
<150 minutes of exercise/week	-0.220	0.392	0.802	0.485	1.328
>150 minutes of exercise/week	0[b]				
Automobile Dependent	-0.531	0.010	0.588	0.392	0.880
Active Transport	0[b]				
Not Sedentary	0.195	0.247	1.215	0.874	1.690
Sedentary	0[b]				
BAUG	-0.147	0.588	0.863	0.507	1.470
PARAP	-0.594	0.025	0.552	0.329	0.927
COSMO	-0.140	0.638	0.869	0.484	1.560
MJDPC	0[b]				
Overweight BMI 25 - 29.99					
Intercept	0.662	0.073			
Females	0.156	0.352	1.169	0.842	1.623
Males	0[b]				
Age Cohort 1	0.383	0.126	1.466	0.898	2.395
Age Cohort 2	-0.195	0.368	0.823	0.539	1.257
Age Cohort 3	-0.366	0.101	0.693	0.448	1.074
Age Cohort 4	0[b]				
Physically Inactive	-0.731	0.000	0.481	0.333	0.695
<150 minutes of exercise/week	-0.151	0.556	0.860	0.519	1.423
>150 minutes of exercise/week	0[b]				
Not Sedentary	0.123	0.581	1.130	0.732	1.747
Sedentary	0[b]				
Automobile Dependent	0.060	0.721	1.062	0.764	1.477
Active Transport	0[b]				
BAUG	0.215	0.440	1.240	0.718	2.141
PARAP	-0.251	0.356	0.778	0.457	1.326
COSMO	0.352	0.240	1.422	0.790	2.561
MJDPC	0[b]				

[a]The reference category is: Obese BMI 30 - 49.99.
[b]This parameter is set to zero because it is redundant.

The Low BMI category did not have a representative sample (n=47) and results were not included in the multinomial regression. After controlling for gender, age, recommended physical activity, active transport and sedentary lifestyle, it was found that those living in PARAP were significantly less likely (*p= 0.025*) to have a healthy BMI compared to those in MJDPC. Residents in PARAP were less likely to record healthy BMIs (OR= 0.552) and more likely be in the obese category than residents in MJDPC. Gender made a significant (*p=0.*000) difference and females were more likely (OR=1.85) to have healthy BMI than males. Age cohorts 1 (OR = 4.57) and 2 (OR = 1.72) (19- 38 years) were both significantly (*p= 0.000 and 0.015,* respectively*)* more likely to have healthy BMIs than those in age cohort 4 (45 – 53 years). Those who depended on automobiles were significantly (*p= 0.010*) less likely to have a healthy BMI than those who were active during transit. Automobile dependent participants were (1.7 times; OR= 0.588) less likely to have healthy BMIs than active transport users. Physically inactive participants were significantly (*p= 0.000*) less likely to have a healthy BMI. They had lower odds of being healthy than obese (OR: 0.409). The only significant difference in those overweight and obese was that those who were physically inactive for fitness (*p= 0.*000) were more likely to be obese than overweight (OR= 0.481).

The National Family Health Survey of India, projected high BMI for urban females in Maharashtra at 32.4% and for males at 31.2% (ICF, 2018). This population differed from state projections. In comparison with the state urban health data, fewer females (3.4%) and males (2.8%) were underweight, fewer females (43.7%) and males (35.2%) had healthy BMI than the urban population of Maharashtra. More females (53%) and males (62%) and had high body weight for their height than the urban population of

Maharashtra. Females had lower mean BMI (26.4) than males (27), which was contrary to national and global trends.

Globally, females have higher BMI than males (Misra, 2019; WHO, 2012, 2014). The proximal determinants i.e. access to physically active lifestyle, and upstream determinants such as socio-cultural milieu, both affect this health outcome (WHO, 2018a). Socio-cultural factors detrimental to females and consequently to their health are common in India, including Mumbai (ICF, 2018; IIPS, 2016; Misra, 2019). The Parsi diaspora in Mumbai are well educated, have socio-economic and community living advantages (Kulke, 1974)but this was not reflected in health behaviors of females. Males were more active for fitness than females. Males chose from a larger variety of activities and they chose more special over simple activities. Males were as sedentary as females, fewer females traveled for work (Table xii), more females than men chose public transportation (Table xii) for traveling to work, and fewer females (43.4%) were automobile dependent than males (56.6%). There are no data to suggest that Parsi females enjoy socio-cultural equity or advantage. Thus, among known factors within the data available, males were clearly at an advantage in terms of access to and choices in physical activity. Automobile dependence was directly related to BMI and this could have made a contribution to higher BMIs in males, but it did not explain the significant difference between the two genders. It remains to be studied what is helping females equalize and further better BMI levels, or if they are at an advantage at all because overall BMI is high. This begs the question as to whether males are suffering worse BMIs than females.

The overall higher BMI in the Parsi population could be attributed in part to better socio-economic status and a higher Human Development Index (HDI). Community housing and provision for all by community philanthropists has improved the socio-economic status of the Parsi community (Kulke, 1974). There is no extreme poverty or homelessness, which automatically controls the sample for income and shifts it to the right of the human development curve. As reported by Aizawa (2019) when exploring bio-economics in India, a higher standard of living is related to increased BMI at the right end of the curve.

Body Mass Indices increased with age. Age cohorts 1 and 2 were more likely to have a healthy BMI than those in age cohort 4 (45–53 years). The increasingly lower age at which inactivity and subsequent high BMI occur are worrisome. Ageing induces inflammatory changes leading to poor health outcomes. Inflammatory changes from exposure to environmental factors at a young age can lead to early ageing often referred to as secondary ageing (Vina, 2016; Zhongje, 2014). Vina et al. (2016) compared active and sedentary individuals aged 20-25 years and 60-65 years. Active older individuals had healthy phenotypes and sedentary young individuals had unhealthy phenotypes with respect to body fat and oxygen consumption. Thus, sedentary lifestyles can lead to early ageing and higher BMIs are signs of these pathological changes.

There is reason to worry about the 43.1% of people who did not spend any time on fitness. After adjusting for gender, age, active transport, sedentary lifestyle and neighborhoods, those physically inactive for fitness were most likely to be obese. The results support the argument that the greatest benefits of incorporating physical activity into lifestyles would be seen in adults who are sedentary (Sherwood, 2000). Fitness is

not the only way to be physically active, but our results are supported by literature studies (Anjana, 2014) suggesting that with increasingly sedentary lifestyles, activity for fitness becomes critically important as activity from occupation is lost (Atkinson, 2016; Dang, 2019). Those who did not exercise were at high risk of obesity. A dual risk is induced with people settling into sedentary occupations at young ages and losing out on physical activity for fitness leading to early ageing. Sedentary lifestyle was not significantly related to BMI, because it may have been underreported and is probably a significant contributor to high BMI. Thus, even though activity for fitness was greater than 50%, overall energy expenditure decreased with the effect of urban lifestyle and reflected as high BMI for most adults all of whom are of working age.

To address morbidity and mortality affecting younger populations and improve years lived without disability, we must take note of younger populations showing signs of early ageing and these data add to existing evidence. Those who do not exercise, likely rely on non-fitness measures for physical activity, which is probably paltry given the burden of globalization and urbanization (Dang, 2019; Monda, 2007). This is most applicable to the urban Parsi as we look at the burden of sedentary life compared to walking, which is the most common way of gaining activity outside of fitness but is decreased in this group.

Data on income were insufficient but socio-economic impact was evident through proxy effects. Automobile dependence also means socio-economic power to choose a more expensive means of transport. Socio-culturally, the automobile can be much more than just a means to travel, and for some this could also mean choosing a more comfortable means of transport. Socio-economic status also explains other behaviors. People with

higher incomes can overcome the burden of poor infrastructure by accessing opportunities for physical activity beyond local neighborhood resources and are increasingly sensitized to the importance of physical activity. They may also have more time to participate in leisure activities (Atkinson, 2016). This is evident by the increased access of 'special' activities in this population and higher levels of physical activity for fitness. The number and types of activities reflect affordability and expensive infrastructures.

The socio-demographics, sedentary lifestyle, automobile dependence, less reliance on public transit, less walking or other simple activities, and high BMI together point towards effects of urbanization and urban sprawl as is seen in many megacities (Frumkin, 2019). Given the high burden of urbanization, local neighborhoods remain an unequalled avenue to provide resources for healthy lifestyles. Local neighborhoods, with their all-purpose nature can be hubs for physical activity. For those who meet WHO recommendations for exercise, neighborhood environments become very critical to sustain active behaviors. For those who do not meet recommended fitness levels or are inactive, neighborhoods can provide opportunities to be active by way of social or utilitarian purposes.

Neighborhood data indicated BMIs were worse in the COSMO cohort (36.9%) and Mancherji Joshi Dadar Parsee Colony (MJDPC) had the most participants with healthy BMI (44.4%). Results of the multinomial regression authenticated the assumption regarding neighborhoods.

Cosmopolitan residents may be suffering a double burden of urbanization and a diminishing socio-cultural milieu because of high automobile dependence and special activities which controlled for the high BMI. Evidently, socio-economic status of the cosmopolitan residents compensated for the high BMI by allowing them to access special activities. BAUGs and MJDPC offered infrastructure for special activities at lower cost but suffered low levels of walking and high BMIs. The communal atmosphere further provided greater opportunity for participation in BAUGs and MJDPC.

Thus, putting together perceptions of neighborhood, walking in and walk-scores of neighborhoods, it is evident that the behavior choices (inactivity, simple and special activities) and health outcomes (BMI) tell a different story and the larger urban area provides compelling rationales for the behaviors and high BMI.

CHAPTER FIVE

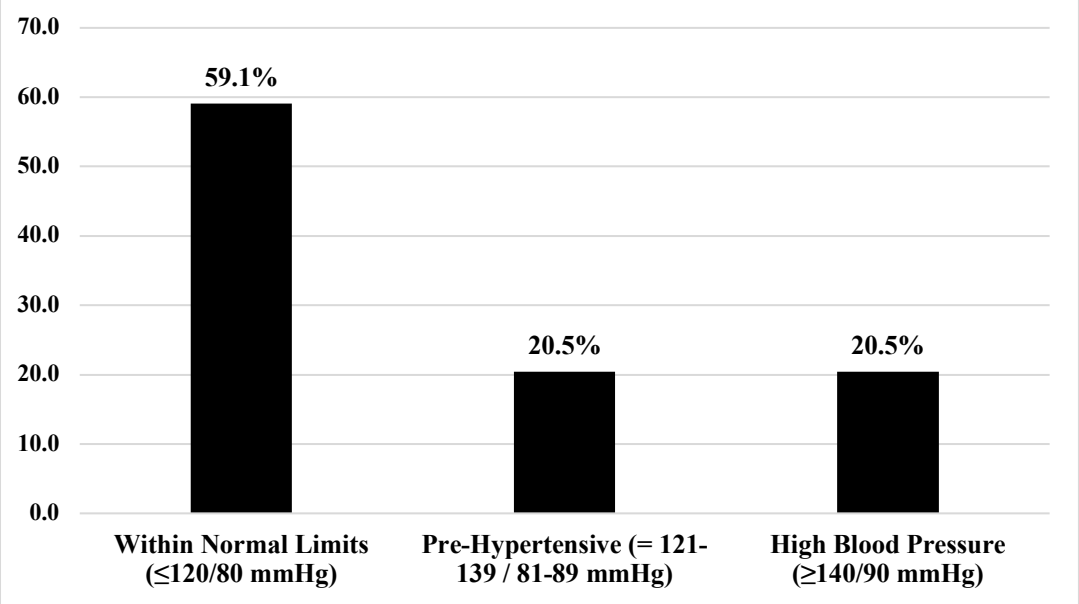
BLOOD PRESSURE AND LOCAL NEIGHBORHOOD ENVIRONMENTS

This chapter presents the results of risk factors and local neighborhoods on blood pressure in the Parsi population.

BLOOD PRESSURE

Healthy blood pressures (120/80 mmHg) were found in 59.1% of the study population. Pre-hypertensive blood pressures were observed in 20.5% and high blood pressures in 20.5% of the participants (Figure 14).

Figure 14. Blood Pressure Prevalence by Categories



Mean systolic blood pressure in this population was 120 mmHg and the mean diastolic blood pressure, 78 mmHg.

VARIABLE		Model 1 β	Model 1 α	Model 1 OR	Model 1 95% Confidence Interval for Exp(B) Lower Bound	Model 1 95% Confidence Interval for Exp(B) Upper Bound	Model 2 β	Model 2 α	Model 2 OR	Model 2 95% Confidence Interval for Exp(B) Lower Bound	Model 2 95% Confidence Interval for Exp(B) Upper Bound	Model 3 β	Model 3 p	Model 3 OR	Model 3 95% Confidence Interval for Exp(B) Lower Bound	Model 3 95% Confidence Interval for Exp(B) Upper Bound
Gender	Females	-1.477	0.000	0.228	0.170	0.306	-1.525	0.000	0.218	0.159	0.299	-1.530	0.000	0.216	0.158	0.297
	Males	Reference Category														
Age Cohort	19-28 years	-0.665	0.001	0.514	0.342	0.773	-0.682	0.002	0.506	0.331	0.772	-0.717	0.001	0.488	0.319	0.748
	29-38 years	-0.314	0.107	0.731	0.499	1.070	-0.306	0.128	0.736	0.496	1.092	-0.321	0.112	0.725	0.488	1.078
	39-44 years	-0.093	0.652	0.911	0.608	1.365	-0.044	0.834	0.957	0.635	1.443	-0.052	0.804	0.949	0.629	1.432
	45-53 years	Reference Category														
Body Mass Index Category	Normal BMI 18.5 - 24.99	-1.210	0.000	0.298	0.200	0.444	-1.158	0.000	0.314	0.208	0.475	-1.152	0.000	0.316	0.209	0.478
	Overweight BMI 25 - 29.99	-0.465	0.016	0.628	0.431	0.916	-0.415	0.036	0.660	0.447	0.974	-0.413	0.038	0.661	0.448	0.977
	Obese BMI 30 - 49.99	Reference Category														
Family History of Hypertension	No	-0.303	0.036	0.739	0.556	0.981	-0.300	0.045	0.741	0.553	0.993	-0.308	0.040	0.735	0.548	0.986
	Yes	Reference Category														
Medications for Hypertension	No	-1.311	0.000	0.269	0.143	0.508	-1.240	0.000	0.289	0.151	0.553	-1.242	0.000	0.289	0.151	0.552
	Yes	Reference Category														
Smoking Score	Never						-0.060	0.836	0.941	0.531	1.668	-0.055	0.852	0.947	0.533	1.683
	Non-Daily						-0.151	0.716	0.860	0.382	1.939	-0.157	0.706	0.855	0.379	1.931
	Past Daily						-0.145	0.721	0.865	0.389	1.922	-0.144	0.725	0.866	0.389	1.930
	Current Daily	Reference Category														
Alcohol more than thrice/week	No						0.107	0.679	1.113	0.669	1.852	0.105	0.686	1.111	0.666	1.854
	Yes	Reference Category														
Excessive Stress in last six months	No						0.011	0.943	1.011	0.748	1.367	-0.003	0.984	0.997	0.737	1.349
	Yes	Reference Category														
Optimally Active for Fitness	No						-0.144	0.378	0.866	0.629	1.192	-0.139	0.397	0.870	0.631	1.200
	<150 mins/week						-0.383	0.083	0.682	0.442	1.051	-0.378	0.088	0.685	0.444	1.057
	>150 mins/week	Reference Category														
Eat Non-Homemade Meals	None						-0.327	0.468	0.721	0.298	1.745	-0.336	0.455	0.714	0.295	1.728
	1 Meal						-0.425	0.344	0.654	0.272	1.575	-0.432	0.336	0.649	0.269	1.565
	2 Meals						-0.405	0.379	0.667	0.271	1.642	-0.411	0.372	0.663	0.269	1.634
	3 Meals						-0.343	0.507	0.709	0.258	1.954	-0.373	0.472	0.689	0.250	1.899
	4+ Meals	Reference Category														
Neighborhood	BAUG											0.164	0.469	1.178	0.756	1.835
	PARAP											-0.075	0.748	0.928	0.587	1.466
	COSMO											-0.095	0.709	0.910	0.554	1.494
	MJDPC	Reference Category														

Table title: Pre-Hypertension — Multinomial Logistic Regression

For Blood Pressure, Within Normal Limits is the reference category

b. This parameter is set to zero because it is redundant.

Table xvii. Multinomial Regression for Pre-hypertension and Neighborhoods

High Blood Pressure																
Multinomial Logistic Regression																
		Model 1					Model 2					Model 3				
					95% Confidence Interval for Exp(B)					95% Confidence Interval for Exp(B)					95% Confidence Interval for Exp(B)	
VARIABLE		β	p	OR	Lower Bound	Upper Bound	β	p	OR	Lower Bound	Upper Bound	β	p	OR	Lower Bound	Upper Bound
Gender	Females	-1.569	0.000	0.208	0.152	0.285	-1.614	0.000	0.199	0.142	0.280	-1.615	0.000	0.199	0.141	0.280
	Males	Reference Category														
Age Cohort	19-28 years	-0.823	0.000	0.439	0.281	0.686	-0.821	0.001	0.440	0.275	0.703	-0.820	0.001	0.440	0.275	0.705
	29-38 years	-0.406	0.045	0.666	0.447	0.992	-0.343	0.102	0.709	0.470	1.070	-0.382	0.071	0.683	0.451	1.033
	39-44 years	-0.136	0.519	0.872	0.576	1.321	-0.108	0.619	0.898	0.586	1.374	-0.118	0.589	0.889	0.580	1.363
	45-53 years	Reference Category														
Body Mass Index Category	Normal BMI 18.5 - 24.99	-2.342	0.000	0.096	0.064	0.145	-2.321	0.000	0.098	0.064	0.151	-2.324	0.000	0.098	0.064	0.151
	Overweight BMI 25 - 29.99	-1.313	0.000	0.269	0.188	0.386	-1.268	0.000	0.281	0.194	0.408	-1.275	0.000	0.279	0.192	0.406
	Obese BMI 30 - 49.99	Reference Category														
Family History of Hypertension	No	-0.288	0.061	0.750	0.555	1.014	-0.322	0.043	0.725	0.531	0.990	-0.305	0.057	0.737	0.539	1.008
	Yes	Reference Category														
Medications for Hypertension	No	-1.473	0.000	0.229	0.122	0.430	-1.494	0.000	0.225	0.118	0.426	-1.463	0.000	0.231	0.122	0.439
	Yes	Reference Category														
Smoking Score	Never						0.188	0.565	1.207	0.637	2.287	0.166	0.614	1.181	0.619	2.251
	Non-Daily						-0.055	0.904	0.947	0.388	2.308	-0.060	0.896	0.942	0.384	2.312
	Past Daily						0.019	0.965	1.020	0.425	2.445	0.000	1.000	1.000	0.416	2.405
	Current Daily	Reference Category														
Alcohol more than thrice/week	No						0.111	0.695	1.117	0.642	1.942	0.048	0.864	1.050	0.602	1.830
	Yes	Reference Category														
Excessive Stress in last six months	No						-0.082	0.611	0.921	0.671	1.264	-0.072	0.657	0.930	0.677	1.279
	Yes	Reference Category														
Optimally Active for Fitness	No						0.167	0.344	1.182	0.836	1.672	0.174	0.328	1.190	0.840	1.685
	<150 mins/week						0.028	0.903	1.029	0.652	1.623	0.059	0.800	1.061	0.671	1.677
	>150 mins/week	Reference Category														
Eat Non-Homemade Meals	None						-0.565	0.189	0.568	0.244	1.322	-0.596	0.169	0.551	0.236	1.287
	1 Meal						-1.128	0.009	0.324	0.139	0.756	-1.167	0.007	0.311	0.133	0.731
	2 Meals						-0.718	0.103	0.488	0.206	1.157	-0.756	0.088	0.470	0.197	1.120
	3 Meals						-0.416	0.399	0.660	0.251	1.734	-0.428	0.387	0.652	0.248	1.717
	4+ Meals	Reference Category														
Neighborhood	BAUG											0.489	0.072	1.631	0.957	2.780
	PARAP											0.561	0.038	1.753	1.033	2.976
	COSMO											0.597	0.039	1.817	1.031	3.201
	MJDPC	Reference Category														

For Blood Pressure, Within Normal Limits is the reference category;

Table xviii. Multinomial Regression for high blood pressure and Neighborhoods

The results of the multinomial logistic regression analysis are presented in Tables xvii and xviii. For this analysis, data were controlled for gender, age, body mass index, family history of hypertension, use of anti-hypertensives, smoking score, alcohol intake, excessive stress, recommended physical activity, and non-homemade meals. Multinomial regression analysis was performed in three phases because of the large number of control variables. Control factors were introduced one at a time and were tested for fitness and validity. Each of the variables is discussed below.

GENDER

Table xix. Blood Pressure and Gender

Gender	Blood Pressure		
	Within Normal Limits	**Pre-Hypertensive**	**High Blood Pressure**
Female	74.4	12.8	12.8
Male	43.4	28.3	28.3
Total	59.1	20.5	20.5

[a]Values are expressed as percent

Females were less likely to be prehypertensive or have higher blood pressure than males (Table xix). Bivariate analysis indicated that the observed difference between females and males was significant. The regression analysis suggested that females were significantly less likely to manifest pre-hypertension (OR=0.216, p=0.000) or high blood pressure than males (OR=0.199, p=0.000). These results conform with global trends, which indicate that males are more prone to hypertension than females in younger age groups. This difference in blood pressure between the two genders can be attributed to physiology, which is generally abrogated after 65 years of age (Carretero, 2000;

Sandberg, 2012). The results of this study were comparable to The National Family Health Survey of India (NFHSI), 2016 (ICF, 2018).

BLOOD PRESSURE AND AGE

Table xx. Blood Pressure and Age Cohort

Blood Pressure	Age Cohorts[a]			
	19-28 y	**29-38 y**	**39-44 y**	**45-53 y**
Within Normal Limits	72.0	60.4	55.2	47.4
Pre-Hypertensive	15.9	20.3	21.2	24.9
High Blood Pressure	12.2	19.3	23.6	27.7

[a]Values presented in the table above are percent

The risk for prehypertension and high blood pressure increased with age (Table xx). After controlling for all other environmental factors and family history, the regression analysis (Tables xvii, xviii) indicated that age cohort 1 was less likely to be pre-hypertensive (OR=0.488, p=0.001) and also less likely to have high blood pressure (OR=0.440, p=0.001) than age cohort 4. Although cohort 1 overall was at lower risk for higher blood pressures, 30% of the cohort presented with higher blood pressures. All other age cohorts were not at a significantly different risk of pre-hypertension or high blood pressure. Higher blood pressures in age cohort 1 and the lack of a significant difference between cohorts 2-4 indicates that younger participants were at a greater risk for higher blood pressures, which is of great concern. Physiologically, blood pressure increases with age and although there is no specific age when arteriosclerosis sets in, the effects of physiological ageing start setting in after 50 years. This is significant and confirms the observation that younger populations are increasingly affected by higher

blood pressures (Lawes, 2008). Geldsetzer et al. (2018) studied the NFHSI data and compared it with previous studies and high blood pressure results from India. They reported that more people in the younger age group (less than 45 years) are suffering from higher blood pressures. The results of this study are in line with their reports. The higher blood pressures in the younger age group are an indication of secondary ageing.

BODY MASS INDEX

Body mass index (BMI) was the only metabolic risk factor examined in this study. A bivariate analysis indicated that BMI was significantly related to blood pressure levels in the population. Those with low BMI (47 participants, 3.1%) when studied for pre-hypertension and high blood pressure were not a representative sample and were excluded from the interpretation. Each lower category of BMI was at a significantly lower risk of pre-hypertension and high blood pressure compared to those in the obese category. Those with healthy BMI (OR=0.316, p=0.000) or with overweight BMIs were less likely (OR=0.661, p=0.038) to be pre-hypertensive compared to those who were obese (Table xvii). For high blood pressure as well, obese participants had worse blood pressure outcomes; those with healthy BMI (OR=0.098, p=0.000) or with overweight BMIs (OR=279, p=0.000) were less likely to have high blood pressure (Table xviii). Our results are in accord with existing research indicating that there is a high likelihood of co-existence of metabolic risk factors and that high BMI directly affects blood pressure (Carretero, 2000) (Cushman, 2003).

FAMILY HISTORY OF HYPERTENSION

Half of the participants (n=765) reported a family history of clinical hypertension. A bivariate analysis of family history and blood pressure indicated that family history did not significantly affect blood pressure (Appendix 8*)*. The regression analysis indicated that after controlling for all environmental and metabolic factors, those with no family history of hypertension were less likely (OR=0.735, p=0.040) to present with prehypertension but not high blood pressure (OR=0.737, p=0.057). Inferring from the results of the general urban population of Maharashtra and from the results of environmental and family history factors in this study, high blood pressure is significantly affected by environmental factors. Family history is usually used as a surrogate for genetic influence on a disease (Lynch, 1979; Reich, 2006; Valdez, 2010). The data in this study reinforce the complex genetic and environmental interactions leading to high blood pressure. Family history was over-powered by all other factors and lost statistical significance as a risk factor for high blood pressure. This does not imply that genetics has no role in developing high blood pressure, but the result emphasizes the complexity of high blood pressure and the role of many known and unknown environmental risk factors in affecting genetic and environmental interactions leading to expression of disease.

LACK OF PROPER SECONDARY CARE OF CLINICAL HYPERTENSION

In this study population 12% (196 participants) had indicated that they were known hypertensives. A small number of participants (6.6%, n=101) were taking medications

for clinical hypertension, and of these 18.4% (n=19) had controlled blood pressure ≤ 120/ 80 mmHg, 33% (n=34) presented with pre-hypertensive blood pressures and 50 (48.5%) participants maintained high blood pressure (≥140/90 mmHg) despite using medications. The multinomial regression indicated significant p values for pre-hypertension (0.000) and high blood pressure (0.000) but the sample size, especially of those who were maintaining healthy blood pressure after taking anti-hypertensives was too small to make any statistical inferences. Nevertheless, this result cannot be ignored or kept out of regression analysis because controlling high blood pressure with lifestyle changes and medications when necessary is important to secondary and tertiary public health. Uncontrolled hypertension is the leading cause of morbidity and mortality because it is a stroke waiting to happen. Screening, treatment and monitoring for blood pressure in adults has changed associated morbidity and mortality in several high-income countries (Blacher, 2016; Wolf-Maier, 2003).

Of the participants in the study, who had high blood pressure, 84% (n= 262) were either unaware of their blood pressure status or were not taking medication for it. There may be several reasons why people don't take medications or stop taking antihypertensives and this was out of the scope of this research study. Of those who were pre-hypertensive or had high blood pressure 44.6% (n= 279) were not physically active for fitness, 14.5% (n=91) did not achieve the recommended activity levels each week, 51.4% (n=322) had sedentary work style or habits, and of those who traveled to work 63.9% (n=400) were automobile dependent. This indicates that either they were not aware of the lifestyle changes they needed to make, or they were not able to make lifestyle changes to improve their health. He et al. (He, 2002) reported that people who were aware of their blood

pressure status and made any kind of lifestyle change to control it, were more likely to have controlled hypertension.

SMOKING SCORE

Smoking prevalence was low in the study population; 82.4% participants reported never having smoked; 5.3% reported non-daily smoking habits now or in the past; 5.2% reported smoking daily in the past and only 5.8% reported current daily smoking. The bivariate analysis did not show smoking to be significantly related to blood pressure levels. Results of the multinomial regression analysis also did not show smoking in this population to be significantly affecting pre-hypertension or high blood pressure. Smoking is a significant and proven risk factor for high blood pressure (WHO, 2013). There is a chance that smoking was under-reported in this study. Females may not have reported smoking because there is a taboo associated with it. Several participants pointed out that they did not smoke because Parsis worship fire and smoking would mean offending their religion. Studies indicate that smoking prevalence among adults in India has decreased in the last decade and is now 21.4%. More people are aware of the harms of smoking tobacco (India, 2018). Higher education in this population may have led to better awareness of ill-effects of smoking and therefore a lower prevalence. Secondhand exposure to tobacco smoke was reported by 430 (28%) participants and was not significantly related to blood pressure outcomes. This factor was not included in the regression analysis.

ALCOHOL

Regular intake of alcohol (more than three times a week), was reported by 128 (8%) of the participants. The bivariate analysis did not indicate a significant relation between alcohol consumption and blood pressure outcomes. Alcohol intake is a leading risk factor for hypertension (Organization, 2014; Wolf-Maier, 2003) and the lack of significance in this study could be because of underreporting or lower rates of alcohol consumption in this community. Underreporting could be because often people do not perceive themselves as drinking much alcohol even when they do. Females may have underreported because of the taboo associated with drinking alcohol. The WHO reported that alcohol consumption in India had increased in 2008-10 from that in 2003-05 (Organization, 2014). Alcohol intake was controlled for in the regression analysis as it is a known risk factor for hypertension.

STRESS

Excessive stress was not related to blood pressure outcomes in a crude bivariate analysis in this study; 37% of the participants reported being excessively stressed. This meant that they had more stress than they could handle on their own. Stress is recognized as a risk factor for hypertension (Cooper, 1997; Matthews, 2004; WHO, 2013). In the multinomial regression analysis (Tables xvii, xviii), after controlling for other factors, stress was unrelated to blood pressure outcomes.

Recommended Physical activity, Sedentary Lifestyle, Automobile Dependence

A bivariate analysis indicated that physical activity and recommended physical activity levels were significantly related to blood pressure outcomes. For multinomial regression, recommended level of physical activity was used as a variable because it was a comprehensive variable and included participants who were physically active or inactive. After controlling for all factors, Model 3 of the multinomial regression analysis (Tables xvii, xviii) indicated that physical activity for fitness did not directly impact blood pressure in this population. Lower physical activity has an impact on high blood pressure by directly affecting BMI (Laverty, 2013; WHO, 2018a). Physical activity cannot be excluded from the analysis because it can potentially affect blood pressure independent of BMI (Bozkurt, 2016; Chobanian, 2003; Cushman, 2003). This may be a result of physical activity reducing peripheral resistance by improving blood flow and this helps the heart maintain healthy blood pressure.

Salt Intake

As stated in Methods, we used proxy measures to understand salt-intake because it was not possible to do a urinalysis. The frequencies and details of all meals are tabulated in Appendix 9. On average, a majority of people ate one or more non-homemade meals per day. Overall, 17.3% participants said they added extra salt to their food, and 31.7% said they consumed packaged beverages regularly. Both these were not significantly related to higher blood pressure.

*Table ix*i. *Frequency of Non-Homemade Meals*

Eat Non-homemade food	**Frequency**	**%**
0 meals outside	519	33.9
1 meal outside	541	35.4
2 meals outside	321	21.0
3 meals outside	105	6.9
4 meals outside	31	2.0
5 meals outside	13	0.8
Grand Total	**1530**	**100.0**

In a crude bivariate analysis homemade and non-homemade meals were both significantly related to blood pressure outcomes but skipped meals were not. Homemade meals were further examined for use of salt. Those who ate non-homemade breakfast and lunch, and homemade breakfast were likely to have worse outcomes for blood pressure. In the Indian context, breakfast is the one meal which when eaten at home has the possibility of including high-salt packaged foods like cheese slices, salted butter, jams, bread, and cereals. This could have affected the results. All other meals when made at home have lower probability of containing high-salt packaged foods. Very few people ate non-homemade dinners and the sample was too small to include in the analysis and interpretation.

Meals made outside the home are uncontrolled for sodium content and are likely to be accompanied with a packaged beverage and restaurants always have salt shakers on tables.

Few people skipped lunch and the sample was not representative for use in analysis. In the multinomial regression, after controlling for all factors, non-homemade meals were found to affect blood pressure outcomes. The results indicated that eating one non-homemade meal per day significantly affected high blood pressure (OR=0.311, p=0.007) but not prehypertension. This is a combination result of the various meals eaten outside of the home. While not very conclusive, it suggests more research is needed to examine salt intake in the population. There are no numbers for salt-intake in India. Studies examining salt in packaged food recommend more labeling and information from the industry.

TYPE 2 DIABETES

Diabetes Mellitus Type 2 (DM2) is also a common complex disease and may increase the risk for high blood pressure. In this study 42 participants self-reported DM2 and of these 29 had higher blood pressures (16: HBP, 13: pre-hypertension). These data were insufficient to make any analysis or interpretation. A detailed study examining other risk factors must be done to understand the co-existence of metabolic risks. In this study many participants were unaware of their high blood pressures. Similarly, people may have been unaware of their diabetes status. Often symptoms are slow to express but most importantly, people may ignore symptoms.

NEIGHBORHOODS

After controlling for known environmental risk factors supported by evidence and BMI, the neighborhood variable was studied in relation to blood pressure. Those living in

PARAP or COSMO were two times as likely (PARAP: OR: 1.753, p= 0.038; COSMO: OR= 1.817, p=0.039) to have high blood pressure than those in the MJDPC. Neighborhoods did not seem to have a significant effect on pre-hypertension, however. Neighborhoods were directly related to activity behaviors, which had an impact on metabolism and affected BMI. However, the neighborhoods could include unknown factors or exposures not included in the questionnaire. The result confirms the hypothesis that neighborhoods have significant exposures that affect behaviors of residents and thereby affect their susceptibility to high blood pressure. The result again highlights the complexity of high blood pressure and is a reminder of the many unknown factors that are interacting with genetics leading to the disease phenotype. It can be argued that factors such as high salt intake or automobile dependence, which affect metabolic risks are more global and urban than local. Walk-score results indicated that most neighborhoods provided access to many dining opportunities within the neighborhood. People live in an increasingly 'online' world and the Indian economy has seen a surge of online food ordering apps. The results indicate that despite the growing urbanization and globalization, neighborhoods have the potential to offer opportunities for a healthy lifestyle depending on the space and socio-cultural milieu. Development of neighborhood space and the socio-cultural environment into healthy opportunities for residents can help to have better health outcomes. 41% of the participants had unhealthy blood pressures. Data indicate that middle-income countries are becoming more burdened with common complex diseases as well as risk factors as they undergo an epidemiologic transition. The global and urban is affecting the lifestyles of populations in more ways than one. Neighborhoods have potential to address part of the problem.

CHAPTER SIX

DISCUSSION

The Single Ethnicity Study on High blood pressure and Local Neighborhood Environments (SESHLoNE) was a quasi-experimental study conducted to test the hypothesis that local neighborhood environments are exposures that affect behaviors and lifestyles of populations altering their susceptibility to high blood pressure. Data were collected from 1530 participants, 774 females and 756 males of the Parsi community living in four distinct neighborhoods in Mumbai. Parsis are a founder population in Mumbai. They present with less genetic variation than the general population. Studying common complex diseases in a founder population helps stabilize the genetic influence and allows exploration of environmental actions. The study included gathering data on neighborhood information, travel behaviors, risk factors to high blood pressure, and participants' own perceptions of their neighborhood. Parsis live in four distinct neighborhoods in Mumbai. Baugs (BAUG) are gated community housing with amenities of a playground and a club to meet or socialize; Parsi apartments (PARAP) are exclusive community apartments but lack third places; the Mancherji Joshi Dadar Parsee Colony (MJDPC) is a large Parsi settlement that has amenities but it is not gated; some Parsi people reside in non-community housing in the city (COSMO).

The study examined the potential of the general external exposome to affect health outcomes through neighborhood environments.

Built and social environments constitute the general external exposome and neighborhood environment facilitates part of this exposure. The exposome has an impact on behaviors, which affect lifestyle; together these modify metabolic risk factors (Travert, 2019). The primary influence of the general external exposome on health has been overlooked in public health research, development, and practice.

Results of this study showed that the local neighborhood environments were a dominant factor in exposure of residents to risks after controlling for socio-demographic and other specific exposures such as alcohol, smoking, medications for hypertension, stress, physical activity and salt intake. Local neighborhoods, with their natural and built ecology influenced health outcomes. People living in a structured environment develop behaviors to adapt to the constraints of that environment (Hicken, 2015), which defines their lifestyle and quality of life. Parsi people living in different neighborhoods developed behaviors to adapt to the constraints of their environments. These adaptations became their lifestyles and formed a link with their metabolism that altered their susceptibility to high body mass index (BMI) and high blood pressure.

High blood pressure is a common complex disease and is a classic example to understand the multitude of exposures within the exposome, which can potentially affect health and disease phenotype. It is a polygenic disease and is expressed after a complex array of interactions between the many genes and environmental factors (Ehret, 2010; Millis, 2011; Pausova, 1999; Wang, 2015). The SESHLoNE study indicated the complex

interplay between family history of hypertension (the genomic component of high blood pressure), sociodemographic factors (age and gender) and the general external exposome affecting the epigenome and resulting in a health or disease phenotype. The general external exposome included known risk factors and the new risk factor (neighborhoods), all of which translated into the health and disease phenotype in the Parsi population.

GENERAL EXPOSOME EXPOSURES AND BEHAVIORS, LIFESTYLE AND HEALTH OUTCOMES IN POPULATIONS

Results of the SESHLoNE study showed how the exposures translated into behaviors and into health outcomes. In anticipating how the exposome influenced lifestyle it was found that local neighborhoods affected mobility by structuring safe and supportive infrastructure to access socio-cultural opportunities, fundamental resources and utilities, and health care. The data indicated that better access was associated with lower blood pressures. The availability of amenities in the neighborhood accounted for better health outcomes.

The MJDPC exhibited the best health outcomes in this population because of overall access to resources for daily physical and socio-cultural needs, including safe and supportive infrastructure.

Public resources are an asset for better health of populations. The healthiest cities in the world are typically in high-income countries, which are able to provide basic infrastructure for a healthy lifestyle including clean water, sanitation, clean air, proper housing, safe infrastructure, green spaces, employment, and social capital and focus on preventive strategies. These qualities are a mark of the most livable cities in the world.

Vienna is one example. Other cities have adopted this theory of providing public resources successfully. New York City suffered high mortality and poor health outcomes compared to the population of USA until the 1980s (Frieden, 2008). The state overturned these statistics by improving access to disease prevention, healthy and safe environments, promoting maternal health and well-being among all (https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/). Thus, access to public resources and infrastructure for all, provide an advantage. Access to public resources builds a culture around using those resources leading to increased prevalence of health behavior. Browning et al. (2003) have reported neighborhood affluence is a more significant influence on health than individual income. They found that neighborhood poverty was related to self-rated health, which nullified the effects of individual poverty after controlling for individual characteristics. They found that neighborhood affluence has exclusive health benefits, individual health factors and the structural controls of the neighborhood notwithstanding. Affluent neighborhoods, or neighborhoods with amenities provide a health advantage by behavior contagion and health related sub-cultures. The built environment provides space and opportunity, which allows residents to access this opportunity and the behavior becomes common. Subsequently, such behavior becomes a culture. Manaugh et al. (2011) report that people in less affluent neighborhoods walk more than those in affluent neighborhoods.

Walking was more common among residents of PARAP, but they did not match the higher activity behaviors of those in MJDPC because of environmental constraints. Walking was not a behavior supported or motivated by the environment but more a necessity or a behavior adopted by those who were very motivated to be active. Thus, it

failed to transform into a behavior contagion and a culture. Actual access to space therefore influenced health behaviors. Participants from MJDPC had lower BMIs and blood pressures. The behavior and health outcome advantage for those in more affluent neighborhoods derives from the theory that affluence provides residents with better access to health promoting opportunities. Residents of affluent neighborhoods can also afford to pay for alternatives as they are likely to have more disposable income than those living in less affluent neighborhoods. Residents of Parsi apartments would be more active if they had access to simple activities like walking, jogging and cycling. Chiu et al. (2016) reported moving to a highly walkable neighborhood was associated with a decreased risk of hypertension. They found an association through walk-scores. Turrell et al. (2010) reported that residents of affluent neighborhoods were more active for fitness but less likely to be active for transport. Residents of advantaged neighborhoods, their study indicated, were less likely to walk for utilitarian purposes. Thus, neighborhood affluence and lack of it are both affecting walking and the overall high levels of obesity and higher blood pressures are a combined effect.

At the beginning of the study the assumption was that people living in neighborhoods with amenities would naturally, by free access to amenities and a high sense of community, practice simple activities and have high mobility within their neighborhoods. Going on that assumption, BAUGs and MJDPC should have reported lower BMIs and blood pressures not just in comparison to other neighborhoods but by themselves. However, BAUGs and MJDPC demonstrated an overall high risk of poor lifestyle and subsequent health effects. Better human development index (HDI) in the Parsi population translated to sedentary behaviors and lifestyle. Within neighborhoods there

was a difference in health outcomes but the overall health outcomes, high BMI and blood pressures, were of a larger concern. This was also influenced by their exposome.

Physical activity behavior was high in the Parsi population and this meant that they were aware of the benefits of activity and many had access to fitness activities. This awareness comes from their literary and social environment. The lack of infrastructure for simple activities to stay physically active led to various adaptations to the exposome. Participants either paid for special activities; tried to pursue simple activities within limited infrastructures; or were not active because of the various constraints including lack of access, motivation and affordability.

Physical activity has been reported to alleviate the effects of ageing (Vina, 2016; Zhongje, 2014). In this population effects of secondary ageing were observed rather than alleviation of ageing effects. In spite of high awareness, physical activity decreased after 28 years of age and sedentary habits and automobile dependence increased. Therefore, the design of local neighborhood environments is central to the means to encourage physical activity to prevent secondary aging.

The higher HDI also meant that the participants had more opportunities for desk jobs, which are sedentary in nature and are associated with less physical activity and high obesity (Dang, 2019). Not only office desk jobs, but also better HDI is associated with less intensive work at home with the aid of domestic help or technology. The high BMI in the Parsi population is a classical representation of improved but compromised quality of life in a middle-income country (Aizawa, 2019; Atkinson, 2016; Hickman, 2019). The benefits of high HDI cannot be contested but result in a high cost, poor health outcomes. Given the unrelenting and high-risk factor of sedentary lifestyle, it is imperative that

walkability be improved, more opportunities must be created for simple physical activity, and automobile dependence must be reduced. Wang et al. (2015) report that lifestyle changes such as decreased alcohol consumption, salt intake, increased physical activity and modification of eating habits reverse epigenetic effects and therefore the disease phenotype.

The sociodemographic of gender was also affected by the environment. Females had better BMI outcomes than males. The high HDI was either working for females to break socio-cultural barriers that work against them or it affected males worse by making them more sedentary and further vulnerable to higher BMI. Both arguments indicate environmental effects on health and drive home the larger point that environmental exposures are modifiable.

WANING THIRD PLACES

The overall perceptions of access to socio-cultural space and opportunities were low in the participants, except for in MJDPC. Oldenburg (2010) explained this as the vanishing third places. Oldenburg stressed mobility and walking, although not from the perspective of physical activity. Much has changed in the two decades since Oldenburg warned of vanishing third places. Digitalization and the use of social media have increased exponentially; automobiles have further encroached on our lives and environments and socio-cultural interactions have all but disappeared from the neighborhoods leading to extremely poor social capital and mobility (Putnam, 2001). Local neighborhoods have the potential to house third places among many other utilities and socio-cultural and economical needs of a community within an urban space. Williams and Hipp (2019)

argue that the presence of third places provides opportunity to constitute socializing with neighbors over a longer period of time. They call this sociospatial opportunity. They report that neighborhood third places may vary with socio-economics and conclude that neighbor interaction is the intermediary between third places and residents. Research indicates that the augmentation of poor health in less affluent neighborhoods is due to the social configuration or rather its absence (Browning, 2003). In this study, results indicated that community housing with amenities provided sociospatial opportunity. This presented as better health outcomes of those living in MJDPC. BAUGs had space to socialize but scored low on people's perception of opportunities to socio-cultural interaction. As Jacobs et al. (2010) point out in their review of physical activity, 'place' and not 'space' may be a more significant factor influencing socio-economic inequalities of activity behaviors. The socio-cultural interactions and opportunities are what make a third place live and mobile to bring factors in the Walkability Framework together. Although the residents of PARAP perceived their neighborhood as socio-culturally close knit, they were not able to overcome the shortfall of space and amenities. They suffered both lack of opportunity to socialize and the lack of space.

Neighborhoods which are walkable but increasingly have poor health outcomes must address third places and sociospatial opportunity. The loss of third places and their isolation into private spaces leads to disconnection from the local neighborhood. It directly impacts the Walkability Framework by disrupting surveillance and safety, streetscape and land-use and affects the purpose and experience of walking.

The results beg the question, "How long will MJDPC and BAUGs remain insulated from the loss of third places?" Automobile dependence has allowed for greater distances

among family units and takes away the immediacy of social interactions in the neighborhood. Technology dependence is taking socio-spatial opportunities online, from connecting with friends and family to watching movies and opera and reading books to ordering food. Everything is an 'app' on a digital device and isolates people from the social environment.

IS URBANIZATION TAKING 'PROXIMITY' AWAY FROM LOCAL NEIGHBORHOODS?

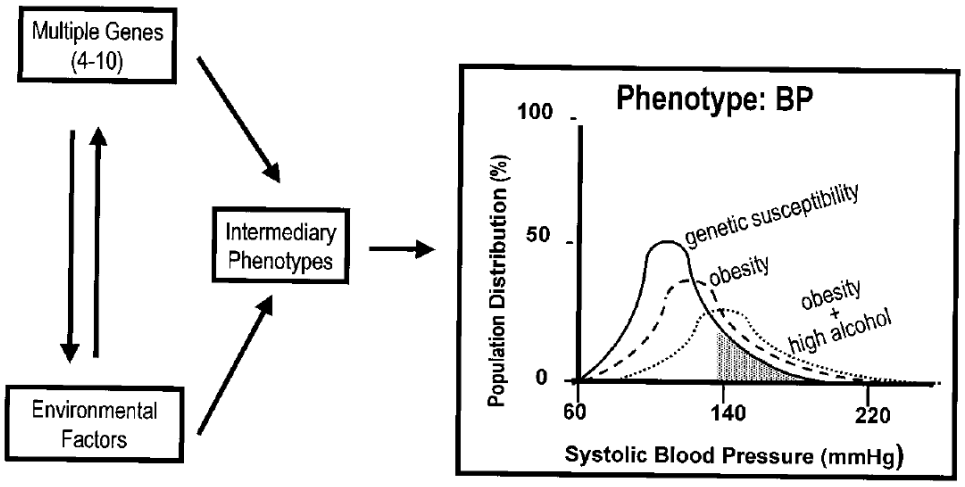
The sedentary occupations, high walk-scores; poor perceptions of neighborhood walkability; high perceptions of access to public transport; and high automobile dependence from the neighborhood to the city at large, indicated that the home and the urban were increasingly connected by automobiles, and walking was not mediating this commute. Public transport infrastructure connects the neighborhood to the larger urban area and provides opportunity for a physically active lifestyle and a cleaner environment due to less pollution. Mumbai has a good network of trains connecting north and south of the city. A Mumbai City Report published in 2010 (Patankar) in context to the floods that brought the city to a standstill in July 2005 reported the dire need to improve the public transport system of the city. Cheshmehzangi et al. (2016) wrote about transportation challenges in Mumbai and the overloaded transport system of the city, which needs to be upgraded. They indicate the need for more trains and buses, improvement of roads and management of the heterogenous mix of traffic and parking. Their research calls attention to the lack of suitable pedestrian facilities among other barriers to better transportation. They write that the city of Mumbai can handle about a quarter million vehicles. As early as 2010, 1.6 million private vehicles were on the roads

of Mumbai. This number was projected to increase as more people were becoming automobile dependent. Our research indicates that automobile dependency has increased, and this is in line with the prediction of rising number of vehicles on the road. The Mumbai Metropolitan Region is lacking key steps towards walkability suggested by Speck (2012). The automobile dependence, less use of transit and walking, and high BMI point to the biggest challenges of putting cars in their place, getting the parking right, letting the transit work, protecting the pedestrian and welcoming bicycles. Pollution is a factor that comes along with the automobile dependence and poor parking. Studies have indicated direct implications of air and noise pollution on high blood pressure (Moshammer, 2019; Rao, 2019) . Green space for shade and weather in Mumbai can be challenging, especially high temperatures and humidity in summer. As Tucker et al. (2007) established, there is need for researching effect of weather on physical activity. Wagner et al. (2016) have also explored the exacerbating impact of socio-demographics on weather affecting physical activity. Socio-demographics in middle income countries are very different, and research specific to these countries is required to understand the dynamics of the built environment and health.

A large number of participants in the study were dependent on the larger urban area for amenities. The disadvantage of these participants was obvious from the connectivity of the neighborhood to the urban, the behaviors and health outcomes of the participants. The city provides amenities but the restricted hours of the parks and play grounds (https://portal.mcgm.gov.in/irj/portal/anonymous/qldeptward), and other roadblocks to access are impregnable barriers to access. Places and behaviors are also gendered

(Phadke, 2011). This makes them inaccessible for females, half the population in this study. Most participants remarked that everyone in Mumbai is stressed. With the addition of each factor, in this study risk factors increased for a few more participants. Carretero et al. (2000) theorize that with the addition of each hypertensinogenic factor, the distributions of normal blood pressure in the population would change (Figure 15), as was observed in this study.

Figure 15. Addition of hypertensinogenic factors affecting prevalence of BP in populations: Source: Carretero and Oparil, 2000



The risks of high BMI and blood pressures for the entire Parsi population were the cumulative effect of all factors. Focus must be on developing common resources and assets for local neighborhoods and urban infrastructure. For MICs this must be done with renewed and locally tuned policies and with urgency because many people are falling in the trap of primary risk factors towards developing common complex diseases.

Automobile dependence, risk of road traffic and pedestrian injuries and sedentary lifestyle are urban phenomena observed globally. Global Environmental Changes are linked with health outcomes through many pathways. Urbanization and GEC are a two-way street (Frumkin, 2019). Emissions from automobiles and industry, sedentary lifestyle and overcrowding are results of poor urban planning and contribute to GEC; parallelly climate change disasters are propelling migration to urban areas. The augmented effect of burden on resources, disruption of resources and health care costs, are part of the epidemiologic transition in MICs.

Health outcomes improved with affordability and social determinants of those who could access healthy behaviors and afford better health. This takes away from the fundamental rights of people. This is where megacities in middle income countries differ from livable cities that rank high on the global livability index. Economic opportunity is coming at the cost of a physically active lifestyle. Research and development in low-and middle-income countries need new and creative approaches if we are serious about ending global health disparities. This study sets apart rapidly emerging metropolitan areas in LMICs from high-income country cities, which top the livability indices. For example, Mumbai Metropolitan Region is densely populated (21,000 per km^2) (Review, 2019). Vienna, a high livability index city, has a much lower population density (4,000 per km^2) (http://worldpopulationreview.com/world-cities/vienna-population/). The HIC cities are able to adapt to global guidelines (A/RES/70/1, 2015) for improving physical activity and use of public transit for health and sustainable development. The guidelines are actually aligned to the feasibility of improving sustainable lifestyles in those cities.

Local neighborhood environments have the potential to affect high blood pressure by channeling physical and social design to influence population behavior. The behavior patterns that emerged from this study strongly reflect the burden of urbanization on the local neighborhood and the population. If neighborhoods were isolated from the urban, and people were isolated in neighborhoods, we would have different health outcomes. But the exposome is all inclusive. It is everything that surrounds the gene. The neighborhood is one portion of the urban ecosystem with potential to significantly affect health outcomes. The neighborhood and the urban must blend, not encroach. As Gehl (Gehl, 2011) points out, cities must be planned by keeping in mind the people who will inhabit them. They must invite the pedestrian and not the car. This directly impacts health of over half the population of the globe living in urban areas ((UNDP)).

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APPENDICES

APPENDIX 1

Single Ethnic Study of High blood pressure and Local Neighbourhood Environment (SESHLoNE)

A study to examine the impact of local neighbourhood environment on high blood pressure in adults (20-50 years).

INFORMED CONSENT

You are invited to participate in this study because you meet the inclusion criteria of being a Parsi in the age group 20- 50 years residing within the Mumbai Metropolitan Region. This study is an examination of differences in blood pressure levels of people based on their neighbourhood.

The study will be done in three groups of Parsi people, each group residing in mutually exclusive neighbourhoods. We will also ask questions on neighbourhood resources and perceptions of residents regarding their neighbourhood. The study will include 1500 participants. On completion of data collection, we will statistically compare average blood pressure of each group.

Please read this consent form carefully and let me know if you have any questions or concerns.

Participation in this study is entirely voluntary. You have the right to withdraw from the study at any point even if you have agreed to participate initially. There will be absolutely no implications if you do not wish to participate or withdraw from the study at a later point.

Your participation will take approximately 15 minutes. The process involves:

1. Recording your blood pressure, height, and weight; (Your blood pressure will be measured twice)

There are no foreseeable risks or discomfort of participating in this study. You may experience a tightness on your arm from the blood pressure cuff while your blood pressure is being measured but it will last only a few seconds. If you are taking blood thinning medication, small petechia (red spots) may appear on your arm. They will settle on their own in some hours.

2. Completion of a questionnaire, which has questions regarding where you live and your individual parameters that can affect your blood pressure (including your family history). The questions are objective. Your personal data will never be shared or disclosed. If you are uncomfortable with a question, you are free to not answer it.
3. The study also uses a Geographical Information Systems (GIS) to map your neighborhood infrastructure, which includes green and open spaces, pedestrian paths, public transport, corner stores, markets, hospitals, pharmacies, schools, culture venues, libraries and department stores. For this purpose, the questionnaire does ask for identifying information in residential and work addresses (without details such as house numbers and room numbers). Data will be stored on password protected server space and will be used only for purposes of this research.

There is no monetary compensation, or that of any kind, for participating in this study. On completion of research, we will be happy to share the pooled results of the study with you, if you indicate so at the end of the survey and provide an email address. We will share the pooled results of the study with the Bombay Parsi Punchayet, and publish them in scientific journals. When taken up to analyze and publish, your data will be used anonymously.

Theoretically, and based on previous research, it is known that blood pressure is affected by multiple factors. These factors are either environmental or genetic. Where we live, i.e. our neighbourhood, forms a significant component of our environment. Many factors in the neighbourhood affect our lifestyle and are known to affect blood pressure. Benefits to public health and you: We will attempt to study if there is any evident relation between neighbourhoods and blood pressure. If this study indicates any trends or linkages, then future studies can be taken up to understand how exactly neighborhoods affect blood pressure residents. The study can suggest changes to the neighbourhood for better health of residents. This will be an opportunity for you to have your current weight and blood pressure recorded.
Blood pressure within 120/ 80 mmHg is considered within normal limits. Readings between 121-139/ 81-89 are considered pre-hypertensive. Blood pressure above 140/ 90

mmHg is considered high. High blood pressure recorded three consecutive times on different days is diagnosed as clinical hypertension.

Management of high blood pressure: If your blood pressure readings are high, you must meet with your physician to monitor, control, and treat it if necessary.

For your own reference, please keep this letter. If you have any queries or concerns about this study you may contact my advisor or me:

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Thank you for your time. Your participation is most valuable to this research!

APPENDIX 2

Neighborhoods and Blood Pressure

Start of Block: Default Question Block

Q1 **I have read the informed consent provided to me and I am participating in this study. I have secured contact information for Dr. Hitakshi Sehgal and will speak/ contact with her in case I have any questions.** (Please be assured that all information is secure and will not be shared or used for any other purposes than this research. We are not seeking any identifying information.)

○ **Agree** (1)

○ **Disagree** (2)

Skip To: End of Survey If I have read the informed consent provided to me and I am participating in this study. I have s... = Disagree

The following questions are about: Location of your residence and office, Past residences Month and year of birth, gender and Marital status, family size and family income

Q2 Please provide your **current residential address with the area pin-code:** (without house or flat number).

○ Building *(Ex. Firoz Apts)* (1)
_____

○ Area 1 (*Ex. Kala Ghoda*) (2)
_____

○ Area 2 (*Ex. Byculla E*) (3)
_____

○ Pincode (*example:400020*) (4)
_____

Q3 For how many **years** have you resided in your current neighborhood? (Please enter a number).
_____ Years (1)

Q4 Do you travel to work/ college daily?

○ Yes (1)

○ No (2)

○ Refuse to answer (3)

Skip To: Q8 If Do you travel to work/ college daily? = No

Skip To: Q8 If Do you travel to work/ college daily? = Refuse to answer

Q5 How do you travel to work/ college? (Choose multiple if you change transport during one trip. Otherwise choose the most likely way you travel)

- [ ] Bus or Train/ Metro (1)
- [ ] Cab/ Autorickshaw (2)
- [ ] Car (with driver) (3)
- [ ] Car (self-drive) (4)
- [ ] Walk (5)
- [ ] Motorbike (6)

Q6 Please provide an address for your work/ college destination: (The purpose of this question is to understand your daily commute)

- ○ Area 1 (*Ex. Sakinaka*) (1) _____
- ○ Area 2 (*Andheri East*) (2) _____
- ○ Pincode (*example 400011)* (3) _____

X→

Q7 Have you ever lived in any other neighborhood/s?

- Yes (1)
- No (2)
- Refuse to answer (3)

Skip To: Q12 If Have you ever lived in any other neighborhood/s? = No

Skip To: Q12 If Have you ever lived in any other neighborhood/s? = Refuse to answer

Q8 Have you lived in a Parsi Baug in the past?

- Yes (1)
- No (2)

Skip To: Q12 If Have you lived in a Parsi Baug in the past? = No

Q9 Please provide the name of the Baug and duration of residence.

	Past Neighbourhoods	Number of years of residence
	Name of the Baug (1)	Years (1)

1. (1)		
2. (2)		
3 (3)		

Q10 Please indicate your marital status:

- ☐ Never married (1)
- ☐ Separated (2)
- ☐ Divorced (3)
- ☐ Married (4)
- ☐ Widowed (5)
- ☐ Refuse to answer (6)

Q11 How many people currently live in your house (including yourself)?

_____ Please enter a number (1)

Q12 What is the **annual income** of your household? (household income: income of all working members in your home)
If the annual income of your household is 5 lakhs, please enter '5' in the space below.

- ○ Annual Income (*do not write the zeros in the lakhs*) (1) _____
- ○ Don't Know (2)
- ○ Refuse to answer (3)

Q13 Please indicate your gender:

- ○ Female (1)
- ○ Male (2)
- ○ Other (3)
- ○ Refuse to answer (4)

JS

Q14 Please enter your birth month and year:

	Month	Year
Please Select: (1)	▼ 1 (1 ... 12 (12)	▼ 1900 (1 ... 2049 (150)

Birthday Reformatted

_____

End of Block: Default Question Block

Start of Block: This section has questions on physical activity

This section has questions about physical activity.

Q15 **Do you regularly engage in a fitness activity?** (brisk walking for exercise/ jogging/ gym/ pilates/ power yoga/ play a sport/ other)
(*Regular = more than thrice a week*)

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Skip To: Q22 If Do you regularly engage in a fitness activity? (brisk walking for exercise/ jogging/ gym/ pilate... = No

Skip To: Q22 If Do you regularly engage in a fitness activity? (brisk walking for exercise/ jogging/ gym/ pilate... = Refuse to answer

Q16 Please name the activity/activities:

- ☐ Activity 1 (1) _____
- ☐ Activity 2 (2) _____
- ☐ Activity 3 (3) _____

Q17 On a regular day, how many minutes do you spend on fitness?
(Please enter a number)
_____ Minutes (1)

Q18 On an average, how many days a week do you follow this fitness regime?
_____ Days/ week (1)

Q19 Do you have a sedentary lifestyle? i.e. Do you/ Must you spend most of your day sitting?
(more than six hours)

- Yes (1)
- No (2)

End of Block: This section has questions on physical activity

Start of Block: This section has questions on how much salt you consume on a regular day

The following questions are about the nature of your meals to assess their salt content

Q20 Please see the matrix below. On a regular day, do you eat homemade meals? Do you tend to skip some meals?
(Regular: more than five days/ week)

	Homemade (1)	Not homemade (2)	Skip (3)
Breakfast (1)	○	○	○
Mid morning snack (2)	○	○	○
Lunch (3)	○	○	○
Evening snack (4)	○	○	○
Dinner (5)	○	○	○

Q21 **For your homemade meals, are packaged foods used for cooking?**
(examples: ready cereals/ frozen cooked food/canned vegetables/ sausages/ salami/ frozen cooked meat/ instant noodles/ instant pasta/ other instant food mixes)

○ Yes (1)

○ No (2)

Q22 **For your homemade meals, are condiments like packaged cheese/ mayonnaise/ ketchup/ packaged salad dressings/ chinese sauces used?**

○ Yes (1)

○ No (2)

Q23 Do you regularly eat pickles (achaar) with homemade meals? *(Regular: with more than three meals a week)*

- ○ Yes (1)
- ○ No (2)

Q24 On a regular day, do you consume papad/ salli/ chips/ wafers/ chivda/ chaklee/ any other packaged salted fritters? *(Regular: More than thrice a week)*

- ○ Yes (1)
- ○ No (2)

Q25 Do you **regularly** consume **packaged beverages** (example: colas/ fruit juices/ other packaged drinks)? (Regular: More than thrice a week)

- ○ Yes (1)
- ○ No (2)

Q26 Do you find yourself occasionally adding extra salt to your food?

- ○ Yes (1)
- ○ No (2)

End of Block: This section has questions on how much salt you consume on a regular day

Start of Block: This section has questions on your exposure to smoke from tobacco or other drugs

The following questions assess your exposure to first or secondhand tobacco smoke.

Q27 Are you a smoker?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Skip To: Q35 If Are you a smoker? = No

Skip To: Q37 If Are you a smoker? = Refuse to answer

Q28 How often do you smoke?

- ○ Daily (1)
- ○ Not Daily (2)

Skip To: Q37 If How often do you smoke? = Daily

Skip To: Q34 If How often do you smoke? = Not Daily

Q29 Did you smoke **daily in the past**?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Skip To: Q37 If Did you smoke daily in the past? = No

Skip To: Q37 If Did you smoke daily in the past? = Yes

Skip To: Q37 If Did you smoke daily in the past? = Refuse to answer

Q30 Have you ever been a smoker in the past?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Skip To: Q37 If Have you ever been a smoker in the past? = No

Skip To: Q37 If Have you ever been a smoker in the past? = Refuse to answer

Q31 How often did you smoke in the past?

- ○ Daily (1)
- ○ Not Daily (2)

Q32 Have you had long-term exposure to second hand tobacco smoke? **i.e. has anyone you have lived with, worked with, or have spent much time with, been a smoker?** *(Parent/ sibling/ close family member/ spouse/ co-workers/ close-friends/ neighbour)*

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Q33 Do you consume alcohol **regularly**? (*Regular= more than thrice a week)*

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

End of Block: This section has questions on your exposure to smoke from tobacco or other drugs

Start of Block: Medical History and stress

The next few questions are about your and your family's health history:

Q34 Have you been under excessive stress lately?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Q35 Does anyone in your family suffer from high blood pressure?
(parents, any grandparent, sibling, parents' sibling)

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Q36 Have you ever been diagnosed with hypertension (high blood pressure)?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Q37 Are you: on medication for High Blood Pressure?

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Q38 Do you suffer from any other long term illness? *(Other than high blood pressure*)

- ○ Yes (1)
- ○ No (2)
- ○ Refuse to answer (3)

Skip To: End of Block If Do you suffer from any other long term illness? (Other than high blood pressure) = No

Skip To: End of Block If Do you suffer from any other long term illness? (Other than high blood pressure) = Refuse to answer

Q39 Please name the illness:

- ☐ Illness 1 (1) _____
- ☐ Illness 2 (2) _____
- ☐ Illness 3 (3) _____

Q40 Are you taking medication for the above ?

- ○ Yes (1)
- ○ No (2)

Section 1 of the survey ends here. The next section has questions regarding your neighbourhood.

End of Block: Medical History and stress

Start of Block: This module has questions regarding your perceptions of the neighborhood you cur

This module has questions regarding <u>your perceptions of the neighborhood</u> you currently live in. It assesses the physical space, the facilities, and safety.

Your neighbourhood is the walkable area around your home (roughly about a kilometres' radius around your home). Please answer the questions based on your living experience.

The neighbourhood I live in:

Q41 Offers me open space for a physically active lifestyle

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q42 Offers me open space for playing sports

- Yes (1)
- No (2)
- Don't Know (3)

Q43 Has cultural activities that I can be a part of

- Yes (1)
- No (2)
- Don't Know (3)

Q44 Has an event space I can visit for theatre, arts, and cultural immersion

- Yes (1)
- No (2)
- Don't Know (3)

Q45 Has a religious facility I can visit

- Yes (1)
- No (2)
- Don't Know (3)

Q46 Offers me public transport options for my need to connect within the city

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q47 Has a library that I can use

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q48 Has a school that my children can go to

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know/ Not Applicable (3)

Q49 Has a fresh food market that I can use

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q50 Has a fresh meat and fish market that I can use

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q51 Has a store I can buy groceries at

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q52 Has a health-care clinic I can go to

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (3)

Q53 Has a general/ departmental store where I can buy sundry items I often need

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q54 Has a good pedestrian path that I can use as I go about my daily activities

- Yes (1)
- No (2)
- Don't Know (3)

Q55 Has a community/ society gymnasium that I can access for fitness

- Yes (1)
- No (2)
- Don't Know (3)

Q56 Has a community/ society swimming pool I can access for fitness and leisure

- Yes (1)
- No (2)
- Don't Know (3)

Q57 Has a neighborhood/ community organization that I can be a part of

- Yes (1)
- No (2)
- Don't know (3)

End of Block: This module has questions regarding your perceptions of the neighborhood you cur

Start of Block: Neighborhood Questions continued

The neighbourhood I live in:

Q58 Offers children open space/ garden for playing

- Yes (1)
- No (2)
- Don't Know (3)

Q59 Is aesthetically pleasing (in other words, you perceive your neighbourhood as beautiful)

- Yes (1)
- No (2)
- Don't know (3)

Q60 Has a good pedestrian path that the elderly and physically challenged can use

- Yes (1)
- No (2)
- Don't Know (3)

Q61 Is a close-knit neighborhood where everyone knows each other and socializes

- Yes (1)
- No (2)
- Don't Know (3)

Q62 Has zebra crossings and regulated traffic and therefore is safe for crossing streets

- Yes (1)
- No (2)
- Don't Know (3)

Q63 Has corner stores for easy access to regular grocery needs

- Yes (1)
- No (2)
- Don't Know (3)

Q64 Has a 24-hour medical store/ pharmacy

- Yes (1)
- No (2)
- Don't Know (3)

Q65 Has a hospital for emergency and other medical needs that may arise

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q66 Is safe for individuals of **all gender** to be out and about

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q67 Is safe for individuals of **all ages** to be out and about

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q68 Is safe for individuals of **any socio-economic class** to be out and about

- ○ Yes (1)
- ○ No (2)
- ○ Don't Know (3)

Q69 Is green with trees providing shade on footpaths

- Yes (1)
- No (2)
- Don't Know (3)

Q70 Is generally free from litter

- Yes (1)
- No (2)
- Don't Know (3)

Q71 Has green pockets, such as parks

- Yes (1)
- No (2)
- Don't Know (3)

End of Block: Neighborhood Questions continued

Start of Block: End of Survey, email information

You have finished the questionnaire. Thank you for your responses.

Please meet with Dr. Hitakshi Sehgal and she will record your blood pressure, height, and weight. The survey will then be submitted.

End of Block: End of Survey, email information

Start of Block: For Hitakshi Sehgal

Display This Question:

If If Please meet with Dr. Hitakshi Sehgal and she will record your blood pressure, height, and weight.... Text Response Is Equal to 8589

*

Blood Pressure, Height and Weight:

☐ Systolic Blood Pressure 1 (1)

_____

☐ Diastolic Blood pressure 1 (2)

_____

☐ Height (3) _____

☐ Weight (4) _____

☐ Birth Weight KG (5) _____

☐ Birth Weight Pounds (6)

_____

☐ Systolic Blood Pressure 2 (7)

_____

☐ Diastolic Blood Pressure 2 (8)

_____

☐ StudyID (9) _____

Nature of Residency

- ○ Baug (1) _____
- ○ Parsi Apartment (2) _____
- ○ Dadar Parsee Colony (3) _____
- ○ Cosmopolitan (4) _____

End of Block: For Hitakshi Sehgal

APPENDIX 3		
	Variables	
1	Neighborhood I	Derived from deidentified address
2	Neighborhood II	Derived from deidentified address
3	Calculated age	Derived from month and year of birth
4	Age Cohort	Derived by splitting data into quartiles
5	Gender	As answered by participant
6	Marital Status	As answered by participant
7	Annual Income	As answered by participant
8	Household Size	As answered by participant
9	Family history of hypertension	As answered by participant
10	Self-history of hypertension	As answered by participant
11	On medication for hypertension	As answered by participant
12	Chronic illness	As answered by participant
13	Illness 1	As answered by participant
14	Illness 2	As answered by participant
15	Illness 3	As answered by participant
16	Medication for other illness	As answered by participant
17	Current Smoker	As answered by participant
18	Current frequency of smoking (daily/ not-daily)	As answered by participant
19	If not daily, frequency of smoking in the past	As answered by participant
20	Past smoker (Question presented to only those participants who answered 'No' to current smoker)	As answered by participant
21	Past frequency of smoking	As answered by participant

22	Secondhand exposure to tobacco smoke	As answered by participant
23	Regular alcohol intake (Regular= more than thrice a week)	As answered by participant
24	Excessive Stress	As answered by participant
25	Travel to Work (daily)	As answered by participant
26	Mode of travel to work: Walk	As answered by participant
27	Mode of travel to work: Bus or Train/ Metro	As answered by participant
28	Mode of travel to work: Cab/ Autorickshaw	As answered by participant
29	Mode of travel to work: Motorbike	As answered by participant
30	Mode of travel to work: Car (self-drive)	As answered by participant
31	Mode of travel to work: Car (with driver)	As answered by participant
32	Active Transport	Derived from mode of travel to work: Active transport is those who travel to work by walking or by public transport and walking.
33	Regular physical activity (Regular = more than thrice a week)	As answered by participant
34	Primary Activity: The main activity participant performs for fitness	As answered by participant
	See	Appendix 4
35	Primary Activity Type	Derived from answer to primary activity
36	Secondary Activity	As answered by participant
37	Secondary Activity Type	Derived from answer to secondary activity

38	Tertiary Activity	As answered by participant
39	Tertiary Activity Type	Derived from answer to tertiary activity type
40	Minutes of physical activity per day	As answered by participant
41	Days per week of physical activity	As answered by participant
42	Total activity per week	Derived by multiplying activity days per week with activity minutes per day
43	Range of Activity	Derived by classifying total activity per week based on > or < than 150 minutes per week
44	Sedentary lifestyle (sit more than six hours per day)	As answered by participant
45	Neighborhood Walk Score	Derived from https://www.walkscore.com/score/
	See Excel sheet: Walk Scores, for neighborhood walk scores	
46	Breakfast	As answered by participant
47	Mid-morning snack	As answered by participant
48	Lunch	As answered by participant
49	Evening Snack	As answered by participant
50	Dinner	As answered by participant
	For homemade meals:	
51	Packaged food usage	As answered by participant
52	Packaged condiments usage	As answered by participant
53	Pickles consumption	As answered by participant
54	Salty fritters consumption	As answered by participant
55	Packaged beverages consumed	As answered by participant
56	Tendency to add extra salt to food	As answered by participant

57	Years of residency in current neighborhood	As answered by participant
58	Resided in any other neighborhood	As answered by participant
59	Resided in a Parsi Baug in the past	As answered by participant
60	Past Baug resided in (name)	As answered by participant
61	Number of years in past Baug	As answered by participant
62	Past Baug resided in (name)	As answered by participant
63	Number of years in past Baug	As answered by participant
64	**Neighborhood Resource Variables**	Appendix 5
1	Systolic Blood Pressure 1	Measured
2	Diastolic Blood pressure 1	Measured
3	Height (inches)	Measured
4	Height in Meters (Calculated) (Ht. in inches / 39.37)	Calculated
5	Height $(Meter)^2$	Calculated
6	Weight	Measured
7	Body Mass Index (BMI): Weight in KGs/ Height $(m)^2$	Calculated
8	Birth Weight KG	As reported by participant
	OR	
8	Birth Weight Pounds	As reported by participant
9	Systolic Blood Pressure 2	Measured
10	Diastolic Blood Pressure 2	Measured
11	Average Systolic BP	Calculated
12	Average Diastolic BP	Calculated
13	Outcome Variable: Blood Pressure	Categorized

APPENDIX 4

Activity	Frequency	%	Type of Activity
Walk	378	23.7	Simple
Gym	208	13.1	Special
Jogging	143	9.0	Simple
Yoga	117	7.3	Special
Football	110	6.9	Special
Badminton	71	4.5	Special
Swimming	50	3.1	Special
Exercise	47	3.0	Simple
Cycling	44	2.8	Special
Cricket	39	2.4	Special
Volleyball	36	2.3	Special
Table Tennis	35	2.2	Special
Dance	30	1.9	Special
Sports	28	1.8	Special
Martial Arts	27	1.7	Special
Weight Training	26	1.6	Special
Aerobics Training	25	1.6	Special
Cardio	22	1.4	Special
Zumba	17	1.1	Special
Lawn Tennis	13	0.8	Special
Athletics	10	0.6	Special
Pilates	8	0.5	Special
Cross-fit Training	6	0.4	Special
Push-ups	6	0.4	Simple
Sepak Takrao	6	0.4	Special
Throwball	6	0.4	Special
Functional Training	5	0.3	Special
Walking on Treadmill	5	0.3	Special
Stretching	4	0.3	Simple
Trekking	4	0.3	Special
Basketball	3	0.2	Special
Fitness Training	3	0.2	Special
Kick Boxing	3	0.2	Special
Horse Riding	3	0.2	Special
Squash	3	0.2	Special
Baseball	2	0.1	Special
Climbing Stairs	2	0.1	Simple
Crunches	2	0.1	Simple

Gymnastics	2	0.1	Special
High Intensity Interval Training	2	0.1	Special
Hiking	2	0.1	Special
Household Work	2	0.1	Simple
Light Weight Training	2	0.1	Special
Personalized Workout	2	0.1	Special
Power Lifting	2	0.1	Special
Skipping	2	0.1	Simple
Squats	2	0.1	Simple
Total Resistance Exercise TRX	2	0.1	Special
Athletics Cycling	1	0.1	Special
Beat Pump	1	0.1	Special
Body Building	1	0.1	Special
Calisthenics	1	0.1	Special
Circuit training with weights	1	0.1	Special
Dog Walking	1	0.1	Special
Farming	1	0.1	Special
Free Weights	1	0.1	Special
Golf	1	0.1	Special
Hockey	1	0.1	Special
Jumping	1	0.1	Simple
Long Distance Cycling	1	0.1	Special
Marathons	1	0.1	Simple
Muscle Training	1	0.1	Special
Parkour	1	0.1	Special
Physical Training	1	0.1	Special
Planks	1	0.1	Special
Power Yoga	1	0.1	Special
Rock Climbing	1	0.1	Special
Rugby	1	0.1	Special
Sailing	1	0.1	Special
Skating Teacher	1	0.1	Special
Soccer	1	0.1	Special
Sprinting	1	0.1	Simple
Strength Training	1	0.1	Special

APPENDIX 5

Neighborhood Perceptions, Affirmative Responses and Perception Scores

5a. Individual response rates

Q. 49: Tally of open space for a physically active lifestyle

Open Space for Physically Active Lifestyle	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	**Tally**	**%**
No	3.6%	34.6%	33%	5.2%	298	19%
Yes	96.4%	65.4%	67%	94.8%	1205	79%
Affirmative Perception Score	5	2	2	5		

Q. 50: Tally of open space for playing sports

Open space for sports	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	2.4%	47.4%	49.7%	5.7%	411	27%
Yes	97.6%	52.6%	50.3%	94.3%	1104	72%
Affirmative Perception Score	5	1	1	5		

Q.51: Tally of opportunity to cultural activities in neighborhood

Cultural Activities	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	15.3%	55.8%	62.4%	16.4%	551	36%
Yes	84.7%	44.2%	37.6%	83.6%	901	59%
Affirmative Perception Score	4	0	0	4		

Q.52: Tally of space for theatre, art, cultural immersion

Space for Theatre, Art, Cultural Immersion	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	47.9%	61.1%	56.2%	45%	784	51%
Yes	52.1%	38.9%	43.8%	55%	683	45%
Affirmative Perception Score	1	0	0	1		

Q.53: Religious Facility in neighborhood

Religious facility	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	11.3%	11.8%	32%	1.9%	217	14%
Yes	88.7%	88.2%	68%	98.1%	1299	85%
Affirmative Perception Score	4	4	2	5	14	1%

Q.54: Public Transport in neighborhood

Public Transport	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	14.1%	13%	10.9%	6.1%	181	12%
Yes	85.9%	87%	89.1%	93.9%	1332	87%
Affirmative Perception Score	4	4	4	5		

Q.55: Library in neighborhood

Library	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	68.8%	78%	67.7%	10.4%	908	59%
Yes	31.2%	22%	32.3%	89.6%	525	34%
Affirmative Perception Score	0	0	0	4		

Q.56: School in neighborhood

School in neighborhood	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	51.5%	30.7%	32%	4.1%	450	29%
Yes	48.5%	69.3%	68%	95.9%	880	58%
Affirmative Perception Score	0	2	2	5		

Q.57: Fresh Food Market in Neighborhood

Fresh Food Market	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	16.6%	13.6%	9.6%	1.9%	183	12%
Yes	83.4%	86.4%	90.4%	98.1%	1323	86%
Affirmative Perception Score						

Q.58 Fresh Meat and Fish Market in Neighborhood

Fresh Meat and Fish Market	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	27.4%	20.2%	22.3%	5.4%	311	20%
Yes	72.6%	79.8%	77.7%	94.6%	1173	77%
Affirmative Perception Score						

Q.59: Grocery Store in Neighborhood

Grocery Store	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	9.2%	7.8%	2.6%	0%	93	6%
Yes	90.8%	92.2%	97.4%	100%	1423	93%
Affirmative Perception Score						

Q.60: Health Care Clinic in Neighborhood

Health Care Clinic	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	26.1%	15.4%	15.7%	2.4%	256	17%
Yes	73.9%	84.6%	84.3%	97.6%	1237	81%
Affirmative Perception Score	3	4	4	5		

Q.61: General Departmental Store in Neighborhood

General Departmental Store	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	11.3%	7.7%	4.7%	3.3%	115	8%
Yes	88.7%	92.3%	95.3%	96.7%	1386	91%
Affirmative Perception Score	4	5	5	5	29	

Q.62: Pedestrian Path to for daily activities

Pedestrian Path	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	35.3%	49.8%	46.8%	13.4%	588	38%
Yes	64.7%	50.2%	53.2%	86.6%	908	59%
Affirmative Perception Score	2	1	1	4		

Q.63: Community or Society Gymnasium

Community Gymnasium	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	39.2%	56.8%	44.3%	7.6%	615	40%
Yes	60.8%	43.2%	55.7%	92.4%	868	57%
Affirmative Perception Score	2	0	1	5		

Q.64: Community or Society Swimming Pool

Community Swimming Pool	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	84.1%	89.7%	65.6%	66.3%	1186	78%
Yes	15.9%	10.3%	34.4%	33.7%	302	20%
Affirmative Perception Score	0	0	0	0		

Q.65: Neighborhood or Community Organization for social or cultural purposes

Community Organization	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	25.6%	53.3%	57.2%	10.7%	526	34%
Yes	74.4%	46.7%	42.8%	89.3%	835	55%
Affirmative Perception Score	3	0	0	4		

Q. 66: Blank

Q.67: Children's Park/ Garden

Children's Park/ Garden	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	1.4%	34.7%	29.3%	0.9%	268	18%
Yes	98.6%	65.3%	70.7%	99.1%	1241	81%
Affirmative Perception Score	5	2	3	5		

Q.68: Aesthetically Pleasing

Aesthetically Pleasing	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	5.8%	36.2%	35.8%	2.4%	315	21%
Yes	94.2%	63.8%	64.2%	97.6%	1174	77%
Affirmative Perception Score	5	2	2	5		

Q.69: Pedestrian path for the elderly and those with disabilities

Pedestrian Path for Elderly and those with disabilities	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	33.6%	63.1%	63.7%	26.7%	722	47%
Yes	66.4%	36.9%	36.3%	73.3%	769	50%
Affirmative Perception Score	2	0	0	3		

Q.70: close-knit neighborhood where everyone knows each other and socializes

Close knit and Social Neighborhood	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	8.3%	25.4%	50.4%	8.9%	320	21%
Yes	91.7%	74.6%	49.6%	91.1%	1121	73%
Affirmative Perception Score	5	3	0	5		

Q.71: Zebra-crossings and road traffic safety

Zebra-crossings and road-traffic safety	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	57.9%	61.9%	60.1%	37.9%	849	55%
Yes	42.1%	38.1%	39.9%	62.1%	643	42%
Affirmative Perception Score	0	0	0	2		

Q.72: Corner stores for simple grocery needs (example: eggs, bread, butter)

Corner Store	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	12.5%	8.2%	7.6%	6.2%	139	9%
Yes	87.5%	91.8%	92.4%	93.8%	1372	90%
Affirmative Perception Score	4	5	5	5		

Q.73 24-hour Pharmacy/ Medical Store

24-hour Pharmacy	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	21%	17.2%	17.8%	3.3%	250	16%
Yes	79%	82.8%	82.2%	96.7%	1256	82%
Affirmative Perception Score	3	4	4	5		

Q. 74: Hospital open at all times for emergency needs

Hospital	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	26.6%	13.7%	26.6%	38.6%	358	23%
Yes	73.4%	86.3%	83.4%	61.4%	1136	74%
Affirmative Perception Score	3	4	4	2		

Q.75 Safe for people of all gender to be out at all times

Safety: Gender	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	7.3%	8.5%	8.2%	13.9%	128	8%
Yes	92.7%	91.5%	91.8%	86.1%	1326	87%
Affirmative Perception Score	5	5	5	4		

Q.76 Safe for people of all ages to be out at all times

Safety: Age	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	7.3%	9.6%	12.7%	17.4%	153	10%
Yes	92.7%	90.4%	87.3%	82.6%	1295	85%
Affirmative Perception Score	5	5	4	4		

Q.77 Safe for people of any socio-economic class to be out at all times

Safety: Socio-Economic Status	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	6.2%	10%	8.7%	10.6%	121	8%
Yes	93.8%	90%	91.3%	89.4%	1290	84%
Affirmative Perception Score	5	5	5	4		

Q.78 Green with Trees providing shade

Greenery, Shade	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	12.9%	43.9%	38.2%	1.9%	400	26%
Yes	87.1%	56.1%	61.8%	98.1%	1103	72%
Affirmative Perception Score	4	1	2	5		

Q.79 Free from Litter

Free from litter	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	28.2%	53.5%	52.5%	15.5%	585	38%
Yes	71.8%	46.5%	47.5%	84.5%	892	58%
Affirmative Perception Score	3	0	0	4		

Q.80 Green pockets such as parks

Green pockets	**BAUG**	**PARAP**	**COSMO**	**MJDPC**	Tally	%
No	12.3%	49%	34.9%	0.5%	404	26%
Yes	87.7%	51%	65.1%	99.5%	1089	71%
Affirmative Perception Score	4	1	2	5		

Appendix 5b. Summary of affirmative and negative responses

	Respondents* Questions	Total	Yes (%)	No (%)	Don't Know (%)
BAUG	505*31	15,655	11,194 (72%)	3042	1419 (9%)
PARAP	505*31	15,655	9310 (59%)	4773	1572 (10%)
COSMO	306*31	9486	5748 (61%)	2855	883 (9%)
MJDPC	214*31	6634	5316 (80%)	716	602 (9%)

Appendix 5c. Categorization of the 31 questions into the Walkability Framework

Green and Open Space: Q 41, Q 42, Q 55, Q 56, Q 71

Third Places and Opportunities: Q 43, Q 44, Q 45, Q 47, Q 48, Q 57, Q 58, Q 61

Streetscape and Experience: Q 59, Q 69, Q 70

Land Use: Q 49, Q 50, Q 51, Q 52, Q 53, Q 56, Q 63, Q 64, Q 65

Connectivity: Q 54

Surveillance: Q 66, Q 67, Q 68

Pedestrian Safety: Q 60, Q 62

Public Transport: Q 46

UNIVERSITY OF MINNESOTA

Twin Cities Campus

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APPROVAL OF NEW STUDY

August 8, 2017

William Toscano

612-859-2120
tosca001@umn.edu

Dear William Toscano:

On 8/8/2017, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Single Ethnic Study of High Blood Pressure and Local Neighborhood Environment (SESHLoNE)
Investigator:	William Toscano
IRB ID:	STUDY00000219
Sponsored Funding:	None
Grant ID/Con Number:	None
Internal UMN Funding:	None
Fund Management Outside University:	None
IND, IDE, or HDE:	None
Documents Reviewed with this Submission:	• Newspaper Blurb, Category: Recruitment Materials; • Phone script Hitakshi Sehgal, Category: Recruitment Materials; • HRP 580 Hitakshi Sehgal 2, Category: IRB Protocol; • Flyer for residential apartment Chairperson, Category: Recruitment Materials; • Questionnaire, Category: Other; • Letter from William Toscano, Category: Letters of Support / Approvals (Location); • Letter from Bombay Parsi Punchayet, Category: Letters of Support / Approvals (Location); • Informed Consent, Category: Consent Form;

The IRB determined that the criteria for approval have been met and that this study involves No greater than minimal risk

This study was approved under Expedited Category(ies):

• (4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

• (7) Research on individual or group characteristics or behavior or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The IRB also made the following determinations for this study:

The IRB has issued an alteration to the consent process for this research because: (1) The research involves no more than minimal risk to the subjects; (2) the alteration will not adversely affect the rights and welfare of the subjects; and, (3) the research could not practicably be carried out without the alteration. The investigator is required to provide the subjects with additional pertinent information after participation, if the subject indicates they wish to receive aggregate results from the study.

The IRB approved the study from 7/19/2017 to 7/18/2018 inclusive. You will be sent a reminder from ETHOS to submit a Continuing Review submission for this study. You must submit your Continuing Review no later than 30 days prior to the last day of approval in order for your study to be reviewed and approved for another Continuing Review period. If Continuing Review approval is not granted before 7/18/2018, approval of this protocol expires immediately after that date.

You must also submit a Modification in ETHOS for review and approval prior to making any changes to this study.

If consent forms or recruitment materials were approved, those are located under the Final column in the Documents tab in the ETHOS study workspace.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the HRPP Toolkit Library on the IRB website.

For grant certification purposes, you will need the approval and last day of approval dates listed above and the Assurance of Compliance number which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003).

Sincerely

Jessica Wright, MA

IRB Analyst

We value feedback from the research community and would like to hear about your experience. The link below will take you to a brief survey that will take a minute or two to complete. The questions are basic, but your responses will help us better understand what we are doing well and areas that may require improvement. Thank you in advance for completing the survey.

Even if you have provided feedback in the past, we want and welcome your evaluation.

https://umn.qualtrics.com/SE/?SID=SV_5BiYrqPNMJRQSBn

APPENDIX 7
Recruitment Material

1. Flyer:

Dr. Hitakshi Sehgal is conducting a research study to examine any relation of neighbourhood environments with blood pressures of residents. The study is among Parsi people in the age group of **18-52 years**. She sincerely requests your participation.
She will measure your blood pressure, height, and weight, and request answers to an objective questionnaire. Time required is 10 minutes. She will be at ____ (venue within neighborhood) on __day, ___**Date from-to ___ Time**.
For questions regarding the study, contact her @ **phone number.**

This research is for her doctoral thesis. She is doing her PhD at the Division of Environmental Health Sciences, School of Public Health University of Minnesota.

2. Standee

Is Mumbai, as a megacity one common exposure, or does it matter where we live in Mumbai? Are neighbourhoods critical to our health? Is the environment of a Parsi Baug different from that of Parsi apartments outside and from cosmopolitan housing? Yes, of-course! Does this impact health? We don't know.

Spare 10 minutes to help a research study on Neighbourhoods and Blood Pressure.

Dr. Hitakshi Sehgal is conducting a research study to examine any relation of neighbourhood environments with blood pressures of residents. The study is among **Parsi people** in the age group of **18-52 years**. She sincerely requests your participation.
She will measure your blood pressure, height, and weight, and request answers to an objective questionnaire.

This research is for her doctoral thesis. She is doing her PhD at the Division of Environmental Health Sciences, School of Public Health University of Minnesota.

WhatsApp script:

i. Dr Hitakshi Sehgal is doing a study to assess if people's blood pressure is affected by the neighbourhood they live in. She will study 1500 Parsi people. Of these, 500 will be cosmopolitan residents, 500 residents of Parsi buildings which are not in big Baug a with facilities, and 500 residents of Baugs. Study participants must be Parsis in the age group 18- 52 years. She sincerely requests your participation. Your participation takes her a long way in her doctoral research.
It takes 10 minutes. It involves a short questionnaire, two readings of your blood pressure, one reading of height and weight. May she contact you?

ii. Hi, I am contactting you with a reference from _____. Thank you for agreeing to let me connect with you regarding my research. I will be in your neighborhood on (dates), (venue), (time). Please do stop by to participate in the study. It will be approximately 20 minutes.

3. Phone script when referred by someone to contact a prospective participant:
Hi, I am Dr. Hitakshi Sehgal. Thank you for agreeing to participate in this study. I will be setting up a mobile clinic in the ___ Parsi Baug where you live. On (dates), I will be there from (time frame) and invite you to please come by at a time convenient to you. What time works best for you? (will make an appointment based on response).
Thank you! (Reconfirm date and time). I will see you then. You don't need to bring anything. You just have to stop by. I have a questionnaire for you to fill out. After that I will record two blood pressure mesurements and also answer any questions that you may have for me. The whole process should take about 20 minutes.
Do you have any questions before you meet me for the study?

5. Letter of Request to be at in an apartment complex or Baug: The letter was always made on a University of Minnesota letterhead.

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May 19, 2019
Chairperson
_____Cooperative Housing Society
_____

Subject: Request space at _____ to conduct my research study.

Dear Chairperson,

I am writing to seek support from the authorities of _____ (name of housing premises), for my doctoral research. I am studying the impact of neighbourhood infrastructure on the blood pressure of residents in the Parsi community. The study will assess and compare 1500 Parsi people living in distinct neighbourhoods across Mumbai Metropolitan Region, in the age group 20 – 50 years. Of these, 500 will be residents of Baugs; 500: residents of Parsi apartments outside of Baugs; and 500: residents in cosmopolitan neighbourhoods and apartments. The data collection will involve a short objective questionnaire, and measuring blood pressure, height, and weight of participant. Each participant will have to spare about 15 minutes. For this,

1. I request a small space at ___ (housing premises) to set-up and conduct my research
2. I am also seeking help to network within the Baug and nearby Parsi residents, to enroll participants into my study. My network within the community is small and hence would appreciate if I could be connected to residents in the age group 20- 50 years.

Appended is some information on the study and its benefits. I will be happy to meet the committee and address any questions. I would like to be at _____ (name of housing premise) on ____ (dates). Please do let me know if you have any questions or concerns.

I look forward to hearing from you!

Sincerely,

APPENDIX 8

The bi-variate analysis of risk-factors and outcome variable: Blood Pressure are shown in the table below:

Pearson Chi-Square Results for confounders

Confounding Factor	Valid Cases	Asymptotic Significance (2-sided)
Age Cohort	1530	0.000
Gender	1530	0.000
Body Mass Index	1530	0.000
Family History of Hypertension	1521	0.060
Known Hypertensive	1525	0.000
On medications for Hypertension	1528	0.000
Physically active for fitness	1515	0.033
Recommended Physical Activity	1515	0.026
Smoking score	1510	0.116
Secondhand-smoke exposure	1519	0.817
Alcohol consumption (> thrice/ week)	1522	0.177
Excessive stress in last six months	1510	0.349
Frequency of homemade meals	1530	0.003
Frequency of non-homemade meals	1530	0.002
Frequency of skipped meals	1530	0.310
Salt in homemade meals	1530	0.220
Packaged Beverages	1530	0.250
Extra salt on food	1530	0.872

APPENDIX 9

Meal Patterns[a]					
Meal	**Breakfast**	**Mid-morning Snack**	**Lunch**	**Evening Snack**	**Dinner**
Homemade	69.1	26.7	70.6	26	88
Not Homemade	9.5	20.1	25.3	44.5	9.7
Skip	21.4	53.1	4.1	29.6	2.2
Grand Total	**1530**	**1530**	**1530**	**1530**	**1530**

[a]Values in the table above are in percent

Eat Homemade Food	Frequency	%
0 meals at home	53	3.5%
1 meal at home	150	9.8%
2 meals at home	400	26.1%
3 meals at home	531	34.7%
4 meals at home	224	14.6%
5 meals at home	172	11.2%
Grand Total	**1530**	**100%**

Consumption	Salt in Homemade Food				Beverages	Extra Salt
	Packaged food	Condiments	Pickles	Fritters		
No	1105	738	1220	964	1045	1266
Yes	425	792	310	566	485	264
Grand Total	1530	1530	1530	1530	1530	1530