FOOD ACCESS, INSECURITY, AND HEALTH: THE EXPERIENCE OF INTERNATIONAL STUDENTS

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ABSTRACT

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Food insecurity is rising among college students and minority groups in the United States. This is closely associated with poor health outcomes, including chronic health risks and poor mental health outcomes. Two key parameters, namely physical access and affordability have been commonly employed for assessing food insecurity by various institutions and researchers. While the food security is assessed for US populations and hinged upon measuring access to healthy and nutritious foods, food security among international students is difficult to comprehend. Moreover, perceptions and experiences of food access for international students does not encompass access to healthy and culturally appropriate foods. Therefore, if international students cannot access healthy and culturally appropriate foods, they are more likely to be food insecure and therefore, suffer from poor health and behavioral outcomes.

The aim of this study is to explore perceived access to healthy and culturally appropriate foods for South Asian students that mitigate their food related health risk. The main research question examines *if international students experience poor health and behavioral outcomes due to food inaccessibility than domestic students*. Three hypotheses were tested to investigate the main research question. The first hypothesis is that international students perceive greater food inaccessibility than domestic students. The second hypothesis is that international students perceive greater food insecurity due to food inaccessibility than domestic students. The third hypothesis is that international students perceive poor health and behavior outcomes due to food insecurity than domestic students. Using mixed-methods research approach, quantitative

assessment (n=427) was supplemented with qualitative – thematic coding to understand the perceptions of accessing healthy and culturally appropriate foods for Indian students (n=88) which formed the majority of the sample population (77%). Additionally, to comprehend the local-level access to foods, built area analysis (n=53) was conducted for one university in the Midwest (with the maximum responses) to explore the experiences of accessing healthy and culturally appropriate foods and the parameters of the modes of transit (mode of transportation, frequency of trips, travel time).

The quantitative assessment utilized chi-square test for hypothesis one and two and logistic regression for the third hypothesis. The affirmation of all three hypotheses showed that access is a critical aspect in assessing food security/insecurity and in turn, good health and behavior outcomes for international students studying in the US universities. The qualitative assessment was based on interviews (n=88) and food journal responses (n=87). This method illustrates two important factors. First, the key definition for culturally appropriate foods emerged from interviews and second, acceptability to healthy and culturally appropriate foods was most preferred among interviewees. However, it was ranked lower in all other dimensions of access, i.e., accessibility, accommodation, availability, and affordability. The built area analysis (n=53) helped in understanding the local level assessment of the food environment of one university.

The study concludes with recommendations on improving access to healthy and culturally appropriate foods through interventions at local planning level in three area- zoning, mobility, and governance.

This thesis is dedicated to my grandfather, Dr. Ramji Das Dua
for inspiring me at the age of four to pursue this degree.
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CHAPTER 1: INTRODUCTION

1.1: Laying the background

Food insecurity is rising among college students and minority groups in the United States. International students may perceive a greater barrier to access healthy and culturally appropriate foods locally. The cumulative examination of physical, social, and economic access is limited for students to understand perceptions of barriers to access healthy and culturally appropriate foods if available locally. International students may also experience greater food insecurity than domestic students due to limitations of access; since access to foods is realized once the student starts to live independently with limited social support. Moreover, international students may experience poor behavioral and health outcomes due to food insecurity while studying at US institutions.

Albert Bandura's (2001) Social Cognitive Theory provides a strong psychological foundation to explain the changing food consumptions patterns related to one's social behavior dependent on an individual's social interactions, experiences, and outside media influences. However, research on food security for South Asian students has not specifically been done. International students are not considered traditional immigrants. According to *Assimilation in American Life* by Milton Gordon, immigrants experience a dynamic process of acculturation followed by integration or structural assimilation wherein they become members of the American society (Healey & Stepnick, 2020; Gordon, 1964). For students pursuing higher education, food insecurity can lead to a lasting impact on their health. While, food access, insecurity and health are three well researched topics, it has not been widely studied for South Asian students in the US.

Therefore, this research investigates access to healthy and culturally appropriate foods for South Asian (with focus on Indian) students and perceptions of health and behavioral risks that stem from dietary acculturation for this population that is both transient and financially insecure. The research questions in this dissertation follow the framework of three papers. These are described below.

1.2: Quantitative assessment of access to healthy and culturally appropriate foods for South Asian students

Food insecurity is rising among college students and minority groups in the United States (El Zein, et al., 2019; Soldavini, Andrew, & Berner, 2022; Reeder, Tapanee, Persell, & Tolar-Peterson, 2020). Food insecurity among disaggregated Asian American communities (Becerra, Mshigeni, & Becerra, 2018) and among immigrant South Asian communities (Danish, 2019) in California underscore the need for more assessment; and measures to mitigate this emerging public health issue. Food insecurity among South Asian students that includes both international and domestic students, studying at US universities has not been researched till date.

People facing food insecurity are more than 4.5 times more likely to face poor health and behavioral outcomes (Reeder, Tapanee, Persell, & Tolar-Peterson, 2020). These include health risks such as poor lifestyle (Ding, Keiley, Garza, Duffy, & Zizza, 2015), unhealthy diets (Sbicca, 2018), food substitution (Budhiraja & Mittal, 2016), lack of physical activity (Ziersch, Baum, MacDougall, & Putland, 2005), chronic health risks (Seligman, Laraia, & Kushel, 2010) and poor mental health outcomes (Bruening, Dinour, & Chavez, 2017). Food insecure South Asian immigrants experience a higher prevalence of food-related chronic illness such as diabetes and cardiovascular diseases (Becerra & Chawdhury, 2018). However, there is limited empirical evidence on poor health and behavioral outcomes for South Asian students in the US.

Food access is broadly defined as consistent access to adequate meals to lead an active lifestyle (USDA, 2019). Physical accessibility (or ability to physically access a food retail store) and affordability (or ability to purchase foods with money) have been commonly employed for assessing food insecurity (USDA, n.d.). Over the last few decades, there have been more than ten models and various metrics devised to understand local food access and consumer behavior when addressing food insecurity. There are five dimensions of "access" which are adapted from Penchansky and Thomas' theory of access in public health - availability, accessibility, affordability, accommodation, and acceptability (Caspi, Sorensen, Subramanian, & Kawachi, 2012; Penchansky & Thomas, 1981). The paper aims to understand the connection between access (complete access not just physical and affordability), insecurity, and behavioral outcomes for South Asian students.

The primary goal of this research is to understand *whether international students experience greater barriers to accessing healthy and culturally appropriate foods than domestic students, which in turn could affect their food security and health and behavioral outcomes?* This is evaluated based on three hypotheses, namely:

- *Hypothesis 1: International students perceive greater food inaccessibility than domestic students.*
- *Hypothesis 2: International students perceive greater food insecurity due to food inaccessibility than domestic students.*
- *Hypothesis 3: International students perceive poor health and behavior outcomes due to food insecurity.*

1.3: Perceptions of Healthy and Culturally Appropriate Foods and Health Risks for Indian students

Culturally appropriate foods have been explored in a contextual understanding of how, when, where, and with whom it is being consumed (Aronson, 2014). It is also believed that culturally appropriate foods can dynamically change based on politics and economics of place (Sampson & Wills, 2013). While acknowledging these factors, the perceptions of healthy and culturally appropriate foods for immigrants may differ when they are living in their home-country, versus in another country, which in this case is United States. Culturally appropriate foods have been studied in limited capacity within the fields of nutrition and nutritional education. However, planning for culturally appropriate foods in communities is extremely limited for South Asians; whereby food insecurity has been rising (Danish, 2019). South Asians are pre-disposed to diabetes and other chronic illness related to poor diets, which may get exacerbated due to food insecurity among this population.

The concept that comes close to understanding the importance of culturally appropriate foods is that of community food security. The condition of community food security considers access to a diet that is safe, culturally acceptable, and nutritionally adequate and is procured through a sustainable food system that promotes community social justice and enhances community self-reliance (Hamm & Bellows, 2003). Evaluations of food insecurity in the US do not encounter examinations of 'culturally appropriate foods' comprehensively. This is firmly rooted in an 'individual's food preferences' and does not encompass preferences of foods for migrant populations. Hence, the comprehensive understanding of perceptions of healthy and culturally appropriate foods is warranted for South Asian communities in the US.

Using an exploratory approach, this research qualitatively examines the concept of culturally appropriate foods for an ethnic minority group such as Indian students in US. Interviews were conducted with students studying at US universities who are either from India or have Indian roots. The inquiry on their perception of what are culturally appropriate foods, their consumption pattern for homemade meals versus procuring foods away from home (FAFH), and any perceived health risks from their current lifestyle are discussed in this section. An inductive approach to thematic coding was employed to understand the themes for defining healthy and culturally appropriate foods for Indian students, and their perceptions of health risks stemming from their consumption patterns.

This study enhances the general understanding of defining foods that are considered culturally appropriate by a sub-group of the South Asian community in the US. Moreover, it deepens the understanding of perceptions of foods in the students' local campus environments and their perceptions of health risk based on their lifestyle.

1.4: Perception of & Experiences with Access to Healthy and Culturally Appropriate Foods for International Students

There has been a dynamic shift of minority populations in US Metropolitan cities since the early 2000s (Frey, 2011). With a history of redlining and racial segregation in American cities, structural inequalities deter food security for ethnic and minority groups in the United States (Elsheikh & Barhoum, 2013; Odoms-Young & Bruce, 2018). International students have restrictive employment policies and therefore, face higher financial stress and high acculturation rates (Maynard, et al., 2019; Becerra, Mshigeni, & Becerra, 2018). They have to often pool their finances for necessary expenditure to support themselves and frequently ignore their personal needs and desires in order to make ends meet (Amirali & Bakken, 2015). Access to foods is a

major determinant of food insecurity (USDA, 2019). Organizations such as International Food Policy Research Institute (IFPRI) (2022), and agencies under the United Nations (FAO, IFAD, UNICEF, WFP and WHO, 2022) have underlined the importance of focusing on the physical, social, and economic access to healthy and nutritious foods that meet the individual's food preferences and dietary needs in their local environment. While physical and economic access are widely understood and assessed for food security (USDA, 2012), social access on the other hand has been discussed based on social determinants of health (Heath, 2019) and health outcomes (Frank, et al., 2020).

Access to culturally appropriate foods from social nodes in the community are less understood even when ethnic groups have strong social linkages (Tselios, Noback, van Dijk, & McCann, 2015). In poorly designed neighborhoods with limited access to grocery stores (Anguelovski, 2015), low social support from friends or family (Ahluwalia, Dodds, & Baligh, 1998; Mohan & Mohan, 2002) and limited access to cultural foods (Moffat, Mohammed, & Newbold, 2017; Danish, 2019), students may perceive heightened physical and mental stress associated with food insecurity (Dean & Sharkey, 2011). This encourages individuals to procure food items from social nodes in the community as well as transition their food consumption based on their social exposure to food retail within their local environment.

In the case of international students and their needs for culturally appropriate foods, physical access to ethnic community nodes in the neighborhood may be limited or complicated due to expenditure on fuel, longer travel times, carpooling with friends or family or accessing public transport (Shannon, 2016). This may result in low mobility which may in turn impact their access to foods and ultimately food security (Coveney & O'Dwyer, 2009). Therefore, perceptions of and experiences with access culturally appropriate foods for South Asian students are warranted to

mitigate the rising food insecurity among this population and alleviating barriers to access such foods.

Using a mixed-methods approach, two queries are examined that support the investigation of food access for Indian students in the US. First, how do students rank their perceptions of access (including five dimensions of access) to healthy-unhealthy and culturally appropriate-not appropriate foods in their local food environment? And second, conducting built area analysis to evaluate what is the difference in physical access parameters (mode of travel, time taken to travel & trip frequency) to procure meals between students living in close proximity than those living further away from the university campus?

CHAPTER 2: REVIEW OF LITERATURE

This research investigates the experiences of access to healthy and culturally appropriate foods for South Asian (with focus on Indian) students and their perceptions of health and behavioral risks. This first part of this study seeks to investigate food accessibility, and it's relation to food security and consequently health and behavioral outcomes. The second part focuses on perceptions of healthy and culturally appropriate foods and health risks for Indian students. The last part focuses on perceptions of and experiences with access to healthy and culturally appropriate foods for South Asian students.

2.1: Access-Insecurity-Health

2.1.1: Understanding Access

2.1.1.1: Physical Access

Physical access refers to the mode of travel to procure grocery items from a retail source. Graduate students (Lockwood, 2018) and more specifically, international students (Wells, 2014) who face housing challenges (Amirali & Bakken, 2015) and transit and mobility barriers (Bista & Foster, 2016), perceived to have a higher prevalence of food insecurity (Soldavini & Berner, 2020). Unequal access to resources to create a healthy food environment (Elmes, 2018) or knowledge about developing an urban fabric with inclusionary zoning (Yellin, 2013) may be difficult to comprehend for international students and therefore, may not instill a sense of community for them (Rawlings, Capps, Gentsch, & Fortuny, 2007). With technology, access to information on types of food stores, availability of foods, restaurants, bus frequency, and similar useful information is available virtually to every college student and yet is difficult in physical sense (Antipova, Sultana, Hu, & Rhudy Jr, 2020).

Physical access to ethnic community nodes in the neighborhood may be limited or complicated due to expenditure on fuel, longer travel times, carpooling with friends or family with a vehicle or accessing public transport (Shannon, 2016). This may result in low mobility which may in turn impact food security (Coveney & O'Dwyer, 2009). Invariably, ethnic grocery shops such as Indian grocery stores are located in strip malls (Danish, 2019; Singer, Hardwick, & Brettell, 2008) which are closer to suburban homes and may not be well connected with a sidewalk or on frequent bus routes around institutions. The parameters such as mode of travel, frequency of travel, and time taken to travel are most commonly studied in transportation research and has not been researched for this population.

2.1.1.2: Social Access

Social access is defined by relying on social networks such as friends and family members, community centers and religious institutions for foods and prepared meals (Berkman, 1983; Umberson & Montez, 2010). According to the healthy people 2020, access to cultural resources, understanding social norms and attitudes, access to health care services, and improving access to economic opportunities could support collective physical wellbeing (The Office of Disease Prevention and Health Promotion, 2020). As an example, some parks in suburbs have created outdoor gyms to engage community in outdoor activities (Cohen, Marsh, Williamson, Golinelli, & McKenzie, 2012) which can encourage physical activity. With premium rents charged closer to campus when on-campus accommodation is not available, students scramble for affordable housing (Wells, 2014). Affordable housing mixed with middle-income residential areas could potentially allow for more interactions with peoples in the community and create better social linkages with them (Browning, Calder, Krivo, Smith, & Boettner, 2017). With the recent pandemic

exposing many food inequities for low-income populations, social networks gained traction to support local communities.

The cultural factors especially provide a sense of belonging to the individual at a personal and communal level and random chance interactions provide a mental wellbeing which enhances a person's overall productivity and quality of life (Ziersch, Baum, MacDougall, & Putland, 2005). Acculturation among Asian Americans has been observed to be low among fully bicultural group (bicultural referring to adoption of host and heritage cultures) as compared to other groups due to associations and tendencies towards their cultural identity, time spent in the U.S., identification and personal sense of belonging towards their ethnic origins and English speaking abilities (Jang, Park, Chiriboga, & Kim, 2017). Low acculturated South Asians have a higher prevalence of food insecurity than their domestic sub-group (Becerra, Mshigeni, & Becerra, 2018). Communities with low levels of social capital (Yang, Jensen, & Haran, 2011) and social cohesion (The office of disease prevention and health promotion, 2020) may suffer from overall high mortality rates, heart disease mortality and low birthweight (Williams, Lawrence, & Davis, 2019). Therefore, issues such as food insecurity, unequal access to food resources, and cultural factors could implicitly affect the health of a minority group.

2.1.1.3: Economic Access

'Access' is the physical ability and economic means to procure foods for consumption (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council;, 2013; The Food Trust, 2010). USDA states that consumer's choices on diet and food expenditure may be affected by an individual's accessibility and affordability means at the food store. This may include time to shop, healthy food options available and food prices (USDA,

2019). Economic access refers to the affordability of foods available in local food environments. As access and affordability are the two main dimensions to assess food security on a block-level and census tract level (USDA, n.d.), the assessment is based on foods in general.

South Asians, more specifically Indians in America are generally known to be more educated and have less rate of unemployment as compared to other Asian minority groups (Yi & Museus, 2015). However, it is unlikely to extend the same conclusion for international students who immigrate for higher education and have restrictive employment policies and therefore, face higher financial stress and high acculturation rate (Maynard, et al., 2019; Becerra, Mshigeni, & Becerra, 2018). For students the stress of finding accommodation in urban centers with affordable transit or multiple access modes that saves travel time may be vital for their physical and social wellbeing (Litman, 2020). Mixed-use and mixed-income housing could diversify the resident population and provide better economic security for a culturally diverse group (Chaskin & Joseph, 2013). Federal nutrition assistance programs such as Supplemental Nutrition Assistance Programs (SNAP), Temporary Assistance Relief Fund (TANF) and state-level initiatives are available for US citizens or permanent resident aliens (FNS Press Team, 2021; Office of Family Assistance, 2020). These are not available for immigrants who may be living on temporary visas or are undocumented. Therefore, students tend to avail foods from college food pantries due to easy access (Khandelwal, 2021).

However, the comprehensive study that looks at all three parameters of physical, social, and economic access for South Asian students is novel. Therefore, our understanding to access to healthy and culturally appropriate foods is enhanced by briefly discussing the accessibility models for food access that were used to holistically design the survey instruments and interview questions to address this research gap.

2.1.1.4: Accessibility Models

Food access has been researched using different models over the past few decades and four models prepare the foundation for this study. Sharkey et al (2010) proposed the 'conceptual model of food access.' Dean and Sharkey (2010) proposed another 'conceptual model of food insecurity and determinants of access to food resources.' Freedman et al (2013) proposed a model on 'developing a theory of food access.' Lastly, White, Stewart and O'Neill (2008) defined access to foods in a changing climate with three supplementary frameworks, namely 1. global environment and food security framework, 2. conceptual model of affordability and 3. conceptual model of physical access to foods.

Sharkey et al (2010) developed a conceptual model of food access to investigate its impact in a high neighborhood deprivation area or low vehicle ownership in a large rural area in Texas. In order to develop the model, the characteristics of the food environment (number, type, size, location, availability of traditional foods, variety, price, quality, and service) were observed along with characteristics of the demography within the selected area (this included neighborhood, vehicle information, access to public transportation, financial resources, the home environment, food preferences, household size (children/adolescent), employment, meal preparation, and culture were noted). The food environment characteristics of the area influenced the availability or the potential access of foods as well as barriers or facilitators; and the demography characteristics suggested the utilization or the realized access and the barriers to the facility for the same demography. These three components led to the assessment of the degree of access which led to the food choice, determinant of a healthful eating outcome for the people. In simpler terms, accessibility was dependent on the physical access to healthier foods along with availability influencing the food choice and consumption for an individual (Sharkey, Horel, & Dean, 2010).

Another model proposed by Dean and Sharkey (2011) was the 'conceptual model of food insecurity and determinants of access to food resources'. In this model, the determination of food insecurity is based on perceived collective social functions, which includes perceived social capital and perceived personal disparity. This led to determination of the plausible intervening variables such as distributional economies, reciprocal economics, and unequal access to food programs. Additionally, context-opportunity structures such as rural or urban food disparities and personal characteristics such as education, age, gender, minority status and household income aid in the assessment of household food depletion. As a result, Dean and Sharkey posit that the dietary outcome for an individual is likely to be associated with his/her experience of personal disparity for accessing financial and social resources of food (Dean & Sharkey, 2011).

Freedman et al. (2011) proposed a 'developing theory of food access' wherein, food access was determined using five dimensions, namely spatial-temporal, economic, social, service delivery and personal. These five dimensions help assess access to foods and other resources such as transportation, knowledge about the food quality, services available that enable or deter food access, and personal perceptions such as eating identity and health status. Moreover, it also considers the social paradigms such as neighborhood segregation, cultural preferences, and heritage (Freedman, Blake, & Liese, 2013).

Lastly, White, Stewart and O'Neill published three distinct systems to determine access to foods. The first, global environment and food security framework combined food system activities and food security interconnected through environmental and socio-economic feedback loop with environmental, natural, and socio-economic drivers. The interaction between the drivers closed the loop to affect the food system activities and the food security in the framework (White, 2015). The second, a conceptual model of affordability shows that food price and the purchasing power

of an individual based on his income, outgoings and savings can help determine the affordability of food (White, Stewart, & O'Neill, 2008). Third, the conceptual model of physical access to foods is determined by available transport systems, physical wellbeing and the retail environment. The availability of the transport modes and the ability to access or utilize these modes assess the transport system parameter (White, Stewart, & O'Neill, 2008).

In summary, the models provide key parameters that can be used to assess access to healthy and culturally appropriate foods in this research. The fundamental exploration of this research is whether food accessibility is critical to mitigate food insecurities among ethnically-diverse populations.

2.1.2: Access & Insecurity

Organizations such as FAO and Robert Wood Johnson Foundation focus on access to healthy and nutritious foods available in the local environment as a basis to configure if community residents are facing food insecurity (RWJF, 2022; FAO, UN, 2022). Food insecurity is defined as the inability to access and afford healthy foods at all times to live a healthy life (Nord, Andrews, & Carlson, 2005; Coleman-Jenson, Gregory, & Singh, 2014). Food insecurity for higher education students has been rising (The Hope Center for College, Community, and Justice., 2021) and for international college students is associated with gender, years in school, having a car, and perceived health rating (Soldavini & Berner, 2020). They have to often pool their finances for necessary expenditure to support themselves and frequently ignore their personal needs and desires in order to make ends meet (Amirali & Bakken, 2015).

A low-quality diet is associated with a low intake of fruits and vegetables and low expenditure on food, associated with food insecurity and poverty (Drewnowski & Specter, 2004). Azuma et al. (2010 March) conducted research to assess food access, affordability, and availability in three Los

Angeles low-income racial/ethnic minority communities. They concluded that access to healthy and affordable foods is a barrier in these communities and suggested healthful strategies to improve the overall health of the communities.

Consumers limited on mobility tend to avail foods from nearby stores (Furey, Strugnell, & McIlveen, 2001). The transit and mobility barriers for residents who do not own a car and are dependent on public transport is difficult when the grocery stores are not within walking distances (Coveney & O'Dwyer, 2009). Areas with low bus frequency, poorly designed bus shelters, broken sidewalks, ramps, and missing safety features may hinder travel for groceries (Rosenberg, Huang, Simonovich, & Belza, 2013; Carp, 1988). Moreover, poor awareness on transit modes and frequencies limits the use for routine trips (Outwater, et al., 2011).

2.1.3: Access & Behavioral - Health Outcomes

In 2010, approximately 80% US adults self-reported having 'good or better physical health' (National Center for Health Statistics, 2012). Physical health is a component of the multi-dimensional tool: Health-related quality of life (HRQOL) which is used to focus on the 'impact of health status on quality of life' (CDC, 2016). Lack of physical activity can lead to other health problems such as obesity, cholesterol, and high blood pressure (GPA, 2017). A joint research by Harvard Alumni Health Study and the Women's Health Study reported that the mortality rates of active men and women were 36% and 55% lower respectively than those who were least active (Kaminsky & Montoye, 2014). The physical health is also dependent on the physical context such as access to healthy or unhealthy foods, community design and the 'built environment' (Woolf & Aron, 2013). Food Research and Action Center considers poverty and food insecurity as the social determinants of health which are highly associated with chronic diseases in the US. Research also shows that people living near or in impoverished areas are more susceptible to bad health outcomes

and have low access to medical care than those who do not (Woolf S. H., et al., 2015 April; FRAC, 2017).

The relationship between food access and health is that people with access to fresh produce have better health outcomes than those purchasing from a supermarket which is linked to an increased consumption of processed foods (Demmler, Ecker, & Qaim, 2018). Contextual factors such as higher density of fast-food outlets in socially deprived neighborhoods is a contributing to creating "obesogenic environments" (Bagwell, 2011). Studies have shown that low-income neighborhoods have approximately half the access to produce and nearly 30% less supermarkets than higher-income neighborhoods (Wetherill & Gray, 2015; Walker, Keane, & Burke, 2010). Therefore, the dietary quality and maintaining health in economically disadvantaged neighborhood is negatively affected due to low access to healthy foods especially in the realm of adverse nutrition environment.

2.1.3.1: Health Impacts from Inaccessibility

Social determinants of health concisely address the physical and social parameters that can promote food health for all (The Office of Disease Prevention and Health Promotion, 2020). However, ethnic minorities' communities are disproportionally affected by low-access to healthy foods (Baker, Schootman, Barnidge, & Kelly, 2006) and unequal food environments (Walker, Keane, & Burke, 2010) which provide low physical and mental health opportunities (The Office of Disease Prevention and Health Promotion, 2020). The neighborhood food environment is thus an important indicator for healthy behavior and outcomes (Holsten, 2009; Caspi, Sorensen, Subramanian, & Kawachi , 2012). Low-income communities have been inundated with food options in their local food environments (Walker, Keane, & Burke, 2010), but access to fast foods and unhealthy food options have disrupted the basic dietary habits (Sbicca, 2018) and associated

with prevalence of non-communicable diseases such as obesity (Larson, Story, & Nelson, 2009; Walker, Keane, & Burke, 2010; Pan, Sherry, Njai, & Blanck, 2012). Socio-economic disparities in accessing quality diet (Ball, Crawford, & Mishra, 2006) may contribute to obesity and cardiovascular issues (Mente, De, Shannon, & Anand, 2009; McLaren, 2007).

A poor neighborhood design with limited access to a grocery store (Anguelovski, 2015) that students may reside in, with low social support such as friends or family (Ahluwalia, Dodds, & Baligh, 1998; Mohan & Mohan, 2002) and limited access to cultural foods (Moffat, Mohammed, & Newbold, 2017; Danish, 2019), students may perceive heightened physical and mental stress associated with food insecurity (Dean & Sharkey, 2011). Moreover, the accommodation needs, limited green spaces for physical activity and perception of unsafe and unknown neighborhoods for international students may limit their mobility and impact their physical and mental wellbeing (The Office of Disease Prevention and Health Promotion, 2020; Ziersch, Baum, MacDougall, & Putland, 2005). Hence, physical- social determinants include access to safe housing and neighborhood food markets which are local, safety, transportation options, green space and minimize physical barriers (The Office of Disease Prevention and Health Promotion, 2020) can improve food security for such students.

2.1.3.2: Health Impacts from Insecurity

Racial and ethnic communities face higher prevalence of morbidities, mortalities, and adverse health outcomes (Deaton & Lubotsky, 2003) which are also associated with neighborhood conditions, poverty, and residential segregation (Gee & Payne-Sturges, 2004). Poor health in adults and children, poor cognitive and emotional development in children and, and adult depression are some of the public health issues related to food insecurity (Gundersen & Ziliak, 2015).

The model myth that Asian American have higher wages and low unemployment rates (Yi & Museus, 2015) has been observed to lead to internalized racism resulting in avoiding mental healthcare services and inducing psychological distress (Gupta, Szymanski, & Leong, 2011). Psychological distress has been associated with food insecurity (Allen, Becerra, & Becerra, 2018; Myers, 2020). Lack of suitable and affordable resources stresses international student to gather basic needs (Wells, 2014). Stress with food insecurity has been associated with lower academic performance including GPA and overall class attendance (Silva, et al., 2017; Maroto, Snelling, & Linck, 2015). Moreover, students who are food insecure report poor health outcomes (Martinez, Frongillo, Leung, & Ritchie, 2020).

Research on food insecurity and availing food assistance showed negative impacts on one's wellbeing as it instills a feeling of hopelessness and stigmatization (Middleton, Mehta, McNaughton, & Booth, 2018; Hecht, Biehl, Buzogany, & Neff, 2018; Pollard & Booth, 2019). Among young adults, food insecurity has also been associated with depression, substance abuse and suicidal ideation (Pryor, et al., 2016). Racial homogeneity was found to have positive health outcomes such as low prevalence of psychosis, common mental disorders, suicide, self-rated poor health, and mortality (Shaw, et al., 2012; Okulicz-Kozaryn, 2019) which supports Lees' argument (2008).

2.2: Perceptions of Healthy and Culturally Appropriate Foods

2.2.1: Understanding Healthy and Culturally Appropriate Foods

Culturally appropriate food and culturally healthy foods are still immensely debated in the nutrition-related research. A simple understanding of culturally appropriate foods is traditional foods and some barriers noted by a recent study in Detroit was transportation, proximity, and awareness on healthier alternatives (Muhammad, 2021). This research uses the term cultural or

culturally appropriate foods broadly to understand the perceptions of South Asian students and experiences with accessing these foods from their local environment. Due to tremendous exposure to social media and new technologies, there is a shift in dietary preferences wherein the traditional homecooked style and authentic style has been substituted with what is considered as healthier options of eating (Popkin, Horton, Kim, Mahal, & Shuigao, 2001).

The 'uncommon' foods such as healthier options, substitutions, or fusion cuisines have joined mainstream diets of young adults that may now be recognized as culturally appropriate foods. Due to popular food diversification, many restaurants try to adopt a varied diet including brahman style vegetarian food, Jain style with no onion and no garlic meals (including holy period of fasting in the Hindu religion), and now vegan and organic foods (Sawant, 2019). With growing online access modes like Amazon Fresh, Instacart, etc. for raw ingredients, and farm to table box schemes (e.g. EdibleFlint, Flint, MI; Hungry Harvest, Miami, FL) and meals kits (Hello Fresh; Hungry Harvest), there is a knowledge gap for understanding the preferences of South Asian students procuring foods through newer channels of foods and examining what other local nodes can be connected for obtaining healthy food such that they promote social and cultural sustainability.

2.2.2: Perceptions of Health Risks

Perceptions of food accessibility for an international student is complex. Students who experience acculturation is associated with negative health behaviors such as smoking (Choi, Rankin, Stewart, & Oka, 2008), and binge drinking, alcohol and tobacco-use in highly acculturated adolescents (Hahm, Lahiff, & Guterman, 2004), and psychological problems such as depression, anxiety, social withdrawal, low self-esteem in children (Yeh, Hough, McCabe, Lau, & Garland, 2004; Lo, 2010). Limited physical activity and poor diet is also associated with obesity and other health risks (Darling, Fahrenkamp, Wilson, D'Auria, & Sato, 2017; Morales & Berkowitz, 2016) such as

metabolic disorders such as diabetes (Becerra & Becerra, 2015), heart diseases (Palaniappan, Wang, & Fortmann, 2004; Klatsky, et al., 2005), high blood pressure and food allergies (Vozoris & Tarasuk, 2003).

Approximately 133 million people in the US have been diagnosed with at least one chronic health disease which are responsible for 1.2 million deaths annually (Tinker, 2017; Raghupathi & Raghupathi, 2018 March). Chronic health-related risks have been linked to poor lifestyle, unhealthy diets, lack of physical activity and other social factors. The food-related health risks include unhealthy behaviors such as Diabetes, High Blood Pressure, Cholesterol, Physical Activity and Chronic Heart Disease (CHD) and health outcome such as Obesity. These can potentially lead to hospitalizations, long term disability, poor quality of life and death if not controlled or treated with medications in a timely manner. However, the prevalence of these risks is highly contextual to the demographic profile, and other social, physical, and economic factors (Centers for Disease Control and Prevention, 2016).

Obesity epidemic in the US affects 64% of Americans who are either overweight (34%) or Obese (30%) (Flegal, Carroll, & Curtin, 2010). Obesity has been found to be more prevalent among low-income and minority populations due to the limited access to healthy foods (Hilmers, Hilmers, & Dave, 2012 September). Low-income ethnic minority populations are at a higher risk of obesity and other diet-related chronic diseases (Gittelsohn, et al., 2008). Diabetes has increased with increase in the diagnosis of obesity. In 2011, diabetes was prevalent in 9% of the US Population and in 2015 is rose to 9.4% (Geiss & Cowie, 2010; American Diabetes Association, 2019; CDC, 2016). The risk to diabetes stems from factors like sedentary lifestyle, unhealthy diets, and overconsumption of food, followed by obesity (Geiss & Cowie, 2010). Many diabetic patients also

consume medications to control cholesterol and hypertension (Centers for Disease Control and Prevention, 2011).

2.3: Accessing Culturally Appropriate Foods

Almost 200,000 students from India, approximately 17.3% of the international students come to US every year to pursue further studies (U.S. Mission India, 2017). Nearly 56% of these international students come for graduate level courses (U.S. Mission India, 2017). 74% of H1B seekers in 2016/2017 were Indian (PTI, 2018). Therefore, the students have a strong tendency to stay longer and gain work experience after graduation. In India, the exposure to the heightened scale, variety of foods and sourcing strategies has led to some drastic consumer behavioral changes across the youth ages and is nascent to relate to policy effects and health changes due to this new diet.

Due to the rising demand for Indian foods and supportive global trade policies in the US, the authentic style foods have tremendously increased in supply in the last decade (Editorial, 2015). These can be easily found in international aisles of supermarkets in many global cities (Sen, 2017; Patel Brothers, 2019). Indian grocery stores are mostly sprinkled in metropolitan-suburban areas (Danish, 2019) that are to now rapidly connecting consumers through e-commerce (Prasad & Raghu, 2018). Factors that influence opening an Indian grocery store in the US is still unknown. However, with increasing e-commerce this may be overcome as more consumers may wish to purchase food items and fresh meals online if it is affordable for them. Moreover, Indian food products available in stores are dependent on items that can be safely procured and regulated by FDA and therefore, some known brands in India face the challenge of entering the American markets as one of the main obstacles is the nutrition labelling of the product (MENAFN - Kashmir Observer, 2020).

To provide the holistic and complex factors of this new food system, the consumer's behavior tends to shift from home-style and/or authentic cooking to healthier patterns (Popkin, Horton, Kim, Mahal, & Shuigao, 2001). This shift may influence Indian shoppers to substitute some products based on availability and affordability in the American market as it does in the Indian Market now (Budhiraja & Mittal, 2016). With an increasing population of Indian-descent and the COVID-19 pandemic, the Indian food demands may have impacted not just the business but also food insecure students who are limited on access. Another food delivery system, known as 'lunch box' (similar to Mumbai's *dubbawalas*) scheme, allows consumers to purchase fresh cooked meals daily with the taste and style they are comfortable with (Jashan Catering, 2020). Meals can be prepared upon special requests for further sensitivity to the consumer's allergens or dietary requirements (Bombay Takeout, 2019). Therefore, you can order no onion and no garlic recipes or meals from Patel Brothers selling packaged read-to-eat meals (Patel Brothers, 2019) and lunch box schemes with naturally vegan and gluten free meals (Bombay Takeout, 2019).

CHAPTER 3: RESEARCH METHODS

3.1: Research procedure

The aim is to examine perceived access to healthy and culturally appropriate foods for South Asian students that mitigates their food related health risk. The main research question examines *if international students experience greater barriers to accessing healthy and culturally appropriate foods than domestic students, which in turn could affect their food security and health and behavioral outcomes?* International students are respondents on a visa and domestic students are permanent and US citizens for this study. Three hypotheses were tested to investigate the main research question as given below:

1. The first hypothesis is that international students perceive greater food inaccessibility than domestic students.
2. The second hypothesis is that international students perceive greater food insecurity due to food inaccessibility than domestic students.
3. The third hypothesis is that international students perceive poor health and behavior outcomes due to food insecurity than domestic students.

The affirmation of hypothesis one, two, and three answers the main research question to illustrate that access is a critical aspect in assessing food security/insecurity and in turn, good health and behavior outcomes for international students studying in the US universities.

The research was approved by the Michigan State University Institutional Review Board (STUDY00006047). Supporting documents such as recruitment letter, consent form and survey instrument were submitted to Michigan State University IRB for an exemption as the risk of the

study participation was estimated to be minimal. The survey was voluntary and ensured anonymity for the participants who took the online survey and completed the interviews.

This research plan followed a three-stage approach. It began with a quantitative online survey, followed by a focus group discussion with selected participants from different universities (refer to Table 1) and lastly, a built area analysis.

The survey link was shared via email or social media platform of selected student organizations at respective universities to recruit participants. The survey was open between May 2021-October 2021. Two reminders were sent periodically on every social media platform according to Dillman method (also known as Total Design Method or TDM) to improve the survey response (Kim, 2019; Dillman, Smyth, & Christian, 2014). Once the online survey was well under way, stage two for conducting focus groups and collection of food journals was opened to those who indicated interest. Participants were provided a $5 gift card for successfully completing the online survey and $30 for completing the stage two of this research. The source of funds for this study were SPDC Fellowship, MSU Graduate Fellowship, Research Enhancement Fund, Mary Louis Gephart Donnell Fellowship and Malcolm C. Drummond-Shunichi Hagiwara Student Assistance Scholarship.

3.2: Study Area

This study encompassed 125 US universities in all five regions in the nation: Northeast, Southeast, Southwest, Midwest, and West (refer to Appendix A). These universities were selected based on web-based data on Indian student enrolment and active social media platforms for Indian or South Asian student organizations (Y-Axis, 2018; Kango, 2018; Bustamante, 2020; College Factual, n.d.; Facebook, 2021).

3.3: Data Collection: Target population, sample and sampling

The survey was pilot tested with a group of Indian students from Michigan State University to improve the questions' quality and to remove redundancies, thereby reducing measurement error. Once the questionnaire was finalized, it was hosted on Qualtrics for online participation. The sampling strategy to be adopted is cluster sampling (Stuff, et al., 2007; Salarkia, Abdollahi, Amini, & Eslami Amirabadi, 2011) since we are targeting South Asians including those from Afghanistan, Nepal, Pakistan, India, Bhutan, Bangladesh, Sri Lanka, and Maldives students studying in five US regions (Northeast, South-East, South-West, Midwest and West) (National Geographic, 2012) and recruiting participants from selected universities. The recruitment began by contacting the student coordinator for Student organizations and South Asian Organizations in selected universities and the representatives at these institutions' international student's centers on campus. The invitation letter was emailed for their confirmation to share the survey opportunity with their patrons or subscribers to participate.

A total of 4,226 responses were entered in the online survey on Qualtrics. Upon reviewing and those with successful completion of the responses were further used for assessment purposes for this study. The online survey results of 427 responses were used for the quantitative assessment and testing of the hypothesis for this study. A sample size of 427 students corresponds to a 95% ± 4.74% confidence interval for the online survey of South Asian students (Sample Size Calculator, 2019). In 2019, Education Data website reported a little over 200,000 students from India were studying at US universities (Bustamante, 2020) and a little under 230,000 students are South Asian students (National Center for Education Statistics, 2021).

Out of this pool, 103 respondents were recruited for stage two of this study, and the result from 88 Indian students are included in the qualitative assessment in this study. One university (Michigan

State University) in the Midwest had the highest participant number of 54, out of which 51 responses that were complete were used for built area analysis in this study.

3.4: Data Collection

3.4.1: Stage One- Survey

The quantitative instrument contained four sections: Food accessibility, food security, health and behavior, and demographic questions. The first section in the survey focuses on food access, primarily categorized under physical, social, and economic access. The questions on physical access assess the ability of a participant to physically access healthy and culturally appropriate foods. Social access refers to an individual's ability to accept and accommodate the foods based on their local environment. Economic access relates to affordability of foods available to the participants. Two questions on the survey focus on participant's grocery shopping behavior and include questions on what mode of transport they use to access the grocery store, how often they travel for groceries, and how much time is taken to get to a store one-way. In a separate question, participants were also asked if they had accessed any on- or off-campus food places other than grocery stores. The responses of international students were compared with domestic students.

The second section was adapted from the six-item short questionnaire used by USDA titled US Adult Food Security Survey Module and also provides the rubrics of assessment (USDA, 2012). This instrument has been suitably adapted for this research study into a seven-item questionnaire and includes a statement on 'mode of access' which was missing in the original tool (Refer to

Part A- Survey Instrument-B. Food Security (1 Question). This scoring will be referred to as Level of Food Insecurity or LOFI.

The third section of the survey is focused on health and behavior, wherein their overall health status and stress including physical, mental, and psychosocial stresses are investigated to see if

they are related to food insecurity. The behavior section uses CDC's Flexible Consumer Behavior Survey (FCBS) Module (CDC, 2012; CDC, 2017) to investigate personal habits and food identity of the participants.

3.4.2: Stage Two- Interviews

The qualitative approach examines the perception of access to healthy and culturally appropriate foods for Indian students in greater depth. Due to the personal nature of questions being asked and to mitigate response bias, the study format was changed from focus group phase of this study to one-on-one interviews. The questionnaire for the interviews had open-ended questions in two sections and one food access activity section. Their typical food knowledge, identities and preferences that influence their consumption pattern and their pattern of substitution of foods due to food inaccessibility or any limiting situations was inquired. The questions regarding health were inquired to see if they perceived any food related health risk based on their current diet, lifestyle or from family background.

To ensure anonymity, the recording of the zoom meetings was only used for transcribing purposes for this study. The responses were transcribed using NVIVO software and thematically coded to explain the variation in assessing food security to achieve healthy and culturally appropriate foods. The discussion section is an extension of the online survey and examines the social access that pertains to community resources, health, and behaviors of purchasing foods.

The interviews were conducted once the online survey was completed, and the participant indicated in the online survey to voluntarily agree to participate in the 45-min interview as well as complete the 1-week food journal. The data collection for this stage two began in August 2021 and the responses were collected till October 2021. The survey instrument (refer to Part B- Interview

Questionnaire Part B- Interview Questionnaire) had seven open-ended questions under three sections of food access activity, local food environment, and food identity and preferences.

3.4.3: Stage Three- Built Area Analysis

The university environment offers different food accessibility options for students, both international and domestic. Therefore, it is important to explore the built environment aspects that may influence a student's behavior for food accessibility. The built-area analysis was conducted in two steps. Step-one was assessing the online survey responses for procuring grocery meals by student status. Their distances and measures of accessibility was compared to investigate the differences between international and domestic students. Step-two included a mapping analysis with one university with the highest number of responses per region. The location of participants was mapped in GIS and linear distance was calculated to assess their proximity to food and community resources. The food retail outlets that were mentioned by the participants in the online survey where they had procured groceries and prepared meals in the last 30 days were also mapped. The food retail outlets were categorized based on supermarkets, Indian food stores, social nodes (where participants procured meals) and residential halls (refer to 4.5.2: Food Density Mapping). A buffer of 0.5 miles (10-minute walking radius) and 2.5 miles (average of all the distances travelled by the participants) from the university boundary was added to compare the travel behavior among those living within the buffer and outside the buffer region.

3.5: Analysis

3.5.1: Pilot Study

Once the IRB was approved from MSU Review board, few students from Michigan State University were recruited through Indian Student Organization (ISO). This sample data was used to screen for internal reliability of the survey instrument used in assessing the scores and

demographic variables. For defining healthy and culturally appropriate foods, the interviews were conducted based on two reasons. Based on preliminary screening, the online responses seemed to cloud authenticity of responses for a typical diet for students which was asked in section three of the survey instrument. Second, to reduce response bias which became apparent from the pilot study when students shared personal opinions and changed responses based on the perceived risk of being judged.

3.5.2: Preliminary Analysis

427 completed responses were included to assess the perceived challenges in accessing healthy and culturally appropriate foods for South Asian students. The missing data or those having a progress with less than 10% were considered incomplete and taken out in the analysis. The descriptive statistics of the sample population are presented from the socio-demographic section APPENDIX C – Demographic Tables). The reliability for the three scales – accessibility score, food insecurity and level of stress was calculated using Cronbach's Alpha as the internal consistency measure (Melgar-Quinonez & Hackett, 2008). The Cronbach alpha values ranged from 0.81 to 0.91 (refer to Table A- 12: Test for Reliability (Cronbach's Alpha).

Descriptive statistics on the demographic questions have been presented (refer to APPENDIX C – Demographic Tables) to show the response comparisons between international and domestic students' behavior. This includes age, country of origin, graduate level (undergraduate/graduate) student status, and by student status (international/domestic): US regions, gender, employment, vehicle ownership (yes or no), individual status (single, married or prefer not to say), and living status (alone, with friends or with family), if they are a primary grocery or not, and if they share their groceries.

3.5.3: Scoring

Two scoring mechanisms have been adopted in this study.

3.5.3.1: Accessibility Score or AScore

The key terms of access dimensions proposed by Penchansky and Thomas (1981) and are categorized under three categories to determine the Accessibility Score or AScore. The physical 'access' is assessed based on statements 1-2, and those with a raw score of 0 are denoted as 'No Accessibility Issues '; raw scores of 0.5-1 are denoted as 'Marginal Accessibility issues' and those with raw score 1.5 and above on a two-point scale is classified as 'High Physical Accessibility Issues'. Similarly, economic statements use the words 'afford' and 'avail' in statements 3-6 and raw score of 0 depicts 'No Accessibility Issues', raw score of 1-2 is considered as 'Marginal Accessibility issues and raw score of 2.5 or more on a four-point scale is denoted as 'High Accessibility Issues'. Lastly, the social access considers personal ability to procure groceries and uses the words 'accommodate' and 'accept/avoid' to assess this dimension. The statements 7-10 with a raw score 0 is regarded as 'No Accessibility Issues', raw score range of 1-2 have 'Marginal Accessibility issues' and those with score 2.5 or above on a maximum score of four is considered as 'High Accessibility Issues'. Accessibility score was assessed from the sum of the individual physical, economic and social statements and categorized as 'No Accessibility Issues' for score 0. Marginal Accessibility issues for score from 0.5-4 and High Accessibility Issues for score above 4, with a maximum of 10.

3.5.3.2: Level of Food Insecurity or LOFI

Level of Food Insecurity score which is based on the US Adult Food Security Questionnaire (2012). The seven statements for food insecurity were weighted based on the scores on a three-point scale. The score of 0 was allocated if the respondents indicated 'Not True', the score of 0.5 for the statements 'Sometimes True' and 1 for the statements indicated as 'Often True'. The

summation of the individual statements scores framed the total food insecurity score (Level of Food Insecurity or LOFI).

The weighting of the statements generated a scale which helped divide the population into two groups for further study. The groups are marginal food insecurity and high food insecurity based on the scoring. The LOFI scale classifies responses into four categories: high food security (score 0), marginal food security (score 1-2), low food security (score 3-4) and very low food security (score 5 and above). The scoring rubric for this study has been adapted into a seven-item questionnaire and includes a statement on 'mode of access' which was missing in the original tool (Refer to

Part A- Survey Instrument-B. Food Security (1 Question). Using the scoring established in the study, the ordinal variable was recoded into a categorical variable for analysis the hypothesis. The minimum score of 0 (or Never True) indicates good food security and the highest score of 7 indicates high food insecurity. A score of 0 was categorized as 'no food insecurity' and a score of 0.5 or more indicates that there is some level of food insecurity and was therefore coded as 'food insecure'.

3.5.3.3: Level of Stress or LOS

The parameter used to assess behavior was stress. The level of stress for students was assessed from physical stress, dietary stress, emotional stress, cognitive stress, perceptual stress, social stress, and financial stress. Respondents who faced any of these stresses could rate how frequently they faced such challenges based on 'often-sometimes-never' scale (Likert). This was scored for every respondent and the metric included 1 for selecting 'often', 0.5 for selected 'sometimes' and 0 for 'never'. For another test on the level of stress, the stress scores were recoded into minor and major stress based on the scores ranging from 0.5-3 for minor stress score (out of seven) and 3.5-

7 for major stress score (out of seven) respectively. This grouping was created due to two reasons, there were 0 cases of domestic students with 'No Stress' observed and the combined mean of stress score 3.58 for the sample population. Therefore, 3.5 was chosen to be the segregating point for assessment.

3.5.4: Analysis Procedures

3.5.4.1: Stage One

The first hypothesis is that *international students perceive greater food inaccessibility than domestic students.* The accessibility for students was assessed from the question investigating the five dimensions of access, namely, physical accessibility, affordability, availability, acceptability and accommodation of both, healthy and culturally appropriate foods respectively. Due to the binary dependent variable, chi-square test was conducted with AScore. The main dependent variable, f(y) is categorical (international or domestic student status) variable. Furthermore, chi-square tests were run independently with physical access, social access, economic access, access to healthy foods and access to culturally appropriate foods.

The second hypothesis is *international students perceive greater food insecurity due to food inaccessibility than domestic students*. Food accessibility used in hypothesis one, is based on the five dimensions of accessibility (Penchansky & Thomas, 1981; Freedman, Blake, & Liese, 2013). Food insecurity was assessed from scoring seven statements adapted from the short US Adult Food Security Module Questionnaire (2012). Chi-square test was performed with international and domestic student variable as the independent (nominal variable) with the categorical variable of food insecurity as the dependent variable. For the hypothesis testing, logistic regression was conducted with food security as dependent (categorical) variable, and the interaction effect for independent variables: food accessibility (categorical) and student status (categorical).

The third hypothesis is that *international students perceive poor health and behavior outcomes due to food insecurity than domestic students*. As a preliminary test, Chi-square test was conducted with student status and health (categorical variables) and with student status and level of stress (categorical variables). For the hypothesis, logistic regression was conducted with food security as dependent variable and the interaction effect of health and student status as the independent variable in one part and the interaction effect of level of stress and student status as the independent variable in part two. These were further combined in another logistic regression that included with food security as dependent variable and interaction effect of food accessibility and student status and interaction effect of level of stress and student status as the independent variables.

The main research question is whether *international students experience poor health and behavioral outcomes due to food inaccessibility than domestic students while studying at US Institutions*. The affirmation of all three hypotheses will answer the main research question showing that access is a critical aspect in assessing food security/insecurity and in turn, good health and behavior outcomes for international students studying in the US universities. The table (A-15) shows a list of dependent and independent variables that were explored in the research study.

3.5.4.2: Stage Two

The interviews were conducted once the online survey was completed, and the participant indicated in the online survey to voluntarily agree to participate in the stage two of this research. Participants were interviewed via zoom and the sessions ran from 30 minutes to 1.5 hours. They were also tasked with completing a one-week food journal. The template was provided via email in MS word and MS Excel formats. The questionnaire (refer to Part B- Interview Questionnaire Part B- Interview Questionnaire) had seven open-ended questions under three sections of food access activity, local food environment, and food identity and preferences.

The qualitative analysis was conducted using thematic coding (inductive) for Indian students studying at US universities. Inductive coding required four steps of transcription, coding, analysis, and writing. Step one required data to be transcribed verbatim in MS Word from the zoom recordings and checked for any grammatical errors. Once the interviews were transcribed, they were imported into NVivo 12, and codes were generated line-by-line. Once first level coding was completed, any similarities or duplications were checked and assimilated in one code or deleted. Codes were then grouped into broad-themes that aligned with the major themes related to the five dimensions of access. For the analysis, the data was interpreted and analyzed; and reviewed by two research peers not associated with the research study. The themes and subsequent codes were reviewed to ensure that they were aligned with the research gaps after the quantitative analysis. The last stage included writing and summarizing the codes in the results section, and they have been discussed in the last chapter.

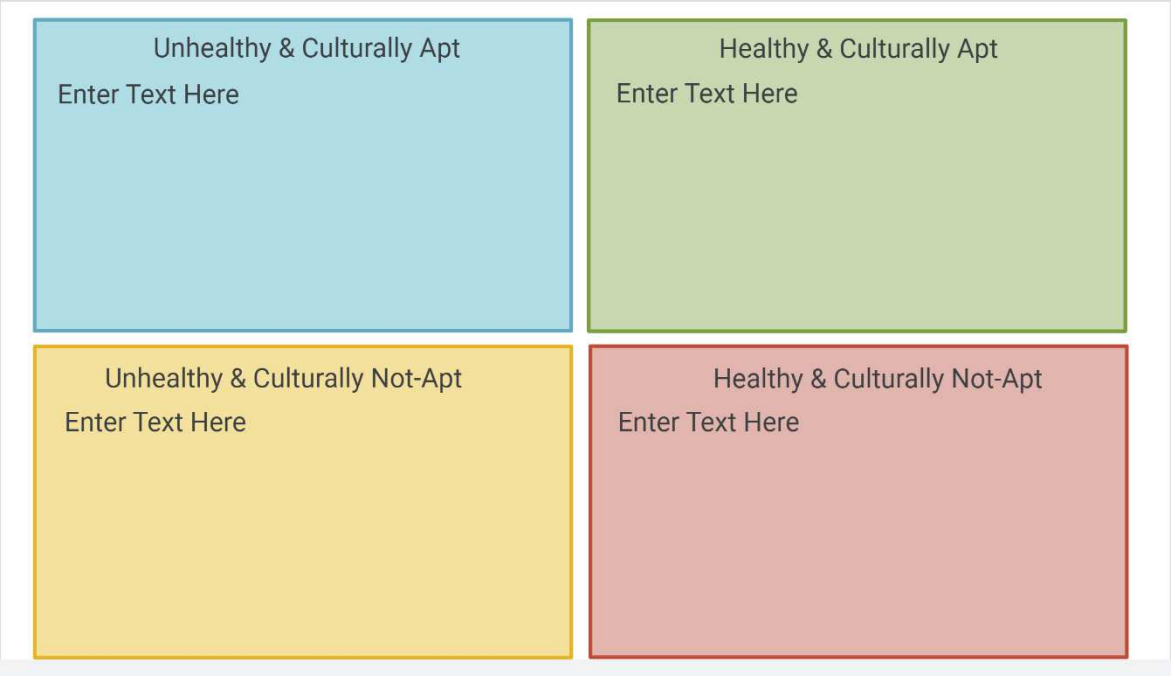

Figure 1: Food access activity ranking chart

The food access activity included a list of 22 commonly known Indian food items that the participants had to allocate in one of the quadrants of healthy-unhealthy and culturally appropriate-not appropriate as shown. Even if the participant did not personally consume it, their perception of that food item helped in inserting the food item in one of the four quadrants (refer to Figure 1). The participants were asked to reflect on this exercise and clarify how they perceived would be the underlying definition of each quadrant. Moreover, under the local food environment, participants were asked how have their eating habits changed since attending college and had they changed their food consumption pattern due to any food insecurity or accessibility issues. This discussion was coded and has been summarized in section 4.4.1.1.

The next section enquired personal preferences of foods, including what foods, they culturally associated with and if they were perceived to be healthy. Additionally, after completing the food access activity, participants were also asked if the foods they classified as healthy or unhealthy

was solely based on their perception of physical health or mental health or both. One situational question was asked about food habits during finals week or any stressful week and what foods does the university provide in terms of healthy and culturally appropriate foods. The responses to these questions helped fill in the missing gaps of understanding access and were combined with codes of understanding access. The results are presented in section 4.4.1.2.

After completing the allocation of food items, the participants were asked to also rank the four quadrants based on their experience of being physically able to access those products, affordability (on average) of the food products, availability of those products in the local food environment, acceptability within their own diets, and accommodation within the local food environment. The results of ranking were assessed on average and have been presented in 4.5.3: Assessing 'Access' in the Local Food Environment.

CHAPTER 4: RESULTS

4.1: Introduction

This study investigates the main research question *if international students experience poor health and behavioral outcomes due to food inaccessibility than domestic students*. Using quantitative analysis, which includes descriptive statistics and preliminary results, followed by Chi-square test with the dependent variable being student status (international and domestic student). Three hypotheses which were tested to investigate the main research question are given below:

1. The first hypothesis is that international students perceive greater food inaccessibility than domestic students.
2. The second hypothesis is that international students perceive greater food insecurity due to food inaccessibility than domestic students.
3. The third hypothesis is that international students perceive poor health and behavior outcomes due to food insecurity.

This was the first stage of the study (paper one). In order to further examine the differences of perceptions of healthy and culturally appropriate foods (paper two) and perceptions of and experiences with healthy and culturally appropriate foods (paper three), stage two consisted of qualitative assessment based on (virtual) interviews and built-area mapping for one university located in the mid-west respectively. Thematic coding (inductive) was conducted on the responses to explore the participants' understanding of access to healthy and culturally appropriate foods and perceived health risks. Simultaneously, this was further examined using built area mapping for one university with the maximum number of respondents.

4.2: Preliminary Results

The online survey was open from May 5th through September 30th, 2021 and was available on Qualtrics. A list of 125 universities (refer to Appendix A) in the US, covering 5 geographical zones, namely Northeast, Southeast, Midwest, Southwest and West was prepared and student organizations were contacted via email and social media (Facebook, Instagram, and Twitter) to distribute the survey. A total of 956 student groups were contacted in addition to 10 social media groups of South Asians and a representation of 109 universities in the US was achieved in this study.

A total of 4,226 responses were entered in the online survey on Qualtrics. Upon screening and removing non-institution-based email IDs to ensure student participation and complete responses, 427 responses were used for testing of the hypothesis for this study. The respondents were 51% female (n=215) and 46% male (n=196). The maximum number of respondents were between 23 and 25 years of age (30.4%) and 80% (n=335) were international students, while approximately 20% (n=80) were domestic students. The 80% international student participants represented eight South Asian countries; the maximum number of respondents from India with 327 (70.7%) composition of the sample population. Within the 20% domestic group (n=78), almost 51.3% (n=40) were first generation, 42.3% (n=33) were second generation, and 6.4% (n=5) were third or more generation. There were 293 graduate student responses and 126 undergraduate student responses. Out of 336 international students, 30% (n=88) were food secure and 70% (n=205) were facing food insecurity. Out of 82 domestic students, 49% (n=35) were food secure, and 51% (n=37) were facing food insecurity. Appendix B presents demographic breakdown of the participants.

4.3: Testing of Research Hypothesis

The three hypotheses are stated below with their results.

1. The first hypothesis is that international students perceive greater food inaccessibility than domestic students.

   There were ten accessibility statements provided based on the model by Freedman, Blake, & Liese (2013). Participants has to select how often they perceived barriers to access (five dimensions) healthy foods and culturally appropriate foods separately. Table 4-1 shows the average breakup of response selected by international and domestic students.

Food Accessibility	Often True	Sometimes True	Never True
International Students			
n=336	82	148	102
80%	25%	45%	31%
Domestic Students			
	Often True	Sometimes True	Never True
n=82	9	37	36
20%	11%	45%	44%

Table 4-1: Breakup of responses for food accessibility for students

A chi-square test was performed with student status (international/domestic) with total food accessibility score (categorical variable) to see if the access score was statistically significantly. The findings indicated that overall food accessibility was significantly associated with the student status ($p \leq 0.05$). International students were more likely to face food accessibility challenges as compared to domestic students. The result therefore indicated that the hypothesis is supported. The physical accessibility and access to healthy foods was also significantly associated with the student status. Therefore, students with the international student status were more likely to be facing physical accessibility challenges as well as access to healthy foods as compared to domestic students.

Food Accessibility Variables	Range	N	Mean for International students	Mean for Domestic students	Chi - Square Value
Total Food Accessibility Score	0-10	415	4.3	3.4	31.82*
Physical Accessibility	0-2	415	1.01	0.81	9.53*
Economic Accessibility	0-4	415	1.83	1.48	8.36
Social Accessibility	0-4	415	1.49	1.11	11.80
Healthy Foods	0-5	418	1.99	1.48	20.02*
Cultural Foods	0-5	418	2.35	1.9	10.92

Table 4-2: Summary table for the Chi-square test results for testing food accessibility for students (denotes $p \leq 0.05$)*

2. The second hypothesis is that international students perceive greater food insecurity due to food inaccessibility than domestic students.

   Stemming from the previous hypothesis, this hypothesis investigates if international students perceived greater food insecurity due to food inaccessibility than domestic students. Food accessibility used in hypothesis one, is based on the five dimensions of accessibility (Penchansky & Thomas, 1981; Freedman, Blake, & Liese, 2013).

   Food insecurity was assessed from scoring seven statements adapted from the short US Adult Food Security Module Questionnaire (2012). The mean of international students for level of food security recorded as 1.91 whereas for domestic students was 1.44. Before proceeding to the interaction effect of food accessibility and student status, Chi-square test was performed with international and domestic student variable as the independent (nominal variable) with the categorical variable of food insecurity as the dependent variable. The findings indicated that food insecurity was significantly associated with the

student status, indicating that international students were more likely to face higher food insecurity than domestic students.

It is interesting to note that keeping the original food insecurity scale as defined by US Adult Food Security Module (2012) and the same scoring used in the earlier test, this test was not statistically significant. Therefore, the original short-instrument used by U.S. Adult Food Insecurity Module which stresses on affordability of foods for assessing food insecurity, might improve the assessment with the added statement of 'means of access' to assess the accessibility perspective for an individual.

For the hypothesis testing, logistic regression was conducted with food security as dependent (categorical) variable, and the interaction effect for independent variables: food accessibility (categorical) and student status (categorical). The model was statistically significant ($p \leq 0.001$; Nigelkerke R-square of 14.5%). From the Table 4-3. we observe that international students who faced high food inaccessibility were more than six times more likely to face food insecurity than domestic students ($p \leq 0.001$). Therefore, the second hypothesis is also accepted.

Variables	Reference Variable	Wald	S.E.	Exp(B)
Food Accessibility * Student Status		33.786		**
Food Accessibility (1) * Student Status (1)	Food Accessibility (Marginal) * Student Status (Domestic)	1.971	0.279	1.480
Food Accessibility (2) * Student Status (1)	Food Accessibility (High) * Student Status (Domestic)	30.135	0.336	6.316**

Table 4-3: Logistic regression between food accessibility and student status

Variables	Reference Variable	Wald	S.E.	Exp(B)
Gender	Female	7.567	.250	1.991*
Employment	Employed	2.399	.271	1.521
Residence status	Living alone	16.285	.336	0.257**
Vehicle	Having a personal vehicle	9.357	.273	2.302*
Food Accessibility * Student Status		17.720		**
Food Accessibility (Marginal) * Student Status (Domestic)	(No Issues) (International)	9.071	1.193	0.028*
Food Accessibility (High) * Student Status (Domestic)	(No Issues) (International)	10.635	.249	.444*

*Table 4-4: Logistic regression model with sociodemographic variables, food accessibility and student status (*p<0.05; **p<0.001)*

Upon further examination, logistic regression was conducted with food security as dependent variable and sociodemographic variables such as gender, employment, residence, ownership of a personal vehicle, and interaction effects of food accessibility and student status (categorial variables). The model was statistically significant ($p \leq 0.001$; Nigelkerke's R-square of 20.2%). Gender, residence status, and ownership of personal vehicle was statistically significant. Males were almost two times more likely to face food insecurity as females ($p \leq 0.05$), living with a family or friend was 0.2 times as likely as living alone to face food insecurity ($p \leq 0.001$) and those not having a personal vehicle were 2.3 times more likely to face food insecurity than those owning a vehicle ($p \leq 0.05$). Also, respondents with high accessibility issues were almost half as likely to face food insecurity due to food inaccessibility that those facing no accessibility issues ($p \leq 0.05$).

3. The third hypothesis is that international students perceive poor health and behavior outcomes due to food insecurity than domestic students.

   The survey instrument included two questions on health, first question enquired on their present status of physical health and the respondents choices were very healthy, somewhat healthy, and not healthy. As a preliminary test, Chi-square test was conducted with student status and health (categorical variables) and the result was not statistically significant.

   The second parameter was the level of stress for students, namely physical stress, dietary stress, emotional stress, cognitive stress, perceptual stress, social stress, and financial stress. The total score for stress (ordinal variables) was tested with student status using independent-sample t-test. The mean levels of stress (perceived) for international student were observed to be 3.58, and that of domestic students was observed to be 3.59 out of seven. The independent samples t-test was not statistically significant.

   Logistic regression was conducted with food security as dependent variable and the interaction effect of health and student status as the independent variable (Table 4-5). The model was statistically significant ($p<0.001$; Nigelkerke's R-square of 6.3%). International students who face food insecurity were almost twice more likely to perceive poor health than food secure domestic students.

Variables in the Equation	Reference Category	Wald	S.E.	Exp(B)
Food Insecurity * Student Status (Health)	Domestic	14.246	0.136	1.67**
Food Insecurity * student status (Level of Stress)	Domestic	27.474	0.152	2.22**

*Table 4-5: Logistic regression with health & stress (binary) as dependent variable and food security and student status as independent variable (*p<0.05; **p<0.001)*

Similarly, the categorical variable for minor and major levels of stress was used in the next analysis. Logistic regression was conducted for level of stress as the dependent variable and food security (categorical) and student status (categorical) (Table 4-5Table 4-5: Logistic regression with health & stress (binary) as dependent variable and food security and student status as independent variable (*p<0.05; **p<0.001)). The model was statistically significant (p<0.001; Nigelkerke's R-square of 13%). Therefore, level of stress among international students is associated with a higher level of food insecurity. International students facing food insecurity were twice more likely to face major levels of stress than domestic students who did not report any food insecurity. Therefore, the interaction effects of the two health variables with student status were more likely to predict the level of food insecurity. The third hypothesis is therefore accepted in this study.

One more test was run with the interaction effect of student status and the two health variables in the model. Logistic regression was conducted with food security as dependent variable and interaction effect of food accessibility and student status and interaction effect of level of stress and student status as the independent variables (Table 4-6).

The association was statistically significant (p<0.001; Nigelkerke's R-square of 17.3%). International students who face marginal food accessibility issues are 1.3 times more likely to face food insecurity than domestic students with no accessibility issues and this is not statistically significant. International students who face high food accessibility issues are almost four times more likely to face food insecurity than domestic students with no accessibility issues and this is statistically significant (p<0.05). International students who face a higher level of stress are almost three times likely to face food insecurity when compared to domestic students who face minor level of stress (p<0.001).

Variables in the Equation	Reference Category	Wald	S.E.	Exp(B)
Accessibility Score * Student Status		10.658		*
Accessibility Score * Student Status	(Marginal) (Domestic)	0.933	0.293	1.33
Accessibility Score * Student Status	(High) (Domestic)	10.142	0.431	3.95*
LOS * Student Status	(Minor Stress) Domestic	13.402	0.291	2.90**

*Table 4-6: Logistic Regression using Level of Stress, Food Insecurity, Food Accessibility and student status (*p<0.05; **p<0.001)*

In summary, the hypotheses of this study namely, (1) international students perceive greater food inaccessibility than domestic students; (2) international students perceive greater food insecurity due to food inaccessibility than domestic students; (3) international students perceive poor health and behavior outcomes due to food insecurity were accepted based on the quantitative assessment of the online responses.

The study proceeds to examine the gaps in terms of the understanding of food accessibility factors for students studying in the United States. The next section illustrates the results of the thematic analysis including the definition coined by the majority of the responses on their understanding of 'healthy and culturally appropriate foods'.

4.4: Thematic Analysis

The online responses were simultaneously tracked during the five-month period when the Qualtrics survey was accessible online. The qualitative approach examines the perception of access to healthy and culturally appropriate foods for Indian students in greater depth. From quantitative analysis, food inaccessibility and food insecurity were perceived higher by international students

than domestic students and poorer health outcomes were perceived by international students than domestic students. The qualitative research examines the descriptions of culturally appropriate foods understood by the research participants and if there are any perceptions of poor health outcomes or unhealthy behaviors based on their current diets or from their personal background. The main research question is once again presented below to center our qualitative examination:

Is the association between accessibility and behavioral outcomes different for international Indian and Indian American students studying at U.S. universities'?

The perceptions for both accessibility and health outcomes for international and domestic students was investigated using inductive coding within thematic analysis and the results of this study are presented in the next section.

4.4.1: Interview

There were in total 103 participants who participated in stage 2 and 102 completed their food journal. 88 participants identified themselves with the Indian culture, including 79 respondents who were international students from India and 9 students had domestic student status.

4.4.1.1: Defining Healthy and Culturally Appropriate

A healthy diet has been defined as a diet comprising of appropriate amounts of sufficient macronutrients to cater to physiological needs including hydration and energy requirements of the body (Cena & Calder, 2020; Stipanuk & Caudill, 2013). The literature review discusses the various definitions of food security framed by USDA and UNICEF and other organizations with the emphasis on social accessibility and a diet inclusive of personal preferences (refer to 2.1.1: Understanding Access). This research examines on how culturally appropriate foods are understood and defined by participants in this study.

There were three key characteristics that accounted for variation in the definition of 'culturally appropriate foods' and 'culturally not appropriate foods'. The overall combined themes have been listed below and referenced to the five dimensions of access to understand the relationship of the factors to the five dimensions of access:

a. Contextual exposure over a time period (i.e., availability, accommodation, and accessibility)

b. Foods that are based on personal needs and preferences, including- their methods of preparation may change if the ingredients remain the same (i.e., acceptability)

c. Scientific information or awareness about foods can influence the perception of cultural foods, for example healthier foods are more easily accepted as cultural foods (i.e., availability of information)

4.4.1.1.1: Culturally Appropriate Foods

The three themes listed above occur when participants discussed their perception of which foods were culturally appropriate or not appropriate during the categorization of the food items in the food access activity. While how the items are different in categorization is beyond the scope of this research, participants notions, and descriptions have been coded to understand the key descriptors for defining a culturally appropriate food. The most common themes used to identify culturally appropriate foods by the research participants was as follows:

A. Consumption behavior

(a) Consumption behavior at home or in India

(b) Personal preferences

B. Global exposure

(a) Identifiable to any specific culture (fully or partially)

(b) More found in the US

C. Health relationship of foods

(a) Comprises of unhealthy foods

(b) Cultural foods are perceived healthier

Consumption behavior (n~72) was the most noted response from the interview participants and the most observed response was reference to consumption behavior at home (n~66) including common Indian foods (n~54) and cultural association of foods (n~27); and personal preferences (n~22) of foods. One female respondent who has stayed in the US for less than one semester used the following phrase for defining culturally appropriate,

"Foods that are mostly inclusive of rice or any type of flour and have a mix of lentils and high on vegetables and fruits, and a lot of spices and herbs."

For cultural association, one female participant categorized a food item (*bhang* or drink made from leaves of cannabis plant) in healthy and culturally appropriate column for the food items activity and mentioned the following:

"I've put bhang there, because it's always there on Holi."

Food items consumed on a routinely basis in the home is also more likely to influence the personal acceptability of foods. One female participant who has stayed in the US for approximately a year mentioned,

"The one that I've grown up with, it's cooked in my household"

Another female respondent who has lived in the US for two years defined unhealthy and culturally appropriate foods mentioned,

"All of these is something that is a part of our diet, each and every day, not everyday…. it is a part of the culture. everybody enjoys eating it"

4.4.1.1.2: Culturally Not Appropriate Foods

The most common themes used to identify culturally not appropriate foods by the research participants was as follows:

A. Acceptance

(a) Cultural or social perception

(b) Health perception

(c) Personal acceptance

B. Contradicting ways to Indian traditions or environment

(a) Economic benefit only

(b) Unsustainable practices

C. Not recognized from India

(a) Foreign to Indian environment

(b) Not associated within India

Acceptance (n~40) or the degree of acceptance was the most common code used by the research participants while defining culturally not appropriate food items. Health perception (n~16), personal perception (n~16) followed by cultural or social perception (n~14) were the broad sub-categories. One respondent shared their understanding of the social perspective of foods that are considered culturally inappropriate, female, who has lived here for more than four years,

> *"Alcohol I think, even though I know a lot of people do it back home, it's not still outspoken. Let's not think about the new generation people but like at least in the age I grew up in, they never say I drink alcohol openly"*

Another respondent, female domestic student mentioned a case wherein a food product was perceived as a health risk in India (Sivani, 2015). Her understanding of culturally not appropriate

foods is stemmed from a health perspective as she coded a food product 'Maggi' (instant noodles) as unhealthy and culturally not appropriate foods but are still consumed by her.

"And I think anther thing for MAGGI is that couple of years back, it was banned, I think they found some plastic in it, and I think it's like psychological, and I still associate Maggi like that but that still doesn't stop me, I'll still eat it."

Contradicting ways to Indian traditions or environment (n~8) was also mentioned and regarded important as it perceived foods being manufactured only for economic benefit (n~4) or foods made from unsustainable practices (n~4). One female who has lived in US for more than four years and has also worked in university dining hall mentioned the following statement:

"I don't like food being wasted. If in any culture, I see food being wasted, that's culturally inappropriate."

While food wastage is a global issue, another participant mentioned when foods are geared only towards economic benefits, they may be considered culturally inappropriate. Female who has been here for less than a year from India states,

"Those that don't have the original India, or they have been white-washed or globally washed, to appease the global palette."

It is important to note that there was a difference between culturally appropriate foods and foods that were culturally associated with on a personal level. The majority of the participants were able to list only Indian ethnic foods or food products that they were able to personally associate with but mentioned that all foods including versions of Indian foods, Mexican, Asian or other cuisines as culturally appropriate to them. Therefore, the definition of culturally appropriate and not

appropriate for individuals when it comes to foods, is not necessarily mutually exclusive and can overlap based on the three overarching themes discussed earlier (contextual exposure over a time period, foods that are based on personal needs and preferences, and scientific information or awareness about foods can influence the perception of cultural foods). Additionally, it is important to note, that students who either had exposure to global foods back home or had spent a significant amount of time in the US (more than 4 years) categorized foods as not being culture specific, and by default, all foods being culturally appropriate for them.

Respondent A, female who has lived in the US for approximately less than one year defined culturally appropriate as:

> *"…anything that I see, and I quickly identify to a specific culture, then I put it in culturally appropriate. But if I see something that like meh, or generic, it just exists, if I can't specify it to a specific culture, intensely then I just put it at culturally not appropriate"*

Respondent B, male who has lived in the US for approximately three years defined culturally appropriate as:

> *"I would say that if I were eating all those things before I came here and it was easily available while I was back in India, I would consider them culturally appropriate."*

These defining criteria were influenced by factors of time spent in the US and exposure to foods in the home environment generally. The combination of the influences also seems to influence the two dimensions of accessibility as previously published by Freedman, Blake, & Liese (2013), acceptability or personal preference to accept different foods in one's diet and accommodation,

the act of including provisions based on community's needs were mentioned by the interviewees. This has been presented in more detail in section D of 4.4.1.2.

Therefore, in summary, the factors most noted for understanding culturally appropriate foods were 1. Indian foods or the foods that were eaten at home and were widely available, 2. ethnic foods including regional foods and variations of ethnic foods, 3. traditionally prepared foods with appropriate ingredients, and 4. foods that were procured sustainably.

4.4.1.1.3: Culturally Associated foods

While the perceptions of what is culturally appropriate varied per individual, familiarity with home-cooked foods and foods that contain the essence of ingredients and spices were more inclined to be categorized as culturally associated. These were typical foods for consumption on routinely basis.

The female respondent A defined foods that are culturally associative as:

> *"It would be like, all Indian food would be like cultural food, from home. From my cultural background. But then other foods, such as like, especially from restaurants, specific type of restaurant. I would associate with a specific culture."*

The male respondent B defined foods that are culturally associative as:

> *"Indian foods or a variation of Indian foods. For example, momos, I consider them Indian. Like, if I find them easily around me and they are not very expensive. So, I associate them with Indian food."*

Another respondent C, female who has lived in the US for approximately three years defined foods that are culturally associative as:

> *I think I'd say mostly Indian foods or Indian version of food. I wouldn't say pasta is not something that I wouldn't consider culturally apt because my mom*

used to make pasta a lot. Maybe like an Indian version, she used to put more spices in it, or used to make it more Indianized. So, I think the umbrella would include Indian foods and maybe Indian versions of other cuisines like the Indochinese cuisines and things like that.

This shows the overlap of culturally associated foods and culturally appropriate foods based on an individual's understanding. From observation, all culturally appropriate foods may or may not be culturally associated foods. However, culturally not appropriate foods would be more likely to not be culturally associated as well for an individual.

4.4.1.1.4: Health

Another interesting aspect that linked culturally appropriate and not appropriate foods was the connection to physical and mental health. One female respondent defined culturally appropriate in association with nutritional foods as,

"foods that are nutritionally beneficial for you, it's culturally apt for you"

Another female, who has lived in the US for almost three years mentioned culturally appropriate foods providing her with a sense of liveliness with the Indian foods she was consuming.

"…These Indian foods are keeping me connected to my culture and keeping me alive."

Another female participant responded to culturally appropriate foods, as

"foods that makes me feel good about myself."

While healthy and culturally appropriate for some was easier to recognize, one participant shared their experience of consuming unhealthy foods and culturally appropriate foods and being able to associate it to their lifestyle. A female participant expressed the level of gratification with unhealthy and culturally appropriate foods as follows:

"If we say about the gratification, obviously it's going to be unhealthy and culturally appropriate food for me"

In another instance, a male participant who has resided in the US for approximately four years, while defining unhealthy and culturally not appropriate food products mentioned the following statements:

"Unhealthy and culturally not appropriate… things I started eating that I started eating after coming here. Those would be pizzas and pastas a few alcoholic drinks. Something that is easily available around me, burgers and stuff…. I try to minimize my monthly bill. so culturally inappropriate and unhealthy would be stuff that I eat mostly to save money and I don't have to cook that often."

While the perception of health risk in the quantitative survey was not statistically significant. It was interesting to note that when asked if the participants perceived any health risk based on current diet, lifestyle or family background, there were three categories of responses recorded.

Student Status	There is no health risk	There is a minor health risk	There is a major health risk
International (n=78)	36% 28	54% 42	10% 8
Domestic (n=8)	12.5% 1	87.5% 7	0% 0

Table 4-7: Student response to any perceived health risk during the interview

Participants who recorded no health risk also mentioned following a healthy diet and staying physically active. Participants who recorded minor health risks mentioned weight gain, nutrient imbalance due to unhealthy diet, and chronic food related illnesses in their family such as diabetes. Some participants who were international students mentioned major digestive problems and experiencing inflammatory problems stemming from poor diet.

In summary, the definition of culturally appropriate foods changes based on the local food environment and other factors for students moving for higher education, which includes international students as well as domestic students from other parts of the country. Therefore, recognizing factors for culturally appropriate and associated foods is vital to understand for diverse groups in the US. The next section explores the other factors that were noted by the participants related to the five dimensions of access. The themes were coded based on responses that played a role in understanding the shift in food accessibility among the participants.

4.4.1.2: Access Components for healthy and culturally appropriate foods

Based on thematic coding for 88 participants from Indian origin, five themes for access were observed for understanding the proponents for accessing healthy and culturally appropriate foods. These along with the sub-themes are briefly described below. The complete list of codes and descriptions are available in appendix E.

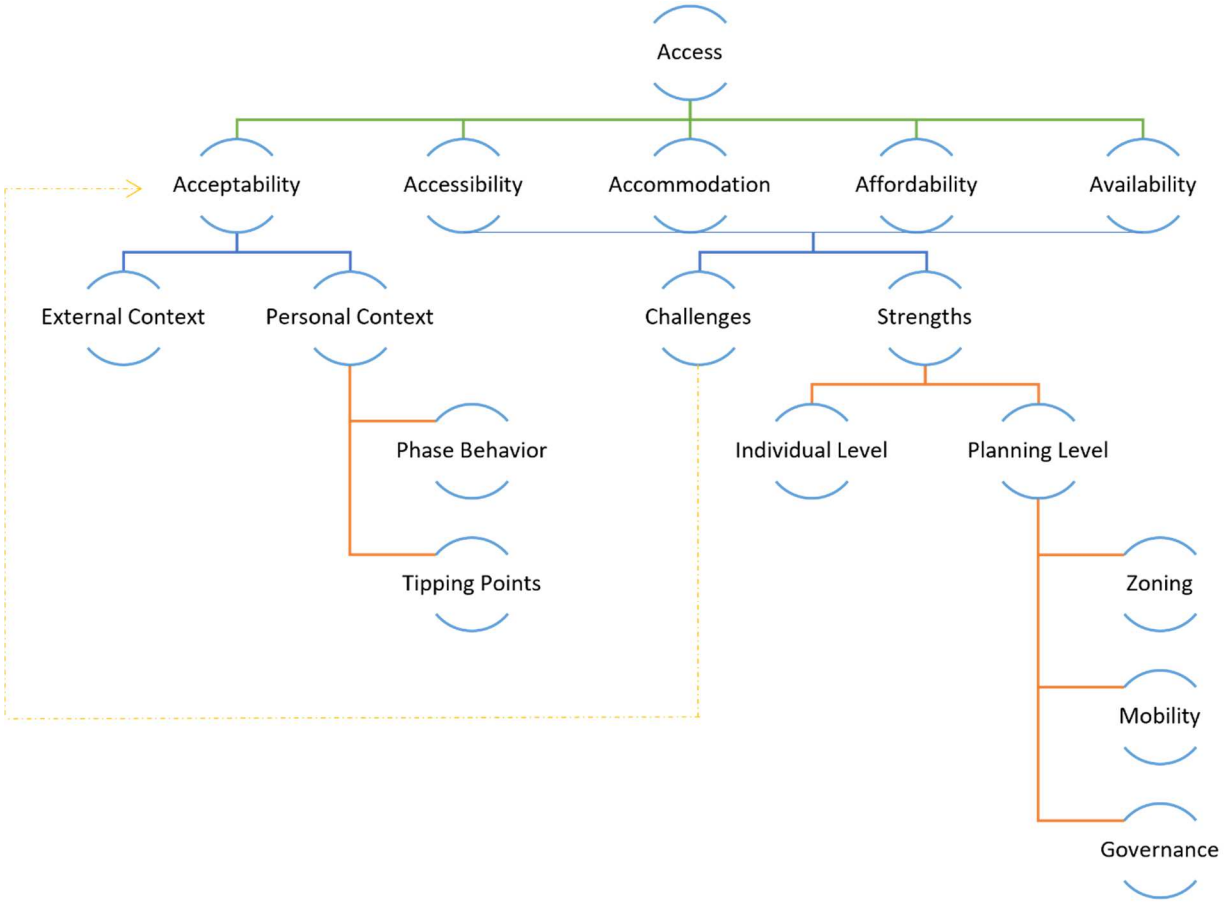

Figure 2: Response code framework for the five dimensions of access

In the interest of this study, challenges and strengths noted in relation to planning under every dimension of access except for acceptability have been presented in the results Figure 2. The challenges noted in accessibility, accommodation, affordability, and availability tended to influence the acceptability for an individual which is represented with a dash yellow line.

4.4.1.2.1: Acceptability

The personal preference to include a food item in one's personal diet can be defined as acceptability. The codes were broadly classified under two categories, namely externalities (or external context) and personal context. There were two behaviors that also emerged from the

discussions on acceptability, these were the phases of behavioral changes with time on food acceptance and tipping points for changes in the food consumption.

(a) External Context

External context influenced an individual's level of acceptance towards a food item or product. These could be observed being spoken with respect to other dimension of access. Respondents (n~63) mentioned external challenges in relation to availability (n~61) and accessibility (n~4) and affordability (n~3) of foods in their local food environment. In addition, they also mentioned a key factor of education and awareness (n~19) with regards to reading food labels, social access, and their relationship to foods.

(b) Personal Context

The statements were coded based on an individual's personal behavior that also shifted acceptability towards different food items. Adjusting (n~79) and health (n~57) were the two criteria mentioned by majority in the personal context for acceptability. Within the umbrella of adjusting, cooking skills (n~74) and personal choices (n~72) were mostly recorded. It is interesting to note that under personal choices, acceptability is influenced by time, people, and environment and one domestic student provided a summary of his experience in the following statement:

> *"Starting around when I was 14 years that when my food palette increased exponentially to where I could handle a bit of spice. Now I absolutely love Indian food and I'm not afraid to go out with my friends and go get some Indian food. when I was younger, I never ate too much Indian food."*

Health has two major components, behavior (n~48) and risk (n~19) of consuming foods. These were mentioned by survey respondents as they influenced their personal choices of accepting the

foods in their diet. In the case of a female student, acceptability was highly intertwined with her physical and mental wellbeing. Her statement below summarizes this experience in her journey till now as an international student.

> *"I miss food. I personally feel as if, you travelled to another country to make your life, or you want to achieve, but sometimes I feel the whole point of studying so hard is so you can have a good meal. You want to feel happy; you want to feel content. I miss it really bad, but its ok. I have no other choice"*

b.1 Phase Behavior

There were three stages of behaviors observed in the majority of the participants. The initial, middle, and late phase experiences were similar and were based on the time spent on higher studies in the US by the respondents. The changing pattern of access to foods followed the three phases. The initial phase (n~28) with majority of the respondents who had spent less than a semester in the US, involved a lot of unhealthy foods including eating out, access to university's provides free foods or snacks for incoming students and for some, shifting to healthier diets or relying on foods from India were mentioned. One female participant mentioned the following experience during her initial few weeks in the US.

> *"Initially, it was mostly cheap frozen food, frozen options, ready to heat."*

With broader diversity of foods, some respondents also slowly shift to healthier pattern while transitioning through the middle phase (n~5).

> *"During the initial semester, during the masters, when the courses were tough, we used to switch to the bottom food or pre-processed food in the initial days, for couple of months. And then we realized the importance of eating healthy foods, fresh food. I started cooking myself. I switched, almost to 90% home-cooked food and 10% outside food, once a week or once in two weeks."*

Once the students have acclimatized, the later phase (n~9) witnessed maturing eating habits while preparing more meals at home and due to health reasons. One male and one female international student mentioned preparing meals at home and consuming fresh meals at regular times.

Male – "But now we mostly eat fresh, homecooked food. For example, Potstickers (dumplings). We have made pizza at home…"

Female – "The foods are homemade on an average. I know am cooking almost every day. ... Earlier, the course load was kind of tough, so I was eating frozen foods or snacks. There was a time when I ate Maggi without cooking it, biscuits, chips, so stuff like that. Even though it was bought in package, I would still eat it at home. The habit was to eat at home… And now I'm coming back on the course where I am cooking everyday"

Similar to this behavior, the concept of acculturation has been discussed in section 5.2.2. Acceptability. This discussion is important because while the majority of the aspects of acculturation may seem similar, there are subtle differences worth noting that makes the acculturation process slightly different for Indian students with regards to accessibility.

b.2 Tipping Points

There were four main behaviors that were observed from responses to accepting various foods in an individual's diet. The first point was cultural shock or homesickness (n~4), second is cost conversion (n~5), third is health or perceptions of health (n~27), and fourth, environmentally conscious behavior (n~9). These shifts were corroborated with changing access to foods for majority of the participants based on their pattern of time spent in the US and exposure to foods in the local food environment while staying in the US. The tipping points were seen as a pattern occurring in most of the respondents however, variation for those in bigger cities or those with scholarships followed a slightly shifted pattern of adjusting and accessing foods in the US.

(c) Strengths

Managing foods and learning (n~46) was perceived as a positive response by a majority of interview participants, followed by accepting quick foods or meals during finals or any stressful week (n~21). One female participant shared her experience on managing foods in the US,

Otherwise, I do tend to cook at home. In my four years, I've learnt a lot of dishes.. also, because I had different kind of roommates, some were south Indian, some were from different parts of India, I got to learn a lot of f different dishes from their regions. And I think this is something that I would not have gotten staying at home or like in India. So, I really enjoyed having to learn different kinds of cuisines which were within India, and I learnt them outside India.

While another female international student was able to compare the foods from three different environments and underlines the notion of acceptability from different sources within a local food environment.

Living off-campus and having to buy groceries and cook… I think its healthier than the dining hall, but I'd say it's not the same as eating at home.

While managing and learning how to prepare meals for international students was interesting, homecooked meals for domestic students came in handy during stressful weeks of the curriculum. One female student shared her process of eating culturally appropriate meals during finals week, written below,

With finals, I do like don't have Indian foods because what ends up happening is that most of the food that my mom sends over throughout the year, I put them in the freezer. And then I save them for finals week .. when it's finals, I don't feel like making anything . so, I probably eat more culturally appropriate foods during finals.

4.4.1.2.2: Accessibility

(a) Challenges

Respondents noted planning level challenges (n~73) and individual level challenges (n~33) when it came to accessibility within the local food environment. Planning level challenges stem from mobility (n~49), zoning (n~48) and governance (n~21) issues.

While challenges to using public transit (n~28) was most noted, online delivery (n~20) was the second most noted challenge. One student shared their experience for a planning of a weekend grocery run when the bus routes did not ply and the grocery store is not within walking distance which was one of the common experiences shared among international students.

> *"Due to access, let me tell you a situation about today. We have run out of onions, and we don't know what to make for dinner tonight. Since today is Saturday, buses don't run, and we can't even go to Walmart. And we cannot even go walking is a challenge. Yes, sometimes we compromise due to access."*

Under the umbrella of zoning, challenging access to grocery stores (n~33), on campus facilities (n~14), and access to religious institutions (n~9) were most noted. Some international students faced similar issues, depicted by a statement used by one international female student who has been in the US for less than one semester.

> *Some stores near campus, they are expensive, so when we go for affordable options, it's not really that physically accessible.*

Another student shared their experience to access an Indian store for groceries during the COVID restrictions, or rather could not access Indian groceries due to limited transit and no online delivery options offered.

A lot of American grocery stores has the online option, but a lot of Indian stores didn't. or if they did, it would be through a third party, which would be very expensive. We couldn't get Indian groceries for a long time.

Another student shared their experience to access a religious institution but failed as it was located beyond the city limits with no public transport connection which may be typical in small university towns.

I wanted to go but never had the access. It's pretty far. The only option is uber. Because the city transportation is limited to the city limits. So, it's beyond the city limits.

COVID impacts for students included both physical access due to limited transit restrictions and budgetary constraints. While there is no supplemental nutritional program that international students can gain access to, some universities tried to overcome the challenge to access to groceries by providing them access on campus. One international student shared her challenges even with this provisional effort by the university

Because of COVID, In our college, we used to get weekly rations, so I used to get them sometimes. But not always, because I had classes when they were giving it out, so I couldn't go and take it

(b) Strengths

While there may be more challenges recorded from the participant perspectives, student also shared planning level (n~75) and individual level (n~5) positive experiences for accessibility. Mobility (n~70), zoning (n~22), and governance (n~4) were the main categories of planning level

positive experiences noted. Mobility included emphasis on free bus transportation on campus (n~20), social access to foods (n~51) and walking or biking (n~22). One student who recently graduated shared her mobility experience while studying in the US and also shares the reason for not transitioning to a owning a personal vehicle on campus.

> *And I still have my ID, so I can go everywhere for free. Any public transit. I think [University Name] has a very good public transit system, which not only is good on campus but also off-campus, if you want to go to the mall or grocery store which might be far away. Even if it is 10 miles away, even that has a very good bus connectively. I think the bus system has been a blessing and that's the primary reason why didn't need a car for like four years.*

Zoning majorly emphasized on local food environment which included access to restaurants (n~7), grocery stores (n~5), and dining halls (n~4). An experience from a domestic male student staying on-campus shares the exposure to the variety of food retail options available in close proximity to the residential colleges. This also indicates the advantage of having dense food retail or mixed-use buildings near them to access the variety of foods near campus.

> *My location on campus is really good. There are 4 dining halls within 5-minutes from me and a bunch of restaurants, because I'm close to high street, which is our main street. There's a bunch of restaurants.*

Another female- international student shared her need of accessing organic foods from sustainable retail opportunities after staying in the US for more than one year

> *I'm trying to get more organic foods and going to co-ops. Before, I just used to go to the cheapest store. Now I go to the farmer's coop, and local products.*

While governance can be focused on access to alternate food retails in and around the university such as community supported agriculture (CSA), food trucks and university co-operatives, it also includes an experience of a registered student organization that helped organize and operate food accessibility initiative during the COVID pandemic.

> *Another thing we did in pandemic- we coordinated with the supplier, the 12 miles one, student could order from their home, they could deliver foods at our doorstep every Wednesday. So, in terms of accessibility, they helped during the pandemic.*

Another interesting attribute that came across while researching alternate markets, was the exploration of employment opportunities related to food service by the students who were interviewed. Two domestic students, one female student mentioned working in the local community supported agriculture garden that helped her access fresh groceries and second, a male student who worked for INSTACART for earning as a side business. Both these cases can show an emerging pattern of off-campus student employment which will be discussed in section 5.3.3.

4.4.1.2.3: Accommodation

(a) Challenges

Accommodation was explained to the students as a when there is a need for a certain food item be made available on demand within a local food environment, the fulfillment of that request was deemed accommodating. While not many students were aware if that was something within their purview, the main challenges they faced were on the planning level (n~48) and personal acceptable level (n~4).

The planning level comprised of two main accommodation locations that students may frequent, grocery stores (n~31) which included both Indian and American supermarkets and on campus facilities (n~19) such as food pantry and from within university departments. One international student exhibited disappointment with accessing Indian foods in her city and therefore leads to challenging accommodation behavior in the local food environment.

I just wish they had more Indian foods even in the small towns… when you stay in a small town like Morgantown, there aren't many Indian communities around here, and then it becomes really difficult.

A domestic student living in a city with a decent Indian professionals population mentioned challenge to access fresh fruits at an Indian grocery store in the city. Similar cases were mentioned of challenging access to fresh product at Indian groceries but were categorized as an availability issue since their comments stemmed from the experience of the foods that were available to them. On a personal level, two instances of poor accommodation behavior were recorded by two international male students studying in the US. The first student shares the incident as follows:

So, there was one weird experience. I went to NY City, few days back. There, I was exploring some lunch options. Since we were out of time, I went to a food stall there, which was on nearby roads, and they were selling hotdogs. So, I was asking if you have any hotdog with chicken, without any beef or pork and he was telling me, there was only one option with chicken in that. When he gave me that hotdog, it did not taste like chicken. One of my friends confirmed that it was pork, so the person lied. So that was weird. I was ok eating pork but not beef. But generally, I try to avoid there.

This poor response to a request can lead to other issues which have been briefly discussed in the discussion section 5.4.1. In another instance, the general experience of visiting an Indian grocery

store was shared by another student. This behavioral response impacted the individual's choice of accessing the Indian grocery store:

> *Usually the interactions are pretty less, with what it is, I don't like going to these places unless it is very necessary. Usually if you go to the US supermarket, they are much more welcoming and more helpful. When you're trying to find information about some item, usually they are very helpful in nature. In Indian store they are not. They are not helpful and not inviting in nature. Most of them have a very established business and they know they have people will def come over here to get the stuff, so their behavior is not very good.*

One international student shared his experience for requesting ingredient information at two separate locations, off campus Indian restaurant and an on-campus dining hall. This anecdote is important to mention as the NHIMES Consumer Behavior Survey requests access to ingredient information and is considered a factor for understanding food insecurity in individuals.

> *If I go to an Indian restaurant, I have to look through the ingredients, because in the board they might say it's chicken but in the ingredients, they will say it has pork also. I saw a lot of them. then on the campus, they added alcohol on most of the desserts, and I need to look at which one doesn't have alcohol, if I need to try anything. Yeah, I find the information easily available, but for the dessert, they scatter all over the things. They don't actually label that this one is this, and this one is this. It's not like one list, that they have ten items available, I have to ask someone, which one is this one that doesn't have alcohol. That's a hustle on on-campus dining.*

(b) Strengths

Participants mentioned two main positive experiences within their local food environment, one was the accommodation of multi-ethnic foods on campus (n~3), American supermarkets accommodating Indian foods in their units (n~3) and accommodating needs on demand (n~2). One

international student who recently travelled from India shared her interesting experience of finding Indian cultural foods in an American supermarket.

> *Previously when I was in India, I was talking to my seniors and everybody used to say that you won't get anything in Walmart, you will have to go to the Indian store, and get this, that. Surprisingly, I did invest a little bit more time than what they do while normal shopping. I found basmati rice and ghee at Walmart, their own brand!*

4.4.1.2.4: Affordability

(a) Challenges

There are two main affordability challenge levels, planning level (n~52) and personal (n~24). Within the planning level, local food environment (n~32), mobility (n~24), zoning (n~9) were the three categories for exploring affordability challenges. The affordability of accessing foods from an Indian store (n~24) was mentioned as a major barrier within the local food environment which included the mention of over-priced food items (n~21) available and problems with payment (n~3) at the front desk. Within mobility, participants mentioned affordability being a deterring factor for online delivery (n~10). Yet, another trade off that student mentioned between affordability and accessibility (n~16) is shared below in a statement by a female international student:

> *Target is close by, but it's costly. And Walmart is affordable, but quite far away*

Lastly, zoning was categorized based on accommodation (n~6) and availability (n~3) perspectives shared by the participants. Students mentioned of a culturally accommodating store on campus and access to Indian stores near campus, however the affordability of foods from anywhere on or

near campus was deemed expensive or unaffordable. Though the number of participants who mentioned this aspect is low, their relationship of these two dimensions of access to affordability is important to understand the behavior when it comes to accessing healthy and culturally appropriate foods.

On the personal level, personal preferences (n~21) included initial phase challenges which were similar to challenges mention under tipping points 1: cost conversion (refer to section D under section 4.4.1.1.). This was closely followed by challenges in affording various types of foods (n~15) such as Indian foods, organic foods, etc. An interesting relation between affordability and acceptability was shared by one international student, when he was asked about accessing canned food items.

> *We were skeptical about who knows how healthy they are or not. Once we realized how not economical buying, or how economical getting certain vegetable as canned vegetables is , we started shopping that from local grocery shops. We saw it's a standard issue here.*

(b) Strengths

There were few positives notes and appreciated by the student respondents with regards to mobility (n~5) and zoning (n~5). First, Access to fare free bus service as mentioned in accessibility also impacted affordability aspect of grocery shopping for students. Second, availability of food retails in some cases was observed as a positive relationship such as culturally appropriate food products that are available in American supermarket were more affordable than the Indian store. One domestic student shared the food payment system that is centralized from the university and that helps in affording the nearby food outlets in his local food environment.

I get 14 swipes a week. One swipe is equivalent to $8-12 dollars. If I want a pasta bowl its $8. So, it's one swipe. I'd say one meal is about $8. I get 14 swipes a week and then I get 150 dining dollar and 135-150 buck dollars. Dining dollars, if you use those, you get 35% off. And buck ID is straight up dollars. For food. but like I can use dining dollars at chipotle, and I can use Buck ID at chipotle. I can use the Buck ID at target and at CVS. So, places around campus are affiliated with that.

4.4.1.2.5: Availability

(a) Challenges

Respondents mentioned personal preferences (n~21) and availability of different market products (n~19) as two main categories under personal level challenges. The majority of responses mentioned about food items that were available but were not personally acceptable (n~14). Under planning level issues, local food environment (n~74), mobility (n~46), and zoning (n~39) issues were observed. Under the local food environment, respondents mentioned that there is lack of relevant (quality or quantity wise) products that deters availability from grocery stores (n~20) and limited availability of Indian cultural foods (n~24) and fresh produce (n~14) at the Indian store (n~51) was a challenge in availability.

Participants also mentioned facilities in the university (n~55) such as availing foods from the food pantry (canned foods) (n~28), less healthy foods available (n~14) and less foods available in general (n~14); and finding student organizations not very useful in sharing information on food access (n~18) to be some of the major challenges. Under mobility, social access to avail foods (n~40) was the major challenge, categorized under the headings –religious institutions (n~26) and education (n~17).

Under the broad topic of zoning, place-based availability (n~30) and affordability (n~15) were the two main criteria noted. Under placed-based availability, majority of the students noted that Indian

stores were usually away from the campus (n~13). Moreover, in relation to affordability, food products that were available near to the campus were not affordable to them (n~15). Both these influenced participants preference of availability.

(b) Strengths

Personal level (n~21) and planning level (n~87) positive experiences were coded from participant responses. Under personal level and as mentioned earlier, respondents tended to avail products that were conveniently available and acceptable to them (n~15). Under the umbrella of planning, local food environment (n~82), mobility (n~55), and zoning (n~18) categories were prevalent. Under the local food environment, participants mentioned that on campus student organizations (n~49) were key in helping availing foods during the COVID pandemic (n~43) and providing information on food access and resources associated (n~7) to that in the initial adjusting weeks. The second most commonly mentioned supermarkets and grocery stores (n~37) had a positive impact due to the variety of foods that were available (n~37) including ready-made meals (n~9) and availing essential food products (n~12). On campus (n~21) availability of different types of foods which was near to the students (n~19) was also a positive experience.

Under mobility, participants mentioned social access to foods (n~50) as a positive experience. This included accessing food from or with their social networks (n~22) and from religious institutions (n~26). The other aspects mentioned under social access was getting foods couriered from India (n~8) and gaining knowledge on foods and diet from the university (n~3). Under zoning, participants observed that more variety of Indian foods were available in an area with a higher demand (for example in big cities or in social enclaves) (n~8) and everything that they needed was available in the Indian store (n~6).

4.4.2: Food Journal

87 participants from the interviews turned in their 1-week food journal in the format provided and they noted three key things. The meals including (1) ingredients, (2) quantities for each meal or ingredient and (3) if the meal was prepared at home or procured from outside. At the time of sharing and receiving responses for the food journal, there were a few times, that a product was store bought (e.g., raw fruits, bottled drinks, yogurt, etc.) that required no element of cooking and were asked to be highlighted as store bought unless prepared from scratch at home. This enabled another classification for homecooked and FAFH meals together instead of depending on participant's perception of only eating at home as homecooked meal even though majority of it was prepared outside.

On average, participants reported eating an average of 15 meals at home in a week which was more than 53.5% of the total time (out of 28 meals). In addition, they also reported having 7.4 FAFH meals (26.7%) , almost 3 meals which included both homemade and FAFH (10.7%) and 2.5 meals were skipped (9%). When comparing international (n=82) with domestic students (n=8), international students were 1.25 times more likely to eat homecooked meals than domestic students and 11 times more likely to eat a combined meal of homecooked and FAFH meals. Whereas domestic students were 1.7 times more likely to eat FAFH and 1.5 times more likely to skip meals. This shows the tendency for international students to access foods that would enable them to eat at home, whereas the tendency of domestic students to access outdoor meals (FAFH) on a more routine basis.

4.5: Built Area Analysis

The built area analysis was conducted to understand the grocery behavior at a local level for students living on and off-campus. The results in this section have been combined with the online

Quantitative analysis requesting information on grocery store access and has been presented below.

4.5.1: Grocery Stores

From the Qualtrics survey, the students completed information on three types of grocery stores that they access and any place where they receive prepared meals from. Apart from the names and location of the grocery stores, students had to fill out their mode of transportation, frequency of trips and time taken to travel one-way to the store (Table 4-8).

Variables for accessing Grocery store by population	International Students (%)	Domestic Students (%)
Mode of Transit	n=881	n=414
Drive	37.2%	57.5%
Walk/Bike	27.1%	24.6%
Public Transit	27.8%	11.6%
Delivery/Pickup	6.7%	6.3%
Others	1.1%	0.0%
Frequency of Transit	n=741	n=178
Less than once a month	13.2%	12.4%
Once a month	27.7%	25.8%
Alternate Weeks	32.8%	37.6%
At least once a week	22.3%	16.9%
More than once a week	4.0%	7.3%
Time Taken to Travel	n=730	n=172
Less than 10 minutes	16.4%	29.1%
10-15 minutes	19.3%	23.8%
16-30 minutes	27.7%	24.4%
31-45 minutes	15.3%	14.0%
More than 45 minutes	21.2%	8.7%

Table 4-8: Online survey responses for access to the grocery stores comparing the student status for all responses

Almost 60% of domestic students prefer to drive or carpool to get to a grocery store, whereas 27% of International students prefer to walk or bike and use public transit to access a grocery store. It is interesting to note that 1.1% of international students were observed to use online delivery or

pickup option to access the supermarket in comparison to no domestic students mentioned they needed to order their groceries online in the last 30 days. This can be explained since majority of the domestic students have access to a car, international students are more likely to opt for online deliveries, especially since certain barriers exist such as physical and economic means of accessing a grocery store during a pandemic.

Less than 9% of domestic students have mentioned taking more than 45 minutes to travel to a grocery store, whereas almost three times that percentage of international students have mentioned spending more than 45 minutes. Since time is a perceived constrain for students to allocate towards grocery shopping, this may also result in forcing international students to pursue alternative modes of transit such as online delivery, to utilize the time more efficiently towards their educational goals.

Variables for accessing Grocery store by type of store	**Supermarket (%)**	**Indian Store (%)**
Mode of Transit	n=105	n=33
Drive	42%	42%
Walk/Bike	14%	3%
Public Transit	40%	48%
Delivery/Pickup	4%	0%
Others	0%	6%
Frequency of Transit	n=104	n=31
Less than once a month	8%	23%
Once a month	18%	42%
Alternate Weeks	41%	23%
At least once a week	29%	10%
More than once a week	4%	3%
Time Taken to Travel	n=103	n=32
Less than 10 minutes	21%	9%
10-15 minutes	22%	16%
16-30 minutes	25%	25%
31-45 minutes	14%	13%
More than 45 minutes	17%	38%

Table 4-9: Online survey responses for university students included in built area mapping

Supermarkets such as Meijer, Aldi, Kroger, Costco, Walmart which were coded if respondents had mentioned even one out of three options. Participant responses for Indian stores were coded if they mentioned the names Swagath or Swadesh. From Table 4 - 9: Online survey responses for university students included in built area mapping, only 3% of students can walk or bike to an Indian grocery store, whereas 14% can walk or bike to a supermarket. Even though the distance is not that different between average of supermarket and Indian store, the percentage of students spending more than 45 minutes to reach to Indian store is double than supermarket, which explains the less frequency of travel of less than once a month to the Indian store (23%) as compared to double that percentage of students travelling to supermarkets (42%).

Alternate food retail outlets	**International students**			**Domestic Students**		
	Mean	**N**	**% of students**	**Mean**	**N**	**% of students**
Food Bank	1.53	n=331		1.68	n=78	
Yes		156	47%		25	32%
No		175	53%		53	68%
Religious	1.74	n=328		1.68	n=77	
Yes		85	26%		25	32%
No		243	74%		52	68%
Farmers Market	1.59	n=330		1.44	n=79	
Yes		136	41%		44	56%
No		194	59%		35	44%
Off-Campus Fast Food Chains	1.18	n=331		1.11	n=81	
Yes		271	82%		72	89%
No		60	18%		9	11%

Table 4-10: Distribution of participants using alternative food retail outlets within the last 30 days

Table 4-110 (cont'd)

Alternate food retail outlets	International students			Domestic Students		
	Mean	**N**	**% of students**	**Mean**	**N**	**% of students**
Online Grocery (Amazon)	1.46	n=328		1.36	n=78	
Yes		177	54%		50	64%
No		151	46%		28	36%
Online Prepared Meals (Blue Harvest)	1.84	n=327		1.73	n=78	
Yes		52	16%		21	27%
No		275	84%		57	73%
Online Food Delivery (Door Dash)	1.32	n=327		1.15	n=80	
Yes		225	69%		68	85%
No		108	33%		12	15%

There are three points to highlight from this table. (1) International students are more likely to use the on-campus food bank than domestic students as domestic students may have the ability to go back home to bring homecooked meals with them and freeze them which was also mentioned during the interviews (availability). (2) International students are more likely than domestic students to reach a religious institution to fulfill their personal needs and maybe able to access meals from there. This point has also been explored further in the thematic analysis under social accessibility. (3) International students are more likely to perceive a farmer's market more expensive and in certain cases, inaccessible.

A clear majority of both international and domestic students access off-campus fast food chains which benefits from the availability of food options in the local food environment. It is also important to report the access to online food models that students have indicated in the online survey. International students are split almost evenly to access groceries through online grocery

portals such as amazon or Instacart and majority of the students are not likely to access online prepared meals. However, a clear majority of both groups are more likely to order online for food delivery of prepared meals from UberEATS and Door Dash. This result was further examined during the interviews and has been discussed in the section 5.5.2: Mobility.

4.5.2: Food Density Mapping

From the maximum number of 133 responses collected from Midwest region of the US, the highest number of 54 responses were from one university in the Midwest. On campus there are two market layouts called Sparty's market located on 1855 Place and Sparty's mini-market, located in fifteen buildings on campus (MSU, 2021). Apart from that, the campus has nine dining halls, three food courts, and nine grab-and-go convenience stores and a weekly food truck service on campus and one food pantry that gives away produce (and sometimes meals) on a weekly basis from the Olin Health Center, north neighborhood. Additionally, there are two stores, MSU Bakers and MSU Dairy on campus for students to grab foods.

After reviewing for completeness, 52 responses were located on the map (Figure 3). Two students locations and grocery points were outside the state of Michigan and were excluded from the mapping analysis. 49 students were international student and only 1 was a domestic student. Respondents had to write any three places where they procured their grocery items from within the last month. 21 Food retail places were mentioned within Michigan for grocery shopping. Within a radius of 0.5 miles around campus, there is one full-service grocery store (Fresh Thyme) on the south-west corner of the campus, 1 urban model of a large grocery store (Target) which was opened in 2019 on the north end of the campus, and one farmer's market in Downtown East Lansing that is organized once a week from May to October, one Indian food store, four dining halls were mentioned, and one college food pantry.

In another question, respondents were asked to fill details for any place they have procured packaged or ready-to-eat meals within the last twelve months. There were 13 times a friend or a relative place was mentioned within the state and 12 places entered outside the state of Michigan, out of which one was a religious institution.

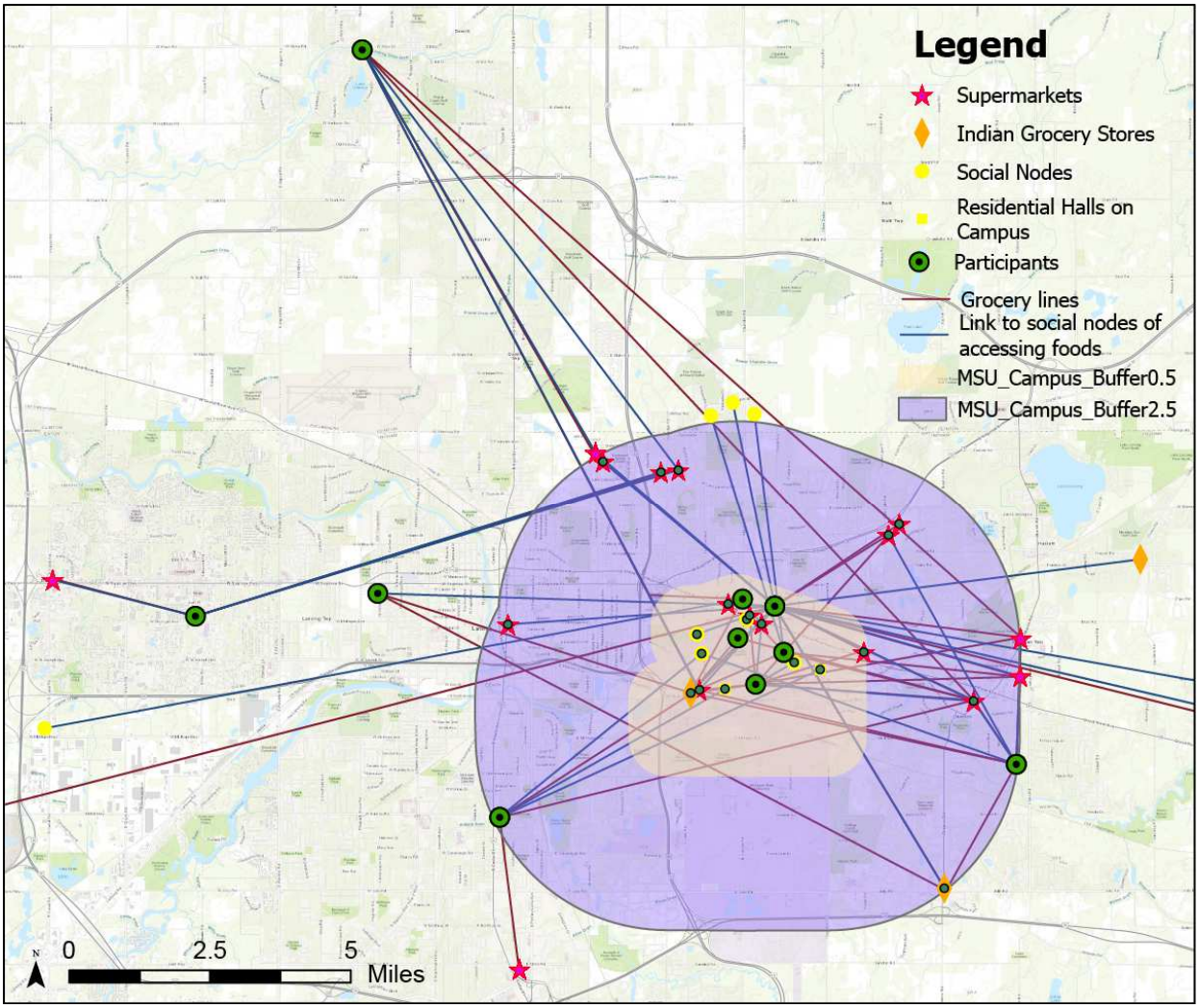

Figure 3: GIS map with respondent locations and grocery store points

Based on the completed responses collected in the online Qualtrics survey, one university with the maximum number of complete responses was chosen for the built area analysis. 53 student responses were completed from Michigan State University located in the Midwest region of the United States.

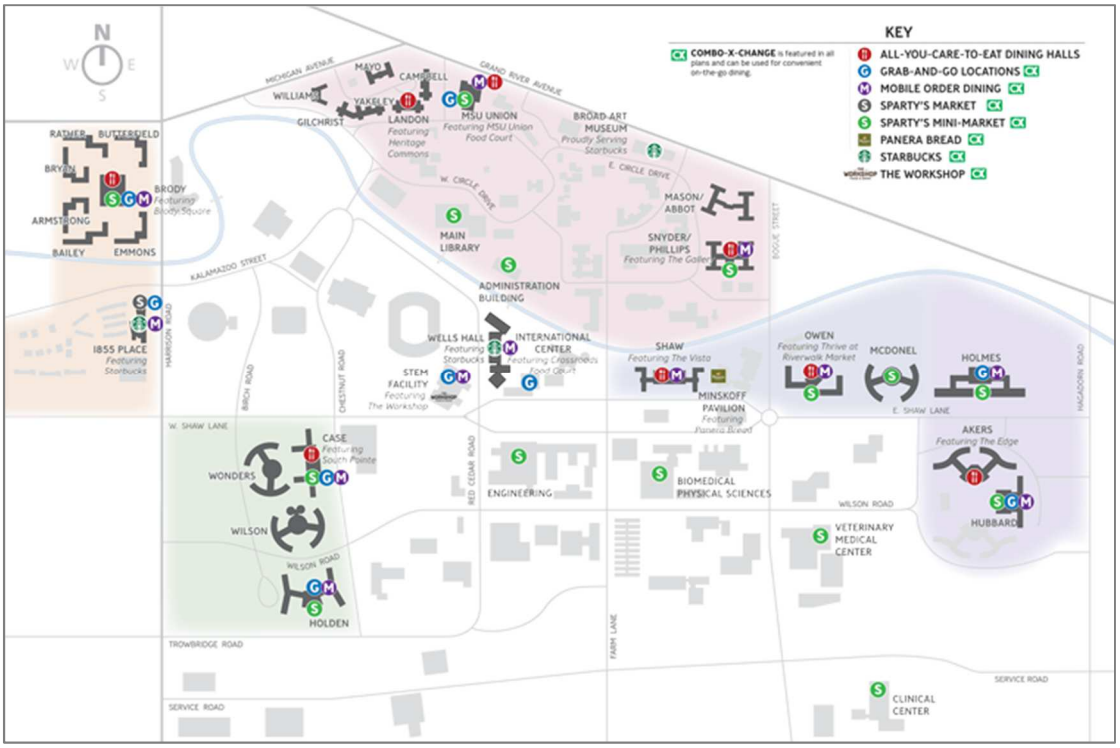

Figure 4: Dining locations on campus (MSU Dining)

The students completed information on three types of grocery stores that they access and any place where they receive prepared meals from. Apart from the names and location of the grocery stores, students had to fill out their mode of transportation, frequency of transit and time taken to travel one-way to the store.

The location of the survey respondents was mapped using the IP address recorded by Qualtrics and was mapped in Google Earth along with the grocery stores and other places mentioned by students. If the IP address was outside the state of Michigan, the centroid of the university campus was used as the participant location. This point-data was inserted into ArcGIS Pro to calculate the displacement between the participant and the grocery store mentioned and recorded in the attribute table that was exported into SPSS for further analysis. A 0.5-mile buffer which is equivalent to a 10-minute walking radius was mapped around the MSU campus and based on the calculated

average distance travelled by students from the online survey, a 2.5-mile radius around the campus was also mapped. The distance was used to compare for mode of transit parameters and average distance to supermarket and Indian store among the students at this university. The table below shows this result . Majority of the students who live within 0.5 miles of the campus spend more than 45 minutes to access their groceries using public transit, whereas those beyond 0.5 miles, usually drive and spend less than 10 minutes to access a grocery store. On the other hand, majority of the students who live within 2.5 miles buffer of the campus spend less than 10 minutes in public transit to access a grocery store in alternate week, whereas those beyond 2.5 miles spend 16-30 mines by driving to do the same at least once a week.

Presence of a grocery store	Mode of Transit (mode)	Frequency of Transit (mode)	Time taken to travel (mode)	Avg. distance to supermarket (in miles)	Avg. distance to Indian store (in miles)
Less than 0.5 Miles	Public Transit	At least once a week	More than 45 minutes	2.47	1.86
More than 0.5 Miles	Drive	At least once a week	Less than 10 min	4	3
Less than 2.5 Miles	Public Transit	Alternate Weeks	Less than 10 min	3.2	2.1
More than 2.5 Miles	Drive	At least once a week	16-30 minutes	4.4	6

Table 4-11: Mode for transit parameters chosen by participants within a defined radius from campus and average distance that participants travel to reach to the two types of grocery stores

Additionally, the buffer of 0.5 miles and 2.5 miles was used to compare the scores of food accessibility, including sub-categories of access and types, level of food insecurity and level of stress to examine if there was any relationship between distance and the scores. Students living within 0.5-mile radius of the campus experienced a higher level of food inaccessibility (including physical, economic and social access, access to healthy and culturally appropriate foods) which is also corroborated in the earlier table. Additionally, they also experienced a higher level of food

insecurity and level of stress compared to those living beyond 0.5 miles. Interestingly, students living more than 2.5 miles away from campus experienced a higher level of food insecurity than students living within the 2.5-mile buffer but not more than students living within 0.5 miles (Table 4-13) .

4.5.3: Assessing 'Access' in the Local Food Environment

	Buffer 0.5 Miles		Buffer 2.5 Miles	
	Less than 0.5 miles	**More than 0.5 miles**	**Less than 2.5 miles**	**More than 2.5 miles**
Accessibility score (AScore)	n=8	n=43	n=28	n=23
Mean (0:No issue - 10:High inaccessibility)	5.18	3.36	4	3.2
AScore-Physical	n=8	n=43	n=28	n=23
Mean (0:No issue -2 range)	1.18	0.86	1.01	0.78
AScore-Economic	n=8	n=43	n=28	n=23
Mean (0:No issue -4 range)	2.25	1.4	1.7	1.35
AScore-Social	n=8	n=43	n=28	n=23
Mean (0:No issue -4 range)	1.75	1.09	1.3	1.08
AScore- Healthy Foods	n=8	n=43	n=28	n=23
Mean (0:No issue -5 range)	2.37	1.41	1.67	1.43
AScore- Culturally Appropriate Foods	n=8	n=43	n=28	n=23
Mean (0:No issue -5 range)	2.81	1.94	2.32	1.78
Level of Food Insecurity	n=8	n=42	n=28	n=23
Mean (0:Food Secure -7 High Food Insecurity)	1.56	0.79	0.85	1
Level of Stress	n=8	n=42	n=28	n=22
Mean (0:No issue -7: High Level of Stress)	4.3	2.8	3.3	2.8

Table 4-12: Comparison of food accessibility, food insecurity and level of stress between students living within and beyond 0.5 miles and 2.5 miles

One survey question allowed participants to insert commonly known Indian food items into four quadrants on Google Jamboard. The matrix was between healthy-unhealthy and culturally apt-culturally non-apt quadrants. Once the list of 24 food items, including two of their own personal favorites was placed in at least one quadrant, the participants were asked to rank the four quadrants

based on their understanding of levels of accessibility, physical access, affordability, availability in their local food environment, acceptability to include in their diet and accommodation, based on their understanding of demand.

4.5.3.1: Physical Accessibility

The quadrants were ranked from 1- most accessible to 4-least accessible. Overall, participants ranked unhealthy and culturally not appropriate the highest mean of 1.73, followed by unhealthy and culturally appropriate (2.39). Whereas healthy and culturally appropriate was ranked third (2.85) and last, healthy and culturally not-appropriate (2.88). The average mean for domestic students for access to healthy and culturally appropriate foods was 2.85, whereas for international students was 2.86. In both the cases unhealthy and culturally not appropriate foods had the best score.

4.5.3.2: Affordability

The quadrants were ranked from 1- most affordability to 4-least affordable. Overall, participants ranked unhealthy and culturally not appropriate the highest mean of 2.14, followed by unhealthy and culturally appropriate (2.28). Whereas healthy and culturally appropriate was ranked third (2.42) and last, healthy and culturally not-appropriate (3.02). The average mean for domestic students for access to healthy and culturally appropriate foods was 2.46, whereas for international students was 2.43. In both the cases unhealthy and culturally not appropriate foods had the best score.

4.5.3.3: Availability

The quadrants were ranked from 1- most easily available to 4-least available. Overall, participants ranked unhealthy and culturally not appropriate the highest mean of 1.63, followed by unhealthy and culturally appropriate (2.50). Whereas healthy and culturally inappropriate was ranked third

(2.74) and last, healthy and culturally appropriate (2.95). The average mean for domestic students for access to healthy and culturally appropriate foods was 2.90, whereas for international students was 2.97. In both the cases unhealthy and culturally not appropriate foods had the best score.

4.5.3.4: Acceptability

The quadrants were ranked from 1- most easily acceptable to 4-least acceptable food preferences for quadrants if at all. Overall, participants ranked healthy and culturally appropriate the highest mean of 1.16, followed by unhealthy and culturally appropriate (2.38). Whereas healthy and culturally inappropriate was ranked third (2.97) and last, unhealthy and culturally not-appropriate (3.44). The average mean for domestic students for access to healthy and culturally appropriate foods was 1.21, whereas for international students was 1.17. In both the cases healthy and culturally appropriate foods had the best score.

4.5.3.5: Accommodation

The quadrants were ranked from 1- most widely accommodated to 4-least accommodated based on the individual or community's demand in their local food environment. Overall, participants ranked unhealthy and culturally not appropriate the highest mean of 1.97, followed by unhealthy and culturally appropriate (2.41). Whereas healthy and culturally appropriate was ranked third (2.68) and last, healthy, and culturally not-appropriate (2.84). The average mean for domestic students for access to healthy and culturally appropriate foods was 1.93, whereas for international students was 1.98. In both the cases unhealthy and culturally not appropriate foods had the best score.

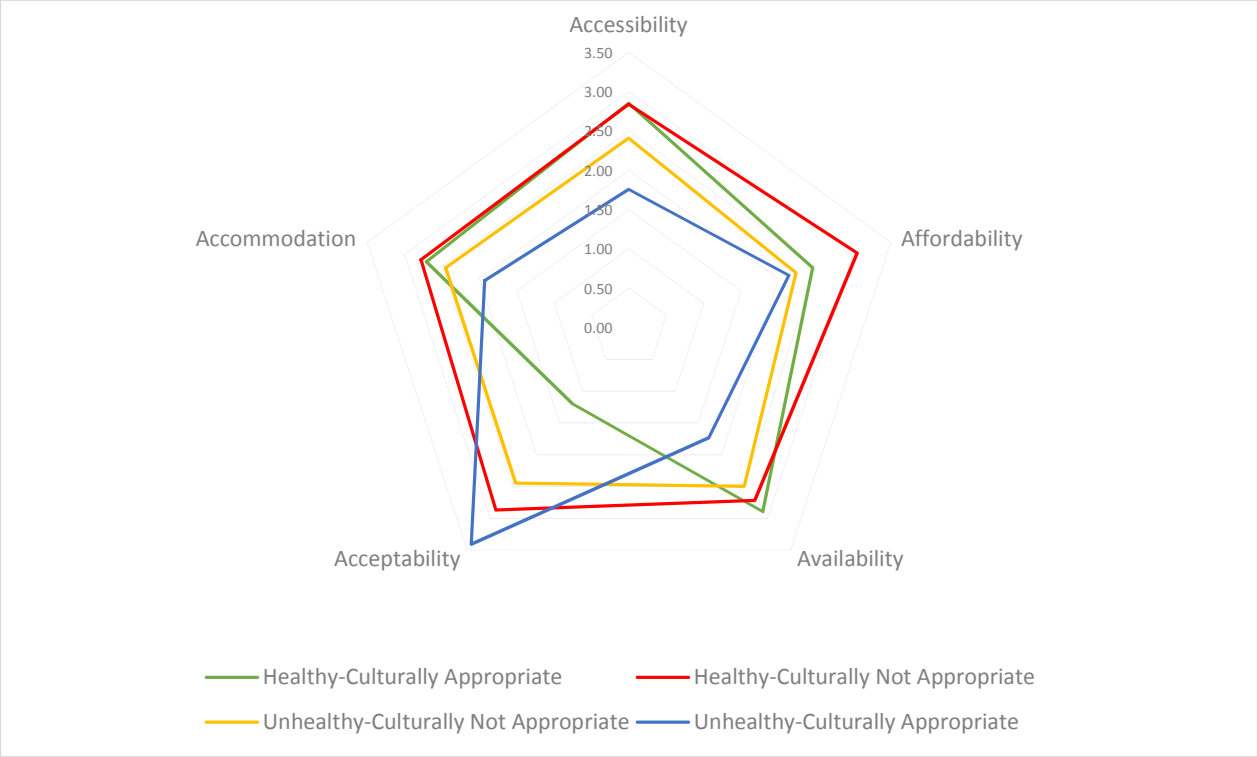

Figure 5: Star chart illustrating the five dimensions of access for South Asian students

The star chart illustrates the average ranking of the five dimensions of accessibility for international students for the four categories of foods, namely: Healthy and Culturally Appropriate (HCA), Healthy and Culturally Not Appropriate (HCNA), Unhealthy and Culturally Appropriate (UCA), and Unhealthy and Culturally Not Appropriate (UCNA) Foods. The acceptability of healthy and culturally appropriate foods was ranked the highest, but in comparison to other dimensions of access it was ranked lower. On the contrary, acceptability of unhealthy and culturally appropriate foods was ranked the lowest but is highest in other categories of foods. Therefore, this diagram clearly illustrates that access to unhealthy and culturally appropriate foods is more easily physically accessible for students, it is more commonly available, it is more easily accommodated and is easily affordable in the local food environment as compared to other food

groups. The next set of star charts compare the rankings between international (orange) and domestic (blue) students and the lines are almost converging with minor differences in average rankings.

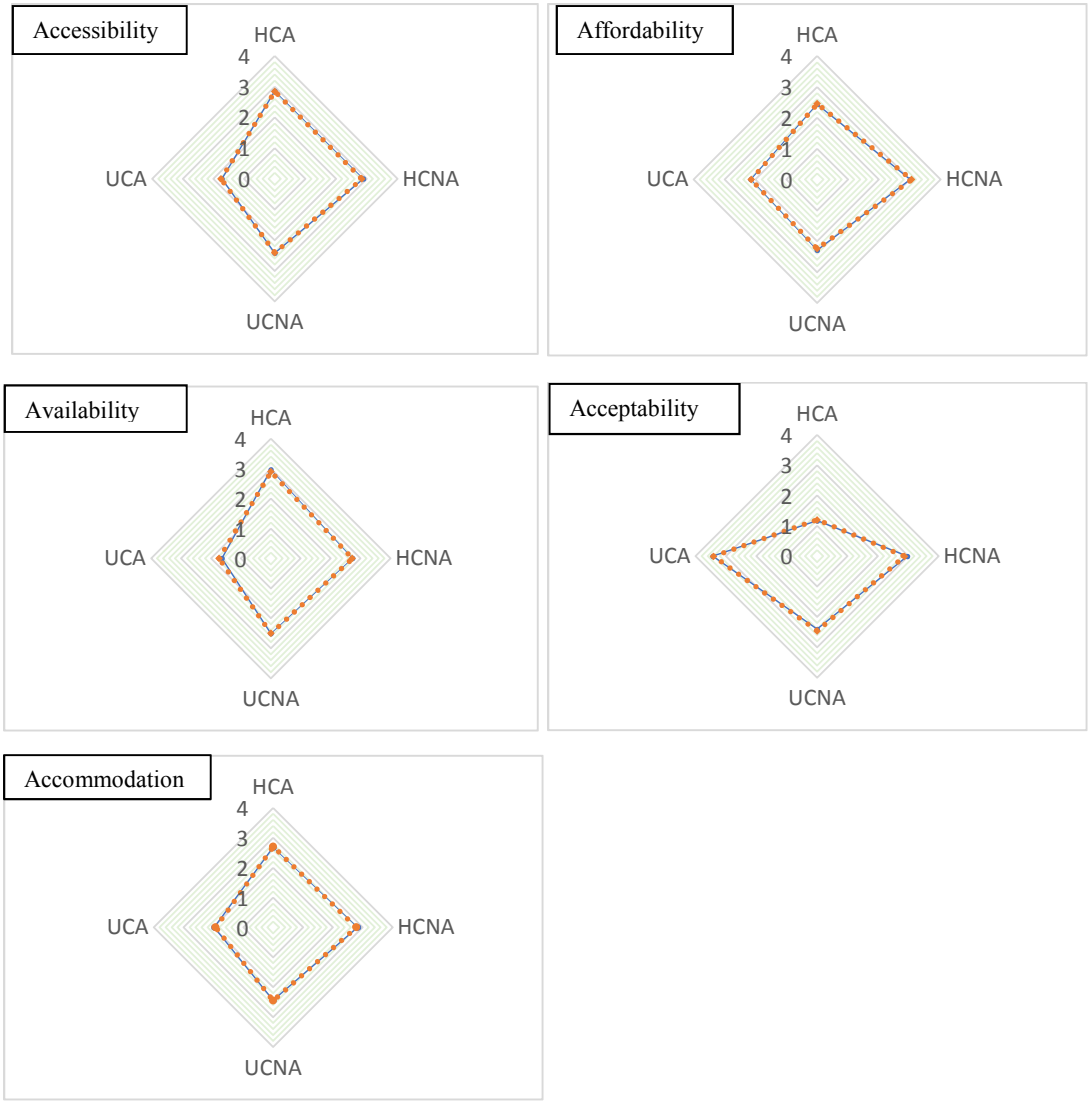

Figure 6: Star Chart to show the rankings of Healthy and Culturally Appropriate (HCA), Healthy and Culturally Not Appropriate (HCNA), Unhealthy and Culturally Appropriate (UCA), and Unhealthy and Culturally Not Appropriate (UCNA) Foods (Score 1- high, 4-low)

Based on the interview responses, the data interpretation shows that while personal preferences to access healthy and culturally appropriate foods is ranked the highest, but in terms of other dimensions it fares poorly for both international and domestic students. There are couple of things important to note based on the ranking exercise. Students who did not consume certain items due

to personal reasons, their perceptions have been included in this study and secondly, international students who on average had stayed longer (greater than 2 years), provided responses to all foods being culturally appropriate.

CHAPTER 5: DISCUSSION

The results presented in this research primarily focus on food insecurity and food accessibility for south Asian college students studying in US universities, and secondarily on the perception of culturally appropriate foods and the level of access international students have to these foods.

The examination of access to foods within the field of planning has overwhelmingly focused on access to healthy foods and nutritious foods emerging from the conceptualization of food deserts in Scotland in 1990s (Beaulac, Kristjansson, & Cummins, 2009). Food deserts as the term have been argued against by the research community as they are not considered naturally occurring phenomena, like are deserts, but are the result of inequities affecting minority populations (Schlangen, 2021; Washington, n.d.). The relationship of food deserts and food insecurity has not been thoroughly explored due to siloed investigation on qualitative approaches and insufficient quantitative data for different demographic groups. This hinders effective strategies to tackle food injustice issues (Semple & Giguere, 2017; Walker, Keane, & Burke, 2010). Moreover, arguments on access to multiple alternative retail types and lack of a consistent definition to measure 'access' to foods (Shaw H. J., 2006; Walker, Keane, & Burke, 2010) led to the notion that neighborhoods could be food swamps if they had access to alternate stores with calorie-dense food products (Taylor & Ard, 2015). Consumers from diverse groups may have different and unequal opportunities (Logan, 2014) and may be subjected to a poor quality of life without access to healthy nutrition and quality diet (The Food Trust, 2010; Kaiser, 2011; CDC, 2020).Today, majority of the literature has focused on concepts such as food deserts, food swamps, food oasis, food apartheid, food sovereignty, etcetera; all aiming to provide deeper understanding of causes and outcomes of food insecurity.

5.1: Access to Food and Food Security

The quantitative analysis showed that international students did perceive greater food inaccessibility than domestic students and that they also perceived greater food insecurity due to food inaccessibility than domestic students. The results from this study support the findings of similar research endeavors on food insecurity among college students (The Hope Center for College, Community, and Justice., 2021; El Zein, et al., 2019), international students (Hanbazaza, et al., 2021; Soldavini, Andrew, & Berner, 2022), and racial-minority students (El Zein, et al., 2019).

Moreover, it is interesting to note that comparing the existing U.S. Adult Food Security Module (2021) with the survey instrument, hypothesis two would be rejected as the level of food security among international students was not different than level of food security for domestic students. A single criterion: 'there were no means of access to purchase what I wanted to buy' changed the quantitative result. The framing of this statement stemmed from the emphasis on personal need and physical accessibility which is missing in the current US Adult Food Security Module. Therefore, this single statement could be a valuable addition to improve the survey tool and to understand the needs of ethnic groups not being able to access requisite food stores within their local food environment.

While food insecurity has been closely linked with food deserts, the study supports the findings that have focused on different dimensions of access, even when the location of the participants for the online interview was not a food desert. Walker, Keane & Burke (2010), who published a systematic review on food desert highlights food accessibility, availability, and affordability as a criterion along with access to supermarkets, racial and ethnic disparities, socioeconomic status and difference in chain and non-chain stores. Azuma et al. (2010 March) suggested healthful food

strategies to overcome the barriers to food access, affordability, and availability in three Los Angeles low-income racially/ethnically diverse communities. The similarity of findings and yet the difference in the physical environment suggest exploration of '*cultural food deserts'* as an entity whereby access to healthy and culturally appropriate foods maybe limited and therefore can be addressed suitably by framing better policies and addressing food justice issues for low-income ethnic minority communities.

Almost 200,000 students from India, approximately 17.3% of the international students come to US every year to pursue further studies and tend to stay longer to gain work experience after graduation (U.S. Mission India, 2017). The quantitative analysis for the third hypothesis, international students face poorer health and behavioral outcomes than domestic students due to food insecurity, was accepted. This result is aligned with another research wherein students perceived heightened physical and mental stress associated with food insecurity (Dean & Sharkey, 2011).

5.2: Culturally Appropriate Foods

From the online interviews, the three aspects of defining culturally appropriate foods were based on the following aspects:

(1) an individual's consumption behavior at home or in home country including personal preferences

(2) global exposure to foods such that they can identify it to any specific culture partially or completely and/or is widely prevalent in their current local food environment, and

(3) their health relationship to different foods including unhealthy foods and cultural foods.

While some respondents found it difficult to define culturally appropriate foods, they were able to provide a description of the foods that were not culturally appropriate. There were two aspects

underscored for defining culturally inappropriate foods and did not overlap with the definition statements provided for culturally appropriate. These were

(1) level of acceptance (and tolerance) towards cultural or social and health perception

(2) contradicting to the Indian traditions or environment such that the foods were meant for economic benefit only, and procured through unsustainable practices

Within the five dimensions of access proposed by Penchansky and Thomas (1981), this section explicitly discusses the acceptability dimension to describe the need for exploring culturally appropriate foods. This is due to the observation that acceptance was a key term mentioned by majority of the survey participants in the online interviews. Previously, no research study has focused on this aspect of access to foods which encompass investigation of both 'healthy' and 'culturally appropriate' foods.

Merriam-Webster dictionary (2022) defines culture as 'the customary beliefs, social forms, and material traits of a racial, religious, or social group' or 'the characteristic features of everyday existence (such as diversions or a way of life) shared by people in a place or time.' The concept of culture is a collective manifestation of arts, customs, social institutions, and achievements of a particular nation, people or a social group was recognized in early 19th century (Oxford Languages, 2022).

Culturally appropriate foods have been explored in a contextual understanding of how, when, where, and with whom it is being consumed (Aronson, Eating in Crisis: Culturally Appropriate Food and the Local Food Movement in the Lives of Domestic Violence, 2014). It is also believed that culturally appropriate foods can dynamically change based on politics and economics of place (Sampson & Wills, 2013). Albert Bandura's Social Cognitive Theory provides a strong psychological foundation to explain the changing food consumptions patterns related to one's

social behavior dependent on an individual's social interactions, experiences, and outside media influences (Bandura, 2001).

Organizations such as International Food Policy Research Institute (IFPRI) (2022), FAO, IFAD, UNICEF, WFP and WHO (2022) have underlined the importance of focusing on the physical, social, and economic access to healthy and nutritious foods that meets the individual's food preferences and dietary needs in their local environment as a basis to configure food insecurity. It however does not encounter any examinations of 'culturally appropriate foods' which is firmly rooted in individual's preference and intertwines with physical, social, and economic access as well.

CDC's Third Report on National Nutrition Monitoring in the United States (1995) published a model on the relationship of food to health, highlighting National Nutrition Monitoring and Related Research Program's (NNMRRP) major components that cover the key terms that were used by interview participants in this study. The flowchart covers the key terms used to define culturally appropriate foods such as consumption behavior, personal preferences, food production and health. The report gave special emphasis on low-income and high-risk population subgroups, however, the direct and indirect relationship between the elements included and the local environment for an ethnically diverse population is missing.

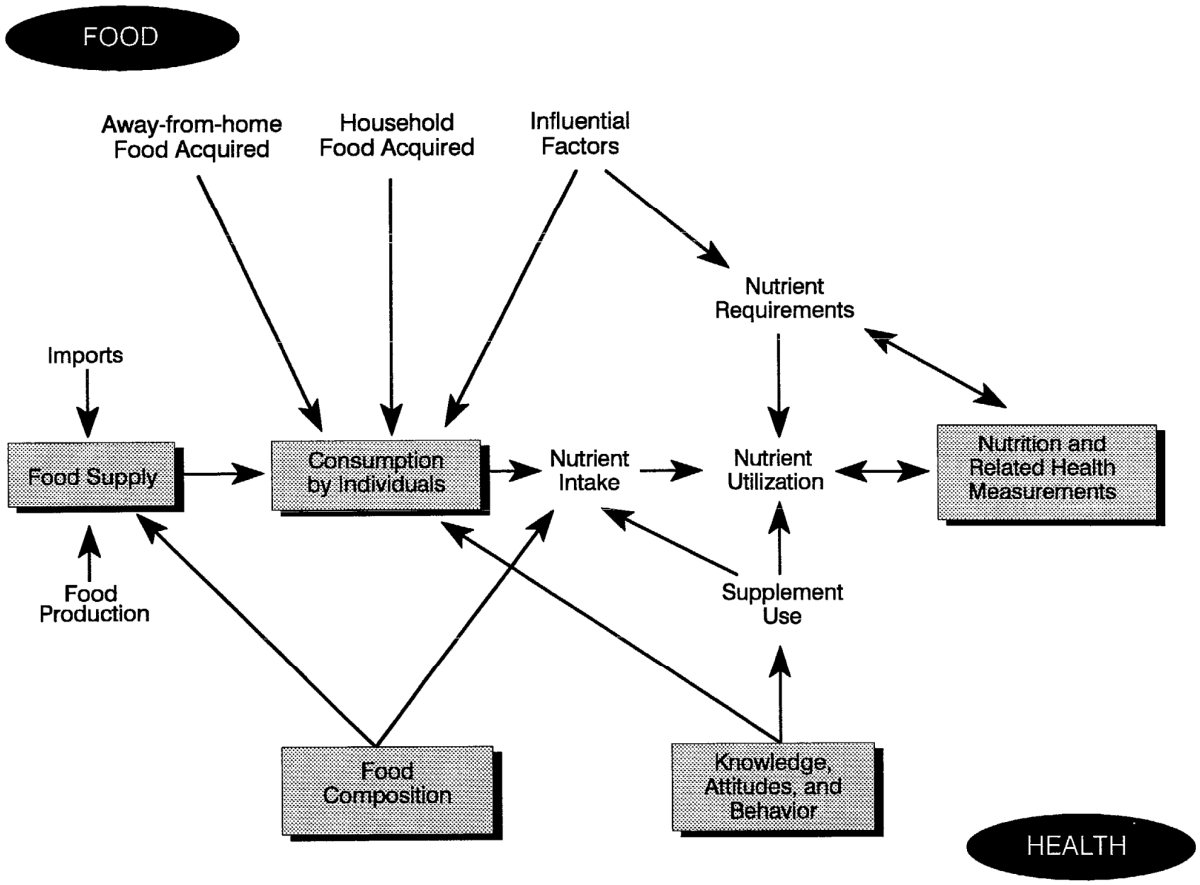

Figure 7: Relationship of food to health (Source: HHA & USDA, 1993)

Every state in India is known for its unique cuisine and dishes. While some cuisines may be more popular, dietary habits of purchasing and consuming foods are deeply rooted in place and tradition (Saraswati, 2015; Srinivas, 2011; Fieldhouse, 1995). This aspect of personal background and acceptability was highlighted when interview participants defined culturally and culturally not appropriate foods. Due to tremendous exposure to social media and new technologies, there is a shift in dietary preferences wherein the traditional homecooked style and authentic style has been substituted with what is considered as healthier options of eating (Popkin, Horton, Kim, Mahal, & Shuigao, 2001). The interview participants corroborated this behavior even after changing their

local food environments. The 'uncommon' foods such as healthier options, substitutions, or fusion cuisines have joined mainstream diets of young adults that were recognized as culturally appropriate foods (Sawant, 2019).

The overarching definition framed by participants in this study for 'healthy and culturally appropriate foods' would be foods that provide healthy nutrition to oneself, both physically and mentally; is procured through sustainable means; and can be associated with any one or more social institution(s). However, this concept cannot be perceived in absolute. Thereby meaning, the criteria such as time and exposure in a new environment heavily determines the perception of healthy and culturally appropriate foods for an individual, especially after experiencing migration to a new environment. Moreover, food access activity participants were able to categorize foods into healthy-unhealthy and culturally appropriate- culturally not appropriate foods. Foods that interview participants were able to personally accept and consume more frequently, were culturally associated foods. The analysis shows the overlap of culturally associated foods and culturally appropriate foods based on an individual's understanding. From observation, all culturally appropriate foods may or may not be culturally associated foods. However, culturally not appropriate foods would be more likely to not be culturally associated as well for an individual.

5.3: Perceptions of Access to Culturally Appropriate Foods

Lastly, the assessment of access (section 4.4.1.3) during the interview based on an individual's experience in their current food environment, the data interpretation shows that while personal preferences to access 'healthy and culturally appropriate' foods is ranked the highest, in terms of other dimensions it fares poorly for both international and domestic students. Hence, a model that can adapt acceptability to the local environment is best explained by Sharkey, Horel & Dean (2010) who developed a conceptual model of food access wherein accessibility was dependent on the

physical access to healthier foods along with availability influencing the food choice and consumption for an individual. Moreover, White, Stewart and O'Neill published three distinct systems to determine access to foods which encompassed a global environment and food security network (White, 2015), affordability of food and conceptual model of physical access to foods (White, Stewart, & O'Neill, 2008) that can add greater clarity towards defining various aspects of cultural food deserts.

5.4: Culturally Appropriate Food Environments & Health Outcomes

5.4.1: Physical Health and Wellbeing

Student populations are generally low-income populations, similar to the study sample. Low-income communities are inundated with unhealthy food options in their local food environments (Walker, Keane, & Burke, 2010). Physical health is dependent on the physical context such as access to healthy or unhealthy foods, community design, and the 'built environment' (Woolf & Aron, 2013). Access to fast foods and unhealthy food options have disrupted the basic dietary habits (Sbicca, 2018) and is associated with prevalence of non-communicable diseases such as obesity (Larson, Story, & Nelson, 2009; Walker, Keane, & Burke, 2010; Pan, Sherry, Njai, & Blanck, 2012). While the online survey respondents on average ranked unhealthy and culturally not appropriate foods higher in all dimensions of access except acceptability, this result supports the findings of the research that the local food environment provides a higher availability of unhealthy foods around college campuses (Horacek, et al., 2013).

The neighborhood food environment is an important indicator for healthy behavior and outcomes (Holsten, 2009; Caspi, Sorensen, Subramanian, & Kawachi , 2012). In the food journal, international students showed higher tendency to eat foods at home which is a positive attribute. Upon further examination of this positive characteristic in the interviews, students' reasons were

time constraints to seek food options outside home and challenges associated with availability and affordability of culturally appropriate and/or healthy foods. Domestic students on the other hand were more inclined to avail foods from outside or skipping meals altogether in the food journal. Majority of the domestic and international students in the online interview mentioned skipping meals due to time constraints but not due to food accessibility or insecurity. Therefore, this does not directly corroborate as a health risk behavior as seen among university students (Pengpid & Peltzer, 2020).

Interestingly, the answer to food habits during finals week or any stressful week were also similar among international and domestic students, mainly relying on three alternatives. First, prepare meals in advance and freeze to consume them over the week of the finals. Second, rely on outside food completely, mainly through online delivery. Third, rely on social networks such as roommates or friends or relatives to provide meals for individuals and vice-versa. The third point is important to highlight as during COVID, food provisions through social networks became an important aspect for students who could not access grocery stores during state-wide travel restrictions.

The behavioral outcomes may be influenced by the local environment and accessibility options as mentioned by participants. The perception of health risk was based on their current diet or personal backgrounds. The majority of the interview participants did not explicitly face any major health risk stemming from food insecurity. Some of the minor health risks mentioned by interview participants were weight gain and diabetes that run in the family. The Food Research and Action Center considers poverty, health, and food insecurity highly inter-linked (FRAC, 2021). Food insecurity is highly associated with chronic diseases in the US (Seligman, Laraia, & Kushel, 2010; Gregory & Coleman-Jensen, 2017). Approximately 133 million people in the US have been

diagnosed with at least one chronic health disease which are responsible for 1.2 million deaths annually (Tinker, 2017; Raghupathi & Raghupathi, 2018 March). In a seminar paper on Diabetes in Asia, Ramachandran, Ma and Snehalatha (2010) discuss the urbanization and migration as one of the factors associated with increased levels of diabetes among native and migrant Asian populations, especially younger Asians. In comparative studies for Type 2 Diabetes, Asian Indians in India were found to have a higher prevalence of Diabetes than Asian Indians in the US (Gujral, et al., 2015) and Shah & Kanaya (2014) in their review article discuss the predisposition of South Asians facing higher levels of diabetes from biologic and lifestyle factors. The National Health Interview Survey (1997-2008) also showed that Asian Indians in the US had higher prevalence of type 2 – diabetes than other ethnic groups in the US (Lee, Brancati, & Yeh, 2011) which was corroborated by a population-based separate study by Misra et al (2010). Therefore, food inaccessibility and insecurity should not be used as a causal factor for poor health outcomes as South Asians are genetically prone to these outcomes.

Limited physical activity and poor diet is also associated with obesity and other health risks (Darling, Fahrenkamp, Wilson, D'Auria, & Sato, 2017; Morales & Berkowitz, 2016) such as metabolic disorders such as diabetes (Becerra & Becerra, 2015), heart diseases (Palaniappan, Wang, & Fortmann, 2004; Klatsky, et al., 2005), high blood pressure and food allergies (Vozoris & Tarasuk, 2003). Participants who recorded no health risk also mentioned following a healthy diet and staying physically active. Mainly, international students who were either male or had stayed in the US longer than 3 years mentioned following some physical activity routine to maintain their health by playing active sports or brisk walking outdoors during COVID as recommended by CDC (CDC, 2021).

Participants who recorded minor health risks mentioned weight gain, nutrient imbalance due to unhealthy diet, and chronic food related illnesses in their family such as diabetes. Some participants who were international students mentioned major digestive problems and experiencing inflammatory problems stemming from their poor diets which were exacerbated during COVID restrictions. Due to COVID restrictions, interview participants were not able to achieve their physical activity levels while some resorted to unhealthy eating patterns as seen from other studies (Masori, Barrington-Trimis, & Leventhal, 2021). Unhealthy eating behaviors is associated with food insecurity (Hazzard, et al., 2022; Uri, n.d.). While majority of the students do not face a major health risk presently, they are conscious about food-related health risks for themselves based on their lifestyle and local food environment. Therefore, there is a growing concern of international students developing unhealthy behaviors due to poor food environments and exacerbating the health risks later in life.

According to the Healthy People 2020, access to cultural resources, understanding social norms and attitudes, access to health care services, and improving access to economic opportunities could support collective physical wellbeing (The Office of Disease Prevention and Health Promotion, 2020). The social access to foods was deemed important from interviews as students accessed or received foods or prepared meals from religious institutions, departments, and student organizations on campus, and in some cases through ghost kitchens. The concept of ghost kitchen closely mimics the Indian version of local food delivery system, known as 'lunch box' (similar to Mumbai's *dubbawalas*) scheme that allows for consumers to purchase daily fresh cooked meals with the taste and style they are comfortable with (Jashan Catering, 2020). Meals can be prepared upon special requests for further sensitivity to the consumer's allergens or dietary requirements (Bombay Takeout, 2019; Patel Brothers, 2019). Students acknowledged the benefits of availing

foods through ghost kitchen networks using social media applications such as WhatsApp and Facebook. However, the greenlight to purchase was dependent on four major aspects: affordability, availability (daily or weekly), choices of access (whether pick-up or drop off) and personal acceptance of food quality and taste.

5.4.2: Mental Health and Wellbeing

Indians in America are generally known to be more educated and have less rate of unemployment as compared to other Asian minority groups (Yi & Museus, 2015). However, it is unlikely to extend the same conclusion for international students who immigrate for higher education, deal with restrictive employment policies and therefore, face higher financial stress (Maynard, et al., 2019; Becerra, Mshigeni, & Becerra, 2018). Within the purview of the third hypothesis, financial stress was associated with the student's level of food insecurity. Therefore, the result of logistic regression showed that international students who perceived higher financial stress were more likely to experience food insecurity when compared to domestic students.

Acculturation among Asian Americans has been observed to be low among fully bicultural group (bicultural referring to host and heritage cultures) when compared to groups with differences in associations (Jang, Park, Chiriboga, & Kim, 2017). It is associated with a higher perception of food insecurity (Becerra, Mshigeni, & Becerra, 2018). This was also visible in the interviews as the students shared their experiences of adjusting in their local environments without facing many issues of limited resources or communication skills. However, some international students shared minor incidents that led to a feeling of being unaccommodated. They shared a feeling of displacement or microaggression based on non-accommodation of their needs which made the student avoid using the food retail outlet in future. Psychological distress has been associated with food insecurity as well (Allen, Becerra, & Becerra, 2018; Myers, 2020). Microaggression

experiences have been linked to stress for people of color (Pace, 2015) and negative mental health outcomes (Torino, 2017).

The cultural factors especially provide a sense of belonging to the individual at a personal and communal level and random chance interactions provide a mental wellbeing which enhances a person's overall productivity and quality of life (Ziersch, Baum, MacDougall, & Putland, 2005). Interviewees who had visited religious institution can be grouped into three categories. Some visited the place solely for religious purposes and not to receive any meals and their experiences were more neutral. Those who shared their positive experiences of visiting a religious temple as more gratifying while gaining a sense of belonging for personal, religious, and social reasons and majority were also able to access a meal and bring back with them. This experience is similar to the research wherein immigrant communities have strong social linkages, integration (Tselios, Noback, van Dijk, & McCann, 2015) and social capital (Ebaugh & Curry, 2000). While some visited a religious institution but were not provided with any foods there were lesser chances of them returning to the same place which may suggest a lower level of social attachment. Research has shown that social isolation may lead to poor health behaviors (Stansfeld, 2006). Therefore, issues such as social isolation, food insecurity, unequal access to food resources, and cultural factors could implicitly affect the mental health of a minority group and requires further examination.

5.5: Policy Implications

Across the US, there are numerous government agencies, non-profits, and food policy councils advocating for better access to healthy and fresh foods. However, local planning for food access and food security is still a very conservative effort limited to cities focused on improving land-use (urban farming, community gardens, farmers' market, etc.) or challenging socio-demographic

profiles (low-income populations, ethnic minority groups, limited physical access due to no personal vehicle). These structural inequalities are due to unequal distributions of resources due to external factors (Global Health Europe, 2009; Reidpath & Allotey, 2007). Due to the history of planning, segregated communities of wealth, power and ethnicities exist in American cities (Horst & Marion, 2019; Goetz, Williams, & Damiano, 2020). Inequalities are linked to diversities, more specifically race (Hallinan, 2001; Williams & Sternthal, 2010), gender (Buchmann, DiPrete, & McDaniel, 2008; Read & Gorman, 2006), employment (Boyle, Cooke, Halfacree, & Smith, 1999; Bowlus & Robin, 2004), income (Pager & Shepherd, 2008), and education (Ball S. J., 2010; Roksa, 2011). Structural inequalities for food access can be discussed within broad categories of 1. Zoning issues, 2. Mobility barriers and 3. Governance.

University campuses tend to provide a plethora of food access opportunities, including dining halls, restaurants and cafeterias, food pantry, and alternate retail stores (university cooperatives, community supported agriculture). Section 5.4.1 discusses zoning policies to enhance spatial planning for cultural foods around college campus communities. Mobility in section 5.4.2 discusses improvements for connecting students with the outside food resources. Due to COVID restrictions, a lot of community resources and network opportunities were felt missing by the interviewees across college towns in different U.S. regions. Therefore, policies aimed towards bridging the gap for students from their current home to community nodes is essential to address food accessibility. Lastly, universities have enormous initiatives underway on engagement & outreach with local planning agencies and communities. Planning policies that address food security and accessibility from a governance perspective are discussed in section 5.4.3.

5.5.1: Zoning

Zoning has been an important tool to guide land-use and development since the 1920s and is broadly classified under residential, commercial, industrial, and agricultural zones (Machemer, 2018). College towns are immensely diverse in demography, employment, social and cultural recreational spaces. However, when it comes to healthy and culturally appropriate food, there are limited resources to avail or accommodated within the local environment to cater to this diverse student population. With tremendous push towards social equity, food insecurity among college campuses, and sustainable agricultural practices (production to waste disposal), a system of 'community food security' has emerged as an important topic for a college community to address the notion of 'cultural food deserts' as proposed in this study. Herein, all community residents have access to 'safe, culturally appropriate, and nutritionally sound diets through an economically and environmentally sustainable food system that promotes community self-reliance and social justice' (Bellows & Hamm, 2003).

The perceptions of food access for South Asian students were highly dependent upon acceptability, availability, accessibility, affordability, and accommodation (in the decreasing order) of foods for themselves. While acceptability of foods is fundamental to any individual living in any space, challenges on availability and accommodation provide a better glance at the contextual space that an individual experiences and manages to adapt based on their local environment. There are three step-wise strategies discussed under zoning that coincide with the three dimensions of access, namely acceptability, availability, and accommodation.

The first step would be an assessment of social and cultural nodes mapping to understand the lay of the land in college communities. Land-use patterns have been influenced by physical disposition, economic judgements, and environmental concerns, but not assessed in terms of social

and cultural capital by city planners. This spatial mapping of social or cultural nodes is important in the community. This step has two broad goals, one to review zoning changes that would enable better spatio-social cohesion and two, to enhance connectivity between social and cultural nodes that may be inaccessible for students from the university center (refer to section 5.3.2). For better spatio-social cohesion, there are three aspects that will be discussed in this section: social and community health and acceptability; urban design, and availability; education and accommodation. Section 5.5.2: Mobility discusses strategies for enhancing connectivity between the social and cultural nodes.

5.5.1.1: Social & community health and acceptability

Social and community context as described in Healthy People 2030 is about providing support to improve health and welling of its community members (Office of Disease Prevention and Health Promotion, n.d.). Community health is integral to any framing of planning policies and comprehensive visions for cities. The community for college campuses is majority students, out of which, international students and out of state students who do not have high food security such as the interviewees for this research, relied on community resources and the external support to address barriers to food accessibility within their built environment (McLoughlin, et al., 2020). Studies have shown that low-income neighborhoods have approximately half the access to produce and nearly 30% less supermarkets than higher-income neighborhoods (Wetherill & Gray, 2015; Walker, Keane, & Burke, 2010). In this study, food insecure students faced challenges to access acceptable and affordable fresh produce and resort to substituting with affordable-available food products. Commonly, these were unhealthy foods from their local food environment that provided a lesser degree of satisfaction and increased risk of poor health outcomes during the pandemic. These results support similar research on food insecurity associated with mental health (Fang,

Thomsen, & Nayga, 2021). Therefore, availability and affordability of unhealthy foods in comparison to healthier food products influences acceptability for individuals who are already constrained by time. Interestingly, availability of culturally appropriate foods does not only cater to the needs of that specific cultural group, but also provides opportunity for diversifying diets for inclusivity by other cultures.

Interviewees in this research study have shown a transitioning pattern of accepting foods based on primarily how it affects one's physical and mental health. In order to mitigate health disparities in South Asian college students (and international students in general), public health and local planning agencies must address social and communal health through equitable development opportunities. Thereby, creating a robust social system through government policies and awareness in partnership with institutions that may help equitable developments. These may include development of healthy community zones for social engagement, food innovation districts that promote education and awareness for healthier lifestyles for ethnically diverse groups, and social entrepreneurship program that promote employment opportunities for providing healthy meals from community members (Wilson, Hutson, & Mujahid, 2008).

Cities may expand the conditional use permits to formalize current ghost kitchens as communal nodes. Additionally, commercial kitchens in religious institutions and neighborhood markets can become social nodes to access healthy and culturally appropriate meals for ethnically diverse student populations. Similar to state-level planning laws such as Michigan's Cottage Food Law (Lynch, 2018) to provide employment opportunities from home when it comes to proving ethnically diverse meals from skilled traditional cooks in the community rather than refined chefs from culinary schools. Therefore, integration of ghost kitchens as social entrepreneurship opportunities for community residents while providing students means of entrepreneurial support

from university-based technology innovation centers or small-business program accelerators. Students may also engage and learn about healthy diets and lifestyle in food innovation centers supported by Public-Private Partnership (PPP) ventures. Social entrepreneurship connected with urban innovation strategies has shown to benefit local communities in terms of economic growth and development and social inclusion (Wilson, Hutson, & Mujahid, 2008). This may also be explored as a collaborative effort between a university to provide social and cultural innovative ventures to explore and take roots in their local urban environments.

5.5.1.2: Urban design and availability

Ethnic grocery shops such as Indian grocery stores are typically located in strip malls (Danish, 2019; Singer, Hardwick, & Brettell, 2008) which are closer to suburban homes and may not be well connected with a sidewalk or on frequent bus routes around institutions. This was commonly mentioned among university students who did not have an Indian store within the city limits and have poor access to available groceries. A poor neighborhood design entails limited access to a grocery store (Anguelovski, 2015) and limited access to cultural foods (Moffat, Mohammed, & Newbold, 2017; Danish, 2019). The improvement in conditions of the physical environment as per the social determinants of health include access to safe housing, transportation, and neighborhood and access to nutritious foods and physical activity opportunities (The Office of Disease Prevention and Health Promotion, 2020).

Urban design can stitch the physical fabric that provides enhanced access to social and cultural nodes, events, and networks. Availability of healthy and culturally appropriate foods within means of access to students can benefit from mixed-use innovative food retail strategies, safe street networks for non-motorized transportation and marketing elements of diverse cultural immersion that become local nodes of enhanced social systems.

Community farms, farmers markets and other alternate healthy sources of fresh foods have motivated diverse groups to participate and engage in healthy eating movements across America (Yellin, 2013; Evans, et al., 2012). Students who mentioned experiencing the fourth tipping point: environmentally conscious irrespective of the time they had spent in the US, were more open to opting for alternative food markets such as university co-ops to access not only organic foods, but also to support local farmers and opt for sustainable packaging of food products (refer to section D under section 4.4.1.1.).

The City of East Lansing Master Plan (2018) focuses on its urban form that may promote dense, mixed land uses utilizing the hybrid form-based codes already implemented. The document also mentioned organizing a year-round farmers' market which can become an important social node for the community that provides education and awareness on local farmers and sustainable agriculture for them to engage in. Supporting urban agriculture in urban cores using innovative technologies can promote higher food production and reduce environmental footprint (Yellin, 2013).

Better wayfinding for transit stations and other facilities that promote inter-and intra-city travel especially for students trying to access bigger cities for food diversity should be undertaken. No research has been published on experiences or behaviors of students accessing foods from outside of city limits. Making communities safer with good street lighting, connecting housing complexes with walking or bike trails is a common initiative within complete streets design guidelines (Smart Growth America, 2022) and among green planning and zoning initiatives (Wilson, Hutson, & Mujahid, 2008). Interviewees did mention accessibility challenges to reach the closest grocery store due to limited crosswalk or poor bus route or poor lighting that deterred their physical accessibility. This is aligned with the research that showed that areas with low bus frequency,

poorly designed bus shelters, broken sidewalks, ramps, and missing safety features hindered travel for groceries (Rosenberg, Huang, Simonovich, & Belza, 2013; Carp, 1988). This initiative also supports better health outcomes as posited by social determinants of health and promote a healthier lifestyle .

Lastly, college communities need to market the social integration and cultural inclusivity for its residents such that it provides sense of belonging to international students as well through social and cultural engagement opportunities at local community nodes. Connecting quality community assets including social, cultural, and/or religious nodes with the campus hub would extend the experience of a city as a local for international students living in the city. The East Lansing Master plan lays out social opportunities for community associations to organize events with student organizations and provide opportunities for students to experience diverse settings within the communities (City of East Lansing, 2018). Literature shows, higher social capital leads to better quality of life, lower mental health risks and ultimately a strong social economy (Stansfeld, 2006). City planners actively working on enabling and empowering employment diversification, and more importantly, areas with higher minority populations, should assess access to culturally diverse resources and nodes in their community that cater to higher social capital than low economic outcomes.

5.5.1.3: Education and accommodation

With increasing availability of brands and food products available in the country of origin and in the US due to globalization, the interviews have illustrated transitioning influences on the perceptions of accessibility to different foods and acceptability in one's own culture. Therefore, availability and exposure to foods associated with different cultures may enable individuals to

accept as a part of their norm and 'resiliate' to the concept of acculturation which entails poor dietary behaviors and health outcomes in the initial phase.

The term 'resiliate' has been coined to demonstrate the resilience to adapt in one's local environment. Exposure to such foods in a local environment are expected to be more common in university towns where the demographic make-up generally tends to accommodate mixed-cultural backgrounds and exhibit a higher socio-cultural interaction on a daily basis. Disenfranchised communities offering affordable rents are commonly located in suburbs with limited access to grocery stores, affordable healthy foods, and access to other resources (Rawlings, Capps, Gentsch, & Fortuny, 2007). Thus, housing and other zoning issues may aggravate the food accessibility issues for a marginalized community (Galster & Godfrey, 2005; Lens & Monkkonen, 2016; Anguelovski, 2015).

Availability of resources such as healthy and culturally diverse foods therefore becomes critical in gaining access and accommodating needs (that maybe essential to one's lifestyle) in a local environment. Moreover, Indian food products available in stores are dependent on items that can be safely procured and regulated by FDA and therefore, some known brands in India face the challenge of entering the American markets as one of the main obstacles is the nutrition labelling of the product (MENAFN - Kashmir Observer, 2020). On the other hand, some major ethnic foods such as clarified butter and basmati rice and various prepared meals are being accommodated at affordable prices in Walmart and other supermarkets as mentioned by interview participants.

5.5.2: Mobility

The literature review discusses 'access to foods' under the specifications of 'healthy' and 'nutritious foods that are safe'. 'Access' is the physical ability and economic means to procure foods for consumption (Committee on Examination of the Adequacy of Food Resources and SNAP

Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council;, 2013; The Food Trust, 2010). Physical accessibility and affordability have been the two main dimensions to assess food (in)security (USDA, 2012). The concept of immigrant enclaves in sociology have shown to persist in low-income urban neighborhoods because of the social and cultural ties that the place offers (Mattis, et al., 2008). However, these enclaves tend to also become marginalized communities due to a higher level of economic insecurity, limited job opportunity, and mobility (Rawlings, Capps, Gentsch, & Fortuny, 2007). Consumers limited on mobility tend to avail foods from nearby stores (Furey, Strugnell, & McIlveen, 2001). In a new food system, the consumer's behavior may tend to shift from home-style and/or authentic cooking to healthier patterns (Popkin, Horton, Kim, Mahal, & Shuigao, 2001). The study on Indian shoppers shows the shift to substitute some products based on availability and affordability in the American market as it does in the Indian Market (Budhiraja & Mittal, 2016). Students in the interview mentioned trading off shopping at a closer grocery store for affordability of foods they wish to purchase but that did not guarantee a product that they were familiar with or was acceptable to them prior to purchasing. Physical access to ethnic community nodes in the neighborhood was found to be limited or complicated due to expenditure on fuel, longer travel times, carpooling with friends or family with a vehicle or accessing public transport (Shannon, 2016). Another study showed that limited physical access may result in low mobility which may in turn impact food security (Coveney & O'Dwyer, 2009). The results of the interviews support these cases wherein challenges of physical accessibility impacted a student's level of food security.

The transit and mobility barriers for residents who do not own a car and are dependent on public transport is difficult when the grocery stores are not within walking distances (Coveney &

O'Dwyer, 2009). Moreover, poor awareness on transit modes and frequencies limits the use for routine trips (Outwater, et al., 2011). This result was also corroborated in this study, wherein students were unable to plan weekend shopping trips using public transit as it was unavailable. Transit planning that promotes non-motorized transit to connect food outlets within campus communities, neighborhoods, and residential complexes near campus is important and was shared by interviewees that would enhance their food accessibility. Bikeshare programs and on-demand shuttle service such as 'redi-ride' for students in and around campus for all other timings including weekends, to connect to large rental apartment complexes with local nodes such as grocery stores, etc. was another initiative mentioned that may support improved access and food security for college students apart from the already existing fare-free bus system.

With technology, access to information on types of food stores, availability of foods, restaurants, bus frequency, and similar useful information is available virtually to every college student and yet is difficult in the physical sense (Antipova, Sultana, Hu, & Rhudy Jr, 2020). However, the positive result from COVID and as shared by students, physical accessibility issues were overcome as more consumers shifted to purchase food items and fresh meals online to avoid going outside. The only decision that played a factor in purchasing online was if it is affordable for them to purchase on their own or would they club their orders with friends to reduce the food expenditure. Amirali & Bakken (2015) threw light on this aspect as well that students have to often pool their finances for necessary expenditures to support themselves and frequently ignore their personal needs and desires in order to make ends meet. With increase in online-delivery mode to access foods, short-span parking facilities such as kiss-and-ride would mitigate congestion to accommodate that surge in food delivery for students. Additionally, some universities are panning out the option of robotic food deliveries (e.g., Starship Technologies) from campus dining or on

campus restaurants to anywhere on campus when students, staff, professionals are unable to physically access the food retail outlet.

5.5.3: Governance

The stress on an international student to gather basic needs is an uphill task with limited budgetary allowances (Wells, 2014). Students may have internet access to shop online for healthy foods if necessary. However, it is not affordable for everyone. One initiative that can be leveraged is a food distribution program that connects social nodes with college food pantries that can be accessible to students. This may help in including a diverse range of food products or meals at food pantries that can be accessed by students and provide information of availability on healthy and culturally appropriate meals.

Providing coupons or vouchers for international students may help overcome the economic hardship and help students access food retail stores conveniently on campus. Urban community gardens and farmer's markets have been observed to enhance the socio-cultural wellbeing generally (Golden, 2013) and proposing food banks for students (Timothy, 2012), stronger campus food services (Freudenberg, Goldrick-Rab, & Poppendieck, 2019) or supportive meal assistance organized by student organizations or religious institutions for students to on campus could potentially aid in accessing healthy and culturally appropriate foods in their communities. In summary, access to foods needs to include social access along with physical and economic access to assess the food security for minority residents.

5.6: Limitations of this study

Due to the nature of quantitative analyses and qualitative assessments, the results of this study are hard to generalize for all South Asian students from different urban contexts and South Asian Countries. There is also a greater need of understanding the health perspective stemming from

emotional and psychosocial dimension for accessing foods in general for students. The outcomes of this study may not be able to be extended to the larger international student population from other Asian countries who may be facing similar challenges in the US due to the different needs on a cultural basis, but examination of that is critical as well.

There are couple of important things to note based on the food access ranking exercise in the study interview. Students who did not consume certain items due to personal reasons, their perceptions have been included in this study and secondly, international students who on average had stayed longer (greater than two-four years), provided responses to all foods being culturally appropriate. Lastly, there was no comparison made between international with domestic students for distance travelled in built area mapping due to limited responses collected for domestic students.

5.7: Conclusion

Access to foods is a complex theme that impacts food security and, in turn, physical and mental health. It is critical to address food inequalities in planning for healthier neighborhoods for a culturally diverse minority group. Many cultures associate food with their personal or social identity. With an individual's physical displacement from their home environment, food becomes one of the most important remaining strings with the culture. Thus, living in a new environment may induce some unknown behavioral shift that impacts their physical and mental wellbeing.

The built environment should be able to address the needs of both on- and off-campus students and accommodate cultural differences to provide a healthy lifestyle for all. Addressing food planning guidelines is important such that cities with transitioning demographic profiles require a resilient food system to prevent food insecurity for its population. This transformation would need to be supported by including more diverse food opportunities such that negative impacts on dietary behaviors can be prevented and mitigated.

This study investigated the main research question *if international students experience poor health and behavioral outcomes due to food inaccessibility than domestic students* studying at U.S. universities. There is a growing knowledge base on food insecurity of college students, low-income, females and minority groups. However, access and health are instrumental in understanding the behavioral outcomes from the physical environment that students live in. The first contribution of this research is the understanding and assessment of healthy and culturally appropriate foods available in local food environments of university campuses. While the existence of food deserts or food swamps is highly debated, cultural foods are yet to be established to fulfill the assessment of personal choices of dietary needs and requirements.

Secondly, nutrition and health knowledge are rarely addressed during freshman or international student orientation programs to acquaint young individuals to live independently. Therefore, the students miss the opportunity to quickly learn about availability and accessibility of community resources, healthy eating, and accepting cultural diversity to improve their own food knowledge and preferences that they need not struggle with during their study vocation. This study highlights the importance of covering these aspects for new students as well as students facing high levels of health risks, new parents, or students with disabilities.

Lastly, alternate food stores and religious institutions have the ability to address social and cultural barriers to promote food accessibility for such students. However, this information heavily relies on word-of-mouth and often first-hand as well. Alternate food stores and religious centers can be considered active physical nodes within a neighborhood to create an alternate food network to achieve resilience that is both integrative and inclusive. University and city's public transit can improve transportation capabilities for students facing physical and economic barriers to access foods from social and cultural nodes in the city. Representatives from the minority communities

can reach out to student organizations or vice-versa to address access to healthy and culturally appropriate foods and the community leaders can contextually propose a response to address these sensitive issues.

APPENDICES

APPENDIX A – List of Universities included in this research

Region	Total Count	Majority University	Count
NE	86	Northeastern	16
SE	28	University of Mississippi	6
MW	133	Michigan State University	54
SW	46	Texas A&M - College Station	15
W	30	University of California, Berkeley	11

Table A-1: Number of participants from five U.S. regions, including majority participants from the universities from each region

S. no.	US Regions	No.	Universities	Total No.
1	Northeast	1	Bennington College VT	1
		2	Boston University	2
		3	Columbia University	3
		4	Carnegie Mellon University	4
		5	Cornell University	5
		6	Harvard University	6
		7	Massachusetts Institute of Technology	7
		8	New Jersey Institute of Technology	8
		9	Northeastern University	9
		10	New York University	10
		11	Princeton University	11
		12	Penn State University	12
		13	Rochester Institute of Technology	13
		14	Rutgers University	14
		15	University of Buffalo, NY	15
		16	University of Massachusetts, Boston	16
		17	University of Maryland	17
		18	Yale University	18
		19	George Mason University	19
		20	George Washington University	20
		21	Long island university	21
		22	Grinnell College	22
		23	Baruch College	23
		24	American University	24
		25	Massachusetts College of Pharmacy and Health Science	25
		26	Mount Holyoke	26

Table A-2: List of participating universities from five U.S. regions

Table A-2: (cont'd)

S. no.	US Regions	No.	Universities	Total No.
		27	National Institute of Health	27
		28	Tufts University	28
		29	University of Massachusetts, Amherst	29
		30	University of Delaware	30
		31	University of Maine	31
		32	University of Massachusetts Lowell	32
		33	University of New Hampshire	33
		34	University of Pittsburgh	34
		35	University of Rhode Island	35
		36	University of Virginia	36
		37	Vassar College	37
		38	Virginia Polytechnic Institute and State University	38
		39	West Virginia University	39
2	Southeast	40	University of North Carolina, Charlotte	1
		41	University of Miami	2
		42	Kansas State University	3
		43	Georgia Tech University	4
		44	University of North Carolina-Chapel Hill	5
		45	University of Florida	6
		46	Elon University	7
		47	University of Mississippi	8
		48	North Carolina State University	9
		49	University of South Florida	10
		50	Florida International University	11
		51	Georgia Institute of Technology	12
		52	Belmont University	13
		53	Oklahoma State University	14
		54	University of Georgia	15
		55	University of Arkansas at Little Rock	16
		56	University of Central Oklahoma	17
		57	University of south	18
		58	University of Tennessee	19
3	Southwest	59	Texas A&M, Austin	1
		60	University of Texas, Dallas	2
		61	University of Houston	3
		62	University of Arizona	4
		63	Arizona State University	5

Table A-2: (cont'd)

S. no.	US Regions	No.	Universities	Total No.
		64	Texas A&M College Station	6
		65	University of Oklahoma	7
		66	Southwestern University	8
		67	University of Texas, San Antonio	9
		68	University of New Mexico	10
		69	Tarrant County College	11
		70	Texas Tech University	12
		71	University of Texas at Arlington	13
		72	University of Texas at Brownsville	14
		73	University of Texas at Galveston	15
		74	University of Tulsa	16
		75	University of Houston	17
		76	University of Phoenix	18
		77	University of Texas at Austin	19
4	Midwest	78	University of Cincinnati	1
		79	University of Illinois, Urbana-Champagne	2
		80	Illinois Institute of Technology	3
		81	University of Michigan	4
		82	Michigan State University (Pilot)	5
		83	Indiana State University	6
		84	Purdue University	7
		85	Ohio State University	8
		86	Miami University Ohio	9
		87	University of Illinois-Chicago	10
		88	Harrisburg University	11
		89	Illinois State University	12
		90	Kent State University	13
		91	Louisiana State University	14
		92	Southern Illinois University Edwardsville	15
		93	St cloud State University	16
		94	The University of Chicago	17
		95	University of Toledo	18
		96	university of Utah	19
		97	University of Kentucky	20
		98	University of Louisville	21
		99	University of Missouri at Kansas City	22
		100	University of Nebraska at Omaha	23

Table A-2: (cont'd)

S. no.	US Regions	No.	Universities	Total No.
		101	University of Wisconsin Madison	24
		102	Utah State University	25
		103	Wayne state university	26
5	West	104	University of California, Berkeley	1
		105	Stanford	2
		106	University of San Diego	3
		107	San Francisco State University	4
		108	Univ. of Washington	5
		109	California Institute of Technology	6
		110	Oregon State University	7
		111	University of California, Merced	8
		112	University of Idaho	9
		113	University of Southern California	10
		114	San Jose State University	11
		115	Loyola Marymount University	12
		116	Pierce College	13
		117	Pikes Peak Community College	14
		118	Truckee Meadows Community College	15
		119	University of California Davis	16
		120	University of California Riverside	17
		121	University of California, Los Angeles	18
		122	University of Colorado Boulder	19
		123	University of Oregon	20
		124	Washington State University	21
		125	Colorado State University	22

APPENDIX B – Questionnaire

Part A- Survey Instrument

This online survey questionnaire assesses the level of food accessibility and insecurity a student has faced in the last 12 months which overlaps the duration of the COVID as well. The instrument is divided into four sections and is semi-structured. The survey should not take more than 10 minutes to complete.

Questionnaire Begins on the Next Page

Please note: Anything in a | text box | is for your reference and will not be included in the online survey.

A. Food Accessibility(6 questions)

Q1a. In your own words, what is *Healthy and Culturally Appropriate Foods* ? (short answer requested, please use examples if needed)

Q2. This section assesses your food purchasing pattern and ability to access healthy and culturally appropriate foods *during your academic year.* Please read the following statements and tell us the extent of agreement with the five dimensions of access for healthy and culturally appropriate foods.

*Often- more than 50% of the time

*Sometimes- between 25-50% of the time

*Never- zero times in the year

S.no	Statements	Often True (2)	Sometimes True (1)	Never True (0)
	Physical Access			
1.	I find physical access (physically being able to get food) to be a major barrier to procure ***healthy foods*** for myself.			
2.	I find physical access (physically being able to get food) to be a major barrier to procure ***culturally appropriate foods*** for myself/my family.			
3.	I cannot find ***healthy foods*** in my locality on a routine basis			
4.	I cannot find ***culturally appropriate foods*** in my locality on a routine basis			
	Economic Access			
5.	I find it difficult to afford ***healthy foods*** in my locality on a routine basis.			
6.	I find it difficult to afford ***culturally appropriate foods*** in my locality on a routine basis.			
	Social Access			
7.	I cannot include ***healthy foods*** in my diet routinely			
8.	I cannot include ***culturally appropriate (South Asian) foods*** in my diet routinely			
9.	I avoid various ***healthy foods*** in my diet routinely, including those that I am unfamiliar with			

10.	I avoid various ***culturally appropriate food*** in my diet routinely, including those that I am unfamiliar with			

Q3. Please list top 3 food store(s) and their location(s) that have you accessed **groceries** (not cooked or prepared meals) from within the past month and select any one from each of the options for mode of travel, frequency of travel and time taken to travel one way to that store.

S.no	Grocery Store Name (please enter full name)	Mode of Travel	Frequency of travel	Time taken to travel (one way)	Location or nearest interaction or address
1.		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other, pl specify	More than once a week	More than 45 minutes	
2		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other, pl specify	More than once a week	More than 45 minutes	
3		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other, pl specify	More than once a week	More than 45 minutes	

S.no	Name (please enter full name)	Mode of Travel	Frequency of travel	Time taken to travel (one way)	Location or nearest intersection or address
1.		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other	More than once a week	More than 45 minutes	
2		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other	More than once a week	More than 45 minutes	
3		Drive	Less than once a month	Less than 10 minutes	
		Walk/Bike	Once a month	10-15 minutes	
		Public Transit	Alternate weeks	16-30 minutes	
		Delivery/Pick up	At least once a week	31-45 minutes	
		Other	More than once a week	More than 45 minutes	

Q4. Please list top 3 places where you have acquired **prepared/cooked meals** from within the past month and select any one from each of the options for mode of travel, frequency of travel and time taken to travel one way to that place.

Q5. Have you accessed food from the places listed below during your current academic year? Please select NA if you do not access a specific food source.

S.no	Relative Location	Food Source	Yes	No	N/A
1.	On Campus	Food Pantry/Food Bank			
2.	On-/Off- Campus*	Community or Religious center			
3.	On-/Off-Campus*	Local Farmer's Market			
4.	Off-Campus	Fast Food Chains (McDonalds/Dominoes)			
5.	Online	Grocery (Amazon Fresh/Instacart)			
6.	Online	Prep Meals (Blue April/ Daily Harvest)			
7.	Online	Food Delivery (Door Dash/UberEATS)			

* On-/Off- refers to On-campus or Off-campus

B. Food Security (1 Question)

Section B : Food security uses the Adult Food Security Survey (USDA, 2012) for statements 1-5 and statements 6 &7 have been added to assess the additional gap in this study.

This section assesses your level of food security in the US during your academic year. Here are couple of definitions for reference. You may skip to answer the questions by clicking Next.

Food refers to any edible items that you consume to fulfil your dietary and bodily needs. Food and Agriculture Organization (United Nations) defines food security as "all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Nutritious food can be defined as fruits, vegetables, whole grains, fat-free or low-fat dairy products, and lean meats, as well as nutrient-dense foods and beverages.

Q6. Please read the statements below that people have made about their food situation. Please answer to the best of your knowledge whether the statement was often, sometimes, or never true for you. These are about the foods you ate in the last 12 months or since you came to the US (whichever is recent).

S.no	Statements	Often True (2)	Sometimes True (1)	Never True (0)
1.	The food that I bought just didn't last, and I didn't have money to get more.			
2.	I couldn't afford to eat balanced meals.			
3.	I cut the size of my meals or skip meals because there wasn't enough money for food			
4.	I ate less than I felt I should because there wasn't enough money for food			
5.	I was hungry but didn't eat because there wasn't enough money for food			
6.	I made trip(s) to food pantries or other community places to access free meals because there was not enough money to purchase food.			
7	I had no means of access to purchase foods that I wanted to buy.			

Conditional for 4-Often True /Sometimes True

How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[ ] Don't know

C. Health (4 questions)

Section C: Health requests information on their physical wellbeing including current intake of healthy and culturally appropriate foods (which is based on Consumer Nutrition survey instrument (CDC, 2012), physical activity (the choices are based on BRFSS and NHANES descriptions), and stress (the categories are based on American Addiction Centers Resource- MentalHelp.Net) and Perceived Stress Scale (PSS from American Sociological Association/Cohen et al., 1988)

Q7. In general, how healthy do you feel? Would you say . . .

a) Very Healthy
b) Somewhat Healthy
c) Not Healthy
d) Others, please describe_____
e) Q9. Please choose your level of activity before and during covid by selecting any one of the options under "Before COVID" and one under "During COVID".

Before COVID				During COVID			
Very active (~ 15,000 steps per day; jogging/ running for 75 min per week and muscle strength training twice a week)	Moderately active (around 10,000 steps in a day; or brisk walking for 150 min every week or 30 min-5 days a week)	Somewhat active (around 5,000 steps in a day; or short slow pace walk approx. one hour everyday)	Sedentary (less than 1000 steps in a day; or less than 20 min total walking in a day)	Very active (~ 15,000 steps per day; jogging/ running for 75 min per week and muscle strength training twice a week)	Moderately active (around 10,000 steps in a day; or brisk walking for 150 min every week or 30 min-5 days a week)	Somewhat active (around 5,000 steps in a day; or short slow pace walk approx. one hour everyday)	Sedentary (less than 1000 steps in a day; or less than 20 min total walking in a day)

Q10. Please use the scale below to rate the level of stress you have faced during this pandemic (i.e., since March 2020) in the following aspects.

Types of Stress	Often True (2)	Sometimes True (1)	Never True (0)
Physical Stress			
Trauma (injury, infection, surgery), over-exertion, environmental pollution, illness, fatigue,			
Dietary stress (nutritional deficiencies, food allergies and sensitivities, unhealthy eating habits), or substance abuse.			
Psychological or Mental stress			
Emotional stress (fear, frustration, sadness, anger, grief)			
Cognitive stress (information overload, worry, guilt, shame, self-criticism, self-loathing, anxiety, panic attacks)			
Perceptual stress (beliefs, roles, stories, attitudes, world view, not feeling like things are real, being out of control/not being in control)			
Psycho-social stress			
Social Stress (Relationship/marriage difficulties, lack of social support, loss of loved ones)			
Financial Stress (lack of resources, loss of employment/investments/savings, bankruptcy or home foreclosure)			

D. Behavior (4 questions)

Section D: Behavior investigates food purchasing knowledge and behavior. A matrix question has been added to understand how participants perceive different food items which are further defined by access point (home made or store bought) and style of cooking. The two dimensions of the access are labelled for healthy and unhealthy on one access and culturally appropriate and non-culturally appropriate on the other.

Q12. How is your typical diet during your current academic year different from your home environment?

_____

_____

Q13. How would you define your food identity? Are you following any special diets during COVID? You may select up to two options

a) Omnivore (a person that eats food of both plant and animal origin)
b) Pescatarian (a person who doesn't eat meat, but does eat fish)
c) Vegetarian (a person that eats food of only plants)
d) Eggetarian (A vegetarian who also eats eggs and egg products)
e) Vegan (a person who does not eat anything that comes from animals)
f) Keto diet (a person who follows a low-carb and high-fat diet)
g) Paleo diet (a person who typically includes lean meats, fish, fruits, vegetables, nuts and seeds)
h) Others, please specify _____

E. Demographic Questionnaire (19 questions)

Q15. What is your university? Please write the full name including campus if you attend a satellite location.

_____

Q16. What is your student level?

a) Undergrad Freshman
b) Undergrad Sophomore
c) Undergrad Junior
d) Undergrad Senior
e) Master's first year
f) Master's second year or more

g) Doctorate First Year
h) Doctorate Second year or more
i) Others, please specify

Q17. What is your current gender identity?

a) Male
b) Female
c) Non-Binary or Genderqueer
d) Prefer to self-describe _____
e) Prefer not to answer _____

Q18. What is your age?

a) Less than 18 years
b) 19-20 years
c) 21-22 years
d) 23-25 years
e) 25-30 years
f) 31-40 years
g) 41-50 years
h) Over 50 years

Q19. Which country do you trace your family roots to? (Please use option (i) Others, for more than one country and specify the countries)

a) Afghanistan
b) Bangladesh
c) Bhutan
d) India
e) Maldives
f) Nepal
g) Pakistan
h) Sri Lanka
i) Others, please specify_____

Q20. Are you currently enrolled as an international student or domestic student?

a) International
b) Domestic

Q20. i. Conditional>Domestic- What generation are you in the States?

j) First Generation
k) Second Generation
l) Third or more Generation

Q23. What is your employment status?

a) I work on campus up to 20 hours per week
b) I work on campus over 20 hours and up to 40 hours per week
c) I work off campus up to 20 hours per week
d) I work off campus over 20 hours and up to 40 hours per week
e) I do not work (on or off campus)
f) Others, please specify_____

Cond. Q.23. a,b,c,d Your monthly income

a) Less than $1000
b) $1001-$1500
c) $1501-$2000
d) $2001-$2500
e) More than $2500

Q24. Do you own a vehicle?

a) Yes
b) No
c) Prefer not to say

Q25. Are you single or married?

a) Single
b) Married
c) Prefer not to say
d) Others, please specify_____

Q28. What is your living situation while attending university?

a) I live alone
b) I live with family
c) I live with friend(s)
d) Others, please specify_____

Q28.i. Cond-28c. & 28d. How often have you shared your groceries or food with your friend(s) within the last year?

a) Everyday
b) Every other day, 3-4 times a week
c) Twice a week
d) Once a week
e) Others, please specify

Q28.b & 28.d. Are you the primary grocery shopper for yourself while attending university?

a) Yes
b) No
c) Sometimes

Q29. In order to understand proximity of your location to food stores, we request that you share your address or nearest intersection of your house along with city name and zip code

Street Address/intersection

_____

City_____ State

_____

Zipcode_____

_____

Q30. If you would like to enter your name for the focus group discussion and be eligible for a $30 Gift card, please enter your name and email below and you will receive further instructions for joining the focus group discussions shortly.

a) Name
b) Email

Part B- Interview Questionnaire

A. Local Food Environment

Q1. How have your eating habits changed since attending college?

Q2. Have you changed your food consumption patterns due to insecurity and access issues? Why?

B. Food Access Activity

Q3. Below is a list of food products, please allocate in appropriate columns [Healthy-Culturally Appropriate, Healthy-Culturally Not Appropriate, Unhealthy- Culturally Appropriate, & Unhealthy-Culturally Not Appropriate]

Food products	Food products
1. Whole Wheat Chapati (I) /Roti (B;I;N; SL)/Naan (B;I) /Bolani (A)/Puri (I;P)/ Gyal (P)/Parantha (B;I;P) / Roshi (M) / Puri (I;N)	2. White Flour Chapati (I) /Roti (B;I; N; SL)/Naan (B;I) /Bolani (Afghan)/Puri (I;P)/ Gyal (P)/Parantha (B;I;P) / Roshi (M)/ Pittu (SL)/String hoppers (SL)
3. White Rice (Basmati/Short Grain) (Pulao/Biryani) (N)/ red rice (Bhu;N; SL) / Mastawa (A)	4. Other types of rice or rice items (wild rice/ brown/ black rice/quinoa)
5. Deep Fried samosa (I)/ momos (Bhu;I;N)/ Ulundhu Vadai (SL)/ Aushak (A) / Gosh-e fil (A)/ Hedhikaa (M)/ Veg. Pakora (N)	6. Baked Samosa (I;SL)/ steamed momos (Bhu;I;N) / microwaved vada/ Steamed Jackfruit (SL) / Chewda (Beaten Rice) (I;N)
7. Home-made Fried rice (I;SL)/ Noodle Soup (Thukpa- Bhu; N)/ Aush /OSH (A)/ Dowdo (P) made at home / Soupy Momos (N)	8. Packaged Noodles (Maggi/Wai Wai/Top Ramen (I) /Rum Pum (N) variations or Fried Rice or Noodle Soup from stores /Cup Noodles
9. Variations of Burgers (Bun kabab(A)/Vada Pav (I) / Pau Bhaji/ Malu Paam (Fish Buns) (SL) from restaurants/readymade/Homemade	10. Pizza from restaurants/readymade/Homemade
11. Potato Chips from stores (Lays, ruffles, uncle Chips, etc.)	12. Banana Chips (I) / Puff rice or Zaow (Bhu) / Cassava Chips (SL)/ Kavaabu (M) / Dried Plums (N)/ Dried fruits
13. Italian pasta (homemade or store bought)	14. Sushi (homemade or store bought)

15. Meat Alternatives/ Beyond Meat products / Plant-based meat products/ lab grown meat	16. Fruit juices (Frooti/minute made/Paper Boat)
17. Any alcohol products – Wine, whiskey, brandy, scotch, sake, Chhyang, Bhang etc (whichever is appropriate)	18. Carbonated drinks (Coke/Pepsi/Thumbs-Up/etc)
19. Chai (Tea); masala chai (I) or suja (Bhu) OR Dud Pathi (P) / Sai (M) / Te (SL) / black coffee / regular coffee / Chya (N)/Filter Coffee / Kahwa (A)	20. Variations of teas or coffees (chai latte/ Frappuccino/ cappuccino)
21. Misti Doi (B; I)/Ras Malai (B;I) / Kheer (I) / Haft Mewa (A)/Halwa (I;P)/ Handulu Bondibai (M) / Mung Kavum (SL) / Gajar Halwa (Carrot Halwa) (N)/ Ras Gulla (I)	22. Fresh coconut water (I) /King Coconut water (SL) / Lemonade / Neebu Pani (I)/ Woodapple Juice (SL)/ Lassi (P;I)/Borhani (B) / Sherbat (N)
23. Your Choice Food item *	24. Your Choice Food item *

Reflection

Q. Are heathy foods for you only in terms of physical health or mental health or both?

C. Food Identities and Preferences

Q4. What foods do you culturally associate with?

Q5. Are these healthy according to you? If yes/no, why?

Q6. During Finals- what happens?

Q7. What does your university provide in terms of healthy and culturally appropriate foods?

D. Food Journal Template

- Request information on ingredients and quantity of any three foods consumed in breakfast, lunch, dinner and snacks.

- Also indicate if the food was prepared at home or bought from a restaurant (Food Away From Home or FAFH)

APPENDIX C – Demographic Tables

Age Groups	Number of participants	Percentage of participants %
18 Years	9	2.1%
19-20 Years	46	10.8%
21-22 Years	63	14.9%
23-25 Years	129	30.4%
26-30 Years	121	28.5%
31-40 Years	48	11.3%
41-50 Years	2	0.5%
Prefer not to say	1	0.2%
Missing	5	1.2%

Table A-3: Age group for sample population in the online survey

Country of Origin N=424	Frequency	Percent
Afghanistan	8	1.9
Bangladesh	28	6.6
Bhutan	4	0.9
India	327	77.1
Maldives	7	1.7
Nepal	17	4.0
Pakistan	26	6.1
Sri Lanka	6	1.4
Others (or two or more countries)	1	0.2

Table A- 4: Sample population based on different South Asian countries of origin

Student Level Breakdown N=419	Frequency	Percent (%)	Percent-Undergraduate and Graduate level (%)
Undergraduate Freshman	18	4.2	30
Undergraduate Sophomore	24	5.7	
Undergraduate Junior	34	8.0	
Undergraduate Senior	50	11.8	
Master's First Year	96	22.6	70
Master's Second or more (recent grad)	47	11.1	
Doctoral First Year	38	9.0	
Doctoral Second or more	105	24.8	
Post Doc / Res Fellow	7	1.7	

Table A-5: Student population representing different levels of education

	North-East	South- East	Midwest	South-West	West
International N=335 (80.7%)	81 19.6%	18 4.3%	143 34.5%	64 15.5%	27 6.5%
Domestic N=80 (19.3%)	25 6%	7 1.7%	19 4.6%	7 1.7%	22 5.3%
Total 415 (100%)	106	25	162	71	49

Table A-6: Break up of international and domestic students from five US zones

	Male	Female	Nonbinary / Third gender / Gender Queer	Prefer not to say
International	174	156	1	4
n=335	51.9%	46.6%	0.3%	1.2%
Domestic	22	59	1	0
n=82	26.8%	72.0%	1.2%	0%

Table 7: Gender classification

Student Status		N	Percent	n	Percent
International		334	80%		
Domestic	First Generation	82	10%	40	48.78%
	Second Generation		8%	33	40.24%
	Third or more Generation		1.2%	5	6.1%

Table A-8: Student population based on international and domestic status included in the study

	On Campus up to 20 hrs.	On Campus 20-40 hrs.	Off Campus up to 20 hrs.	Off campus 20-40 hrs.	I do not work
International n=335	169	40	13	22	91
%	50.4	11.9	3.9	6.6	27.2
Domestic n=81	26	8	10	7	30
%	32.1	9.9	12.3	8.6	37.0

Table A-9: Employment break-up

	Vehicle Ownership			**Individual Status**				**Living Status**			
Student Status	**n**	**Yes**	**No**	**n**	**Single**	**Married**	**Prefer not to say**	**n**	**Alone**	**With Family**	**With Friend(s)**
International	328	71	257	334	273	51	10	336	89	58	189
%		21.6	78.4		81.7	15.3	3.0		26.5	17.3	56.3
Domestic	82	29	53	82	75	5	2	82	24	17	41
%		35.4	64.6		91.5	6.1	2.4		29.3	20.7	50.0

Table A-10: Vehicle ownership, individual status and living status for online participants

		Primary Grocer			**Share Groceries**						
Student Status	**n**	**Yes**	**Sometimes**	**No**	**n**	**Every day**	**Every other day, 3-4 times a week**	**Twice a week**	**Once a week**	**Never**	**Once a month/Once**
International	246	150	77	19	184	90	27	23	29	12	3
%		61.0	31.3	7.7		48.9	14.7	12.5	15.8	6.5	1.6
Domestic	58	36	14	8	41	9	7	6	15	4	0
%		62.1	24.1	13.8		22.0	17.1	14.6	36.6	9.8	0

Table A- 11: Primary grocer and frequency of sharing groceries by online participants

APPENDIX D – Survey Tables

Measure	Cronbach's Alpha	N of Items
Accessibility Score	0.81	10
Level of Food Insecurity	0.91	7
Level of Stress	0.82	7

Table A- 12: Test for Reliability (Cronbach's Alpha)

S.no	**Statements**	**Mean Score for International Students n=335**	**Mean Score for Domestic Students n=80**
1.	The food that I bought just didn't last, and I didn't have money to get more.	0.29	0.27
2.	I couldn't afford to eat balanced meals.	0.36	0.21
3.	I cut the size of my meals or skip meals because there wasn't enough money for food	0.26	0.19
4.	I ate less than I felt I should because there wasn't enough money for food	0.24	0.21
5.	I was hungry but didn't eat because there wasn't enough money for food	0.20	0.19
6.	I made trip(s) to food pantries or other community places to access free meals because there was not enough money to purchase food.	0.25	0.18
7	I had no means of access to purchase foods that I wanted to buy.	0.28	0.16

Table A- 23: Mean score per statements for Food Insecurity Question in the Online Survey

Student Status	**Gender**	**Time Spent in the US**	**Level of Health Risk Perceived**
International	Female (43)	Less than a semester (9)	There is a minor risk (5)
			There is no risk (4)
		Approximately a year (8)	There is a minor risk (5)
			There is no risk (3)
		2-4 years (21)	There is a major risk (4)
			There is a minor risk (11)
			There is no risk (6)
		More than 4 years (5)	There is a major risk (2)
			There is a minor risk (3)
	Male (35)	Less than a semester	There is a major risk (2)
			There is a minor risk (4)
			There is no risk (3)
		Approximately a year	There is a minor risk (5)
			There is no risk (6)
		2-4 years	There is a minor risk (5)
			There is no risk (6)
		More than 4 years	There is a minor risk (4)

Table A- 14: Number of interview respondents and basic classification of gender, time spent in the US and level of health risk perceived

Table A-14: (cont'd)

Domestic	Female (6)	NA	There is a minor risk (4)
			Did not answer (2)
	Male (2)	NA	There is a minor risk (3)
			There is no risk (1)

APPENDIX E – List of Variables

S.no.	Dependent Variable-Category	Dependent Variable- Sub-Categories	Independent Variable	Data Source
1.	Food Insecurity (0-food secure 1-food insecure)		Socio-Demographic Variables	Survey
				Built Area
2.	Access A-Score	5 Dimensions of Access		Survey
		Physical	Travel Time	Survey
			Travel Mode	Survey
			Technological Access	Survey
			Land Use	Built Area
			Transport Resources (bus stops, bus passes, bicycle stands)	Built Area
			Boundaries of Local Food Environment	Interviews; Built Area
			Community Resources	Survey
		Social	Cultural Foodways	Interviews
			Relationship and Social Networks	Interviews
			Presentation of Store and Consumer Base (discriminatory behavior pattern)	Interviews
		Economic	Income	Survey
			Food Cost	Survey
			Travel Cost	Survey
			Store Incentives	Survey
			Quality and Variety (QV-Score)	Survey
			Diversity of Food Available	Survey
3a.	Health Outcomes	Overall	Health Status	Survey
			Food Related Illness	Survey
		Physical	Physical Activity	Survey
		Stress	Over-exertion, environmental pollution, illness, fatigue, dietary stress (nutritional deficiencies, food allergies and sensitivities, unhealthy eating habits), or substance abuse.	Survey

Table A-15: List of dependent and independent variables for analysis

Table A-15 : (cont'd)

		Mental (Stress)	Emotional stress (fear, frustration, sadness, anger, grief), cognitive stress (information overload, worry, guilt, shame, self-criticism, self-loathing, anxiety, panic attacks, not feeling like things are real, being out of control/not being in control), and perceptual stress (beliefs, roles, stories, attitudes, world view)	Survey
		Psychosocial	Relationship/marriage difficulties, lack of social support, lack of resources for adequate survival, loss of employment/ investments/ savings, loss of loved ones, bankruptcy, home foreclosure, and isolation.	Survey
			Social Distance	Survey
			Social Isolation	Survey
3b.	Behavior		Food and Nutrition Knowledge	Interviews
			Food Identities and Preferences	Interviews
			Discriminating Practices of Reducing Access	Interviews
			Perceived Value of Food	Interviews

APPENDIX F – Thematic Codes

Name	Description & Sub-Codes	Files	References
Consumption behavior		74	200
Consumption behavior at home	Frequency of consumption, freshly cooked or warm meals, meal combinations are cultural foods, prepared by my own self, stemming from parent's background	24	31
Consumption behavior in India	Common Indian foods, cultural association, personal preferences	64	136
Global exposure	Identifiable to any specific culture, more in US	16	20
Health relationship of foods	Comprises of unhealthy foods as well, cultural foods are healthier	23	29

Table A-16: Culturally appropriate codes

Name	Description & Sub-Codes	Files	References
Acceptance	Cultural or Social Perception, Personal Acceptance, Health perception	40	57
Contradicting ways to Indian traditions or environment	Economic benefit only, Unsustainable Practices	8	9
Not recognized from India	Foreign to Indian Environment, Not associated within India	27	44

Table A:17: Culturally not-appropriate codes

Name	Description & Sub-Codes	Files	References
Acceptability Challenges	Participants mention issues with adjusting to the new food environment. This has been categorized under externalities and personal context.	83	372
Externalities	Accessibility, Availability, Education	63	156
Personal Context	Adjusting, Health, Phase Behavior, Tipping Points	63	126

Table A-18: Codes for acceptability

Name	Description & Sub-Codes	Files	References
Accessibility Challenges	Participants mentioned challenges to access foods or food retail outlets. This has been categorized under individual level issues and planning level issues.	76	228
Individual Level Issues	Acceptability, COVID impacts	33	52
Planning Level Issues	Governance, Mobility, Zoning	72	176
Strengths	Acceptability, Planning level issues (mobility & zoning)	75	186

Table A-19: Codes for accessibility

Name	Description & Sub-Codes	Files	References
Accommodation Challenges	Participants mentioned challenges to food products being accommodated in their local food environment and other issues. These have been sub-coded on personal and planning level.	44	85
Individual Level Issues	Acceptability, Behavioral challenges outside, More accommodating behavior in India	4	4
Planning Accommodation	Local food environment (grocery stores, Indian store, On campus), Zoning (Affordability, Social Access, Spatial challenges)	40	81
Strengths - Local food environment	Campus accommodates multi-ethnic, accommodating Indian foods at Grocery Stores	5	6

Table A-20: Codes for accommodation

Name	Description & Sub-Codes	Files	References
Affordability Challenges	Participants mentioned challenges related to affordability of food products and associated costs. This has been sub-coded as acceptable based on affordability and planning level issues.	61	109
Individual Level Issues	Personal preferences	24	29
Planning	Local food environment (Grocery stores, Indian store, Ghost Kitchen, On Campus, restaurants), Mobility (Accessibility & Online Delivery), Zoning (Accommodation & Availability)	51	80
Strengths	Mobility (accessibility), Zoning (Affordability, availability)	12	14

Table A-21: Codes for affordability

Name		Files	References
Availability Challenges	Participants mentioned challenges regarding availability of food products which has been coded on two levels, acceptable based on availability and planning level.	86	435
Individual Level Issues	Market Products, personal Preferences	32	56
Planning	Local Food Environment (Alternate food retail, ghost kitchens, grocery stores, Indian stores, multi-ethnic food retail, religious institutions, university), Mobility (accessibility, online delivery, social access), zoning (affordability, place-based availability)	86	379
Strengths	Acceptability, planning (Local Food Environment, mobility & zoning)	87	342

Table A-22: Codes for availability

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