

GROCERY SHOPPING DESTINATION CHOICE AND OBESITY:
AN EMPIRICAL STUDY OF URBAN POPULATION IN BANGKOK, THAILAND

by

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A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
In Partial fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Public Policy

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ACKNOWLEDGEMENTS

I would like to express my sincerest gratitude to my committee chair, Naoru Koizumi, whose guidance and motivation both in academic and personal matters proved invaluable not only to this dissertation but also to my future research undertakings. She was always available for questions, generous with her time, knowledge, and useful comments. I am also appreciative of my committee members, Lisa Pawloski and Kenneth Reinert, for their contributions without which the completion of this project would not have been possible.

Besides my committee members, I would also like to thank my supervisor, Arnauld Nicogossian, for the opportunity to be part of the wondrous world of space medicine research that I had never fathomed I would experience. I am truly thankful for your support through all these years.

Last but not least, I am forever indebted to my parents, my sister, my brother, and my loving husband for their endless patience and encouragement, for the sacrifices they make for me to be on this journey, for always having faith in me and still letting me be the baby of the family.

TABLE OF CONTENTS

LIST OF TABLES	vii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS.....	x
ABSTRACT.....	
CHAPTER ONE: INTRODUCTION	1
I: Statement of the Problem	1
II: Study Objectives	2
III: Potential Contributions and Challenges.....	3
CHAPTER TWO: LITERATURE REVIEW	5
I: Grocery Retailing and Shopping in Asia.....	5
Subsection 1.1 Grocery Retailing in Asia.....	6
Subsection 1.2: Factors Impacting the Consumer’s Choice of Store Type.....	9
II: Grocery Revolution in Thailand.....	15
Subsection 2.1: The Arrival of Western-Format Grocery Outlets in Thailand.....	16
Subsection 2.2: Major Players in Bangkok, Thailand.....	20
Subsection 2.3: Grocery Shopping Behavior of Bangkok Residents.....	22
III: Thailand’s Food and Health Policy.....	26
Conclusion	40
CHAPTER THREE: THEORETICAL FRAMEWORK.....	57
I: The Evolution of the Obesity Issue Framework.....	57
II: The Social Cognitive Theory	61
III: The Ecological Perspective Framework	63
IV: Social and Structural Environment in Obesity Research.....	67

Conclusion	69
CHAPTER FOUR: RESEARCH QUESTIONS AND HYPOTHESES	80
I: Spatial Analysis of Bangkok Food Landscape	80
II: Socio-Demographic Analysis.....	82
III: Grocery Destination Choice and Health Behavior.....	88
IV: Grocery Destination Choice and Obesity	91
Conclusion	93
REFERENCES	94
CHAPTER FIVE: DATA AND METHOD.....	98
I: Description of Data.....	98
Subsection 1.1: GIS Mapping Data.....	98
Subsection 1.2: The Grocery Shopping and Health Survey and Data Collection.....	101
Subsection 1.3: Definitions of Grocery Retailers	105
Subsection 1.4: Sample Populations	107
II: Description of Methods and Model.....	108
Subsection 2.1 Average Nearest Neighbor Distance (NND) and Moran's I Spatial Analysis	108
Subsection 2.2: Shopper Group Characteristics (ANOVA, Chi-Squares, and Independent t-tests).....	111
Subsection 2.3: Grocery Destination and Health Behavior (Negative Binomial Regression)	115
Subsection 2.4: Grocery Destination Choice and Weight Status (Ordinary Least Squares Regression)	119
REFERENCES	128
CHAPTER SIX: STATISTICAL ANALYSIS RESULTS.....	130
I: Descriptive Statistics	130
II: Research Question I	137
III: Research Question II.....	141
IV: Research Question III	150
Negative Binomial Regression Analysis.....	153
V: Research Question IV	160

Subsection 5.1: Shopper Groups	160
Subsection 5.2: Frequent Shoppers	168
Conclusion	176
CHAPTER SEVEN: DISCUSSION AND IMPLICATIONS	180
I: Limitations and Generalizability	182
II: Policy Implications and Recommendations	185
III: Directions for Future Research	194
Conclusion	196
APPENDIX A: GROCERY PURCHASING BEHAVIOR QUESTIONNAIRE	201
APPENDIX B: GROCERY STORE EVALUATION FORM	209
APPENDIX C: BODY COMPOSITION ANALYSIS SAMPLE	211
APPENDIX D: STATA COMMANDS	212
Research Question II.....	212
Chi-squares test (Tables 6.3, 6.4, 6.5, 6.8).....	212
ANOVA tests (Table 6.6)	213
t-tests (Table 6.7)	214
Research Question III	214
Negative Binomial (Table 6.9).....	214
Test 1 Histogram (Table 6.10)	216
Test 2 mean equal variance (Table 6.11)	216
Test 3: Poisson Goodness of Fit (GOF) test	216
Test 4: The Likelihood Ratio Test of Alpha	216
Research Question IV	216
BMI and shopping destination (Table 6.14)	216
PBF and shopping destination (Table 6.15).....	217
Waist circumference and shopping destination (Table 6.16).....	218
BMI and Shopping Frequency (Table 6.17)	218
PBF and Shopping Frequency (Table 6.18).....	219
Waist Circumference and Shopping Frequency (Table 6.19).....	219
BIOGRAPHY	221

LIST OF TABLES

Table	Page
Table 2.1: Household Income and Food Expenditure of Bangkok Residents.....	23
Table 3.1: EPF's Levels of Influence and Definitions.....	65
Table 4.1: Expected Signs of Variables of Interest.....	84
Table 5.1: Socioeconomics of Respondents and General Bangkok's Working Population (Census Data).....	108
Table 5.2: Shopper Group Definitions.....	111
Table 5.3: The Categorical Variables Tested using the Chi-square Test.....	112
Table 5.4: The variables to be tested using ANOVA	114
Table 5.5: Variables to be Tested by Independent T-Tests.....	115
Table 5.6: Health Behavior Variables and Control Variables	117
Table 5.7: Independent Variables of Interest for Negative Binomial Regression (Shopper Group).....	118
Table 5.8: Independent Variables of Interest for Negative Binomial Regression (Frequent Shopper).....	118
Table 5.9: Independent Variables (Primary Shopping Destination Choice)	120
Table 5.10: Independent Variables (Shopping Frequency)	121
Table 5.11: Control Variables for OLS models (Shopper Group)	122
Table 5.12: Control Variables for OLS models (Frequent Shopper)	125
Table 6.1: Gender, Age, and Educational Attainment of Primary and Non-Primary Shoppers.....	131
Table 6.2: Household Income, Residence Type, Marital Status, Family Composition and Car Ownership of Primary and Non-Primary Shoppers.....	133
Table 6.3: Sex, Age, and Educational Attainment of Modern, Traditional, and Mixed Shoppers (Chi-squares test).....	143
Table 6.4: Monthly Household Income and Residence Type of Modern, Traditional, and Mixed Shoppers (Chi-squares test).....	144
Table 6.5: Household Size and Car Ownership of Modern, Traditional, and Mixed Shoppers (Chi-squares test).....	145
Table 6.6: Spending, Shopping, and Traveling Time per Trip (ANOVA).....	146
Table 6.7: Shopping Frequency and Spending per Trip among Car Owners and Non-Car Owners (ttest).....	148
Table 6.8: Importance of Store Attributes by Shopper Groups (Pearson Chi2).....	149

Table 6.9: Negative Binomial Regression controlling for Age, Sex, and Education.....	151
Table 6.10: Histograms of Health Behavior Variables (Dependent Variables).....	154
Table 6.11: Mean and Variance of Dependent Variables are not Equal.....	155
Table 6.12: Pearson's Chi-Squares Statistics and their Significance.....	156
Table 6.13: Results from the Likelihood Ratio Test of Alpha.....	157
Table 6.14: OLS Results of BMI and Shopper Groups.....	162
Table 6.15: OLS Results of PBF and Shopper Groups.....	164
Table 6.16: OLS Results of WC and Shopper Groups.....	166
Table 6.17: OLS Results of BMI and Shopping Frequency.....	168
Table 6.18: OLS Results of PBF and Shopping Frequency.....	170
Table 6.19: OLS Results of WC and Shopping Frequency.....	172
Table 7.1: shows summary of findings.....	180

LIST OF FIGURES

Figure	Page
Figure 2.1: Food Expenses as Percentage of Total Food & Beverages Expenditure.....	25
Figure 5.1: Area of Study.....	99
Figure 5.2: Area of Study as GIS Layer.....	99
Figure 6.1: Educational Attainment of Primary and Non-Primary Shoppers.....	132
Figure 6.2: Monthly Household Income of Primary and Non-Primary Shoppers.....	135
Figure 6.3: Average Nearest Neighbor Distance Analysis of Traditional Markets.....	136
Figure 6.4: Average Nearest Neighbor Analysis of Modern Retailers.....	138
Figure 6.5: Choropleth Map of District-Level Convenience Stores adjusted for the Number of Total Population in the District.....	139

LIST OF ABBREVIATIONS

AAN	Alternative Agricultural Network
ACFS	National Bureau of Agricultural Commodity
ASEAN	Association of Southeast Asian Nations
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
CSR	Corporate Social Responsibility
EPF	Ecological Perspective Framework
FASC	Family and School Collaborative
FDI	Foreign Direct Investment
GDA	Guideline for Daily Amount
LBW	Low Birth Weight
NCD	Non-Communicable Disease
NEMS	Nutrition Environment Measures Survey
NHANES	National Health and Nutrition Examination Survey
NHES	National Health Examination Survey
PBF	Percent Body Fat
RCPT	Royal College of Physicians of Thailand
SCT	Social Cognitive Theory
SES	Socioeconomic Status
SNOCOP	School Network on Childhood Obesity Prevention
TBW	Total Body Water
TCS	Thai Cohort Study
TFC	Transnational Food Company
TRHR	Thyrotropin-releasing Hormone Receptor
VF	Visceral Fat
WC	Waist Circumference
WHR	Waist-Hip Ratio

ABSTRACT

GROCERY SHOPPING DESTINATION CHOICE AND OBESITY: AN EMPIRICAL STUDY OF URBAN POPULATION IN BANGKOK, THAILAND

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George Mason University, 2016

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The dissertation explores the effects of the food retail landscape in Thailand that has been going through a major transformation since the late 1990s on the population's health. The rapid expansion of Western-format grocery outlets such as hypermarkets, supermarkets, and convenience stores was most evident in Bangkok, the capital city, at the same time that obesity rates have been rising. The research on the food retail industry has focused primarily on the economic effects of Western-format grocery store expansion such as the impacts on small-scale producers and the survival of traditional mom-and-pop stores. The role of Western-format grocery stores in increasing the availability and desirability of Western food products in the developing world, which has potentially significant health impacts, has rarely been looked at. The purpose of this study is to bridge this gap in the literature by looking at the relationship between the choice of grocery shopping destination and obesity using measures including body mass index (BMI), percent body fat (PBF), and waist circumference (WC). The findings suggest uneven distribution of

food outlets in Bangkok. Sociodemographic characteristics also differ by shopper groups. Modern shoppers are significantly more likely to hold a graduate degree, live in a condominium, and live by themselves. Traditional shoppers are likely to be in the lowest income category, and mixed shoppers are likely to live in larger households with at least one child under the age of 18. Grocery destination choice alone does not appear to be associated with health behaviors, but frequent shopping does. Particularly, those who visit convenience stores three or more times a week are significantly more likely to eat fast foods ($p<0.002$), consume sweet drinks ($p<0.003$), consume alcohol ($p<0.039$), and sit 8 or more hours a day on average ($p<0.012$). These undesirable health habits have not translated into greater propensity to be obese as postulated. Surprisingly, those who frequent traditional markets (three or more times a week) appear to have significantly higher BMI ($p<0.05$) even after controlling for age, gender, education and health habits. Policy implications, recommendations, and future research directions are discussed.

CHAPTER ONE: INTRODUCTION

I: Statement of the Problem

Southeast Asia is a region with distinct cultures, values, as well as body composition features. The region is also experiencing nutrition transition, a process whereby patterns in the human diet shifts from traditional meals that are high in fiber and cereal to more Western diets that are high in sugar and fat (Popkin 1993). Similar changes in nutrition and the food retail environment that took place in now-industrialized countries over 50 years have unfolded in Southeast Asia in the last 15-20 years (Reardon et al. 2008).

Western-style markets are replacing traditional fresh markets and people are more exposed to processed foods. On the one hand, modern retailers increase diet diversity, offering consumers nutrition benefits. On the other hand, modern retailers also increase the availability of energy-dense and low nutrient foods (Hawkes 2008, Kelly et al. 2014). What most people can agree on, however, is the supermarket revolution has led to an increase in average caloric consumption regardless of what foods have been consumed (Hawke 2008). In less than two decades, the estimated daily calorie intake of Thai populations increased from 2250 kcal in 1990 to 2540 kcal in 2008. During the same period, daily fat intake rose from 45 grams to 56 grams (FAOSTAT).

The much more rapid pace of modern retailing expansion in this part of the world has raised concerns regarding the emergence of chronic diseases and the adequacy of the region's healthcare capacity (Aekplakorn et al. 2009). Obesity rate is rising in this part of the world along with related non-communicable diseases (NCDs) such as hypertension and diabetes. To exacerbate the matter, obesity, in Western standards, is not necessarily present for an individual of Asian descent to develop conditions commonly linked to having high body mass index (BMI). Ethnicity, it turns out, is also an important determinant of body tissue proportions. Diabetes cases are greater among Asians than in people of European descent of the same BMI (Park et al. 2001; McNeely and Boyko 2004). In other words, an Asian person is more likely to develop diabetes than a Caucasian person of the same weight and height. The impact of nutrition transition is thus expected to be more severe in this part of the world.

II: Study Objectives

The aim of this dissertation is three-fold. First, it explores the food retail landscape of Bangkok. Second, it seeks to understand the factors influencing store choice behavior among Bangkok grocery shoppers. Third, it investigates the relationship between obesity and the store format of grocery destination choice. There are, thus, three main objectives for this dissertation.

- to explore the Bangkok spatial distribution of grocery stores
- to examine the characteristics of those who shop at different types of grocery stores

- to investigate how an individual's health behavior and weight status is related to their grocery destination choice and shopping frequency

III: Potential Contributions and Challenges

a.) Contributions

The contributions of this dissertation include: (1) It takes the public health perspectives on the expansion of modern food retailers in emerging economies whereas existing literature is focused primarily on the economic challenges. This brings to the fore the importance of the impacts on health from urbanization and change in lifestyle which often takes the back seat to the economic perspectives. (2) It takes into account the spatial relationship between grocery store locations and where one shops. This allows for observation in the importance of distance to grocery stores as a determinant of destination choice. There is a wealth of literature in this area in the developed world but none in Thailand. (3) It focuses on the largest metropolitan area in Thailand where the supermarket revolution is most pronounced. As such, it provides a visualization of a potential path for growing smaller cities in the country and the Southeast Asia region. It is hoped that this dissertation will bring forth policy implications on creating conditions for healthy living in the still-urbanizing city of Bangkok.

b.) Challenges

Policy challenges of this study include: (1) Obesity is a multifaceted condition. The dissertation includes some of very important contributors but leaves out others such as the influence of the media and access to exercise facilities due to time and budget

constraints. (2) The study uses a convenience sample of working population from selected industries who may be systematically different than the public at large. (3) The scope is limited to Bangkok which is markedly different in demographic profile and level of development than the rest of Thailand and may not be generalizable. It will, however, be a good example for other urbanizing mega-cities in Southeast Asia.

CHAPTER TWO: LITERATURE REVIEW

The issue of food retail environments and obesity has attracted the attention of researchers only in recent years with the vast majority of work being conducted on Western populations, exploring the effects of the lack of food outlets in low-income neighborhoods. Literature on Asian populations is almost always drawn from minorities in Western countries who face a different set of factors than those in the developing world. Studies on food environments in Southeast Asia are scant as the supermarket revolution is still unfolding at the same time that diet-related diseases are on the rise. This chapter reviews literature related to food retailing in Asia, grocery destination choice, and the prevailing situation in Thailand.

I: Grocery Retailing and Shopping in Asia

Culture has been used in a number of disciplines to represent different concepts. In the social sciences, culture refers to shared characteristics of members of a particular society that include beliefs, language, cuisine, habits, morals, and everything else that make up their way of life (McNeely 1996). Culture has undeniable influences on dietary patterns and lifestyles of populations especially in the Southeast Asia region. Understanding dietary and other health behaviors in cultural context can shed light on the consequences of interactions between social, environmental and biological factors on the prevalence of chronic diseases (Shatenstein and Ghadirian 1998).

Subsection 1.1 Grocery Retailing in Asia

Asia is one of the most dynamic and diverse region for grocery retailing in the world. While there are certainly common elements among Asian markets, each country has fairly distinct food and shopping cultures. Countries in Asia are experiencing a rise in educational attainment, increasing wealth, urbanization, smaller families, condominium living, and the general Westernization influence. These factors together propel the growth and popularity of Western-format grocery stores. As consumers become more educated and purchasing power increases, they also demand higher quality and greater variety of products. Between 2008 and 2012, the average growth in grocery sales were double digits at 13% though has since slowed down to about 8% (Retail Asia 2014). The number of new players expanding into the region has also slowed, allowing existing retailers to strengthen their presence, especially in Southeast Asia. The massive income gap in Asian countries, nonetheless, means that traditional open-air markets still maintain a strong presence and serve a large portion of the population, creating a bifurcated retail industry (Kelly et al. 2014).

Despite their phenomenal proliferation, there is still room for growth for big box stores in Asia, particularly in suburban area and smaller cities. Foreign retailers have been trying to address the needs of diverse populations and overcome the cultural barriers in tastes and preferences. Niche markets are also just emerging for health foods, organic produce, supplements, and imported luxury grocery products. In addition, large chain stores are experimenting with online retailing although it hasn't gained much traction for many people view grocery shopping as leisure activity and prefer to browse the stores

themselves. There is positive outlook for expansion, however, as Internet access reaches wider audience and online shopping becomes more common.

While the expansion trend of modern grocery outlets in Asia mirrors that in the West in many ways, the level of community penetration differs due to structural and cultural disparities. There remains a lack of consensus in the literature regarding the future of modern retailers in Asia. Each year, the number of new stores goes down but the size of each store gets larger, emphasizing the importance of being a one-stop-shop (Trappey and Lai 1997). The supermarket revolution happened in three waves. The first wave occurred in the early 1990s in Latin America. The second wave, to which Thailand belongs, took off in the late 1990s in Southeast Asia with an exception of Vietnam. The market share of modern retailers in second-wave countries reached 30-50% by the mid-2000s. The third wave began in the late 1990s and early 2000s and includes China, Vietnam, India, and Russia. Countries in Africa are just starting to see the increasing presence of modern retailers and have yet to take off (Reardon 2003, Reardon et al. 2004, Reardon et al. 2012).

In all three waves, the progress had similar stages. Expansion starts in big cities. The upper income populations lead the trend, followed by less wealthy populations. Processed foods are the first to hit the supermarket shelves, then semi-processed, and eventually fresh produce. The revolution also typically starts with pioneer domestic supermarket chains that are later overtaken or overpowered by transnational food companies (Ibid).

Many believe that modern retailers would never fully replace traditional markets in Asia because of the non-economic significance that fresh markets have in people's lives as a venue for socialization and staying connected with the community (Trappey and Lai 1997, Reardon et al. 2012; Kelly et al. 2014). People are more likely to engage in a conversation with fellow shoppers or stallholders at traditional markets (Chenxi 2013, Isaacs et al. 2010). Some have argued that Asians do not value convenience, variety, and cleanliness, which are the advantages of supermarkets, as much as Westerners do. Instead, Asians perceive traditional markets as offering fresher products at lower costs because they do not have to bear the higher labor and rental costs (Goldman et al. 2002). This, nonetheless, may not be the case for much longer as modern retailers have been improving their efficiency in procurement of fresh produce by building relationship with suppliers directly (Reardon et al. 2004, Gorton et al. 2011) and have been gaining market share by offering similar pricing with superior food safety and hygiene than their traditional counterparts (Minten and Reardon 2008).

Studies have also noted the structural improvements in the supply chain efficiency of modern retailers that fueled their expansion. Supermarkets have taken advantage of economies of scale to build their own supply networks and impose their own standards (Reardon et al 2003, 2004, 2007). To address their disadvantage vis-à-vis traditional markets, Western-style markets have imitated certain aspects of the traditional markets, embedding a fresh market setup with stalls of fruits, meat, and vegetables within their modern aisle format (Minten and Reardon 2008). Some supermarkets have live fish in aquariums and offer butchering and fishmonger services (Gorton 2011). The growth of

supermarket chains in Asia has been constant over the past 2 decades with third-wave countries such as China, India, and Vietnam showing the highest growth rate (Reardon et al. 2012). In 2007, modern retailers make up 5% of the total food retail outlets in absolute store number but commanded 45% of total sales in Thailand (Di 2008). They are no longer insignificant players in the fresh fruit and vegetable markets. In Hong Kong, fresh market's share in fresh product sales fell from 65% in 1994-1995 to 49% in 1999-2000 (Ho 2005).

Subsection 1.2: Factors Impacting the Consumer's Choice of Store Type

The process of replacing traditional fresh markets with Western-format grocery stores has been incomplete in Asia even in developed countries such as Japan, Hong Kong, and Taiwan. After over a decade since the introduction of supermarkets, traditional markets still have a stronghold over the sale of fresh produce and meat (Cadilhon et al. 2006). Opinions differ regarding the prospects of traditional market's survival in the face of expanding modern grocery retailers. Some have said that, in Asia, consumers' idea of 'fresh' is to be as close as possible to the live animal or plant. Therefore, traditional markets where many animals are sold live are still the preferred destination for many (Ibid). In Hong Kong the economy is fully developed but Western-style retailers surprisingly still only occupy approximately 57% of the grocery sales (Li 2013). On the other hand, some researchers have suggested that the dwindling trend of traditional markets in some places such as Taiwan will probably continue until they cease to exist as modern retailers grow in popularity (Trappey and Lai 1997, Agriculture and Agrifood Canada Global Analysis Report 2013). In some regions, wet markets appear to only be

serving a shrinking population of older generations while younger consumers prefer modern-format retailers such as supermarkets and hypermarkets (Trappey and Lai 1997). In Singapore, however, advocates of traditional markets argue that shopping is a social activity. It is easy for people to initiate a conversation with strangers in a traditional market setting. By contrast, supermarkets do not promote community bonding the way traditional markets do. Both types of retailers should, therefore, coexist (Chenxi 2013). The following paragraphs describe the potential factors influencing people's choice of marketplace.

a.) Family Dynamics

Family dynamics has been explored with respect to grocery purchases. The increase in female participation in the labor force has increased the demand for convenience foods. Given that women are typically the one responsible for food preparation, this is a big change in the family dynamics. Working wives were found to prefer eating out or foods that require minimal preparations more so than housewives. Housewives also reportedly feel a greater sense of responsibility over the family's health than do their working counterparts (Jackson et al. 1985, DeVault 1994).

Children and adolescents exert influences of varying degrees in household decision making including during grocery shopping trips (Gaumer and Arnone 2009). Families with children reported that getting meals outside, take-out, delivery, or eating at a restaurant, makes life more manageable, according to the National Restaurant Association (2009). Ready-made meals are a convenience that is increasingly available, accessible, and affordable. These include both frozen meals and those that are prepared

and then packed fresh for same-day consumption. The proliferation of frozen meal options in Bangkok have been incredible in the past few years, revolutionizing the meaning of eating at home.

b.) Generation Gap

Age dynamics has also been explored as an influential factor. Traditional markets shoppers tend to be older generations and predominantly female whereas modern retailers see customers from all age and gender groups (Trappey and Lai 1997, Gorton et al. 2011, Chenxi 2013). Younger people are more likely to accept variety and novelty (Dixon et al. 2007). Such generation gaps may also reflect the desire for the younger generations to be informed and make their own judgment on their food choices by shopping at self-service Western-style markets. While at supermarkets, people decide on which products to purchase from external cues such as price, nutrition facts, and packaging, at traditional markets, patrons rely more on stallholders' recommendations. Traditional market shoppers are, therefore, more dependent on others in making their food choices (Chenxi 2013).

c.) Single-person Households

One-person households are not able to take advantage of economies of scale when it comes to purchasing perishables as they may go bad before one can finish them. They are more likely to live in smaller spaces with little room for storage and may be more likely to shop at neighborhood or convenience stores with few selections of healthful foods and a large array of sweet drinks and energy dense snacks. They shop for fresh foods less frequently because they perceive cooking for oneself as being wasteful in time and effort

(Fowler 2008). The trend in preference for smaller format stores is likely to continue as lifestyle and demographic changes towards urban living, increasing time-constraint, and smaller household sizes. In Thailand, the average household size fell from 3.3 in 2005 to 2.8 in 2012 (Retail Asia 2014). These new smaller households as well as single person households seek convenience that fits their lifestyle. Living alone is, therefore, a possible reason for choosing modern grocery outlets, eating fast foods and purchasing ready-to-eat meals that are often higher in calories and less nutritious than home-cooked meals (Buckley et al. 2007). It may also provide an additional incentive that encourages people to eat out at restaurants among friends as a social event.

d.) Location

Access is an important determinant in selecting a grocery outlet. Traditional markets have been part of neighborhoods but the small size of convenience stores enables them to penetrate and spread throughout communities more easily. In Korea, Thailand, and Indonesia, convenience stores and minimarkets have gained as much as 25% of market share in packaged grocery sales in recent years (Retail Asia 2014). Location appears to be more important for traditional market shoppers than modern retailer shoppers. In Taiwan, a study found that, whereas most traditional market patrons live or work nearby, location did not play a similarly significant role among Western-style grocery store shoppers (Trappey and Lai 1997). The authors also showed that the four most important factors attracting patrons to supermarkets were: 1. Good environment; 2. Good product quality; 3. Sales promotions; and 4. Good service quality, whereas the most

important factors for wet market patrons were proximity to home and workplace as well as their social nature as a place where acquaintances meet. (Ibid).

e.) Price

Existing literature consistently show that health outcomes are positively linked with educational attainment and SES (Hampson et al. 2007; Braveman et al.2005; Adams et al. 2002). Affordability and price of products are unsurprisingly important determinant of grocery purchases including brands and stores they visit. This is particularly true for poorer and often less educated households. Income, urbanization, and college education are positively associated with shopping frequency at supermarkets (Meng et al. 2014, Kelly et al. 2014, Banwell et al. 2013). Price has the power to alter short-term quantity demanded of products and is an important factor of product value as perceived by consumers. Big box retailers share similar marketing strategies aimed at enhancing consumers' shopping experience such as offering a wide range of products, temporary price reduction, and other promotional campaigns. As such, traditional markets with their lack of marketing promotion may be less appealing to bargain hunters (Kelly et al 2014, Banwell et al. 2013).

f.) Quality and Food Safety

Another distinction between traditional and modern grocery outlet is the common general perception that traditional markets are less hygienic than modern markets. Many Thai consumers believe that TFCs offer higher standards for products and services at reasonable prices (Watchravesringkan et al. 2011). Food safety has been rated as the most important factor in consumers' food choice (Dixon et al. 2006). Due to a lack in industry

standard for open-air market cleanliness and organization, some appear dirty, and sanitation guidelines are necessary (Filiouis et al. 2009). Thailand has been a major exporter of chicken meat and shrimp that meet stringent quality control and hygienic standards (Sriwichailamphan 2007). Domestic availability, nonetheless, varies in quality and cleanliness. Modern retailers, adopting Western standards, sell prepackaged products under refrigeration. In Thailand, it has been noted that packaging has been a key driver of the competitive environment for fast moving consumer goods (Silayoi and Speece 2004).

At traditional markets meat is sold at outdoor temperature and is often exposed to contaminations but substantial proportion of consumers in urban cities and the majority of consumers in rural areas are willing to overlook the lack of refrigeration and believe that traditional markets still offer superior quality fresh foods and only purchase dry ingredients at modern retailers (Kelly et al. 2014). In addition, the traditional sector in certain areas has been working on improving their hygienic appearance (Ibid.). Some local authorities have taken initiatives to improve the situation of sanitary practices. For example, in Chiang Mai, the public health department visits stall owners every few months to educate them on how to wash, soak, and rinse their produce thoroughly before selling them (Isaacs et al. 2010). Physical renovations are difficult and they cause disruption of business to stall owners and loss of income. Without reorganization, however, these traditional markets are sure to lose their customers to modern retailers that are becoming ever more prevalent (Ibid).

g.) Time Pressure

Time pressure bears a strong influence on decision making of grocery shoppers. In the western research literature, perceived time pressure limits the effort of searching for price and promotional information such as coupon clipping and unit price comparison (Vermeir and Van Kenhove 2005). Similarly, many working women in Asia find supermarket more convenient for grocery shopping as they offer greater variety of products, both grocery and non-grocery items, than the traditional sector (Kelly et al. 2014). Younger and more educated shoppers were found to be more time-constrained and more likely to purchase prepared meals. Time is of an essence for supermarket shoppers more so than for wet market patrons. Those who shop at fresh markets spend more time at the venue because they socialize with friends and acquaintances. Consumers who shop at supermarkets are attracted by time-saving products such as processed foods, ready-to-eat meals, and various bottled and canned beverages (Trappey and Lai 1997). Modern retailers also advertise themselves to be one-stop shop, offering a full range of household necessities from food, basic medications, and personal care products (Minten and Reardon 2008).

II: Grocery Revolution in Thailand

Emerging markets or emerging economies such as Thailand receive special attention with regard to dietary change and subsequent health implications. Significant transformations in grocery shopping formats are clear over the past two decades whereas similar changes occurred in the Western hemisphere over 50-80 years (Reardon and

Hopkins 2006). In the 1980s and early 1990s, Thailand's average household income rose and the problems of under-nutrition declined. With this decline, however, new problems of diet-related chronic illnesses became visible (James et al. 2010). The change in dietary pattern in these countries is occurring much sooner and at a much lower level of per capita income than when now-industrialized countries experienced it.

Subsection 2.1: The Arrival of Western-Format Grocery Outlets in Bangkok

The first modern retailer in Bangkok, Thai Daimaru, opened its doors in 1964. The Japanese department store had a food section that targeted high income customers. The success of Daimaru attracted competitors. Central and Robinson Department Store opened several Bangkok locations in 1970s, each with their own grocery section. The embedded grocery stores take the form of a typical western supermarket carrying mostly food items and many household essentials. They expanded to the suburbs in the 1980s. Convenience stores were introduced in 1987 and quickly taking presence at gas stations, bus stops, and office buildings. Lotus and Big C, the largest hypermarket chains, arrived in 1994, as domestic chains before getting taken over by foreign firms (Jitpleecheep 2006). Hypermarkets in Thailand are stand-alone buildings with usually 2-3 floors that include the grocery section resembling a supermarket as well as clothing stores, restaurants, fast food outlets, and food courts. Some hypermarkets even include large children playground with a bounce house and rides, a bowling alley, and a movie theater.

The rise of supermarkets in the 1990s changed Thai social, economic, and culinary culture in significant ways. Changes in food retailing environment were slow in

the 1980s and early 1990s, owing in part to the Alien Business Law which requires that at least 51% of company shares must be owned by Thai nationals. When the Asian Crisis hit in 1997, the law was adjusted, and many foreign partners in transnational food companies took over control and quickly expanded their presence in Thailand. The Alien Business Operations Act of 1999 allowed foreign investors to conduct business in all kinds of retailing and wholesaling that are worth over 100 billion baht in capital. The act also changed the law so that aliens can hold the majority of company shares. They can also buy land, condominiums and rent property, the rights previously restricted to Thai nationals (Tosonboon 2003). Waves of new foreign direct investments then followed the decline of the local distribution system (Shannon 2009). The main companies in this movement were Tesco (UK), Carrefour (France), and Big C (France) (Banwell et al. 2013). In 2010, Big C acquired Carrefour (Groupe Casino 2010). In less than 2 years, these retailers were owned by foreign investors (Tosonboon 2003).

The Alien Business Operations Act was just one reason for the influx of FDI into retailing. Strong market potential and the absence of strong local competitors also attracted these large transnational food companies (TFCs). TFCs were facing saturated market at home and the demands for Western products in Thailand were increasing with the rising income. These combined push and pull forces led to an explosion of Western-format grocery outlets. In the early 1990s, while mom-and-pop stores were the primary food retail outlet numbering over 200,000 stores, there were reportedly fewer than 50 supermarkets, and only a single hypermarket in the city (Smith and Mandhachitara 2000). The number of supermarkets and hypermarkets increased almost fourfold from 110 in

1997 to 391 in 2007 while convenience stores increased six fold during the same period (Shannon 2009). Hypermarkets alone accounted for over 60 percent of food sales in Bangkok in 2008 (Shannon and Mandhachitara 2008). By the end of March 2011, the number of modern retail outlets had increased from 1,429 stores in 1999 to 10,871 (Pratruangkrai 2011). A recent estimate indicates that modern retailers are commanding as much as 70% of the market share (Global Agricultural Information Network 2013). The rapid expansion of big box retailers has raised concerns over the eminent threats to the existence of traditional fresh markets and mom-and-pop stores which, local trade groups argue, are integral to Thailand's unique grassroots culture (Crispin 2008).

As competition grows and zoning regulations become stricter, retailing giants start exploring smaller store sizes because they are faster and cheaper to set up. Tesco introduced Lotus Express in 2001 and Big C introduced Mini Big C in 2007. These stores are between hypermarkets and convenience stores, averaging between 4000 m² to 6000 m² while hypermarkets are upwards of 8500 m² and convenience stores are around 80 m². Other competitors are also catching up (Crowley 2014). Among modern retailers, urban shoppers appear to favor hypermarkets and convenience stores. One report indicated over half of Bangkok dwellers shop primarily at hypermarkets and over 85% visit convenience stores regularly several times a week (Di 2008). Meanwhile, supermarkets are losing their share in the market to larger and smaller store formats that better meet the needs of urban residents (Ibid.). The latest development in the food retailing business is the movement towards online shopping and home delivery. Tesco Lotus recently implemented Content Acceleration in order to speed up their websites and improve online shopping experiences

for their customers in emerging markets including China, Thailand, and Malaysia (Crowley 2014).

The growth of the modern retailing sector provides greater access to low-nutrient energy-dense foods. Western-style markets are replacing traditional fresh markets and are turning towards greater consumption of processed foods (Dixon et al. 2006). In less than two decades, the estimated daily calorie intake of Thai populations increased from 2250 kcal in 1990 to 2540 kcal in 2008. During the same period, daily fat intake rose from 45 grams to 56 grams (FAOSTAT). The Thai population is being increasingly exposed to obesogenic environment. A study found that urban residence is linked to an increased risk of childhood obesity (Firestone et al. 2011). Children living in urban settings are typically wealthier than their rural counterparts and they are more exposed to media exposure and Western style fast food outlets (Ibid.).

Although Western-style markets are quickly becoming the preferred shopping venues in Bangkok, in provincial cities, traditional markets still maintain a level of popularity (Isaacs et al. 2010). Ethnographic investigations were carried out in Chiang Mai, a city in the north of Thailand, to understand people's choice in shopping venues. In this much smaller city of less than one million, compared with Bangkok's population of over 8 million, the social circle is also much smaller. Here, traditional markets act as more than just a place to shop but also double as a place to socialize. Sellers are usually owners of the stores who recognize their frequent buyers and greet them in personal manner, even asking about the wellbeing of their family members. The same people who shop at traditional markets, however, also shop at Western style markets due to

convenience, cleanliness and, to some people, the perceived superior quality of products (Ibid.). In addition, the people who frequent supermarkets for packaged foods are significantly younger (Gorton et al. 2011). Such findings suggest that traditional markets may only be holding on in close-knit societies for social reasons among older generations.

Subsection 2.2: Major Grocery Retailers

Traditional retailers do not operate in franchise as do modern retailers. The market or store space varies widely as well as the organization and cleanliness. They are, however, generally open-air in nature. Modern retailers adhere to corporate quality standards and store format. The following is a list with description of major players in the modern retailing market in Bangkok.

a.) Big C

Big C is a retailer chain owned by Groupe Casino of France. Big C's presence in Thailand is primarily in the form of hypermarkets. In 2010, Big C acquired Carrefour, another French hypermarket chain and became Tesco Lotus' main competitor. As of May 2014, there are 121 branches, 49 of which are located in Bangkok. In 2007, as Big C tries to capture market share in the provincial areas, they have introduced small convenience store format that are located closer to communities called Mini Big C (Big C company website <http://www.biggc.co.th>).

b.) Tesco Lotus

Tesco Lotus, a UK hypermarket chain, is the biggest player and has been most aggressive in expanding its market share. They offer the most varied store types including

in, receding size order, Extra, Hypermarket, Compact Hyper, Supermarket, and Express. Lotus Extra, Hypermarket, and Compact Hyper offer both food and non-food products and are located in major cities and communities. The Supermarket and Express formats serve smaller communities and offers primarily fresh foods and groceries. There are over 1,700 Lotus store outlets and 5 distribution centers currently in operation. The newest distribution center was opened in May 2014 in Khon Kaen, the first center outside of the central region of Thailand. Tesco Lotus introduced online shopping in April 2013 and is now in the process of improving the web loading time in order to improve service to their e-business customer base. The chain also advertises itself as being socially and environmentally conscious through their corporate social responsibility (CSR) work. It makes multi-million baht donations annually to various charities in Thailand and as emergency response fund in areas hit by natural disasters (Tesco Lotus website).

c.) Tops

Tops, originally part of the US-based Tops Markets LLC, is now managed by a local company, Central Retail Corporation. Tops is the leader in the supermarket format, operating 139 stores in Thailand, including 87 stores in Bangkok and 52 stores in the provinces. Most Tops outlets are located within a department store while a smaller number are stand-alone supermarkets.

d.) Seven-Eleven

Seven-Eleven is an international franchise, headquartered in Japan. It is the world's largest convenience store franchiser with over 50,000 outlets. Thailand is its 3rd largest market after Japan and the US. There are over 7,000 stores in Thailand, half of which are

in Bangkok. Seven-Eleven also operates as a place where people can pay their utility bills and put money on their prepaid mobile phones. The primary purpose of convenience stores is, of course, convenience. The selections of products are, therefore, limited.

Subsection 2.3: Grocery Shopping Behavior of Bangkok Residents

A study examining Bangkok dwellers' attitudes towards hypermarkets and mom-and-pop shops found that respondents were more satisfied with the product quality and the prices at hypermarkets than at mom-and-pop shops. They were also more satisfied with the availability of parking spaces, cleanliness, quality of facility such as toilets, as well as organization of products at hypermarkets. The strength for mom-and-pop shops, the author found, was in customer relationship due to its small size and its relationship with the community (Di 2008).

Modern-format grocery stores offer ready-made meals, both fresh and frozen, that have been gaining popularity as more women join the labor force and as young people migrate to cities for job opportunities and become a single-person household. They seek convenience and foods that require less preparation time. Small food stalls sell precooked meals in plastic bags are popular among households where the mother works outside of home (Banwell et al. 2013). **Table 2.1** shows average household income and food expenditure of Bangkok residents in absolute term from year 2000 to 2011 and their annual percentage change. Prepared Food Eaten at Home is the only category that logged a constant increase throughout the period even in 2011 when the big flood hit the city. That year, expenditure in other categories went down as people saved to repair the

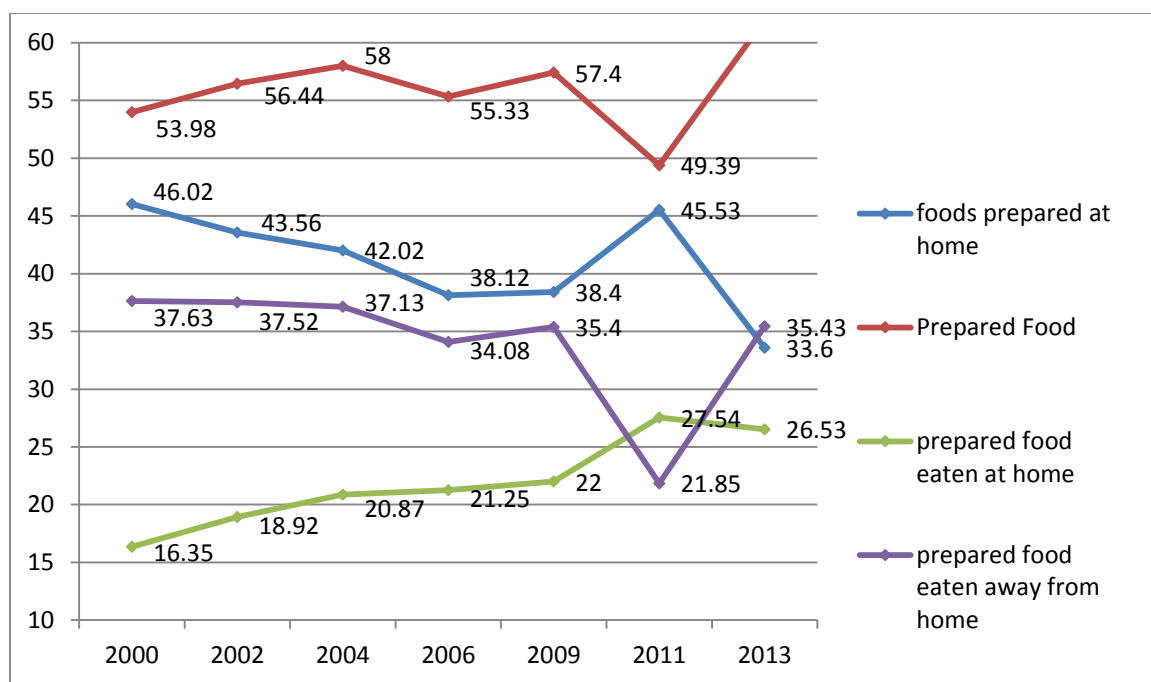
damages on their homes from the devastating flood that began in July 2011 and in some areas persisted until January 2012.

Table 2.1: Household Income and Food Expenditure of Bangkok Residents

Year	2000	2002 (% change from previous date)	2004 (% change from previous date)	2006 (% change from previous date)	2009 (% change from previous date)	2011 (% change from previous date)	2013 (% change from previous date)
Income	25,242	28,239 (11.87%)	28,135 (-0.37%)	33,088 (17.69%)	37,732 (14.04%)	41,631 (10.33%)	43,058 (3.42%)
Total Expenditure	19,582	21,087 (7.69%)	21,716 (2.98%)	24,194 (11.41%)	27,988 (15.68%)	27,566 (-1.51%)	32,425 (17.63%)
All Foods and Beverages	5,498	5,783 (5.18%)	5,769 (-0.24%)	6,333 (9.77%)	7,972 (25.88%)	6,376 (20.02%)	9,019 (41.45%)
Foods Prepared at Home	2,530	2,519 (-0.43%)	2,424 (-3.77%)	2,414 (-0.41%)	3,061 (26.80%)	2,903 (-5.16)	3,030 (4.37%)
Prepared Food Eaten at Home	899	1,094 (21.69%)	1,204 (10.05%)	1,346 (11.79%)	1,754 (30.31%)	1,756 (0.11%)	2,393 (36.28%)
Prepared Food Eaten Away From Home	2,069	2,170 (4.88%)	2,142 (1.29%)	2,158 (0.74%)	2,822 (30.77%)	1,393 (-50.63%)	3,195 (129.36%)

Source: National Statistical Office of Thailand <http://service.nso.go.th/>

As **Table 2.1** indicates, people do not always eat out but many often purchase prepared food to be eaten at home. **Figure 2.1** shows expenses on foods prepared at home and ready meals (eaten at home and eaten away from home) as percentage of total food & beverages expenditure. Expenses on prepared foods always exceeded those on foods prepared at home. Of the expenses on prepared foods, more was spent on eating out than eating at home. This does not suggest higher frequency of eating prepared food away from home than at home as dining out is typically more expensive. In 2011, severe flooding during the monsoon season in Thailand destroyed homes and businesses, with estimated damage of 45.7 USD. Seventy-five of Thailand's 77 provinces declared flood disaster zones. That year, the graph shows people spending a greater proportion of their budget on raw ingredients for home food preparation. It was also the only year in which expenses on prepared foods eaten at home exceeded those on dining out. This may stem from several factors including store closing, difficulty in transporting, and people saving money to repair water damages in their homes.



Source: National Statistical Office of Thailand <http://service.nso.go.th/>

Figure 2.1: Food Expenses as Percentage of Total Food & Beverages Expenditure

III: Thailand's Food and Health Policy

Thailand has been successful in a number of health initiatives including those to reduce the prevalence of anemia in pregnant women in 1970-1990s (Winichagoon 2002), HIV/AIDS incidence in the 1990s (Nelson et al. 1996), and using tax from alcohol and tobacco to fund health promotion activities, primarily through the Thai Health Promotion Foundation. Several anti-smoking policies were implemented between 1991 and 2006 that resulted in 25% reduction in prevalence of smoking (Levy et al. 2008). In the 1980s to mid-1990s, community-based nutrition program successfully reduced malnutrition and micronutrient deficiency in children and women (Winichagoon 2013). Obesity is a relatively new problem in Thailand, starting to emerge as the country is still battling the issue of under-nutrition (Pawloski et al. 2011). The macro-economic trends in developing countries are such that obesity rate is predicted to continue to rise, along with NCDs, unless governments introduce major policies to redirect the lifestyle path that comes with globalization (Prentice 2006). To further complicate the matter, the nutrition transition is happening so rapidly that coexistence of obesity and malnutrition among family members within the same household is not uncommon, as with other developing countries (Prentice 2006). Efforts by the Thai government are there but whether they are effective and sufficient remain to be seen.

There are undeniably many facets contributing to the rise in population body weight globally. Researchers have been trying to find the primary culprit. In developed countries, there is evidence that increased food energy supply is a major driver of the obesity epidemic (Vandevijvere et al. 2015) while decreased physical activity (from

urbanization and change in lifestyle) may be a more important factor for developing regions such as China (Ng et al. 2010). It can be expected that developing countries, too, will see an excess in food energy supply from heavily processed foods available at cheaper prices as the economy advances and food distribution systems progress. In anticipation of such changes, policy efforts should aim at creating healthy eating habits and environments that are conducive to engagement in physical activities. Once an economy is fully developed, as in the United States, an increase in physical activity level appears to have only small influence on obesity prevalence (Dwyer-Lindgren et al. 2013).

The expansion of Western-format grocery stores in Thailand in the last 15 years parallels the rise in obesity rates and reflects the modernization of the food retail and distribution sectors as part of globalization. Reardon et al. (2003) described the supermarket product introduction as a two-stage process. In the first stage, supermarkets carry mainly dry ingredients, processed and packaged foods while in the second stage, fresh fruits and produce are introduced. In terms of customers, too, there is a two-stage process. Western-format markets initially target high-income consumers, selling products of higher quality standards and higher prices than traditional markets. Later when they gain greater market share, they expand their outlets, product selections, as well as lower prices from economy of scale, and develop marketing strategies to attract lower-income consumers (Hagen 2002). As the array of products expands and highly processed foods become part of everyday life, health concerns arise and a number of programs and policies have been initiated.

Starting in 1991, the Ministry of Public Health has been conducting a periodic National Health Examination Survey (NHES) to monitor the prevalence of life style diseases and risk factors such as diabetes, hypertension, obesity, smoking, physical activity, and fruit and vegetable intake. The fifth and latest survey was conducted in 2013. The results of the NHES are used by government agencies to guide the national health, economic and social development plans, among others (Tangcharoensathien et al. 2014). The Universal Health Coverage Scheme, implemented in 2002, increased access to healthcare, lowers the level of unmet health needs and provides financial risk protection (Ibid.). Initiatives to encourage healthy lifestyle and promote the prevention of chronic diseases are taking place through various channels but lack coordination and concerted efforts among stakeholders. Lifestyle modification programs also lack proper monitoring and evaluation (Chavasit et al. 2013).

a.) Food Labeling

Food labeling policy in Thailand was implemented in 1998 on a voluntary basis for most food except milk, milk products, and those that claim certain nutrients (Whitehead 2015a). It was therefore a marketing tool to enhance the image of some products rather than an educational tool. A number of food scares in the 1990s diminished consumer's confidence and the presence of food labeling gives a sense of security, a trend observed in other Asian countries as well. Recently, the Taiwanese government announced their plan to address the need for a food system that would track the entire supply chain after a series of high-profile scandals in 2014 (Ibid).

According to a recent study by TNS market research institute, Asian consumers are much more likely to check nutrition label than Europeans and Americans. While 64% of American and European survey respondents reported reading nutrition labels when shopping, significantly greater proportion, 74%, of consumers in China, Indonesia and Thailand do so (Whitehead 2015c). Nutrition label studies show that people living with lifestyle diseases such as diabetes and hypertension learn to use food labels to make healthier food purchases, but while they avoid or limit the intake of certain ingredients, they may be neglecting other aspects of diet that contributes to holistic health (Lippa and Klein 2008; Lane 2014). For instance, some people are careful about their fat intake by selecting low-fat but high sugar or low-sugar but high sodium food items. In addition, some studies reported that the format was too complicated for the general population to understand. A similar concept of guideline for daily amounts (GDA) was also implemented on a voluntary basis except for snacks. It was impractical for a variety of foods since the calculations are not based on serving portion but on the entire package which could be large or small. Academics and health policy professionals pushed for the utilization of the traffic light model to categorize healthy and unhealthy foods based on fat, sugar, and sodium contents. Naturally, the idea faced strong opposition from the food industry (Chavasit et al. 2013).

Labeling for fresh produce, especially vegetables, is a different story. The industry is capitalizing on the increase in income and an increasing concern for food safety. In the early 1990s as the Thai economy was swiftly developing, the heavy use of pesticides in farm produce that had helped the growth of agricultural exports in the 1960s

and 1970s became a serious health concern among more educated consumers (Posri et al. 2007). The import of pesticides more than doubled between 1987 and 1996 (Thapinta and Hudak 2000). Inspections by the Ministry of Public Health showed Thai farmers overusing highly toxic chemicals that are considered hazardous by the WHO to improve the agricultural output and appearance. Vegetables, in particular, showed the greatest pesticide residue limit violations based on samples collected between 1994 and 2001 (Chadbunchachai 2005).

Following a series of scandals, both public and private movements started to promote certified “safe” vegetables, guaranteed pesticide residue within legal limits (Posri et al. 2007). In 2004, the National Bureau of Agricultural Commodity and Food Standards (ACFS) rolled out its plan for food production quality control throughout the food chain dubbed “From Farm to Table” policy. A year later, it introduced a voluntary accreditation procedure called “Q Mark” for fresh produce that are able to demonstrate safe production and processing with traceability and product liability. Q Marks come in two colors, green and gold. Green labels indicate low-pesticide, or safe, produce. Gold labels indicate premium produce such as organic products that are free from pesticides as well as other chemical inputs such as synthetic fertilizers. The Ministry of Public Health, the Department of Agriculture, and other private certification bodies also set their own standards and assign labels to various produce that pass their safety requirements (Roitner-Schobesberger et al. 2008).

As the economy advances, consumers are more educated, more selective and continuously look for better alternatives. Although farmers were first reluctant to modify

their farming methods and seek certification, unsure of the added value of the labels, several surveys conducted in Bangkok as well as in the provinces show that Thai consumers are willing to pay the premium for these low-pesticide and organic produce (Posri et al. 2007, Roitner-Schobesberger et al. 2008, Wongprawmas et al. 2014). Clean food consumption and labeling is another trend that has been around for several years. More Asian consumers, 74%, pay attention to the presence of artificial coloring and preservatives in their purchasing decision than the global average of 60% (Food News International Team 2015). Despite the enthusiasm, however, few people understand what the labels stand for such as the criteria used for evaluation and the responsible organization. The presence of the labels simply gives them greater confidence for the safety, in addition to the mandatory regulation, of the products they are purchasing (Roitner-Schobesberger 2008, Wongprawmas et al. 2014).

Efforts are being made to improve the understanding of and outlets for organic produce among Thai consumers. The Alternative Agriculture Network (AAN) is a network of organic farmers with strongest presence in the Northeast region. The AAN has been working with the Thai Health Promotion Foundation (ThaiHealth), an independent government agency, to educate children on organic farming and to create outlets for organic farmers to sell their produce. The designated Green Markets are farmer's markets that operate regularly at various times in various locations, selling local organic produce. These markets are held mostly in five provinces outside of Bangkok.

b.) Food Outlet Accreditation

In a similar manner to food products, food outlets may also seek certification. The Bureau of Food and Water Sanitation under the Ministry of Public Health has evaluation procedure with Key Performance Indicators for traditional retailers. Those who perform well receive a Healthy Market seal. The assessment on environmental health, food safety, and consumer protection is said to be carried out every 6 months by district health authorities. However, 2011 is the latest year for which data is publicly available. In that year, only 150 markets were evaluated, of which 74 markets did not pass. Of the markets that passed the evaluation, 25 received “good” status and 3 received “excellent” status (Bureau of Food and Water Sanitation 2015).

The ACFS also awards Q Mark accreditation to qualifying food stores. Major hypermarket and supermarket chains including Tesco Lotus, Big C, and Tops have all received the accreditation. For fresh markets, only 34 markets out of over 290 are certified. Additionally, because market stalls are separately owned, the government-backed Q Mark label is displayed only on individual stalls that pass the inspection making it difficult for new customers who value the accreditation to select a fresh market over a modern retailer. All restaurants, food stores and stalls must apply for renewal every 3 years (ACFS 2015). Thailand also serves as a coordinator of the ASEAN Food Safety Network (AFSN), working closely with Member States on addressing diet-related health issues and disseminating food safety regulations and requirements (AFSN 2015).

c.) Food Advertisements

Children and adults worldwide are exposed to a large amount of food advertisements, most of them are non-staple or snack foods including fast foods, chocolate and confectionery, dairy products, and high-sugar, high-fat, or high-salt sauces and spreads (Lobstein and Dobb 2005, Kelly et al. 2010, Harris et al. 2009, Ng et al. 2014). An experimental study suggests that food advertising increases consumption of unhealthy foods in children (Harris et al. 2009, Ng et al. 2014) and both healthy and unhealthy foods in adults (Harris et al. 2009). In developing countries, the potential negative influence on children's diets from TV advertising is amplified by the lack of knowledge and proper regulations (Ng et al. 2014).

Advertising law and regulations are fragmented in Thailand. Several agencies are responsible for approving advertising materials including the Office of the Consumer Protection Board, the Directing Board for Broadcast Division, the Food and Drug Administration and the Office of Alcoholic Beverage Control at the Department of Disease Control, Ministry of Public Health. The focus appears to be on truthful and non-exaggerated advertising for the purpose of food safety. Exaggerated advertising may include bigger and more appealing McDonald's burgers than the actual products. Alcohol advertising is governed by the Alcoholic Beverage Control Act and tobacco advertising by the Tobacco Product Control Act. With regard to advertising unhealthy foods to children, however, there is simply a voluntary agreement by large food companies such as Coca-Cola, Nestle, and Kellogg. Signed in 2008, these transnational food giants committed to "not advertise food and beverage products to children under the age of 12

in Thailand unless the products meet specified nutritional criteria” in support of the governments’ aim to promote healthy lifestyles (Thai Pledge 2008). In addition to being voluntary and self-monitoring, specific commitments by each of the members and the nutrition criteria are not published. The Advertising Association of Thailand has guidelines for commercials and promotional materials targeting children, but it is unclear how they are being enforced (AAT 2015).

At the same time, the advertising industry in Thailand is highly competitive and considered one of the most vibrant in the region with double digit growth in revenues for many years (Hawkes 2006). Regulations are poor and trade openness allows numerous foreign brands into the country, encouraging fierce marketing campaigns to promote products and brand loyalty.

d.) Taxes and Subsidies

Imposing taxes on unhealthy foods and subsidizing healthy ones have been suggested as appropriate approach to encouraging healthy eating habits. Many developed countries such as France have introduced tax on sugary drinks, believing it would curb the level of sugar consumption and reduce incidents of diabetes and other lifestyle diseases. Although evidence for the effectiveness of such policy is lacking, it has not been ruled out and has been gaining support in the UK where the Children’s Food Campaign has been advocating a 20% tax on sugary drinks that would go toward Children’s Health Fund. Such tax could reportedly save the UK up to £15 million in a year in direct healthcare costs (Bosely 2015).

A recent study shows that the impact of sugar-sweetened beverages on chronic diseases vary widely between populations, but 71% of sugar-sweetened beverages (SSB)-related deaths occur in middle-income countries, many in Latin America but also in Asia like China and Thailand (Singh et al. 2015). Over 20% of adults living in Beijing are now identified as clinically obese, and the trend is rising outside the capital as well. The national Health and Family Planning Commission reported that the adult obesity rate was 11.9% in 2012, a 4.8% increase from 10 years ago in 2002 (Whitehead 2015c). Despite this rapid increase, some have argued that the population proportion that stand to benefit from SSB tax is too small (lower than 20%) to warrant the policy as the evidence for its effectiveness is still lacking and it may provoke negative feedbacks from the beverage industry and the general public (Jou and Techakehakij 2012).

The intention behind what kinds of non-alcoholic beverages are taxed and at what rates in Thailand is unclear. In developed countries, SSB taxes reflect the potential health risks. In developing countries, the same taxes may be imposed for their “luxury” nature. Literature is lacking with regard to what policy rationale the Thai government is using to guide their product selection and tax rate setting (Preece 2012). The effective rates are highest for soda water, which has no sugar, at 25%, 20% for carbonated soft drinks but syrups, ready-to-drink tea and coffee, and sports drinks are exempt. Sale growth has been highest for ready-to-drink tea, reflecting the rising trend for bottled green tea which contain about 9-10% sugar (Ibid).

e.) Obesity and NCD Prevention Programs

Programs and policies aimed at reducing obesity are recent developments. The Health Plan of the Ministry of Public Health and the National Economic and Social Development Plan of Thailand (2002-2006) stated a goal of 60% participation rate in sports and exercise programs (Banchonhattakit et al. 2009). The “Thai People Have Flat Belly” campaign, led by the Royal College of Physicians of Thailand in 2006, created a network of stakeholders in both the public and private sectors at the national as well as local levels. It received much media attention from the involvement of high profile politicians. The campaign raised awareness in obesity self-monitoring using waist circumference method. The 3E concept including Eating, Emotion, and Exercise was used to educate people about weight reduction and maintenance. Demonstrations and classes promote inexpensive but effective exercise tools and exercises that can be done at home or at a work desk (RCPT 2011). Thai Health, a government agency, has been using social marketing to provide various education tool clips on their website for tech-savvy individuals. Despite the vibrancy in activities, there is, to date, no reports of measurable outcomes.

A diabetes education prevention program was implemented for 35 community healthcare workers in Chiang Mai province, Thailand (Sranacharoenpong et al. 2009). The program was culturally tailored based on formative research. The course consisted of 8 in-person classes and 8 online sessions and included problem-based learning, discussion, reflection, community-based application, self-evaluation, and online support. Assessment using a pre-post knowledge test shows improvement in knowledge of

diabetes and NCD prevention in general. The program was well-received and participants reported that activities were fun and information relevant. Authors suggested ongoing access to web-based materials and expert support to sustain the gains (Ibid).

Nationally, there have been several initiatives to address obesity and related NCDs, but implementation has been intermittent and their impacts have not been measured. The food-based dietary guidelines were developed in 1996 recommending proper food group combination and portions for one's age. The guidelines also recommend avoiding sweet and salty foods while encouraging clean and safe food. The original charts were not effective because portions were measured in weight. Later they were adjusted to reflect familiar tools and utensils such as cups and tablespoons. These became more useful for dietitians and nutritionists in communicating with target populations. There was a host of activities that utilized this concept such as the Sweet Enough Campaign Network to lower children's sugar consumption, the school lunch program, the elderly menu development, and nutrition education training for school staff and administrators (Sirichakwal and Sranacharoenpong 2008). The Ministry of Public Health launched a campaign to promote eating 'half fruits and vegetables and half of others' in 2005. The concept was popular for its simplicity and practicality but the campaign died in 2006 when it ran out of funding (Chavasit et al. 2013).

The Thai National Health Assembly is fully aware of the grave consequences of nutrition-related NCDs on the economy should no action be taken to curb the increasing prevalence. The Assembly passed a resolution for the management of overweight and obesity in 2009. The government established the National Food Committee in 2010

involving several subcommittees, task forces, and working groups that work together to pursue exercise, healthy diet, and educational campaigns as well as establish dietary guidelines. The visible enthusiasm is a positive sign but obesity-related health programs in the past have been fragmented and inconsistent. Implementations have depended on the availability of funding and at the mercy of the political party in power (Chavasit et al. 2013). Finally, there appears to be a lack of evaluation mechanism for short-term and long-term effectiveness (Pawloski et al. 2011).

f.) School-based Programs

Children spend significant amount of time in school. Administrators play an important role in creating food environment that can shape students' life-long eating habits through lunch programs and availability of snacks in school. Early nutrition has also been shown to influence the development of obesity and chronic diseases later in life (Winichagoon 2013). Schools are, therefore, a natural site to implement various nutrition programs and policies, but their effectiveness has rarely been evaluated. A systematic review of school-based nutrition policy evaluations worldwide only included studies in the US and Europe. The review found some evidence for impacts of school policies including nutrition guidelines and price interventions on creating healthy food environment and improving students' diet quality but little can be said of their impacts on BMI (Jaime and Lock 2009).

Similarly, in Thailand, several school-based programs are promising but lack evidence for long-term effectiveness. The School Network on Childhood Obesity Prevention (SNOCOP) was an 8 month program aimed at empowering school

administrators, teachers, parents, and community leaders in Saraburi province to promote healthy diet, enhance physical activities, and improve school lunch programs for primary school students. Six schools, and a total of 195 students, participated. Results showed improved diets, knowledge, attitude, and intention towards leading a healthy lifestyle among intervention schools. Similar results were not observed in the control group. Though potentially effective, the authors conceded that the program duration was too short to measure effects on change in obesity prevalence (Banchonhattakit et al. 2009). The Family and School Collaborative (FASC) program in Chiang Mai aimed to promote healthy diets and exercise (Chotibang et al. 2013). The program involved 110 stakeholders such as teachers, parents, and cafeteria staff, coming together in participatory workshops and discussions to establish school policies and guidelines for obesity prevention activities such as raising awareness and limiting snack sale and sugary drink consumption. The experiment achieved a level of success in laying out school policies, but concrete changes in policy implementation and subsequent behavior modification are yet to be seen. The program is also extremely localized, only implemented in one school (Ibid).

Social networking strategy has been successful in lowering smoking uptake rates by adolescents (Valente et al. 2003) and prevention drug abuse and drop outs in many countries (Eggert et al. 1994). The same concept, used at the school-level as opposed to the individual-level, proved ineffective in a Thai primary school setting. In school settings, peer leaders may be nominated to discuss targeted issues and groups share stories and progress. A study of 107 schools in Saraburi province indicated that only 42%

of the schools were connected to a social network. Of those, more than half (60%) did not utilize the network regularly. Forty percent of the schools organized activities such as educational meetings and sports events but did not cooperate with other schools. School networks have not expanded social contacts for facilitated exchange of ideas and support between schools (Banchonhattakit et al. 2009).

Conclusion

Thailand has always had liberal FDI policies allowing influx of foreign food companies, leading up to the current supermarket revolution. Many important factors affect one's shopping destination choice. Meanwhile, the growing economy increases people's purchasing power and options for grocery outlets. Grocery shopping behavior of Bangkok populations is undergoing a transition at the same time that NCDs are becoming a concern. While Thailand has had notable successful health campaigns in the past, the fight against obesity may prove more difficult as it requires concerted and sustained efforts from authorities in diverse fields. The biggest challenges may be to ensure continuous funding for programs that are in place and to establish a monitoring and evaluation system.

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CHAPTER THREE: THEORETICAL FRAMEWORK

This chapter explores the theories and frameworks used to explain obesity over the course of evolution. Section I presents the thrifty genotypes and thrifty phenotypes hypotheses that have partially explained the rise in the prevalence of type 2 diabetes but that researchers do not believe to be the main driver. Section II and III details the two concepts most relevant to contemporary obesity research, the Social Cognitive Theory (SCT) and the Ecological Perspective Framework (EPF), both pointing to the environment as playing a significant role in encouraging unhealthy lifestyle leading to the rise in obesity.

I: The Evolution of the Obesity Issue Framework

Traditionally, obesity is thought of as an imbalance between caloric intake and energy expenditure or a net positive energy balance. In other words, overweight individuals overeat (Prentice and Jebb 1995). The interactions between genotypes and phenotypes have been used to explain differences in body composition that leads to high prevalence of obesity and diabetes in certain populations (Wulan et al. 2010). A genome-wide association study of independent samples of Caucasian and Chinese populations found a link between polymorphism in the thyrotropin-releasing hormone receptor

(TRHR) and levels of lean body mass. The receptor signals growth hormones that determine the development of vertebrae skeletal muscle and muscle protein balance (Liu et al. 2009). Some have argued that the human genes from hunters and gatherers times, metabolism efficiency and fat storage, have not evolved rapidly enough to adjust the modern way of life (Hu 2011). Human biology gives us preferences for sweet and fatty foods and the desire to avoid labor-intensive tasks (Popkin et al. 2012). The thrifty genotypes we inherited from our ancestors are unmatched for lifestyle in a society where sweet and fatty foods are in abundance and automation spares us manual labors. Our genes combined with the modern lifestyle, therefore, make us susceptible to conditions such as obesity and diabetes (Hu 2011).

For all populations, the thrifty phenotype hypothesis posits that the intrauterine environments affect one's susceptibility to obesity and diabetes in adulthood. In developing countries where under-nutrition still exists, pregnant women who do not receive adequate nutrition may send signals to their unborn babies to metabolize more efficiently which will be beneficial for survival during famines but may increase their susceptibility to obesity later in life when food scarcity is no longer an issue (Ramachandran and Snehalata 2010). This is particularly relevant in Southeast Asia where the same generation that may have grown up under-nourished now faces the risks of over-nutrition (Dans 2011). Stunting in childhood has been linked to lower energy metabolism, increased fat storage, and impaired food regulation system (Ramachandran and Snehalata 2010). As such, stunted children are more prone to overweight and obesity later in life. The effects can be further amplified by a sedentary lifestyle that includes

spending several hours a day watching television, browsing the Internet, and playing video games. Studies have shown that low birth weight (LBW) is linked to an enhanced risk of type-2 diabetes because the condition promotes a thrifty phenotype including insulin resistance and low β -cell function (Hales and Barker 1992; Hu 2011).

Undeniably, there are unmodifiable genetic and modifiable behavioral components to the issue of obesity. Absence of obesogenic environment, variability in behavior does not usually result in excess weight gain, but people can deliberately fatten themselves through overfeeding (Pasquet et al. 1992). It seemed obvious, then, that behavior modification at the individual level should be the target of interventions to reduce and prevent the spread of obesity. The behavior-change theoretical framework has been used to guide the understanding and interventions of obesity (Gibbs and Waters 2011). Countless interventions aimed at increasing nutrition education, reducing fat and caloric intake, and/or increasing physical activity level to address the imbalance of caloric intake and energy expenditure. Over the years, we have learned, however, that interventions at the individual-level without accompanying changes in the surrounding environment have limited success especially in the long-run (Wells 2012). The approach, while straight forward and relevant, ignores the socio-political context of regulation, legislation, social norms, and the environment in which the individuals reside (Gibbs and Waters 2011). It is now clear that animals put captive in similar obesogenic environment with abundant fattening foods and reduced opportunities for physical activity also develop obesity (Kemnitz and Francken 1986; German 2006).

The two prevailing frames in obesity are the personal responsibility frame and the obesogenic environment frame. Those in support of the personal responsibility frame advocate demand-side interventions that include such measures as education campaigns, food labeling, and menu labeling. The food and beverage industry has long used this argument to block government interventions to regulate the sales of unhealthful diets. For many years, the food industry had been successful at using this line of reasoning to block school reforms aimed at restricting the sale of junk foods and sugary drink (Brownell et al. 2009). Personal responsibility advocates have lobbied for nutrition education, physical activity campaigns, and asking the food and beverage industry to voluntarily adopt healthy practices instead of using the regulations approach (Kersh, 2009).

The view on the obesity issue at the population level slowly evolved from that of an overly simplistic personal responsibility to a product of more complex interactions between humans, their changing lifestyle, and the industrializing surrounding environment. The next subsections describe two theories that look at people through the lens of the problem and are often used in the study human health behavior as well as provide the basis for health promotion campaigns. The two include the social cognitive theory (SCT) and the ecological perspective framework (EPF). Both the theory and the framework recognize the environment and the study of people's values as important factors in the issue of obesity and represent a move away from the personal responsibility perspective.

II: The Social Cognitive Theory

The Social Cognitive Theory (SCT) is a theory that is often used in studying human behavior including food choices. The conceptual origin of the theory is derived from Edwin B. Holt and Harold Chapman Brown's 1931 book describing animal action as being based on satisfying psychological needs (Holt and Brown 1931). A decade later, Neal E. Miller and John Dollard created the Social Learning and Imitation Theory, adding the process of element of behavioral imitation, taking cues on whether the model receives a reward or punishment (Miller and Dollard 1941). Finally, in 1986, Albert Bandura introduced SCT from the study of children's aggressive behavior using concepts adapted from Miller and Dollard's Social Learning and Imitation Theory. SCT focuses on the interactions of multiple factors of influence rather than only on individual-level factors in recognition that people live lives as part of a society and that, oftentimes, personal goals are only achievable through socially interdependent effort. People must then come together and share their resources, skills, and work together to help individuals accomplish their goals that are in the society's best interests (Bandura 2002).

The unique aspect of SCT is its emphasis on social influence and internal and external motivations. Bandura also reckoned the cultural difference variable and asked that cultural analyses be addressed to differentiate cultural social norms from universal human nature (Bandura 2002). He believed that effective health promotions must involve equipping individuals with knowledge and skills as well as identifying social supports within cultural context in order to manage their health habits (Bandura 1998, Bandura

2004). The theory, most often used in the psychology, education, and communication disciplines, explains human behavior using the concept of reciprocal determinism. Individual behavior is thought of as product of reciprocal interactions between three constructs; behavioral factors, personal factors, and environmental factors. SCT considers individual's past experiences and social environment such as family members, peers, and colleagues to explain their likelihood of engaging in a particular behavior. Despite the interplay of several factors that SCT brings to the fore, the theory is only loosely organized. It does not delve into how and the extent to which each construct of the three factors, behavioral, personal, and environmental, may influence targeted behavior.

SCT has been used to study human nutrition choices in the face of obesogenic environments that include an increase in convenience foods, pricing strategies and agricultural policies that encourage unhealthy eating, and a decrease in opportunities for physical activity. Such an environment requires individuals to make a considerable conscientious effort to develop or maintain healthy dietary habits. Anderson et al. has done extensive research on self-efficacy and outcome expectations components of the SCT. Using self-reported food frequency surveys and food-shopping receipts, Anderson et al. found self-efficacy, mediated through physical outcome expectations, to be significantly associated with food shoppers' nutrition behaviors. Those with high self-efficacy (high confidence for change) were more likely to expect positive outcomes from a better diet which was reflected in the grocery items they purchased (Anderson et al. 2000; Anderson et al. 2001). Later studies on SCT-based interventions revealed similar results (Steptoe et al. 2004; Fuemmeler et al. 2006). SCT was also applied to exercise

behavior studies and was found to be effective in predicting behavior modification both in adolescents and older populations (Wallace et al.2000, Booth et al. 2000, Conn 1998)

III: The Ecological Perspective Framework

In 1924, McKenzie introduced the ecological approach to the study of the human community. Ecology had previously referred to existence of plants and animals in the environment, their relationships, and interdependence. Applying the same concept, he defined human ecology as “a study of the spatial and temporal relations of human beings as affected by the selective, distributive, and accommodative forces of the environment,” (McKenzie p.288). He pointed out that the difference between the two is that while animals can move across space in their environment to gather food, humans, in addition, can also select their own habitat and have the ability to adapt to and alter the conditions of the habitat. Even with superior control, humans are relatively weak because they need the company of other human beings as well as shelter and clothing. Unlike the SCT where environment predominantly entails people surrounding the targeted individual, the ecology approach stresses the importance of physical and structural environment such as prevalence of grocery stores and availability of public transportation. Three essential elements for human community are a house, a road, and water whereas food can be more easily transported from outside. It is the advancements in transportation technologies that allow for the growth of large cities where businesses are concentrated. Foods are transported from outside of large economic bases where goods and produce are most easily produced (McKenzie 1924).

The concept, now termed the Ecological Perspective Framework (EPF), was introduced to the public health discipline by McLeroy et al. in 1988. It acknowledges the interaction between, and interdependence of, various factors across multiple levels of a health problem (McLeroy et al. 1988). Most researchers, policy makers, and health professionals now agree that obesity is no longer simply individual responsibility but a societal issue. Individual psychological and social factors cannot adequately account for the widespread prevalence of the obesity epidemic in the developed world and interventions at the individual level have had limited success at best. As the world witnesses the development of more chronic diseases, it becomes evident that the structural environment and social influences have important impacts on human health (McLaren and Hawe 2005). The current lifestyle encourages an imbalance between caloric intake and physical exercise. While there has been increasing varieties of palatable foods, opportunities for physical activities have been quickly dwindling, especially for city dwellers. Such conditions contribute to the proliferation of chronic diseases and obesity.

According to the EPF model, behavior modification is most effective when there are multiple levels, or “spheres,” of influence, namely

Table 3.1: EPF's Levels of Influence and Definitions

Level of Influence	Definition
Intrapersonal or individual level	Personal traits and characteristics including attitude, behavior, self-concept, skills, etc.
Interpersonal level	A person's social network such as family, work group, and friends
Organizational or institutional level	Rules and regulations of social institutions to which an individual belong.
Community level	Norms or standards within formal and informal networks
Public policy level	Laws and policies at the local, state, and national levels

The second key concept in the ecological perspective is reciprocal causation. Reciprocal causation is the idea that an individual both shapes and is shaped by the environment in which he lives. At the psychobiologic core, humans are genetically programmed to favor fat and sugary foods as they provide more energy. At the same time, surrounding environments can enable people to purchase more and consume more. Within the realm of food retailing, the concept of reciprocal causation well describes the relationship between the retailers and the consumer. John Dawson wrote in 1995;

Whilst retailers respond to the culture of consumers and provide goods which are expected in a way which is acceptable, nonetheless the retailers also extend the horizons of consumers by presenting them with new products sold in new ways. Retailers, therefore, are both reactive and proactive agents in the process of consumer choice, (p.77).

It is apparent that modern food retailers have already exerted control over the supply chain, imposing new standards on suppliers and pushing some small-scale farmers off the food supply chain (Hawkes 2008). It is less apparent that they are, at the same time, taking control over shaping consumer food choice through various marketing tools (Ibid). This shift in power is of concern. Policymakers have the interest in balancing the power between the suppliers, the retailers, and the consumer (Ibid).

In 2001, Booth et al. published an article detailing strategies to combat obesity that focus on changing environmental factors and require the collaboration of various sectors not traditionally within the health domains (Booth et al. 2001). In examining factors affecting individual's eating and exercising choices, they identified two types of leverage points; proximal and distal. Proximal, or primary, leverage points directly control behavior settings such as family, employer, and supermarket. Distal, or secondary, leverage points exert indirect, but crucial, influences on the controllers of those settings. Examples of distal leverage points include policies, the entertainment industry, education system, transportation system, and the media. Certain factors have stronger influence on some segments of populations. Adolescents, for instance, are most influenced by body image and eating behavior in media and advertising (Story et al. 2002). The government

has pervasive influence over both proximal and distal leverage points. It will require the cooperation of public agencies at all levels to achieve sustainable changes in the macro- and micro-environments that are conducive to the prevention and reduction of population-wide obesity problems (Booth et al. 2001).

IV: Social and Structural Environment in Obesity Research

The role of built environment in shaping one's health outcomes has been a popular subject of obesity research. Using the ecological perspective, supermarkets are part of the environment, a community-level factor. In developed countries, food availability and presence of supermarkets have been investigated as possible determinants of diet and subsequently lifestyle diseases such as diabetes and cardiovascular diseases, of which obesity is a major risk factor (Eisenhauer 2001, Fitzgibbon et al. 2005, Story et al. 2008, Morland et al. 2002). By making processed-foods more accessible and affordable, supermarkets influence consumer choice. Marketing tools such as promotions and advertisements are used to drive up the demand for such products, influencing change in a population's dietary patterns and allowing supermarkets to expand further (Hawkes 2008). A study on values and preferences of fresh market shoppers and supermarket shoppers in Chiang Mai, Thailand, revealed stronger preferences for rice among regular fresh market shoppers. Whereas 100% of fresh market shoppers in the sample reported preferences for rice, a small number of supermarket shoppers displayed preferences for bread and wheat noodles (Isaacs et al. 2010).

Previous studies capture pieces of the complex relationships between residents, race, socioeconomic status, grocery stores, health, community, and society at large (Yeager and Gatrell 2014, Burns et al. 2004, Block et al. 2004, Lewis et al. 2005, Zenk et al. 2005). Disparities in food availability in various settings have been observed (Morland et al. 2002, Burns et al. 2004, Zenk et al. 2005, Larson et al. 2009). For example, in Australia, there is greater availability of healthy foods at lower costs in non-rural settings. The highest price variability was found among fresh fruits and vegetables (Burns et al. 2004). While literature on the absence of grocery stores in poor neighborhoods is abundant, proximity, it has been shown, is not the only determinant of destination choice nor is it the only indicator of access to healthful foods. Other factors such as prices and physical disabilities of individuals can also limit people's access even in areas where grocery stores are plentiful (Choi and Suzuki 2013).

Food prices influence dietary patterns and subsequently health as evidenced by the link between regional food prices and obesity rates among low-income households (Lovasi et al. 2009, Todd et al. 2011, Ford and Dzewltowski 2009). During the 1990s, there were increasing discussions on "populated areas with little or no food retail provision" (Cummins and Macintyre 1999). The term "food desert" was coined by the Nutrition Task Force Low Income Project Team of the United Kingdom Department of Health in 1995 as concerns on food issues such as genetically modified foods and diet-related diseases such as obesity were rising (Beaumont et al. 1995). While there are variations on the exact meaning of food desert, the USDA defines it as "parts of the country void of fresh fruit, vegetables, and other healthful whole foods, usually found in

impoverished areas” (American Nutrition Association 2010). In Portland, Oregon, food deserts are rare but food mirages where grocery store prices are too high for low-income families are commonly found (Breyer and Voss-Andreae 2013). Fresh produce are consistently more affordable in supermarkets than in small neighborhood food outlets that are present in poorer neighborhoods (Horowitz et al. 2004), and those with better access to supermarkets have lower levels of obesity (Larson et al. 2009). In Japan where the socio-economic discrepancy is not as large, elderly who were without a car and unemployed were a socially excluded group (Choi and Suzuki 2013). Food deserts are often determined by area demographics while ignoring personal attributes. Elderly individuals had lower accessibility to grocery stores whether or not they live in what is considered to be food desert (Ibid).

Conclusion

Social ecological theories such as the EPF and the SCT described in this chapter have just started to be applied to obesity research studies in recent decades (McLeroy et al. 1988; Green and Kreuter 2004). The models of analysis in this dissertation are built on these theories exploring sociocultural influences, in this case, types of grocery stores, on health behaviors and weight status. While environmental influences on obesity risk encompass a wide range of factors unable to all be covered in a single study, some of the elements included in this dissertation are drawn from three aspects of the environment including physical, economic, and sociocultural. The increasing presence of modern

format grocery stores in Bangkok may be able to explain the concurrent rise in obesity and chronic diseases in the population.

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CHAPTER FOUR: RESEARCH QUESTIONS AND HYPOTHESES

This chapter states and explains the main research questions and hypotheses for this research project. The analyses are divided into four major components, each with its own research question and hypotheses. The first two components are exploratory data analyses of the spatial food landscape of Bangkok and of socio-demographic characteristics of shoppers who choose to purchase their groceries at various store formats. The remaining two components are inferential analyses, examining the relationship of grocery destination choice with health behavior and obesity measure.

I: Spatial Analysis of Bangkok Food Landscape

Research Question

R1: What does the spatial food landscape in Bangkok look like?

To my knowledge, there exists no study on the general food landscape of Bangkok. Spatial analysis in obesity research has only been receiving attention in the last decade or so, in part, because much progress on the analysis software was made only in recent years. The number, types, and proximity to food retail outlets may play an important role in destination choice and subsequently health outcomes because of the availability and accessibility of different types of foods. The literature has mixed results

with some studies finding a modest association between distance to grocery store and weight status (Smith et al. 1998, Robert and Reither 2004) whereas other studies did not find such association (Burdette and Whitaker 2004, Simmons et al. 2005). This section aims to provide basic visualization of the food shopping scene in Bangkok.

Hypothesis

H₁: Food retail outlets in Bangkok are not evenly distributed

Because this is a pioneer study attempting to examine Bangkok food landscape with limited data, the hypothesis is a simple one. Existing Western research literature suggests that most of the time grocery outlets are not evenly distributed, giving birth to terms such as “food desert” and “food mirage” (defined in chapter 3). These imply unequal access to nutrition for people living in different locales. Historically, development patterns, certain economic and land-use policies are socioeconomically discriminatory such that urban food resources are unevenly distributed (Eisenhauer 2001). In the US, the common pattern is for supermarkets to locate in the suburbs where higher income families reside while poor inner city residents have most readily access to neighborhood stores and small food outlets with limited selections of fresh fruits and vegetables (Ibid).

In Thailand, the situation is different as the country is still considered agricultural-based. Fruits and vegetables are inexpensive and plentiful. Similar problems of food deserts and food mirages may not be an issue, at least not yet. Rather, the market appears to be bifurcated between modern and traditional food outlets (Kelly et al. 2014).

While this has been empirically observed, it has not been spatially analyzed. I hypothesize that food retail outlets in Bangkok are not evenly distributed as the supermarket revolution pattern is such that modern retailers concentrate in higher income areas such as city centers before sprawling into lower income populations (Reardon et al. 2012). Traditional markets are not always registered with the city. So the count can vary depending on what the data source is. It is, however, also hypothesized that they would likely be crowded in the city center where it is more densely populated.

II: Socio-Demographic Analysis

Research Question:

R2: Is there any discrepancy in the sociodemographic characteristics of modern, traditional, and mixed shoppers?

Past studies indicate significant differences in characteristics of people who shop at different store formats. Regular patrons of department stores are likely to be younger, more educated, and had higher incomes than occasional patrons (Crask and Reynolds 1978). Warehouse club members tend to be from upper socio-economic class, compared to the general public (Sampson and Tiger 1992), and compared to supermarket shoppers (Stone 1995). Fox et al. (2004) found that supermarkets receive more frequent visits and per trip spending than mass merchandisers and drug stores. The same study also found that patrons of mass merchandisers are least sensitive to travel time and supermarket patrons are most sensitive to product assortment (Fox et al. 2004).

Similarly, people who choose to shop at modern retailers may have different characteristics and values than those who shop at traditional retailers and those who shop at both store formats. These three groups of shoppers may differ by: 1.) Individual characteristics i.e., age, income, education, family size, type of residence, 2.) Individual shopping behavior i.e., frequency, duration, and spending, 3.) Individual's values with regard to store characteristics i.e., product pricing, organization, availability of parking space, and 4.) Health behavior i.e., smoking, drinking, and exercising frequency. For example, those who shop at a modern retailer may be younger, spend less money per trip, and be more concerned about facilities such as air-conditioning and parking space. Those who shop at fresh markets may be more concerned about the personalized service and opportunities to connect with their community and may live a more active lifestyle. Those who shop at both store formats may have a larger family size to accommodate their members' diverse needs. They may also be more concerned about product quality and therefore shop for different products at different stores. Many people believe fresh produce at traditional markets are of higher quality than their supermarket counterpart whereas supermarkets carry a much wider variety of imported goods.

Hypothesis

H₂: The socio-demographic profile of consumers significantly influences their choice of grocery destination

Empirical evidence suggests that sociodemographic factors such as age, gender, educational attainment and income have significant influences in determining the food

choices of people around the world (Aranceta et al. 2003; Hulshof et al. 2003; Shi and Holmboe-Ottesen 2005; Goyal and Singh 2007). In China, for example, socioeconomic status and urban residence was positively linked with intake of high-energy foods, Western style foods, and dairy products (Shi and Holmboe-Ottesen 2005). Food retailers are major players in influencing food availability and consumption choices (Dixon and Banwell 2012), which, in turn, affects health of the population. Those who frequent modern food retailers are more likely to consume sodas, snacks, and processed foods, and are less likely to consume fruits and vegetables (Kelly et al. 2014). It is, therefore, crucial to examine how differently store formats may impact their respective patrons.

More specifically, variables of interest are expected to be related with destination choice in the following manners

Table 4.1: Expected Signs of Variables of Interest

Variable	Expected Sign		
	Modern	Traditional	Mixed
Male	+	-	-
Age	-	+	+
Educational attainment	+	-	-
Monthly household income	+	-	-
Residence type (house)	-	+	+
Residence type (condo)	+	-	-
Residence type (dorm/apt)	+	-	-
Household size	+	-	+
Presence of child in family	+	-	-
Car ownership	+	-	-

Being male is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. Men are comparatively more independent shoppers who do not value personalized services that traditional markets offer. They are expected to be negatively associated with being a mixed shopper because, compared with women, they value convenience and time over good deals. For example, in the US, women are significantly more likely to be deal seekers and coupon users (Harmon and Hill 2003).

Age is expected to be negatively associated with being a modern shopper, positively associated with being a traditional shopper, and positively associated with being a mixed shopper. Younger individuals are more likely to welcome change and to try new shopping venues (Dixon et al. 2007). They are also more curious and receive greater western cultural influence in other aspects of life through the media. Older individuals are more likely to be traditional shopper because they are set in their ways and are more inclined to opt for familiar things (Trappey and Lai 1997). At the same time, however, modern retailers are doing more in an attempt to attract older customers such as selling pre-packaged offerings for monks and holding daily aerobic sessions.

Educational attainment is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. Educated consumers are more likely to demand greater product information and value convenience. They are more likely to desire and understand the importance of nutrition labels (Rimal et al. 2008). They also tend to have higher purchasing power and be more open to trying new unfamiliar store settings and

products. I, thus, hypothesize that educated consumers would be more likely to shop at modern retailers and less likely to shop at traditional markets. As they are also likely to value convenience, I would also be less likely to be mixed shoppers.

Monthly household income is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. High income earners are likely to be time-poor and value convenience. They want to be able to navigate their way quickly to the items they need and receive fast service at check-out (Kenhove and De Wulf 2000). Modern retailers are more accommodating to such demands because their organizations of products and aisles do not vary much from store to store within the same chain. Customers also pay once at the end of their shopping trip instead of paying for each stall owner at traditional markets. They are then hypothesized to prefer modern retailers where they can purchase both grocery and non-grocery items and spend less number of trip and less time finding their desired items. The products are more organized than at traditional markets, making them easier to find.

Living in a house is expected to be negatively associated with being a modern shopper, positively associated with being a traditional shopper, and positively associated with being a mixed shopper. Substantial number of house residents has live-in maids, especially in Bangkok where the general populations earn higher income than the rest of Thailand. The maids usually do the grocery shopping at traditional markets while occasionally the family members shop for Western items at modern retailers.

Living in a condominium is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. Condominium dwellers usually live alone or with few members and face limited storage. University students who live away from home develop unhealthy dietary habits such as increasing sugary beverage and processed food consumption (Papadaki et al. 2007). I hypothesize that they would be more likely to value convenient foods with little preparation time and excess that needs storage. They are, thus, expected to shop primarily at modern retailers.

By the same line of argument with condominium dwellers, those who live in a dormitory or an apartment setting are expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper.

Household size is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and positively associated with being a mixed shopper. Modern retailers offer a one-stop shop for many families for grocery and non-grocery items. People are thus able to forego traditional markets. The same is not true with the traditional sector as they offer much smaller selections of products. Meanwhile, some households who prefer to shop at both formats may become mixed shoppers to serve family members' needs.

Presence of a child (or children) in the household is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. Children are likely to be

attracted to the comfort of air conditioning, western snacks, and fun playground that modern retailers offer. Traditional markets are not known to be children-friendly place. Parents are likely to want to double-purpose their grocery shopping trip as an excursion for their children.

Car ownership is expected to be positively associated with being a modern shopper, negatively associated with being a traditional shopper, and negatively associated with being a mixed shopper. Modern retailers usually have parking arrangements for their customers whereas traditional markets usually do not. Those who own a car are likely to want to drive to grocery store rather than taking public transportation because of the convenience of loading and unloading grocery items to and from a private vehicle.

III: Grocery Destination Choice and Health Behavior

Research Question:

R3: Is there a correlation between grocery destination choice, shopping frequency, and health behavior?

Grocery destination choice and shopping frequency may have influential effects on consumers' health behaviors. Health behavior is defined as any activity undertaken by a person that may affect their health positively or negatively. By making processed-foods more accessible and affordable, supermarkets play a role in consumer choice. Marketing tools such as promotions and advertisements are used to drive up the demand for such products, influencing change in population dietary patterns and allowing supermarkets to expand further (Hawkes 2008). The media, in its various forms, is a powerful tool in

disseminating nutrition and health information. The quality, reliability, and the amount of information that reach the consumers, however, are difficult to determine. The time use survey 2009, conducted by the National Statistical Office, revealed that Thais ages 10 and over spend on average 2.9 hours per day on mass media. People at the ends of the educational spectrum, those with no education and those with more than high school education, spend over 3 hours daily on mass media (NSO 2009).

A study on values and preferences of fresh market shoppers and supermarket shoppers in Chiang Mai, Thailand, revealed stronger preferences for rice among regular fresh market shoppers. Whereas 100% of fresh market shoppers in the sample reported preferences for rice, a small number of supermarket shoppers displayed preferences for bread and wheat noodles (Isaacs et al. 2010).

The frequency at which one shops at a particular format grocery store may also alter one's lifestyle. Kelly et al. looked at food shopping at supermarkets and its relationship to processed food consumption and health, using a subsample of the Thai Cohort Study (TCS) conducted in 2005 and 2009. The original survey had wide-ranging questions related to health-risk behaviors. The authors sent out another survey to a subsample of these participants in 2012 regarding local food environments, food provisioning patterns, and dietary intake (Kelly et al. 2014). They found an association between frequent modern grocery store visits and consumption of "problem foods" (soft drinks, snack foods, processed meats, western style bakery items, instant foods, and deep fried foods) while frequent fresh market shopping was linked to increased vegetable

intake. The authors also found a link between grocery destination choice and hyperlipidemia, but not with BMI, diabetes, or hypertension (Kelly et al. 2014).

H3: Modern grocery shoppers will demonstrate a greater level of undesirable health behaviors than traditional market shoppers and mixed shoppers.

In developing countries such as Thailand, modern grocery retailers enter the market first with processed foods and dry ingredients for which they have economy of scale advantage over the traditional sector (Reardon and Berdegue 2006). These processed foods are often palatable and high in fat and sugar while lacking fiber and essential micronutrients. They are also foods of convenience such as frozen meals and bakery items. Such products discourage home cooking and are often associated with sedentary behavior such as television watching (French et al. 2001). Marketing strategies such as pricing promotion, point-of-purchase posters, product placement, and targeting of children prompt impulse purchases of sugary beverages, sweets, and other unhealthy items (Zhou and Wong 2004).

Hypermarkets, the most common modern store format in Bangkok, usually have food courts, children playground, and popular fast food restaurants while traditional markets do not offer such options. Modern shoppers, exposed to these attractions, are expected to be more likely to engage in dining out and fast food experiences.

H4: Those who frequent modern grocery retailers will demonstrate greater level of undesirable health behavior than those who do not frequent modern grocery retailers.

Modern shoppers are more likely to be exposed to processed foods, Western snacks, sweet drinks, and fast food restaurants. Although marketing strategies can be used to promote purchases and consumption of healthy food items, they are more often used to promote “fun” food laced with sugar, fats, and refined grains. These items are palatable, convenient, and inexpensive. They are also energy-dense and less satiating according to lab studies, which can result in passive overeating and weight gain (Drewnowski and Darmon 2005). Because those who frequent modern retailing establishments encounter these factors that encourage undesirable health behavior, it is likely that they will demonstrate greater level of such behaviors.

IV: Grocery Destination Choice and Obesity

Research Question:

R4: Is there a correlation between grocery destination choice, shopping frequency, and obesity measures?

In developed countries, food availability and presence of supermarkets have been investigated as possible determinant of diet and subsequently lifestyle diseases such as diabetes and cardiovascular diseases, of which obesity is a major risk factor (Eisenhauer 2001, Fitzgibbon et al. 2005, Story et al. 2008, Morland et al. 2002). The direction in which grocery shopping destination choice influences diets and subsequently health is unclear. While studies on food environment are plentiful, studies on where one shop and the link to health are far and few between. In the US, Inagami et al. showed that an individual’s grocery destination choice is a significant determinant of one’s BMI

(Inagami et al. 2006). Those who shopped at stores in lower-SES neighborhoods than one they lived in showed higher BMI than those who shopped in their own neighborhood (Ibid). In Guatemala, a study links supermarket purchases to an increase in consumption of processed food. Supermarket shopping is also significantly associated with BMI of household members (Asfaw 2008). In Tunisia, a different study found the opposite effect linking supermarket shopping to improved diet quality (Tessier et al. 2008). The difference in the direction of influence is likely due in part to the discrepancies in levels of economic development, modern retailing penetration, and cultural factors of different countries.

Hypotheses

H₅: Those who shop primarily at modern grocery retailers will score higher on obesity measures than those who shop primarily at traditional markets and those who shop at both equally.

As previously stated, modern retailers expose customers to marketing strategies that encourage purchases of processed foods, Western snacks, bakery items, and other palatable unhealthy foods. These items are convenient and attractive especially to time-poor shoppers, single-person households, and families with children. They often are ready-to-eat or require little preparation time while boasting long shelf life. The obesity epidemic in the US is believed to be driven in large part by the increase in consumption of these food items. Traditional markets, on the other hand, offer mostly fresh fruits and vegetables. Although you do see some processed foods such as sausages and bakery items, they are not primary products in the traditional sector. It is, therefore, likely that

those who shop primarily at modern grocery retailers will score higher on obesity measure than traditional and mixed shoppers who do not face the same level of exposure to unhealthy foods.

H₆: Those who frequent modern grocery retailers will score higher on obesity measures than those who frequent fresh markets

By the same line of argument, the more frequent shoppers are exposed to factors that encourage the purchase of unhealthy foods, eating out, and consumption of fast food, the more likely they are to be overweight or obese.

Conclusion

Four research questions and six hypotheses have been proposed and explained in this chapter. The first two research questions and their pertinent hypotheses are exploration of data whereas the remaining research questions and hypotheses are more analytical in nature. Because there is a lack of literature in this field for the Southeast Asia region, supporting arguments often are drawn from Western literature and from developing areas outside of Southeast Asia and are to be tested in the following chapters with appropriate mathematical models.

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CHAPTER FIVE: DATA AND METHOD

Quantitative analysis methods using secondary and primary data are presented in this chapter. Mapping and spatial data retrieved online are used in Bangkok food landscape exploratory analysis. Primary data are used in subsequent analysis at the individual level. They were collected in collaboration with Theptarin Hospital, a private healthcare organization located in Bangkok Thailand in two waves, in the summer of 2014 and the summer of 2015, together yielding a total of 510 usable questionnaires and observations.

I: Description of Data

Subsection 1.1: GIS Mapping Data

a.) Boundary data

The area of study was mapped using district-level shape files available on BangkokGIS website.

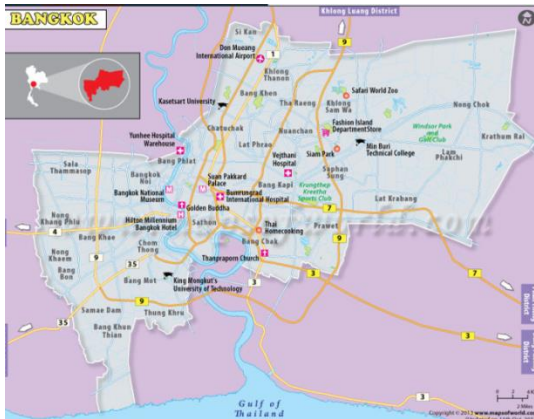


Figure 5.1: area of study

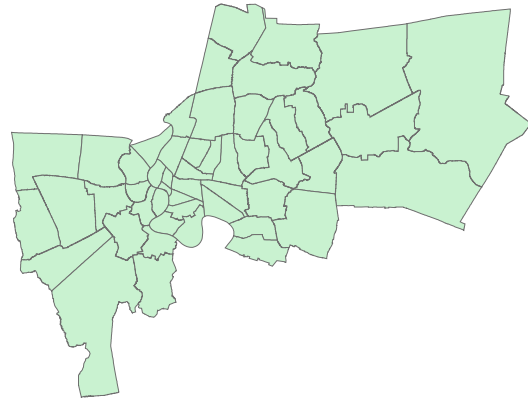


Figure 5.2: area of study as GIS layer

While Bangkok, in some studies, may refer to the city of Bangkok and its peripheral suburban areas, this study restricts the analyses to the 50 districts of Bangkok for the ease of defining boundaries. The 50 districts include

Bang Bon, Bang Kapi, Bang Khae, Bang Khen, Bang Kho laen, Bang Khun thain, Bang Na, Bang Phlat, Bang Rak, Bang Sue, Bangkok Noi, Bangkok Yai, Bueng Kum, Chatu Chak, Chom Thong, Din Daeng, Don Mueang, Dusit, Huai Khwang, Khan Na Yao, Khlong Sam Wa, Khlong San, Khlong Toei, Lak Si, Lat Krabang, Lat Phrao, Min Buri, Nong Chok, Nong Khaem, Parthum Wan, Phasi Charoen, Phaya Thai, Phra Khanong, Phra Nakhon, Pom Prap Sattru Phai, Pra Wet, Rat Burana, Ratchathewi, Sai Mai, Samphanthawong, Saphan Sung, Sathon, Suanluang, Taling Chan, Thawi Watthana, Thon buri, Thung khru, Vadhana, Wang Thong Lang, Yan na wa

b.) Grocery Store Data

Modern Retailers

Modern grocery retailers, in this study, refer to western-format food stores including hypermarkets, supermarkets, and convenience stores. The difference between convenience stores and the other two formats, hypermarkets and supermarkets, is obvious

due to the sheer size disparities. Few people, however, know the difference between hypermarkets and supermarkets. As such, the two store formats are treated as one in this study.

While hypermarkets and supermarkets are represented by point data, convenience stores' specific locations are not captured in this study due to its overwhelming presence of 2,974 stores in Bangkok. The data on convenience stores are retrieved from district offices and joined to district polygons. The three biggest hypermarket and supermarket chains in Bangkok are BigC, Tesco Lotus, and Tops. They have the highest sales-volumes and are most popular among Thai consumers. The locations of these chain stores were retrieved from their websites. A total of 88 addresses were manually geocoded using GIS coordinates obtained from freegeocoder.com. The coordinates were input into an excel spreadsheet that was then imported into ArcMap and projected onto the boundary file.

Traditional Market

Traditional markets are open-air markets where meat and fresh produce are traded without modern day packaging and refrigeration. There are small stalls selling various products, many of them identical. The stalls are owned by mostly the person selling the meat or produce. Data on traditional market locations were downloaded in shape file format from BangkokGIS.com and projected onto the boundary file. There are 148 traditional markets in record.

Population Density

Population size is important to the analyses of the food retail landscape as they form the customer base of grocery outlets. The data were obtained in excel file format from the Bureau of Registration Administration which I imported to ArcGIS and joined them to boundary data layer for analysis.

Subsection 1.2: The Grocery Shopping and Health Survey and Data Collection

In the summer of 2014, a convenience sample that included 344 hospital employees was selected to fill out a questionnaire after their annual health check-up which included a body composition analysis. The survey is adapted from the US National Health and Nutrition Examination Survey (NHANES) and the Flexible Consumer Behavior survey. A content analysis has been conducted with the help of professional nutritionists in Thailand to validate its cultural relevancy. The following summer, in 2015, additional data sites were chosen including Kuk Kai elementary school where 58 teachers, administrators, and other personnel were recruited and True Corporation, a telecommunication company, where 174 individuals participated. Grocery shopping behavior, health behavior, and sociodemographic data were collected using a survey questionnaire. The survey included 35 questions on grocery shopping routine, 18 questions on dietary and health behavior, and 12 questions on demography. In return, participants received a brief health check-up that included a bioelectrical impedance body composition analysis where we obtained their obesity measures, namely body mass index (BMI), percent body fat (PBF), waist circumference (WC), visceral fat (VF), and waist-hip ratio (WHR). The survey document is presented in **Appendix A**.

c.) Grocery shopping behavior data

Grocery shopping behavior data are individual-level. Respondents fill out a survey on their grocery shopping experience that includes questions on their destination choice, frequency and duration of shopping, average spending per trip, mode of transportation, items purchased at different types of stores, and factors that they consider in choosing a grocery store. Refer to **Appendix A** for a full questionnaire.

Questions selected for use in this study are

(Q1):

What is your primary grocery shopping store/market? Please give the name and location (ie. Lotus, Rama 4 Rd. or Klongtoey Market)

*This was an open ended question that was later coded as:

- 1 for modern grocery retailers
- 2 for traditional markets, and
- 3 for those who shop equally at both store formats

(Q6-15):

On a scale of 1-5, 5 being “very important” and 1 being “not at all important,” How important is each of the following grocery store characteristics when you shop?

	Level of Importance				
	Highest				Lowest
6. Pricing	5	4	3	2	1
7. Convenience of location	5	4	3	2	1
8. Facilities including parking lots and air conditioner	5	4	3	2	1
9. Store promotions	5	4	3	2	1
10. Store cleanliness and organization	5	4	3	2	1
11. Store product quality	5	4	3	2	1
12. The assortment of different brands and products	5	4	3	2	1
13. Store service; helpfulness, availability, and friendliness of staff	5	4	3	2	1
14. Availability of product in large-size packaging	5	4	3	2	1
15. Opportunity to connect with the local community	5	4	3	2	1

(Q16, 18, 19)

How often do you shop for food items at the following grocery outlets?

	Less than once a month	Once a month	1-2 times a week	3-4 times a week	More than 4 times a week
16. Hypermarket/Supermarkets (ie. Lotus, Big C, Tops, Gourmet)					
18. Convenience stores (7-eleven, Family Mart)					
19. Traditional wet markets					

(Q. 21, 23, 24)

How much do you spend on average per shopping trip at each of the following places?

21. Hypermarket/Supermarkets (ie. Lotus, Big C, Tops, Gourmet)

_____ baht

23. Convenience stores (7-eleven, Family Mart)

_____ baht

24. Traditional wet markets

_____ baht

d.) Health behavior data

Health behavior data are individual level 7-day recall. Participants indicate how many days they engaged in certain diet and health-related behavior in the past 7 days.

Selected for use in this study are (Q36-48)

How many days in the past 7 days did you do the following?

	Number of days in the past 7 days								
36. Have breakfast at home	0	1	2	3	4	5	6	7	
37. Have breakfast elsewhere (not at home)	0	1	2	3	4	5	6	7	
38. Have dinner that is prepared at home	0	1	2	3	4	5	6	7	
39. Eat at restaurants for dinner (excluding cafeterias and food courts)	0	1	2	3	4	5	6	7	
40. Eat at fast food or pizza restaurants (KFC, McDonalds, Pizza Hut)	0	1	2	3	4	5	6	7	
41. Have food or fruits purchased from street stalls	0	1	2	3	4	5	6	7	
42. Have fruits or Thai snacks between meals	0	1	2	3	4	5	6	7	
43. Have Western snacks between meals (ie. potato chips, pastries)	0	1	2	3	4	5	6	7	
44. Drink soda or other sugary drinks (juice, energy drinks, sweet tea)	0	1	2	3	4	5	6	7	
45. Smoke cigarettes	0	1	2	3	4	5	6	7	
46. Drink alcoholic beverages (liquor, beer, cocktails)	0	1	2	3	4	5	6	7	
47. Be physically active for more than 60 minutes per day (add up all the time that increase heart rate and make you breathe hard some of the time)	0	1	2	3	4	5	6	7	
48. Spend more than 8 hours sitting (at work, at home, in a car, on a bus)	0	1	2	3	4	5	6	7	

e.) Grocery store data

Grocery store data are store-level. Modern and traditional grocery outlets are evaluated for their availability and affordability of healthy food options such as low-fat milk, whole-grain bread, and green vegetables.

A food store assessment criteria adapted from the validated Nutrition Environment Measures Survey (NEMS) will be used to score each store between 0 to 27 points. A healthy food availability index (HFAI) will be determined according to the assessment. A content analysis has been conducted with the help of professional nutritionists in Thailand to validate its cultural relevancy. The researcher sampled grocery

store outlets of various formats to complete the evaluation form. Refer to Appendix B for an evaluation form.

f.) Health outcomes data

Health outcomes data are individual-level. Specific outcomes collected are measures of obesity including BMI, percent body fat, waist circumference, visceral fat, and waist-hip ratio. The Bioelectrical Impedance Analysis (BIA) was used to determine body composition. BIA measures total body water (TBW) by sending a low electric current through body tissues. TBW can, in turn, be used to calculate body fat and muscle mass. BIA has been widely used clinically for nutrition and weight management purposes. The data obtained were matched with consumer behavior data from the survey for analysis. Refer to **Appendix C** for a body composition analysis sample.

Subsection 1.3: Definitions of Grocery Retailers

While there are numerous types of grocery store outlets in Bangkok, the present study focuses on four major types, one traditional and four Western-style markets. This section briefly describes each type of grocery outlet.

a.) Traditional retailers

Fresh market – Also known as open-air markets and wet markets. A collection of stalls commonly found in Asian countries where live animals, meat, and fresh produce are sold out in the open with no refrigeration and minimal packaging. Sizes vary from market to market as do sanitation and organization.

b.) Modern retailers

- Hypermarket* – Also known as supercenter and superstore. Large size retailer typically between 8,000 to 15,000 m² in space, carrying a large product variety with in-store bakeries and pharmacy. The average size for hypermarkets in Bangkok is 8500 m². This type of retailers also rent out space in the mall area to independent small stores selling clothing, food, mobile phones, etc. The biggest players in Thailand are Tesco Lotus and Big C.
- Supermarket* – Typically ranging between 400 to 2,500 m², carrying all major household goods, food and non-food items, and some personal care products. In Bangkok, the most common supermarket chain is Tops and is usually situated within a department store.
- Convenience store* – Small stores of approximately 80 m² carrying essential every day products and open long hours. Many are open 24 hours. The most common chains in Thailand are Seven-Eleven and Family Mart. The number of convenience stores has been rising rapidly. As of 2012, the Thai Retail Association reported there were 12,246 convenience stores in Thailand, each serving about 3,000 households, compared to 10,000 households when it was first introduced in 1989.

Subsection 1.4: Sample Populations

The target population for this dissertation is working individuals living in Bangkok. The sampling frame is limited by the need for health outcome data which requires an on-site body composition analysis. There were 510 usable surveys in total from 130 male and 383 female participants between ages of 17 and 65. Overall, the sample is slightly younger and has lower household income, but much more educated than the underlying Bangkok working age population. The sample's average age is 35 with household income between 10,000-30,000 baht per month whereas the largest age group of working population in Bangkok is 40-49 years old with average household income of 43,058 baht per month (NSO 2013). As much as 72% of the sample holds a bachelor's degree or higher, compared with 35% of Bangkok population ages 15 and over (NSO 2015). It is suspected that this is due to the points of data collection and the interest in study participation. One of the venues of data collection was a mobile phone application development office of a large telecommunications company. It is known that this sector of the industry attracts primarily younger individuals. Though participation in the study was open not only to desk workers but also to housekeepers, security guards, and others, those make up a small portion of the sample. In addition, some people with lower education were not proficient readers and had difficulty filling out the survey. More educated individuals are also thought to be more health conscious and interested in getting a health check-up in general. Lastly, older individuals who are more likely to hold managerial positions may be more occupied with work and less interested in events such as this.

Table 5.1: Socioeconomics of Respondents and General Bangkok's Working Population (Census Data)

	Survey	Census (2015)
Median age	26	40-49
Average household size	2.7	2.7
Educational Attainment (of employed persons 2013)		
Primary or less	3.94%	29%
Junior HS	2.36%	13.9%
HS	12.6%	16.7%
Vocational	9.06%	4.9%
Bachelor's and higher	72.05%	35%
Household income (baht/month)	10,000-30,000	43,058

II: Description of Methods and Model

The analysis for this dissertation will be in 4 parts. The first two parts are exploratory analysis of the food retail landscape and consumer characteristics of each store format. The third part investigates the relationship between health behavior, shopping destination, and shopping frequency. Finally the fourth part relates destination choice and shopping frequency with obesity measures.

Subsection 2.1 Average Nearest Neighbor Distance (NND) and Moran's I Spatial Analysis

To get an understanding of what the food retail landscape in Bangkok looks like, I use the Geographic Information Systems to conduct an Exploratory Spatial Data Analysis (ESDA). In public health, GIS methods have been most widely used to determine

disparities in access to healthcare (McLafferty 2003). The utilization of GIS to analyze local food environment is a relatively recent phenomenon, but is one that is becoming increasingly common as spatial data are more readily available and GIS software capability improves (Thornton et al. 2011).

Local food environments are often assessed in terms of proximity and/or density. A review of GIS methods in food environment analysis was published in 2010. The study found that measuring Euclidean distance or travel times to the closest food store are the most common approaches to assess proximity. The buffer method, kernel density estimation, and spatial clustering are used to assess density of grocery stores (Charreire et al. 2010).

Limited by the availability of data, this section of the study uses the Average Nearest Neighbor Distance (NND) and Moran's I methods of spatial clustering to determine the density of modern food retailers and traditional markets. Both methods evaluate whether food stores are randomly distributed within the study area. The analysis of supermarkets and traditional markets are conducted using point data and the NND approach for accuracy of location. The downfall of this method being that the population density is not taken into account. Convenience store data are available as district-level areal data which is less accurate than point location but allows for the integration of population density information. This part of the analysis will be conducted using the Moran's I method.

Calculations

The Average Nearest Neighbor ratio is defined as:

$$ANN = \frac{\bar{D}_0}{\bar{D}_E}$$

where \bar{D}_0 is the observed mean distance between each feature (grocery outlet) and their nearest neighbor:

$$\bar{D}_0 = \frac{\sum_{i=1}^n d_i}{n}$$

and \bar{D}_E is the expected mean distance for the features in a random pattern:

$$\bar{D}_E = \frac{0.5}{\sqrt{n/A}}$$

d_i represents the distance between feature i and its nearest neighbor

n represents the total number of features, and

A is the total study area

The Z-score is calculated as follows

$$z_{ANN} = \frac{\bar{D}_0 - \bar{D}_E}{SE}$$

Where

$$SE = \frac{0.26136}{\sqrt{n^2/A}}$$

The z-score is then translated into p-value, similar to regression analyses. Significant p-value would suggest a pattern that is significantly different from random.

Subsection 2.2: Shopper Group Characteristics (ANOVA, Chi-Squares, and Independent t-tests)

This step examines factors affecting grocery destination choice at the individual level of influence according to the ecological perspective. Series of chi-square and ANOVA tests are to be conducted to determine these differences between shoppers in groups *a*, *b*, and *c* while independent t-tests will examine car owners and non-car owners. Given that the median grocery shopping frequency of the sample is 1-2 times a week, the following definitions are used in the analysis. The categories are mutually exclusive.

Table 5.2: Shopper Group Definitions

A. Traditional retailer shoppers	those who visit hyper/supermarkets at least once a week and visit traditional markets less than once a week on average
B. Modern retailer shoppers	those who visit traditional open-air markets at least once a week and visit hyper/supermarkets less than once a week on average
C. Mixed shoppers	those who visit both hyper/supermarkets and traditional open-air markets at least once a week on average

Table 5.3: The Categorical Variables Tested using the Chi-square Test

Shopper's Characteristics	Categories
Male	male female
Age group	<30 30-44 45-60 60+
Education	primary or less junior high school high school vocational bachelor's degree master's degree or higher
Income group	<10,000 baht/month 10,000-30,000 baht/month 30,001-50,000 baht/month 50,001-100,000 baht/month >100,000 baht/month
Type of residence	house condo dorm/apartment
Household size	Live alone 2 family members 3 family members 4 family members 5 or more family members*
Child in family	Yes No
Car ownership	Yes No
Store's Characteristics (Importance of)	Categories
Price	Most important Very important Neutral Somewhat important Least important
Location	Most important

	Very important Neutral Somewhat important Least important
Amenities (parking, air conditioning, etc.)	Most important Very important Neutral Somewhat important Least important
Promotion (sale)	Most important Very important Neutral Somewhat important Least important
Cleanliness and organization	Most important Very important Neutral Somewhat important Least important
Product quality	Most important Very important Neutral Somewhat important Least important
Product variety	Most important Very important Neutral Somewhat important Least important
Service	Most important Very important Neutral Somewhat important Least important
Family size packages	Most important Very important Neutral Somewhat important Least important
Community relationship (opportunity for)	Most important Very important Neutral Somewhat important Least important

The null hypothesis for each variable is that there is no significant difference between groups. As an example, the following is null hypothesis for the variable *gender*.

$H_0: \mu_a = \mu_b$: There is no significant difference in the gender distribution between groups *a*, *b*, and *c*.

Analysis of Variance (ANOVA)

Table 5.4: The variables to be tested using ANOVA

Shopping Behavior	Type
Spending per trip to supermarket	Continuous
Spending per trip to traditional market	Continuous
Spending per trip to convenience store	Continuous
Shopping duration per trip	Continuous
Travel time per trip	Continuous

The null hypothesis for each variable is that the means are the same for all shopper groups. As an example, the following is the null hypothesis for the variable *age*.

$H_0: \mu_a = \mu_b = \mu_c$: The mean age of shoppers is the same across groups *a*, *b*, and *c*.

ANOVA tests for an overall difference between groups *a*, *b*, and *c*, but it does not indicate which specific groups differ. Should ANOVA show statistical significance, the Sidak, Bonferroni, and Scheffe post-hoc tests will be conducted to confirm where the differences occur between groups.

Independent t-test

The independent t-tests will be used to examine the differences between car owners and non-car owners on the following variables

Table 5.5: Variables to be Tested by Independent T-Tests

Shopping Behavior	Type
Supermarket Shopping Frequency	Ordinal
Traditional Market Shopping Frequency	Ordinal
Convenience Store Shopping Frequency	Ordinal
Spending per trip to the supermarket	Continuous
Spending per trip to traditional market	Continuous
Spending per trip to convenience store	

Subsection 2.3: Grocery Destination and Health Behavior (Negative Binomial Regression)

This section of the analysis uses the negative binomial regression to observe the relationship between the number of days a subject engages in certain health behaviors and their shopping behaviors. The model was selected based on the nature of the dependent variable being count data and pre-hoc and post-hoc goodness-of-fit tests. Discrete count data containing high number of zero values are typically fitted into

Poisson or negative binomial distribution as they are not normally distributed. The Poisson distribution assumes that the mean and variance are equal. Data sometimes contain variation that is greater than the mean, resulting in over-dispersion and standard errors could be biased. The negative binomial regression relaxes this assumption and adjusts the variance independently from the mean.

The Poisson probability distribution is as follows

$$\Pr(Y = y|\lambda) = \frac{e^{-\lambda}\lambda^y}{y!} \text{ for } y = 0,1,2,\dots$$

Where

λ represents both the mean and the variance

The negative binomial distribution relaxes the mean equal variance assumption such that

$$\Pr(Y = y|\lambda, \alpha) = \frac{\Gamma(y + \alpha^{-1})}{y! \Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \lambda} \right)^{\alpha^{-1}} \left(\frac{\lambda}{\alpha^{-1} + \lambda} \right)^y$$

Where

λ represents the mean of the distribution

α represents the over dispersion parameter

Note that the Poisson distribution only has one parameter, λ , whereas the negative binomial has two parameters, λ and α . When $\alpha = 0$, the negative binomial distribution is exactly the same as the Poisson distribution.

Diagnostic tests reveal that for this study, the negative binomial regression is the better model. Histograms of the dependent variables show that none of the variables is normally distributed. Most variables are skewed to the right with high number of zero

values. Poisson and negative binomial regressions are typically used to analyze such data. The mean-equal-variance test, goodness-of-fit test, and the likelihood ratio test of alpha all indicate that the negative binomial, which is less restrictive allowing variance to be greater than the mean, is a better fit. The results of these tests are detailed in chapter six.

The variables included in this negative binomial regression analyses are drawn from the 7 day recall of health behaviors asking how many days in the past 7 days did participant do the following

Table 5.6: Health Behavior Variables and Control Variables

Dependent Variables	Type
Eat breakfast outside	Ordinal
Dinner outside	Ordinal
Eat fast food	Ordinal
Consume western snacks	Ordinal
Consume Sweet drinks	Ordinal
Drink alcohol	Ordinal
Exercise 60 (not necessarily consecutive) min or more	Ordinal
Sit 8 (not necessarily consecutive) hours or more	Ordinal

Control Variables	Type
Age group	Categorical
Gender	Categorical
Educational attainment	Categorical

Two sets of regressions are conducted. The first set investigates the relationship between shopping destination choice and health behaviors. The second set investigates the relationship between frequent visits to each destination and health behaviors.

The independent variables of interest in the first set of regressions are primary shopping destination choice. They are mutually exclusive. Convenience store is excluded from the analysis as only a negligible number of participants indicated they shop primarily at a convenience store. The variables, thus, include binary variables

Table 5.7: Independent Variables of Interest for Negative Binomial Regression (Shopper Group)

Independent Variables of Interest (primary shopping destination choice)	Type
Supermarket	Binary
Traditional market	Binary
Mixed (both supermarket and traditional market)	Binary

The independent variables of interest in the second set of regressions are whether or not one shops at a particular store format at least 3 times a week. Because one can shop 3 times a week at both supermarket and at traditional market, these variables are **not** mutually exclusive. It is also beneficial to tease out the effect of convenience stores as they offer significantly less fresh foods and are heavily reliant on processed foods.

Table 5.8: Independent Variables of Interest for Negative Binomial Regression (Frequent Shopper)

Independent Variables of Interest (shopping frequency)	Type
Frequent visit to supermarket	Binary
Frequent visit to traditional market	Binary
Frequent visit to convenience store	Binary

Subsection 2.4: Grocery Destination Choice and Weight Status (Ordinary Least Squares Regression)

This step of the analysis uses ordinary least squares (OLS) regression to examine the relationship between where one shops and one's obesity status. OLS is one of the simplest forms of multivariate regression. The goal of OLS is to minimize the sum of squared errors from the data to create the best fit line.

The general form of OLS is

$$Y = \alpha + \beta X_i + \varepsilon$$

Where

Y is the dependent variable

α is a constant

β is a coefficient representing the slope of the line, and

X_i is the observed value of the independent variable for the i^{th} case, and

ε is the error term

The dependent variables for this step are obesity measures. Recall that I collected primary data through bioelectrical impedance analysis for measures including BMI, PBF, VF, WC, and WHR. Of these five measures, two were excluded from the analysis. VF in the two waves of data collected were measured using different machines that yielded results in two different irreconcilable measurement units. It had to, therefore,

unfortunately be dropped. The second measurement excluded from the analysis was WHR due to lack of evidence for its accuracy in indicating obesity status.

Two sets of regressions, each with three subsets for the three obesity measure dependent variables, are conducted. Similar to the previous step of negative binomial regressions, the first set investigates variations within shopper groups (shopping destination) whereas the second set investigates frequent shoppers (shopping frequency).

As with the negative binomial regression, the independent variables of interest in the first set of regressions are primary shopping destination choice. They are mutually exclusive. Convenience store is excluded from the analysis as only a negligible number of participants indicated they shop primarily at a convenience store. The variables, thus, include binary variables

Table 5.9: Independent Variables (Primary Shopping Destination Choice)

Independent Variables of Interest (primary shopping destination choice)	Type
Supermarket	Binary
Traditional market	Binary
Mixed (both supermarket and traditional market)	Binary

As with the negative binomial regression, the independent variables of interest in the second set of regressions are whether or not one shops at a particular store format at least 3 times a week. Because one can shop 3 times a week at both supermarket and at traditional market, these variables are **not** mutually exclusive. It is also beneficial to tease

out the effect of convenience stores as they offer significantly less fresh foods and are heavily reliant on processed foods.

Table 5.10: Independent Variables (Shopping Frequency)

Independent Variables of Interest (shopping frequency)	Type
Frequent visit to supermarket	Binary
Frequent visit to traditional market	Binary
Frequent visit to convenience store	Binary

Each subset of regressions is further expanded into four models using different control variables in order to examine the effects of various factors on the independent variables of interest. For example, regression set one (shopping destination choice) subset one (BMI as dependent variable) has 4 different models. The following regression models form the general regression models for the analyses.

a.) Shopper Groups (Shopping Destination)

a.1) BMI and Shopping Destination

Model 1 has only independent variable of interest, *ShopperGroup*, which is a categorical variable that includes modern shoppers, traditional shoppers, and mixed shoppers.

$$BMI = \alpha + \beta_1 \text{ShopperGroup} + \varepsilon$$

Model 2 contains control variables basic control variables for age, sex, and education.

$$BMI = \alpha + \beta_1 ShopperGroup + \beta_2 AgeGroup + \beta_3 Male + \beta_4 Education + \varepsilon$$

Model 3 adds controls for household characteristics including number of household members, whether a child (18 years old or under) is present, car ownership, and number of full-time workers.

$$BMI = \alpha + \beta_1 ShopperGroup + \beta_2 AgeGroup + \beta_3 Male + \beta_4 Education + \beta_5 HHMem + \beta_6 child + \beta_7 car + \beta_8 FTworkers + \varepsilon$$

Lastly, **Model 4** replaces the household characteristics variables with health behavior variables.

$$BMI = \alpha + \beta_1 ShopperGroup + \beta_2 AgeGroup + \beta_3 Male + \beta_4 Education + \beta_5 HHMem + \beta_6 child + \beta_7 car + \beta_8 FTworkers + \beta_9 BFOutside + \beta_{10} DinnerOutside + \beta_{11} FastFood + \beta_{12} WestSnack + \beta_{13} SweetDrinks + \beta_{14} Alcohol + \beta_{15} Exercise60Min + \beta_{16} Sit8Hrs + \varepsilon$$

Table 5.11: Control Variables for OLS models (Shopper Group)

Control Variables			
Model 1	Model 2	Model 3	Model 4
None	Age group	Age group	Age group
	Male	Male	Male
	Education	Education	Education
		Number of household members	Number of household members
		A child in household	A child in household
		Own a car	Own a car
		Number of FT workers	Number of FT workers
			Days eat breakfast outside
			Days eat dinner outside
			Days eat Fast food
			Days eat western snacks

	Days drink sugary beverage
	Days drink alcohol
	Days exercise 60 min or more
	Days sit at least 8 hours

a.2) PBF and Shopping Destination

As with the previous regression, the control variables for all models remain the same. Only the dependent variables changes and the regressions take the following forms.

Model 1:

$$PBF = \alpha + \beta_1 \text{ShopperGroup} + \varepsilon$$

Model 2:

$$PBF = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \varepsilon$$

Model 3:

$$PBF = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \beta_5 \text{HHMem} + \beta_6 \text{child} + \beta_7 \text{car} + \beta_8 \text{FTworkers} + \varepsilon$$

Model 4:

$$PBF = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \beta_5 \text{HHMem} + \beta_6 \text{child} + \beta_7 \text{car} + \beta_8 \text{FTworkers} + \beta_9 \text{BFOutside} + \beta_{10} \text{DinnerOutside} + \beta_{11} \text{FastFood} + \beta_{12} \text{WestSnack} + \beta_{13} \text{SweetDrinks} + \beta_{14} \text{Alcohol} + \beta_{15} \text{Exercise60Min} + \beta_{16} \text{Sit8Hrs} + \varepsilon$$

a.3) WC and Shopping Destination

As with the previous regression, the control variables for all models remain the same. Only the dependent variables changes and the regressions take the following forms.

Model 1:

$$WC = \alpha + \beta_1 \text{ShopperGroup} + \varepsilon$$

Model 2:

$$WC = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \varepsilon$$

Model 3:

$$WC = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \beta_5 \text{HHMem} + \beta_6 \text{child} + \beta_7 \text{car} + \beta_8 \text{FTworkers} + \varepsilon$$

Model 4:

$$WC = \alpha + \beta_1 \text{ShopperGroup} + \beta_2 \text{AgeGroup} + \beta_3 \text{Male} + \beta_4 \text{Education} + \beta_5 \text{HHMem} + \beta_6 \text{child} + \beta_7 \text{car} + \beta_8 \text{FTworkers} + \beta_9 \text{BFOutside} + \beta_{10} \text{DinnerOutside} + \beta_{11} \text{FastFood} + \beta_{12} \text{WestSnack} + \beta_{13} \text{SweetDrinks} + \beta_{14} \text{Alcohol} + \beta_{15} \text{Exercise60Min} + \beta_{16} \text{Sit8Hrs} + \varepsilon$$

b.) Frequent Shoppers (Shopping Frequency)

b.1) BMI and Frequent Shoppers

Model 1 has only independent variables of interest, *FrequentSuperShopper*, *FrequentMarketShopper*, and *FrequentConvStrShopper*. Recall that frequent shoppers are those who shop at a particular store format 3 or more times a week.

$$BMI = \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr + \varepsilon$$

Model 2 contains control variables basic control variables for age, sex, and education.

$$BMI = \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr + \beta_4 AgeGroup + \beta_5 Male + \beta_6 Education + \varepsilon$$

Model 3 adds controls for household characteristics including number of household members, whether a child (18 years old or under) is present, car ownership, and number of full-time workers.

$$BMI = \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr + \beta_4 AgeGroup + \beta_5 Male + \beta_6 Education + \beta_7 HHMem + \beta_8 child + \beta_9 car + \beta_{10} FTworkers + \varepsilon$$

Lastly, **Model 4** replaces the household characteristics variables with health behavior variables.

$$BMI = \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr + \beta_4 AgeGroup + \beta_5 Male + \beta_6 Education + \beta_7 HHMem + \beta_8 child + \beta_9 car + \beta_{10} FTworkers + \beta_{11} BFOutside + \beta_{12} DinnerOutside + \beta_{13} FastFood + \beta_{14} WestSnack + \beta_{15} SweetDrinks + \beta_{16} Alcohol + \beta_{17} Exercise60Min + \beta_{18} Sit8Hrs + \varepsilon$$

Table 5.12: Control Variables for OLS models (Frequent Shopper)

Control Variables			
Model 1	Model 2	Model 3	Model 4
None	Age group	Age group	Age group
	Male	Male	Male
	Education	Education	Education
		Number of household members	Number of household members
		A child in household	A child in household

	Own a car	Own a car
	Number of FT workers	Number of FT workers
		Days eat breakfast outside
		Days eat dinner outside
		Days eat Fast food
		Days eat western snacks
		Days drink sugary beverage
		Days drink alcohol
		Days exercise 60 min or more
		Days sit at least 8 hours

b.2) PBF and Frequent Shoppers

As with the previous regression, the control variables for all models remain the same. Only the dependent variables changes and the regressions take the following forms.

Model 1:

$$PBF = \alpha + \beta_1 \text{FreqSuperShppr} + \beta_2 \text{FreqMktShppr} + \beta_3 \text{FreqConvStrShppr} + \varepsilon$$

Model 2:

$$PBF = \alpha + \beta_1 \text{FreqSuperShppr} + \beta_2 \text{FreqMktShppr} + \beta_3 \text{FreqConvStrShppr} + \beta_4 \text{AgeGroup} + \beta_5 \text{Male} + \beta_6 \text{Education} + \varepsilon$$

Model 3:

$$PBF = \alpha + \beta_1 \text{FreqSuperShppr} + \beta_2 \text{FreqMktShppr} + \beta_3 \text{FreqConvStrShppr} + \beta_4 \text{AgeGroup} + \beta_5 \text{Male} + \beta_6 \text{Education} + \beta_7 \text{HHMem} + \beta_8 \text{child} + \beta_9 \text{car} + \beta_{10} \text{FTworkers} + \varepsilon$$

Model 4:

$$\begin{aligned}
PBF = & \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr \\
& + \beta_4 AgeGroup + \beta_5 Male \\
& + \beta_6 Education + \beta_7 HHMem + \beta_8 child + \beta_9 car + \beta_{10} FTworkers \\
& + \beta_{11} BFOutside + \beta_{12} DinnerOutside + \beta_{13} FastFood + \beta_{14} WestSnack \\
& + \beta_{15} SweetDrinks + \beta_{16} Alcohol + \beta_{17} Exercise60Min + \beta_{18} Sit8Hrs \\
& + \varepsilon
\end{aligned}$$

b.3) WC and Frequent Shoppers

As with the previous regression, the control variables for all models remain the same. Only the dependent variables changes and the regressions take the following forms.

Model 1:

$$WC = \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr + \varepsilon$$

Model 2:

$$\begin{aligned}
WC = & \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr \\
& + \beta_4 AgeGroup + \beta_5 Male + \beta_6 Education + \varepsilon
\end{aligned}$$

Model 3:

$$\begin{aligned}
WC = & \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr \\
& + \beta_4 AgeGroup + \beta_5 Male + \beta_6 Education + \beta_7 HHMem \\
& + \beta_8 child + \beta_9 car + \beta_{10} FTworkers + \varepsilon
\end{aligned}$$

Model 4:

$$\begin{aligned}
WC = & \alpha + \beta_1 FreqSuperShppr + \beta_2 FreqMktShppr + \beta_3 FreqConvStrShppr \\
& + \beta_4 AgeGroup + \beta_5 Male \\
& + \beta_6 Education + \beta_7 HHMem + \beta_8 child + \beta_9 car + \beta_{10} FTworkers \\
& + \beta_{11} BFOutside + \beta_{12} DinnerOutside + \beta_{13} FastFood + \beta_{14} WestSnack \\
& + \beta_{15} SweetDrinks + \beta_{16} Alcohol + \beta_{17} Exercise60Min + \beta_{18} Sit8Hrs \\
& + \varepsilon
\end{aligned}$$

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CHAPTER SIX: STATISTICAL ANALYSIS RESULTS

This chapter presents the results of analysis models described in chapter five. All analyses were performed using Stata statistical analysis software, version 12/IC with the exception of food retail landscape analysis which used the ArcGIS software. In section one, descriptive statistics, the entire sample is included in the analysis. In subsequent sections, only surveys completed by household's primary shopper are analyzed. Where it makes sense, modern retailers are teased out to differentiate supermarkets from convenience stores.

I: Descriptive Statistics

The objective of this section is to provide an overview of the sample characteristics being presented in this study.

Results

Of the 510 usable questionnaires, 63.33% of respondents reported being the primary grocery shoppers for their household among whom approximately 75% are female. **Table 6.1** summarizes the breakdown of gender, age, and educational attainment between the two groups. Age is significant at the $p < 0.05$ level. Non-primary shoppers appear to be concentrated in the younger than 30 years old category whereas the highest

proportion of primary shoppers is between 30-44 years old. It is probable that younger participants are still living with their parents who do the grocery shopping or have a domestic helper who does the chore. Those in the 30-44 years old category may be young individuals who have left their parents and started their own family but cannot yet, or prefer not to, have a domestic helper. They are therefore responsible for their own grocery shopping trips. With the greater movement of labor, rising wage, and smaller urban residence, it has become increasingly difficult for young families to afford a domestic helper.

Educational attainment is significant at the $p < 0.01$ level for the primary school or less category and at the $p < 0.001$ level for master's degree or higher category. Substantially more primary shoppers appear to have completed primary school or less whereas significantly more non-primary shoppers hold a master's degree or higher. This is not surprising as more educated individuals are more likely to be able to afford a maid and utilize their time on work-related more so than on household-related matters. **Figure 6.1** shows a visual representation of the discrepancies in educational attainment among primary and non-primary shoppers. It is evident that respondents are overwhelmingly college graduates. The largest gaps are at the two extremities of primary education or less and master's degree or higher.

Table 6.1: Gender, Age, and Educational Attainment of Primary and Non-Primary Shoppers

Characteristics	Total N=510(%)	Primary Shopper N=323(%)	Non- primary Shoppers N=187(%)	P-value
Sample size		63.33	36.66	
Male, n(%)	130 (25.49)	78 (24.15)	52 (27.81)	0.361
Age, n(%)				
<30	186 (36.47)	104 (32.20)	82 (43.85)	0.008***
30-44	213 (41.76)	149 (46.13)	64 (34.22)	0.009***
45-59	99 (19.41)	64 (19.81)	35 (18.72)	0.763
60+	12 (2.35)	6 (1.86)	6 (3.21)	0.332
Educational attainment, n(%)				
Primary or less	20 (3.94)	18 (5.59)	2 (1.08)	0.012***
Junior HS	12 (2.36)	7 (2.17)	5 (2.69)	0.716
High School	64 (12.6)	45 (13.98)	19 (10.22)	0.215
Vocational	46 (9.06)	33 (10.25)	13 (6.99)	0.215
Bachelor's	299 (58.86)	187 (58.07)	112 (60.22)	0.659
Master's or higher	67 (13.19)	32 (9.94)	35 (18.82)	0.004***

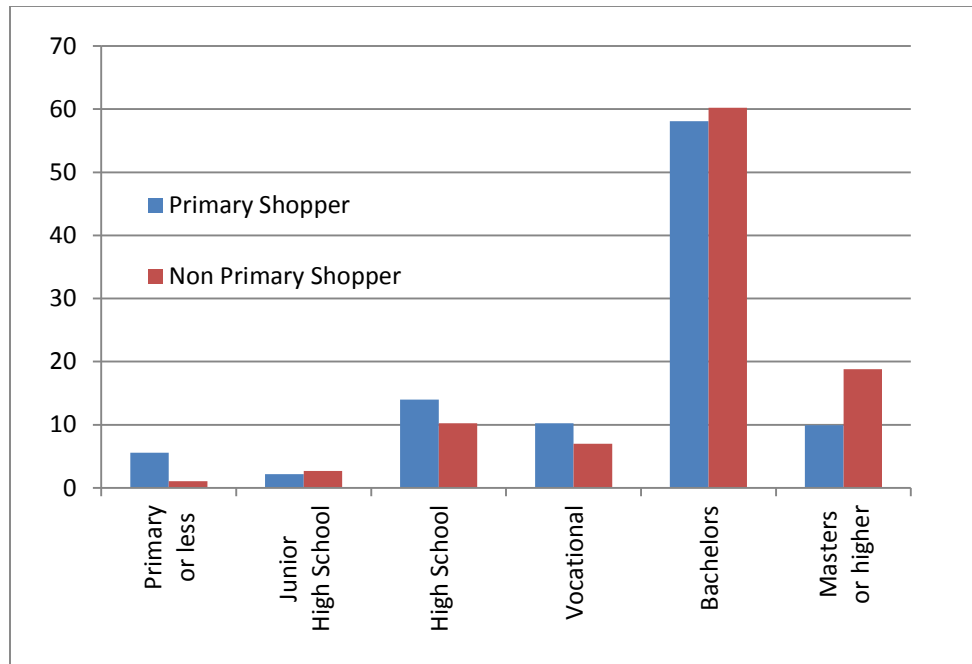


Figure 6.1: Educational Attainment of Primary and Non-Primary Shoppers

Table 6.2 shows monthly household income, residence type, marital status, family composition, and car ownership of primary and non-primary shoppers. As non-primary shoppers are significantly more educated than their primary shopper counterparts, they are also more likely to have higher monthly household income. This is significant at $p < 0.01$ level. While as high as 21% of non-primary shopper households earn more than 100,000 baht per month, only 10% of primary shopper households do.

Table 6.2: Household Income, Residence Type, Marital Status, Family Composition and Car Ownership of Primary and Non-Primary Shoppers

Characteristics	Total N=510	Primary Shopper N=323(%)	Non- primary Shoppers N=187(%)	P-value
Monthly HH income (%)				
<10,000	31 (6.29)	23 (7.37)	8 (4.42)	0.195
10,000-30,000	184 (37.32)	124 (39.74)	60 (33.15)	0.153
30,001-50,000	113 (22.92)	79 (25.32)	34 (18.78)	0.100
50,001-100,000	96 (19.47)	56 (17.95)	40 (22.10)	0.259
>100,000	68 (13.79)	30 (9.62)	38 (20.99)	0.000***
Residence type(%)				
House	247 (48.72)	124 (38.63)	123 (66.13)	0.000***
Condo	74 (14.60)	60 (18.69)	14 (7.53)	0.001***
Dorm/apt	184 (36.29)	136 (42.37)	48 (25.81)	0.000***
Marital Status				
Married	170 (33.40)	103 (31.99)	67 (35.83)	0.363
Single	327 (64.24)	209 (64.91)	118 (63.10)	0.716
Divorced	12 (2.36)	10 (3.11)	2 (1.07)	0.146
Household size(%)				
Live alone	115 (22.55)	94 (29.1)	21 (11.23)	0.000***
2 members	107 (20.98)	79 (24.46)	28 (14.97)	0.011***
3 members	82 (16.08)	52 (16.10)	30 (16.04)	0.987
4 members	93 (18.24)	49 (15.17)	44 (23.53)	0.018**
5 members or more	113 (22.16)	49 (15.17)	64 (33.22)	0.000***
Car Ownership	347 (68.85)	212 (66.67)	135 (72.58)	0.167

Figure 6.2 below shows the discrepancies in monthly salary between primary and non-primary shoppers. These numbers, of course, do not take into account the fact that non-primary shoppers are more likely to live with multiple family members. As such, their combined income is higher and each member is less likely to be the primary shopper. Conversely, single person households have, by default, one income earner and that person is also by default the primary grocery shopper. This is also reflected in the significant difference in the residence type and household size whereby primary shoppers are proportionately skewed to living in an apartment or a condominium with fewer family members (29.1% live alone) and non-primary members tend to live in larger households (33.22% live with 5 or more family members) in a house setting (66.13%) (**Table 6.2**).

Marital status does not differ between primary and non-primary shoppers, with the majority of both groups being single. Divorcees only make up a small percentage, 3% or less, of the groups. This is attributable to the sample being fairly young and highly educated. Car ownership also does not significantly differ between primary and non-primary shoppers. While having a car may increase access to a greater number grocery outlets, those who own a car are also likely to be of higher income and have someone else who does the chore for them.

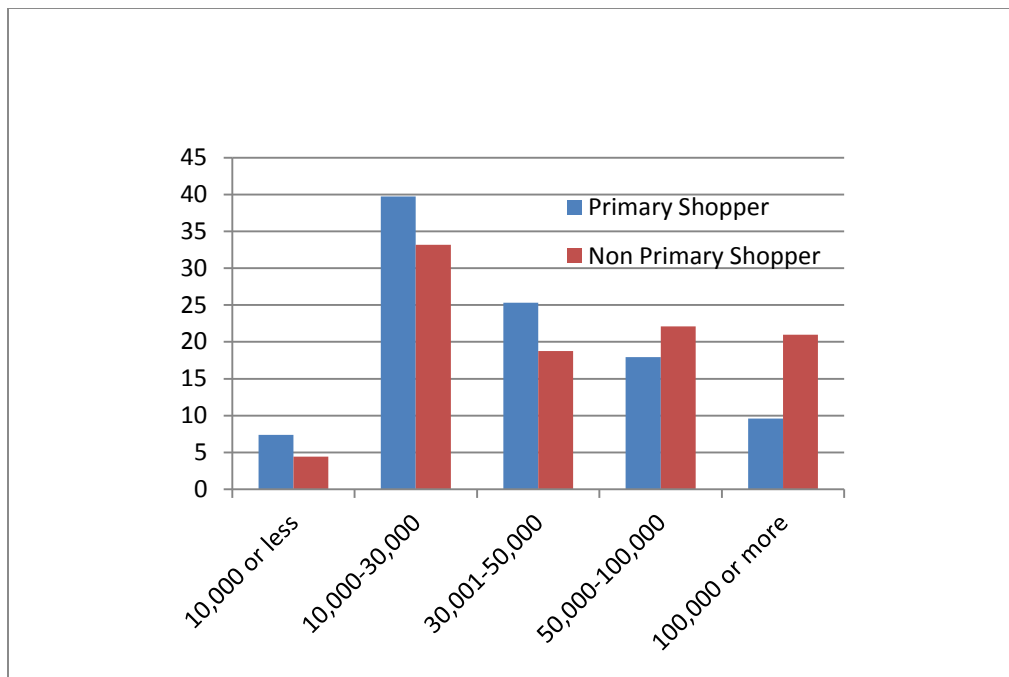


Figure 6.2: Monthly Household Income of Primary and Non-Primary Shoppers

II: Research Question I

The objective of this section is to conduct an exploratory analysis using ArcGIS software that gives an overview of the food retail landscape in Bangkok.

Results

This initial step of the analysis looks at the potential spatial clustering of grocery outlets using the Average Nearest Neighbor Distance (NND) approach. The locations of traditional markets in Bangkok are shown in **Figure 6.3**. Traditional markets are either publicly or privately owned and vary widely in size, prices, and selections of products. Stalls are typically individually owned and operated by the owners themselves. A visual scan shows that there appears to be some clustering in the smaller districts in the heart of Bangkok. The results of the NND pattern analysis confirms that the markets are significantly more clustered than random with a z-score of -7.209 and a p-value of 0.000.

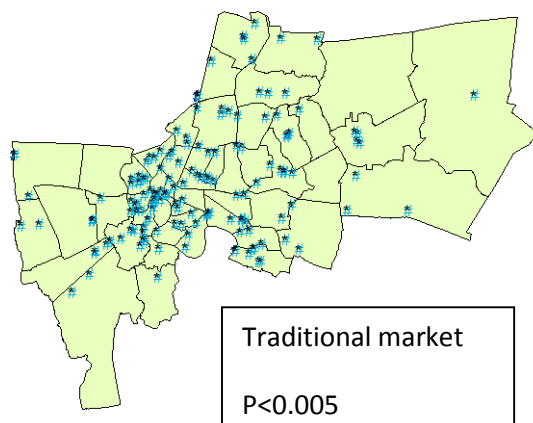


Figure 6.3: Average Nearest Neighbor Distance Analysis of Traditional Markets

Modern grocery retailers operate differently than traditional markets as they are chain stores as opposed to independent individual traditional markets. The placement of their stores is centrally and strategically planned. They also engage in territorial and product competition with other chains (Matsa 2011). To observe the pattern for each chain, the NND analysis for modern grocery outlets was first carried out separately for BigC, Tesco Lotus, and Tops. The resulting p-values for these chains were 0.88, 0.06, and 0.81, respectively. Because none of these chains achieved statistically significant p-value (0.05 or lower), the analysis indicates that the distributions of modern grocery retailers are not different from random when looked at separately. When I merged the three layers of modern retailers together and repeat the NND analysis for all the stores together, however, the p-value was 0.000. This suggests that the clustering of modern grocery retailers is not of the same chain but across chains from competition. Such competition is said to be intra-competition among different modern store chains, as opposed to the more widely discussed inter-competition between big-box retailers and traditional outlets. As development reaches parts of Bangkok, grocery chains are eager to make their presence in the area. Urban Thai consumers have been enthusiastic adopters of novel western products. They also display no preference for a particular hypermarket chain for the most part as they all offer similar products and similar prices (Watchravesring et al. 2011). Thus, success of a food chain in a particular location often attracts competition for market share. **Figure 6.4** shows the locations of hypermarket and supermarkets in Bangkok. Due to the nature of grocery store data being point data and population data being aerial data, the analysis does not take into account population

density where the grocery outlets are located. The districts where the outlets are more concentrated are also generally more densely populated. This is, therefore, an extremely preliminary analysis.

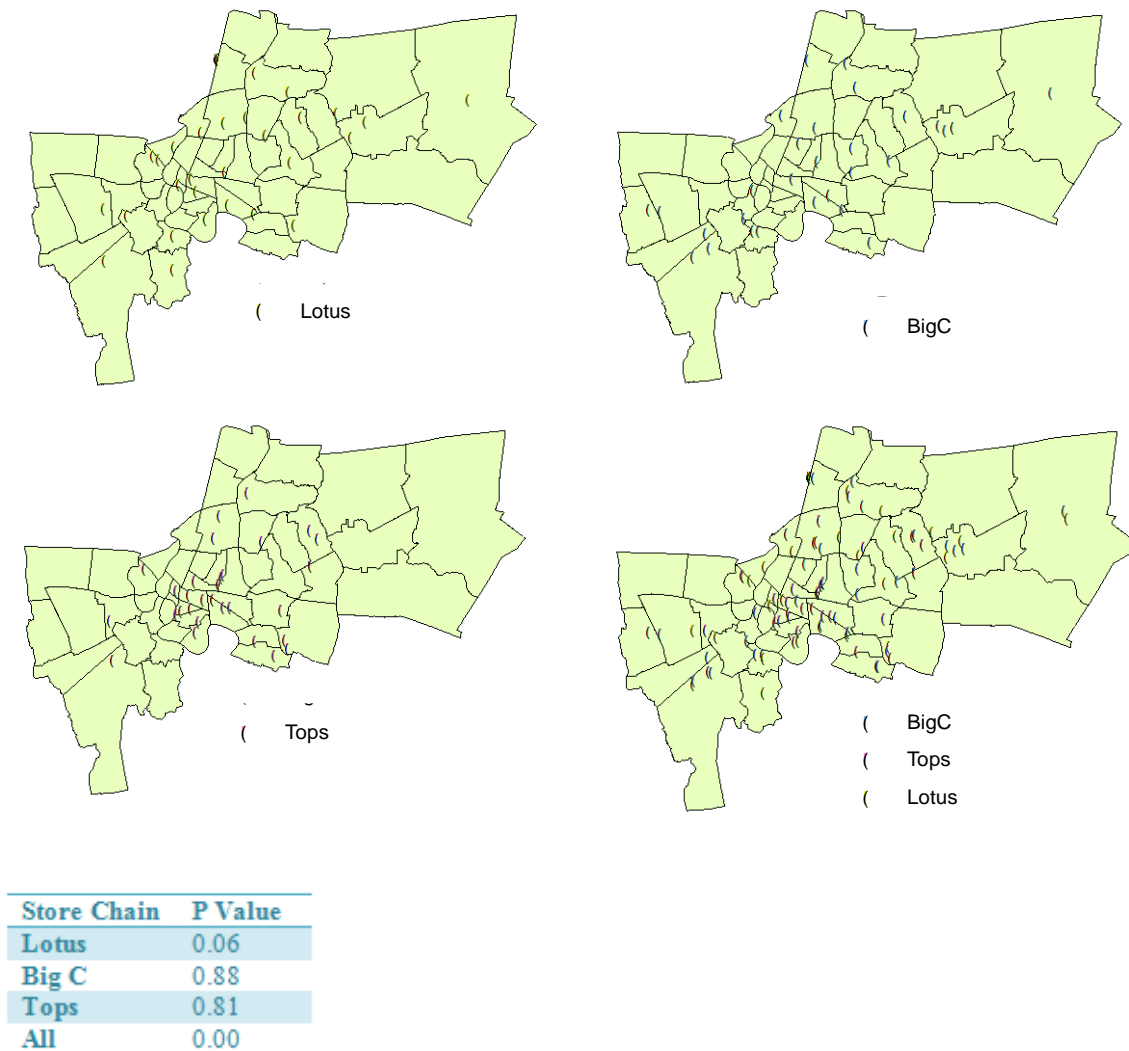


Figure 6.4: Average Nearest Neighbor Analysis of Modern Retailers

Convenience stores are common at almost every corner of the streets in Bangkok and that is reflected in the random spatial pattern, indicated by insignificant Moran's I test in **Figure 6.5**. The analysis is adjusted for the total population in each district.

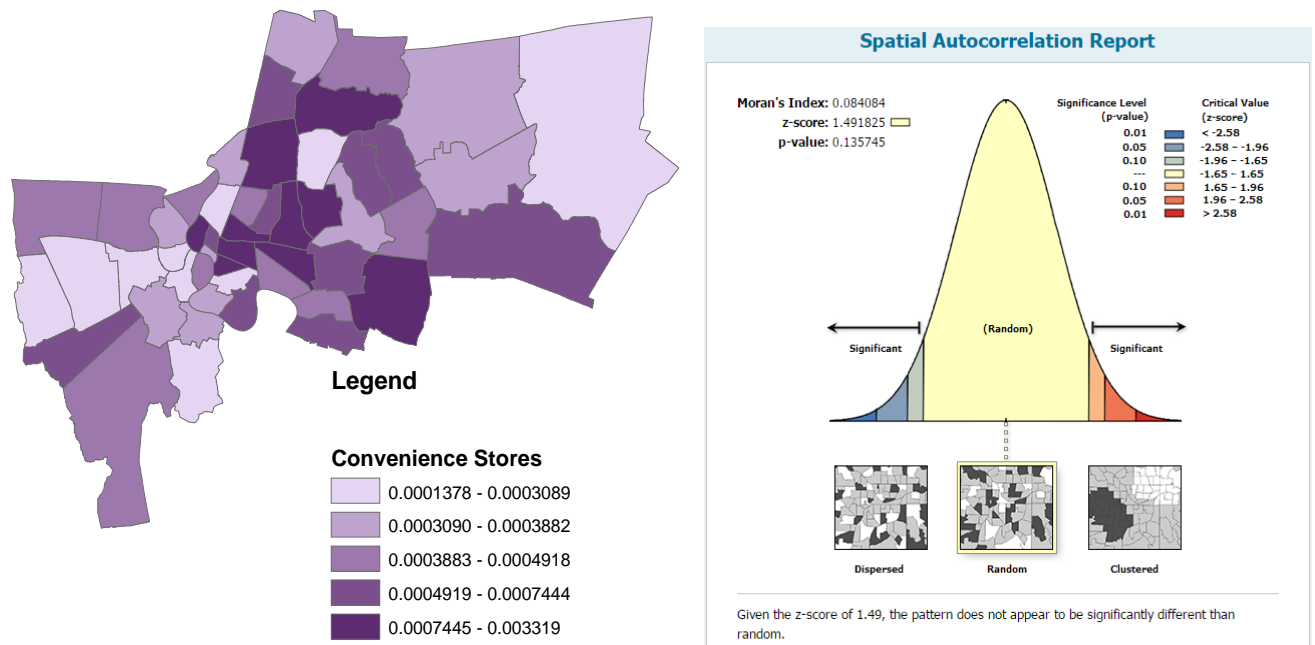


Figure 6.5: Choropleth Map of District-Level Convenience Stores adjusted for the Number of Total Population in the District.

My hypothesis, **H₁**, stating that *food retail outlets in Bangkok is not evenly distributed* is partially supported. Traditional markets, the distribution is significantly more clustered than random using the NND approach. Supermarkets are not significantly clustered at $p < 0.05$ level when examined each chain separately, but are highly clustered at $p < 0.001$ when all three large chains were combined. These analyses did not take into account the population density in each district. Convenience store findings did not support the hypothesis. The distribution appeared to be random. This is presumed to be the result of the rapid expansion of the store format in the last decade. Seven-Eleven, the largest convenience store chain, alone has over 3,000 outlets in Bangkok.

III: Research Question II

The objective of this section is to explore any existing socio-economic differences between urban populations who shop at different store formats. Shopping frequencies at various store formats are used to differentiate the sample into modern, traditional, and mixed shoppers.

Definition

Recall that the median grocery shopping frequency of the sample is 1-2 times a week.

The following definitions were used in the analysis

Modern Grocery Store Shoppers are defined as those who visit hyper/supermarkets at least once a week and visit traditional markets less than once a week on average.

Traditional Market Grocery Shoppers are defined as those who visit traditional open-air markets at least once a week and visit hyper/supermarkets less than once a week on average.

Mixed Shoppers are defined as those who visit both hyper/supermarkets and traditional open-air markets at least once a week on average.

Results

Sex, Age, Educational Attainment, Monthly Household Income, Residence Type, Household Size, and Car Ownership among Shopper Groups

There are 71 (27%) modern grocery shoppers, 85 (32%) traditional market shoppers, and 106 (40%) mixed shoppers. Using ANOVA and chi-squares tests, significant differences were found between the three shopper groups for educational attainment, monthly household income, residence type, household size, and whether there is a child (under 18 years old) in the family. No differences were found for age group, sex, and car ownership.

Table 6.3 shows the breakdown of sex, age, and education for the three shopper groups. Modern grocery store shoppers are significantly ($p < 0.001$) more likely to hold a master's degree or higher. While 16% of shoppers in this group have a graduate degree, only 5% and 4% of traditional and mixed shoppers do, respectively. Those who attained junior high school education or less also appear to be more inclined to be mixed shoppers with weaker statistical significance of $p < 0.1$. This finding indicates that more highly educated individuals are more receptive to western style grocery shopping. This may be

due to several factors such as wider array of products (both grocery and non-grocery items), convenience such as parking, availability of rest rooms, air conditioning, and restaurants, and perhaps concerns for food safety.

Contrary to the differences between primary and non-primary shoppers in the previous section, the higher likelihood of having attained higher education is not accompanied by higher household income (**Table 6.4**). This may be attributable to the sample being young populations who are in their early stages of career. Residence type, household size and whether or not there is a child (18 years and under) in the family, however, are significant at the $p<0.1$, $p<0.05$ and $p<0.01$ levels respectively (**Table 6.5**). It appears that those who live in a condominium and those who live by themselves are more likely to be modern shoppers. They may find that western-format grocery stores carry more options for ready-to-eat meals or those that require minimal preparation time. Those who live in larger household may shop at traditional markets for fresh foods because of lower prices but also visit modern stores for other items such as dairy and bakery products. About 40% of modern shoppers live alone, compared with 28% and 16% in the traditional and mixed shopper categories, respectively. On the other hand, those living in larger households are more likely to be mixed shoppers. About 22% of mixed shoppers live with 5 family members or more, compared with 11% for both modern and traditional shopper categories. Presence of children in the household has a significant influence on where one shops, with greater proportion of those with at least one child choosing to shop at both store formats regularly (mixed shoppers). Car

ownership did not achieve significance in neither among primary vs non-primary shoppers nor among shopper groups.

Table 6.3: Sex, Age, and Educational Attainment of Modern, Traditional, and Mixed Shoppers (Chi-squares test)

Characteristics	Total	Modern Grocery Store Shoppers N=71 (%)	Traditional Market Shoppers N=85 (%)	Mixed Shoppers N=106 (%)	P-value
Male, n (%)	64 (24.52)	16 (22.54)	20 (25.53)	28 (26.67)	0.795
Age, n (%)					
<30	82 (31.30)	26 (36.62)	26 (30.59)	30 (28.30)	0.497
30-44	129 (49.24)	33 (46.48)	42 (49.41)	54 (50.94)	0.843
45-60	45 (17.18)	11 (15.49)	14 (16.47)	20 (18.87)	0.825
60+	6 (2.29)	1 (1.41)	3 (3.53)	2 (1.89)	0.635
Education, n (%)					
Primary or less	15 (5.75)	3 (4.23)	6 (7.06)	6 (5.71)	0.749
Junior HS*	6 (2.30)	1 (1.41)	0 (0.00)	5 (4.76)	0.081
HS	31 (11.88)	4 (5.63)	13 (15.29)	14 (13.33)	0.151
Vocational	30 (11.49)	9 (12.68)	8 (9.41)	13 (12.38)	0.770
Bachelors	154 (59.00)	38 (53.52)	53 (62.35)	63 (60.00)	0.528
Masters or higher***	25 (9.58)	16 (22.54)	5 (5.88)	4 (3.81)	0.000

Table 6.4: Monthly Household Income and Residence Type of Modern, Traditional, and Mixed Shoppers (Chi-squares test)

Monthly HH Income (baht)	Total	Modern Grocery Store Shoppers n=67 (%)	Traditional Market Shoppers N=82 (%)	Mixed Shoppers N=101 (%)	P-value
Monthly HH Income (baht), n (%)					
< 10,000*	16 (6.40)	2 (2.99)	9 (10.98)	5 (4.95)	0.097
10,000 - 30,000	98 (39.20)	25 (37.31)	33 (40.24)	40 (39.60)	0.894
30,001 – 50,000	62 (24.80)	19 (28.36)	18 (21.95)	25 (24.75)	0.716
50,001 – 100,000	48 (19.20)	12 (17.91)	15 (18.29)	21 (20.79)	0.870
> 100,000	26 (10.40)	9 (13.43)	7 (8.54)	10 (9.90)	0.637
Residence Type, n (%)					
House	113 (43.97)	25 (35.71)	37 (45.53)	51 (50)	0.235
Condo*	43 (16.73)	18 (25.71)	11 (12.94)	14 (13.73)	0.059
Dorm/apt	101 (39.30)	27 (38.57)	37 (43.53)	37 (36.27)	0.474

Table 6.5: Household Size and Car Ownership of Modern, Traditional, and Mixed Shoppers (Chi-squares test)

Characteristics	Total	Modern Grocery Store Shoppers n=71 (%)	Traditional Market Shoppers N=85 (%)	Mixed Shoppers N=106 (%)	P-value
Household Size, n (%)					
Live alone***	69 (26.34)	28 (39.44)	24 (28.24)	17 (16.04)	0.002
2 family members	67 (25.57)	13 (18.31)	25 (29.41)	29 (27.36)	0.246
3 family members	41 (15.65)	11 (15.49)	14 (16.47)	16 (15.09)	0.966
4 family members	45 (17.18)	11 (15.49)	13 (15.29)	21 (19.81)	0.647
5 or more family members*	40 (15.27)	8 (11.27)	9 (10.59)	23 (21.70)	0.058
Child in Family, n (%)					
Yes***	70 (27.34)	14 (19.72)	16 (19.75)	40 (38.46)	0.004
Car Ownership, n (%)					
Yes	172 (66.93)	43 (62.32)	52 (62.65)	77 (73.33)	0.193

Spending per Trip, Shopping Time, and Travel Time among Shopper Groups

Table 6.6 shows results from analysis of variance (ANOVA) to look at the possible differences in spending, shopping, and traveling time. Sidak Bonferroni, and Scheffe post-hoc tests were conducted to examine pairwise comparison.

While most factors do not differ significantly between shopper groups, post-hoc pairwise tests indicate that mixed shoppers appear to spend significantly more money per trip to a traditional market. I previously found that shoppers in larger households are more likely to be mixed shoppers and because ANOVA does not control for this fact, it is probably that mixed shoppers spend more at markets than other shopper groups simply because they are buying for more people. Markets are generally cheaper than western stores and that could be why they choose to purchase more at markets.

Table 6.6: Spending, Shopping, and Traveling Time per Trip (ANOVA)

Characteristics	Modern Grocery Store Shoppers N=69 (SD)	Traditional Market Shoppers N=73 (SD)	Mixed Shoppers N=98 (SD)	P- value
SpendSuper	884.78 (551.822)	1037.64 (785.703)	1039.54 (656.607)	0.277
SpendMkt***	281.7 (222.213)	283.44 (193.013)	415.73 (359.519)	0.002
SpendConvStr	178.01 (155.491)	216.03 (467.07)	208.61 (244.50)	0.414
MinShop	107.06 (72.760)	83.11 (72.584)	101.71 (111.353)	0.240
MinTravel	17.74 (13.911)	19.61 (23.149)	17.92 (15.800)	0.624

Shopping Frequency and Spending per Trip among Car Owners and Non-Car Owners

Independent t-tests were conducted to detect the differences in grocery shopping behavior among car owners and non-car owners. Results are displayed in **Table 6.7**.

Even though shopping frequency to all grocery store formats, supermarket, traditional market, and convenience store, were similar for both groups, car owners spend significantly more per shopping trip. Car owners spend about 174 baht more than non-car owners at supermarkets ($p < 0.05$) about 86 baht more per trip to a traditional market ($p < 0.01$) and about 62 baht more per trip to a convenience store ($p < 0.1$). This is presumably because it is easier to transport more groceries in private vehicles and because car owners generally earn higher income.

Table 6.7: Shopping Frequency and Spending per Trip among Car Owners and Non-Car Owners (ttest)

	Car Owner N=210 (SD)	Non Car Owner N=105 (SD)	P-value
Supermarket Shopping Frequency	2.685 (0.906)	2.673 (1.065)	0.914
Traditional Market Shopping Frequency	2.73 (1.239)	2.63 (1.440)	0.538
Convenience Store Shopping Frequency	3.90 (1.083)	3.93 (1.152)	0.227
Spend at Supermarket**	1040.58	866.65	0.023
Spend at traditional market***	346.14	259.91	0.010

Spend at Convenience Store*	215.64	153.65	0.070
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Importance of Store Attributes among Shopper Groups

Table 6.8 shows results from chi-square tests to examine the importance of store attributes among shopper groups.

Most shoppers reported giving great importance to most store attributes including *price, location, amenities, cleanliness and organization, product quality, product variety, and service*. Factors that seem less important to shoppers were *promotion, availability of family size packages, and opportunity to build a community relationship*. The three that showed statistical significance in chi-square tests were *amenities, service and opportunity to build a community relationship*. The results are not surprising as modern grocery shoppers are more concerned about amenities such as parking, air conditioning, and bathrooms which are lacking at most traditional markets. Meanwhile, traditional markets are known for being a place for community building and personalized service, characteristics that are not present at modern grocery retailers.

Table 6.8: Importance of Store Attributes by Shopper Groups (Pearson Chi2)

Attributes	N	Mean	Mode	SD	P-Value
Price	320	3.95	4	0.82	0.709
Location	323	4.42	5	0.66	0.468
Amenities*	318	3.65	4	1.02	0.086
Promotion	320	3.73	3	0.95	0.257
Cleanliness and Organization	321	4.32	5	0.72	0.672
Product Quality	323	4.48	5	0.68	0.672
Product Variety	321	4.01	4	0.80	0.437
Service**	320	3.66	4	1.06	0.028
Family Size Packages	322	2.84	3	1.05	0.466
Community Relationship***	322	2.64	3	1.06	0.006

My hypothesis, **H₂**, that socio-demographic profile of consumers significantly influences their choice of grocery destination, is partially supported. Those with master's degree or higher, those who live in a condominium, and those who live alone prefer to shop exclusively at modern grocery retailers. Participants in the lowest income category, less than 10,000 baht/month, are significantly more likely to shop primarily at traditional markets. Finally, those with junior high school education, those who live with 5 or more household members, and those who live with at least one child ages 18 or younger are significantly more likely to be mixed shoppers.

IV: Research Question III

The objective of this section is to observe the relationship between the number of days a subject engages in certain health behavior and their shopping behavior.

Results

Table 6.9 shows results from negative binomial regressions to examine the relationship between health behaviors and shopping destination and the shopping frequency, controlling for age, gender, and educational attainment. Two sets of regressions were performed using the same dependent variables.

Table 6.9: Negative Binomial Regression controlling for Age, Sex, and Education

Health Behavior (number of days)	Modern Grocery Store Shoppers	Mixed Shoppers	Frequent Traditional Market Shoppers	Frequent Supermarket Shopper	Frequent Convenience Store Shopper
Eat breakfast outside	0.088 (0.352)	0.069 (0.431)	-0.040 (0.574)	0.041 (0.615)	0.001 (0.986)
Eat dinner outside	0.127 (0.449)	0.117 (0.461)	-0.089 (0.504)	-0.136 (0.377)	0.195 (0.127)
Eat fast food***	0.222 (0.363)	0.385 (0.088)*	0.112 (0.527)	0.179 (0.368)	0.560 (0.002)***
Consume Western snacks	0.174 (0.278)	0.135 (0.365)	-0.050 (0.694)	0.223 (0.115)	0.158 (0.200)
Consume sweet drinks***	0.030 (0.803)	-0.057 (0.609)	-0.025 (0.785)	0.017 (0.878)	0.266 (0.003)***
Drink Alcohol***	-0.271 (0.526)	0.136 (0.722)	-0.028 (0.930)	-1.520 (0.003)***	0.651 (0.039)**
Exercise 60 min	0.079 (0.680)	0.030 (0.861)	0.091 (0.531)	0.098 (0.559)	-0.110 (0.427)
Sit at least 8 hours/day***	-0.108 (0.239)	-0.065 (0.443)	-0.014 (0.843)	-0.051 (0.532)	0.172 (0.012)***

Note: traditional market shoppers is a reference group and always takes the value of 1

Results from negative binomial regressions suggest that shopping frequency matters more than shopping destination. The only variable that achieved statistical significance in the first set of regressions was *Fastfood* (the number of days the subject consumed fast food in the past 7 days) at $p < 0.1$ level for mixed shoppers. From this, one can say that those who shop regularly at both modern and traditional grocery stores are

more likely to consume fast food more often although there is still 10% chance that this is a pattern but a random chance.

The second set of negative binomial regressions show much stronger results. Recall that frequent shoppers are defined as “someone who shops at a particular store format at least three times a week.” Results in **Table 6.9** suggest that those who shop at convenience stores at least three times a week are significantly more likely to engage in undesirable health behaviors including consuming fast food ($p < 0.01$), sweet drinks ($p < 0.01$), alcohol ($p < 0.05$), and sitting at least 8 hours a day ($p < 0.01$). An unexpected result is present for frequent supermarket shoppers as they appear to be significantly less likely to consume alcohol than their non-frequent supermarket shopper counterparts. Without additional information, it is unclear why this is the case.

Interestingly, those who shop at traditional markets three or more times a week are not more likely to engage in undesirable health behaviors than their non-frequent traditional market shopper counterparts.

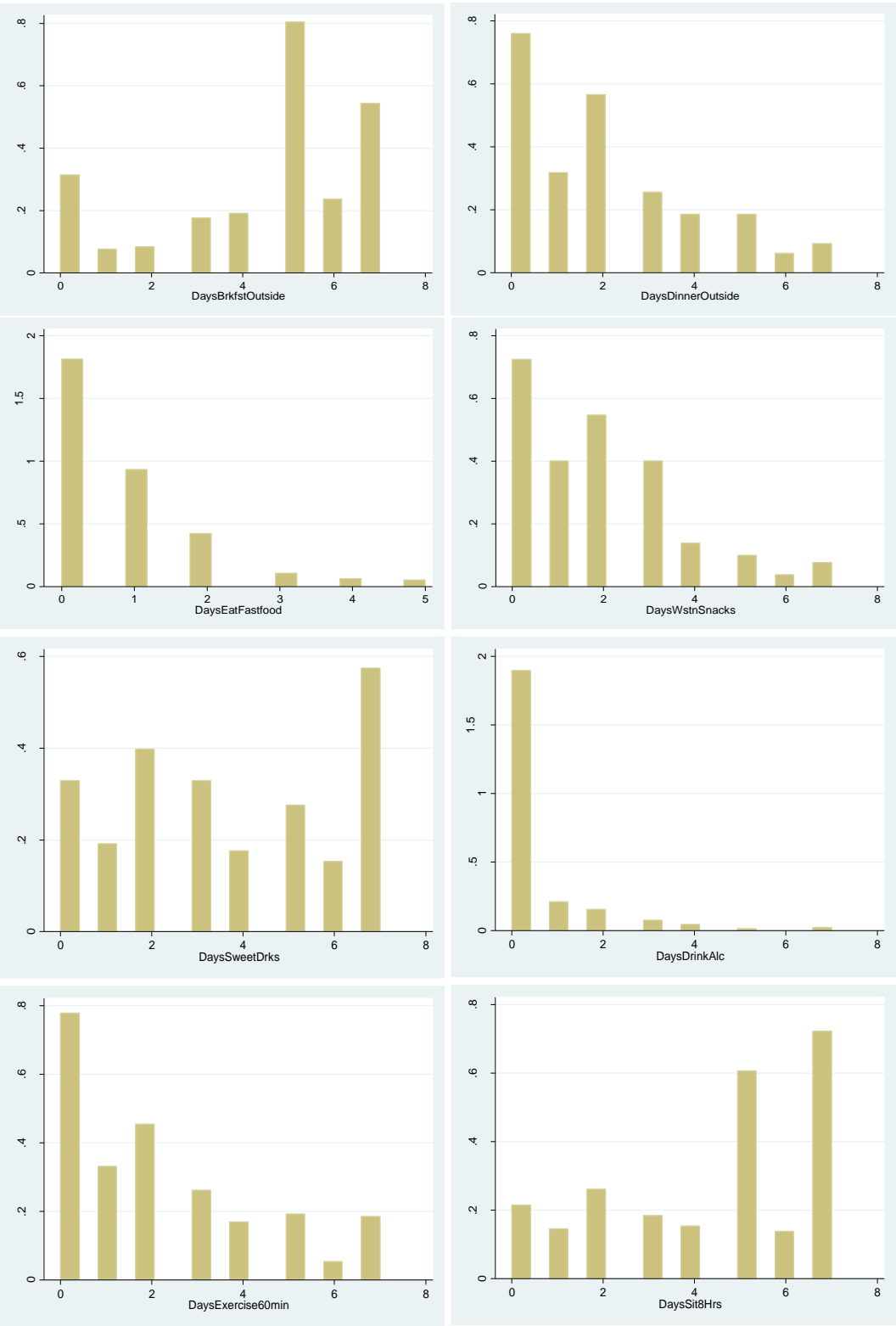
Negative Binomial Regression Analysis

The model was selected based on the nature of the dependent variable being count data and pre-hoc and post-hoc goodness-of-fit tests. The histograms, the mean-equal-variance test, goodness-of-fit test and the likelihood ratio test of alpha all indicate that the negative binomial, which is less restrictive allowing variance to be greater than the mean, is a better fit.

Test 1: Histograms

Histograms of the dependent variables show that none of the variables is normally distributed, thus OLS is not an appropriate model (**Table 6.10**). Most variables are skewed to the right with high number of zero values. Poisson and negative binomial regressions are typically used to analyze such data.

Table 6.10: Histograms of Health Behavior Variables (Dependent Variables)



Test 2: mean equal variance

While both Poisson and Negative Binomial regression models are typically used to analyze count data, the Poisson is more restrictive in a sense that it assumes the variable mean to equal its variance while Negative Binomial relaxes such assumption. The results are displayed in **Table 11**.

Table 6.11: Mean and Variance of Dependent Variables are not Equal

variable	Mean	Variance
Breakfast outside	4.445	5.121
Dinner outside	2.026	3.865
Eat fastfood	0.776	1.168
Western snacks	1.863	3.163
Sweet drinks	3.707	6.100
Drink alcohol	0.489	1.341
Exercise 60 min or more	2.178	4.764
Sit 8 hours or more	4.430	5.452

As indicated in **Table 6.11**, the mean and variance of all dependent variables are not the same. The variance is substantially and consistently larger, a sign of over-dispersion. This test suggests that Poisson is not an appropriate model.

Test 3: Poisson Goodness of Fit (GOF) test

A goodness-of-fit test can be conducted as a post Poisson regression analysis. **Table 6.12** details the results from the regressions on my eight dependent variables.

Table 6.12: Pearson's Chi-Squares Statistics and their Significance

Dependent Variable	Pearson's Chi-Square	P-value
Breakfast outside	363.846	0.022
Dinner outside	573.580	0.000
Eat fastfood	460.477	0.000
Western snacks	509.676	0.000
Sweet drinks	514.073	0.000
Drink alcohol	739.204	0.000
Exercise 60 min or more	681.217	0.000
Sit 8 hours or more	380.634	0.004

The Poisson GOF test results are another indicator that the survey data do not fit Poisson model very well.

Test 4: The Likelihood Ratio Test of Alpha

The likelihood ratio test of alpha is a test of over-dispersion parameter alpha. When there is no over-dispersion in the data, the negative binomial distribution is the same as a Poisson distribution ($H_0: \alpha=0$).

Table 6.13: Results from the Likelihood Ratio Test of Alpha

Dependent Variable	Pearson's Chi-Square	P-value
Breakfast outside	5.88	0.008
Dinner outside	42.70	0.000
Eat fastfood	18.15	0.000
Western snacks	28.01	0.000
Sweet drinks	42.43	0.000
Drink alcohol	63.70	0.000
Exercise 60 min or more	109.58	0.000
Sit 8 hours or more	5.23	0.011

The p-value for all dependent variables is significant suggesting that the null hypothesis of no over-dispersion is rejected. This reinforces the conclusion that the Poisson distribution is too restrictive and that the Negative Binomial is a more appropriate model.

Hypothesis **H₃** stating that modern grocery shoppers will demonstrate a greater level of undesirable health behaviors than traditional market shoppers and mixed shoppers is not supported by this section's findings. Where one shops does not appear to be related to one's health behavior. Conversely, mixed shoppers are found to be more likely to consume fast foods than their modern and traditional shopper counterparts. The association is moderately significant at $p < 0.1$ level. Recall that mixed shoppers tend to live in large households, and larger households are more likely to have children who often are attracted to fast foods. This may prompt shoppers in this group to be more likely to dine out with family members.

Hypothesis **H₄** stating that those who frequent modern grocery retailers will demonstrate greater level of undesirable health behaviors than those who do not frequent

modern grocery retailers is partially supported. Certain undesirable health behaviors were found to be significantly associated with the frequency at which one shops at a particular grocery store format. The strongest results were found among frequent convenience store shoppers. Those who visit convenience store at least three times a week were more likely to consume fast food, sweet drinks, alcohol, and to sit for at least 8 hours a day. An unexpected finding was that frequent supermarket shoppers were significantly less likely to consume alcohol than those who visit supermarkets less than 3 times a week. Thailand has law where alcohol beverages could be sold only between 11 am – 2 pm and 5 pm – midnight. Large grocery stores strictly follow this law whereas smaller ones are more flexible. As such, drinkers may choose to go to smaller food outlets for their alcohol purchases.

From these findings, a shopping destination does not appear to have a significant association with one's tendency to engage in undesirable health behaviors. However, the frequency at which one visits a certain type of store outlet does. In this case, frequent convenience store shoppers are more likely to have taken up a number of undesirable health habits.

V: Research Question IV

Results

Subsection 5.1: Shopper Groups

Tables 6.14 to 6.16 show results from Ordinary Least Squares regressions to examine the relationship between obesity measures (BMI, percent body fat, and waist circumference) and primary shopping destination (modern, traditional, or mixed). Each set of regressions contain four models using the same dependent variable with varying control variables.

a.) BMI and Shopping Destination

The first set of regression explores the association between BMI and shopping destination.

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*).

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

Mixed shoppers are significantly more likely to have higher BMI than those who shop primarily at only one type of store format (traditional or modern) at $p < 0.05$ level, controlling for age and sex (model 1 and model 2). *Ceteris paribus*, mixed shoppers are

predicted to have 1.5 points higher BMI than non-mixed shoppers. After adding controls for household characteristics, however, the significance diminishes in model 3. Age and sex are consistently significant in all models. Not surprisingly, increasing age is associated with increasing BMI. Contrary to finding in other studies, being male is associated with having higher BMI (Aekplakorn et al. 2014, Jitnarin et al. 2010, Pongchaiyakul et al. 2006).

This is perhaps due to the sample being younger than Thailand average population and being urban dwellers. Young Asian women have been reported to develop greater body dissatisfaction than all other cultural groups (Soh et al. 2008). Similarly, young women in Bangkok are conscious about their image and strive to stay skinny whereas men do not have the same level of societal pressure from the media. Unlike in the West where discussions of body positivity are becoming the norm and people have learned to embrace different body types, that trend has not reached Southeast Asia. Though slowly changing, the prevailing beauty standards in Thailand are still skinny and fair-skinned as portrayed through the media and represented by TV stars. There is an enormous pressure to conform. It is challenging to find clothes larger than a size 4. Most local fashion stores carry only one size clothing and that one size is equivalent to a small or even an extra small in US sizing. Larger women either give up fashion by wearing men's clothes or spend significantly more by shopping in department stores.

Other factors that appeared to be significant determinant of BMI in the sample were the number of household members ($p < 0.05$) and the frequency of fast food

consumption ($p < 0.05$). Living in a large household is associated with higher BMI. As eating is a social activity, it is possible that people eat more often and in greater quantity when there are many people to share food with. The only health behavior that has a significant impact on BMI is the number of days the subject ate fast food in the last 7 days. A one day increase in the number of days one consumes fast food is associated with a 0.599 points increase in BMI. This is consistent with findings from previous studies on fast food consumption and obesity (Pereira et al. 2005; Dhingra et al. 2007; Niemeier et al. 2006).

Table 6.14: OLS Results of BMI and Shopper Groups

	Model 1	Model 2	Model 3	Model 4
N	242	242	227	212
Traditional shoppers	1	1	1	1
Modern shoppers	-0.071 (0.925)	0.131 (0.860)	0.278 (0.721)	-0.158 (0.851)
Mixed Shoppers	1.524 (0.029)**	1.509 (0.027)**	0.866 (0.229)	0.458 (0.555)
Age group		1.266 (0.001)***	0.803 (0.058)*	0.990 (0.033)**
Male		1.527 (0.022)**	1.478 (0.031)**	1.790 (0.018)**
Education		-0.019 (0.936)	-0.276 (0.326)	-0.410 (0.209)
Number of household members			0.657 (0.034)**	0.753 (0.021)**
A child in household			-0.712 (0.374)	-0.592 (0.482)
Own a car			1.115 (0.109)	0.976 (0.192)
Number of FT workers			-0.217 (0.618)	-0.377 (0.421)
Days eat breakfast outside				0.047 (0.738)
Days eat dinner outside				0.105 (0.574)
Days eat Fast food				0.553 (0.073)*
Days eat western snacks				0.160 (0.409)
Days drink sugary beverage				0.102 (0.440)
Days drink alcohol				-0.336 (0.300)
Days exercise 60 min or more				-0.157 (0.273)
Days sit at least 8 hours				0.092 (0.518)

b.) Percent Body Fat (PBF) and Shopping Destination

The second set of regression explores the association between PBF and shopping destination.

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*)

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

In the second set of regressions with PBF as the dependent variable, none of the shopper groups achieved significance in any of the models. Shopping destination does not appear to play an important role in one's PBF. As with BMI, age and sex are consistently significant in all 3 models that they are included.

In terms of household characteristics, the number of household members one lives with is not significant. Instead, people who own cars are significantly more likely to have higher PBF than those who do not own cars.

Table 6.15: OLS Results of PBF and Shopper Groups

	Model 1	Model 2	Model 3	Model 4
N	241	241	226	211
Traditional	1	1	1	1
Modern	0.014 (0.991)	0.050 (0.959)	0.356 (0.723)	-0.415 (0.714)
Mixed Shoppers	0.407 (0.698)	0.568 (0.521)	0.043 (0.964)	-0.359 (0.731)
Age group		2.196 (0.000)***	1.695 (0.004)**	1.899 (0.002)***
Male		-7.743 (0.000)***	-7.773 (0.000)***	-7.146 (0.000)***
Education		0.182 (0.572)	-0.346 (0.356)	-0.734 (0.094)*
Number of household members			0.195 (0.653)	0.393 (0.367)
A child in household			0.021 (0.984)	0.387 (0.732)
Own a car			2.221 (0.030)*	1.771 (0.079)*
Number of FT workers			0.446 (0.460)	0.027 (0.966)
Days eat breakfast outside				0.177 (0.355)
Days eat dinner outside				0.382 (0.133)*
Days eat Fast food				0.451 (0.275)
Days eat western snacks				0.012 (0.963)
Days drink sugary beverage				0.176 (0.320)
Days drink alcohol				-0.796 (0.068)*
Days exercise 60 min or more				-0.173 (0.366)
Days sit at least 8 hours				-0.007 (0.970)

c.) Waist Circumference (WC) and Shopping Destination

The third set of regression explores the association between WC and shopping destination.

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*).

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

Table 6.16: OLS Results of WC and Shopper Groups

	Model 1	Model 2	Model 3	Model 4
N	240	240	226	211
Traditional	1	1	1	1
Modern	0.707 (0.692)	0.769 (0.657)	1.050 (0.560)	0.122 (0.954)
Mixed Shoppers	3.039 (0.075)*	2.968 (0.074)*	1.538 (0.401)	0.641 (0.742)
Age group		2.454 (0.005)***	1.498 (0.156)	1.775 (0.127)*
Male		6.394 (0.000)***	6.218 (0.000)***	7.119 (0.000)***
Education		0.623 (0.249)	0.099 (0.885)	-0.131 (0.873)
Number of household members			1.688 (0.060)*	1.965 (0.016)**
A child in household			-2.006 (0.309)	-2.004 (0.342)
Own a car			1.789 (0.337)	1.315 (0.485)
Number of FT workers			-0.826 (0.427)	-1.204 (0.305)
Days eat breakfast outside				0.457 (0.196)
Days eat dinner outside				0.061 (0.896)
Days eat Fast food				1.062 (0.170)
Days eat western snacks				0.159 (0.743)
Days drink sugary beverage				0.214 (0.516)
Days drink alcohol				-0.832 (0.306)
Days exercise 60 min or more				-0.693 (0.054)**
Days sit at least 8 hours				0.254 (0.478)

Subsection 5.2: Frequent Shoppers

Tables 6.17 to 6.19 show results from Ordinary Least Squares regressions to examine the relationship between obesity measures (BMI, percent body fat, and waist circumference) and shopping frequency (whether one shops at a particular store type at least 3 times a week). Each set of regressions contain four models using the same dependent variable with varying control variables.

a.) BMI and Shopping Frequency

The first set of regression explores the association between BMI and shopping frequency.

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive.

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstmSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

Table 6.17: OLS Results of BMI and Shopping Frequency

	Model 1	Model 2	Model 3	Model 4
N	325	324	293	271
FQ Modern shoppers	0.325 (0.625)	0.369 (0.564)	0.486 (0.459)	0.247 (0.730)
FQ Traditional shoppers	1.247 (0.036)**	1.216 (0.036)**	0.938 (0.122)	1.020 (0.120)*
FQ convenience store Shoppers	-0.018 (0.972)	0.411 (0.418)	0.679 (0.201)	0.273 (0.630)
Age group		1.339 (0.000)***	1.00 (0.007)***	1.212 (0.003)***
Male		1.756 (0.004)***	1.725 (0.005)***	2.327 (0.001)***
Education		-0.152 (0.484)	-0.260 (0.300)	-0.429 (0.140)*
Number of HH members			0.637 (0.021)**	0.681 (0.020)**
A child in HH			-0.537 (0.420)	-0.314 (0.645)
Own a car			1.000 (0.089)*	0.733 (0.241)
Number of FT workers			-0.503 (0.164)	-0.647 (0.103)*
Days eat breakfast outside				0.031 (0.814)
Days eat dinner outside				-0.008 (0.956)
Days eat fast foods				0.587 (0.023)**
Days eat western snacks				0.157 (0.372)
Days drink sugary beverage				0.116 (0.295)
Days drink alcohol				-0.341 (0.183)
Days exercise 60 min or more				-0.150 (0.268)
Days sit at least 8 hours				0.138 (0.246)

b.) PBF and Shopping Frequency

The second set of regression explores the association between PBF and shopping frequency.

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive.

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstmSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

Table 6.18: OLS Results of PBF and Shopping Frequency

	Model 1	Model 2	Model 3	Model 4
N	324	323	292	296
FQ Modern shoppers	1.115 (0.298)	1.272 (0.201)	1.569 (0.128)	0.855 (0.180)
FQ Traditional shoppers	1.716 (0.055)	1.187 (0.132)	1.077 (0.208)	1.539 (0.056)
FQ convenience store Shoppers	-2.443 (0.003)***	-0.293 (0.699)	-0.137 (0.864)	-0.812 (0.316)
Age group		1.951 (0.000)***	1.712 (0.002)***	2.138 (0.000)***
Male		-7.578 (0.000)***	-7.464 (0.000)***	-6.255 (0.000)***
Education		0.154 (0.596)	-0.213 (0.531)	
Number of HH members			0.077 (0.848)	
A child in HH			-0.512 (0.596)	
Own a car			2.094 (0.018)**	
Number of FT workers			0.172 (0.740)	
Days eat breakfast outside				0.200 (0.251)
Days eat dinner outside				-0.121 (0.515)
Days eat Fast food				0.506 (0.103)
Days eat western snacks				0.122 (0.591)
Days drink sugary beverage				0.216 (0.160)
Days drink alcohol				-0.994 (0.000)***
Days exercise 60 min or more				-0.298 (0.083)*
Days sit at least 8 hours				0.118 (0.478)

c.) WC and Shopping Frequency

The third set of regression explores the association between WC and shopping frequency.

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive.

The second model contains the control variables *Age*, *Male*, and *Educ*.

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrkrs*.

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs*.

Table 6.19: OLS Results of WC and Shopping Frequency

	Model 1	Model 2	Model 3	Model 4
N	324	322	292	295
FQ Modern shoppers	1.739 (0.408)	0.667 (0.700)	0.576 (0.745)	-0.030 (0.987)
FQ Traditional shoppers	2.445 (0.122)	2.269 (0.113)	1.854 (0.221)	2.352 (0.218)
FQ Convenience store Shoppers	0.687 (0.594)	0.814 (0.524)	1.459 (0.280)	0.109 (0.936)
Age group		-2.925 (0.001)***	2.145 (0.023)**	3.389 (0.000)***
Male		6.891 (0.000)***	6.477 (0.000)***	8.666 (0.000)***
Education		0.390 (0.398)	0.141 (0.798)	
Number of HH members			1.675 (0.030)**	
A child in HH			-1.785 (0.299)	
Own a car			2.092 (0.156)	
Number of FT workers			-1.467 (0.101)	
Days eat breakfast outside				0.457 (0.121)
Days eat dinner outside				-0.499 (0.132)
Days eat Fast food				1.650 (0.008)***
Days eat western snacks				0.160 (0.682)
Days drink sugary beverage				0.268 (0.318)
Days drink alcohol				-0.897 (0.097)*
Days exercise 60 min or more				-0.626 (0.037)**
Days sit at least 8 hours				0.366 (0.172)

Hypothesis **H₅** stating that those who shop primarily at modern grocery retailers will score higher on obesity measures than those who shop primarily at traditional markets and those who shop at both equally is not supported by this section's findings. Modern grocery retailer shoppers and traditional market shoppers were not associated significantly with any obesity measures (BMI, PBF, and WC). Although mixed shoppers were found to be significantly more likely to have higher BMI and WC in some models, the effects were not consistent for all three measures of obesity. In addition, the significance disappeared after controlling for household characteristics and health behaviors.

Bangkok dwellers, especially, the young and single often eat out as a way to socialize and be seen. Yasmeen (2000) termed the phenomenon 'public eating' and observed that incredibly few people in Bangkok cook at home regularly given the availability and affordability of prepared foods outside of home. Many apartments and small condominiums also do not have full kitchen or lack proper ventilation for efficient cooking of aromatic Thai cuisine. Another reason for the popularity of dining out is that Thailand, and particularly Bangkok, has the highest female labor force participation rates in Southeast Asia (Ibid.). Few women stay home and cook. For many people in the sample, then, grocery shopping may not be the main source of caloric intake such that grocery destination of choice does not influence health behavior in significant ways.

Hypothesis **H₆** stating that those who frequent modern grocery retailers will score higher on obesity measures than those who frequent fresh markets was not only rejected

but was contradicted. Findings from this section suggest that frequent traditional shoppers are more likely to have higher BMI than non-frequent traditional shoppers. The association was quite strong at $p < 0.05$ even after controlling for age, gender, and health habits, but was not true with other obesity measures, PBF and WC, where association was not significant. While BMI is the most common indicator of obesity, PBF and WC are better indicators of health risks. A person with a high BMI but low PBF and small WC are less likely to develop diabetes and hypertension, among other conditions, than those who are centrally obese with normal BMI. This finding is, thus, not necessarily alarming although further investigation is required. Stature was not looked at in this study but could be a factor that explains this outcome. Traditional shoppers were found to be significantly more likely to be in the lowest income category and thus are more likely to face the problem of stunting which would affect their BMI. Another possible explanation could be that traditional shoppers are more likely to be labor workers with high muscle mass. Since muscle weighs more than fat, they would appear to be heavy for their height while maintaining low PBF.

Convenience store frequent shoppers show strong negative association with PBF suggesting that they are likely to have lower PBF. The effect, however, disappear when age and gender were controlled for, telling us that those who frequent convenience stores are probably significantly younger than those who do not. A person's PBF is likely to increase naturally with age. No significant relationship was observed for WC and shopping frequency.

Conclusion

In this chapter, descriptive statistics show the sociodemographic discrepancies between primary and non-primary grocery shoppers. The two groups differ significantly in age, educational attainment, monthly salary, as well as household size. The proposed hypotheses were supported, partially supported, rejected, or contradicted by the results of the model analyses. **H₁** was supported by an exploratory spatial analysis revealing unequal access to grocery stores and traditional markets in different areas of Bangkok. The analysis is preliminary and requires further examination with more data to draw any meaningful conclusions.

H₂ was partially supported. Certain socio-demographic characteristics of primary shoppers including educational attainment, monthly salary, residence type, household size, and presence of a child in the family, are related to their choice of grocery destination. In terms of spending, car owners, as expected, spend more per shopping trip both to modern and traditional outlets. Amenities, service, and opportunity for community relationship are store factors that differ between shopper groups.

H₃ and **H₄** explore the relationship between health behavior and grocery shopping destination and were also partially supported. Shopping frequency appears to matter more than simply choice of grocery store. Those who shop at supermarkets and convenience stores three or more times a week display significantly more undesirable health behavior, compared with those who visit such stores less often. Frequent shoppers of traditional markets, however, do not have similar tendencies.

The association between grocery destination choice and obesity measures was tested with **H₅** and **H₆**. Both hypotheses were not supported by the findings and **H₆** was even contradicted. Modern grocery shoppers were not more likely than traditional or mixed shoppers to be obese. Grocery destination choice did not significantly influence shoppers' BMI, PBF, and WC. When frequency of visits was taken into consideration, those who visit traditional markets three or more times a week appeared to have significantly higher BMI than infrequent traditional shoppers. Those who shop at supermarkets or convenience stores three or more times a week did not show significantly higher likelihood of scoring higher on any obesity measures.

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CHAPTER SEVEN: DISCUSSION AND IMPLICATIONS

This research provides both relevant and valuable information on the relationship between the Bangkok food retail scene and diet-related behaviors and weight status. The project has utilized several models to examine the characteristics of people who regularly shop at traditional and/or modern outlets and how their grocery destination choice relates to their health behavior and weight status. The analysis of the spatial and collected survey data indicates unequal access to grocery stores in different parts of Bangkok. Each shopper group has distinct socio-demographic characteristics. It also shows that while shopping at modern grocery stores may not influence health behavior, the frequency at which shoppers visit these outlets are related to certain unhealthy habits in similar ways the previous study by Kelly et al. (2014) found. These unhealthy habits have not translated to higher likelihood of obesity in this frequent shopper group. On the contrary, the results show frequent traditional market shoppers to be more likely to have higher BMI. **Table 7.1** shows summary of findings.

Table 7.1: Summary of Findings

Research Questions	Hypotheses	Findings
R1: What does the spatial food landscape in Bangkok look like?	H1 Food retail outlets in Bangkok are not evenly distributed	Traditional markets are significantly clustered. Hyper/supermarkets are significantly clustered. Convenience stores are neither clustered nor dispersed.
R2: Is there any discrepancy in the sociodemographic characteristics of modern, traditional, and mixed shoppers?	H2 The socio-demographic profile of consumers significantly influences their choice of grocery destination	Traditional shoppers are significantly more likely to earn 10,000 baht or less per month. Modern shoppers are significantly more likely to hold master's degree or higher, live in a condominium, and live alone. Mixed shoppers are significantly more likely to have junior high school degree, live in a household with 5 or more members, and have a child in the household.
R3: Is there a correlation between grocery destination choice, shopping frequency, and health behavior?	H3 Modern grocery shoppers will demonstrate a greater level of unhealthy behaviors than traditional market shoppers and mixed shoppers. H4 Those who frequent modern grocery retailers will demonstrate greater level of unhealthy behavior than those who do not frequent modern grocery retailers.	Mixed shoppers are significantly more likely to eat fast foods. Frequent hyper/supermarket shoppers are significantly less likely to consume alcohol. Frequent convenience store shoppers are significantly more likely to eat fast foods, consume sweet drinks, drink alcohol, and sit 8 hours or more a day.
R4: Is there a correlation between grocery destination choice, shopping frequency, and obesity measures?	H5 Those who shop primarily at modern grocery retailers will score higher on obesity measures than those who shop primarily at traditional markets and those who shop at both equally. H6 Those who frequent modern grocery retailers will score higher on obesity measures than those who frequent fresh markets	Mixed shoppers are significantly more likely to have higher BMI than non-mixed shoppers, controlling for age, gender, and education. Mixed shoppers are significantly more likely to have larger WC than non-mixed shoppers, controlling for age, gender, and education. Frequent traditional shoppers are significantly more likely to have higher BMI than non-frequent traditional shoppers, controlling for age, gender, education, and health behaviors. Frequent convenience store shoppers are significantly more likely to have lower PBF than non-frequent convenience store shoppers (no controls).

This study is one of the first to examine the relationship between grocery destination choice, health behavior, and weight status as the supermarket revolution is taking place, changing the way people shop and consume. This chapter details the limitations and applicability of the study. Policy implications and recommendations are also discussed given the findings. The final section gives directions for future research projects.

I: Limitations and Generalizability

As mentioned in chapter five, the survey for this study was adapted from the US National Health and Nutrition Examination Survey (NHANES) and adjusted for cultural relevancy which has its strengths and weaknesses. The NHANES has been in use since 1971 to assess the health and nutritional status of adults and children living in the US. It has been tested and validated to measure and track changes over time but has never been used with the Thai population. There may be important discrepancies between the American and Thai populations not picked up by the survey.

The spatial analysis of Bangkok food landscape is rudimentary. While it is visually interesting to see the spread and clustering of grocery outlets, conclusions cannot be drawn using current data. First, the analysis does not take into account population density and income in each district which would create varying demands for the number and types of grocery stores. Second, traditional markets vary tremendously in size and the products they carry. Some are publicly owned while others are privately owned. Many of

the private markets are not registered with the city. It is, therefore, difficult to have an accurate count and picture of traditional markets in Bangkok.

The study has limited generalizability. It was conducted using a convenience sample to represent working age individuals living in Bangkok, Thailand. This undercoverage creates an “error of non-observation” where the sample characteristics and responses deviate from those of the population the survey wishes to represent (Groves et al. 2009). While the frame population come from three survey sites; an elementary school, a hospital, and a telecommunication company, that are diverse industries, workers in these industries have higher educational attainment than the general Bangkok population as indicated by the high proportion of college graduates in the sample. Participants were self-selected, as opposed to randomly-selected, and therefore were likely to be those who are more health-conscious. Non-participants may be aware of their undesirable health behavior and did not wish to be consulted by health professionals. In addition, although participation was open to workers of lower income level within those institutions such as housekeepers, security guards, and drivers, interest was low among the group, partly due to their lack of reading proficiency.

A major difficulty with recruiting participants from more diverse populations is, first and foremost, funding. A limited amount of fund available was sufficient to get a pilot data collection for the project. Each event was run by approximately 20 health care professionals and facilitators who were paid a daily rate. Several dietetics student interns were used to minimize costs. Another obstacle was in the entrepreneurial nature of jobs in Thailand. The meager Thai salary and benefits of being employed by a company often

gives people with lower level of education the economic incentives to set up their own small business. Many people choose to own a food stall or a clothing or souvenir shop that requires little capital and gives them work schedule flexibility and independence. Because these people are not part of an organization, it is difficult to capture this segment of the working population.

There is no accepted international standard for the measurement of obesity for Asian populations and “construct validity”, or the “extent to which the measure is related to the underlying construct” (Groves et al. 2009 p.49) may be of concern. BMI is the most common measure of obesity but the cut-offs are arbitrary. Five indicators of obesity, BMI, PBF, VCF, WC, and WHR were planned to be used as proxies for health status and analyzed as continuous outcomes. However, we had access to different body composition analysis machines during the first and second waves of data collection which yielded differing units of measurements for visceral fat (VCF). Because the differences could not be reconciled, the variable was dropped during the analysis. Waist-hip ratio (WHR) was also dropped. It is low-cost but has not been a popular measure as there is high risk of human error when measuring due to differences in understanding of where waist and hips are. Waist-hip ratio is more likely to detect obesity in populations who store fat mid-body but who are at a healthy weight. The final analysis, therefore, included only BMI, PBF, and WC.

In a bigger picture, the generalizability of the study to other provinces of Thailand is also limited. Bangkok, as the country’s capital city, is distinct in its population, educational attainment, land use, as well as policy characteristics. The manner in which

other major cities in Thailand develop may not take the exact pattern as Bangkok. The study may be more applicable to other capital cities in the Southeast Asian developing region such as Laos, Cambodia, and Burma, as they have similar culture, political dynamics and development pattern. As the region becomes a free trade zone under the Asia Economic Community (AEC), the gaps will become even smaller.

II: Policy Implications and Recommendations

In examining the policy implications of this study, it is useful to look at the parallels and lessons that can be learned from the smoking epidemic (Sacks et al. 2011). The issue of obesity epidemic is often compared to cigarette smoking prevalence, glorified by the media as a fashionable thing to do, during the 1950s and 1960s. It took 50 years of concerted efforts, lawsuits, studies, and intense pressure on the cigarette industry to demonstrate the harm of smoking and curb the incidents of smoking-related diseases. A large part of why it took so long for scientific evidence of the harm of smoking to translate into health policies is due to conflicting interests of the powerful cigarette industry.

Similarly, it's undeniable that multibillion food and beverage industries have an interest in keeping their most profitable products on the supermarket shelf. As it turns out, these high margin products are usually not healthy options. In the US, concerns over national health care costs solidified the issue of obesity into a "policy regime" with clear stakeholders and public officials dominating the media coverage and the policy debates (Kersh 2009). Unfortunately, health policies seem to be driven, in a large part, by

economic imperatives rather than scientific evidence. Now, obesity is in many ways different from smoking. One obvious aspect is the fact that there is no clear villain in the case as with cigarette smoking. Food is necessary for survival. Scientists and researchers cannot agree on what constitutes bad foods and the connotation keeps changing from fat, to specific kinds of fats like transfat, to sugar. New studies keep the field evolving and at times present conflicting results. There is also an issue of lack of physical activity from the proliferation of labor-saving innovations and increased screen time, on the television, computer, as well as smart phone. As it is a multi-faceted condition, there is no simple solution. Effective interventions must involve the collaboration of many stakeholders not only in the health field but also in transportation, urban planning, education, among others. Obesity is, thus, a much more complex issue.

The study findings have important policy implications regarding the control and prevention of obesity and diet-related chronic diseases. Thailand is a rapidly developing country that has yet to be free from third world diseases including undernutrition, stunting, and wasting. Thai policymakers, therefore, face battles at both fronts and must find a middle ground to address issues of nutrition backlog. The following paragraphs details policy recommendations based on the dissertation's literature review, the surveyed populations, and mathematical analyses.

a.) Create a task force on obesity

Some of the findings in this study could not be explained with the included control variables. Obesity is not a straight forward issue. Increased exposure to processed foods and even unhealthy behaviors are not associated with a greater likelihood of being

obese. Obesity problem transcends the health field and a multidisciplinary task force is necessary to effectively address the issue. The government must acknowledge that this is no longer an issue of personal responsibility. Looking at the population and understanding the people that need help is essential in creating a coordinated inter-agency plan that includes participants from different fields, levels of government, as well as the private and NGO sector. Community participation is crucial in finding solutions. Insights from non-traditional disciplines will be helpful in tackling the issue from several angles as eating is not only daily activity but also an integral part of core social processes. The task force must establish a clear and achievable goal, identify key benchmarks, guidelines, evaluation mechanisms, and provide a forum for idea-sharing both at the local and national levels.

The task force should have funding allocated to design and validate a tool such as the survey used in this study that would be available for researchers in this field. A representative group of participants from regions of Thailand should be recruited for, first, an in-depth interview, then to answer candidate questions for the survey questionnaire. A validated survey that can be commonly used will allow for comparability between studies. This is beneficial for program evaluation and longitudinal studies. In the long run, having a standardized measurement tool is more economical and has communication advantages because it eliminates the discrepancies in the wordings of surveys that could alter participants' understanding and responses.

Thailand already has the National Health Examination survey focusing on identifying disease prevalence and risk factors such as physical activity, diet, tobacco and

alcohol use, and living conditions. This is one venue where questions regarding diet and grocery shopping behavior can be added to investigate the issue of obesity.

A similar task force was created in the US to combat childhood obesity. Following the Let's Move campaign led by First Lady Michelle Obama, President Barack Obama appointed a task force aimed at eradicating childhood obesity within a generation. Members of the task force included authority figures from departments such as Agriculture, Health and Human Services, Education, and Office of Management and Budget. The objectives were broadly grouped into 1. Forming healthy path in early childhood 2. Empowering parents and caregivers 3. Providing healthy food in schools 4. Increasing access to healthy and affordable food, and 5. Increasing physical activity.

It is unclear what will happen to the task force once the Obama administration term ends. The election cycle and change of administration in Thailand also has had effects on funding for many programs rendering them unsuccessful due to interrupted financial flow. Collaboration with the private and NGO sectors may help maintain existence of the task force beyond the life of the administration that creates it. Evaluation mechanisms will also allow for case studies and replications in various localities as well as expansion of program scale.

b.) Utilize the Healthy Cities model to address diet-related risk behaviors and environments

Literature review suggests there is a need for monitoring and evaluation which affects the effectiveness and sustainability of health programs. Using existing health promotion models and adapting to the local needs is one way to avoid trial and error each

time. The concept and importance of “healthy settings” is not new in Thailand. In 1996, the Thai government launched Healthy Cities Project on World Health Day, in collaboration with the WHO. The project receives an annual budget to improve community environments to address sanitation and other health issues. The movement is led by the National Steering Committee with subcommittees at both national and local levels. Public and private organizations and the civil society actively work together to establish and implement policies aimed at creating healthy environments (WHO 2003). The decentralization approach of the model gives local administrative authorities the power to identify and provide sustainable solutions to the problems in their own communities.

Although the model has been successful in a number of areas, the focus is still mainly on food and water safety and waste management to prevent infectious diseases (ACFSb 2015). As Thailand experiences greater level of chronic conditions such as hypertension, obesity, and diabetes, the Healthy Cities model can provide a promising framework and network of authorities to address some of the food environments and physical infrastructure that encourage risk behaviors such as the lack of footpath discouraging people from walking. Building supportive environments for healthy living should be made a priority in the face of rapid regional development. The task force on obesity should take the role in advising how the healthy cities model could be adapted to meet the local needs.

c.) Target women and young children

Seventy-five percent of surveyed primary shoppers in this study are women. Women are often the primary grocery shopper and cook for the household. Getting women to lead a healthy lifestyle will have positive influence on the family as a whole. Nutrition education aimed at women with less than a bachelor's degree can be a starting point. Highly educated women with salary in the upper range are less likely to be primary shoppers.

There is abundant evidence that the most effective way to form healthy habits is by starting as early in life as possible (Brotman et al. 2012). This study also shows that households with children are more likely to be mixed shopper. Mixed shoppers are more likely to consume fast food and have higher BMI and WC than other shopper groups. It is important that socially and culturally appropriate measures be identified to minimize effects of changing food shopping and consumption patterns on children. This may include encouraging employers to offer longer paid maternity leave which can lengthen the duration of breastfeeding (Ogbuanu et al. 2011). Breastfeeding is shown to be a significant protection against childhood obesity (Yan et al. 2014). If policymakers can give children healthy early years, they will be less likely to develop undesirable conditions later or be more resilient to illnesses.

The Health Promoting Schools Framework (HPSF) has been widely used in the past decade to address childhood obesity. The model aims to create healthy school environments, consistent with social ecological theories and the social cognitive theory. Children spend significant amount of time in school which makes schools an intuitive

setting for interventions. Evidence also points towards potential long-term effects from obesity interventions in school settings (Kelishadi and Azizi-Soleiman 2014). Local authorities should set standards for school environment to promote healthy habits. For example, soda and candies should not be sold in school. The HPSF encourages multilevel interventions that do not only include environmental change but also community participation and behavior modification programs. The stress on community involvement and the understanding of the target population, in terms of their values and way of life, is crucial to the success of the program. The model addresses many aspects of health influences that are beneficial for obesity prevention efforts as well as forming healthy habits in general (Gibbs and Waters 2011).

It is undeniable that today the media is a major actor in the issue of childhood obesity widely utilized by both the industry and the government. Pediatricians, researchers, and child development experts have found evidence linking media to childhood obesity in various ways such as increasing sedentary time, exposing children to advertisements that influence them to make unhealthy food choices, inducing excessive snacking behavior while watching television (Kaiser Family Foundation, 2004; Hastings et al. 2003). Given the influence the media has on its audience, it is clear that the media can be used to make positive impact on children's behavior modification. It is, however, a tool that is operated by monetary power, and in that respect, the food and beverage industry wields more power than the government does. The food and beverage industry has been facing pressures from the international communities for its potential role in promoting healthy diets. Many industry associations have demonstrated their social

responsibility by establishing industry standards and codes of conduct vis-à-vis such issues as marketing to children. These self-regulations, while beneficial, are voluntary and likely to not be properly complied, monitored, and reported (Hawkes 2005; Jensen et al. 2015).

The political, social, and cultural environments play an important role in determining the commitment to and effectiveness of self-regulations (Jensen et al. 2015). Common nutrition standards on advertising to children were established for and adopted by member countries of the European Union in 2007 per the European Commission's encouragement. In 2008, the International Food and Beverage Alliance (IFBA) adopted similar guidelines at the global level. In the US, however, there is preference for individual firm's self-regulation, as opposed to industry's self-regulations. In an ideal world, food and beverage companies would join hands with the media and entertainment industry in responsibly marketing to children by setting nutrition guidelines for advertisements, commercial, and promotional materials. As this is unlikely to happen voluntarily given the liberal history of advertising and the strength of advertising and promotion agencies in Thailand (Hawkes 2007), the government may step in to regulate the dissemination and disclosure of information. Children are not considered "rational consumers." Government's interventions are therefore appropriate. Recently, there have been independent efforts to monitor and report on activities of food and beverage companies such as the Access to Nutrition Index (ATNI 2015) created by the Access to Nutrition Foundation. Whether these initiatives will become fruitful remains to be seen (Jensen et al. 2015).

d.) Use convenience stores as point of intervention

As the study findings show that those who frequent convenience stores are significantly more likely to exhibit undesirable health behavior, this is a good point for interventions. Convenience stores are extremely popular in Thailand. In addition to being a place for people to grab a quick meal, snacks, breakfast or other daily essentials, people can also pay their phone bills and utilities at Seven-Eleven. It is likely that impulse purchases happen during these transactions. Educational, advertising, warnings, and other health campaigns can be implemented at convenience stores to reach target audience. The specifics of campaigns should be further researched.

e.) Avoid obesogenic environment in health-promoting settings

While the goal is to eliminate obesogenic environment completely, I recommend starting with health promoting settings such as gyms and hospitals in addition to schools. The government may impose nutritional standards for food items sold at these establishments. Sale of sugar-sweetened drinks and bakery items should be limited though not eliminated. Wherever possible, educational materials should be provided to inform consumers of their potential harm. Gyms and hospitals typically have nutrition experts in house that are able to offer consultation to interested individuals and provide basic nutrition knowledge to the general public. With the growing health-conscious population, healthy vending machines have become the newest trendy business that some have claimed is “recession-proof.” Some selections of products include cereal bars, string cheese, yogurt, pudding, trail mix, nuts, fruit cups, and sliced vegetables. Beverage vending machines usually offer low-fat milk, water, and 100 percent fruit juice. Many

healthy vending companies were born in recent years and have experienced rapid growth rates such as Atlanta-based HUMAN Healthy Vending, San Diego-based Yonaturals, Inc., and Healthy You Vending in Kaysville, Utah. Some companies have included eye-catching technologies and marketing strategies to capture potential customers' attention such as a 23" LCD display, some of which have a touch screen that you can use to put in your order. Competition is fierce and many have sought to diversify their products by offering hot food vending machines, healthy gourmet coffee vending machines, and healthy frozen food vending machines (Stephen, 2011).

III: Directions for Future Research

Few research projects on the connection between grocery store choice and health in developing countries precede this study. A study by Kelly et al. 2014 reported significant increase in people who regularly visit supermarkets and convenience stores. Frequent modern grocery shoppers were also found to consume more "problem foods" high in fat, salt, and energy. More research is needed on the specific case of Asian populations. Currently nutrition implications on Asians are mostly drawn from Asian ethnics living in the US or the UK. These people face a different set of factors influencing their lifestyle and consumption. Research on food environment in developing countries has come mainly from South America. In order to get an accurate picture to inform policymakers, research on Asian populations in Asia is essential.

First, research needs to focus on what are the determinants of grocery store selection. Understanding what drives people to shop at certain grocery outlets will inform

policymakers on how best to intervene to ensure people lead a healthy lifestyle while maintaining economic development. This study initially included a component on determinants of grocery destination choice but due to incompatibility of data and the discrete choice statistical model, I was not able to conduct analysis. Literature shows that modern and traditional grocery outlets have unique features that attract different clienteles. While supermarkets/hypermarkets and convenience stores are on the rise, however, the existence of traditional markets are being threatened. Policies should allow for the control of modern grocery expansion and preservation of traditional markets. Resources must be made available for stall owners in traditional markets to offer competitive products at competitive prices and to maintain sanitation. Data and analysis are needed to establish guide policymakers.

Second, future research should be longitudinal in order to examine the direction of relationship between grocery shopping, health behavior, and subsequently weight status. This study is cross-sectional due to the lack of existing longitudinal data and the funding to conduct a longitudinal study. While associations were found between grocery destination choice and health behavior, nothing can be said of causation. A longitudinal study can reveal whether the targeted behaviors develop before or after subjects start grocery shopping at their preferred stores. If the behaviors follow the store selection, a closer look at what consumers purchase would guide policy formulation. If the behaviors are pre-existing, then the question becomes what store characteristics attract consumers with those behaviors. In addition, the weight status in this study did not

show statistical significance. However, if shopper groups practice different health behaviors, it is likely that there would be discrepancies in their weight status over time.

Conclusion

According to the WHO, approximately 3.4 million people worldwide die annually as a result of overweight status or obesity (WHO 2014). It is a preventable condition that will reduce the burden of non-communicable diseases such as diabetes and heart diseases. There are few other comparable studies linking shopping environments, health behavior, and weight status in developing countries, and especially in Southeast Asia. As this study and other existing literature show, however, obesity is not simply a matter of personal responsibility. It is “the result of people responding normally to the obesogenic environments they find themselves in,” (Swinburn et al. 2011; 804).

It is vital that policy makers, national and local authorities, understand the health needs of their populations and utilize appropriate models and evidence to guide their policy formulations in order to fully benefit from available resources. The issue of obesity must be viewed within a context of family, community, and society at large. Interventions must, therefore, be comprehensive and address multiple influencing factors. Thailand, and other developing Southeast Asian countries, is facing nutrition backlog where both malnutrition and obesity coexist, many times in a single household. Prevention and control efforts must involve local communities and multidisciplinary professionals that the locals trust. There can be unintended effects that must be considered before policy or program implementations. For example, school-based obesity

interventions that target overweight children may create stigma and increase bullying incidents in schools. If obesity patterns in Thailand follow the path of that in the Western world, the epidemic will affect people of lower socioeconomic strata more severely than their wealthy counterparts. As such, obesity is not only a health issue but is also a matter of social justice where the less fortunate populations do not have equal access to healthy diets (Marks 2015).

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APPENDIX A: GROCERY PURCHASING BEHAVIOR QUESTIONNAIRE

Are you the primary grocery shopper in your household? (Check yes if you live by yourself and shop for yourself)

___ Yes ___ No

I: Grocery shopping experience

1. What is your primary grocery shopping store/market? Please give the name and location (ie. Lotus, Rama 4 Rd. or Klongtoey Market)

2. How much time do you usually spend on grocery shopping per week excluding the transportation time?

_____ hours _____ minutes

3. How long does it usually take for you to get to the grocery store/market?

_____ minutes

4. What mode of transportation do you usually use to get to the grocery store/market?

___ walk

___ taxi

___ bus

___ private vehicle

___ other, please specify

5. Do you usually read the nutrition label when available?

___ yes ___ no

On a scale of 1-5, 5 being “very important” and 1 being “not at all important,” How important is each of the following grocery store characteristics when you shop?

	Level of Importance				
	Highest		Lowest		
6. Pricing	5	4	3	2	1
7. Convenience of location	5	4	3	2	1
8. Facilities including parking lots and air conditioner	5	4	3	2	1
9. Store promotions	5	4	3	2	1
10. Store cleanliness and organization	5	4	3	2	1
11. Store product quality	5	4	3	2	1
12. The assortment of different brands and products	5	4	3	2	1
13. Store service; helpfulness, availability, and friendliness of staff	5	4	3	2	1
14. Availability of product in large-size packaging	5	4	3	2	1
15. Opportunity to connect with the local community	5	4	3	2	1

How often do you shop for food items at the following grocery outlets?

	Less than once a month	Once a month	1-2 times a week	3-4 times a week	More than 4 times a week
16. Hypermarket/Supermarkets (ie. Lotus, Big C, Tops, Gourmet)					
17. Warehouse stores (Makro)					
18. Convenience stores (7- eleven, Family Mart)					
19. Traditional wet markets					
20. Mom-and-pop shops					

How much do you spend on average per shopping trip at each of the following places?

21. Hypermarket/Supermarkets (ie. Lotus, Big C, Tops, Gourmet)

_____ baht

22. Warehouse stores (Makro)

_____ baht

23. Convenience stores (7-eleven, Family Mart)

_____ baht

24. Traditional wet markets

_____ baht

25. Mom-and-pop shops

_____ baht

Where do you usually buy the following products? Check all that applies.

	Hypermar kets/super markets	Warehouse stores	Convenien ce stores	Local wet market	Mom-and- pop stores	Other, specify	Do not buy
26. Fresh fruits							
27. Fresh vegetables							
28. Meat products							
29. Grain products (ie rice)							
30. Dairy products							
31. Processed and dried foods (ie. instant noodle, sausages)							
32. Non-frozen ready meals							
33. Frozen meals ie. S&P Quick Meals							
34. Frozen fruits and vegetables							
35. Pastries and bread							

II: Health Behaviors

How many days in the past 7 days did you do the following?

	Number of days in the past 7 days
36. Have breakfast at home	0 1 2 3 4 5 6 7
37. Have breakfast elsewhere (not at home)	0 1 2 3 4 5 6 7
38. Have dinner that is prepared at home	0 1 2 3 4 5 6 7
39. Eat at restaurants for dinner (excluding cafeterias and food courts)	0 1 2 3 4 5 6 7
40. Eat at fast food or pizza restaurants (KFC, McDonalds, Pizza Hut)	0 1 2 3 4 5 6 7
41. Have food or fruits purchased from street stalls	0 1 2 3 4 5 6 7
42. Have fruits or Thai snacks between meals	0 1 2 3 4 5 6 7
43. Have Western snacks between meals (ie. potato chips, pastries)	0 1 2 3 4 5 6 7
44. Drink soda or other sugary drinks (juice, energy drinks, sweet tea)	0 1 2 3 4 5 6 7
45. Smoke cigarettes	0 1 2 3 4 5 6 7
46. Drink alcoholic beverages (liquor, beer, cocktails)	0 1 2 3 4 5 6 7
47. Be physically active for more than 60 minutes per day (add up all the time that increase heart rate and make you breathe hard some of the time)	0 1 2 3 4 5 6 7
48. Spend more than 8 hours sitting (at work, at home, in a car, on a bus)	0 1 2 3 4 5 6 7

Do you agree or disagree with the following statements

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
49. I believe obesity is caused by factors that are beyond my control such as genetics	1	2	3	4	5
50. I believe obesity is caused by factors that I have control over such as overeating and lack of exercise	1	2	3	4	5
51. I believe I get enough exercise	1	2	3	4	5
52. I believe I eat nutritious diets	1	2	3	4	5
53. I believe I am at a healthy weight	1	2	3	4	5

III: Background Information

Individual

54. Name

_____please skip_____

55. What is your district and zip code? (ie. Klongtoey 10110)

district_____ zip code_____

56. What is your gender?

____Male ____Female

57. What was your age at your last birthday?

_____ years old

58. What is your marital status?

____ married ____ single

59. What is the highest level of education you attained?

____ Primary school

____ Junior high school

____ High school

____ Associate Degree/vocational
training

____ Bachelor's degree

____ Master's degree and beyond

Family

60. Approximately what is your family's monthly income?

- ___ 10,000 baht or less
- ___ 10,000 – 30,000 baht
- ___ 30,001 – 50,000 baht
- ___ 50,000 – 100,000 baht
- ___ 100,000 baht or more

61. Which of the following describes your current residence?

___ house ___ condominium ___ dorm/apartment ___ other, specify

62. How many persons live in your household, including yourself?

___ persons

63. How many of them are children and their age?

___ children, ages _____

64. How many people in your household work full-time?

___ persons

65. Does your family own a car?

___ yes ___ no

APPENDIX B: GROCERY STORE EVALUATION FORM

Name of store: _____

Address: _____

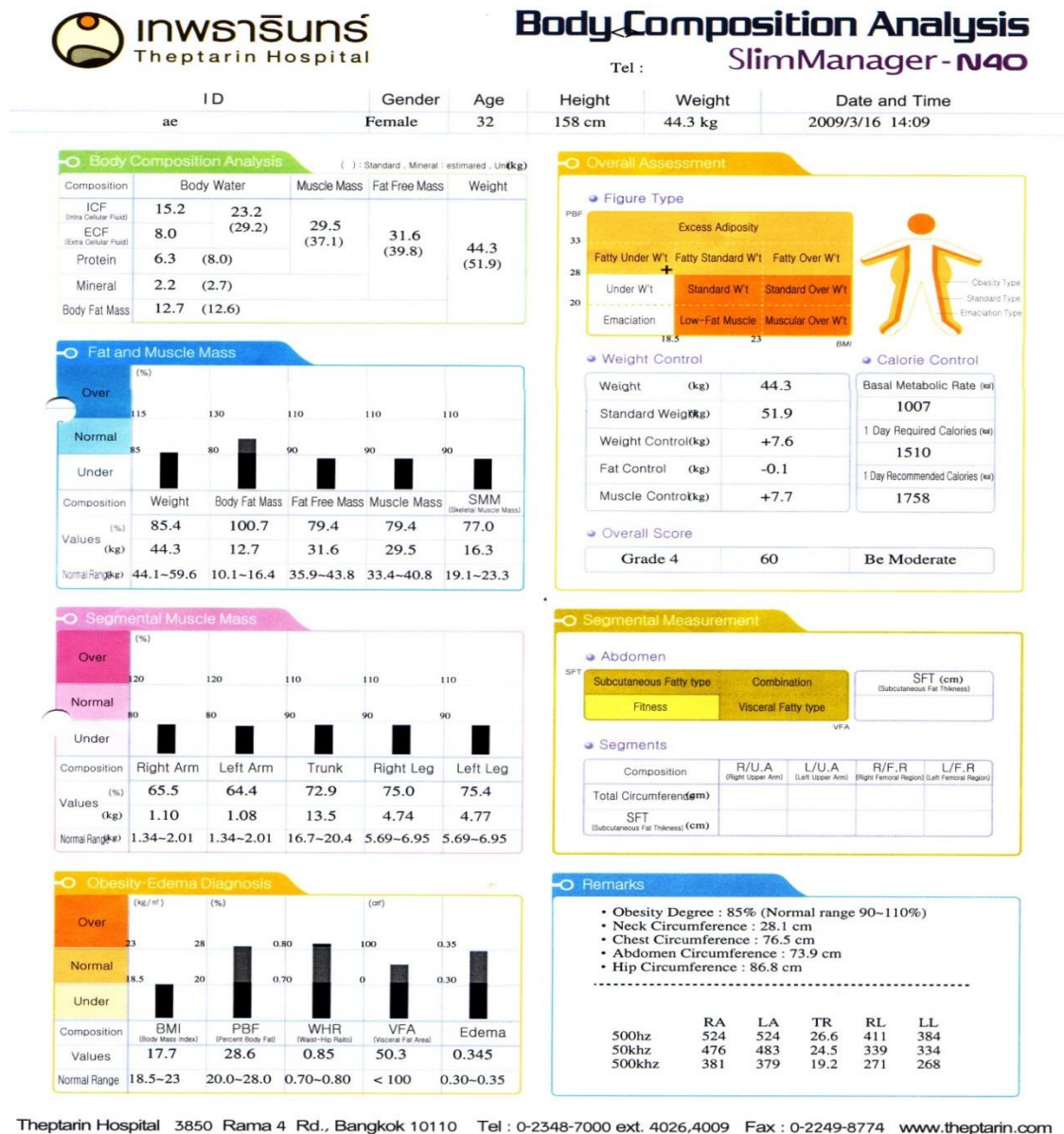
What type of store is this? (choose one)

_____ hypermarket _____ supermarket _____ convenience store

FOOD CATEGORY	SCORE	PRICE
Nonefat/low-fat Dairy (max 2 pts) 0 – none +1 – if low-fat/non-fat milk is 50% or more of shelf space +1 – presence of low-fat/non-fat yogurt		Lowest price per gallon of nonfat milk
Fruits and vegetables (max 4 pts) 0 – none +2 – 10 or more fresh varieties +1 – presence of locally-grown food +1 – 10 or more varieties of frozen varieties (not canned)		Lowest price per pound of fresh bananas Lowest price per pound of fresh carrots
Lean Meat (max 3 pts) 0 – none +1 – ground pork or ground chicken, 15% fat or less +1 – skinless breast present +1 – fresh ปลาหมู ปลากระพง ปลาหีบต้ม available		Lowest price per pound of lean ground beef Lowest price per pound of skinless chicken breast Lowest price per pound of filet of

		salmon
Frozen foods (max 2 pts) 0 – none +1 – low-calorie complete meals available such as Lean Cuisine พรานทะเล +1 – ratio of vegetables to ice cream shelf space great than 1:4		Lowest price per ounce of frozen peas Lowest price per individual serving of low-calorie complete meal (not multi-serving)
Low-sodium soup ก๋วยเตี๋ยวน้ำ 0 – no low-sodium soup +1 – low-sodium soup		Lowest cost per ounce of low-sodium chicken noodle soup
ข้าวกล้อง (max 2 pts) 0 – no ข้าวกล้อง available +2 – two or more varieties available		Lowest cost per ounce of whole-grain bread. One ounce = 1 slice of bread
คุกกี้ธัญพืช ขนมปังธัญพืช (max 2 pts) 0 – none + 2 – two or more varieties with less than 7g sugar/serving available		Lowest cost per ounce of low-sugar cereal

APPENDIX C: BODY COMPOSITION ANALYSIS SAMPLE



APPENDIX D: STATA COMMANDS

Research Question II

Chi-squares test (Tables 6.3, 6.4, 6.5, 6.8)

The general Stata command used was

tab DepVar shopcat, chi2 column

where

DepVar represents the categorical variables

Male, Age, Educ, HHinc, Resid, FamMem, Child, and OwnCar

The option **chi2** generates chi-squares values and the option **column** generates column percentage

Table 6.3

tab Male shopcat, chi2 column

tab Age shopcat, chi2 column

tab Educ shopcat, chi2 column

Table 6.4

tab HHinc shopcat, chi2 column

tab Resid shopcat, chi2 column

Table 6.5

tab FamMem shopcat, chi2 column

tab Child shopcat, chi2 column

tab OwnCar shopcat, chi2 column

Table 6.8

The general Stata command used was

tab DepVar shopcat, chi2

where **DepVar** represents the categorical variables

Price, Location, Amenities, Promotion, CleanOrg, ProdQual, ProdVar, Service, FamSizePac, and ComRel

tab Price shopcat, chi2

tab Location shopcat, chi2

tab Amenities shopcat, chi2

tab Promotion shopcat, chi2

tab CleanOrg shopcat, chi2

tab ProdQual shopcat, chi2

tab ProdVar shopcat, chi2

tab Service shopcat, chi2

tab FamSizePac shopcat, chi2

tab ComRel shopcat, chi2

ANOVA tests (Table 6.6)

The general Stata command used was

oneway DepVar shopcat, tabulate sidak bonferroni scheffe

where **DepVar** represents the continuous variables

SpendSuper, SpendMkt, SpendConvStr, MinShop, and MinTravel in four separate tests

The option **tabulate** generates a table with means and standard deviations

The options **sidak**, **Bonferroni**, and **scheffe** generate Sidak, Bonferroni and Scheffe post-hoc test statistics respectively

oneway SpendSuper shopcat, tabulate sidak bonferroni scheffe

oneway SpendMkt shopcat, tabulate sidak bonferroni scheffe
oneway SpendConvStr shopcat, tabulate sidak bonferroni scheffe
oneway MinShop shopcat, tabulate sidak bonferroni scheffe
oneway MinTravel shopcat, tabulate sidak bonferroni scheffe

t-tests (Table 6.7)

The general Stata command used was

ttest DepVar, by (OwnCar)

where **DepVar** represents the continuous variables

SuperFreq, MktFreq, ConvStrFreq, SpendSuper, SpendMkt, and SpendConvStr

ttest SuperFreq, by (OwnCar)

ttest MktFreq, by (OwnCar)

ttest ConvStrFreq, by (OwnCar)

ttest SpendSuper, by (OwnCar)

ttest SpendMkt, by (OwnCar)

ttest SpendConvStr, by (OwnCar)

Research Question III

Negative Binomial (Table 6.9)

The first set of regressions used the general Stata command

nbreg DepVar Shopcat Age Male Educ

The second set of regressions had frequent shoppers as independent variables of interest and used the general Stata command

nbreg DepVar FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

Where **DepVar** represents ordinal variables (0-7 days)

BrkfstOut, DinnerOut, Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs

Shopper Group

nbreg BrkfstOut Shopcat Age Male Educ

nbreg DinnerOut Shopcat Age Male Educ

nbreg Fastfood Shopcat Age Male Educ

nbreg WstnSnacks Shopcat Age Male Educ

nbreg SwtDrinks Shopcat Age Male Educ

nbreg Alcohol Shopcat Age Male Educ

nbreg Exercise60Min Shopcat Age Male Educ

nbreg Sit8Hrs Shopcat Age Male Educ

Frequent Shopper

nbreg BrkfstOut FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg DinnerOut FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg Fastfood FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg WstnSnacks FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg SwtDrinks FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg Alcohol FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg Exercise60Min FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

nbreg Sit8Hrs FreqMktShppr FreqSuperShppr FreqConvStrShppr Age Male Educ

Test 1 Histogram (Table 6.10)

Hist BrkfstOut

Hist DinnerOut

Hist Fastfood

Hist WstnSnacks

Hist SwtDrinks

Hist Alcohol

Hist Exercise60Min

Hist Sit8Hrs

Test 2 mean equal variance (Table 6.11)

summarize *variable*, detail

Test 3: Poisson Goodness of Fit (GOF) test

poisson *depvar agegroup male Educ*

estat gof

Test 4: The Likelihood Ratio Test of Alpha

nbreg *DepVar Shopcat Age Male Educ*

Research Question IV

BMI and shopping destination (Table 6.14)

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*) and uses the following Stata command

Regress bmi i.Shopcat

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

Regress bmi i.Shopcat Age Male Educ

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

Regress bmi i.Shopcat Age Male Educ HHMem Child OwnCar FTWrks

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

Regress bmi i.Shopcat Age Male BrkfstOut, DinnerOut, Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs

PBF and shopping destination (Table 6.15)

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*) and uses the following Stata command

regress pbf i.Shopcat, robust

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

regress pbf i.Shopcat Age Male Educ, robust

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

regress pbf i.Shopcat Age Male Educ HHMem Child OwnCar FTWrks, robust

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

regress pbf i.Shopcat Age Male BrkfstOut, DinnerOut, Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs, robust

Waist circumference and shopping destination (Table 6.16)

The first model contains only the independent variables of interest *Shopcat* (*Modern_Shoppers*, *Traditional_Shoppers*, and *Mixed_Shoppers*) and uses the following Stata command

regress WC i.Shopcat, robust

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

regress WC i.Shopcat Age Male Educ, robust

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

regress WC i.Shopcat Age Male Educ HHMem Child OwnCar FTWrks, robust

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

regress WC i.Shopcat Age Male BrkfstOut, DinnerOut, Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs, robust

BMI and Shopping Frequency (Table 6.17)

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive. The following Stata command was executed

regress bmi Freq_Super Freq_ConvStr Freq_TradMkt, robust

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

regress bmi Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ, robust

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

```
regress bmi Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ HHMem Child  
OwnCar FTWrks, robust
```

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

```
regress bmi Freq_Super Freq_ConvStr Freq_TradMkt Age Male BrkfstOut, DinnerOut,  
Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs, robust
```

PBF and Shopping Frequency (Table 6.18)

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive. The following Stata command was executed

```
Regress PBF Freq_Super Freq_ConvStr Freq_TradMkt
```

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

```
Regress PBF Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ
```

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

```
Regress PBF Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ HHMem Child  
OwnCar FTWrks
```

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

```
Regress PBF Freq_Super Freq_ConvStr Freq_TradMkt Age Male BrkfstOut, DinnerOut,  
Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs
```

Waist Circumference and Shopping Frequency (Table 6.19)

The first model contains only the independent variables of interest *Freq_Super*, *Freq_ConvStr*, and *Freq_TradMkt*. Note that these categories are NOT mutually exclusive. The following Stata command was executed


```
regress WC Freq_Super Freq_ConvStr Freq_TradMkt, robust
```

The second model contains the control variables *Age*, *Male*, and *Educ*, using the following Stata command

```
regress WC Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ, robust
```

The third model contains the control variables *Age*, *Male*, *Educ*, *HHMem*, *Child*, *OwnCar*, and *FTWrks* using the following Stata command

```
regress WC Freq_Super Freq_ConvStr Freq_TradMkt Age Male Educ HHMem Child  
OwnCar FTWrks, robust
```

The fourth model contains the control variables *Age*, *Male*, *BrkfstOut*, *DinnerOut*, *Fastfood*, *WstnSnacks*, *SwtDrinks*, *Alcohol*, *Exercise60Min*, and *Sit8Hrs* using the following Stata command

```
regress WC Freq_Super Freq_ConvStr Freq_TradMkt Age Male BrkfstOut, DinnerOut,  
Fastfood, WstnSnacks, SwtDrinks, Alcohol, Exercise60Min, and Sit8Hrs, robust
```

BIOGRAPHY

Tinapa Himathongkam grew up in Bangkok, Thailand. She attended Wesleyan University in Middletown, Connecticut, where she received her Bachelor of Arts in East Asian Studies with a concentration in Political Economy in 2005. She spent two years teaching English in Japan before spending one year working in the healthcare industry in Thailand. She went on to receive her Master of Public Policy in 2011 from Georgetown University in Washington, DC. She then received her Doctor of Philosophy in Public Policy from George Mason University in 2016.