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Examining the Changing Role of Influencing Factors in the Association between Food Insecurity & Obesity

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EXAMINING THE CHANGING ROLE OF RISKY BEHAVIORS IN THE ASSOCIATION BETWEEN FOOD INSECURITY AND OBESITY

by

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CHAPTER 1

INTRODUCTION

Food insecurity is a global problem which has been around for centuries but has not been able to gather the appropriate concern from the policy makers nor the general population. For those who do intend to work on this challenge, they are faced with multiple issues, such as social customs, behavior of individuals and stages in the human life cycle, food availability and quality. A big concern that we face today is bringing a consensus to the understanding of the problem to come up with an effective response.

Leading a healthy lifestyle is a choice but having access to it is a basic human right. There are many who just don't have access to it whereas others who choose to follow an unhealthy routine. Living a "healthy" lifestyle takes time and energy. It requires giving extra in everything, be it the time one spends in the grocery store – aisle to aisle looking up the organic products, cooking/preparing the meals instead of ordering in, saying no to that extra drink, and being careful when eating out. The world today is more globalized than ever and almost every community has people from different backgrounds, lifestyle, access to resources and level of education. Hence, the problem which I will discuss in this paper is 'Examining the changing role of risky behaviors in the association between food insecurity & obesity'. We will explore the association between food insecurity and obesity over time and adding the element of time would help us make more careful considerations in making policies.

The concept of 'food security' first began to draw attention in the 1940s and is now commonly used in planning, implementing and assessing philanthropic emergency and development policies and programs. The universal definition of 'food security', acknowledged by the highest level of global governance on food security, the Committee on World Food

Security (CFS), describes it as a situation where ‘all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life’ (CFS 2012 as per the FAO 1996 definition). Until recently, it was assumed that the only reason for being overweight was excessive eating. Food insecurity could also cause weight gain and obesity due to adverse social and physical environments with certain identifiable risk factors.

Obesity is often linked with unhealthy behavior and laziness; however, it is not only health but also an economic phenomenon. Because of the high costs of obesity, and the fact that majority of these costs are financed by taxpayers, there is a clear motivation for government to try to reduce these costs. However, because obesity may result from poor information, lack of education, addictive behavior and/or as a result of being a part of an increasingly unhealthy lifestyle, interventions will need to be multifaceted to ensure the best chance of success. It is also to be noted that eating healthy comes at a cost. In a world where an entire meal with unlimited soda refills is for $4.00 on average, a mere bowl of salad might cost about $7.00 or more. Hence healthier options are also much more expensive.

There are economic, social, environmental and political systems related to food (in)security and these are all inter-connected: eliminating one cause of food insecurity may bring to light a more deeply rooted cause of which the original insecurity may have been a symptom. An example of this case would be, we might give cash to a poor family to buy food, only to find that lack of cash was a stemmed from another problem, such as a lack of work opportunities. But theoretical disagreements may distract from the problem. One such disagreement from Pangaribowo et al. (2013) offers the argument: that food security is an aim in itself, not just a prerequisite for adequate nutrition. So here it is assumed that food insecurity is a bigger issue

than just the availability of adequate nutrition and such differences in opinions of experts cause difficulty in effective policy related decisions. (Hendriks and Drimie 2011; Coates2013; Candel 2014) claim that how we understand and define food security determines how we measure it. Our knowledge on the subject has increased incrementally but more research needs to be done to be able to dissect and solve the problem for good. This paper aims to provide better understanding of food (in)security and the various dimensions that incorporate it.

CHAPTER 2

REVIEW OF LITERATURE

The literature reviewed for this project is majorly selective rather than exhaustive and various scientific, government and industry sources of information have been studied. French et al. (2001) states that obesity is on the rise in USA and currently about 50% of US adults and 25% of US children are overweight. There is a certain percentage among these people who are food insecure and still in the obese category. It is hard to fathom how one can be food insecure and obese at the same time, but this is a real epidemic. Better understanding of food (in)security leads to better measurement and reforms and the measurement can consider quantitative, qualitative, psychological and social or normative paradigms of the experience of food insecurity (Campbell 1991, p410). There are various other approaches which have emerged over time and there is no set formula that exists to base the measurement. Roughly three decades ago, food insecurity was based on the belief that it is just caused by insufficient food supply. The solution was therefore, to produce more food. This was not the actual problem as different studies led to the understanding that food insecurity is also when people experience food deprivation because they have difficulty in accessing it and not necessarily because it is not available in the marketplace (Sen 1981). This understanding led to a shift in the focus towards identifying subjective experiences of hunger and 'coping' tactics as determinants of food security. This is an ever evolving topic and Renzaho and Mellor (2010) claim that coping strategies based on the perspective of availability as a whole is misrepresentative and we should consider social, political and cultural aspects when looking at food insecurity. When we talk about the measurement of food security, it is important to know its linkage with utilization which is based either on dietary quality i.e. food consumption and dietary diversity, or on biological analysis on

the effects of food consumption. Nutrient requirements however, vary from person to person and depend on things like age and sex of each individual. Therefore, it is not easy to generalize utilization and nutrition data among populations and the data cannot be aggregated at household or national levels as it has been done in the past (Coates 2013). An example that does exhibit this scenario would be that stunting levels of young children can be aggregated at household level and across populations. However, nutrition can only be measured at an individual level. Thus, it cannot be claimed that a said household is well nourished unless all members meet the criteria for sound nutrition as per their age, sex, weight, height and activity levels.

The first three food security dimensions are availability, access and utilization and these are hierarchical in order. Food availability is necessary but not sufficient for access, and access is necessary but not sufficient for utilization (Webb et al. 2006). However, these factors depend on constant availability, access to food and the means to obtain adequate food for all household members throughout the life cycle. Until now, very little importance has been given to the stability dimension of the food security challenge. Some reports may show individuals to having enough the be placed in the food secure category, but that might be their temporary state and could very easily change in matter of months. So, it is critical to study how households have progressed over time as that would give a better picture of their scenario.

An instrument developed by the USDA has been administered since the mid-1990s as part of the CPS (Current Population Survey) and it has been used in many surveys (such as NHANES, Panel Study of Income Dynamics, the Los Angeles Family and Neighborhood Survey). It has also become the foundation for official approximations of the number of hungry people in the United States (Bhattacharya et al. 2004). The CPS is a source that is updated relatively consistently and frequently and subsequently helps in building data sets like the NHANES.

CHAPTER 3

DATA DESCRIPTION AND VARIABLES

The data used for this research is from the National Health and Nutrition Examination Survey (NHANES) and three different data sets are used to observe trends over time. The three sets of data used are 2009-2010, 2011-2012 and 2013-14. NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interview and physical examinations. The program began in the 1960s and has conducted a series of surveys focusing on different population groups or health topics. It has been a continuous program since 1999 and has followed an evolving focus on a variety of health and nutrition measurements to meet emerging needs. The NHANES interview includes demographic, socioeconomic, dietary and health related questions.

The dependent variable in the study is going to be (Y) Obesity (Y/N) and there are several independent variables which include (X2) Food Security which covers the levels of food security the respondents are currently in, (X3) Education which covers the highest grade or level of school completed or the highest degree received, (X4) Race which covers reported race and Hispanic origin information and (X5) Expenses which shows that during the past 30 days, how much money you spend on eating out. Another independent variable (Y6) is Smoking which asks respondents if they currently smoke. This variable will be examined at a later part of the research. In addition, we will use dummy variables for Food Security, Education, Income and Race so additional variables will include for Food Security: Food Security2, Food Security3, Food Security4; for Education, Education2, Education3, Education4 & Education5; for Race: Race2, Race3, Race4 & Race5. In order to study variables with multiple levels, some levels were

omitted as dummy variables. These include Education (>9th grade), Race (Non-Hispanic Whites) and Food Security (Full Food Security).

A summary of the definitions and descriptive statistics of variables used in the model is shown in the table below:

Table1: Definitions of Variables Used in the Empirical Model

Variable	Description
BMI	Body Mass Index (kg/m**2)
Food Security 1 (Omitted Category)	Adult food security category for last 12 months (Full Food Security)
Food Security 2	Adult food security category for last 12 months (Marginal Food Security)
Food Security 3	Adult food security category for last 12 months (Low Food Security)
Food Security 4	Adult food security category for last 12 months (Very Low Food Security)
Food Security 5	Adult food security category for last 12 months (Full Food Security)
Race1	Recode of reported race and Hispanic origin information (Mexican American)
Race2	Recode of reported race and Hispanic origin information (Other Hispanic)
Race3 (Omitted Category)	Recode of reported race and Hispanic origin information (Non-Hispanic White)
Race4	Recode of reported race and Hispanic origin information (Non-Hispanic Black)
Race5	Recode of reported race and Hispanic origin information

	(Other Race - Including Multi Race)
Education1 (Omitted Category)	What is the highest grade or level of school completed or the highest degree received? (>9th grade)
Education2	What is the highest grade or level of school completed or the highest degree received? (9th – 11th grade)
Education3	What is the highest grade or level of school completed or the highest degree received? (High School Graduate)
Education4	What is the highest grade or level of school completed or the highest degree received? (Some College Degree)
Education5	What is the highest grade or level of school completed or the highest degree received? (College Graduate)
Smoking 1	Do you now smoke cigarettes (Yes/No)

Following are the codes which are going to be used to define the responses for the variables (a detailed list showing trends over the years is shown in the appendix section).

BMXBMI - Body Mass Index (kg/m2)**	
Code	**Value Description**
12.1 to 82.9	Range of Values

Table 2: Body Mass Index (BMI) Classifications

Height	Weight Range	BMI	Considered
5' 9"	124 lbs. or less	Below 18.5	Underweight
	125 lbs. to 168 lbs.	18.5 to 24.9	Healthy weight
	169 lbs. to 202 lbs.	25.0 to 29.9	Overweight
	203 lbs. or more	30 or higher	Obese
	271 lbs. or more	40 or higher	Class 3 Obese

Table 3: Education Description

Education	
Code	**Value Description**
1	Less than 9th grade
2	9-11th grade (Includes 12th grade with no diploma)
3	High school graduate/GED or equivalent
4	Some college or AA degree
5	College graduate or above

Table 4: Food Security Description

Food Security	
Code in NHANES	**Value Description**
1	AD full food security
2	AD marginal food security
3	AD low food security
4	AD very low food security

Table 5: Race Description

Race	
Code	**Value Description**
1	Mexican American
2	Other Hispanic
3	Non-Hispanic White
4	Non-Hispanic Black
5	Other Race - Including Multi-Racial

Table 6: Smoking Description

Smoking	
Code	**Value Description**
1	Every day
2	Some days
3	Not at all

Table 7: Expense

Expense	
Code	**Value Description**
0 to 2142	Range of Values
777777	Refused
999999	Don't know

The data has been partially reorganized as certain respondents have been removed from the source since their responses to single or at times multiple variables were missing. Most respondents have not replied to the smoking category and over 70% of the answers have not been recorded. Therefore, the smoking variable will not be examined at this point of the research.

CHAPTER 4

DATA DESCRIPTION / SUMMARY STATS

Table 8 shows the level of food security for respondents with different levels of education. It can be seen from the data that for people with education level below 11th grade - there are more people (in percentage terms) with low food security compared to those having marginal food security. As we move up towards respondents with higher education levels, a gradual trend can be noticed for decreasing food security levels and there are more and more people who are food secure.

Table 10 (page 14) is a representation of the BMI levels of individuals with different levels of Food security. The point of concern are those individuals who have low food security but are still obese. The table shows at least 25% of the people fall in this category of being obese or class 3 obese despite being food insecure. One of the reasons for this could be eating unhealthy food or having varied meal portions for example a small meal for breakfast and a very large meal for dinner.

In section 7 we look at the OLS results of the Linear Probability Model used in this research and all three datasets were compared to observe any variation in the results. The results observed were not quite as per the expectations in the first two data sets (2009-10 and 2011-12) but we did see some variables having a strong effect on the dependent variable (obesity) in the 2013-14 dataset.

Table 8:

Average $ Spent on Eating out			
	2009-10	2011-12	2013-14
Full Food Security	145	165	171
Marginal Food Security	108	112	107
Low Food Security	83	89	100
Very Low Food Security	73	83	83

As shown in the table above, the average expenditure of the respondents on eating out has increased for those who have Full, Low and Very low food security over time from 2009 to 2014, whereas it has slightly decreased for those individuals who are in the Marginal Food security category. The reason for the increase is most likely the increasing trend of eating out in the United States in the past decade and as people now have more options, some of which are affordable as well, this trend is likely to increase even though it is not the healthiest of act as food from restaurants such as fast food is known to be less nutritious compared to food prepared at home.

CHAPTER 5

EMPIRICAL MODEL

While examining the role of risky behavior in the association between food security and obesity, it is vital to note that individuals who are food insecure could be obese and vice versa. The factors causing this peculiar occurrence are diverse and will be discussed in the results section. An obvious differentiating factor between people with high and low level of education is the availability of resources. Better educated people are expected to earn more compared to those with lesser education and these difference in earnings could affect health and the behavior associated with the lifestyle. This however does not mandate that all those who are highly educated will be leading a healthy lifestyle and are avoiding risky behavior such as smoking or excessive eating. The following two hypothesis will be used in this case and they are as follows:

The independent variable in this study is going to be Food Security, Race, Education and Expense whereas the dependent variable is going to be the Obesity level of the respondents. Following is the model which is going to be used for this study:

$$\textbf{Obesity (Y)} = ß_0 + ß_1*FS2 + ß_2*FS3 + ß_3*FS4 + ß_4*Race2 + ß_5*Race3 + ß_6*Race4 + ß_7*Race5 + ß_8* Edu2 + ß_9*Edu3 + ß_{10}*Edu4 + ß_{11}*Edu5 + ß_{12}Inc + ß_{13}Age + \mu i$$

Hypothesis I

Null Hypothesis: Marginal food security is not associated with obesity

Alternate Hypothesis: Marginal food security is associated with obesity

Hypothesis II

Null Hypothesis: Very Low Food Security is not associated with obesity

Alternate Hypothesis: Very Low Food Security is associated with obesity

CHAPTER 6

DESCRIPTIVE STATS

Table 9

Food Security Levels (For different levels of Education) in percent (%)						
	Less than 9th grade			9-11th grade		
	2009-10	2011-12	2013-14	2009-10	2011-12	2013-14
Full Food Security	47	54	53	57	56	58
Marginal Food Security	15	16	16	15	16	12
Low Food Security	23	20	20	15	15	20
Very Low Food Security	15	10	11	13	14	11
Grand Total	100	100	100	100	100	100

High school graduate			Some college or AA degree			College graduate or above		
2009-10	2011-12	2013-14	2009-10	2011-12	2013-14	2009-10	2011-12	2013-14
66	61	66	73	67	70	90	87	90
13	14	13	11	13	12	6	6	4
11	14	13	8	10	10	3	4	4
10	11	9	8	10	9	2	2	2
100	100	100	100	100	100	100	100	100

Table 10

Food Security Levels (BMI Levels among food security classes) in percent (%)						
		Underweight	Healthy Weight	Overweight	Obese	Class 3 Obese
Full Food Security	2009-10	18	30	25	22	4
	2011-12	22	31	23	20	5
	2013-14	19	3	23	21	5
Marginal Food Security	2009-10	18	30	25	22	6
	2011-12	22	29	23	21	5
	2013-14	21	31	22	21	5
Low Food Security	2009-10	22	26	26	21	5
	2011-12	21	31	25	19	4
	2013-14	21	32	22	21	4
Very Low Food Security	2009-10	20	28	26	21	5
	2011-12	21	34	23	19	4
	2013-14	22	28	24	20	5

Table 11

Food Security Levels (Race Specific) - in percent (%)						
	Mexican American			Other Hispanic		
	2009-10	2011-12	2013-14	2009-10	2011-12	2013-14
Full Food Security	48	47	55	55	57	57
Marginal Food Security	19	23	15	19	15	14
Low Food Security	21	21	22	14	14	20
Very Low Food Security	12	9	9	13	13	9
Grand Total	100	100	100	100	100	100

Table 11 (Contd.)

Food Security Levels (Race Specific)									
	Non-Hispanic Black			Other Race - Multi-Racial			Non-Hispanic White		
	2009-10	2011-12	2013-14	2009-10	2011-12	2013-14	2009-10	2011-12	2013-14
Full Food Security	57	55	61	73	77	79	78	73	74
Marginal Food Security	17	19	16	11	11	9	9	9	10
Low Food Security	14	16	14	11	6	6	7	9	8
Very Low Food Security	12	10	9	6	6	6	7	9	8
Grand Total	100	100	100	100	100	100	100	100	100

CHAPTER 7

RESULTS

Correlation and multiple regression analyses were conducted for three different data sets covering a period from 2009 through 2014), to examine the relationship between those who were obese and various explanatory variables which might contribute towards obesity. The same explanatory variables were also regressed against underweight participants to better understand health outcomes of extremely high or low BMI values. The tables below summarize the descriptive statistics and analytical results. The objective to examine three different data sets is to observe any prevailing trends for variables such as education, income, race and lifestyle habits.

The dependent variable, Obese, is a binary variable where respondents are considered either obese or otherwise (coded as 1) in this linear probability model. As can be seen in Table 1, where the dependent variable is Obese, the coefficient for income for 2009-10 is 0.001, so for every 1-unit increase in income category is associated with a 0.1% increase is predicted in obesity. The coefficient was slightly high in 2011-12 at 0.004 which tells us that every 1-unit increment in income category will lead to a 0.4% increase in obesity. For the 2013-14 data, the coefficient for income was 0.001, so for every 1-unit increase in income category, a 0.1% increase is predicted in obesity. In all these data sets, the coefficient for income is not significant since the p-value is greater than 0.05 (0.784, 0.279 and 0.637) respectively.

Looking at the age variable, for every unit increase in age -or a year increase in age, we expect a 0.01% decrease in obesity for the 2009-10 and 2013-14 data sets. We do see a positive relationship for the 2011-12 data set i.e. for every year increase in age, obesity would see a 0.1% positive change. The coefficient for age in all data sets are not significant and the p-values can be seen at 0.686, 0.479 and 0.884, respectively (from 2009 through 2014).

The next variable which we examine is education and how different levels of education are associated with obesity of the respondents. The omitted variable is Education (>9th grade) and the remaining variables are studied against the it. The results are somewhat in contradiction of what the general perception of education is where the society expects a higher level of education to enable individuals to be more knowledgeable and as a result be more physically fit but our results show that none of the education levels are significant for our research. For example, the p-value for Education (9th -11th grade) in 2009-10 is 0.616. The coefficient is 0.024 which shows that, compared to someone who has Education (>9th grade), those having the Education level (9th – 11th grade), will have a 2.4% higher chance of becoming obese. We do see a negative impact in the 2013-14 data set for the Education levels of (9th-11th grade, Highschool grads, some college education and college graduates). So as per the 2013-14 data set, the coefficient for Education (9th-11th grade) is -0.043, which shows that compared to someone with Education (>9th grade), that person will have a 4.3% less chance of being obese. This is what we expect to see as an influence of higher education that it curtails an unhealthy lifestyle. These results however are not significant, that is, the p-values are high.

Race is an important variable when studying obesity and is an important contributor towards the health and wellbeing of individuals. Lifestyle also plays a critical part and when race and lifestyle are both contributing together towards a particular direction, the results can have significant effects on health. Since we were observing multiple races, we had to omit one variable and that was Race (Non Hispanic Whites). So compared to those belonging to the Race (Non-Hispanic White) category the Mexican Americans, Other Hispanics and Other Race (which includes Asians, Europeans and others) are not found to be significant towards obesity. A look at Mexican Americans show us that the coefficient for the 2009-10 data set is 0.008. So compared

to someone who belongs to the Non-Hispanic White category, the individual is 0.8% more likely to be obese (but a P-value of 0.835 makes this variable not significant). For the non-Hispanic black respondents, the 2013-14 figures show this variable to be significant as the p-value is 0.021. With the coefficient at -0.058, our data shows that compared to someone who is Non-Hispanic White, an individual who belongs to the Non-Hispanic Black community is 5.8% less likely to be obese.

Moving forward to our next variable, Food Security is directly linked with obesity and one of the major inspiration for writing this report is to gauge whether having enough or too less food impacts the BMI levels and obesity of our respondents. Since we are studying different variables from the Food Security category, we decided to omit the Full Food Security category as a dummy variable. The first level that we are going to report compared to the Full Food Security category is Marginal Food security. For 2009-10 and 2011-12, the beta value (ß) is negative, at -0.007 and -0.028 which tells us that compared to someone having Full Food Security, an individual having marginal food security is 0.07% and 2.8% less likely to be obese. This is aligned with the general opinion that having a higher food security will enable respondents to have access to a large number of food options and they will choose to eat healthy rather than eat whatever is available to them. The 2013-14 data set for the same variable – Marginal Food Security shows the coefficient at 0.020 which shows that compared to someone having Full Food Security, someone who has marginal food security has 2.0% chance of being obese. This fuels the counter argument for the general opinion shared above that having larger quantities of food contributes to larger eating portions and hence a rise in obesity is predicted. However, this variable is not significant for all three data-sets so the results are inconclusive. For the Low Food Security variable, the p-values are not significant as well as they are greater than 0.05. We do see

a positive relationship in the 2009-10 and 2011-12 data sets. With a coefficient of 0.005 and 0.010, so for compared to someone having Full Food Security, an individual having low food security is has 0.5% and 1% chance of being obese. These numbers point towards the possibility of unhealthy eating habits and patterns. However, we see a negative coefficient for the 2013-14 data set, it is noted compared to the omitted category, an individual having low food security is a 1% less likely to be obese - which could be caused with lack of food resources. For the Very Low Food Security variable, it is also found to be not significant since the p-values are greater than 0.05.

The last variable which we are going to evaluate in this section is Smoking. It is common knowledge that smoking is injurious to health and the causes a number of diseases. The industry also faces a lot of challenges from the governments and social workers do to the harmful impact of smoking on the human body. The 2009-10 and 2011-12 data sets show smoking to be not significant towards impacting obesity with p-values of 0.289 and 0.203 respectively. For the 2013-14 data-set however, the p-value is significant at the 10% alpha level at 0.053. This leads us to the observation that for every unit increase in smoking, or for every additional cigarette smoked, we expect a 1.9% less chance of being obese. It's long been known that nicotine causes a slump in appetite, and scientists suspected that this worked through receptors associated with reward and behavior reinforcement (Williams 2011). The brain considers both food and cigarettes to be rewards and at times works in a way that a supply of nicotine leads to a loss of appetite and hence lesser chances of higher BMI or obesity.

Table 11

Dependent Variable: Obese	2009-10 ß (P-Value)	2011-12 ß (P-Value)	2013-14 ß (P-Value)
Income	0.001	0.004	0.001
	(0.784)	(0.279)	(0.637)
Age	-0.0001	0.001	-0.0001
	(0.686)	(0.479)	(0.844)
Education 9-11Grade	0.024	0.050	-0.043
	(0.616)	(0.359)	(0.313)
Education - HSGrad	0.017	0.070	-0.043
	(0.674)	(0.165)	(0.300)
Education - Some College	0.008	0.026	-0.028
	(0.825)	(0.602)	(0.499)
Education - CollegeGrad	0.058	-0.008	-0.009
	(0.106)	(0.889)	(0.828)
Race - MexAmerican	0.008	-0.036	0.002
	(0.835)	(0.446)	(0.944)
Race - OtherHisp	0.034	-0.011	-0.033
	(0.476)	(0.818)	(0.350)
Race - NonHispBlk	0.030	-0.026	-0.058**
	(0.375)	(0.414)	(0.021)
Race - OtherRace	-0.024	-0.017	0.027
	(0.680)	(0.673)	(0.346)
Food Security -Marginal	-0.007	-0.028	0.020
	(0.863)	(0.473)	(0.519)
Food Security - Low	0.005	0.010	-0.010
	(0.907)	(0.823)	(0.744)
Food Security - Very Low	-0.017	0.001	-0.002
	(0.723)	(0.991)	(0.951)
Smoking	0.014	-0.017	-0.019*
	(0.289)	(0.203)	(0.053)

Notes: *p*-values are given in parentheses

Number of respondents were 1304, 1076, 2409 for 2009-10, 2011,12 and 2013,14 respectively

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

Moving on to the other end of the spectrum where we studied 'Underweight' as the dependent (Y) variable so as to peruse at what could factors contribute towards low BMI or the underweight category. As can be seen in Table 2, the income coefficient for 2009-10 is -0.001, so for every unit increase in income category, there is a 0.1% less chance of being underweight. This is aligned with the results in Table 1 as the results are opposite for obesity and underweight variable. The coefficient is consistent for the next two data sets which were examined at -0.001 (or 0.1% less chance of being underweight). The coefficient is not significant in all the cases as the p-value is greater than 0.05 (0.673, 0.678 and 0.685) respectively.

The next variable we studied was Age as it is commonly perceived that physical activity decreases as people get older. For the 2009-10 period, the coefficient is negative and stands at -0.0002 with a high p-value of 0.758 so even though the impact is negative, the coefficient stands as not significant. There is a positive relationship for the 2011-12 data set and the coefficient value is 0.0005 which shows that for every year increase in the Age of the individual, there is a 0.05% chance of being underweight. The 2013-14 data set is significant as the p-value is 0.032. With a positive coefficient of 0.001, we see a positive relationship which is contrary to the societal norms and for every unit increase in age, or with every passing year, there is a 0.1% chance of the individual to be underweight which means that people are more likely to be underweight as they grow older.

We now look at education its association with the underweight variable for our study. The omitted variable is Education (>9^{th} grade) and the remaining variables are interpreted relative to it. Looking at the Education (9^{th} -11^{th} grade variable), for the 2009-12 period, the coefficient is not significant as the p-values are 0.644 and 0.692, the coefficients however are positive at 0.020 and 0.0204 which shows a positive relationship between the two. For the 2013-14 period, the

coefficient (0.068) is significant at the 10% alpha level as the p-value stands at 0.081. We can comprehend from this information that compared to those having Education (>9th grade), those with an Education (9th-11th grade) have a 6.8% higher chances of being underweight. This is somewhat conflicting to the social expectations as more education should enable individuals with more knowledge and therefore, being physically fit but the results show a positive relationship and hint towards increasing education leading to more and more people towards the underweight end of the spectrum. The next education level, High school graduates show a negative relationship for the 2009-10 period which means that with a coefficient of -0.035, compared to those from the Education (>9th Grade) category, individuals with High school education are 3.5% less likely to be underweight which makes sense according to the perspective that education should enable a healthier lifestyle. The p-value however is not significant as it is shown to be 0.944. For the 2013-14 period, the coefficient (0.068) is significant at the 10% alpha level as the p-value stands at 0.074. This shows that compared to those with Education (>9th Grade), individuals from Education (High school graduates) category are 6.8% more likely to be underweight. A similar trend is seen in the next immediate variable which is Education (Some College degree). We see a negative relationship in 2009-10 and a positive coefficient in 2011-12 (not significant from 2009-12). However, a 0.080 coefficient and a 0.031 p-value shows a very strong narrative that, compared to those having Education (>9th Grade), we expect those with some level of college education to have an 8% higher chance of being underweight. One reason for this consistent trend could be that with increasing education levels, people become more and more health conscious and spend large amount of time at working out trying to look fit and lose weight which could lead them to have a low BMI which they might not even be aware of. The last category for Education is the College grads and they also show they exact same trend as the

previous three variables, which is a negative coefficient (-0.011) in 2009-10, followed by a positive coefficient (0.034) in 2013-14 and only that the p-value is not significant for the any of the time period (0.743, 0.440, 0.381) for 2009-14 periods.

Race is an interesting variable to study when observing obesity or underweight individuals and at times there can be genetic reasons for people to be on either extreme of the weight spectrum. However, with race, lifestyle also comes into play and we different races are observed to have different lifestyles. For example, people from South Asia and parts of Middle East are prone to having dinner/meals very late and night and sleeping very soon after eating. This is a practice which is not commonly observed in North America or Europe and it is something which can have serious effects on the health and wellbeing of individuals. Since we were observing multiple races, we had to omit one variable and that was Race (Non Hispanic Whites). We look at Mexican Americans and they have a negative coefficient of -0.109 for the 2011-12 data set. The p-value is significant with a value of 0.013. We can determine that there is a negative relationship and hence, compared to Non Hispanic Whites, Mexican Americans respondents are 1.9% less likely to be underweight. This is however challenged in the next immediate data set as the p-value is 0.007 and with a coefficient of 0.072, we observe a positive relationship and in this case, Mexican Americans are 7.2% more likely to be underweight. This is rather surprising to see such a stark difference in two immediate datasets and it makes interpreting the race variable very challenging. The next variable is Race- Other Hispanics and we observe the data to be not significant from 2009-2012 as the p-values are 0.639 and 0.947. However, for the 2013-14 data-set, the variable is significant with a positive coefficient of 0.108 so compared to Non Hispanic Whites, Other Hispanics are 10.8% more likely to be underweight. Other Race variables (Non-Hispanic Black & Other Races) do not show any significant data for our research.

The next variable we studied is Food security and we are trying to gauge the relationship between food security and underweight individuals. Since we are studying different variables from the Food Security category, we decided to omit the Full Food Security category as a dummy variable. Common sense tells us that a low food security should warrant a low BMI or underweight prevalence, but our results show somewhat a different image. For the Food Security – Marginal variable, the coefficient is 0.074 and the p-value is significant with a value of 0.039. This positive relationship shows compared to those having full food security, individuals with marginal food security have a 7.4% higher chance of being underweight. This information sticks in simple terms tells us that those having a higher food security have lesser chance to be underweight when compared to those having lower level of food security (marginal food security in this case). The results are not significant for 2011-14 for the Marginal Food Security Variable. We see very similar results in the Low Food Security variable as for 2009-10, the p-value is significant at 0.099 and the coefficient is positive with a 0.066 value. Hence, it is noted that compared to those having full food security, individuals having low food security have a 6.6% chance of being underweight. For 2011-14, the p-value is not significant, but we can still see a positive relationship between Low Food Security and the Underweight variable. Very Low Food Security is also observed to have a positive relationship in all years with a coefficient of 0.043, 0.033 and 0.025 but the p-values are not significant.

The last variable is Smoking and it has a negative relationship for 2009-2012 years as the coefficient has a value of -0.015 and -0.021 respectively. It is noted that p-value is significant for 2011-12 data at the 10% level and we observe that for every incremental cigarette smoked, we expect a 2.1% lower chance of being underweight. In the next immediate data set, we see a positive relationship between these two variables as the coefficient is 0.021. With the p-value of

0.016, we find this relationship to be significant and here we can see that for every incremental cigarette smoked, we expect a 2.1% higher chance of being underweight. This is in contrast to the relationship of the same variables in the previous data set and it questions the existing theories about whether smoking has a positive or a negative impact on the BMI levels. We will require further research to determine the answer to this particular question.

Table 12

Dependent Variable: Underweight	2009-10 ß (P-Value)	2011-12 ß (P-Value)	2013-14 ß (P-Value)
Income	-0.001	-0.001	-0.001
	(0.673)	(0.679)	(0.685)
Age	-0.0002	0.0005	0.001**
	(0.758)	(0.488)	(0.032)
Education 9-11Grade	0.020	0.0204	0.068*
	(0.644)	(0.692)	(0.081)
Education - HSGrad	-0.035	0.048	0.068*
	(0.337)	(0.313)	(0.074)
Education - Some College	-0.002	0.031	0.080**
	(0.944)	(0.513)	(0.031)
Education - CollegeGrad	-0.011	0.039	0.034
	(0.743)	(0.440)	(0.381)
Race - MexAmerican	-0.006	-0.109*	0.072***
	(0.858)	(0.013)	(0.007)
Race - OtherHisp	-0.020	-0.003	0.108**
	(0.639)	(0.947)	(0.001)
Race - NonHispBlk	0.002	0.008	0.106
	(0.952)	(0.798)	3.08847E-06
Race - OtherRace	-0.050	0.002	0.039
	(0.335)	(0.948)	(0.139)
Food Security -Marginal	0.074**	-0.029	0.028
	(0.039)	(0.436)	(0.328)
Food Security - Low	0.066**	0.005	0.014
	(0.099)	(0.911)	(0.624)
Food Security - Very Low	0.043	0.033	0.025
	(0.305)	(0.500)	(0.449)
Smoking	-0.015	-0.021*	0.021**
	(0.208)	(0.083)	(0.016)

Notes: *p*-values are given in parentheses

Number of respondents were 1304, 1076, 2409 for 2009-10, 2011,12 and 2013,14 respectively

*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

CHAPTER 8

CONCLUSION

The purpose of this study was to study the effects of behaviors by individuals and the effects of these behaviors over obesity. While considering Obesity as the dependent variable, the results from our data sets were not conclusive towards providing evidence for any of the variable to be associated with Obesity. The only variables which came out to be significant were Race (non-Hispanic Black) for the 2013-14 data set and it is very challenging to associate a person's race with their behavior. The only other variable which was shown to be significant was Smoking but only for the 2013-14 dataset. Smoking is known to have negative effects on the health and wellbeing and this result just solidifies this fact which has been proven already.

Interestingly, when we studied being Underweight as the dependent variable, we were able to see quite a few variables which played a significant role. Smoking once again was a key factor in contributing towards adverse health results. For the 2013-14 data set, we saw almost all education variables to be significant and to have an impact towards being underweight which shows that Education is a critical factor for leading a healthy lifestyle and even though people might underestimate its short term impact, it can have serious effects in the long run towards losing weight.

While the study does present some important findings, results must be interpreted keeping the limitations in mind. Most importantly, not all respondents answered all the questions which resulted in removal of a lot of individuals whose data was not compiled completely. Moreover, future informational campaigns should incorporate the results of this report and similar reports which show the findings to have significant impact on the health and wellbeing of individuals. It is critical to understand that Food availability is necessary but not sufficient for access, and

access is necessary but not sufficient for utilization (Webb et al. 2006). Hence there needs to be a holistic policy makeover where it is ensured that not just on the farming level (which takes care of availability), individuals also have proper access to food which is eventually utilized in a manner which is advantageous for their health.

Appendix

Table 7.1

Smoking habits at different levels of Food Security						
	Year	**Every day**	**Some days**	**Not at all**	**Refused/Don't Know/ Missing**	**Total**
Full Food Security	2009-10	10%	2%	15%	73%	100%
	2011-12	9%	2%	13%	76%	100%
	2013-14	10%	2%	13%	75%	100%
Marginal Food Security	2009-10	12%	2%	14%	72%	100%
	2011-12	10%	3%	13%	74%	100%
	2013-14	10%	3%	12%	75%	100%
Low Food Security	2009-10	11%	2%	12%	74%	100%
	2011-12	9%	2%	11%	77%	100%
	2013-14	9%	2%	14%	75%	100%
Very Low Food Security	2009-10	9%	3%	15%	73%	100%
	2011-12	9%	1%	12%	77%	100%
	2013-14	10%	3%	13%	74%	100%

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