Relationship Between Acculturation and Elevated BMI Among Foreign-Born US Residents - NHANES 2015-2016

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ABSTRACT


By

ELIZABETH O. AKINDELE
May 06, 2019

Abstract:

INTRODUCTION: Health risks and economic burden associated with obesity calls for prevention, reduction, and urgent need to bridge the racial and ethnic disparities in its prevalence. More so net international migration is projected to be the highest driver of population growth in the US by 2030. Hence, an exploratory study to understand the burden of obesity across racial/ethnic groups and various sociodemographic subgroups is imperative.

AIM: To describe the relationship between acculturation and elevated BMI among Foreign-born US residents.

METHODS: Using survey data from the 2015 - 2016 National Health and Nutrition Examination Survey (NHANES), this thesis examined the relationship between acculturation using Length of stay as a proxy and elevated body mass index [BMI]) among racial-ethnic groups, Hispanics (n=946), non- Hispanic black (n=145), non-Hispanic whites (n=81), non-Hispanic Asians (n=587), and Multiracial/others (n=29). Descriptive statistics were conducted for all participant characteristics including age, gender, race, marital status, education, and family to income ratio (PIR). Bivariate analyses were conducted using Chi-Square Test for categorical variables and the Wilcoxon Rank sum test for continuous variables. Multivariable logistic regression models were constructed to explore the association of the primary independent variable on elevated BMI outcome. The logistic regression results are reported as odd ratios (OR) and 95% confidence interval (CI).

RESULTS: The is a no significant risk for elevated BMI with length of stay after adjusting for other age, gender, race, education and poverty (adjusted OR 1.19, 95% CI 0.857, 1.654). This finding is at variance with existing literature that shows there is an association between obesity and duration of stay. Gender is a significant factor in the relationship between acculturation and BMI and differs by race/ethnicity.

Conclusions: There is a need for future research to explore the relationship between gender and acculturation among immigrants of different racial-ethnic groups.

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Author’s Statement Page

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Elizabeth Akindele
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CHAPTER I – INTRODUCTION

1.1. Background

Obesity is an established risk factor for cardiovascular diseases (CVD), and a leading cause of death in the US (Centers for Disease Control and Prevention (CDC), 2011). More than a third of adults in the United States were classified as obese in 2011 – 2013 with overall prevalence among non-Hispanic blacks at 47.8%, Hispanics 42.5%, non-Hispanic whites 32.7%, and Asians 10.8% (Ogden, Carroll, Kit, & Flegal, 2013) while in 2014, the costs of obesity in the nation was estimated at $149.4 billion at the National level, and $1901($1239 - $2582) at the individual level (D. D. Kim & Basu, 2016). The health risks and burden associated with obesity makes it a public health primacy.

Furthermore, evidence suggests significant racial and ethnic differences in the prevalence of obesity and susceptibility to obesity related illnesses among Hispanics, non- Hispanic Blacks, Asians relative to non – Hispanic Whites, and that there is paucity of data on the epidemiology of obesity among immigrants, the fastest growing segment of the United states population. (Goel, McCarthy, & Phillips, 2004). Other research studies done among immigrants of Latino origin in the last ten years indicate that obesity prevalence increases with acculturation. Results from a recent review show that among Latino immigrants, acculturation is consistently associated with increased body mass index (BMI), and higher likelihood for obesity (Ro & Bostean, 2015). The study suggests that longer-term immigrants (as measured by length of stay in the United States) have higher BMI than their recently arrived counterparts and are more likely to be integrated into US cultural and behavioral norms. It is unknown if this observation will be consistent when immigrant populations are grouped by various demographic characteristics such as race, gender, education level and, socio economic status etc.

The typical American is less likely to engage in regular physical activity and consumes more calories than he/she needs. Foreign-born US residents are likely to learn and practice these
behaviors as they become more assimilated in U.S. society. Eventually, they may end up health challenges such as obesity, other conditions associated with metabolic dysfunction. Immigrants in the US may also be less healthy than US-born individuals because of challenges in health care access such as having health insurance (Derose, Bahney, Lurie, & Escarce, 2009), and less likely to receive preventive health care (Goel et al., 2004).

According to the US Census Bureau 2017 national population projections, if the present trends continue, by 2028 the foreign-born share of the U.S. population is projected to become higher than at any time since 1850, and net international migration is expected to surpass natural drivers of population growth in the U.S. This report projects that foreign-born persons will grow from 44 million currently to 69 million by 2060. This accentuates the need for understanding the relationship between acculturation and elevated BMI among foreign born US adults to advance the health of migrants and reduce the comorbidity, health and economic burden of obesity, and cardiovascular disease (CVD).

1.2. Research Aims and Hypothesis

Aim 1. To examine the relationship between acculturation in the United States and body mass index among different racial-ethnic groups.

Aim 2. Determine if the relationship is consistent among different race/ethnic groups, and across subgroups e.g. gender, level of education, and socio-economics status (SES)?

Hypothesis 1. Foreign-born U.S residents 20+ years resident in the US for 10 years or more are more likely to have elevated BMI (>25 kg/m²), than individuals who have been resident for less than 10 years.
Hypothesis 2. The relationship between length of residence and obesity within different race/ethnic groups will remain significant across sub groups, gender, level of education, and socio-economic status.
CHAPTER II – LITERATURE REVIEW

2.1. Acculturation and Epidemiology

Epidemiologists have frequently observed trends in minority population health that seem to reflect changes in “cultural orientations” or the degree to which individuals espouse the culture (values, identity, preferences, behaviors, and traditions) of their heritage (ethnic, racial, religious, and national) group Schenker, M. (2008). Consequently, many studies have investigated the relationship between various aspects of acculturation and health, particularly in Hispanic Americans (Thomson & Hoffman-Goetz, 2009), Asian Americans (Salant & Lauderdale, 2003), (Abraido-Lanza, Echeverría, & Flórez, 2016), ethnic minority immigrants to Canada (Sanou et al., 2014) (Urquia, O’Campo, & Heaman, 2012), and Native Americans (Duncan et al., 2014) (Garrett, Baldridge, Benson, Crowder, & Aldrich, 2015). Notable inconsistencies have emerged in the relationship between acculturation and health (Castro, 2007; M. Lopez-Class, F. Castro, & A. Ramirez, 2011). For example, among Hispanic Americans, acculturation has been associated with higher (Moscicki, Locke, Rae, & Boyd, 1989) lower (González, 2001) and no difference (Cuellar & Roberts, 1997) in depression risk, and higher (West et al., 2002), lower (Hazuda, Haffner, Stern, & Eifler, 1988), and no difference (Harris, 1991) in diabetes risk. For another example, among Asian Americans, acculturation has been associated with better (Dey, 2006), worse (Acevedo-Garcia, Bates, Osypuk, & McArandle, 2010), and no difference (John, de Castro, Martin, Duran, & Takeuchi, 2012) in self-rated health.

These kinds of inconsistencies call into question how acculturation, including its various components and domains, affects health related biological and behavioral processes. Shortcomings in the conceptualization and operationalization of acculturation likely account for the many contradictory findings in this area of research. Widely-used methodologies to characterize

2.2. The Construct of Acculturation

Acculturation has been defined as a process of interactivity between two cultures (Redfield, 1936), maintenance of the original culture and development of relationships between two cultures (John Berry, 2003). Acculturation consists of a given set of features (unidimensional, bidimensional or orthogonal change in relationships (Lafromboise, Coleman & Gerton, 1993, Cuellar, Arnold, and Maldnado, 1995), (Kim and Abreu, 2001) has suggested that beyond behavioral indicators such as language use, acculturation should include values and attitudes. They proposed an acculturation scale with three levels of acculturative change; behavioral, cognitive and affective using language use and or choice of friends and values and knowledge to measure each dimension.

Does acculturation reflect internal state (attitudes/preferences/feelings), external state (behaviors), or both? Internal state is comprised of attitudes, preferences, and feelings, while external state is comprised of behaviors. Previous authors have disagreed about whether the construct of acculturation should reflect internal or external state (Ward & Kus, 2012). Internal state (e.g., low mood) may be reflected in external state (e.g., avoidant behavior), and thus internality and externality can be strongly correlated. However, the internal and external aspects of acculturation do not necessarily parallel one another. In a Native American cohort, internalized negative attitudes about Native cultural identity were associated with less adoption of Anglo cultural behaviors (Duncan et al., 2014). Thus, despite the expectation that internal rejection of Native identity should be associated with a shift towards an Anglo cultural status, the opposite was
observed, calling for need of more empirical tests to validate some of the underlying assumptions in literature that beliefs, norms concerning behavior change with greater acculturation.

Acculturation affects health at the point at which acculturation becomes directly or indirectly (i.e., via behavior) “biologically embedded” in an individual. Life experiences, such as social interactions, behaviors, and events, can affect human health (Fox, Entringer, Buss, DeHaene, & Wadhwa, 2015). The supposition that life experiences shape human health was proposed and theoretically developed in the field of medical anthropology, i.e., the study of “cultural embodiment” (Csordas, 1994). The frameworks of “embodiment” in anthropology and “biological embedding” in developmental sciences converge in their mutual interest addressing the social origins of epidemiological inequalities (Gravlee, 2009). Because people in different sectors of society (e.g., based on socio-economic status, ethnicity, geography) have systematic differences in experiences, when those experiences become biologically embedded they can result in systematic differences in health status (Hertzman, 2012). Therefore, certain external aspects of cultural orientation may affect health directly, for example, via use of culturally-favored products that contain heavy metals (Lin, Schaider, Brabander, & Woolf, 2010). Other external aspects of culture may affect health indirectly, i.e., the external manifestation of culture may affect another factor that results in biological change. For example, lacking the ability to speak English is an external manifestation of culture that does not directly affect human health, but may affect access to healthcare resources (Flores, 2006) and thereby indirectly affect health. Internal aspects of culture can affect health only indirectly, often mediated by behavior or psychological stress. For example, low degree of internal adherence to traditional religiosity does not directly change human health but may have an indirect influence by affecting whether an individual engages in illicit drug use.
(Engs & Mullen, 1999), which affects health. Deciding whether acculturation should reflect internal or external states determines which items are appropriate to include in the assessment instruments and invariably has an impact on how it impacts health. To foster theory building in acculturation research, (Sackmann & Phillips, 2004) advocated using contextual analysis, person specific factors such as immigration experience and structural factors such as historic racism which can affect the relationships between acculturation and health outcomes as described by Alegria et al., (2007) (Chirkov, 2009) argued in favor of diverse methodologies and multidisciplinary perspectives, and (Hong, Morris, Chiu, & Benet-Martinez, 2000) recommended using qualitative methods to examine the specific cognitive-affective responses to real-life cultural transitions, (Berry, 2007) calls for the use of specific scales that are meaningful to the health outcome of interest. For instance, in measuring acculturation and obesity

2.3. Acculturation Models

The two dominant theoretical frameworks that have been used in the study of this complex cultural phenomenon are the Linear (unidimensional) and the Bidimensional model.

The Linear Model posits that migrants gradually become like the host group until they become assimilated with the majority host community, and that the host community is not modified by the migrant culture. This theoretical perspective assumes that the acculturation process is a zero-sum phenomenon (Cuellar, Arnold, & Maldonado, 1995). In other words, the nature of the acculturation process involves a loss in one cultural domain as the individual moves toward another cultural domain. Is it really the case that the migrant community really want to merge with the host (majority) community, and that all individuals in the migrant group move along a single continuum, ranging from
the immersion in one’s culture of origin to the immersion in the dominant (host) culture (Cabassa, 2003)?

Berry’s bi-dimensional model says it all depends on the value placed by the migrant on their culture, the host culture and the change in attitude that results from those values. This model as conceptualized by (Berry & Sam, 1996) (Berry, 1997) organizes the process of acculturation into two distinct independent dimensions; adhering to the dominant culture and maintenance of origin culture which could then result in four models of acculturation; Integration (values own and host culture), assimilation (does not value own but values host culture), Separation (values own but not the host culture), and Marginalization (does not value own but host culture) (Berry, 2009).

2.4. Conceptualization to Measurement

How do both theoretical frameworks influence the empirical measurement of acculturation, and what are some of the challenges and limitations of measuring this complex cultural phenomenon. A measure captures the changes that occurs in the individuals and groups that are being acculturated to the dominant culture.

Acculturation Rating Scale for Mexican Americans (ARMSA), Short Acculturation Scales for Hispanics (SASH) predicated on the unidimensional models rely on several behavioral, cognitive attitudinal domains related to acculturation to determine where individuals fall along this theoretical trajectory. Other researchers have depended on proxy variables such as generational status, length of stay, age at immigration, years lived in the new country, place of birth, and place of education to measure acculturation (Cabassa, 2003) (Sanchez, Rice, Stein, Milburn, & Rotheram-Borus, 2010). For example, multiple scales deployed to reflect these conceptualizations use indexes of acculturation that
predominate nativity, generational status, language use, and length of stay. Notable limitations of this model include that all these variables provide constricted measures of acculturation that do not have the ability to capture all nuances of the acculturation process, for instance, ARMSA the most popular rating scale used for Mexican Americans imposes a one-dimensional model by asking respondents to rate different cultural domains (e.g. language, food, music and television viewing preferences) along a single continuum ranging from Mexican/Spanish to Anglo/English, failing to recognize the possibility of other points along this trajectory such as bicultural/bilingual. (Cuellar et al., 1995).

(Berry, 1997) noted that a culture contact situation will involve an individual in two enculturation (i.e. process of becoming a competent member and identifying with a culture) processes. This will involve an individual in two enculturation courses which may result in four acculturation strategies (Marginalization, separation, assimilation, and integration) portrayed in his cultural transmission framework. (Berry et al, 2003); Variables moderating acculturation can lead to high or low acculturation which will impact on level of acculturative stress; which is classified as high or low. High acculturative stress is positively linked to high suicide ideation and depression (Hovey & King, 1996), Acculturative stress significantly affects the physical and mental health of many Latino immigrants (Caplan, 2007), perceived racism as a unique psycho social stressor is strongly correlated with hypertension for Native Hawaiians who identified with American Mainstream culture and lifestyle (Kaholokula, Iwane, & Nacapoy, 2010).
Bidimensional measurement scales should be developed to capture some of the realities and challenges inherent in the acculturation process at both individual psychological and group socio cultural levels that will capture changes towards origin and dominant culture (Berry & Sam, 1996), (Cabassa, 2003). The Bidimensional Acculturation Scale (BAS) is a 24-item measure of acculturation under three domains: general language use, language proficiency, and language use in media, and within two subscales (Hispanic and non-Hispanic subscales); using a 4-point Likert scale (1 = almost never, 4 = almost always) allowing respondents evaluate their involvement in both cultures across measured domains. While the revised Acculturation Rating Scale for Mexican Americans (ARSMA-II) was developed as an instrument that assessed acculturation processes through an orthogonal, multidimensional approach by measuring cultural orientation toward the Mexican culture and the Anglo culture independently. Both measurement scales were established to correct the zero-sum assumption inherent in the unidimensional acculturation scales (captures changes towards dominant culture) by using a mirror technique in which the two culture dimensions of interest are measured using the same type of sentence structure.
2.5. Acculturation Measurement Challenges

Proxy measures relying on age at the time of immigration, nativity (place of birth), length of stay, and generational status capture incomplete pieces of the acculturation experience/process. Using these measurements have been attributed to the large inconsistences in acculturation research findings (Cabassa, 2003). At best these proxy measures inform us about possible relationships between acculturation and some outcomes but provide little information about how the relationships are formed for instance the mechanism by which acculturation affects health.

Acculturation is not a uniform process, contextual forces that affect this process are often overlooked, yet they have direct impacts on how individuals adopt to a new culture. Although changes in language use may reflect deeper acculturative change, they can also arise due to the necessity of language use and media availability (Berry, 1997). Furthermore, acculturation is not a static but developmental process, it is imperative to consider the role of prior immigration context, immigration context and settlement context in the acculturation process to better understand the acculturation experience of individuals. For instance, trajectory models of acculturation change across time have been employed in recent studies that conducted prospective latent growth model analyses of acculturation and enculturation changes among adolescents (Knight et al., 2009). In this approach, acculturative changes among adolescents were examined in the domains of (a) ethnic identity, (b) language use, and (c) affiliation with peers as examined across the period of seven years (from ages 14 to 20). More of such is needed for acculturation research to remain relevant in capturing acculturative change process. (M. Lopez-Class, F. G. Castro, & A. G. Ramirez, 2011)
2.6. Acculturation and Health Outcome

In high and middle-income countries, where 65% of the world’s population lives, mortality rates associated with obesity-related diseases are very high (WHO, 2014). This has led to The World Health Organization (WHO) designating obesity as a serious public health problem (WHO, 2014). Majority of migrants to the United States are from low income countries where obesity is not such a big problem. Several studies have highlighted the health outcomes of immigrant adults who have lived in the United States for many years. The immigrant paradox describes how first-generation ethnic minority groups, who are less acculturated, have better health-related outcomes than native born populations (Dey, 2006). Migrants to high-income countries are often in better psychological and physical health than the native-born residents of their destination country (Crimmins, Kim, Alley, Karlamangla, & Seeman, 2007), a phenomenon referred to as the healthy migrant effect (Kandula, Kersey, & Lurie, 2004). However, over time, migrants are exposed to both healthy and unhealthy behaviors associated with the host country (Goel et al., 2004), and influenced by environmental and contextual factors that may eventually impact their health.

(Alidu & Grunfeld, 2018) conducted a review of studies that aimed to identify associations between acculturation and body weight among immigrants to high-income countries and examine if the studies accounted for the role played by health behaviors. They performed a systematic literature search using keywords in three databases (Medline, Psych INFO and EMBASE). They included thirty-five studies that utilized quantitative methodology and presented empirical findings focused on acculturation and body weight among adult immigrants. Majority of the studies were cross sectional, and they did not allow an examination of drivers of change in health behaviors and weight gain. The studies examined associations between acculturation and body weight among migrants utilizing both
acculturation scales and proxy measures of acculturation to examine the role of health behaviors. There was evidence presented across multiple studies for an association between acculturation as measured with standard measures or as duration of stay and obesity. They found that there is broad evidence for weight gain among people migrating from low/middle-income to high-income countries, some of which may be due to acculturation factors. Evidence from this review suggested that health interventions should target first generation migrants to promote retention of their original healthy behaviors and avoid uptake of unhealthy behaviors.

(Delavari, Sonderlund, Swinburn, Mellor, & Renzaho, 2013) conducted a systematic review of nine studies on migrant populations from eight different countries and explained that the health status of immigrant’s changes from healthy to less healthy under the influence of acculturation which promotes more unhealthy behavior especially among men. Women were more likely to have reduced weights as an influence of the westernized ideal of a slim female body.

(Ai, Appel, & Lee, 2018) Examined if acculturation played a part in obesity of Latino men, this parallel study was conducted based on the literature (Abraído-Lanza et al., 1999; Chung, 2006; Hayward et al., 2014; Markides & Coreil, 1986; Vega et al., 1998), it was hypothesized that risk of obesity in Latino men would increase with the status of acculturation. Obesity was positively correlated with U.S.-Born and Years in the United States but negatively correlated with Ethnicity (Mexican as the reference category) and Acculturation Stress. This result is consistent with the Hispanic paradox which has received national evidence underlining the role of acculturation in Latinos’ health status. Latinos tended to report better health outcomes and lower mortality than their U.S. born counterpart despite having lower social economic status (SES) which is consistently related to poor public health and higher mortality globally (Smith & Bradshaw, 2006).
(Haffner, Stern, and Eifler (1988) in their study, researched the association between increased socioeconomic status, acculturation and obesity and diabetes. The results suggested that among Mexican-American men, increased acculturation was associated with a linear decline in both obesity and diabetes, while SES had no significant effect on either outcome. Among Mexican American women, increased acculturation and increased socioeconomic status were associated with linear declines in obesity and diabetes.

A study that examined the associations between indicators of acculturation (generational status, length of US residence, and age at immigration) and overweight (BMI ≥ 25kg / m²) and 5-year BMI changes among 7,073 Chinese, Japanese, Korean, Filipino, and Vietnamese men in US aged 44–71 years at baseline of the California Men's Health Study (2002–2003) observed that BMI increased among Asian immigrants as they became more acculturated, Less acculturated Asians had larger BMI increases over time. Interventions preventing weight gain in recent Asian immigrants are needed. (Erber Oakkar et al., 2015).

In another study by (Ghaddar S, Brown CJ, Pagán JA, & V., 2010) the effect of acculturation on health outcomes among Mexican immigrants living on the border between United States and Mexico was investigated. They found that those migrants who were less acculturated with the dominant white American culture had lower health outcomes than other Mexican immigrants who had acculturated with the mainstream culture. (B. S. Kim & Omizo, 2010) investigated a similar pattern among Asian Americans who did not assimilate with the white dominant culture. Most of the Asian Americans did not have the adverse health outcomes, such as obesity, experienced by other indigenous cultures. They suggested that this was because they had not assimilated with the larger culture hence they had better health outcomes.
(Ivbijaro, 2010) Notes that culture plays a role in the presentations of mental health problems. He found a rather different pattern with West Africans whose views about health beliefs have changed due to acculturation. For instance, in early West Africa, most delusions and hallucinatory experiences were rooted in the concept of witchcraft. But with technological developments these experiences evolved to include X-rays, laser beams and radio waves, the westernized Africans no longer held the same beliefs about witchcraft as their counterparts in West Africa and are more likely to get medical health. (El-Sayed & Galea, 2010) in their study of Arab Americans in the United States found that acculturation has affected the mindset of this once indigenous group of migrants. Through interaction, Arab Americans now have health outcomes like the dominant culture in America. They are now experiencing low birth-weight risk which is different from the outcomes in their native countries. (E. Kim, Seo, & Cain, 2010) examined a cultural response set to positive affect items and depressive symptom items in CES-D among 172 Korean immigrants. Bi-dimensional acculturation approach, which considers maintenance of Korean Orientation and adoption of American Orientation, was utilized. As Korean immigrants increased American Orientation, they tended to score higher on positive affect items, while no changes occurred in depressive symptom items. Korean Orientation was not related to either positive affect items or depressive symptom items. Korean immigrants have response bias toward positive affect items in CES-D, which decreases as they adopt more American Orientation. CES-D lacks cultural equivalence for Korean immigrants. found out that acculturation plays a big role in the high incidence of Depression among Korean immigrants. Overall, Korean immigrants in this study reported experiencing lack of positive affect even though they did not report experiencing depressive symptoms. This is contrary to findings among a community American sample living in Los
Angeles who did not report either lack of positive affect or existence of depressive symptoms. Because traditional Confucian Korean culture discourages the expression of positive emotion, it is likely that this response set may be due to Korean national character (Bernstein, Park, Shin, Cho, & Park, 2011; Scherer & Brosch, 2009).

(Dhokarh et al., 2011) In a cross-sectional study conducted from 1998–1999 designed to examine the influence of acculturation and social capital indicators on various food, nutrition, and health outcomes among low-income Puerto Rican families in Hartford. Results showed that food insecurity was positively associated (p<0.05) with being unemployed, not owning a car, having older children, being Spanish speaking only, planning or possibly planning to return to Puerto Rico, and almost never/never attending Latino church and cultural events, receiving food stamps, not having food stamps lasting for the whole month (among food stamp recipients), and accessing any emergency food assistance. They concluded that food security is associated with acculturation. Food insecurity is an important determinant of obesity as it has been associated with decreased nutrient consumption and obesity (Nord, September 2009).

(Kepka, Coronado, Rodriguez, & Thompson, 2010) used National Health and Nutrition Examination Survey (NHANES) data to study the relationship between acculturation and human papillomavirus (HPV) infection among diverse Latina populations living in the United States. They found that Latinos who had stayed longer in the United State were more likely to be infected with high-risk HPV than less acculturated women. In multivariate analyses, Mexican Americans with higher levels of self-rated English language ability were more likely to present HPV infection than those still living in their native country. Other studies, such as (Kaholokula et al., 2010) used the cross-sectional correctional study design to examine the effects of perceived racism and acculturation
on the hypertension status of 94 native Hawaiians adults aged 18 years and up. More perceived racism and a greater identification with the American mainstream culture were both, independently, related to self-reported hypertension in Native Hawaiians. The effective use of cross-sectional study shows that the design would be useful in other public health studies. (Oster & Yung, 2010) conducted a cross sectional study on the association between socio-demographic factors, dietary acculturation and BMI, physical activity, and fasting glucose among Chinese immigrants 18 years and older. The authors found out that increases in western diet may not predispose to obesity or Diabetes. However, BMI was the strongest positive risk factor of Diabetes. Interventions targeting weight maintenance and physical activity, rather than specific dietary practices may be most effective in preventing diabetes among Chinese immigrants.

(Ro, 2014) The negative acculturation effect has been the dominant interpretation of duration patterns, despite empirical and theoretical uncertainties about this assumption. This theory assumes that immigrant health declines with longer residence in the United States because of poorer health behaviors and health risks that reflect Americanized lifestyles. She evaluated empirical support for this theory among Asian immigrants using key health behaviors; healthcare utilization, body weight, chronic condition, disability, self-reported health, and concluded that empirical contradictions and methodological issues limit the negative theory as the primary interpretation for duration pattern that exists. Her findings from a review of 28 studies did not warrant support for the negative acculturation theory to adequately explain Asians health pattern with duration of stay in the US. Evaluation of health behavior outcomes in Asians using four criteria namely; body weight, chronic conditions, disability and self-rated health showed that BMI increased with duration
of stay in the US. Chinese immigrants displayed higher waist circumference with longer
duration of stay but no significant duration pattern for work disability was noted. She then
proposed an alternative framework between duration and health outcome that considers
environmental influences stating that years in the United States only provide an enabling
environment in which certain health risks appear and suggest an alternate pathway for
duration of stay that incorporates contextual factors and produce multiple health outcomes.

2.7. Body Weight Measurement

Body mass index (BMI) is a measure of body size and is calculated as weight adjusted for
height \( \text{kg/m}^2 \). It measures excess weight instead of excess fat but is used as a surrogate for
excess fat measurement. It is simple, inexpensive, and non-invasive and has been used
extensively by public health professionals as standardized measurement of excess weight. It is
preferred than Skin fold thickness, Bioelectrical impedance, under water weighing, dual energy
x-ray absorptions and waist to hip circumference ratio (CDC, 2009). Though some of these
methods may be a better indication of body fat, they are expensive, intrusive, difficult to
standardize, not readily available and may rely on complex techniques (CDC, 2009). In addition,
there are few reference standards for body fatness based on above mentioned methods,
consequently they are not recommended for routine practice (CDC, 2009). BMI is interpreted
for adults 20 years and older, using standard weight status categories that are the same for all
ages and for both men and women. The standard weight status categories associated with BMI
ranges for adults are: Underweight (< 18.5), Normal (18.5 – 24.9), Overweight (25 – 29.9), and
Obese (≥ 30). This standard has been used globally for adults since 1993 (WHO, 1993). However,
for the same amount of body fat, age, and sex, Asians have consistently lower BMI by 2-3kg/m²,
in comparison to Whites, partly due to difference in body build and muscularity. There is no
significant difference in percentage body fat and body mass index for Asian male compared with
Hispanic American, and African American male. But differences exist for Asian Americans and
European Americans, Asian Americans and European American females (Fernandez et al., 2003)

Also, conventional cut points for overweight/obesity do not correspond to similar
metabolic risk in all ethnic groups. In US, even though Asian Americans have lower obesity
prevalence using the standard BMI cut point, they suffer a larger burden of type 2 diabetes/
metabolic abnormalities compared with Hispanic Americans, African Americans, and European
Americans (Jih et al., 2014), (Fernandez et al., 2003). As such standard BMI measurement may
underestimate the impact in these populations. Based on these shortcomings, a WHO expert
panel proposed lowering BMI cut points to 23-27-.5kg/m2 for overweight, and >27.5kg/m2 as
obese for the Asian population (Jih et al., 2014). The authors conducted a study using data from
2009 California Health interview survey, a population–based random dial telephone survey of
non-pregnant adults aged 18yrs and older. They found that among 6 major non-Hispanic Asian
subgroups (Chinese, Filipino, Japanese, Korean, South Asian, and Vietnamese), the prevalence of
overweight/obesity (BMI ≥ 23kg/m²) was highest among Filipinos (78.6%) and is comparable to
that observed among African-Americans and Hispanics (64.9%, 69.7%) compared with their
non–Hispanic White counterparts (P < 0.001). Filipinos also had the highest prevalence of type
2 diabetes (12.7%) across all groups while Vietnamese had the lowest prevalence of diabetes
(2.4%) (Jih et al., 2014). They concluded therefore, that Filipinos should be high priority for
screening, counseling and treatment of overweight/obesity and related health conditions.
CHAPTER III – METHODOLOGY

3.1. Data Source

Data from the National Health and Nutrition Examination Surveys (NHANES) 2015–2016 was used for these analyses. NHANES is a cross-sectional survey designed to observe the health and nutritional status of the civilian noninstitutionalized U.S. population. It is piloted by the Centers for Disease Control and Prevention’s (CDC) National Center for Health Statistics (NCHS) using survey consisting of interviews conducted in participants’ homes and standardized physical examinations conducted in mobile examination centers. (National Center for Health Statistics. Questionnaires, September, 2017)

Oversampling is done to increase the reliability and precision of estimates of health status indicators for persons of Hispanic, non-Hispanic black, and non-Hispanic Asian population subgroups. Sample weights allow estimates from these subgroups to be combined to obtain national estimates that reflect the relative proportions of these groups in the population. In the 2015-2016 sample designs, the Hispanic category included all persons who reported as Mexican American, self-identified Hispanics, or other Hispanics. The non-Hispanic black category included all persons who were reported to be non-Hispanic black race (single race or in combination with any other race). The non-Hispanic Asian category (single race or in combination with another race except black) included all persons having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. All other persons not falling into the categories above were assigned to the non-Hispanic white and Other category. (National Center for Health Statistics. Questionnaires, September, 2017).
3.2. Outcomes of Interest

Dependent variable

Elevated body mass index was defined as having a body mass index (BMI) of (>25) measured as weight in kilograms divided by the square height in meters among adults (Overweight/obese (BMI; in kg/m²) were collapsed and classified as elevated body mass index because they are higher than the gold standard). Our dependent variable was a categorical outcome variable; underweight (BMI < 18.5) and normal weight (18.5-< 25) = normal; and overweight (BMI 25-<30) and obese (> 30) = elevated BMI. Height and weight were self-reported by respondents.

Independent Variable

The Predictor variable for the analysis was length of stay (LOS). Which was dichotomized into two categories: less than 10 years (< 10 years) and 10 years or more (≥ 10 years). Based on participants’ response to the question “About how long have you been in the United States?”

Respondents were categorized according to their years of residence in the US used for comparable analysis with previous researches where time spent in new country is a proxy for exposure and adjustment to new culture, increased social interactions, improved communication, and increased ability to navigate through society (Gordon, 1967; Lara et al., 2005; Salant & Lauderdale, 2003).

Covariates

We controlled for potential confounding factors: age, gender, race, education and poverty income ratio (PIR). Age was reported as the age in years at the time of participation in the interview survey calculated based on participants’ birth date or self-reported; Gender of the participant at the time of screening was grouped into male and female based on self-reported data; race-ethnicity
were Hispanics, non-Hispanic blacks, non-Hispanic Asians, Non-Hispanic whites, and Others/Multiracial; Level of education was categorized into three based on the respondents answer to the question “What is the highest grade or level of school you have completed or the highest degree” (LT High school, High school and some college, and College graduate and above). PIR denotes the ratio of the family’s income to the poverty threshold and was used in this study as a measure of socioeconomic status. Based on the standard recommended by United States Poverty Guideline 2018, participants’ PIR was classified into three categories; (< 1.00, 1.00 <> 4.99, and 5 and above).

3.3 Statistical Analysis

All analyses were performed using SAS 9.4 (Statistical Analysis System, Cary, NC, USA). In 2015-2016, NHANES included 15,327 persons selected from 30 different survey locations to participate in the study. 9,971 and 9,544 completed the interview and examination respectively. Interview response rate was 63%. The total sample (N = 1865) representing all Foreign-born respondents were used for this analysis based on our inclusion criteria, and missing values (N = 77) was set at null value.

Descriptive statistics were conducted for all participant characteristics including age, gender, race, marital status, education, and poverty (family to income ratio (PIR). Bivariate analyses were conducted using Chi-Square Test for categorical variables and the Wilcoxon Rank sum test for continuous variables.

Multivariable logistic regression models were constructed to explore the effects of the primary independent variable on elevated BMI outcome. The logistic regression results are reported as odd ratios (OR) and 95% confidence interval (CI).
CHAPTER IV – RESULTS

4. 1. Descriptive Statistics

A total of 1788 foreign-born 20 years+ adults were included in the analyses 1352, (73.8%) and 436, (26.2%) have resided in the United States for 10 years or more and less than 10 years respectively. The sample was representative of gender with females at 934, (50.3%). Respondents median age, 43 (33-56), (P < 0.01). Most of the participants were Hispanics (46.2%), (61%) of them were married, (50%) attained above high school education, and (65.4%) are above the poverty level, while 84.9% of all respondents were physically inactive. All respondents with missing variables were excluded for the analysis.

Table 1 Distribution of participants’ characteristics by Length of Stay

Using length of stay as a measure of acculturation, (73.8%) of all participants had lived in the US ≥ 10 years compared with 26.2% for less than 10 years category; Median age was 48 [37-60], 33 [27-42] for ≥ 10 years, and < 10 years category respectively. Gender was representative females in the ≥ 10 years category 50.9%, and males at 49.1%. Hispanics were in the majority among those with longer than 10 years stay (58%), and least was the multiracial/other group (1.7%). Majority of the participants who had lived in the US GTE 10 years or less were married (63%, 54.5%) respectively. Across both categories, level of education was comparable. (79.4% ≥10 years, 82% < 10 years). 42% of those with length of stay below 10 years lived in poverty compared with 31 % for participants with GTE length of stay. Physical inactivity was prevalent comparatively (83.7%, GTE 10 years, 88.3% <10 years). The most burden of elevated BMI was among the participants with GTE 10 years length of stay.

Table 2 Distribution of participants’ characteristics by Elevated BMI

The prevalence of elevated BMI among all participants was 66.1%, males are likely to be more obese than females (52.6%), Elevated BMI is more common among Hispanics (57.5%),
participants who are married (60%), had above high school education but no college degree (45.6%), lived in poverty (40%), and are physically inactive (83.2%). The results are consistent with evidence suggesting that migrants show obesogenic behaviors in high income host culture; The healthy migrant effect diminishes with greater acculturation (Delavari et al., 2013). The median age was 53, [37-68 for those with elevated BMI, and 42 years [30-54) for those with the normal body mass index (BMI), p< 0.0001.

Table 3 Prevalence of elevated BMI among racial/ethnic groups

The Hispanics had the highest (57.5%) burden of elevated BMI among the racial/ethnic groups (Table 2) However, the estimate of within racial ethnic group by length of stay reflects what is already known in literature that there is a linear correlation between length of stay and elevated BMI among non- Hispanic Asians (65%) with elevated BMI have resided in the US GTE 10 years, lower than multiracial/others (68%), non-Hispanic black (75%), non-Hispanic whites (84.7%) and Hispanics (84.7%) (Table 3, figure 2).

4. 2. Multivariable Analysis

Table 4 Unadjusted results for relationship between BMI and Length of Stay

Unadjusted analysis shows that those who have lived in the US greater than 10 years were 1.4 times (95% CI 1.116, 1.876) more likely to have elevated BMI compared to those that have resided in the US less than 10 years. There was a non-significant odd (OR 1.191, 95% CI 0.87, 1.654) for having elevated BMI among participants with longer than 10 years stay compared with those who have lived in the US less than 10 years after adjusting for age, gender, race, education and poverty (Table 5).

Table 6 Adjusted OR for elevated BMI among racial-ethnic groups

For each level rise in years of stay in the United States after adjusting for age, race, educational, and poverty, the odds of elevated BMI among different racial groups was [OR, 1.32, 95% confidence interval [CI], 0.53, 3.31) among blacks. , [OR, 0.89%, confidence interval [CI] 0.59,
among Asians, [OR, 1.43%, confidence interval [CI] 0.91, 2.26] among Hispanics, [OR, 0.09%, confidence interval [CI] 0.01, 1.50] among non-Hispanic whites, and [OR, 0.07%, confidence interval [CI] 0.00, 2.71] among Multiracial/Others.

Table 7 Association between Independent variables and odds for elevated BMI

After adjusting for age, race, gender, educational level and poverty to income ratio, the odd of elevated BMI among participants who have resided in the United States for GTE 10 years is 1.210 times the odd for elevated BMI among those who have stayed for LT 10 years, which was not statistically significant (95% CI 0.872, 1.679)

The odds of elevated BMI among male participants is 1.361 times the odd among female participants, significant (95% CI 1.015, 1.826). However, when examining estimates of gender differentials among participants with elevated BMI there was a consistent pattern across all racial groups except among non-Hispanic Blacks were the burden was higher for females; Multiracial/others (63.3%) of men were obese compared (36.7%) females, (55.9%) of non-Hispanic white male compared with (44.1%) white females, Hispanic (52.3%) males compared with (47% ) females but on the contrary non-Hispanic black females (55.6%) compared with their male counterparts (44.3%) (figure 3).

The odd of elevated BMI among participants that attained less than high school education is 1.561 times not significant among those who had up to college education (95% CI 0.9868, 2.517). Participants who had poverty income ratio of < 1.00 are 1.251 times were more likely to have elevated BMI compared to those that have poverty income ratio between 1.00 and 4.99 but not significant (95% CI 0.756, 2.071).
CHAPTER V – DISCUSSIONS

Obesity is a serious public health problem with 65% of the world population living with obesity related health problems. (WHO, 2014), and an established risk factor for cardiovascular disease which is a leading cause of death in the US. Furthermore, it is noted also that the Hispanics are disproportionately affected by the burden of obesity compared with other racial/ethnic groups. (Goel et al., 2004) alludes that there is paucity of data on the epidemiology of obesity among immigrants. While there has been research done among Latino immigrants documenting that obesity prevalence increases with acculturation there is a dearth of research among other racial ethnic groups hence the need for a study like this thesis.

Previous studies on acculturation and health have been mercurial (John et al., 2012; M. Lopez-Class et al., 2011). And it has been conjectured that exposure to long stay in high income countries is detrimental to health; Though evidence from our analysis show that more acculturated individuals with length of stay greater than 10 years have increased risk for elevated BMI (73.8%, Crude OR 1.44, 95% CI 1.11, 1.87) compared with participants with less than 10 years. However, the observed risk is no longer significant after adjusting for other covariates; age, gender, race, education and poverty (adjusted OR 1.19, 95% CI 0.857, 1.654). This finding is incoherent with existing literature showing that there is an association between obesity and duration of stay (Alidu & Grunfeld, 2018; Delavari et al., 2013). Notwithstanding, it is worthwhile to mention that our analysis was based on secondary data of foreign born adults aged 20 years and over who were categorized based on their response to the question “where you born in the US or Other”. Therefore, the possibility that there could have been some nonimmigrants in our sample exists and may possibly have introduced some sampling errors in our analysis. Overall, our analysis shows significant differences in elevated BMI between males and females. OR 1.361, (95% CI 1.015, 1.826) consistent with literature; In men higher degree of acculturation was associated with BMI, (Dhokarh et al., 2011; Goel et al., 2004; Hazuda et al.,
However, the gender distribution in the prevalence of elevated BMI across racial/ethnic groups was not similar (figure 3). Baring that there might be a sexual dimension to acculturation and calls for studies on how acculturation affects men and women differently. (Berry, 2003) cited Reitz, noted that they were unable to analyze differences between immigrant subgroups which may be an important factor, particularly given that different immigrant groups exhibit diverse patterns of assimilation or cultural integration, and experience differing degrees of acceptance into the US. This study was able to show differences among subgroups and future research is needed to explore sexual dimension in the study of acculturation.

A major limitation to this research is using a proxy measure Length of stay as a measurement for acculturation which have previously been attributed to the large inconsistencies in acculturation research findings (Cabassa, 2003). However, the decision to use it was based in part that it is simple, feasible, and would be impractical to use a more comprehensive acculturation measurement scale. At best these proxy measures inform us about possible relationships but provide little information about how the relationships are formed for instance the mechanism by which acculturation affects health which are necessary to better understand the acculturation processes, and is central to developing effective public health practices, and polices that promote healthy population. There is also need for studies that use more comprehensive assessments of acculturation that incorporate a greater range of behaviors and individual preferences, as well as studies that utilize better measures of social support and social networks (Acevedo-Garcia and Bates, 2008), and use trajectory analysis models of acculturation change across time (Knight et al., 2009).
CONCLUSIONS

Our observed results shows that the risk of a positive correlation between length of stay and elevated BMI is not significant after adjusting for age, gender, race, education and poverty (adjusted OR 1.19, 95% CI 0.857, 1.654); This finding is at variance with existing literature showing that there is an association between obesity and duration of stay (Alidu & Grunfeld, 2018; Delavari et al., 2013). Given that evidence from previous studies reveal that foreign-born adults 20+ years in the US (immigrants) appear to assume a higher burden of elevated BMI a catalyst for other health sequelae with duration of stay compared with their non- Hispanic white counterparts, we propose more evidence-based longitudinal research, more standardized, culture sensitive acculturation measurements to capture both quantitative and qualitative psychosocial, socio cultural and Eco developmental aspects of culture interactivity. With the growing immigrant population in the United States, health promotion programs, early clinician intervention on diet and physical activity may represent an important opportunity to prevent weight gain, obesity, and obesity related chronic illnesses among immigrants.
Table 1 Description of participants’ characteristics by acculturation (length of stay)

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>GTE 10 years</th>
<th>LT 10 years</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>1352 (73.8)</td>
<td>436 (26.2)</td>
<td>1788</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>644 (49.1)</td>
<td>210 (61.1)</td>
<td>854</td>
<td>(49.6)</td>
</tr>
<tr>
<td>Female</td>
<td>708 (50.9)</td>
<td>226 (38.9)</td>
<td>934</td>
<td>(50.4)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Hispanic Whites</td>
<td>71 (16.3)</td>
<td>10 (7.3)</td>
<td>81</td>
<td>(13.9)</td>
</tr>
<tr>
<td>Hispanics</td>
<td>779 (49.0)</td>
<td>167 (38.2)</td>
<td>946</td>
<td>(46.2)</td>
</tr>
<tr>
<td>Non Hispanic Blacks</td>
<td>102 (7.5)</td>
<td>43 (9.9)</td>
<td>145</td>
<td>(8.2)</td>
</tr>
<tr>
<td>Non Hispanic Asians</td>
<td>379 (25.4)</td>
<td>208 (40.9)</td>
<td>587</td>
<td>(29.4)</td>
</tr>
<tr>
<td>Others/Multiracial</td>
<td>21 (1.7)</td>
<td>8 (3.65)</td>
<td>29</td>
<td>(2.3)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Married</td>
<td>853 (63.0)</td>
<td>255 (64.5)</td>
<td>1108</td>
<td>(60.8)</td>
</tr>
<tr>
<td>Others</td>
<td>499 (37.0)</td>
<td>181 (35.5)</td>
<td>680</td>
<td>(39.2)</td>
</tr>
<tr>
<td>Educational Level</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>LT High School</td>
<td>354 (20.6)</td>
<td>87 (17.1)</td>
<td>441</td>
<td>(19.7)</td>
</tr>
<tr>
<td>High School up to Some</td>
<td>686 (51.5)</td>
<td>48 (42.6)</td>
<td>863</td>
<td>(49.2)</td>
</tr>
<tr>
<td>College</td>
<td>311 (27.9)</td>
<td>172 (40.3)</td>
<td>483</td>
<td>(31.2)</td>
</tr>
<tr>
<td>Poverty to Income Ratio</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>&lt; 1.00</td>
<td>499 (31.7)</td>
<td>191 (42.7)</td>
<td>690</td>
<td>(34.6)</td>
</tr>
<tr>
<td>1.00-4.99</td>
<td>683 (51.4)</td>
<td>198 (43.7)</td>
<td>881</td>
<td>(49.4)</td>
</tr>
<tr>
<td>5.00 and above</td>
<td>170 (16.9)</td>
<td>47 (13.4)</td>
<td>217</td>
<td>(16.0)</td>
</tr>
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<td>Physical activity Status</td>
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<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Active</td>
<td>161 (16.3)</td>
<td>40 (11.7)</td>
<td>201</td>
<td>(15.1)</td>
</tr>
<tr>
<td>Inactive</td>
<td>939 (83.7)</td>
<td>315 (88.3)</td>
<td>1254</td>
<td>(84.9)</td>
</tr>
<tr>
<td>Missing</td>
<td>252</td>
<td>81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevated BMI</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>No</td>
<td>409 (31.9)</td>
<td>190 (39.4)</td>
<td>599</td>
<td>(33.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>943 (68.1)</td>
<td>246 (60.6)</td>
<td>1189</td>
<td>(66.1)</td>
</tr>
</tbody>
</table>

Source: Author’s calculations using National Health and Nutrition Examination Survey (NHANES) - 2015 to 2018.
Notes
*Acculturation length of stay in the US
Sample sizes are based on unweighted and unadjusted data; however, all analyses and proportions are weighted to reflect national population estimates.
P-values < 0.0001.
°chi-square test for categorical variables and the Wilcoxon rank sum test for continuous variables, were used to compare independent characteristics across the subgroups.
Body mass index (BMI) was calculated as weight in kg divided by height in meters squared.
Persons are considered overweight if they have a body mass index (BMI weight/height squared) of ≥25 and are considered obese if they have a BMI of ≥30. Source: CDC 2015
P-value < 0.0001
### Table 2 Description of participants’ characteristics by BMI

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Elevated BMI</th>
<th>Normal BMI</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>1244 (66.1)</td>
<td>621 (33.9)</td>
<td>1865 (100)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>53 (37-68)</td>
<td>42 (33-52)</td>
<td>44 (30-54)</td>
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</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>604 (52.6)</td>
<td>286 (43.8)</td>
<td>890 (49.6)</td>
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</tr>
<tr>
<td>Female</td>
<td>640 (47.4)</td>
<td>335 (56.2)</td>
<td>975 (50.4)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Hispanic Whites</td>
<td>60 (14.5)</td>
<td>23 (11.5)</td>
<td>83 (13.6)</td>
<td>&lt;0.0001c</td>
</tr>
<tr>
<td>Hispanic</td>
<td>820 (57.5)</td>
<td>194 (29.0)</td>
<td>1014 (47.9)</td>
<td></td>
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<tr>
<td>Non Hispanic Blacks</td>
<td>102 (8.2)</td>
<td>46 (7.7)</td>
<td>148 (8.0)</td>
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<td>Non Hispanic Asians</td>
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<td>348 (49.1)</td>
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<tr>
<td>Others/Multiracial</td>
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<td>10 (2.3)</td>
<td>29 (2.2)</td>
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<td>Marital Status</td>
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<td></td>
<td>&lt;0.0001c</td>
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<td>392 (60.6)</td>
<td>1141 (59.9)</td>
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<td>Others</td>
<td>494 (40.4)</td>
<td>228 (39.4)</td>
<td>723 (40.1)</td>
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</tr>
<tr>
<td>LT High School</td>
<td>386 (25.1)</td>
<td>96 (12.6)</td>
<td>482 (20.8)</td>
<td></td>
</tr>
<tr>
<td>High School up to some college</td>
<td>589 (49.0)</td>
<td>305 (49.2)</td>
<td>894 (49.1)</td>
<td></td>
</tr>
<tr>
<td>College Graduate or Above</td>
<td>267 (25.9)</td>
<td>220 (38.2)</td>
<td>487 (30.1)</td>
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<td>Physical activity Status</td>
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<td>51 (11.3)</td>
<td>207 (14.9)</td>
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<td>Inactive</td>
<td>648 (83.2)</td>
<td>461 (88.7)</td>
<td>1309 (85.1)</td>
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<td>Poverty to Income Ratio</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001c</td>
</tr>
<tr>
<td>&lt; 1.00</td>
<td>545 (39.8)</td>
<td>198 (9.6)</td>
<td>743 (35.9)</td>
<td></td>
</tr>
<tr>
<td>1.00-4.99</td>
<td>578 (31.1)</td>
<td>327 (52.1)</td>
<td>905 (48.8)</td>
<td></td>
</tr>
<tr>
<td>5.00 and above</td>
<td>121 (8.7)</td>
<td>96 (19.6)</td>
<td>217 (15.3)</td>
<td></td>
</tr>
<tr>
<td>Length of Stay</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001c</td>
</tr>
<tr>
<td>GTE 10 Years</td>
<td>943 (76.0)</td>
<td>406 (69.5)</td>
<td>1352 (73.5)</td>
<td></td>
</tr>
<tr>
<td>LT 10 Years</td>
<td>246 (24.0)</td>
<td>190 (30.5)</td>
<td>436 (26.2)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations using National Health and Nutrition Examination Survey (NHANES) - 2015 to 2016.

Notes
- *Acculturation is Length of stay in the US*
- Sample sizes are based on unweighted and unadjusted data; however, all analyses and proportions are weighted to reflect national population estimates.
- *P values* < 0.0001.
- c, w chi-square test for categorical variables and the Wilcoxon rank sum test for continuous variables. were used to compare respondent characteristics across the subgroups.
- Body mass index (BMI) was calculated as weight in kg square divided by height in inches square.
- Persons are considered overweight if they have a body mass index (BMI weight/height squared) of >25 and are considered obese if they have a BMI of > 30. Source: CDC 2015
- P-value < 0.0001
Table 1: Prevalence of elevated BMI among racial/ethnic groups

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Non-Hispanic Black</th>
<th>Non-Hispanic Asian</th>
<th>Non-Hispanic White</th>
<th>Hispanic</th>
<th>Multiracial/Others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 15</td>
<td>&lt; 15</td>
<td>Total</td>
<td>≥ 15</td>
<td>&lt; 15</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34 (43.5)</td>
<td>12 (45.7)</td>
<td>46 (44.8)</td>
<td>81 (45.8)</td>
<td>52 (46.5)</td>
</tr>
<tr>
<td>Female</td>
<td>41 (55.1)</td>
<td>13 (54.2)</td>
<td>54 (55.4)</td>
<td>100 (45.7)</td>
<td>64 (44.4)</td>
</tr>
<tr>
<td><strong>Educational Level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT High School</td>
<td>8 (8.7)</td>
<td>4 (15.4)</td>
<td>12 (12.3)</td>
<td>16 (11.6)</td>
<td>3 (10.9)</td>
</tr>
<tr>
<td>High School + Some college</td>
<td>47 (60.6)</td>
<td>3 (11.8)</td>
<td>50 (57.3)</td>
<td>93 (60.6)</td>
<td>13 (6.9)</td>
</tr>
<tr>
<td>College Graduate or Above</td>
<td>20 (13.2)</td>
<td>4 (14.8)</td>
<td>24 (14.8)</td>
<td>46 (14.8)</td>
<td>7 (14.7)</td>
</tr>
<tr>
<td>Poverty to Income Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1.00</td>
<td>21 (26.1)</td>
<td>11 (41.8)</td>
<td>32 (26.1)</td>
<td>69 (42.9)</td>
<td>15 (42.9)</td>
</tr>
<tr>
<td>1.00-4.99</td>
<td>42 (55.8)</td>
<td>11 (41.8)</td>
<td>53 (55.8)</td>
<td>97 (57.1)</td>
<td>11 (33.3)</td>
</tr>
<tr>
<td>5.00 and above</td>
<td>52 (63.1)</td>
<td>3 (11.8)</td>
<td>55 (63.1)</td>
<td>113 (63.1)</td>
<td>3 (11.8)</td>
</tr>
</tbody>
</table>

Table 4: Unadjusted analysis results for relationship between BMI and Length of Stay

<table>
<thead>
<tr>
<th>Length of Stay</th>
<th>n (%)</th>
<th>Unadjusted OR</th>
<th>Adjusted OR¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>≥ 10 years</td>
<td>1352 (73.8)</td>
<td>1.447</td>
<td>1.116, 1.876</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>436 (26.2)</td>
<td>REF</td>
<td>REF</td>
</tr>
</tbody>
</table>

Source: Author's calculations using NHANES 2015 - 2016
OR Odds of having an Elevated BMI, ORs adjusted for Age, Gender, Race, Education & Poverty-to-income ratio
Persons are considered overweight if they have a body mass index (BMI lbs./height2) of >25 and are considered obese if they have a BMI of > 30. Source: CDC 2015

Table 5: Adjusted odds ratio for elevated BMI in the general sample

<table>
<thead>
<tr>
<th></th>
<th>n=1708</th>
<th>OR²</th>
<th>95% Wald Confidence Interval (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Stay</td>
<td>1.191</td>
<td>0.857</td>
<td>1.654</td>
</tr>
<tr>
<td>Age</td>
<td>1.002</td>
<td>0.992</td>
<td>1.012</td>
</tr>
<tr>
<td>Sex</td>
<td>0.746</td>
<td>0.559</td>
<td>0.995</td>
</tr>
<tr>
<td>Race</td>
<td>0.599</td>
<td>0.537</td>
<td>0.668</td>
</tr>
<tr>
<td>Education</td>
<td>0.834</td>
<td>0.665</td>
<td>1.045</td>
</tr>
<tr>
<td>Poverty</td>
<td>0.87</td>
<td>0.68</td>
<td>1.112</td>
</tr>
</tbody>
</table>

Source: Author’s calculations using NHANES 2015 - 2016
OR Odds of having an Elevated BMI, ORs adjusted for Age, Gender, Race, Education & Poverty-to-income ratio
Persons are considered overweight if they have a body mass index (BMI lbs./height2) of >25 and are considered obese if they have a BMI of > 30. Source: CDC 2015
### Table 6: Adjusted odds ratio for elevated BMI among racial/ethnic groups

<table>
<thead>
<tr>
<th>Length of Stay</th>
<th>n (%)</th>
<th>Unadjusted OR</th>
<th>95% CI</th>
<th>Multivariable-Adjusted OR*</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic Blacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE 10 years</td>
<td>102 (68.4)</td>
<td>1.73</td>
<td>(0.78, 3.83)</td>
<td>1.32</td>
<td>(0.53, 3.31)</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>43 (31.6)</td>
<td>0.78</td>
<td>REF</td>
<td>REF</td>
<td>REF</td>
</tr>
<tr>
<td>Non-Hispanic Asians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE 10 years</td>
<td>379 (63.6)</td>
<td>0.98</td>
<td>(0.68, 1.40)</td>
<td>0.89</td>
<td>(0.59, 1.35)</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>208 (36.4)</td>
<td>0.78</td>
<td>REF</td>
<td>REF</td>
<td>REF</td>
</tr>
<tr>
<td>Hispanics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE 10 years</td>
<td>779 (78.3)</td>
<td>1.78</td>
<td>(1.16, 2.73)</td>
<td>1.43</td>
<td>(0.91, 2.26)</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>167 (21.7)</td>
<td>0.78</td>
<td>REF</td>
<td>REF</td>
<td>REF</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE 10 years</td>
<td>71 (87.9)</td>
<td>0.08</td>
<td>(0.009, 0.780)</td>
<td>0.09</td>
<td>(0.005, 1.499)</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>10 (12.3)</td>
<td>0.78</td>
<td>REF</td>
<td>REF</td>
<td>REF</td>
</tr>
<tr>
<td>Multiracial/Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE 10 years</td>
<td>21 (72.4)</td>
<td>0.23</td>
<td>(0.024, 2.170)</td>
<td>0.07</td>
<td>(0.002, 2.718)</td>
</tr>
<tr>
<td>LT 10 years</td>
<td>8 (27.6)</td>
<td>0.78</td>
<td>REF</td>
<td>REF</td>
<td>REF</td>
</tr>
</tbody>
</table>

* Odds of having an Elevated BMI, adjusted for Age, Gender, Race, Education & Poverty-to-income ratio

### Table 7: Association between Independent variables and the odds for elevated BMI

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>Adjusted OR (95% Wald Confidence Limits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LENSTAY GE10 vs LT10</td>
<td>1.21 (0.87, 1.68)</td>
</tr>
<tr>
<td>Age</td>
<td>1.00 (0.99, 1.01)</td>
</tr>
<tr>
<td>Male vs Female</td>
<td>1.36 (1.02, 1.83)</td>
</tr>
<tr>
<td>Non-Hispanic Asian vs Hispanic</td>
<td>0.16 (0.11, 0.22)</td>
</tr>
<tr>
<td>Non-Hispanic Black vs Hispanic</td>
<td>0.54 (0.34, 0.86)</td>
</tr>
<tr>
<td>Multi/ Other race vs Hispanic</td>
<td>0.70 (0.21, 2.30)</td>
</tr>
<tr>
<td>Non-Hispanic White vs Hispanic</td>
<td>0.60 (0.31, 1.15)</td>
</tr>
<tr>
<td>LT High School vs GT College degree</td>
<td>1.56 (0.96, 2.51)</td>
</tr>
<tr>
<td>College Graduate vs GT College degree</td>
<td>0.98 (0.67, 1.42)</td>
</tr>
<tr>
<td>PIR &lt; 1a</td>
<td>1.25 (0.75, 2.07)</td>
</tr>
<tr>
<td>PIR GE 5</td>
<td>0.849 (0.53, 1.35)</td>
</tr>
</tbody>
</table>

Abbreviations: OR, Odds ratio; PIR, Family Income to Poverty Ratio

*Adjusted model for Length of Stay, Age, Race, Educational Level, Gender, Poverty

Reference category for Length of Stay—Less than 10 Years,
Reference category for Gender—Female
Reference category for Race—Hispanic
Reference category for Educational Level—Up to college
Reference category for family income ratio—PIR < 1.00
Figure 2 Elevated BMI by length of stay across race/ethnic groups

There is consistent correlation between elevated BMI and length of stay across racial ethnic groups.
Figure 3 Elevated BMI by gender across race/ethnic groups

Prevalence of obesity differed by gender across race/ethnicity
REFERENCES


Nord, M. (September 2009). *Food Insecurity in Households with Children*
Prevalence, Severity, and Household Characteristics (Number 56). Economic Information Bulletin


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