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The Relationship Between Socioeconomic Factors and Obesity in Adults (25-54 Years) in Guam in 2020

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Walden University
2023

Abstract

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by

Perinne O'Brien

MA, University of Guam, 2019

BS, University of Hawai'i, 2006

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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May 2023

Abstract

In Guam, a United States Pacific Island territory, the rate of obesity in adults continues to rise. Relationships between obesity and six socioeconomic factors (health care coverage, education level, employment status, home ownership, household income, and marital status) in adults 25 to 54 years of age living in Guam in 2020 were explored. Because obesity may be affected at multiple levels of influence, the socioecological model grounded this research. Secondary data from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System was used to carry out a quantitative, cross-sectional study. Complex samples binary logistic regression analyses were carried out to determine if there were significant relationships between obesity and the six socioeconomic factors. Significant associations were found between obesity and four of the socioeconomic factors: health care coverage (Wald χ^2 (1) = 10.167, p = .001), employment status (Wald χ^2 (1) = 7.741, p = .005), education level (Wald χ^2 (3) = 35.731, p < .001), and household income level (Wald χ^2 (4) = 56.034, p < .001). The results of the analyses showed that associations between obesity and homeownership (Wald χ^2(2) = 3.025, p = .220), as well as obesity and marital status were not significant (Wald χ^2 (1) = 1.459, p = .227). This study promotes positive social change by contributing to the limited body of knowledge regarding obesity in adults in Guam. Additionally, it increases awareness pertaining to factors that influence the island's obesity rates. Public health practitioners can use this research to guide future investigations and to create targeted programs and policies that will successfully reduce the rates of obesity in adults in Guam.

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Dedication

This is dedicated to my husband, Junior – who is the epitome of a life-long learner and the one who is always encouraging and inspiring me to keep learning and keep growing. And to my MENG.O – no matter how difficult something may be or how long it may take, always remember that you can do anything you put your mind to. Never give up. Keep on keeping on. Hu sen guaiya hamyo.

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I'd like to acknowledge to the Guam Department of Public Health and Social Services for allowing me to use their data for my research. Additionally, I'd like to thank the Walden University quantitative statistics tutors for their assistance with my data analysis.

A heartfelt un dångkolo na si Yu'os ma'åse' to my parents, my sister, my brothers, and my whole family for their continuous support throughout this entire journey. Thank you for always being there to help with my kiddos and encouraging me to not give up, no matter what kind of crazy curve balls life threw my way. Last but certainly not least, to my biggest cheerleaders, my favorite five – my husband Junior and my babies, Malachi, Ezra, Nehemiah, and Genesis – thank you for your endless love and support during this what-seemed-like-it-would-never-end-PhD-journey. You all gave me the strength and inspiration to keep going and I wouldn't have been able to do it without your patience, understanding, encouragement, and all the hugs and kisses I needed to help conquer any obstacle in my way! Hu sen guaiya hamyo!

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Chapter 1: Introduction to the Study

Obesity, which the World Health Organization (WHO, 2021) defined as, "abnormal or excessive fat accumulation that presents a risk to health," continues to be a worldwide public health issue (para. 1). In the island of Guam, a United States territory, the prevalence of obesity increased from 27.4% in 2011 to 34.4% in 2020 (Centers for Disease Control and Prevention [CDC], National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020). I focused this study on the relationship between obesity and socioeconomic factors, including health care coverage, education level, employment status, home ownership, household income, and marital status, in adults (25–54 years) living in Guam in 2020. An understanding of this relationship is needed in order to create or improve targeted obesity-related policies and intervention programs on the island, which may potentially contribute to positive social change by decreasing obesity rates and reducing the overall burden of obesity in Guam. This chapter includes background information about the problem, the problem statement and purpose of the study, the research question and hypotheses, the study's theoretical framework, nature of the study, definitions, assumptions, scope and delimitations, limitations, and significance of the study.

Background

Obesity is a major health concern worldwide and could potentially affect one billion people around the globe by 2030 (Najafi, 2020). Overweight and obesity stem from several different causes, including over consumption of high energy foods, lack of physical activity, medication use, and genetics (CDC, 2022a; Najafi 2020). Additionally,

obesity may be influenced by various socioeconomic factors. A study by Law et al. (2020) found that monthly household income was a significant contributor to body mass index (BMI) among an indigenous group of women in Malaysia, while Ogden et al. (2017) found that a relationship between obesity and income in the United States was complex and differed among population subgroups. Ogden et al. also found that in the United States, adults who graduated from college had a lower prevalence of obesity than those with less education. Results from a study by Klabunde et al. (2020) showed that working in the 3 months before the study was a significant predictor of overweight and obesity amongst Brazilian immigrants living in Massachusetts. Mylona et al. (2020) examined the relationship between obesity and health insurance coverage in Rhode Island and found that participants with Medicaid were more likely to be obese than those with commercial insurance. In Jordan, Ajlouni et al. (2020) discovered that marital status was significantly associated with obesity in both males and females. The results of a study by Pongiglione and Fitzsimons (2019) revealed that parental homeownership was a predictive factor of obesity in 14-year-old children who live in the United Kingdom.

Much of the current obesity research in Guam focuses on children (Leon Guerrero et al., 2020; Matanane et al., 2017; Novotny et al., 2016; Novotny et al., 2017; Novotny et al., 2018). Additionally, recent studies that focus on obesity in adults in Guam discuss genetic factors related to obesity and obesity in college students (Hanson et al., 2019; Nazareno et al., 2020). Research has also reported on the prevalence of adult obesity on the island (CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020; Guam Department of Public Health Social Services

& Non-Communicable Disease Consortium Guam, 2013). However, investigations regarding the relationship between socioeconomic factors and obesity in adults living in Guam are limited.

Research on the relationship between obesity and socioeconomic factors is needed to identify factors that may be contributing to the increasing prevalence of obesity in adults in Guam. This will help to create or modify current obesity policies and interventions on the island. It is hoped that these targeted policies and interventions will assist in reducing the rates of adult obesity in Guam, and in turn help to improve the overall health and well-being of the island's people.

Problem Statement

The specific research problem that was addressed through this study was to determine the possible relationship between obesity (dependent variable) and health care coverage, education level, employment status, home ownership, household income, and marital status (independent variables) in adults (25–54 years) living in Guam in 2020. Obesity rates have been on the rise not only in the United States, but also around the world (CDC, 2022a; WHO, 2021). On the island of Guam, the rate of obesity in adults has increased from 27.4% in 2011 to 34.4% in 2020 (CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020). Obesity is a significant public health problem as it is a major risk factor for a number of noncommunicable diseases (NCD; including cardiovascular disease, musculoskeletal disorders, and some cancers), increased health care costs, and premature death (Hoebel, 2019; WHO, 2021).

Increased consumption of energy-dense foods as well as sedentary lifestyles and physical inactivity have contributed to a rise in obesity worldwide (CDC, 2022b; WHO, 2021). However, these dietary and physical activity changes may also be a result of environmental and societal changes (WHO, 2021). Recent studies have found that socioeconomic factors, such as health care coverage, education level, employment status, home ownership, household income, and marital status may have an influence on obesity (Ajlouni et al., 2020; Klabunde et al., 2020; Law et al., 2020; Mylona et al., 2020; Ogden et al., 2017; Pongiglione & Fitzsimons, 2019). However, results regarding the influence of socioeconomic factors on obesity differ in various populations. For instance, in some populations, obesity was more prevalent amongst higher socioeconomic groups while in others it was more prevalent in lower socioeconomic groups (Hoebel et al., 2019; Najafi, 2020).

While various studies exploring these socioeconomic factors have been conducted around the globe, there is limited research on how these factors influence obesity in Guam. Therefore, research is needed to better understand the ways that socioeconomic factors may impact obesity on the island. A deeper understanding of these possible relationships will help to inform obesity policy and prevention measures that may ultimately improve population health and reduce health inequalities in Guam.

Purpose of the Study

The purpose of this quantitative study was to explore the possible relationship between socioeconomic variables, including health care coverage, education level, employment status, home ownership, household income, and marital status, and obesity

in adults (25 – 54 years) living in Guam in 2020. The study's dependent variable was obesity, and the independent variables were health care coverage, education level, employment status, home ownership, household income, and marital status. Age, sex, and race were the study's control variables.

Research Question and Hypotheses

The question and associated hypotheses that were used to address the research problem were:

RQ: What is the relationship between health care coverage, education level, employment status, home ownership, household income level, marital status, and obesity in adults in Guam when controlling for age, sex, and race?

$H_0$1: There is no significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

H_a1: There is a significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

$H_0$2: There is no significant association between education level and obesity in adults in Guam when controlling for age, sex, and race.

H_a2: There is a significant association between education level and obesity in adults in Guam when controlling for age, sex, and race.

$H_0$3: There is no significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

H_a3: There is a significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

$H_0$4: There is no significant association between home ownership status and

obesity in adults in Guam when controlling for age, sex, and race.

H_a4: There is a significant association between home ownership status and obesity

in adults in Guam when controlling for age, sex, and race.

$H_0$5: There is no significant association between household income level and

obesity in adults in Guam when controlling for age, sex, and race.

H_a5: There is a significant association between household income level and

obesity in adults in Guam when controlling for age, sex, and race.

$H_0$6: There is no significant association between marital status and obesity in

adults in Guam when controlling for age, sex, and race.

H_a6: There is a significant association between marital status and obesity in adults

in Guam when controlling for age, sex, and race.

Theoretical Framework for the Study

The theory that grounded this study was the socioecological model (SEM). This

model, originally introduced by Bronfenbrenner in the 1970s as a conceptual model for

understanding human development, was formalized as a theory in the 1980s (Kilanowski,

2017). According to the ecological model of health behavior, which builds upon the work

of Bronfenbrenner, Belsky, and Steuart, behavior is determined by five levels of

influence: intrapersonal factors, interpersonal processes and primary groups, institutional

factors, community factors, and public policy (Glanz et al., 2015; McLeroy et al., 1988).

Intrapersonal factors are characteristics of the individual while interpersonal processes

and primary groups include formal and informal social network and social support

systems (McLeroy et al., 1988). Institutional factors are those that stem from social institutions with organizational characteristics, and community factors are the relationships among organizations, institutions, and informal networks (McLeroy et al., 1988). Public policy includes local, state, and national laws and policies (McLeroy et al., 1988). A more detailed explanation of the socioecological model will be presented in Chapter 2.

The logical connections between the SEM and the nature of my study included the notion that multiple levels of influence may affect potential socioeconomic factors related to obesity in adults. The socioeconomic variables that were included in this study span various levels. Education, employment status, and home ownership are at the intrapersonal level; marital status and household income (if more than one person in the household contributes to income) are at the interpersonal level; and health care coverage is at the institutional level. A summary of the SEM levels and the study variables at each level can be found in Table 1. Identifying potential relationships between socioeconomic factors and obesity will allow for further investigation into these factors in order to design targeted obesity interventions that will span multiple levels of influence.

Nature of the Study

To address the research question in this quantitative study, the specific research design entailed a nonexperimental, cross-sectional study that investigated the possible correlation between socioeconomic variables and obesity in adults in Guam (see Salazar et al., 2015). The independent variables that were used to answer the research question were health care coverage, education level, employment status, home ownership,

household income, and marital status while the dependent variable is obesity. Age, sex, and race were the study's control variables. Secondary data from the CDC's 2020 Behavioral Risk Factor Surveillance System (BRFSS) were used to carry out complex samples binary logistic regression analyses in order to address the research question and test for significant relationships between the dependent and independent variables.

Table 1

Socioecological Model Levels and Study Variables

SEM Level	Variable(s)	Research Question
Intrapersonal	Education level	
	Employment status	
	Home ownership	What is the relationship between health care
	Sex	coverage, education level, employment status,
	Race	home ownership, household income level,
	Age	marital status, and obesity in adults in Guam
Interpersonal	Household income level	when controlling for age, sex, and race?
	Marital status	
Institutional	Health care coverage	

Definitions

The following are the operational definitions for the independent and dependent variables in this study. Definitions were produced using questions from the 2020 BRFSS Questionnaire (CDC, 2021a).

Education level: The highest grade or year of school the respondent completed.

Employment status: Whether the respondent is employed for wages, self-employed, out of work for one year or more, out of work for less than one year, a homemaker, or a student.

Health care coverage: Whether the respondent has any kind of health care

coverage, including health insurance, prepaid plans, or government plans.

Home ownership: Whether the respondent owns or rents his or her home.

Household income: Respondent's annual household income from all sources.

Marital status: Whether the respondent is married, divorced, separated, never married, or a member of an unmarried couple.

Obesity: Abnormal or excessive fat accumulation that presents a risk to health; BMI is 30.0 or higher (WHO, 2021).

Assumptions

For this study, I assumed that the BRFSS was conducted in accordance with the guidelines set forth by the CDC. Additionally, I assumed that questions were asked without modification in wording and that responses were accurately recorded. I also assumed that respondents answered truthfully and to the best of their ability. These assumptions were necessary because they presumed the data that had been collected was accurate, which was essential for a precise analysis and interpretation of the results.

The ecological model for health promotion assumes that interventions are based on beliefs, understandings, and theories of the determinants of behavior (McLeroy et al., 1988). Because the model incorporates various levels of analysis (intrapersonal, interpersonal, institutional, community, public policy), it presents a variety of strategies available for health promotion planning and interventions (McLeroy et al., 1988). Thus, the results of this study may provide possible insight for a wide range of obesity prevention strategies for adults in Guam.

Scope and Delimitations

The potential relationships between socioeconomic factors and obesity were chosen as the focus of this study because, while research from around the world has shown that socioeconomic factors may have an influence on obesity, recent literature on these relationships is limited for Guam. (see Ajlouni et al., 2020; Klabunde et al., 2020; Law et al., 2020; Mylona et al., 2020; Ogden et al., 2017; Pongiglione & Fitzsimons, 2019). In line with the current global trend, the island of Guam has also seen a rise in the rates of obesity in adults between 2011 and 2020 (CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020). Therefore, the study population comprised adults living on the island of Guam, with the target age group being 25 to 54 years old.

A study conducted by Chooi et al. (2019) used data from the Global Burden of Disease Study to determine the global prevalence of obesity by age group. They found that obesity increased with age starting at 20 years old and reached its peak between 50 and 65 years old. Furthermore, data from the 2014 – 2019 BRFSS showed that the percentage of obese adults in Guam was highest in the 25 – 34, 35 – 44, and 45 – 54 years age groups (except in 2015 when the 55 – 64 years age group had a higher percentage than the 35 – 44 years age group). The overall obesity prevalence on the island then decreased in the 55 – 64 years and 65 years and older age groups. Additionally, recent studies on obesity have been conducted in college students in Guam, in which the mean age was 22.7 ± 3.5 years (Hanson et al., 2019). Thus, this study aimed to evaluate the relationship between obesity and socioeconomic factors in adults 25 – 54

years old since obesity data is limited for these age groups and they are the age groups with the highest percentages of obesity in Guam.

Because Guam has a unique population and culture, generalizability of the results is limited. However, other Mariana and Micronesian islands may benefit from the results of this study as it may provide an initial point of study for their unique, but similar, populations and cultures.

Limitations

There were several limitations of this study. One limitation was the inability to select particular variables or ask specific questions that may be of interest. Instead, variables were chosen based on the type of data that was available. Using the BRFSS for this study provides access to publicly available data. However, using this data source resulted in a number of limitations. One BRFSS limitation was that the survey excludes certain groups of people. Since it is based on noninstitutionalized populations, the survey does not include people living in nursing homes, long-term care facilities, or other types of institutions (Giles et al., 2003). Another limitation was that BRFSS data is based on self-reports, which may have led to recall bias, and may have incomplete or missing values (Giles et al., 2003). Additionally, I focused this study on a single year (2020) and thus it does not provide long-term data on the relationship between obesity and socioeconomic factors in Guam. Other limitations of this study stem from its theoretical framework. While ecological models can broaden perspectives, they may lack information on how models interact across levels. Ecological models may also have limited guidance on how to improve research or interventions. While several limitations

existed for this particular study, the results may direct future research in which these current limitations may be minimized.

Significance

This study is significant in that it may help to identify factors that may be contributing to the prevalence of obesity in adults in Guam. This may contribute to the field of public health by filling a known gap in knowledge. Furthermore, this study can contribute to positive social change by providing a better understanding of the relationship between socioeconomic factors and obesity. This understanding can assist public health officials and local policy makers to create or improve targeted policies and intervention programs that span different levels of influence to decrease obesity rates on the island. A reduction in the rates of obesity in Guam may then lead to a reduction in the overall burden of obesity, including premature deaths due to obesity-related noncommunicable diseases, health care costs, and productivity loss (Agha & Agha, 2017).

Summary

Just as rates of obesity continue to rise around the world, they are also rising on the island of Guam. I explored the relationship between obesity and socioeconomic factors, including health care coverage, education level, employment status, home ownership, household income, and marital status, in adults (25 – 54 years) living in Guam in 2020. As multiple levels of influence may affect potential socioeconomic factors related to obesity in adults, the SEM grounded this research. Data from the CDC's 2020 BRFSS and complex samples binary logistic regression analyses were used to

address the study's research question. It is hoped that the results of this study will assist in the creation of targeted policies and interventions that will aid in decreasing the rates of obesity in adults in Guam. The next chapter will provide a review of literature on obesity and its potential relationship with various socioeconomic factors, as well as the study's theoretical approach.

Chapter 2: Review of Literature

In the United States territory of Guam, obesity rates climbed 7% from 2011 to 2020 (CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020). This increase presents a major public health problem because obesity is a risk factor for noncommunicable diseases, increased health care costs, and premature death (Hoebel, 2019; WHO, 2021). The purpose of this study was to investigate the possible relationship between socioeconomic variables and obesity in adults (25 – 54 years) living in Guam in 2020. The specific variables that were explored in this study included health care coverage, education level, employment status, home ownership, household income, and marital status. While studies from around the globe have found that these socioeconomic factors may have an influence on obesity, current research regarding this matter in Guam is limited (see Ajlouni et al., 2020; Klabunde et al., 2020; Law et al., 2020; Mylona et al., 2020; Ogden et al., 2017; Pongiglione & Fitzsimons, 2019). This chapter will provide a description of the literature search strategy, an explanation of the theoretical foundations that ground this research, and an in-depth literature review related to obesity and the socioeconomic factors that will be investigated in this study.

Literature Search Strategy

The Walden University Library was used to access several different health profession databases to explore and review scholarly literature that was published from 2016 to 2022. These databases include Medline with Full Text, Academic Search Complete, CINAHL Plus with Full Text, Embase, ProQuest Health and Medical

Collection, ProQuest Nursing & Allied Health Database, and ScienceDirect. Key terms

and pairings that were used to search through the databases include: *obesity, obesity and*

Guam, socioecological model, socioecological model and obesity, socioecological model

and health promotion, socioeconomic factors and obesity, health care coverage and

obesity, health insurance and obesity, education level and obesity, employment status and

obesity, home ownership and obesity, household income and obesity, and *marital status*

and obesity. Additionally, relevant literature was also obtained through Google Scholar,

the CDC website, and the WHO website. The literature search focused on the Asia-

Pacific region and the United States due to their cultural similarities (Asia-Pacific) as

well as political and economic similarities (United States) to Guam.

Theoretical Framework

Several different individual and community factors continue to contribute to the

rising prevalence obesity (Anekwe et al., 2020). Since this is a multifaceted issue, strictly

focusing on the behavioral changes of individuals may not be an adequate approach to

improving the current public health problem at hand. Furthermore, Marmot and Bell

(2019) argued that integrated action and system-wide efforts are needed to tackle the

causes of NCDs, one of which is obesity. A broader, multilayered evaluation is needed to

understand the different levels of influence that may impact the health behaviors related

to obesity in Guam. Therefore, the SEM, which can be used to identify relationships

amongst various levels of influence, was used to ground this study (Jones et al., 2021).

While it originated as a conceptual model introduced by Bronfenbrenner in the 1970s, the

SEM was formalized as a theory in the 1980s (Kilanowski, 2017). In Bronfenbrenner's

original model, behaviors were affected by multiple levels of environmental influences: the microsystem, mesosystem, exosystem, and macrosystem (McLeroy et al., 1988). In 1988, McLeroy et al. described an ecological model for health promotion that was built upon the work of Bronfenbrenner, Belsky, and Steuart. In this model, five sources of influence on health behaviors were identified and reflect an array of strategies that can be used for health promotion programming. The first level, intrapersonal factors, include the characteristics and developmental history of the individual, such as knowledge, attitudes, and behaviors. The next level is interpersonal processes and primary groups, which is the formal and informal social network and social support system. The social institutions with organizational characteristics are included in the institutional level, while the relationships among organizations, institutions, and informal networks fall under community factors. Lastly, public policy includes all the local, state, and national laws and policies.

The SEM has been applied to health promotion and interventions for the past thirty years, including several different programs that have been designed to reduce the prevalence of obesity (Almutairi et al., 2021; Jones et al., 2021). While these obesity programs may have different objectives, they all adopted a comprehensive socioecological approach that incorporates multiple levels of influence. These studies have been conducted to gain perspectives from target populations in order to design obesity intervention programs that influence change at various levels of the SEM. The SEM provided Hayes et al. (2021) with a framework to understand various levels of influence that families may have on school-based obesity interventions, which include

child demographic factors, parental beliefs, home environments, household income, parental education, and food insecurity. Almutari et al. also used the SEM to inform their investigation of factors associated with obesity in intermediate school students. At the individual level, they explored sociodemographic characteristics as well as students' knowledge, attitudes, and behaviors; family and teachers were factors examined at the interpersonal level; and organizational level factors included the school's food service and environment. In order to incorporate multiple levels of influence into interventions that reduce physical activity barriers in rural communities, Jones et al. used cohort and focus group data to gain perspectives from community residents regarding individual factors, social determinants, the physical environment, and policy determinants. The results of these studies, which all investigated possible factors that influence obesity, can be used to guide the development of targeted, multifaceted, multilevel interventions to reduce the prevalence of obesity in their respective communities.

In order to develop successful intervention programs and policies to reduce the prevalence of obesity in Guam, a multilayered approach that targets different levels of the SEM is needed. In this study, I aimed to identify possible socioeconomic variables at multiple levels to inform these interventions and policies. Figure 1 provides a visual representation of the model and the corresponding variables that will be used in this study. At the intrapersonal level, education level, employment status, and home ownership were investigated. Marital status and household income are variables at the interpersonal level, while health care coverage is an institutional level variable. These variables were investigated while controlling for sex, age, and race. The results of the

current study could potentially inform program and policy makers of the variables that may be best used to guide a multilevel approach to obesity prevention. Additionally, once these relevant variables are identified, they can be further explored for possible synergistic relationships that may also be important for obesity policy and interventions in Guam.

Figure 1

McLeroy's Ecological Model for Health Promotion and Corresponding Research Variables
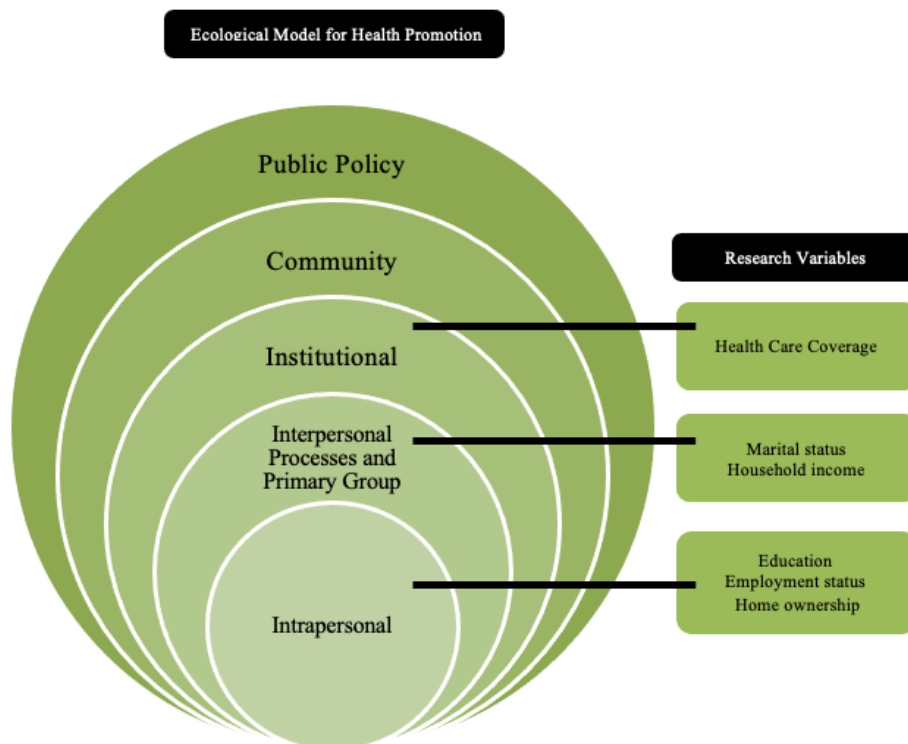
Note: see McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, *15*(4), 351-377.

Review of Literature

Obesity in Guam

The island of Guam lies in the western Pacific Ocean and is the largest of the Mariana and Micronesian islands (Guampedia, 2022). It has an approximate land area of 214 square miles with a population of approximately 153,836 (United States Census Bureau, 2021). Guam has been an unincorporated territory of the United States of America since 1950, but historically has also been colonized by Spain and Japan (Guampedia, 2022). Major ethnicities on the island include Chamoru and other Pacific Islanders, Filipino, White, and Asian. Guam's economy is mainly supported by tourism and the United States military (Guampedia, 2022).

The prevalence of self-reported obesity among adults in Guam is 34.4% (CDC, 2020). Much of the island's current obesity literature focuses on children, particularly research that is part of the Children's Healthy Living Program (CHL). This program is an intervention partnership created with other institutions in the Pacific region to study childhood obesity among Pacific children (2 – 8 years old; Wilken et al., 2013). The CHL has explored a number of different topics related to obesity in Guam, which include the prevalence of obesity and acanthosis nigricans, the dual burden of malnutrition in the Pacific region, implementation strategies and barriers to obesity intervention programs, as well as prevalence and predictors of overweight and obesity in children in Guam (Butel et al., 2019; Leon Guerrero et al., 2020; Novotony et al., 2016; Novotony et al., 2017; Novotony et al., 2018). Other current obesity related literature includes investigations into food stores and restaurants to describe Guam's food store environment and to

determine healthy food availability (Lundeen et al., 2017; Matanane et al., 2017).

Research has also been published regarding obesity in students attending the University

of Guam, where results showed that almost one fourth of students were obese (Nazareno

et al., 2020).

Socioeconomic Variables

Education

The association between education level and obesity varied across locations and

populations. In the Solomon Islands, Tsuchiya et al.'s (2017) research suggests that

individuals with higher education levels take care of their health in order to maintain a

healthy weight. This differs from research in Samoa, another Pacific island country,

where men with higher education had higher adjusted BMI compared to those with lower

levels of educational attainment (Choy et al., 2020). Nakamura et al. (2018) reported that

lower education levels were found to be inversely associated with obesity in Japanese

men. However, the results of their cohort analysis also showed a positive association

between lower education levels of adult women and overweight or obesity (Nakamura et

al., 2018). In Taiwan, Hsieh et al.'s (2020) cross-sectional study found that the odds of

being obese were higher in older men and women with less than twelve years of

education. Similarly, a study in Korea, which also focused on obesity in older adults,

found that in middle age, the lower education group had a higher risk of obesity (Chung

& Kim, 2020). In this same study, however, there was a reversal of this association in the

older age group, where higher education was positively associated with obesity,

specifically highly educated women. This association was also found in Malaysian adults,

where the prevalence of obesity and abdominal obesity were higher amongst highly educated individuals (Apalasamy et al., 2021). However, in contrast to Apalasamy et al.'s study, research conducted by Pell et al. (2016) showed that levels of education were poorly predictive of overweight and obesity among adolescents and young adults in Malaysia.

There have also been studies that explored the relationship between parental education and childhood obesity. In Guam and in the southeast Asian countries of Vietnam and Bangladesh, it was found that overweight and obesity were associated with caregivers who had higher education levels (Hossain et al., 2020; Leon Guerrero et al, 2020; Ngan et al., 2018). This differed, however, from a study conducted by Cook and Tseng (2019) which found that higher parental education levels were inversely associated with overweight and obesity in U.S.-born Asian adolescents. There have also been studies, such as that of Zhai et al. (2018) in southwest China, that found no association between parental education and overweight among children. Not only has the association between obesity and parental education been explored, but neighborhood education was also a factor that has been investigated. Young et al. (2016) found that lower neighborhood education during adolescence was associated with excess risk for becoming overweight and obese for 18-year-olds who are transitioning into adulthood.

Income

As with the current literature regarding the relationship between education levels and obesity, research shows no general agreement regarding the relationship between income and obesity in the regions focused on in this review of literature. However, there

is a consistency in the literature that displays an association between higher rates of obesity and lower incomes in wealthier societies, such as Australia and Japan (Asahara et al., 2020; Gibson et al., 2016; Nakamura et al., 2018). In the United States, income disparities in regard to obesity prevalence has been evident since the 1980's (Kumanyika, 2019). Current studies continue to show that family income is a key predictor and was significantly associated with overweight and obesity in Asian American adolescents (Cook et al., 2016, Cook et al., 2017). Young et al.'s (2017) Southern California study also found that adolescents who live in low-income neighborhoods are at increased risk for obesity.

Also consistent with research in other parts of the world, it was found that in less wealthy nations, higher rates of obesity were associated with higher incomes. Hossain et al. (2020) and Zhai et al. (2018) found associations between income and overweight, where more affluent households were more likely to have overweight children. Higher income was also associated with obesity among older Malaysians while higher asset ownership was associated with higher BMI in Samoa. (Apalasmy et al., 2021; Choy et al., 2020).

Health Insurance

Although there are limited studies regarding the association between health care coverage and obesity, researchers have explored the relationships between health care coverage and other aspects of health. In a study conducted among U.S. Marshallese (those from the Republic of the Marshall Islands) with diabetes, it was found that BMI was not associated with health care coverage (Wang et al., 2021). However, those with

larger financial strain (health care bill payments) had a higher BMI (Wang et al., 2021).

Other research amongst Pacific Islanders found that both insured and uninsured Pacific

Islanders experience health care cost barriers significantly more than U.S. Asians

(Morisako et al., 2017). Additionally, when compared to U.S. Asians, uninsured Pacific

Islanders were found to be significantly less likely to obtain an annual checkup (Lipton,

2020).

One possible reason for the limited number of studies regarding the association

between health insurance coverage and obesity is that some countries in the Asia-Pacific

region, such as Japan, Singapore, and Australia, have various forms of universal health

care programs (Lim et al., 2017). Therefore, almost all residents in these countries are

able to receive adequate medical services supported by the government (Lim et al., 2017).

In these countries, research regarding the association between health care insurance and

obesity may not be practical since the majority of citizens have some sort of health care

coverage.

Marital Status

Studies concerning the relationship between marital status and obesity found

significant associations between the two variables. Studies in Japan and Malaysia found

that unmarried status was significantly associated with obesity (Apalasamy et al., 2021;

Asahara et al., 2020). In contrast, however, research in China and Korea reported higher

BMI or prevalence of obesity amongst those who were married or those who were

divorced, widowed, or separated compared to those who were unmarried (Lee et al.,

2020; Liao et al., 2018; Yu et al., 2019). This association was also reported amongst men

in the United States, where married men had higher odds of obesity compared to unmarried men (Bell & Thorpe, 2019). Associations were also found when Bell and Thorpe included race and income in their analysis – Black, married men had the highest probability of obesity, whereas white men who have never been married had the lowest probability of obesity. When investigating multiple variables, Murakami, Ohkubo, and Hashimoto (2017) found various associations between educational attainment and obesity by marital status in Japan. Furthermore, research has also shown an association between family structure and childhood overweight and obesity, where overweight and obesity in children were associated with single-parent family structure (Gibson et al., 2016).

Home Ownership

Current literature regarding the association between home ownership and obesity was limited. Studies, however, have found a relationship between obesity and housing costs or property values (Drewnowski et al., 2017; Nobari et al., 2019). Results from Nobari et al.'s study in Los Angeles showed that severe housing-cost burden was associated with an increase in the odds of childhood obesity. Additionally, higher levels of obesity were found to be associated with low residential property values, as well as more foreclosures in a metropolitan area (Drewnowski et al., 2017; Jones et al., 2020). Studies have also shown associations between housing costs or property values and food consumption. Drewnowski et al.'s article discussed a relationship between higher residential property values in Seattle and higher Healthy Eating Index scores. In contrast, however, Wong et al.'s (2020) study, which utilized data from the BRFSS, found that higher home prices were associated with reductions in fruit and legume consumption.

Home ownership has also been associated with overall health and wellness. Results from the CDC's 2019 National Health Interview Survey showed that a larger percentage of renters declared their health to be fair or poor compared to those who owned their homes (CDC, 2021b). Furthermore, Park and Seo's (2020) study in Korea found that that those who owned their homes were less likely to report depressive symptoms compared than those who rented.

Employment Status

Recent studies have found a relationship between the number of hours worked and obesity. An association between weekly hours worked and obesity among employed adults in the United States was reported by Doerrmann et al. (2020). Their study showed that people who worked 40 or more hours a week had higher odds of obesity than those who worked less than 40 hours a week. This association was also found amongst Korean male workers, where higher odds of obesity were found amongst workers with 50 to 59 hours and workers with 60 or more hours compared to those with less than 40 hours (Eum & Jung, 2021).

Current literature also discussed the employment status of parents and its association with obesity in their children. Positive associations have been found between maternal employment and children's BMI (Crosnoe & Dunifon, 2017). In U.S. Black and Latino families, higher odds of childhood obesity were found amongst mothers who increased their work hours during their child's preschool years (Ettinger et al., 2018). In Japan, however, if mothers were employed, high paternal involvement in caregiving was associated with lower likelihood of overweight or obesity compared to lower paternal

involvement (Sato et al., 2020). A study in Korea also found that elementary school children were more likely to be obese if they lived in maternal or dual-earner households compared to paternal breadwinner households (Kim, 2019).

Summary

A review of literature has found an array of research relating to the association between obesity and the socioeconomic variables that were explored in this study. However, while there have been studies regarding certain aspects of each variable, not many studies were available regarding the direct relationship between each variable and obesity. Additionally, results of the research regarding some of the variables, such as education, vary depending on location, age, sex, ethnicity and other demographic variables. This limited amount of research for certain variables and lack of consensus for others displays the gap in the literature regarding the relationship between socioeconomic variables and obesity in adults in Guam. Guam's unique population may result in relationships between socioeconomic variables and obesity that are exclusive to the island and are unlike those found in the United States or the Asia-Pacific region. Therefore, research is needed to understand these potential relationships so that public health practitioners and island leaders can devise targeted measures to decrease the rates of obesity in Guam. The next chapter will describe the research design and methodology that was used to investigate these potential relationships that are specific to the island's population.

Chapter 3: Research Methods

In this study, I aimed to examine the potential relationships between socioeconomic variables (health care coverage, education level, employment status, home ownership, household income, and marital status) and obesity in adults (25 – 54 years old) living in Guam in 2020. This chapter describes the research design and the rationale behind the design choice. Additionally, it includes a description of the research methodology, including the study's population, sampling and sampling procedures, and information about the data that was used. Ethical procedures are also discussed.

Research Design and Rationale

This was a quantitative, nonexperimental, cross-sectional study that used secondary data. The independent variables were health care coverage, education level, employment status, home ownership, household income, and marital status. The dependent variable was obesity. Age, sex, and race were the control variables.

This study used numerical, secondary data from the BRFSS, an annual telephone survey conducted by the CDC. Salazar et al. (2015) stated that quantitative methods include observations or data that take on numerical values and use statistical procedures for analyses. Quantitative research was also used to maximize objectivity, reliability, replicability, and generalizability of results (Amoh & Appiah-Brempong, 2017). One type of research design that is suitable for quantitative methods is a cross-sectional design. In cross-sectional designs, data is collected at one point in time and can be used to assess the relationships among variables in a population (Salazar et al., 2015). A cross-sectional design was appropriate for this specific study because its purpose was to

explore the potential relationships between obesity and various socioeconomic variables. This type of research design may involve determining the risk or protective factors for a given health-related outcome, which in this study was obesity (Salazar et al., 2015). Cross-sectional designs are also less time consuming and can include a large number of subjects at little cost (Amoh & Appiah-Brempong, 2017). Furthermore, most survey research designs, such as the BRFSS, are cross-sectional in nature and are used to understand the characteristics of a population, including their behaviors (Salazar et al., 2015).

Methodology

Population

The target population for this study was adults living in Guam who were 25 to 54 years old. The study included all ethnicities as well as both males and females. According to the United States Census Bureau (2021), the population of adults in Guam who were 20 to 54 years old was 76,809.

Sampling Procedures

The CDC (2021b) stated that a sample record in a telephone survey is one telephone number in the list of all telephone numbers the system randomly selects for dialing. In the 2020 Guam BRFSS, samples of interviews were conducted by landline and cellular telephone. A probabilistic, simple random sample design was utilized for landline samples. In a simple random sample, each element must have an equal and nonzero chance of being selected (Salazar et al., 2015). This results in a sample determined entirely by chance. Interviews conducted via cellular telephone were based off the

Telecordia database of telephone exchanges and 1,000 banks. Cellular telephone samples targeted people living in a private residence or college housing who own a cellular phone. Using the G*Power 3.1 software, the minimum sample size requirement was 337. A 0.05 alpha level was used to reduce the risk of Type 1 error and a 0.95 power level was applied to reduce the risk of Type 2 error.

Data Collection

BRFSS data was collected through a computer-assisted telephone interview (CATI) system using the Ci3 WinCATI software package (CDC, 2021a). Interviews were conducted 7 days a week, both daytime and evening, throughout the year and followed BRFSS scripting and guidelines. If interviews were conducted via a landline, data was collected from a randomly selected adult in the household. For cell phone surveys, data was collected from the adult who answered the cellular telephone. Verbal informed consent was obtained at the beginning of the interview. At the end of the survey, respondents were thanked for their time and cooperation and no follow-up interviews were required. Demographic information that was collected during the survey included age, race, sex, marital status, level of education, whether respondent rents or owns a home, zip code, employment status, number of children in the household, annual household income, height, and weight. The core section of the survey lasted an average of 17 minutes while additional modules and state-added questions added approximately 5-10 minutes to the interview.

Archival Data

For this study, I used data from the CDC's 2020 BRFSS survey. The BRFSS, which was established in 1984, is a collaboration between the CDC and U.S. states and territories (CDC, 2020). The goal of this surveillance system is to collect annual, nationwide data on health risk behaviors, chronic diseases and conditions, access to health care, and the use of preventive health services related to the leading causes of death and disability in the United States (CDC, 2020). The 2020 BRFSS was conducted in 53 states and territories. Various published studies have assessed the validity and reliability of the BRFSS, such as Pierannunzi et al.'s (2013) systematic review of 32 studies published from 2004 to 2011. They found that the BRFSS data was reliable and valid as measured against other surveys that collected self-reported data. This survey was appropriate for the current study because it included questions regarding the various socioeconomic factors of interest. According to the CDC (2021a), BRFSS data and materials may be used without permission, though they do request for acknowledgement in any published materials that use the data.

Operationalization

There were six independent variables for this study: health care coverage, education level, employment status, homeownership, annual household income, and marital status. The study's dependent variable was obesity. Age, race, and sex were the study's covariates. The operational definitions and the scale of measurement for each variable can be found in Table 2. Table 3 describes the response categories for each variable.

Table 2

Variable Operational Definitions

Variable name	Survey Question(s)	Variable type	Scale of measurement
Health care coverage	"Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?"	Independent	Nominal
Education level	"What is the highest grade or year of school you completed?"	Independent	Ordinal
Employment status	"Are you currently…?" (Given employment response categories)	Independent	Nominal
Home ownership	"Do you own or rent your home?"	Independent	Nominal
Annual household income	"Is your annual household income from all sources—" (Given income response categories)	Independent	Ordinal
Marital status	"Are you…" (Given marital response categories)	Independent	Nominal
Obesity	"About how much do you weigh without shoes?" "About how tall are you without shoes?"	Dependent	Dichotomous
Age	"What is your age?"	Covariate	Ordinal
Ethnicity	"Which one of these groups would you say best represents your race?"	Covariate	Nominal
Sex	"Are you male or female?"	Covariate	Nominal

Table 3

Variable Response Categories

Variable name	Response category
Health care coverage	1 = Yes 2 = No 7 = Don't know/not sure 9 = Refuse
Education level	1 = Never attended school or only attended kindergarten 2 = Grades 1 through 8 (Elementary) 3 = Grades 9 through 11 (Some high school) 4 = Grade 12 or GED (High school graduate) 5 = College 1 year to 3 years (Some college or technical school) 6 = College 4 years or more (College graduate) 9 = Refused
Employment status	1 = Employed for wages 2 = Self-employed 3 = Out of work for 1 year or more 4 = Out of work for less than 1 year 5 = A Homemaker 6 = A Student 7 = Retired 8 = Unable to work 9 = Refused
Home ownership	1 = Own 2 = Rent 3 = Other arrangement 7 = Don't know / Not sure 9 = Refused
Annual household income	01 = Less than $10,000 02 = Less than $15,000 03 = Less than $20,000 04 = Less than $25,000 05 = Less than $35,000 06 = Less than $50,000 07 = Less than $75,000 08 = $75,000 or more 77 = Don't know / Not sure 99 = Refused

Variable name	Response category
Marital status	1 = Married
	2 = Divorced
	3 = Widowed
	4 = Separated
	5 = Never married
	6 = A member of an unmarried couple
	9 = Refused
Obesity	_ _ _ _ = Weight (pounds/kilograms)
	7777 = Don't know / Not sure
	9999 = Refused
	_ _ / _ _ Height (ft / inches/meters/centimeters)
	77/ 77 Don't know / Not sure
	99/ 99 Refused
Age	_ _ = code age in years
	07 = Don't know / Not sure
	09 = Refused
Ethnicity	10 = White
	20 = Black or African American
	30 = American Indian or Alaska Native
	40 = Asian
	41 = Asian Indian
	42 = Chinese
	43 = Filipino
	44 = Japanese
	45 = Korean
	46 = Vietnamese
	47 = Other Asian
	50 = Pacific Islander
	51 = Native Hawaiian
	52 = Guamanian or Chamorro
	53 = Samoan
	54 = Other Pacific Islander
	60 = Other
	77 = Don't know / Not sure
	99 = Refused
Sex	1 = Male
	2 = Female

Research Question and Hypotheses

RQ: What is the relationship between health care coverage, education level, employment status, home ownership, household income level, marital status, and obesity in adults in Guam when controlling for age, sex, and race?

$H_0 1$: There is no significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

$H_a 1$: There is a significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

$H_0 2$: There is no significant association between education level and obesity in adults in Guam when controlling for age, sex, and race.

$H_a 2$: There is a significant association between education level and obesity in adults in Guam when controlling for age, sex, and race.

$H_0 3$: There is no significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

$H_a 3$: There is a significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

$H_0 4$: There is no significant association between home ownership status and obesity in adults in Guam when controlling for age, sex, and race.

$H_a 4$: There is a significant association between home ownership status and obesity in adults in Guam when controlling for age, sex, and race.

$H_0 5$: There is no significant association between income level and obesity in adults in Guam when controlling for age, sex, and race.

H_a5: There is a significant association between income level and obesity in adults in Guam when controlling for age, sex, and race.

H_06: There is no significant association between marital status and obesity in adults in Guam when controlling for age, sex, and race.

H_a6: There is a significant association between marital status and obesity in adults in Guam when controlling for age, sex, and race.

Analysis Plan

IBM SPSS Version 28 software was used to perform the data analysis for this study. After receiving the survey data from a state or territory, the CDC processed the files and ran them through editing and year-end programs to identify any problems and undergo data cleanup and fixes (CDC, 2021a). After the data was processed, it was weighted by the CDC to make the sample data more representative of the population of interest. SPSS was also used to analyze missing data.

To better understand and describe the data set, a descriptive statistical analysis was conducted to obtain measures of frequencies, central tendencies, and variation. Complex samples binary logistic regression analyses were performed to determine if there were significant associations between the six socioeconomic factors and obesity. Age, sex, and race were selected as covariates because they were variables that may have potentially masked the true association between the dependent and independent variables and therefore influence the outcome of the study. Odds ratios were used to understand the effects of the independent variables. Deviance R^2 was used to determine how well the model fits the data.

An assumption of logistic regression is that the type of logistic regression used for the analysis must match the dependent variable. Since the dependent variable in this study was binary (obese/not obese), binary logistic regression was utilized. Logistic regression also assumes that the independent variables are not highly correlated. If highly correlated independent variables are in the study, eliminating one or more of the redundant variables can resolve this issue. Another assumption is the absence of highly influential outlier data points. While some outliers may not have a significant effect, those with a strong influence on the model can be eliminated. Logistic regression also assumes that there is a linear relationship between continuous independent variables and their respective logit-transformed outcomes (Stoltzfus, 2011). One method to assess this assumption is to create a statistical term representing the interaction between each continuous independent variable and its natural logarithm (Stoltzfus, 2011). If this assumption is violated, a possible solution is to dummy code the independent variable.

Threats to Validity

According to Burkholder et al. (2016), valid findings in research are those that accurately describe the phenomenon that is being studied. The methods of data collection, types of data collected, the sample of data collected, the questions that were asked in data collection, and the number of participants all need to be considered when considering the validity of a study (Burkholder et al., 2016). One threat to the validity of this study was the truthfulness of the participants' responses. Since the data is self-reported, there was the possibility that the information provided by the participant may not have been completely accurate (Burkholder et al., 2016). Another threat to validity was the sample

quality of the study and the ability to reach all areas of the population. However, the

BRFSS included both landlines and cellular phones in the telephone survey and thus

increased the reach for all demographic subgroups and improved the quality of the

sample (Gundersen et al., 2013). Additionally, the BRFSS transitioned to a new

weighting system in 2011 to incorporate cell phone data and new variables as controls.

Ethical Procedures

Approval from the Walden University Institutional Review Board (IRB) was

formally requested and granted before any data was obtained and processed. The IRB

approval number for this study is 07-06-22-0615274. The 2020 Guam BRFSS data and

materials were obtained from the Guam Department of Public Health and Social

Services. The BRFSS data does not include any personal information that can be used to

identify participants. Additionally, verbal informed consent to participate in the study

was obtained from each participant. The dataset will be kept on a password protected

computer for five years and then destroyed thereafter.

Summary

Secondary data from the CDC's BRFSS was used to carry out a quantitative,

nonexperimental, cross-sectional study. The study included a dichotomous dependent

variable (obesity), six independent variables (health care coverage, education level,

employment status, home ownership, household income level, marital status), and three

covariates (age, sex, and race). IBM SPSS Version 28 software was used to analyze the

dataset and carry out both descriptive statistics and binary logistic regression. Threats to

the study's validity included the accuracy of self-reported data and the ability to reach all

demographic subgroups for a quality sample. Institutional review board approval was

requested and granted before accessing the dataset and data will be kept on a password

protected computer. The following chapter will discuss the results of the study.

Chapter 4: Results

The purpose of this study was to investigate the potential relationships between socioeconomic variables and obesity in adults living in Guam in 2020. The independent variables in this study were health care coverage, education level, employment status, home ownership, household income, and marital status, while the dependent variable was obesity. The study's control variables were age, sex, and race. This chapter includes a description of the data collection methods and provides descriptive characteristics of the sample. The results of the complex sample binary logistic regression analyses are also reported.

Data Collection

In this study, I used data from the 2020 Guam BRFSS. Computer-assisted telephone interviews (via both cell phones and landlines) were conducted during each calendar month in 2020. Interviews were conducted by state health personnel or contractors who followed the guidelines specified by the CDC. The main portion of the interview lasted an average of 17 minutes, while state-added questions lasted approximately another 5-10 minutes. The combined response rate for both cell phone and landline samples in Guam was 51.0 (CDC, 2021b).

Results

Descriptive Statistics

The 2020 Guam BRFSS dataset included 2,183 total participants (CDC, 2021c). According to the CDC (2021b), analyses conducted using BRFSS data should be carried out with complex sampling procedures. This can reduce bias that may result from

selection probabilities and noncoverage segments of the population (CDC, 2021b).

Therefore, a complex sample plan was created in SPSS to appropriately weight and

stratify the data using the stratification, cluster and weighting variables set out by the

CDC. Following the creation of the complex sample dataset, age parameters were set (25

– 54 years old) and cases with missing, "I don't know," or refused answers were

excluded. This resulted in an unweighted sample size of 874 participants.

 To create a dichotomous dependent variable, the BMI variable was recategorized

to "Obese" and "Not Obese," where the "Not Obese" variable included the underweight,

normal, and overweight categories. Additionally, initial frequency analyses revealed that

some variable categories had a small number of cases, which may lead to inaccurate

results. Therefore, some categories were combined, and new category classifications

were created for the income, race, marital status, education, and employment variables.

 Characteristics of the unweighted sample population are shown in Table 4. A little

more than one third of the sample population fell into the obese category (36.5%, $n =$

319). Males made up 47.1% ($n = 412$) of the sample, while females accounted for 52.9%

($n = 462$). The proportions of the three age categories were similar, with 30.9% ($n = 270$)

of the sample falling in the 25 to 34 years category, and 34.6% ($n = 302$) of participants

were in both the 35 to 44 years age group and 45 to 54 years age group. Native

Hawaiians or Pacific Islanders (37%, $n = 323$) and Asians (31.8%, $n = 278$) comprised

almost 70% of the sample. Other race categories included white (12.1%, $n = 106$),

multiracial (11.3%, $n = 99$), and other (7.8%, $n = 68$). College graduates made up 40.8%

($n = 357$) of the sample population and 24.9% ($n = 218$) of participants attended college

for one to three years. Participants who graduated from high school or obtained their GED made up 29.2% (*n*=255) of the sample, while less than 5% (*n* = 44) of participants did not complete high school. Most of the participants owned their home (42%, *n* = 367), while 38.1% (*n* = 333) rented their homes, and 19.9% (*n* = 174) had other home arrangements. A little more than half of participants were married (56.5%, *n* = 494), a large percentage had health care coverage (82.8%, *n* = 724), and most participants were employed (72.2%, *n* = 631).

Table 4

Characteristics of Sample Participants

Variables	Frequency	Percent	Estimate	Standard error	Weighted percent
BMI					
Not obese	555	63.5	35105.301	482.416	64.1
Obese	319	36.5	19660.318	290.258	35.9
Sex					
Male	412	47.1	28078.047	422.404	51.3
Female	462	52.9	26687.573	380.397	48.7
Age Groups					
Age 25 to 34	270	30.9	17478.946	306.162	31.9
Age 35 to 44	302	34.6	19335.032	380.58	35.3
Age 45 to 54	302	34.6	17951.641	341.346	32.8
Race					
White only	106	12.1	4917.995	119.114	9
Asian only	278	31.8	17744.186	353.232	32.4
Native Hawaiian or Pacific Islander	323	37	22738.626	385.772	41.5
Multiracial	99	11.3	5163.91	169.711	9.4

Variables	Frequency	Percent	Estimate	Standard error	Weighted percent
Race (Cont)					
Other	68	7.8	4200.901	207.241	7.7
Employment Status					
Employed	631	72.2	36958.065	393.085	67.50%
Unemployed	243	27.8	17807.554	400.657	32.50%
Education Level					
Less than HS	44	5	10148.147	415.546	18.5
HS Grad or GED	255	29.2	15370.259	263.538	28.1
Some College	218	24.9	13586.001	317.285	24.8
College Grad	357	40.8	15661.212	165.621	28.6
Marital Status					
Married	494	56.5	29195.904	384.208	53.3
Not Married	380	43.5	25569.715	421.407	46.7
Income Level					
Less than $15,000	110	12.6	8888.421	338.364	16.2
$15,000 - $24,999	145	16.6	10828.826	275.117	19.8
$25,000 - $49,999	208	23.8	12626.326	284.719	23.1
$50,000 - $74,999	133	15.2	7587.313	178.496	13.9
$75,000 or more	278	31.8	14834.735	274.866	27.1
Home Ownership Status					
Own	367	42	27342.992	419.563	49.9
Rent	333	38.1	17391.116	323.223	31.8
Other arrangement	174	19.9	10031.511	255.026	18.3
Health Care Coverage					
Yes	724	82.8	44551.551	461.242	81.3
No	150	17.2	10214.068	274.072	18.7

Note. Unweighted data $N = 847$; Weighted data $N = 54,765.619$

Characteristics of participants with obesity are shown in Table 5. When looking exclusively at the obese population, almost an equal percentage of males (49.2%, *n* = 157) and females (50.8%, *n* = 162) were obese. The majority of obese participants were of Native Hawaiian or Pacific Islander descent (53.0%, *n* = 169), with Asian only participants (16.6%, *n*=53) and multiracial participants (13.5%, *n* = 43) making up the second and third largest groups. More than half of participants with obesity were employed (69.0%, *n*=220), had health care coverage (85.3%, *n* =272), and were married (52%, *n* = 166). Most obese participants owned their homes (42%, *n* = 134) and a little over one-third reported that their highest level of education was graduating from high school or obtaining a GED (36.4%, *n* = 116). The 35 to 44 age group and 45 to 54 age group had almost equal percentages of obese participants, with 36.1% (*n* = 115) and 37% (*n* = 118), respectively.

Table 5

Characteristics of Participants with Obesity (N = 319)

Variable	Frequency	Percent
Gender		
Male	157	49.2
Female	162	50.8
Age Groups		
Age 25 to 34	86	27
Age 35 to 44	115	36.1
Age 45 to 54	118	37

Variable	Frequency	Percent
Race		
White only, non-Hispanic	26	8.2
Asian only, non-Hispanic	53	16.6
Native Hawaiian or Pacific Islander only	169	53
Multiracial, non-Hispanic	43	13.5
Other	28	8.8
Employment Status		
Employed	220	69
Unemployed	99	31
Education Level		
Less than HS	22	6.9
HS Grad or GED	116	36.4
Some College	76	23.8
College Grad	105	32.9
Marital Status		
Married	166	52
Not Married	153	48
Income Level		
Less than $15,000	52	16.3
$15,000 - $24,999	52	16.3
$25,000 - $49,999	69	21.6
$50,000 - $74,999	44	13.8
$75,000 or more	102	32
Home Ownership Status		
Own	134	42
Rent	113	35.4
Other arrangement	72	22.6

Variable	Frequency	Percent
Health Care Coverage		
Yes	272	85.3
No	47	14.7

Test of Hypotheses

The main research question that was used to address the research problem was "What is the relationship between health care coverage, education level, employment status, home ownership, household income level, marital status, and obesity in adults in Guam when controlling for age, sex, and race?" In the following section, this question was divided into six subquestions to report the results of each individual independent variable.

Health Care Coverage

RQ1: What is the relationship between health care coverage and obesity in adults in Guam when controlling for age, sex, and race?

$H_0$1: There is no significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

H_a1: There is a significant association between health care coverage and obesity in adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the relationship between health care coverage and obesity in adults in Guam when controlling for age, sex, and race. First, an analysis was carried out to examine the

association between the independent variable, health care coverage, and obesity. The model was statistically significant, Wald $\chi^2 (1) = 8.484$, $p = .004$, and correctly classified 64.1% of the cases. In this model, the odds ratio signified that those with health care coverage were 1.207 times as likely to be obese than those without health care coverage ($OR = 1.207$, 95% CI [1.063, 1.370]).

A complex samples logistic regression analysis was then carried out with the control variables, age, sex, and race. The logistic regression model was statistically significant, Wald $\chi^2 (8) = 986.748$, $p < .001$. The model explained between 10.1% (Cox and Snell R^2) and 13.9% (Nagelkerke R^2) of the variance in obesity and correctly classified 63.6% of the cases. Sensitivity was 30.6% and specificity was 82.1%. The results of this analysis indicated a significant association between health care coverage and obesity, Wald $\chi^2 (1) = 10.167$, $p = .001$. When comparing participants with health care coverage to those without health care coverage, there was an increase in the likelihood of being obese ($OR = 1.233$, 95% CI [1.084, 1.402]). Because the results indicated a significant relationship, the null hypothesis was rejected, and the alternative hypothesis was accepted.

Education Level

RQ2: What is the relationship between education level and obesity in adults in Guam when controlling for age, sex, and race?

$H_0 2$: There is no significant association between education level and obesity in adults in Guam when controlling for age, sex, and race.

H_a2: There is a significant association between education level and obesity in

adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the

relationship between education level and obesity in adults in Guam when controlling for

age, sex, and race. The first step examined the association between the independent

variable, education level, and obesity. The model was statistically significant, Wald χ^2 (3)

= 152.455, p < .001, and correctly classified 64.1% of the cases. The odds ratios indicated

that those who graduated from college had lower odds of being obese compared to those

who did not graduate from college (Less than High School OR = 1.568, 95% CI [1.326,

1.853]; High School Grad or GED OR = 1.705, 95% CI [1.556, 1.869]; Some College OR

= 1.037, 95% CI [.932, 1.154]).

In the next step, the control variables, age, sex, and race were added to the model.

The logistic regression model was statistically significant, Wald χ^2 (10) = 1179.601, p <

.001. The model explained between 10.3% (Cox and Snell R^2) and 14.1% (Nagelkerke

R^2) of the variance in obesity and correctly classified 66.4% of the cases. Sensitivity was

36.4% and specificity was 83.1%. The results of this analysis indicated a significant

association between education level and obesity, Wald χ^2 (3) = 35.731, p < .001.

Participants who graduated from college were less likely to be obese than those who did

not graduate from college (Less than High School OR = 1.069, 95% CI [.897, 1.274];

High School Grad or GED OR = 1.34, 95% CI [1.217, 1.476]; Some College OR = 1.121,

95% CI [1.006, 1.249]). Because there was a significant association between education

level and obesity, the null hypothesis was rejected, and the alternative hypothesis was accepted.

Employment Status

RQ3: What is the relationship between employment status and obesity in adults in Guam when controlling for age, sex, and race?

$H_0$3: There is no significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

H_a3: There is a significant association between employment status and obesity in adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the relationship between employment status and obesity in adults in Guam when controlling for age, sex, and race. The first step examined the association between only the independent variable, employment status, and obesity. The model was statistically significant, Wald χ^2 (1) = 18.138, $p < .001$, and correctly classified 64.1% of the cases. The odds ratio signified that those who were employed were less likely to be obese compared to those who were unemployed ($OR = .800$, 95% CI [.722, .887]).

The control variables, age, sex, and race were then added to the model. The logistic regression model was statistically significant, Wald χ^2 (8) = 968.224, $p < .001$. The model explained between 10.1% (Cox and Snell R^2) and 13.9% (Nagelkerke R^2) of the variance in obesity and correctly classified 65.0% of the cases. Sensitivity was 27.1% and specificity was 86.2%. The results of this analysis indicated a significant association between employment status and obesity, Wald χ^2 (1) = 7.741, $p = .005$. Participants who

were employed were less likely to be obese than those who were unemployed ($OR =$ .850, 95% CI [.758, .953]). Because there was a significant association between employment status and obesity, the null hypothesis was rejected and the alternative hypothesis was accepted.

Home Ownership

RQ4: What is the relationship between home ownership and obesity in adults in Guam when controlling for age, sex, and race?

$H_0$4: There is no significant association between home ownership status and

obesity in adults in Guam when controlling for age, sex, and race.

H_a 4: There is a significant association between home ownership status and

obesity in adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the relationship between home ownership and obesity in adults in Guam when controlling for age, sex, and race. The first step examined the association between the independent variable, home ownership, and obesity without the control variables. The model was statistically significant, Wald χ^2 (2) = 12.534, p = .002, and correctly classified 64.1% of the cases. The odds ratio signified that participants who owned and rented their homes were less likely to be obese than those with other living arrangements (Owned $OR =$ .952, 95% CI [.844, 1.073]; Rented $OR =$ .819, 95% CI = .723, .929].

The control variables were then added to the model. The analysis showed that the logistic regression model was statistically significant, Wald χ^2(9) = 973.974, $p <$ .001). The model explained between 10% (Cox and Snell R^2) and 13.8% (Nagelkerke R^2) of the

variance in obesity and correctly classified 64.7% of cases. Sensitivity was 29.6% and specificity was 84.3%. The results of the analysis revealed that home ownership, when controlling for age, sex, and race, was not significantly associated with obesity in adults in Guam, Wald $\chi^2(2) = 3.025$, $p = .220$. Because the results of the analysis were not significant, the null hypothesis was accepted, indicating no significant association between ownership status and obesity in adults in Guam when controlling for age, sex, and race.

Household Income

RQ5: What is the relationship between household income level and obesity in adults in Guam when controlling for age, sex, and race?

$H_0 5$: There is no significant association between household income level and obesity in adults in Guam when controlling for age, sex, and race.

$H_a 5$: There is a significant association between household income level and obesity in adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the relationship between income and obesity in adults in Guam when controlling for age, sex, and race. The first step examined the association between the independent variable, household income, and obesity without the control variables. The model was statistically significant, Wald $\chi^2(4) = 58.760$, $p < .001$, and correctly classified 64.1% of the cases. The odds ratio signified that those whose total household income was \$50,000 - \$74,999 were less likely to be obese than those who made more than \$75,000 ($OR = .697$, 95% CI [.617, .787]. However, the odds of being obese were slightly more for participants who

made less than $50,000 compared to those who had incomes of $75,000 or more ($OR =$ 1.175, 95% CI [1.003, 1.376]; $OR = 1.102$, 95% CI [.966, 1.258]; $OR = 1.015$, 95% CI [.902, .1.142]).

The control variables, age, sex, and race were then added to the model and a complex samples logistic regression analysis was carried out. The logistic regression model was statistically significant, Wald $\chi^2 (11) = 1107.211$, $p < .001$. The model explained between 10.5% (Cox and Snell R^2) and 14.4% (Nagelkerke R^2) of the variance in obesity and correctly classified 67.4% of the cases. Sensitivity was 37.3% and specificity was 84.2%. The results of this analysis indicated a significant association between income and obesity, Wald $\chi^2 (4) = 56.034$, $p < .001$. Participants whose household incomes were $50,000 - $74,999 were less likely to be obese than those who had incomes in the $75,000 or more category ($OR = .608$, 95% CI [.530, .698]). Those who had household incomes less than $25,000 had slightly lower odds of being obese when compared to those in the highest income category ($OR = .900$, 95% CI [.762, 1.064]; $OR = .978$, 95% CI [.856, 1.118]). When compared to participants in the highest income category, those in the $25,000 - $49,000 category had similar odds of being obese, $OR = 1.012$, 95% CI [.898, 1.140]. Because there was a significant association between household income and obesity, the null hypothesis was rejected and the alternative hypothesis was accepted.

Marital Status

RQ6: What is the relationship between marital status and obesity in adults in Guam when controlling for age, sex, and race?

$H_0$6: There is no significant association between marital status and obesity in adults in Guam when controlling for age, sex, and race.

H_a 6: There is a significant association between marital status and obesity in adults in Guam when controlling for age, sex, and race.

A complex samples logistic regression analysis was carried out to determine the relationship between marital status and obesity in adults in Guam when controlling for age, sex, and race. An initial analysis was conducted to determine the association between only the independent variable, marital status, and obesity. The model was statistically significant, Wald χ^2 (1) = 26.479, p < .001, and correctly classified 64.1% of the cases. Participants who were married were .788 times as likely to be obese than those who were unmarried (95% CI [.719, .863]).

The control variables, age, sex, and race were then added to the model and a multivariate analysis was performed. The logistic regression model was statistically significant, Wald χ^2 (8) = 977.785, p < .001. The model explained between 10.0% (Cox and Snell R^2) and 13.8% (Nagelkerke R^2) of the variance in obesity and correctly classified 66.5% of the cases. Sensitivity was 29.9% and specificity was 86.9%. The results of this analysis revealed that marital status, when controlling for age, sex, and race, was not significantly associated with obesity on in adults in Guam, Wald χ^2 (1) = 1.459, p = .227. Therefore, the null hypothesis was accepted.

Table 6

Complex Samples Logistic Regression Results for Relationship Between Socioeconomic Variable

	Wald χ^2	Sig.	Exp(B)	95% Confidence Interval	
				Lower	Upper
Health Care Coverage	10.167	0.001			
Yes			1.233	1.084	1.402
Ref: No					
Home Ownership Status	3.025	0.22			
Own			1.074	0.944	1.222
Rent			0.981	0.862	1.116
Ref: Other arrangement					
Employment Status	7.741	0.005			
Employed			0.85	0.758	0.953
Ref: Unemployed					
Education Level	35.731	<.001			
Less than HS			1.069	0.897	1.274
HS Graduate/GED			1.34	1.217	1.476
Some College			1.121	1.006	1.249
Ref: College Graduate					
Marital Status	1.459	0.227			
Married			0.941	0.853	1.039
Ref: Not married					
Income Level	56.034	<.001			
Less than $15,000			0.9	0.762	1.064
$15,000 - $24,999			0.978	0.856	1.118
$25,000 - 49,999			1.012	0.898	1.14
$50,000 - $74,999			0.608	0.53	0.698
Ref: $75,000 or more					

*Reference Category: Not Obese; Variables controlled for in the model: age, sex, & race

Summary

A complex sample plan was created to appropriately weight and stratify the data. After selecting the target age groups and only including valid cases, the unweighted sample population included 874 participants. Of these participants, a little over one-third were obese (36.5%, $n = 319$). Complex samples logistic regression analyses were conducted to determine if there were significant relationships between obesity and six socioeconomic factors. Results of the analyses found significant associations between obesity and four of the socioeconomic factors: health care coverage, employment status, education level, and income level. The complex samples logistic regression analyses showed no significant association between obesity and homeownership as well as no significant association between obesity and marital status. The following chapter will further discuss the results of these analyses.

Chapter 5: Discussion

The purpose of this quantitative, cross-sectional study was to explore the relationship between six socioeconomic variables (health care coverage, education level, employment status, home ownership, household income, marital status) and obesity in adults living in Guam in 2020. This study was conducted in attempt to inform targeted obesity policy and prevention measures on the island. Secondary data from the 2020 BRFSS was used to perform complex samples binary logistic regression analyses. Significant associations were found between obesity and health care coverage, employment status, education level, and income level.

Interpretation of the Findings

The results of the complex samples logistic regression analysis indicated a significant relationship between obesity and education (when controlling for age, sex, and race) and showed that those who graduated from college were less likely to be obese than those who did not graduate from college. These results were like the studies by Tsuchiya et al. (2017), Chung and Kim (2020), and Hsieh et al. (2020), which indicated higher odds of obesity for participants with lower education levels. However, in contrast to the current study, some of the literature also found that higher education was associated with higher odds of obesity, such as the study by Apalasamy et al. (2021) that found abdominal obesity was higher amongst highly educated individuals. Current literature also explored education levels in conjunction with age and sex, something I did not examine in this current study. Another important thing to note about the current study is that higher levels of education did not necessarily indicate lower odds of obesity. When

compared to the reference group, participants with some college education had higher

odds of being obese than high school graduates with no college education. Because the

current literature varies regarding education level and obesity, and because there's a lack

of hierarchy of the current results in regard to increasing or decreasing odds of obesity

with educational levels, additional research should be conducted to further analyze the

association between education level and obesity in Guam. The CDC (2022a) stated that

the association between obesity and education level differs by sex and race, therefore

these factors should also be included in future research studies.

The results of the analysis regarding income level and obesity (when controlling

for age, sex, and race) showed a significant association between the two variables.

However, as with education level, there was no clear-cut pattern of increasing or

decreasing likelihood of being obese. The analysis used the $75,000 and above bracket as

the reference group and found that the $25,000 - $49,999 bracket had slightly higher odds

of being obese, with participants in all other income brackets having lower odds of being

obese. When compared to the reference group, participants in the $50,000 - $74,999

bracket were the least likely to be obese. Current literature indicates that in wealthier

countries, higher rates of obesity are associated with lower incomes, while in less wealthy

countries, higher rates of obesity are associated with higher incomes. Guam is unique

because it has political and economic similarities to wealthier countries since it is a

territory of the United States. However, the ethnic and cultural make-up of the island is

more similar to countries in the Asia-Pacific region, some of which are less wealthy

countries, such as the Federates States of Micronesia (see CDC, 2020). Thus, it may be

beneficial to explore the relationship between obesity and household income with other factors, such as race, in order to gain a better understanding of the relationship between obesity and income level in Guam. This association between obesity, income, and race/ethnicity is also seen in the United States, where non-Hispanic Black men in the highest income group had a higher prevalence of obesity than those in the lowest income group (CDC, 2022a).

The results of the analysis regarding health care coverage and obesity indicated that participants with health care coverage were more likely to be obese than those without health care coverage. This study extends knowledge of the association between health care coverage and obesity, as literature regarding this relationship in the Asia-Pacific region is limited. Current literature discussed other aspects of health care costs and insurance, but research is lacking regarding the direct association between health care coverage and obesity. An important thing to note about the current study is that the variable "health care coverage" included health insurance, prepaid plans, and government plans, and therefore included participants across a wide range of socioeconomic statuses. Different types of coverages may also be associated with other socioeconomic factors. For example, health insurance may be linked to employment status, Medicaid is linked to income levels, and Medicare is linked to age. A study by Mylona et al. (2020) found that Medicare or Medicaid beneficiaries in Rhode Island were more likely to have obesity than those who had commercial insurance. Additionally, 40% of individuals with obesity and 46% of those with obesity related comorbidities and complications were covered by Medicare and Medicaid. Therefore, to create policies and programs targeted at the correct

populations, it would be beneficial to explore and analyze the various types of health care coverages individually instead of combining them into one larger group.

The results from the analysis that examined the relationship between employment status and obesity revealed a significant association between the two variables (when controlling for age, sex, and race). The results indicated that employed participants were less likely to be obese than those who were unemployed. Current literature regarding the relationship between employment status and obesity is limited. However, some studies have explored the association between number of hours worked and obesity. Doermann et al. (2020) and Eum and Jung (2021) revealed higher odds of obesity for those with a higher number of work hours. These results differ from the results of the current study, as unemployed participants had higher odds of being obese than those who were employed. Although I did not look specifically at the number of hours worked, if a participant is unemployed, then he or she is working 0 hours. Some scholars have noted that unemployment may be harmful to health as it deprives people of potential benefits of being employed, including daily routines, experiences and social contacts outside of the family, personal identity, and status (Acevedo et al., 2020). One thing to note regarding the current study is that the "employed" category included those who were employed for wages as well as those who were self-employed, and the "unemployed" category included those who were out of work, a homemaker, a student, retired, or unable to work. So, while the results showed that unemployed participants were more likely to be obese, I was not able to explore the association between obesity and specific subcategories of unemployment. Exploring these subcategories may be advantageous, as the reasons for

unemployment may differ. The concerns regarding unemployment and health discussed by Acevedo et al. may not apply to certain subcategories. For example, students, although unemployed, may still have daily routines and social contacts outside of the family. Additionally, Acevedo et al. also found that the effect of unemployment on health differs according to the sex and age of the participants and therefore including these variables may also be of interest in future studies.

The relationship between marital status and obesity in adults in Guam (when controlling for age, sex, and race) was insignificant. These results were unexpected, as current literature found significant associations between these two variables. Furthermore, literature also discussed the relationship between obesity and marital status in addition to other socioeconomic variables, such as race and education level (Bell & Thorpe, 2019; Murakami, Ohkubo & Hashimoto, 2017). I, however, did not explore marital status in conjunction with other variables. This may be an area for further exploration in the future.

There was also no significant association found between obesity and home ownership status in adults in Guam (when controlling for age, sex, and race). Current literature is lacking regarding the association between these variables and therefore this study extends the knowledge in the field. While current literature regarding home ownership and obesity is limited, there are other aspects of housing that have been explored and studied in the mainland United States, including obesity and housing costs or property values, which may also be an area of future research that may be valuable to the island.

The results of this study show that multiple levels of the ecological model for health promotion are at play when it comes to obesity. Education level and employment status are at the intrapersonal level; household income is at the interpersonal processes and primary group level; and health care coverage is at the institutional level. The results of this study reveal that prevention programs and policies in Guam may also benefit by influencing change at various levels of the SEM. This is also supported by current literature in which numerous health promotion and prevention programs have been designed to incorporate multiple levels of influence to reduce obesity (see Almutairi et al., 2021; Jones et al., 2021).

Limitations of the Study

Several limitations were discussed in Chapter 1, including the inability to ask specific questions that may be of interest, the exclusion of individuals who may be part of institutionalized populations, possibility of recall bias since data is self-reported, missing values in the dataset, and the inability to provide long-term data. Additionally, this study has limitations that may hinder its generalizability to other populations around the world. More than two-thirds of participants were of Native Hawaiian, Pacific Islander or Asian descent (68.8%). Therefore, the results of this study may not be generalizable to areas outside of the Asia-Pacific region or in communities where Asians and/or Pacific Islanders are not the major racial groups.

Another limitation of the study was the limited number of responses for certain questions in the survey. This led to the combination of multiple response categories into one larger category, resulting in less detailed analyses for those variables. For example,

the employment status variable included responses such as "homemaker," "student," and "unable to work." However, since there was a low number of responses in these categories, they were all combined into the category "unemployed." Therefore, the relationship between the more detailed response categories, such as the relationship between obesity and being a student, was unable to be analyzed.

An important limitation to discuss is the potential impact that may have been caused by the COVID-19 pandemic, especially for the employment status and household income variables. The BRFSS survey data was collected in 2020, the same year that the pandemic reached Guam and decimated the tourism industry, the island's main economic industry. According to Ruane et al. (2020), the island saw 76% less visitors from January to October 2020 compared to the same time period in 2019. This resulted an estimated loss of $1.38 billion dollars of local income and spending. In June 2020, the official estimated unemployment rate was 17.3%, the highest since the Guam Department of Labor began collecting data in 1974 (Ruane et al., 2020). Therefore, the data collected during this time period may drastically differ from the years before and after the pandemic and thus the results may have limited generalizability to other time periods.

Recommendations

One recommendation for further research is to explore the relationships between the independent variables as well as age, sex, and race. Age, sex, and race were controlled for in this study to explicitly explore the independent variables and limit the possible influences of these control variables. However, many studies in Chapter 2 included age, sex, and/or race in their research, such as looking at marital status and sex

or education level and age (Bell & Thorpe, 2019; Chung & Kim, 2020). Additionally, while there was a significant association between obesity and some of the independent variables, such as education and income level, there was no clear-cut pattern regarding their association. Furthermore, the CDC (2022a) stated that the association between obesity and socioeconomic variables, such as income or education level, is complex and differs by sex and ethnicity. Thus, additional research should be conducted to further analyze the possible association between the independent variables in addition to age, sex, and race.

Another recommendation is to collect more data on some of the response categories in order to analyze them individually instead of a larger group. For example, it would be of interest to analyze the different types of health care coverages in Guam (such as Medicaid, Medicare, and private health insurance) or the different subcategories of unemployment (such as student, retired, homemaker, etc.). This would enable the creation of programs and policies that can target specific demographics. An obesity intervention program created for Filipino college students may not be as successful if implemented with a group of retired Chamoru men.

While the results of this study indicated no significant association between obesity and home ownership, it may be beneficial to explore other possible factors related to housing. Current literature showed associations between obesity and housing costs or property values. For example, Nobari et al. (2019) found that severe housing-cost burden was associated with higher odds of childhood obesity. Currently in Guam, the island's real estate market is being affected by disparities in the local economy and

homeownership is becoming more out of reach for many families on the island (Gilbert, 2022; Toves, 2022). Thus, instead of looking at specifically homeownership, per se, future studies may instead look at other aspects of housing.

Implications

The results of this study indicate a significant association between socioeconomic factors and obesity in adults in Guam in 2020. The four socioeconomic factors that showed significant associations with obesity were health care coverage, employment status, education level, and household income level. While the creation of programs and policies would be beneficial in these areas, it is believed that further research is needed before these are initiated and set in place. Additionally, as mentioned above, the results of this study show that various levels of the SEM are involved when it comes to obesity in Guam, indicating that programs and policies on the island should also span multiple levels.

While the results of the study do not provide the information needed to create policies and programs that can be implemented today, it is one small step in the long journey ahead to improve the overall health and wellness of the people of Guam. This study contributes to positive social change by expanding the field of public health knowledge pertaining to obesity. According to Cockerham (2022), social determinants may play significant roles in weight gain and obesity. This study adds to the growing body of evidence by identifying significant relationships between various socioeconomic factors and obesity. Furthermore, it adds to the limited body of literature specifically pertaining to obesity in adults in Guam and brings to light some of the factors that are

influencing the island's obesity rates. This study also contributes to positive social change by providing Guam's public health practitioners and local policy makers with initial data that can be used in the preliminary planning stages for local obesity prevention programs. Additionally, it provides baseline data and evidence that can be used to justify and guide resource allocation and further research to investigate the root causes regarding the relationships between obesity and socioeconomic factors on the island (Islam et al., 2021). A greater understanding regarding the relationships between obesity and these socioeconomic factors will help to create programs and policies that will be more successful in the long run. Furthermore, this study contributes to positive social change for the Guam community by bringing to light the need for additional research that explores obesity in adults in Guam. While obesity is a serious disease in itself, it is also linked to many other serious health conditions that are common on the island, such as heart disease, type 2 diabetes, and cancer (CDC, 2022a). It is hoped that future obesity prevention policies and programs in Guam not only decrease the overall obesity burden, but also decreases the island's NCD burden as well.

Conclusion

Although a significant public health problem exists in Guam due to the rising rates of obesity, limited research has been conducted on the island regarding the possible relationship between obesity and socioeconomic factors (see CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health, 2020). This study explored these potential relationships and found that, when controlling for age, sex, and race, obesity is significantly associated with health care coverage, education

level, employment status, and income level. Although these significant relationships were revealed, further research is needed to construct targeted obesity prevention policies and programs that will truly be beneficial for the island's people. This study promotes positive social change by providing insight into some of the factors that are influencing Guam's obesity rates. Public health practitioners in Guam should use the results of this study, as well as the recommendations, to guide future research and to create successful programs and policies that will reduce the island's rates of obesity. Ultimately, it is hoped that these programs and policies will decrease the island's overall obesity burden, leading to increased health and wellness for the people of Guam.

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