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ASSOCIATION BETWEEN OBESITY AND SOCIO-ECONOMIC FACTORS RE-LINKED

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ABSTRACT

Background: Research has shown that the prevalence of obesity has been on the rise for over three decades. The obesity epidemic is now one of the biggest public health challenges to practitioners and policy makers in the health sector. **Objectives:** Using data from Behavioral Risk Factor Surveillance System (BRFSS), this study analyzed the relationship between obesity and socio-economic status. **Methods:** The data represents information about 5,228 people (2030 men and 3198 women) from the state of Missouri. Using Analysis of Variance (ANOVA), the variables analyzed include age, Body Mass Index (BMI), income, education, race and metropolitan index. **Results:** An ANOVA comparing the average BMI with education, income and race showed that there was a significant difference between income level less than $75,000 and more than $75,000 with a significance of ($F(2, 4462) = 20.09$; $p<0.05$). There was a statistically significant difference ($F(2, 5174) = 15.54$; $p<0.05$) between blacks and other races. The results indicate that people who earn less than $75,000 were more likely to be obese than their wealthier counterparts. Blacks were found to have higher prevalence of obesity in comparison to other races. **Conclusions**: An overall association between socio-economic status and obesity was observed.

Keywords: *Obesity, prevalence, socioeconomic status, race, BMI United States*

1. INTRODUCTION

Obesity continues to be the biggest public health challenge facing United States. While obesity affects all sections of the U.S. population, studies have shown that families and individual at lower income bracket face greater risk. This study aims to increase the pool of scientific knowledge on the relationship between socio-economic factors and obesity.

Studies have shown that the prevalence of obesity has increased in the past three decades [1, 2, 3]. Unfortunately, this trend continues in the United States posing as one of the biggest public health challenge to both practitioners and policy makers in the health sector. There has been an increase in diseases and disabilities related to obesity. Just in the United States, death related to obesity has been estimated at 300,000 [1]. In addition, direct and indirect cost related to obesity has been estimated at $117 billion by 2000 [1]. A recent study from the Centers for Disease Control (CDC) has linked autism to maternal obesity. The study found that the risk of autism and other developmental disorders was 60% higher among children who were born to obese or diabetic mothers [4]. The authors add that the odds of autism and other developmental delays were significantly higher in children of obese moms versus those who weren't.

Research has suggested several behavioral and environmental factors to be influencing this trend. Specifically, poor dietary habits, physical inactivity, socio-economic status and other neighborhood characteristics contribute to obesity [5]. Therefore, increase in understanding of the relationship between obesity and socio-economic status, is important for both public health practice and policy implications. Several studies have found that communities in socially and economically distressed neighborhoods and inner cities are at higher risks of obesity. Babey et al. (2010) found that adolescent whose family incomes were below the poverty line had the highest obesity rate. They further assert that this magnitude doubled the period between 2001 – 2007 [6]. It was also found that the prevalence of obesity was lower among teenage children in highly educated households than children in families where the head of the household had no college education [7]. A study that examined the prevalence of obesity among inner-city school children in Baltimore found that 33.9% of children in their study were overweight or at-risk of overweight [8] which is a startling rate. Another study conducted in midtown Manhattan found that obesity was six times more common among low SES women than those of high SES [9]. More so, inner cities and lower income neighborhoods have less access to healthy food store options, as what is available to them are limited. Although the association between environment and obesity is complex, researchers have focused on the role of neighborhood environments and how they influenced obesity in the recent past. It was found that food-stores like

supermarkets that offered variety of fresh foods decreased the prevalence of obesity in the neighborhoods where they operate, whereas the existence of fast foods and convenient stores increased the risks of obesity [10]. A study in the metropolitan areas in Massachusetts found a similar trend, residents who had supermarkets within their zip codes were 11% less likely to be obese [11]. Bodor et al (2010) conducted a study to assess the association between access to food retail outlets and obesity in the city of New Orleans, the most obese city in the United States. They found that the existence of supermarkets in the respondent's neighborhood was associated with reduced odds for obesity (OR 0.93, 95% CI 0.88–0.99) while the existence of fast food restaurants and convenience stores predicted higher obesity odds [12].

Although obesity has increased across all ages and races, race has been found to be predictor of obesity in the United States. According to CDC report, compared to whites, blacks had 51% higher and Hispanics had 21% higher obesity rates. Cossrow and Falkner (2010) reported that obesity is disproportionately higher among Africa Americans and Hispanics. However, they emphasize that although race differences in lifestyle behaviors and economic inequalities may account for some of the disparities in obesity, environmental factors do not explain all the disparities in obesity across racial groups [13]. On the other hand, other researchers have argued that SES measured in income and education can be more powerful than genetics in predicting health problems including obesity. It is interesting to note that, in industrialized countries, low socio-economic groups are more likely to be obese than their high socio-economic counterparts, whereas in developing countries, high socio-economic groups are more likely to be obese [1].

In conclusion, from the above literature review it is evident that obesity is a multifaceted problem. To reduce the prevalence of obesity, an effective and holistic public health response is needed that includes more research, policies, targeted programs, and supportive environments achieved through the effort of government, communities, workplaces, schools, families, and individuals.

2. MATERIALS AND METHODS

The data used in this study comes from the Behavioral Risk Factor Surveillance System (BRFSS), which is a state-based system of health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. For many states, the BRFSS is the only available source of timely, accurate data on health-related behaviors. It was established in 1984 by the CDC; currently data are collected monthly in all 50 states. About 35,000 adults are interviewed each year, making the BRFSS the largest telephone health survey in the world.

The study used data obtained for the state of Missouri. It includes information from adults, people who are above 18 years of age. The mode of the data collection is by telephone calls made both to cellular phones and traditional landline numbers. The questionnaire consists of questions regarding population groups defined by demographic and health-related characteristics that are at greater risk of unhealthy behavior, such as physical inactivity, smoking, low intake of fruits and vegetables, and noncompliance with recommended health screening schedules, the height and weight as reported by the individual, calculated Body Mass Index (BMI), geographic region, urban status of residence, education levels, income and determine levels of health care availability, including preventive health care coverage.

For this study information on the age, education, income, metropolitan status of residence and race was used. A total of 5228 participants were interviewed and the above-mentioned information was obtained for the year 2010. For the optimal use of the data collected variables were re-categorized; the income, race and education considering the significant information available. ANOVA test was used to analyze the data to find the underlying relation between these factors and BMI.

3. RESULTS

The results from the study show different patterns of distribution in the population regarding socioeconomic factors. The predictors of BMI were age, education, income, metropolitan status and race. The study population consisted of both men (n=2030) and women (n=3198), the average age in men was 56.1 (SD±16.9) and women 58.4 (SD±17.2). They had a mean BMI of 28.5(SD±5.5) and 28.1 (SD±6.82) respectively for men and women (Table 1.)

There were more college graduate in the women group compare to the men group (41.6%); 65 % of women had a GED diploma (n=1886) as opposed to men who represented only 39.7 % (Table 1). Most of our study participants lived in the center of the city (n=1907) and were 62.9 % of women compare to 37.1 % of men. 722 participants lived inside a suburban county of the metropolitan area. In the income category less than $ 10,000 (n=305) were less than those who had more than $75,000 per year (n=876). Women were preponderant in these groups and there was a few number who were not sure of their income (n=376) and some refused to reveal (n=389) (table 1).

The majority of the study participants were white, non-Hispanic (n=4259) among them 61.1% of women compare to 38.9% of men. Black represented (n=592) 32.8 % of men and 67.2 of women (table 1).

Table 1: The Table Presents Results of Descriptive Statistics.

Socio-economic characteristic of Adult (18+ years) in Missouri	N	Men (n=2030)	Women (n=3198)
Age	5228	56.1 ±16.9	58.4±17.2
BMI		28.5±5.5	28.1±6.82
Education Level, %			
Never attended school or only kindergarten	3	33.3	66.7
Grades 1 through 8	168	38.7	61.3
Grades (9-11) Some high school	409	39.9	60.1
Grade 12 or GED	1886	39.7	60.3
College (1-3) Some college	1331	34.3	65.7
College (4+ years) College Graduate	1423	41.6	58.4
Refused	8	62.5	37.5
Metropolitan Status Code, %			
In the center city of an MSA Code	1907	37.1	62.9
Outside the center city of an MSA, but inside the county containing the center city	693	39.2	60.8
Inside a suburban county of the MSA	722	39.3	60.7
Not in the MSA	1906	40.2	59.8
Income Level, %			
<$10,000	305	27.9	72.1
$10,000 to $15,000	311	32.8	67.2
$15,000 to $20,000	476	30.9	69.1
$20,000 to $25,000	488	38.1	61.9
$25,000 to $35,000	595	37.5	62.5
$35,000 to $50,000	755	43.8	56.2
$50,000 to $75,000	657	43.5	56.5
>$75,000	876	49.3	50.7
Don't know /Not sure	376	28.7	71.3
Refused	389	130	259
Race, %			
White, non-Hispanic	4259	38.9	61.1
Black, non-Hispanic	592	32.8	67.2
Asian, non-Hispanic	20	40	60
Hawaiian and Pacific Islander, non-Hispanic	3	66.6	33.3
American Indian or Alaska native, non-Hispanic	43	65.1	34.9
Other race, non-Hispanic	45	53.3	46.7
Multiracial, non-Hispanic	122	41.8	58.2
Hispanic	91	45.1	54.9
Don't Know / not sure / refused	53	47.2	52.8

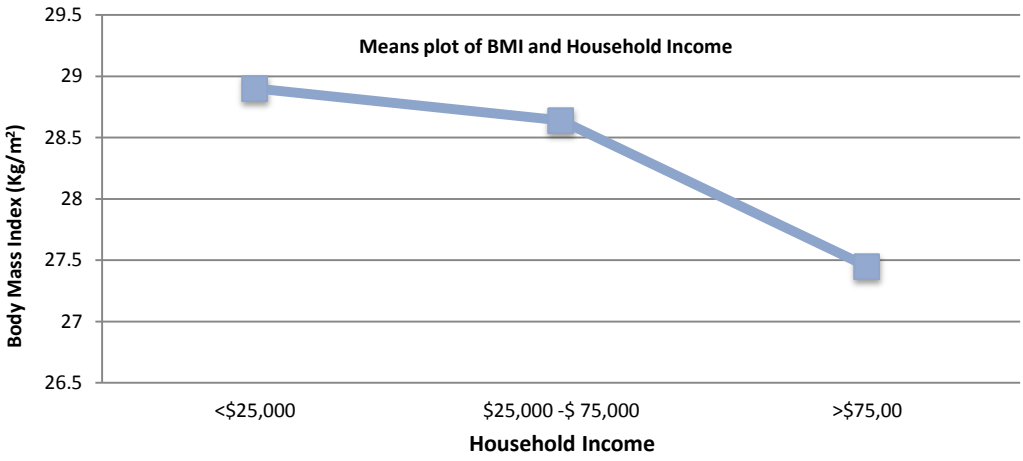
Analysis of variance (ANOVA) was conducted to assess the difference between groups of socioeconomic factors to see whether there were any trends of dissimilarity. The homogeneity of variance for Levene's test was violated with significant p-value. As the assumption of ANOVA was violated, the robust test of equality of means (Welch's F test) was conducted to determine which predictors was significantly predicting BMI. For income a ($F(2, 5226) = 20.09; p < 0.005$) which was significant and for the race the ($F(2, 5174) = 15.54$; p value <0.05) (table 2). The other predictors metropolitan status and education revealed not to be significant predictors of BMI in this study.

Table 2: Table 2 Shows the Results of Robust Tests of Equality of Means (Welch's F-test).

Predictor	F-statistic	Significance
Income	20.09	p<0.05
Metropolitan status code	1.04	p=0.355
Education	2.49	p=0.115
Race	15.54	p<0.05

A total of 1580 participants had income less than $ 25,000 and had mean BMI of 28.9 (SD±7.04) as opposed to the middle group $25,000 to $75,000with mean BMI of 28.64 (SD±6.22) (n=2007) and more than $75,000 represented the minority in these categories and had a lower mean BMI of 27.45. White were majority in the study, the mean BMI was 28.42(SD ±6.17) and 29.77 (SD±7.29) for blacks. The other / multiracial had an average BMI of 28.47 (SD±6.41). The majority had high school diploma and had a mean BMI of 28.42 compare to college graduate who had 28.14 (SD±6.27). (Table3). The mean BMI in the population living in the center of metropolitan area was 28.42 (SD±6.45) as opposed to the people who lived outside the city with a BMI of 28.1 (SD±6.12).(Table3).The analysis also indicates that income was inversely related to BMI; as the income increased the BMI decreased among the population who had high income per year compare to those who had lower income (figure 1).

Figure 1: Figure 1 presents the means plot of BMI and household income.



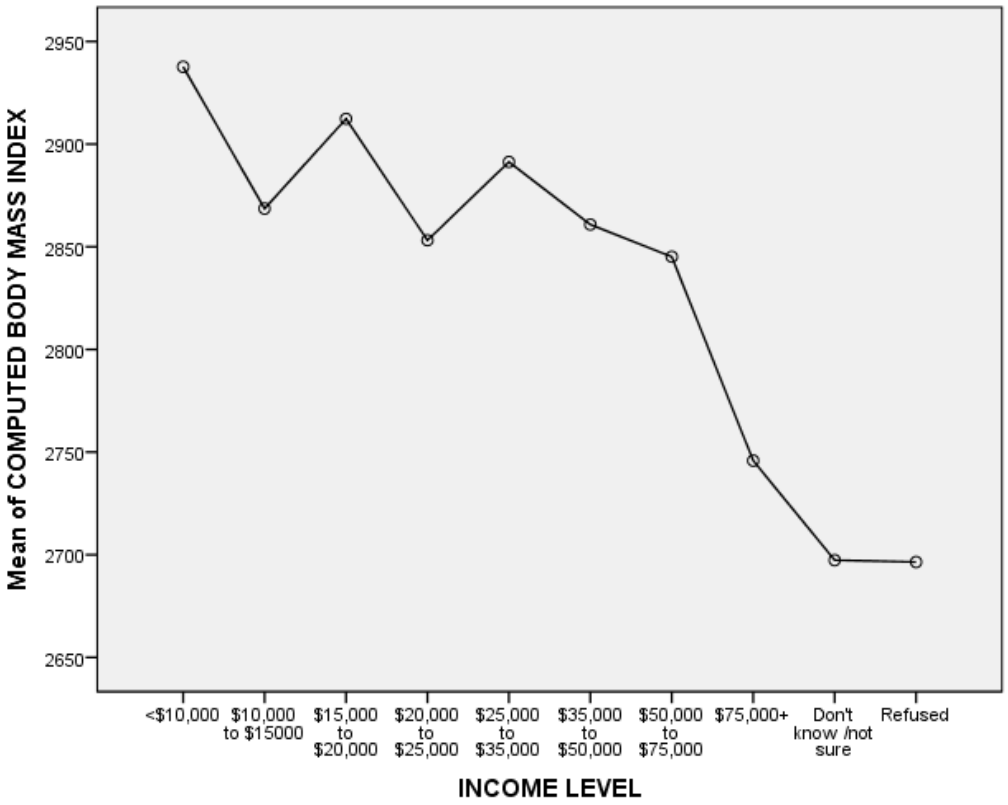


Figure 2: Figure 2 presents the crude means plot of BMI and household income.

Figure above 3 shows Blacks had high BMI compared to White, and the other /multiracial were in between the two groups of White and Black regarding the mean BMI (Figure 3).

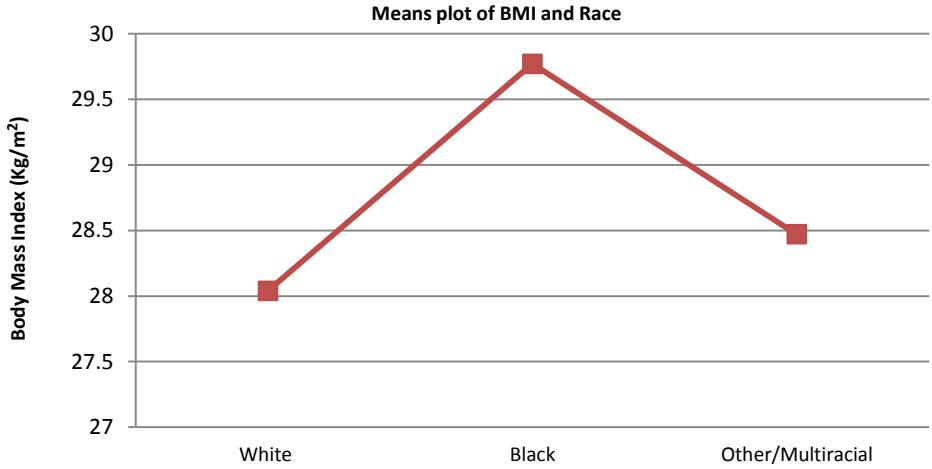


Figure 3: Figure 3 Presents the Means plot of BMI and Race.

4. DISCUSSION

This is among the first studies to examine the association between adult obesity and socioeconomic status in the state of Missouri. Obesity is the newest public health concern and its prevalence is increasing at an alarming rate. Previous studies have shown that prevalence of overweight has increased to relatively high levels in many developed countries [14]. The average BMI calculated for our study was 28.5 and 28.1 for men and women respectively, which is far above the normal range of 18.5 to 24.9. It would be valid to state that the Missouri population is overweight. Previously, studies have also shown association between obesity and socioeconomic factors [15].

This study showed a statistically significant difference in BMI among those with income of above $75,000 and below $75,000. Table 2 confirms that race was another factor found to be associated with obesity. Upon conducting post-hoc examination of the difference between groups it was observed that non-Hispanic black populations had a higher prevalence of obesity than whites and others/multiracial groups. According to our adopted data from BRFSS the prevalence of obesity is 42061 per 100,000 among blacks and 32193 per 100,000 in all races. The prevalence of obesity also seemed to decrease as the household income level decreased. Graph 1 shows that as the household income increased from $25,000 to $75,000, the prevalence of obesity decreased. There was not a statistically significant difference between those who earned below $25,000 and those who earned $25,000 to $75,000, but the overall prevalence of obesity decreases as the household income increases. Figure 3 shows the crude means plot of BMI and household income before the income categories were re-coded. A downward trend as household income increases is evident.

These finding are consistent with findings from previous research which have also shown association between obesity and education [16]. However, the current study did not observe the inverse association as observed by Wardle, Waller and Jarvis (2002) thus, this data did not show any changes as years of education increased. Some studies have reported higher obesity rates in rural populations when compared to urban populations [16]. A Swedish study showed that people living in rural areas had a higher risk of being obese than those living in an urban environment [17]. The current study showed an opposite trend with urban population having higher prevalence of obesity than rural or suburban populace. One must mention that the Swedish study studied a cohort of 1,578,694 people which is substantially larger than the sample size used in this analysis [17].

The study design was cross-sectional and a secondary analysis was conducted on data collected by BRFSS. The data was not specifically collected for research on obesity and its association with socioeconomic factors ergo the survey questions might have been ineffective in truly elucidating the association between obesity and socioeconomic factors. A questionnaire that assesses socioeconomic factors in greater detail will help create a model for association between obesity and socioeconomic factors. During the analysis similar categories were collapsed to create categories with similar sample sizes. Even after collapsing the categories, homogeneity of variance in all the predictors were not met. Collapsing similar categories resulted into normal distribution within groups in all predictors. The Welch's F statistic was reported since homogeneity of variance was not met.

A limitation of this study is that the survey was conducted over the telephone, which may have introduced interviewer bias. It must be stated that some participant response bias was also present. Figure 3 shows that those who refused to answer or did not know their income level had the lowest BMI when compared to all other categories. A similar coincidence was noticed when asked about the participants' education level. Those who refused to answer the question

about their education had highest BMI's. The sample sizes in both cases were comparable to other categories within each predictor. Further studies should focus their efforts to maximize the response rates sensitive questions such as income and education.

In comparison to similar studies in other countries, the trend seems to be going in the opposite direction. For example, in China and Russia, obesity is found predominantly among those with higher socioeconomic status. There are many factors that contribute to obesity and the factors contributing towards prevalence of obesity are not consistent among different populations [15]. Better models need to be created to explain such variances among various populations. In terms of generalizing these findings, since the data for this study included samples from the state of Missouri, the results can be generalized to other mid-western states with similar demographics as Missouri.

5. CONCLUSION

Previous researches have shown that the prevalence of obesity is on the rise. The link between obesity and socio-economic factors is not new. This study adds to this scientific literature with a more robust statistical analysis. This cross-sectional study design utilized the data from the BRFSS to analyze the relationship between obesity and the socioeconomic status. ANOVA was utilized to conduct for data analysis, income and race to be statistically significant.

Those who had a household income of less than $75,000 had a higher prevalence of obesity in comparison to those who earned more than $75,000. The results show an overall inverse relationship between income and BMI. Blacks had a higher BMI compare to other races. Further studies should be conducted to analyze additional factors that contribute to obesity. Increasing representation of other races by increasing their sample size will help better analyze health disparities among that populace.

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