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Association between Cardiovascular Disease, Cerebrovascular Disease and Overweight and Obesity among Adults in Puerto Rico

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Abstract

Background: According to the World Health Organization (2011), a high body mass index is an important risk factor for no communicable diseases such as cardiovascular diseases, mainly heart disease and stroke.

Methods: Data from the Behavioral Risk Factor Surveillance System (BRFSS), 2009 and 2010 were used for this study (n = 7,522). In order to estimate the prevalence ratio of overweight and obesity adjusted for multiple variables, Cox regression was used.

Results: Overall, 63.2% of participants were overweight or obese. Individuals with hypertension had a higher prevalence of overweight and obesity than those without hypertension (p <0.01). Those with a diagnosis of stroke had a higher prevalence of overweight and obesity compared with those who had no such diagnosis (p <0.01). In patients with angina, the prevalence of overweight and obesity was higher compared with those without (p <0.01). With regards to the variable history of stroke, the prevalence of overweight and obesity was higher in those who had suffered this condition, compared with those without this history (p = 0.88).

Conclusion: Our study reveals that there is a relationship between overweight and obesity and diseases such as hypertension, heart attack and angina. However, we found no statistically significant association between overweight and obesity and cerebrovascular disease.

Keywords: Overweight; Obesity; Cardiovascular disease; Hypertension; Stroke; Angina pectoris; Cerebrovascular disease; Puerto Rico; BRFSS (Behavioral Risk Factor Surveillance System)

Introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation, manifested by an increase in body weight and body mass index (BMI) that may impair health. The BMI is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). The World Health Organization (WHO) defines overweight as a BMI greater than or equal to 25 and obesity as a BMI greater than or equal to 30 [1].

Obesity is one of the biggest challenges to public health not only in the United States and Puerto Rico. In the 21st century alarming trends were observed in various parts of the world, these have more than doubled in all worlds since 1980 [2].

According to the Center of Disease Control and Prevention [3], in the United States between the periods of 2007 to 2008, approximately 72.5 million American adults were obese. The prevalence of obesity was higher than 30% in most age groups and sex. For 2009 the estimated prevalence of obesity in the United States according to data from the Behavioral Risk Factor Surveillance System (BRFSS) was 26.7% [3]. In 2010, no state had a prevalence of obesity less than 20%. Thirty-six states had a prevalence of 25% or more; twelve of these states had a prevalence of 30% or more [4]. In 2013, according to data from the National Health and Nutrition Examination Survey (NHANES), a total of 154.7 million of Americans older than 20 years old are overweight or obese (BMI of 25.0 kg / m 2 and higher), 79.9 million are men and 74.8 million are women [5]. In 2014, all the states continue to have a prevalence of obesity more than 20% [6].

According to the BRFSS in Puerto Rico, from 1996 to 2013 trends in the prevalence of overweight and obesity have been increasing. The prevalence of obesity increased from 16.8% to 29.9% and the prevalence of overweight from 37.2% to 38.7% respectively [7].

According to WHO [1], a high BMI is an important risk factor for no communicable diseases such as cardiovascular diseases (CVD), mainly heart disease (coronary heart disease) and stroke (leading cause of death in 2008). In 2005, the total number of CVD deaths had increased globally to 17.5 million from 14.4 million in 1990. Of these, 7.6 million were attributed to coronary heart disease and 5.7 million to stroke [8].

By 2030, researchers' project that non-communicable diseases will account for more than three-quarters of deaths worldwide; CVD alone will be responsible for more deaths in low income countries than infectious diseases (including HIV/AIDS, tuberculosis, and malaria), maternal and perinatal conditions, and nutritional disorders combined [9]. Thus, CVD is today the largest single contributor to global mortality and will continue to dominate mortality trends in the future [8]. As mentioned, WHO and FAO (Food and Agriculture Organization) reviewed the evidence on the relationship between obesity and the risk of CVD and concluded that overweight and obesity confer a significantly elevated risk of coronary heart disease [10].

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Methods

This study was conducted using data from Puerto Rico Behavioral Risk Factor Surveillance System (BRFSS-PR). The PR-BRFSS is an ongoing phone surveillance system that works in collaboration with the Centers for Disease Control and Prevention Disease (CDC). This system uses a standardized questionnaire for determining the distribution of risk behaviors and health practices among adults over 18 years. The PR-BRFSS monitors chronic and degenerative diseases, injuries, and preventable infectious diseases that are considered the main causes of morbidity and mortality in the island [11]. This study was approved by the Institutional Review Board (IRB) of the Ponce School of Medicine & Health Sciences (Protocol No. 1200315-MB). The sample size used was 7,522 individuals.

The data were processed and analyzed using SPSS version 19.0 [12]. Since the survey uses complex sampling, the data were processed after including weighing used by the PR-BRFSS to ensure the best possible representation of the Puerto Rico population.

For sample analysis, 2009 and 2010 years were combined, weighing the sample being used for each of the samples, so that the total sample had the same distribution as the population of Puerto Rico. The crude prevalence ratio was calculated by dividing the prevalence of obesity in the exposure among unexposed (reference) for each category of the variables under study. Confidence intervals were calculated at 95% for the prevalence ratio, in order to know the accuracy of the crude prevalence ratio as an estimator. The statistical significance of the prevalence ratio (PR) was calculated using Fisher's exact test (Ho: OR = 1.0) two-tailed using a type I error of 5%, to determine whether or not the findings were statistically significant [13].

To identify the concomitant variables, the associations between each other of all the variables associated with obesity were explored. This was done by dichotomizing all variables and using cross tabulation. The association was measured using the odd ratio (OR) and their statistical significance using Fisher's exact test [13]. Interaction and confounding variables were explored using stratified analysis Mantel-Haenszel [14].

In this study, each variable associated with overweight and obesity was stratified for each concomitant variable, to explore its possible role as a confounder or effect modifier. It is important to note that in this study no statistically significant interaction was found once adjusted for confounding variables.

In order to calculate the prevalence ratio for overweight and obesity adjusted for multiple variables, Cox regression was used [15]. As a cross-sectional study, the same constant (in this case the number 1) was used as follow-up time for all individuals in the sample. Thus time tracking is overridden and allows the calculation of adjusted prevalence ratio [16]. Also the confidence intervals were calculated for the accuracy of the estimator (PR) and its statistical significance using the chi square test of Wald two-tailed (Ho: OR = 1.0) with an error type I from 0.05 to 5% [14]. No statistically significant interaction was found in the multivariate analysis. The presence of confounding effect was studied by comparing the crude prevalence rate with the adjusted prevalence rate and reason why that confusion was evaluated. Several models were tested after identifying confounding and interaction between the variables, the best was used for adjustment.

Results

Table 1 shows the distribution of overweight and obesity by variables such as hypertension, diagnosis of infarction, angina pectoris and cerebrovascular disease for BRFSS sample in Puerto Rico. The results below were adjusted for age, gender, marital status, education and exercise.

A total of 63.2% of study participants were overweight or obese. Individuals with hypertension had a higher prevalence (78.4%) of overweight and obesity than those without hypertension (58.4%), with an adjusted prevalence ratio 1.44. This difference between the prevalence was statistically significant ($p < 0.01$).

When analyzing the variable diagnosis of infarction, it was found that those individuals, who had this diagnosis, had a prevalence of overweight and obesity of 75.4%. This prevalence was higher when compared to individuals who don't have a diagnosis of infarction, whose prevalence was of 65.0%. A ratio of adjusted prevalence of 1.10 was obtained; however, these results were not statistically significant ($p > 0.05$). For this variable there were considerable differences between

Variables	Overweight and obesity (Prevalence 100)	Total sample	Crude prevalence ratio (CI 95%) statistical significance	Adjusted prevalence ratio[2] (CI 95%) statistical significance
Hypertension				
Yes	1083 (78.4)	1,382	1.64 (1.5 - 1.8) p < 0.01	1.44 (1.3 - 1.6) p < 0.01
No	1538 (58.4)	2,633		
Diagnostic of infarct[4]				
Yes	230 (75.4)	305	1.29 (1.2 - 1.4) p < 0.01	1.19 (1.07 - 1.34) p < 0.01[3]
No	4,683 (65.0)	7,200		
Angina pectoris or coronary artery disease [5]				
Yes	436 (77.4)	563	1.37 (1.2 - 1.5) p < 0.01	1.32 (1.19 - 1.47) p < 0.01[3]
No	4,465 (64.5)	6,923		
History of cerebrovacular disease				
Yes	96 (69.1)	139	1.09 (0.9 - 1.4) p = 0.43	1.02 (0.8 - 1.3) p = 0.88
No	4,818 (65.3)	7,374		

[1]The sample weight was used to approximate the distribution of the population in Puerto Rico for 2009 and 2010 combined
[2]Adjusted for age, gender, marital status, education, exercise
[3]Adjusted for gender, education and exercise
[4]Adjusted for age, gender, marital status, education, exercise 1.10 (0.98 - 1.2) p =0.10
[5]Adjusted for age, gender, marital status, education, exercise 1.22 (1.1 - 1.3) p < 0.01

Table 1: Crude and adjusted prevalence of overweight and obesity in variables related to health status and some chronic diseases[1].

the crude and adjusted results, which mean that there is a significant degree of confusion. For this reason, the model was changed and adjusted by gender, education and exercise alone. By adjusting for these three variables only, the results were statistically significant ($p < 0.01$) and increased the strength of association (OR = 1.19). This means that according to the statistical model used, the variables of age and marital status explain this association.

In those with angina or coronary heart disease, the prevalence of overweight and obesity was 77.4%. This prevalence was higher than the prevalence of those who did not have angina or coronary heart disease, which had a prevalence of 64.5%. A ratio of adjusted prevalence of 1.22, and a statistically significant difference between the prevalence ($p < 0.01$) was obtained.

With respect to the variable history of stroke, the prevalence of overweight and obesity was 69.1% in those who had suffered this condition. This prevalence resulted higher compared to those without this history, who had a prevalence of 65.3%. A ratio of adjusted prevalence of 1.02 was obtained; this ratio was not statistically significant ($p = 0.88$).

Discussion

Obesity is recognized as a modifiable risk factor for cardiovascular disease [17-21]. Our results confirm a statistically significant association between overweight and obesity and the prevalence of hypertension, diagnosis of infarction and angina pectoris. The results of our study are consistent with other studies conducted outside of Puerto Rico who have demonstrated a strong association between BMI and hypertension [20, 22-26]. Also, the direct relationship between cardiovascular disease mortality and BMI has been shown in many large-scale studies [27]. According to Willet, Diets, and Colditz [24] relative risk (RR) of developing hypertension in women who gained 5 to 9.9 kg, was 1.7; those who gained more than 25 kg, the relative risk was 5.2. Field et al. [23] found that those who were overweight had a significantly increased risk compared with their thinner peers to develop hypertension (RR = 1.7) and heart disease (RR = 1.4).

Regarding the stroke variable, in this study no association between BMI and history of stroke was found. However, Akil and Ahmad [22] found a moderate association between increasing BMI and stroke. Other studies also demonstrated a strong association between BMI and stroke for each one-unit increase in BMI [20,22,28-30]. Cerebrovascular diseases are the second leading cause of death in middle-income countries, accounting for 12.8% of all causes of death, according to the World Health Organization [1]. Its incidence has increased by 100% in developing countries and is the leading cause of neurological disability sustained in the world [31]. The high rates of mortality and disability from cerebrovascular diseases not only affect the health and quality of life of the victims, but also cause significant economic and psychological burdens for families and society [32]. This lack of strength in the association in our study may be due to possible recall bias or lack of knowledge of having suffered a mild cerebrovascular accident. This would produce a random bias that results in an underestimation of the prevalence ratio.

Conclusion

In conclusion, to our knowledge, this is the first study to examine the relationship between selected variables and overweight and obesity using a representative sample of the entire population of Puerto Rico. This being a cross sectional study provided an opportunity to evaluate the consequences of obesity. It was confirmed once again that hypertension and coronary heart disease or angina are associated with obesity. The results of this study are useful to both the clinician and the general population to prevent and reduce the risk of obesity, which is now a disease in pandemic phase and has become the most important health problem in the West.

Our study has some limitations, first, selection bias and response rate, although BRFSS-PR has begun to incorporate cell phones in the sample, in the past only fixed landline phones were included. Second, the data are subject to recall bias, as the event is being asked may have occurred long time ago and the respondent do not remember information accurately. Third, there is the response bias. Because the data is self-reported, they are subject to bias given that the interviewee can understand that their behavior is not acceptable and then provide a socially appropriate response. Four, health status (self-report) is reported based on a diagnosis made by a physician or health professional, so the data may overlook individuals whose health problems have been recognized and / or diagnosed.

Despite these limitations, BRFSS-PR has proven to be a reliable and cost-effective source of health information collection. Among the strengths of this study using BRFSS data, we can say that the methodology of the BRFSS has been used and evaluated by the CDC and the participating states since 1984. The content of the survey questions, questionnaire design, data collection data, procedures, interviewing techniques and data processing have been carefully developed to improve data quality. In general, data from the BRFSS are extremely reliable and valid. Between 2003 and 2009, the response rates obtained by the BRFSS in Puerto Rico have fluctuated between 81.3% and 70.6%. These rates were calculated according to the formulas developed by the Council of American Survey Research Organization (CASRO). Moreover, cooperation rates of Puerto Rico have fluctuated between 92.1% and 88.0%. These response rates and cooperation, place Puerto Rico as one of the best in BRFSS participants across the United States.

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