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Association between Concomitant Diseases (Asthma, Diabetes, Arthritis and Cancer) and Overweight and Obesity among Adults in Puerto Rico

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Abstract

Objective: To assess the association between overweight and obesity and chronic diseases such as asthma, diabetes, arthritis and cancer. **Methods:** Data from the Behavioral Risk Factor Surveillance System (2009-2010) were used (n= 7,522). To calculate the adjusted prevalence of multiple variables, Cox regression was used. **Results:** The prevalence of overweight and obesity in individuals with diabetes was higher (80.5%) compared with those without the diagnosis, who had a prevalence of 63.1% ($p < 0.01$). Individuals diagnosed with asthma had a higher prevalence (71.4%) of overweight and obesity than those who had no diagnosis of asthma (64.3%) ($p < 0.01$). The prevalence of overweight and obesity in individuals with a history of arthritis was higher (73.9%) compared to those without history of arthritis (64.0%) ($p<0.01$). In the case of variable cancer, the prevalence of overweight and obesity in individuals with a history of cancer was 71.0%. Those who had no history of cancer had a prevalence of 65.1% ($p < 0.81$). **Conclusion:** This study confirmed that in Puerto Rico diabetes, asthma and arthritis are associated with overweight and obesity. However, we found no statistically significant association between overweight and obesity and those with a history of cancer.

Keywords: obesity, asthma, diabetes, arthritis, cancer, Puerto Rico, BRFSS (Behavioral Risk Factor System)

1. Introduction

The prevalence of obesity worldwide has nearly doubled since 1980. In 2008, more than 1.4 billion adults aged 20 and older, were overweight. Of these, more than 200 million men and nearly 300 million women were obese. By 2008, 35% of adults aged 20 or older were overweight and 11% were obese (World Health Organization, 2013). According to the World Health Organization (World Health Organization, 2013), a high BMI is an important risk factor for non-communicable diseases such as diabetes; musculoskeletal disorders especially osteoarthritis (degenerative joint disease); and some cancers of the endometrial, breast and colon. The risk of these NCDs increases with increasing BMI.

In Puerto Rico, according to the BRFSS, trends in the prevalence of overweight and obesity have been increasing. The prevalence of obesity increased from 16.8% to 27.9% and the prevalence of overweight increase from 37.2% to 38.7% from 1996 to 2013 respectively (BRFSS, 2015a).

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2. 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 (BRFSS, 2015b). The Institutional Review Board (IRB) of the Ponce School of Medicine & Health Sciences (Protocol No. 1200315-MB) approved this study. The sample size used was 7,522 individuals.

The data were processed and analyzed using SPSS version 19.0 (SPSS, 2010). 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 (Rosner, 2010).

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 (Rosner, 2010). Interaction and confounding variables were explored using stratified analysis Mantel-Haenszel (Szklo & Nieto, 2006).

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 (Hosmer, Lemeshow & May, 2008). 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 the adjusted prevalence ratio (Barros & Hirakata, 2003). 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% (Szklo & Nieto, 2006). 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.

3. Results

Table 1 show the distribution of overweight and obesity variable related to health status and selected chronic diseases such as diabetes, asthma, arthritis and cancer.

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

Variables	Overweight and obesity (Prevalence 100)	Total sample	Crude prevalence ratio [CI 95%] statistical significance	Adjusted prevalence ratio[2] [CI 95%] statistical significance
All adults	4,920 (63.2)	7,522	—	—
General health status[3]				
Excellence	901 (55.7)	1,619	Reference	Reference
Very good	661 (60.9)	1,085	1.15 [0.98 – 1.3] p =0.71	1.16 [1.0 – 1.3] p < 0.05
Good	1,643 (66.6)	2,467	1.32 [1.2 – 1.5] p < 0.01	1.22 [1.1 – 1.4] p < 0.01
Fair	1467 (72.3)	2,029	1.52 [1.4 – 1.7] p < 0.01	1.34 [1.2 – 1.5] p < 0.01
Poor	241 (77.7)	310	1.73 [1.5 – 2.0] p < 0.01	1.49 [1.3 – 1.7] p < 0.01
Diagnosis of de asthma				
Yes	799 (71.4)	1,119	1.19 [1.1 – 1.3] p < 0.01	1.26 [1.1 – 1.4] p < 0.01
No	4,113 (64.3)	6,395		
Currently have asthma				
Yes	431 (76.6)	563	1.29 [1.1 – 1.6] p < 0.01	1.26 [1.1 – 1.5] p = 0.01
No	366 (66.1)	554		
Diagnosis of diabetes				
Yes	782 (80.5)	971	1.53 [1.4 – 1.6] p < 0.01	1.36 [1.3 – 1.5] p < 0.01
No	4,129 (63.1)	6,539		
History of. arthritis[4]				
Yes	529 (73.9)	716	1.30 [1.2 – 1.4] p < 0.01	1.19 [1.1 – 1.3] p < 0.01
No	2,101 (63.2)	3,323		
History of. cancer				
Yes	115 (71.0)	162	1.16 [0.9 – 1.4] p=0.097	1.02 [0.9 – 1.2] p = 0.81
No	2,518 (65.1)	3,870		

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 - Chi square test linear by linear 14.450 p < 0.01

4 - Adjusted for gender, education and exercise 1.31 [1.18 – 1.45] p < 0.01

A total of 7,522 individuals make up the pooled sample of 2009 and 2010 results were then adjusted for age, gender, marital status, education and exercise. These variables were selected because they were found to have a possible confusion with multiple variables associated with overweight and obesity and had a significant predictive contribution in the Cox regression model.

A total of 63.2% of study participants were overweight or obese. Regarding the variable related to overall health, individuals who reported poor general health had the highest prevalence of overweight and obesity (77.7%), while those reporting excellent general health had the lowest prevalence (55.7%). This difference was statistically significant (p <0.05).

Individuals diagnosed with asthma had a higher prevalence (71.4%) of overweight and obesity than those who had no diagnosis of asthma (64.3%). Adjusted prevalence ratio of 1.26 was observed and the difference between the prevalence was statistically significant ($p < 0.05$). Subjects who reported having asthma at the time of the interview, had a higher prevalence (76.6%) of overweight and obesity than those who reported don't having asthma (66.1%).

Adjusted prevalence ratio of 1.26 was observed and the difference between the prevalence was statistically significant ($p < 0.01$).Regarding the variable diabetes, we found that the prevalence of overweight and obesity in individuals with diabetes was 80.5%. This prevalence was higher when compared to those without the diagnosis, who had a prevalence of 63.1%. This difference was statistically significant ($p < 0.01$).

For the variable arthritis, the prevalence of overweight and obesity in individuals with a history of arthritis was higher (73.9%) compared to those without history of arthritis (64.0%). Adjusted prevalence ratio of 1.19 was observed and the difference between the prevalence was statistically significant ($p < 0.01$). However, the strength of association decreased considerably after adjusting for the variables in the model, which means that there is a significant degree of confusion. Consequently, the model was changed and adjusted by gender, education and exercise. By adjusting these three variables only the results were statistically significant ($p < 0.01$) and increased the strength of association to 1.31. This means that the variables of age and marital status explain the association.

In the case of variable cancer, the prevalence of overweight and obesity in individuals with a history of cancer was 71.0%. Those who had no history of cancer had a prevalence of 65.1%. An adjusted prevalence of 1.02 was obtained. However, although found to be lower prevalence of overweight and obesity in those who had no history of cancer, this difference was not statistically significant ($p = 0.81$).

4. Discussion

In our study as the perception of respondents regarding their overall health was worse, the prevalence of overweight and obesity increased. Those with poor general health had a higher prevalence of overweight and obesity compared to those with an excellent condition. This difference was statistically significant and consistent with the results of Burkert, Rasky, Großschädl, Muckenhuber and FreidlLa (2013), who established that obesity in adults is associated with poorer health, and poorer quality of life.

An increasing prevalence of asthma in developed countries has coincided with the increased prevalence of obesity (Litonjua, Sparrow, Celedon, DeMolles & Weiss, 2002). Obesity can directly affect respiratory function through various mechanisms. Fat accumulation can hinder the expansion of the diaphragm preventing its decline during forced inspiration (Lazarus, Gore, Booth & Owen, 1998). Fat deposits between the muscles and the ribs may also hinder the movement of the chest wall (Biring, Lewis, Liu & Mohsenifar, 1999) that increases metabolic demands and workload of breathing in obese, even when at rest (Pankow et al., 1998). In our study, we observed that individuals with diagnosed asthma had a higher prevalence of overweight and obesity compared to those without this diagnosis, with a statistically significant difference. Similarly, those who suffered asthma at the time of the interview had a higher prevalence (76.6%) of overweight and obesity compared to those without asthma at the time (66.1%), with a statistically significant difference ($p < 0.01$). The results observed for Puerto Rico are consistent with the results of research conducted previously within and outside Puerto Rico, according to Jones & Nzekwu (2006), a linear relationship of decreased lung volumes and BMI. We also found a relationship between high BMI and the subsequent diagnosis of asthma (Camargo, Weiss, Zhang, Willett, Speizer, 1999). Other studies have found that the prevalence of asthma is higher in overweight and obese subjects (Camargo et al., 1999; Thomson, Clark, Camargo, 2003), and the relative risk of incident asthma increases with increasing obesity (Guerra et al., 2004; Aaron et al., 2004). According Baruwa and Sarmah (2013), obesity often causes a restrictive effect on the lungs.

Diabetes type 2 is the result of a complex interaction between genetic and environmental factors (Bray, 2004; Li et al., 2011). In this study, the prevalence of overweight and obesity was higher in those individuals diagnosed with diabetes compared to those without the diagnosis, with a statistically significant difference. The results for Puerto Rico in our study, consistent with the results of numerous studies in and outside Puerto Rico that have shown a relationship between overweight and obesity and the risk of developing diabetes (Li et al., 2011; Field et al., 2001; Sasai et al., 2010; Colditz, Willett, Rotnitzky & Manson, 1995; Chan, Rimm, Colditz, Stampfer & Willett, 1994;

Vázquez, Duval, Jacobs & Silventoinen, 2007; Disdier, Rodríguez, Perez & Perez, 2001; Koh-Banerjee et al., 2004; Resnick, Valsania, Halter & Lin, 2000; Mokdad et al., 2003).

In regards to the arthritis variable, we investigated whether there was an association between some form of arthritis, including osteoarthritis, rheumatoid arthritis, gout, lupus or fibromyalgia with overweight and obesity. It was found that those individuals with any of these conditions had a higher prevalence of overweight and obesity compared with those who did not have them. These results were statistically significant ($p < 0.05$) and consistent with the information found in the literature review.

According to the CDC (2011), obesity and arthritis are critical public health problems in the United States, with a high prevalence and high medical costs. Among the risk factors include: age, gender, obesity, genetics, race / ethnicity, diet, injury history among others (Johnson, Guiffre & Hunter, 2012). Prospective studies confirmed that obesity contributes to disease progression in patients with osteoarthritis (Cooper et al., 2000; Reijman et al., 2007). However, the effect of a high BMI in the incidence of disease is stronger than the effect on the progression of the illness (Cooper et al., 2000). According of Hair et al. (De Hair et al., 2012), excess weight can contribute significantly to the onset of clinical arthritis in individuals at risk of developing rheumatoid arthritis. Zakkak Similarly, Wilson and Lanier (Zakkak, Wilson & Lanier, 2009), established that the BMI is an independent risk factor for arthritis.

As for the cancer variable, according to the results obtained in our study, although we found a slightly higher prevalence of obesity among subjects who reported having cancer, this association was not statistically significant. These results, although not statistically significant are consistent with the literature review in which we found that obesity was associated with the incidence and mortality of cancer, and found positive associations between obesity and the risk of various cancers (Kuriyama et al., 2005; Batty et al., 2005; Samanic, Chow, Gridley, Jarvholm & Fraumeni, 2006). According to World Health Organization (2013), approximately 30% of cancer deaths are due to five factors of behavioral and dietary risk including: high rate of body mass, low fruit and vegetable intake, physical inactivity, consumption of tobacco and consumption of alcohol.

In conclusion, this study confirmed that in Puerto Rico diabetes, asthma and arthritis are associated with overweight and obesity. 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 helps us to recognize that obesity is now a serious illness and a major modifiable risk factor from the point of view of prevention. According to WHO (2011), overweight and obesity and their associated non-communicable diseases, are largely preventable.

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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