

Unequal Burden of Diabetes and Hypertension in the Adult Population of the San Juan Metropolitan Area of Puerto Rico

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Abstract

Objective: The study describes critical information gaps regarding diabetes, hypertension, prediabetes, prehypertension and its comorbidities in a representative sample of the Hispanic adult population living in Puerto Rico.

Research design and methods: A representative sample of non-institutionalized Puerto Ricans adults aged 18-79 years residing in the San Juan metropolitan area participated in a face-to-face interview, anthropometric measurements and blood draws. Prevalence of diabetes, hypertension, prediabetes, and prehypertension were estimated using logistic regression. Levels of awareness, treatment, adherence to medications, and control of these conditions were assessed.

Results: Of 452 participants, 15.2% had diabetes, 35.3% had pre-diabetes, 39.9% had hypertension and 44.9% had pre-hypertension. Females were more likely to have diabetes, except those aged 18-64 years. Prevalence of diabetes, pre-diabetes, hypertension and pre-hypertension increased significantly with age in both sexes. Pre-hypertension was more prevalent among males in all age groups. Only 35% of those diagnosed with diabetes and 52.5% of those diagnosed with hypertension were controlled on pharmacotherapy.

Conclusions: There is an unequal burden of diabetes, pre-diabetes, hypertension and pre-hypertension in Puerto Rico. The prevalence is high, increased significantly with age, and although the vast majority of participants with diabetes and hypertension were under treatment, control rates are suboptimal. These findings underscore the need for continued physician's efforts to improve control rates in our population.

Introduction

The Behavioral Risk Factor Surveillance System (BRFSS) suggests higher prevalence of diabetes mellitus and arterial hypertension among Puerto Rican Hispanics compared to other racial/ethnic groups in the United States (US) [1]. Puerto Ricans show an even higher prevalence of both conditions among Hispanic subgroups living in the US [2,3]. Since both type 2 DM and hypertension are important contributing risk factors for end-organ damage and cardiovascular diseases, management of these conditions is therefore essential for the reduction of associated morbidity and mortality [4,5]. Increasing awareness, treatment, and control of these chronic conditions is expected to reduce morbidity and mortality [6-8]. The National Health and Nutrition Examination Survey (NHANES) has demonstrated that despite the documented benefit of blood pressure lowering and glycemic control, rates of detection and control of these conditions have been suboptimal in the US [8]. However, such information is less clear for Hispanic subgroups, especially those living in Puerto Rico. This information is essential for detecting, monitoring and evaluating the quality of care for individuals diagnosed with these conditions.

The present study addressed some of the critical information gaps regarding diabetes and hypertension in a representative sample of the adult population in the San Juan Metropolitan Area (SJMA) of Puerto Rico. The primary aims of the study were to estimate the overall and age- and gender-specific prevalence of pre-hypertension, hypertension, pre-diabetes, and diabetes; determine the percentage of adults with diabetes and hypertension who were aware of their status; determine the percentage of adults diagnosed with these conditions who are under treatment; and determine the percentage of adults with hypertension and diabetes who are under control. The results from this

study will provide preliminary data to develop culturally-appropriate interventions which can address improvement of quality of care and reduction of health disparities of these important chronic conditions.

Research Design and Methods

Study sample

The study population consisted of a sample of non-institutionalized Puerto Ricans residing in the SJMA. According to the 2010 Census, there were 955,431 inhabitants aged 18 to 79 years in this geographical area that consists of seven municipalities [Carolina (n=152,396), Trujillo Alto (n=65,732), San Juan (n=347,065), Guaynabo (n=86,746), Bayamón (n=195,814), Toa Baja (n=82,418), and Cataño (n=25,260)] [9].

An estimated sample of 452 Puerto Ricans aged 18-79 years residing in the SJMA was selected through a complex, multistage probability sampling design [10-12]. The sampling frame was determined by the

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maps of census tracts of the SJMA provided by the Census Bureau, Puerto Rico Planning Board. The statistical information provided by the Census in every tract was divided in groups of blocks of households. A total of 50 groups of blocks were randomly selected in the SJMA using a systematic procedure after ordering the total groups of blocks by the median household value. Afterward, for each selected group of block, one block of households was randomly selected. Then, all the selected blocks were visited to identify the total number of occupied households. Finally, for each household in the selected blocks, all individuals aged 18-79 years were invited to participate in the study. A priori exclusion criteria included pregnant females and subjects who were cognitively or physically impaired. The study was approved by the Institutional Review Board of the University of Puerto Rico Medical Sciences Campus, and written informed consent was given by all participants.

Data collection

Participants who met eligibility criteria were scheduled to visit the Puerto Rico Clinical and Translational Research Consortium of the University of Puerto Rico-Medical Sciences Campus to undergo the physical evaluation, biochemical measurements, and a face-to-face interview. A questionnaire was administered by specially-trained interviewers and covered the following areas: socio-demographic characteristics, lifestyles, medical history, current medication use, and family history of various chronic diseases. Subjects were considered ever smokers if they reported having smoked at least 100 cigarettes during their lifetime. Participants who reported having at least one drink of any type of alcohol during the past 30 days were considered current drinkers. Respondents were classified as meeting national guidelines on physical activity if they reported participation in moderate-intensity activities for a minimum of 30 minutes on five days per week or vigorous-intensity activity for a minimum of 20 minutes on three days per week [13].

Anthropometric and blood pressure measurements

Weight, height, and waist and hip circumferences were taken in duplicate following the NHANES III Anthropometry Procedures Manual [14], and the average of the two measurements was used. Weight and height were measured to the nearest 0.5 kg and 0.1 cm, respectively. Body mass index (BMI) categories were defined as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥ 30.0 kg/m²). Waist circumference was measured using a Gulick 2 Plus measuring tape to the nearest 0.1 cm at the high point of the iliac crest at minimal respiration when the participant was in a standing position [14]. Hip circumference was measured at the level of greater trochanters and symphysis pubis to the nearest 0.1 cm. Waist to hip ratio was calculated as the ratio of waist (cm) and hip (cm) measures.

Three blood pressure measurements were taken 10 minutes apart using an appropriate cuff size and a standard aneroid sphygmomanometer. Prior to the measurement, participants were asked to seat quietly in a chair for at least five minutes, with feet on the floor and arm supported at the chest level. Blood pressure status was based on the average of the three measurements.

Biochemical assays

Blood samples were drawn in the morning after at least a 10-hour fast. Fasting blood samples (5 mL) were drawn for determination of fasting plasma lipids, chemical comprehensive metabolic panel, and

hemoglobin A1c using standard assays: microalbumin/creatinine in urine and hemoglobin A1c in blood were collected using the DCA quantitative assays (Siemens Healthcare Diagnostics Inc., Tarrytown, NY); concentrations of HDL cholesterol, total cholesterol, triglycerides, and fasting plasma glucose were collected using Vitros' colorimetric kits (Ortho-Clinical Diagnostics, Inc., Rochester, NY); and high sensitive CRP was collected using the immunoturbidimetric method (Roche Diagnostics Corporation, Hague Rd, IN).

Definitions of study outcomes

Prevalent diabetes was defined based on fasting plasma glucose levels of at least 126 mg/dL, HbA1c of at least 6.5%, or both, and/or reported current use of prescribed anti-diabetic medications [4]. Prevalent pre-diabetes included subjects who did not self-report diabetes but had HbA1c levels between 5.7% and 6.4%, fasting blood glucose between 100 mg/dL and 125 mg/dL or both [4]. Diabetes awareness was determined based on those participants who responded "yes" to the question "Have you ever told by a doctor that you have diabetes?". Diabetes was considered under treatment if participants responded "yes" to the question "Have you ever told by a doctor that you have diabetes" and were taking prescribed anti-diabetic medications, including insulin. Diabetes was considered to be under control in subjects under treatment if HbA1c levels were below 7% [4].

Prevalent hypertension was defined as mean systolic blood pressure levels of at least 140 mm Hg, mean diastolic blood pressure of at least 90 mm Hg, or both, and/or reported current use of prescribed antihypertensive medications [6]. Prevalent pre-hypertension was defined as a participant who did not report hypertension, and had mean systolic blood pressure between 120 mm Hg and 139 mm Hg or a mean diastolic blood pressure between 80 mm Hg and 89 mm Hg [6]. Hypertension awareness was determined based on those participants who responded "yes" to the question "Have you ever told by a doctor that you have hypertension?". Hypertension was considered under treatment if participants responded "yes" to the question "Have you ever told by a doctor that you have hypertension" and self-reported taking prescribed antihypertensive medications. For participants that had not been diagnosed with diabetes, hypertension was considered to be under control in subjects on treatment if the average blood pressure was below 140/90 mm Hg. For participants diagnosed with diabetes, hypertension was considered to be under control in subjects under treatment if the average blood pressure was below 130/80 mm Hg.

Statistical analysis

Prevalence of diabetes, prediabetes, hypertension, and prehypertension (overall and age- and gender specific) was estimated using a logistic regression model. In order to get an unbiased estimator of the prevalence, a weighting factor was considered in this model to control the effect of the sampling design. This weighting factor was normalized using the following expression:

$$w_i = \frac{1 / (f_1 * f_2 * f_3)}{\bar{w}}$$

where f_1 was the selection probability for each participant, f_2 was the rate of participation in each block, f_3 was the post-stratification adjustment based on the age and gender distribution of the Census 2010 in the SJMA, and \bar{w} was the mean final weight for the entire sample [10]. Data management and all statistical analyses were performed using the statistical package Stata (Version 11.0, College Station, TX, USA).

Results

Of the selected residents, 452 (63%) consented to participate in the face-to-face interview and provided blood and urine samples suitable for analyses. The gender distribution of the sample (female: 59.1%; males: 40.9%) was similar to that of the adult population of the SJMA of Puerto Rico according to the Census 2010 (female: 54.1%; males: 45.9%) (Table 1). However, the age distribution of the sample was different to that of the SJMA of Puerto Rico (sample: 18-44 years: 39.4%; 45-64 years: 39.4%; 65-79 years: 21.2% vs. Census: 49.5%, 34.5%, 16.0%, respectively).

The majority of women were aged 45-64 years, whereas most males were aged 18-44 years. Most of the participants had at least 12 years of education, and approximately 60% of the participants reported a family annual income below \$20,000. Around 33% of the participants reported public health insurance, with a larger proportion among females. Lifetime smoking exposure was more frequent among women than among males (68.4% vs. 48.1%). Nearly 79% of adults were overweight (34.7%) or obese (43.8%), with no significant differences in gender. A significant higher proportion of women reported meeting physical activity recommendations, and had elevated waist circumference, waist-to-hip ratio, and hs-CRP. However, a higher proportion of men

exhibited reduced HDL-cholesterol, and elevated triglycerides, AST and ALT levels.

Prevalence of diabetes, prediabetes, hypertension and pre-hypertension

Overall prevalence of diabetes was 15.2% (95% CI: 11.9%, 18.5%), corresponding to 119,300 adults (95% CI: 93,000, 144,800) in the SJMA of Puerto Rico (Table 2). The overall prevalence of diabetes increased with age in both genders, from 2.5% in the age group 18-44 years to 35.6% among those aged 65-79 years. Males aged 18-64 years were more likely than females of the same age group to have diabetes (31.9% versus 22.1%), whereas females 65 years and older had a higher prevalence of diabetes compared to their male counterparts (47.9% versus 18.9%).

On the other hand, the overall prevalence of pre-diabetes was 35.3% (95% CI: 30.9%, 39.7%), corresponding to 275,800 (95% CI: 241,750, 310,600) adults with pre-diabetes. This prevalence also increased markedly with age in both genders and reached the peak at age 65-79 years (64.8%). Prevalence of prehypertension was higher among women aged 65-79 compared to their male counterparts (81.8% versus 41.7%).

Characteristics	Total (n = 452)		Women (n = 267)		Male (n = 185)	
	Frequency	%	Frequency	%	Frequency	%
Age (years)						
18-44	178	39.4	99	37.1	79	42.7
45-64	178	39.4	108	40.4	70	37.8
65-79	96	21.2	60	22.5	36	19.5
Education (years)						
≤8	56	12.4	34	12.8	22	11.9
9-12	167	37.0	88	33.1	79	42.7
≥12	228	50.6	144	54.1	84	45.4
Marital status						
Single	108	23.9	68	25.6	40	21.6
Married	178	39.5	97	36.4	81	43.8
Other	165	36.6	101	38.0	64	34.6
Annual family income						
<\$20,000	259	57.4	154	57.9	105	56.8
\$20,000-\$50,000	122	27.1	70	26.3	52	28.1
>\$50,000	25	5.5	13	4.9	12	6.5
Primary medical insurance*						
Public	147	32.6	97	36.5	50	27.0
Private	252	55.9	148	55.6	104	56.2
None	52	11.5	21	7.9	31	16.8
Smoking status*						
Yes	271	60.1	182	68.4	89	48.4
No	179	39.7	84	31.6	95	51.6
Perceived health status						
Excellent	51	11.3	25	9.4	26	14.1
Very good	47	10.4	26	9.8	21	11.3
Good	170	37.7	104	39.1	66	35.7
Regular	162	35.9	96	36.1	66	35.7
Poor	21	4.7	15	5.6	6	3.2
BMI (kg/m ²)						
<18.5	10	2.2	9	3.4	1	0.5
18.5 - 24.9	87	19.3	47	17.7	40	21.6
25.0 - 29.9	156	34.7	90	34.0	66	35.7
≥ 30.0	197	43.8	119	44.9	78	42.2
Alcohol consumption						

Yes	140	31.0	86	32.3	54	29.2
No	311	69.0	180	67.7	131	70.8
Physical activity*						
Yes	139	30.7	93	34.8	46	24.9
No	313	69.3	174	65.2	139	75.1
Waist Circumference*						
Normal (women: <35", men: <40")	228	50.4	106	39.7	122	65.9
Elevated (women: ≥ 35", men: ≥ 40")	224	49.6	161	60.3	63	34.1
Waist to Hip Ratio* Eliminate (cm)						
Normal (women: ≤ 0.8, men: ≤ 0.9)	117	25.9	52	19.5	65	35.1
Elevated (women: >0.8, men: >0.9)	335	74.1	215	80.5	120	64.9
Blood Pressure*						
<120 / 80	199	44.2	133	50.2	66	35.7
120 - 139 / 80 - 89	151	33.6	69	26.0	82	44.3
140 - 159 / 90 - 99	74	16.4	44	16.6	30	16.2
≥ 160 / 100	26	5.8	19	7.2	7	3.8
Blood Glucose (mmol/L)						
<5.6	340	75.4	205	77.1	135	73.0
5.6-6.9	71	15.7	36	13.5	35	18.9
≥ 7.0	40	8.9	25	9.4	15	8.1
HbA1c (%)						
<5.7	184	40.8	96	36.1	88	47.6
5.7-6.4	218	48.3	140	52.6	78	42.1
≥ 6.5	49	10.9	30	11.3	19	10.3
Total Cholesterol (mmol/L)						
<5.2	303	67.2	170	63.9	133	71.9
5.2 - 6.1	101	22.4	62	23.3	39	21.1
≥ 6.2	47	10.4	34	12.8	13	7.0
HDL-C* (mmol/L)						
<1.0	111	24.6	45	16.9	66	35.7
1.0 - 1.5	274	60.8	171	64.3	103	55.7
≥ 1.6	66	14.6	50	18.8	16	8.6
Triglycerides* (mmol/L)						
<1.7	297	65.9	187	70.3	110	59.5
1.7 - 2.2	80	17.7	45	16.9	35	18.9
2.3 - 5.6	68	15.1	33	12.4	35	18.9
≥ 5.7	6	1.3	1	0.4	5	2.7
Albumin-creatinine ratio (mg/G)						
< 30	389	87.4	233	89.3	156	84.8
30 - 299	54	12.1	27	10.3	27	14.7
≥ 300	2	0.5	1	0.4	1	0.5
CRP* (mg/L)						
<1.0	153	33.9	74	27.8	79	42.7
1.0 - 3.0	137	30.4	73	27.5	64	34.6
3.1 - 10.0	121	26.8	87	32.7	34	18.4
≥ 10.1	40	8.9	32	12.0	8	4.3
AST* (U/L)						
<15.0	59	13.1	44	16.5	15	8.1
15.0 - 46.0	345	76.5	197	74.1	148	80.0
>46.0	47	10.4	25	9.4	22	11.9
ALT* (U/L)						
<11.0	50	11.1	39	14.6	11	6.0
11.0 - 66.0	380	84.3	222	83.5	158	85.4
>66.0	21	4.6	5	1.9	16	8.6

*P value for gender differences <0.05

Table 1: Baseline characteristics of participants by sex in the SJMA, Puerto Rico.

Overall prevalence of hypertension was 39.9% (95% CI: 35.4%, 44.4%), corresponding to 312,250 (95% CI: 276,900, 347,450) adults with hypertension in this geographical area of Puerto Rico. The overall prevalence of pre-hypertension was 44.9% (95% CI: 40.3%, 49.5%), corresponding to 351,400 (95% CI: 315,350, 387,200) adults with pre-hypertension. The prevalence of both conditions increased steeply from 18-44 years onwards reaching a peak at age 65-79 years for both genders. Although there were no marked differences in the age-specific prevalence of hypertension by gender, prevalence of prehypertension was higher in men across all age groups.

Distribution of co-morbidities among subjects with diabetes and hypertension

Almost three-quarters of the participants with diabetes reported hypertension (74.4%), over half reported hypercholesterolemia (53.7%), and 39% reported hypertriglyceridemia (39%) (data not shown). A significant number of participants with a diagnosis of hypertension were also diagnosed with diabetes (68.2%), hypercholesterolemia (47.9%) or hypertriglyceridemia (31.8%). Among those with a diagnosis of diabetes, 80.5% reported to have three or more co-morbidities. However, among those with a diagnosis of hypertension, 62.0% reported to have at least three co-morbidities.

Percentage of participants under treatment and control

More than 75% of participants with diabetes and hypertension were aware of their diagnosis (78.6% and 81.5%, respectively) (Table 3). The overwhelming majority of participants diagnosed with diabetes and hypertension were under treatment (90.9% and 91.6%, respectively). Notwithstanding, only 35% of those diagnosed with diabetes and 52.5% of those diagnosed with hypertension were controlled on pharmacotherapy. Despite the limited sample sizes, there were no marked variations in the percentages of adults with diabetes and hypertension who were aware, treated and controlled by gender.

Conclusion

These analyses provide up-to-date estimates of the prevalence diabetes, prediabetes, hypertension and prehypertension among adults aged 18-79 living in the SJMA of Puerto Rico. In addition, we assessed the levels of awareness, treatment, and control among adults with diabetes and hypertension. We found that nearly 15.2% of adults have diabetes and 35.3% to have pre-diabetes, estimates that are higher than those reported by BRFSS in 2010 (12.8% and 8.6%, respectively) [1]. As expected, prevalence of both diabetes and pre-diabetes increased significantly with age, finding that is consistent with previous studies in Puerto Rico [15,16]. The findings of this study support the notion that the burden of DM and prediabetes in Puerto Rico is significant [2,3,17].

	Total		Men		Women	
	Percent	Estimated population (95% CI)	Percent	Estimated population (95% CI)	Percent	Estimated population (95% CI)
Diabetes						
18-79 years	15.2	119,300 (93,000 - 144,800)	15.8	51,200 (37,750 - 75,800)	16.1	68,100 (48,650 - 85,850)
18-44 years	2.5	9,750 (800 - 18,550)	4.5	8,300 (2,200 - 28,800)	0.73	1,450 (350 - 6,300)
45-64 years	24.1	64,950 (48,100 - 82,000)	27.4	32,850 (18,650 - 52,250)	21.4	32,100 (19,850 - 49,100)
65-79 years	35.6	44,600 (32,600 - 56,550)	18.9	10,050 (3,100 - 24,850)	47.9	34,550 (14,750 - 55,350)
Pre-diabetes						
18-79 years	35.3	275,800 (241,750 - 310,600)	30.8	110,200 (86,600 - 134,750)	39.1	165,600 (140,450 - 189,950)
18-44 years	9.8	38,100 (20,900 - 55,000)	7.6	14,150 (5,750 - 32,550)	11.9	23,950 (11,800 - 45,700)
45-64 years	58.0	156,550 (136,850 - 176,300)	61.7	73,900 (38,600 - 101,200)	55.0	82,650 (60,550 - 103,500)
65-79 years	64.8	81,150 (69,100 - 93,150)	41.7	22,150 (6,250 - 42,050)	81.8	59,000 (42,000 - 67,500)
Hypertension						
18-79 years	39.9	312,250 (276,900 - 347,450)	37.6	135,050 (110,050 - 160,200)	41.9	177,200 (129,300 - 171,800)
18-44 years	14.2	55,150 (35,100 - 74,850)	12.3	23,050 (7,750 - 58,750)	16.0	32,100 (14,900 - 62,500)
45-64 years	54.7	147,650 (127,950 - 167,400)	56.5	67,650 (42,700 - 90,100)	53.2	80,000 (62,750 - 96,750)
65-79 years	87.4	109,450 (101,150 - 117,750)	83.6	44,350 (28,800 - 50,700)	90.2	65,100 (50,700 - 70,200)
Pre-hypertension						
18-79 years	44.9	351,400 (315,350 - 387,200)	53.9	193,600 (167,900 - 219,481)	37.3	157,800 (133,250 - 182,300)
18-44 years	31.0	120,100 (93,750 - 146,300)	43.1	80,350 (48,150 - 116,050)	19.8	39,750 (16,950 - 79,800)
45-64 years	59.8	161,300 (142,000 - 180,850)	66.0	79,000 (50,400 - 100,350)	54.8	82,300 (41,400 - 119,300)
65-79 years	55.9	70,000 (57,550 - 82,450)	64.5	34,250 (12,700 - 48,450)	49.5	35,750 (16,700 - 54,950)

Table 2: Prevalence of diabetes, pre-diabetes, hypertension and pre-hypertension in the adult population of the San Juan Metropolitan Area of Puerto Rico.

	Men			Women		
	Aware n (%)	Treated n (%)	Controlled n (%)	Aware n (%)	Treated n (%)	Controlled n (%)
Diabetes	30 (76.9)	26 (86.7)	13 (50.0)	36 (80.0)	34 (94.4)	8 (23.5)
Hypertension	58 (82.9)	50 (86.2)	26 (52.0)	96 (80.7)	91 (94.8)	48 (52.7)

Table 3: Percentage of adults aged 18-79 with diabetes and hypertension who are aware, treated, and controlled in the San Juan Metropolitan Area of Puerto Rico .

Our findings are consistent with other studies showing that the prevalence of hypertension is higher in the Hispanic population in the US [18-20]. We found a prevalence of hypertension and pre-hypertension of 39.9% and 44.9%, respectively. Prevalence of hypertension was higher than that reported in the 2010 BRFSS data in Puerto Rico (34.0%) [1]. Prevalence of hypertension and prehypertension increased with age in both genders and pre-hypertension was more prevalent among males in all age groups. In the 2000-2005 National Health Survey Interview Survey, it was found that Puerto Ricans had a higher prevalence of diabetes and hypertension compared to other Hispanic sub-groups [2]. Participants in our study with both diabetes and hypertension were older, had a lower income and less formal education, findings in accordance with previous reports [2,15-17]. Similar to other studies, participants with diabetes and obesity had a significantly higher prevalence of hypertension than those without diabetes.

Ong et al. reported that the rate of awareness, treatment and control of hypertension in US did not increase from 2000 to 2004 [18]. However, recent data indicate that the age-adjusted prevalence of hypertension in the US has remained unchanged (29.9% for the period 2005-2008), but the control rates have improved to 50.1% [8]. This analysis also revealed that rates of uncontrolled hypertension were higher among those classified as obese and those with diabetes. Although we found that the vast majority of participants in our study with diabetes and hypertension were under treatment, control rates were suboptimal. Only 35% of those diagnosed with diabetes and 52.5% of those diagnosed with hypertension were controlled on pharmacotherapy, findings consistent with previous studies. Cooper et al. reported that African Americans are disproportionately affected by hypertension and its complications, and several barriers affect the effective blood pressure control [20]. In our study population of Hispanics the burden of hypertension is higher than in mainland Caucasians, and most of our subjects had uncontrolled hypertension. Potential barriers to control include low socioeconomic status, financial difficulties, higher costs of medication, low health literacy, and unemployment [20].

Individuals with both diabetes and hypertension also had higher mean levels of BMI and waist circumference. In this study, 78% of study participants were overweight or obese (34.7% overweight and 43.8% obese), a figure higher than the BFRSS combined self-reported estimate for 2010 (38.1% overweight and 27.5% obese) [21]. This estimate was also higher than the most recent NHANES estimate for overweight and obesity (68.0% for all adults \geq 20 years); however, it was similar to the estimate reported for all Hispanics (77.9%) [21]. In addition to general and abdominal obesity, study participants with diabetes and hypertension also had more co-morbidities including elevated blood lipids, conditions that increase their cardio-metabolic risk.

Strengths of our study include that the sample was representative of the adult population living in the San Juan metropolitan area and that the response rate was adequate. Amongst the limitations are that findings cannot be generalized to the entire population of Puerto Rico, and the small number of subjects with either diabetes or hypertension precluded the assessment of awareness, treatment and control of these conditions across sociodemographic and clinical characteristics.

The study findings underscore the unequal burden of diabetes, prediabetes, hypertension, and prehypertension in a Hispanic subgroup, placing this population at a higher cardiometabolic risk. The study findings also underscore the need for continued physician's efforts to improve control rates in our population. Such information may be helpful to health care decision makers. Future research should address the burden of these conditions in a broader representative sample in Puerto Rico.

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MZAV, CMP, JJH and ES participated in the design concept of the study. MZAV, CMP, CRT, YV and RR participated in acquisition of data. ES and CRT participated in the data analysis, and ES, CMP, and MZAV researched and interpreted the data and drafted the manuscript. JJH contributed to interpretation of data and discussion. All authors reviewed, commented on, and approved the final manuscript.

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