Association between the hypertriglyceridemic waist phenotype and diabetes mellitus among adults in Puerto Rico

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ABSTRACT

Aims: Hypertriglyceridemic waist (HTGW) phenotype has been proposed as a simple approach to identify patients with excess intra-abdominal adiposity and cardiometabolic abnormalities. This study described the prevalence of HTGW phenotype and assessed its association with diabetes mellitus (DM). **Methods:** Data from a cross-sectional study using a representative sample of 858 adults residing in the San Juan Metropolitan Area was analyzed. HTGW phenotype was defined as elevated triglycerides (men: ≥ 177 mg/dL, women: ≥133 mg/dL) and elevated waist circumference (men: ≥90 cm, women: ≥85 cm). Participants were classified into three groups: group 1 (n=241): normal waist circumference and triglycerides, group 2 (n=378): elevated waist circumference and normal triglycerides & normal waist circumference and elevated triglycerides, group 3 (n=239): elevated waist circumference and triglycerides. Individuals were classified as having DM if they answered affirmatively to the question of whether a doctor had ever told them they have DM. Logistic regression was used to estimate the adjusted prevalence odds ratio for DM according to HTGW status. **Results:** Overall prevalence of HTGW phenotype was 27.9% (25.4% for males vs. 29.1% for females, p<0.05). After adjusting for age, sex, education, smoking, alcohol consumption, physical activity, family history of DM, BMI, hs-CRP, fibrinogen, and PAI-1, subjects with the HTGW phenotype were 3.56 (95% CI: 1.39-9.14) times more likely to self-report DM than subjects who did not have the HTGW phenotype. **Conclusion:** The HTGW phenotype was associated to type 2 DM in our population. Future studies should assess the usefulness of the HTGW phenotype as a screening tool to identify individuals at risk for DM.

INTRODUCTION

•DM has rapidly become a global health issue, due largely to rapid economic development, urbanization, aging and increasing prevalence of obesity(1).
•According to the 2010 Behavioral Risk Factor Surveillance System, the prevalence of DM in the United States was 8.7%, a lower figure than that observed in Puerto Rico (12.8%).
•Although obesity is a major risk factor for insulin resistance and type 2 DM, not every obese patient is at high risk of DM and cardiovascular disease (2). Thus, for any given body mass index (BMI), it is necessary to assess the location of excess body fat to refine the evaluation of the risks associated with overweight and obesity(3).
•Studies have shown that a central pattern of body fat distribution, particularly an increased amount of visceral fat, is an independent risk factor for type 2 DM (3).
•The measurement of waist circumference (WC) has been previously reported as a good crude correlate of abdominal and visceral obesity (4). However, an increased WC alone is not sufficient to identify an abdominal obese person with excess visceral adipose tissue. Clinical markers of an altered metabolic risk profile must also be present to suggest the presence of visceral obesity (5).
•Lemieux et al.(6) showed that concurrently high serum fasting triglycerides and WC could predict metabolic abnormalities in people with an increased waist line.
•This phenotype, known as HTGW, is defined as the simultaneous presence of abdominal obesity (**WC ≥ 85 cm in women or WC ≥ 90 cm in men**) and hypertriglyceridemia (**triglycerides concentration ≥177 mg/dl in men or ≥ 133 mg/dl in women**).

STUDY AIMS

•To determine the prevalence of HTGW phenotype among adults in the San Juan Metropolitan Area.
•To compare the baseline characteristic according to HTGW phenotype.
•To assess the association between HTGW and DM after adjusting for potential confounders.

METHODS

Study design and data collection procedures

•This is a secondary analysis of the cross-sectional study, *Prevalence of the metabolic syndrome in San Juan, Puerto Rico.* The study population consisted of non-institutionalized persons aged 21 to 79 years(7).

•The parent study was composed of subjects who were randomly selected from a probability survey using a complex sampling design based on a sample of households of the San Juan Metropolitan Area during 2005-2007.

•From the parent study population, we analyzed the information of 858 subjects to assess the study aims.

•Information collected in the parent study included socio-demographic characteristics, lifestyles, medical history, anthropometric and blood pressure measurements, and blood and urine laboratory test results.

Definition of study variables

•DM was defined as having responded "Yes" to the question "Have you ever been told by a doctor or health professional that you have diabetes?"

•HTGW phenotype was defined as follows:

Group 1 (n=241): Normal WC and triglycerides.

Group 2 (n=378): Elevated WC and normal triglycerides (n=335).
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Normal WC and elevated triglycerides (n=43).
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Group 3 (n=239): Elevated WC and triglycerides.

Statistical analysis

ANOVA was used to assess the means differences between the HTGW groups for continuous variables. Pearson's χ^2 statistic was used to assess the association between HTGW phenotype and different categorical variables. Logistic regression models were used to estimate the prevalence odds ratio (POR) to determine the strength of the association between DM and HTGW phenotype after controlling for potential confounding variables. HTGW phenotype group 1 was considered the reference group. The likelihood ratio test statistic was used to assess the presence of first-order interaction terms. All statistical analyses were performed with STATA software version 10 (StataCorp LP, College Station, TX).

RESULTS

Table 1: Baseline characteristics of study participants based on HTGW phenotypes (n=858).

Characterisitcs	Group 1 (n=241)	Group 2 (n=378)	Group 3 (n=239)	P- value
Demographic data				
Age[a] (years)	42.1 ± 16.7	50.1 ± 15.7	54.5 ± 13.5	<0.001
Sex (%)				
Male	31.5	38.1	31.4	0.13
Female	68.5	61.9	68.6	
Health care coverage (%)				
Private	48.6	55.3	59.4	0.17
Public	39.0	33.1	31.8	
None	12.5	11.6	8.8	
Annual family income (%)				
<$20,000	66.7	67.1	67.8	0.97
≥$20,000	33.3	32.9	32.3	
Lifestyle data				
Current drinking (%)				
Yes	50.8	44.4	42.3	0.14
No	49.2	55.6	57.7	
Moderate/vigorous physical activity (%)				
Yes	44.4	39.7	31.4	0.01
No	55.6	60.3	68.6	
Current smoking (%)				
Yes	27.4	18.0	15.5	0.002
No	72.6	82.0	84.5	
Clinical data				
BMI[a] (kg/m^2)	24.1 ± 3.7	31.3 ± 6.2	32.7± 6.1	<0.001
Overweight (%)	38.1	38.9	34.7	<0.001
Obesity (%)	4.9	51.3	60.3	<0.001
Waist circumference[a] (cm)	30.4 ± 2.9	38.6 ± 5.0	39.7 ± 4.3	<0.001
Systolic blood pressure[a] (mm Hg)	108.9 ± 15.2	122.7 ± 22.5	127.2 ± 19.3	<0.001
Diastolic blood pressure[a] (mm Hg)	66.9 ± 9.1	74.1 ± 10.6	77.2 ± 11.1	<0.001
HbA1c[a] (mg/dl)	5.7 ± 0.8	6.4 ± 1.6	6.9 ± 1.8	<0.001
Blood glucose[a] (mg/dl)	95.1 ± 23.4	112.9 ± 42.2	132.8 ± 65.5	<0.001
Total blood cholesterol (mg/dl)	173.2 ± 34.0	188.4 ± 40.2	214.0 ± 47.7	<0.001
HDL cholesterol[a] (mg/dl)	52.9 ± 15.0	49.5 ± 12.3	45.5 ± 10.7	<0.001
High sensitive CRP[b] (mg/L)	0.1 (.06,0.3)	0.3 (0.1,0.7)	0.5 (0.2,0.9)	<0.001
Fibrinogen[a] (mg/L)	303.6 ± 74.0	329.9 ± 81.2	326.2 ± 73.6	<0.001
PAI-1[b] (ng/L)	2 (0, 6)	7 (3, 17)	16 (7, 30)	<0.001
Type 2 DM (%)	4.2	20.1	21.6	<0.001
Cardiovascular disease (%)	2.1	4.8	7.1	0.03
Hypertension (%)	15.0	45.0	54.6	<0.001

Abbreviations: BMI, body mass index; hemoglobin A1c; PAI-1, plasminogen activator inhibitor 1, HDL, high-density lipoprotein; CRP, C reactive protein.
[a]Mean (s.d), [b] Median (Percentiles 25 and 75).

STATEMENT OF FUNDING

This work was supported by an unrestricted grant from Merck, Sharp & Dohme Corporation with additional support from the NIH-NCRR grant 1U54RR026139-01A1. The content of this publication is solely the responsibility of the authors and do not necessarily represent the official view of the sponsor.

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Figure 1: Prevalence of HTGW phenotype by sex and age group.

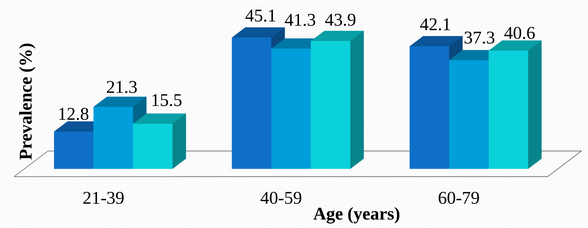

Table 2: POR estimation to assess the strength of association between DM and HTGW phenotype.
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HTGW Phenotype	Crude Model			Adjusted Model*		
	POR	95% CI	P-value	POR	95% CI	P-value
Group 1[†]	1.00	-	-	1.00	-	-
Group 2	5.57	2.81-11.04	<0.001	3.04	1.25-7.38	0.014
Group 3	6.10	3.00-12.38	<0.001	3.56	1.39-9.14	0.008

[†]Reference group
***Adjusted for age, sex, physical activity, education level, smoking, alcohol consumption, BMI, family history of DM, hs- CRP, fibrinogen and PAI-1 antigen. First-order interaction terms in the adjusted model were not significant (p>0.05).**

RESULTS

• Overall prevalence of HTGW phenotype was 27.9% (25.4% for males vs. 29.1% for females, p<0.05).
•After adjusting for age, sex, education, smoking, alcohol consumption, physical activity, family history of DM, BMI, hs-CRP, fibrinogen, and PAI-1, subjects with the HTGW phenotype were 3.56 (95% CI: 1.39, 9.14) times more likely to self-report DM than subjects who did not have the HTGW phenotype.

CONCLUSIONS

•Our results indicate that the HTGW phenotype is relatively prevalent in this population. The prevalence of this phenotype is similar to the study reported by Arsenault and colleagues (30%).(10)
•The HTGW phenotype was significantly associated to type 2 DM after adjustment for multiple factors, a finding consistent with previous studies.(8,9)
•Future prospective studies should identify the optimal cutoff values for defining HTGW and assess the usefulness of this phenotype as a screening tool to identify individuals at risk of developing type 2 DM and coronary artery disease.
•Limitations of this study include the lack of generalization to the population of Puerto Rico and that causality between HTGW and DM cannot be established due to the cross-sectional nature of the study.

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