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HYPERTRIGLYCERIDEMIC WAIST CIRCUMFERENCE AND ITS ASSOCIATION WITH ARTERIAL HYPERTENSION IN A SAMPLE OF PERUVIAN ADULT POPULATION

CINTURA HIPERTRIGLICERIDÉMICA Y SU ASOCIACIÓN CON LA HIPERTENSIÓN ARTERIAL UNA MUESTRA DE POBLADORES ADULTOS PERUANOS

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ABSTRACT

Objective: To evaluate the prevalence of hypertriglyceridemic waist (HTGW) and its association with arterial hypertension (AHT) in Peruvian adults. **Methodology:** Cross-sectional analytical study of the secondary database from the "National Survey of Nutritional, Biochemical, Socioeconomic and Cultural Indicators related to Chronic-Degenerative Diseases". HTGW was measured according to the presence of hypertriglyceridemia (≥ 150 mg/dl) and increased abdominal waist, according to JIS (men ≥ 94 cm and women ≥ 80 cm) and ATPIII (men ≥ 102 cm and women ≥ 88 cm) criteria. **Results:** the prevalence of AHT was 12.48%, HTGW -JIS was 21.49%, and HTGW-ATPII was 13.96%. In multiple regression, HTGW-JIS showed that they had 1.35 higher frequency of having AHT versus those without HTGW (PR=1.35; CI95%: 1.13 - 1.61; p = 0.001) and HTGW-ATPIII showed that they had 1.38 higher frequency of having AHT versus those without HTGW (PR=1.38; CI95%: 1.14 - 1.67; p = 0.001), both adjusted for convenience variables. **Conclusion:** HTGW was positively associated with AHT.

Keywords: Hypertension, Hypertriglyceridemic Waist, Waist Circumference, Triglycerides, data analysis (Source: Mesh Terms)

RESUMEN

Objetivo: Evaluar la prevalencia de cintura hipertrigliceridémica (CHTG) y su asociación con hipertensión arterial (HTA) en pobladores adultos peruanos. **Metodología:** Estudio transversal analítico de base de datos secundario de la "Encuesta Nacional de Indicadores Nutricionales, Bioquímicos, Socioeconómicos y Culturales relacionados con las Enfermedades Crónicas-Degenerativas". La CHTG se midió de acuerdo con la presencia de hipertrigliceridémica (≥ 150 mg/dl) y cintura abdominal aumentada, según los criterios JIS (hombres ≥ 94 cm y mujeres ≥ 80 cm) y ATPIII (hombres ≥ 102 cm y mujeres ≥ 88 cm). **Resultados:** La prevalencia de HTA fue 12,48 %, de CHTG-JIS fue 21,49% y CHTG-ATPII fue 13,96%. En la regresión múltiple, la CHTG-JIS mostro que tenían 1,35 mayor frecuencia de tener HTA versus quienes no presentaban CHTG (RP=1,35; IC95%: 1,13 – 1,61; p = 0.001) y la CHTG-ATPIII observó que tenían 1,38 mayor frecuencia de tener HTA versus quienes no presentaban CHTG (RP=1,38; IC95%: 1,14 – 1,67; p=0.001), ambos ajustados por variables convenientes. **Conclusión:** La CHTG se asoció positivamente con HTA.

Palabras clave: Hipertensión arterial, cintura hipertrigliceridémica, Cintura abdominal, Triglicéridos, análisis de datos (Fuente: DeCS BIREME)

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INTRODUCTION

Arterial hypertension (AHT) is defined as the increase in arterial pressure numbers in the organism [1]. Globally, AHT prevalence is around 30% [2]. In Peru, the TORNASOL II study, performed in 2010, indicates that prevalence is around 27%. In other words, 1 out of 4 Peruvians are hypertensive in Peru [3].

The presence of ATH doubles the risk of cardiovascular diseases, such as coronary disease, heart failure, valvular disease, cerebrovascular disease (ischemic and hemorrhagic), peripheral arterial disease, aortic aneurysm, sudden cardiac death, among others [4,8]. Due to its importance in global health, it is necessary to recognize the factors associated to AHT, with the goal of trying to avoid disease progression. Prior studies have focused on their relationship with dyslipidemia, eating habits, diabetes mellitus, tobacco consumption, and its effect on cardiovascular disease [9,12]. However, it is important to also consider the role of visceral adipose tissue (VAT) on AHT, which could be reflected on abdominal waist and serum lipid levels, such as triglycerides [13,14].

It has been demonstrated that hypertriglyceridemic waist (HTGW), which is the simultaneous measure between altered triglycerides and altered abdominal waist, is a good parameter to measure VAT, rather than each compartment separately[15,19]. HTGW has been proposed as a diagnostic tool in identifying individuals with hyperinsulinemia, prediabetes, and type 2 diabetes mellitus[20,22]. Furthermore, these last years they have also been studied for cardiovascular risk [16,23]. In the case of AHT, there are still few studies. For this reason, this study's objective was to determine the prevalence of HTGQ and its association with AHT in a sample of Peruvian adult inhabitants.

METHODOLOGY

Type and design

Cross-sectional analytical observational study. Analysis of a secondary from the "National Survey of Nutritional, Biochemical, Socioeconomic and Cultural Indicators related to Chronic-Degenerative Diseases", (NSNBSCI), which was carried out between the years 2004-2005 [24]. The purpose of this survey was to learn the prevalence of chronic diseases of metabolic origin, such as Type 2 Diabetes Mellitus and AHT.

Study population

The original study was carried out nationally, divided into five areas: Metropolitan Lima, the remainder of the Coast, Urban Mountains, Rural Mountains and Jungle. It was composed of all the people 20 years and above, who resided in the location during the survey.

The NSNBSCI had a multistage design. Clusters were selected in each step, by simple random sample, and within each one, blocks, houses, and people were selected. The sample unit was the housing of clusters, and the unit of analysis was the people with the beforementioned characteristics. Additional information about selection criteria, sample size and all variables that were taken have been published elsewhere [24].

In this study we included only the subjects who had changed their habitual diet due to the presence of disease and had to have the complete data of variables of interest.

Variables and instruments

The dependent variable was AHT. In NSNBSCI, AHT was self-reported and valued as a specific question "Have you been diagnosed with arterial hypertension?" If the response is positive, it was marked "yes", and if it was negative, it was marked "no".

The independent variable was HTGW. The hypertriglyceridemia waist variable was created from the sum of 2 cut-off points, the presence of triglycerides ≥ 150 mg/dl and the presence of altered abdominal waist, according to the Joint Interim Statement (JIS) criteria (waist circumference in men ≥ 94 cm and waist circumference in women ≥ 80 cm) and according to the criteria of the Cholesterol Education Program Adult Treatment Panel III (ATPIII) (waist circumference in men ≥ 102 cm and abdominal waist circumference in women ≥ 88 cm). If they presented both alterations it was taken as "yes", while if they only presented one or none it was considered "no". This way, we had two principal independent variables: HTGW from ATPIII (HTGW-ATPIII) and HTGW from JIS (HTGW-JIS).

In NSNBSCI, abdominal waist was triple measured in the middle point between the inferior rib and the iliac crest. The measurement was carried out in the horizontal plane, while participants were standing. On the other hand, triglycerides were taken through venipuncture, with a minimum fasting of 8.

The remaining covariables taken as potential confounders were sex (masculine and feminine), age (in years), place of origin (metropolitan Lima, the remainder of the coast, rural mountains, urban mountains, and jungle), if any physical activity is performed outside of work (yes and no), tobacco use (if they have ever smoked), alcohol consumption (if they ever had an alcoholic drink), and categorized body mass index (low weight, normal weight, overweight, and obesity).

Procedures

The database of the primary study has free access, without restrictions. The researchers accessed the scientific information, the variables of interest for the study were taken and the present manuscript was carried out.

Statistical analysis

A statistical analysis was carried out with STATA v16.0 software. For the descriptive analysis, the qualitative variables were summarized in proportions, while the quantitative variables were presented as median and interquartile range, for the not normal distribution of age, which were evaluated through bias, kurtosis and histogram. For the bivariate analysis, according to the presence or not so much of AHT, a Chi-square test of independence was performed if we worked with categorical variables. And in the case of numeric variables, the Mann-Whitney U test was chosen.

In order to evaluate the strength of association between the two variables of interest, a generalized lineal model of the Poisson family (crude and adjusted) with log link and robust variance was carried out. The beforementioned variables were used in the adjustment. The measure of association was the prevalence ratio (PR) with its respective confidence interval (CI) of 95%.

Ethical considerations

This is a secondary analysis of the free access data, for which there will be no contact with human subjects. In this sense, the possible risks for the analysis subjects were minimal, and are related mainly to a breach of confidentiality. Furthermore, during the implementation of this study we respected the delineated ethical principles in the Declaration of Helsinki.

RESULTS

We worked with a total of 4090 subjects. We found that the feminine sex was made up of 50,34 %. The age median was 40 years. 65.77% had smoked at least once, and only 6.41% drank alcohol. 31.64% practiced physical activity. A Little over half had normal weight (52,74 %). AHT prevalence was 12.48% while the prevalence of HTGW-JIS and HTGW-ATPII was 21.49% and 13.96%, respectively. Table 1.

Table 1. Characteristics of the study population

Characteristics	n%	Characteristics	n%
Sex		**Additional Physical Activity**	
Feminine	2059 (50,34)	Yes	1294 (31,64)
Masculine	2031 (49,66)	No	2796 (68,36)
Age (years)*	*40 (30 – 52)	**Body Mass Index**	
Place of origin		Low Weight	99 (2,45)
Metropolitan Lima	815 (19,93)	Normal	2133 (52,74)
Remainder of the Coast	819 (20,02)	Overweight	1290 (31,90)
Jungle	804 (19,66)	Obesity	522 (12,91)
Rural Mountains	806 (19,71)	**Hypertriglyceridemic Waist (JIS)**	
Urban Mountains	846 (20,68)	No	3211 (78,51)
Smoking status		Yes	879 (21,49)
No	1400 (34,23)	**Hypertriglyceridemic Waist (ATPIII)**	
Yes	2690 (65,77)	No	3519 (86,04)
Alcohol Drinker		Yes	571 (13,96)
Yes	3828 (93,59)	**Arterial Hypertension**	
No	262 (6,41)	No	3569 (87,52)
		Yes	509 (12,48)

*Median and Interquartile range

With respect to the bivariate analysis, we found statistically significant differences between AHT and sex (p<0.001), place of origin (p<0,001); BMI (p<0,001) and smoking status (p=0,001) and physical activity (p=0,001). Regarding variables of interest, we also found statistically significant differences among patients with HTGW, whether they were HTGW-JIS (p<0.001) or HTGW-ATPIII (p<0.001). The remainder of variables did not present any changes. Table 2.

Table 2. Bivariate analysis of characteristics associated to the presence of arterial hypertension

Characteristics	Presence of arterial hypertension		*p
	No n (%)	Yes n (%)	
Sex			<0.001
Feminine	1743 (84,98)	308 (15,02)	
Masculine	1826 (90,08)	201 (9,92)	
Age (years)**	38 (29 – 50)	54 (40 – 65)	<0.001
Place of origin			<0.001
Metropolitan Lima	680 (83,54)	134 (16,46)	
Remainder of Coast	709 (86,57)	110 (13,43)	
Jungle	716 (89,39)	85 (10,61)	
Rural Mountains	727 (90,76)	74 (9,24)	
Urban Mountains	737 (87,43)	106 (12,57)	
Smoking status†			0.001
No	1188 (85,10)	208 (14,90)	
Yes	2381 (88,78)	301 (11,22)	
Alcohol drinker			0,508
Yes	3344 (87,61)	473 (12,39)	
No	225 (86,21)	36 (13,79)	
Physical activity			<0.001
Yes	1173 (90,72)	120 (9,28)	
No	2396 (86,03)	389 (13,97)	
Body Mass Index†			<0.001
Low weight	92 (92,93)	7 (7,07)	
Normal	1964 (92,42)	161 (7,58)	
Overweight	1095 (85,15)	191 (14,85)	
Obesity	382 (73,18)	140 (26,82)	
Hypertriglyceridemic Waist (JIS)			<0.001
No	2891 (90,32)	310 (9,68)	
Yes	678 (77,31)	199 (22,69)	
Hypertriglyceridemic waist (ATPIII)			<0.001
No	3153 (89,88)	355 (10,12)	
Yes	416 (72,98)	154 (27,02)	

*Performed with Chi-square test
**Performed with Mann-Whitney U test
† Some values do not add up to the total due to missing data

For the first analysis, in the simple regression, we found that people with HTGW-JIS had 2.34 times greater frequency of having AHT, in comparison with those who did not present HTGW (PR=2,34; CI95%: 1,99 – 2,75; p<0.001). Afterwards, in the multiple regression we observed that patients with HTGW had 1.35 greater frequency of having AHT, compared to those who did not present HTGW CHTG (PR=1,35; CI95%: 1,13 – 1,61; p = 0.001).

For the second case, in the simple regression analysis, we found that people with HTGW-ATPIII had 2.67 times greater frequency of having AHT, compared to those who did not present HTGW (PR=2,67; CI95%: 2,26 – 3,15; p<0.001). Afterwards, in the multiple regression we observed that patients with HTGW-ATPIII had 1.38 greater frequency of having AHT, compared to those who did not present HTGW (PR=1,38; CI95%: 1,14 – 1,67; p = 0.001). Table 3.

Table 3. Crude and adjusted Poisson Regression Model to evaluate the association between the presence of hypertriglyceridemic waist and arterial hypertension

Characteristics	Bivariate Analysis			Multiple Regression*		
	PR	CI 95%	p	PR	CI 95%	p
Hypertriglyceridemic waist (JIS)						
No	Ref.			Ref.		
Yes	2,34	1,99 – 2,75	<0.001	1,35	1,13 – 1,61	0.001
Hypertriglyceridemic waist (ATPIII)						
No	Ref.			Ref.		
Yes	2,67	2,26 – 3,15	<0.001	1,38	1,14 – 1,67	0.001

*Adjusted for sex, categorized age, place, physical activity, BMI, alcohol consumption, smoking activity and hypertriglyceridemic waist
PR: Prevalence rate. CI 95%: confidence Interval at 95%

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DISCUSSION

Principal findings

With the objective of finding the association between HTGW and AHT, we found that those who present HTGW have a greater probability of presenting AHT, as opposed to those who did not have AHT. In addition, this remained true after the adjustment of all covariables of interest.

Despite using two subtypes of HTGW, based on two different abdominal waist measures (80 vs 88 cm in women; 94 vs 102 cm in men), the association regarding AHT remained the same, which implies the role that this marker plays on this pathology.

Comparison with other studies

The prevalence of HTGW-JIS was 21.49%, while the prevalence of HTGW-ATPII was 13.96%. Regarding the latter, it is a little greater than values found in other Latin studies[25,26], while greater values have been obtained in other populations in the northern hemisphere [16,18,19]. The differences could be due to the characteristics and ethnicities of the populations studied.

This association studied has been reported in some studies. Both markers have been previously related to hypertension, separately, including with prehypertension[27]. In the study by Janghorbani [28] they found that, unlike the visceral adiposity index, HTGW as a more useful predictor for the incidence of AHT in an Iranian population with risk factors. The same occurred in a rural population in China by Quanman et al [29], which concluded that HTGW was a good incident indicator of AHT.

In the study by Chen et al[30], HTGW showed to be a useful tool for the follow-up of hypertensive adults with metabolic alterations in the rural zone of China.

Fan et al [31], among other objectives, found that HTGW is the best index for predicting hypertension risk. In relation to HTGW type, Mota et al [32] designed a work that had the objective of finding the best parameter of HTGW, in which it showed the criteria by the International Diabetes Federation (IDF) to be more useful.

Results interpretation

The mechanism behind the association observed between HTGW and AHT has a proinflammatory substrate. Subjects with a selective excess of intraabdominal or visceral adipose tissue, which is anthropometrically translated as the increase of abdominal waist in size and biochemically, such as elevated levels of triglycerides in blood, have a substantially greater risk of AHT. This is because a greater number of adipocytes produce a mechanism of lipotoxicity, which implicates a production of proinflammatory cytokines, such as TNF-alfa, IL-1a, IL-1b e IL1-IL8[22,33]. These produce the activation of vasoconstrictor factors, such as thromboxane A2, endothelin-1, angiotensin-II, among others, who induce endothelial dysfunction, increasing peripheral vascular resistance, and therefore AHT.

In the same manner, visceral adipocytes increase the release of free fatty acids, which could accumulate in the subintimal lever of arteries, causing atherosclerosis, which could also cause endothelial dysfunction, with an increase of vasoconstrictor substances, that will cause AHT in the long term [34].

Study limitations

The following limitations of this study should be considered. First, the study is cross-sectional, therefore, only association can be determined, and not causality. Second, NSNBSCI was not originally designed for this objective, however, these results give us a first draft on the behavior of these variables. Third, within the primary study, the variables "sleep state" or "stress level" have not been measured, which are variables that could be implicated with the presence of AHT. For this reason, while it is possible that my association is under or overestimated due to the absence of control that these variables have, it is very likely that the result obtained does not differ significantly from the value if they could have been adjusted for said characteristics.

CONCLUSIONS

This study indicated that HTGW was positively associated with AHT. If the current results are confirmed in future research, and due to the simplicity and low cost of the measures of abdominal waist and triglyceride levels, the detection of HTGW can be useful in detecting patients at risk of AHT and intervene on time to avoid the disease progression.

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