



Original/*Obesidad*

# Hypertriglyceridemic waist (EWET), glycidic and lipid profile in patients with newly diagnosed heart attack

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## Abstract

**Introduction:** hypertriglyceridemic waist phenotype (EWET) has been poorly tested in patients with established cardiovascular disease.

**Objectives:** to evaluate a possible association between EWET, glycidic and lipid profile in patients with newly diagnosed heart attack (HA).

**Methods:** cross-sectional study among 45 inpatients with myocardial infarction. Lipid profile (total cholesterol, HDL-c, LDL-c, serum triglycerides, TC/HDL-c ratio, non-HDL cholesterol) and glycidic profile (fasting glucose, serum insulin, glycated hemoglobin, HOMA-IR, glucose/insulin ratio) were obtained. Weight, height and waist circumferences (WC) were assessed; BMI and EWET were calculated. Analysis of Covariance Models (ANCOVA) was used to assess the objectives.

**Results:** mean age of participants was  $58.75 \pm 12.41$  years and 55.6% (n = 25) were men. After adjustment for age, gender and BMI, EWET was significantly associated with lower HDL-c ( $p = 0.02$ ), higher TC/HDL-c ratio ( $p = 0.003$ ) and a trend toward fasting glucose ( $p = 0.11$ ).

**Conclusion:** EWET phenotype seems to be associated with a worse lipidic profile in patients with newly diagnosed HA.

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Key words: *Hypertriglyceridemic waist. Myocardial infarction. Cholesterol. Cholesterol, HDL. Glucose metabolism disorders. Obesity.*

## CINTURA HIPERTRIGLICERIDÉMICA (CHT), PERFIL GLICÍDICO Y LÍPIDOS EN PACIENTES CON NUEVO DIAGNÓSTICO DE INFARTO

### Resumen

**Introducción:** el fenotipo de la cintura hipertrigliceridémica (CHT) ha sido poco estudiado en pacientes con enfermedad cardiovascular establecida.

**Objetivos:** evaluar la posible asociación entre el CHT, el perfil glicídico y los lípidos en pacientes con nuevo diagnóstico de infarto.

**Métodos:** estudio transversal en 45 pacientes con infarto de miocardio. Se obtuvieron los lípidos (colesterol total, HDL-c, LDL-c, triglicéridos séricos, relación CT/HDL-c, colesterol no-HDL) y el perfil glicídico (glucosa, insulina sérica, hemoglobina glucosilada, HOMA-IR, relación glucosa/insulina). Fueron evaluados peso, talla y circunferencia de la cintura (CC); se calcularon el IMC y el CHT. Se utilizó el análisis de los modelos de covarianza (ANCOVA) para evaluar los objetivos.

**Resultados:** la media de edad de los participantes fue de  $58,75 \pm 12,41$  años, y el 55,6% (n = 25) eran hombres. Tras ajustar por edad, sexo y el IMC, el CHT se asoció significativamente con una menor HDL-c ( $p = 0,02$ ), mayor relación CT/HDL-c ( $p = 0,003$ ) y una tendencia hacia la glucosa en ayunas ( $p = 0,11$ ).

**Conclusión:** el fenotipo CHT parece estar asociado con un peor perfil lipídico en pacientes con diagnóstico reciente de infarto.

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Palabras claves: *Cintura hipertrigliceridémica. Infarto de miocardio. Colesterol. Colesterol, HDL. Trastornos del metabolismo de la glucosa. Obesidad.*

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## Abbreviations

WHO: World Health Organization.

CAD: coronary artery disease.

HA: heart attack.

EWET: Enlarged Waist Elevated Triglycerides.

WC: waist circumference.

TG: serum triglycerides.

MACE: major adverse cardiac events.

IPAQ: International Physical Activity Questionnaire.

BMI: Body mass index.

TC: total cholesterol.

HDL-c: high-density lipoprotein.

LDL-c: low-density lipoprotein.

HOMA-IR: Homeostasis Model Assessment Insulin Resistance.

SPSS: Statistical Package for the Social Science.

ANCOVA: Analysis of Covariance Models.

## Introduction

According to World Health Organization (WHO), cardiovascular diseases are the number one cause of death globally, representing 31% of worldwide mortality. In 2012, it was estimated that 7.4 million deaths were due to coronary artery disease (CAD), being this the main cardiovascular disorder<sup>1</sup>. Despite both incidence of and in-hospital mortality from heart attack (HA) has declined in developed countries during the last decade, HA remains the leading cause of death<sup>2</sup>.

There is increasing evidence that variables other than smoking, blood pressure, obesity and the traditional lipoprotein-lipid profile may further improve the discrimination of individuals at high risk for CAD. The atherogenic metabolic triad [hyperinsulinemia, high levels of apolipoprotein B and small, dense low-density lipoprotein (LDL-c) particles] has been highly associated with heart disease, but these parameters are routinely difficult to obtain, which makes their use impractical in screening individuals at high cardiovascular risk or established CAD<sup>3</sup>. The hypertriglyceridemic waist (EWET, Enlarged Waist Elevated Triglycerides), defined as the simultaneous presence of increased waist circumference (WC) and high levels of serum triglycerides (TG), seems to better discriminate individuals at cardiovascular risk when compared to WC or TG used isolated, being an indicator easily applied in clinical practice<sup>4</sup>. In addition to its correlation with the atherogenic triad<sup>5</sup>, EWET has been also associated with increased levels of visceral adipose tissue<sup>6</sup>, a worse glycidic and lipidic profile in individuals with CAD<sup>7</sup> and in general population<sup>6,8-10</sup>, and with cardiovascular mortality<sup>11</sup>.

Although patients with established heart disease are already considered at high risk, impaired glucometabolic and lipoprotein-lipid profile have been associated with major adverse cardiac events (MACE) independently of other factors<sup>12</sup>. The ability of EWET to

discriminate a worse cardiometabolic profile in hospitalized patients with CAD has been poorly tested. The aim of this study was to evaluate a possible association between EWET, glycidic and lipid profile in patients with newly diagnosed HA.

## Methods

This cross-sectional study enrolled 45 subjects with newly diagnosed myocardial infarction, aged  $\geq 40$  years and admitted in a Special Care Cardiology Unit in a tertiary hospital in Porto Alegre/Brazil. Patients with more than 48h of hospitalization, who did not have biochemical data available in their medical records, who were not able to walk and/or to verify measures as weight, height and WC were excluded. The Ethics Committees of the Institute of Cardiology of Rio Grande do Sul (n<sup>o</sup> 4664.11) and of the Nossa Senhora da Conceição Hospital (n<sup>o</sup> 11-177) approved the protocol, which was in accordance with the Declaration of Helsinki and all patients signed a consent term to participate.

Clinical (previous medical diagnosis) and demographic data (age, sex and self-reported skin color), information regarding education (years at school) and lifestyle characteristics [smoking, abusive alcohol consumption ( $\geq 30$  g for men and  $\geq 15$  g for women)] were collected using a standardized questionnaire. IPAQ (International Physical Activity Questionnaire) short version was used to detect the levels of physical activity<sup>13</sup>.

Weight (kg) was measured with patients in light clothes, barefoot, in a 100 g scale (Cauduro<sup>®</sup>) and height was obtained with a Sunny<sup>®</sup> stadiometer with 0.1 cm scale. Body mass index (BMI) was calculated by the weight (kg)/height (m)<sup>2</sup>. WC (cm) was obtained with a plastic, flexible, inelastic measuring tape in the middle point between the lower costal rib and the iliac crest in a perpendicular plane, with patient standing in both feet and with both arms hanging freely<sup>14</sup>.

Serum lipids [total cholesterol (TC), high-density lipoprotein (HDL-c), LDL-c and TG] and glycidic profile (fasting glucose, serum insulin and glycated hemoglobin) were measured according to protocols at the certified laboratory by the Nossa Senhora da Conceição Hospital. Homeostasis Model Assessment Insulin Resistance (HOMA-IR), glucose/insulin ratio, TC/HDL-c ratio and non-HDL cholesterol were calculated. Measurements of systolic and diastolic blood pressure (SBP, DBP) were also collected from medical records, and the mean of the three first measures of the morning was used for analyses. EWET was calculated according to formula [WC  $\geq 94$  cm (men) or  $\geq 80$  cm (women) + TG  $\geq 150$  mg/dL] and the cut-off points of enlarged waist and elevated TG were used according to Brazilian guidelines<sup>15</sup>.

Statistical analyses were performed using SPSS (Statistical Package for the Social Science, version

17.0, IL, USA). Means  $\pm$  SD and percentages were compared using Student's t test, Mann-Whitney or Pearson's chi-square test; non-parametric variables were log-transformed. The potential relationship of EWET with glycidic and lipidic profile was tested using Analysis of Covariance Models (ANCOVA), with the adjustment for age, gender and BMI. The statistical significance level was set at a two-tailed type I error of 0.05.

## Results

A total of 25 men and 20 women were assessed, with a mean age of  $58.75 \pm 12.41$  years and scholaryty of  $5.02 \pm 3.14$  years; 80% were whites, 64.4% current or past smokers and 17.8% had abusive alcohol consumption. The prevalence of EWET was 48.9%; regarding other risk factors for CAD, the prevalence was as follows: 33.31% of obesity according to BMI  $\geq 30$  kg/m<sup>2</sup>, 55.6% of obesity according to enlarged waist, 66.7% of hypertension, 28.9% of type-2 diabetes mellitus, 35.6% of dyslipidemia and 20% of sedentarism/irregular physical activity. All inpatients were using statins when data were collected and those who had previous diagnosis of diabetes were using anti-diabetic drugs.

Table I shows the characteristics of the sample according to EWET phenotype. Patients with hypertri-

glyceridemic waist have lower levels of HDL-c, higher values of TC/HDL-c and fasting glucose, and a trend toward higher BMI, non-HDL cholesterol levels and HOMA-IR index when compared to individuals without EWET. Despite no statistical significance, SBP and DBP levels were considered controlled according to cut-off values ( $>140/90$  mmHg), and increased levels of glycated hemoglobin in both groups were found.

After adjustment for confounding factors (Table II), lower means of HDL-c ( $p=0.02$ ) and higher means of TC/HDL-c ratio ( $p=0.003$ ) were associated with EWET; however, there was no association between EWET and fasting glucose after adjustment for age, gender and BMI ( $p=0.11$ , trend toward), suggesting a role of overall adiposity on glycidic profile.

## Discussion

In our study, we were able to confirm a possible association between hypertriglyceridemic waist phenotype and an impaired lipid profile in patients with CAD and newly diagnosed HA, independently of age, gender and overall obesity. Although individuals with EWET had higher levels of glycemic measures, we did not find statistical differences according to groups. Our data suggest that inpatients in general (with and without EWET) had an impaired glycidic profile pro-

**Table I**  
Characteristics of the sample according to EWET [mean  $\pm$  SD, n(%)]

	Without EWET n = 23	With EWET n = 22	P-value
Age, years	58.29 $\pm$ 12.42	59.25 $\pm$ 12.70	0.81
Gender			0.46
Male	14 (56)	11 (44)	
Female	9 (45)	11 (55)	
Body mass index (BMI), kg/m <sup>2</sup>	27.08 $\pm$ 5.39	31.66 $\pm$ 10.49	0.07
Systolic blood pressure (SBP), mmHg	124.36 $\pm$ 18.60	118.11 $\pm$ 13.10	0.21
Diastolic blood pressure (DBP), mmHg	74.39 $\pm$ 9.93	72.25 $\pm$ 9.77	0.48
Total cholesterol (TC), mg/dL	171.41 $\pm$ 48.12	191.55 $\pm$ 59.74	0.23
High-density lipoprotein (HDL-c), mg/dL	43.77 $\pm$ 13.28	33.74 $\pm$ 11.01	0.01
Low-density lipoprotein (LDL-c), mg/dL	103.10 $\pm$ 40.87	110.95 $\pm$ 50.89	0.60
TC/HDL-c ratio	4.06 $\pm$ 1.03	6.06 $\pm$ 2.47	0.003
Non-HDL cholesterol, mg/dL	127.64 $\pm$ 42.09	155.21 $\pm$ 56.62	0.08
Fasting glucose, mg/dL	110.18 $\pm$ 32.20	143.06 $\pm$ 59.71	0.04
Glycated hemoglobin, %	6.42 $\pm$ 1.61	7.04 $\pm$ 1.78	0.27
HOMA-IR*	1.37 $\pm$ 1.08	2.42 $\pm$ 1.29	0.05
Serum insulin, $\mu$ U/mL*	2.61 $\pm$ 0.99	3.28 $\pm$ 1.51	0.35
Glucose/insulin ratio*	2.11 $\pm$ 0.94	2.08 $\pm$ 1.59	0.77

HOMA-IR: Homeostasis Model Assessment Insulin Resistance index; \* variables log-transformed.

**Table II**  
Metabolic profile adjusted-means\* according to EWET [mean ± SD, (CI 95%)]

	Without EWET n = 23	With EWET n = 22	P-value
Fasting glucose, mg/dL	113.74 ± 47.80 (92.54 - 134.94)	139.87 ± 46.65 (116.89 - 162.87)	0.11
High-density lipoprotein (HDL-c), mg/dL	43.58 ± 12.78 (37.91 - 49.26)	33.05 ± 12.82 (26.72 - 39.37)	0.02
TC/HDL-c ratio	4.09 ± 1.84 (3.27 - 4.91)	6.03 ± 1.85 (5.12 - 6.94)	0.003

\* Adjusted for age, gender and BMI. TC: total cholesterol

bably linked to myocardial infarction, and a possible insulin resistance may be in developing not only by excess of adiposity per se.

As expected, we found higher prevalence of cardiovascular risk factors in our sample. When compared to other studies<sup>6,9,10,11</sup>, our proportion of EWET was very superior. Noteworthy is the fact that a large number of EWET mathematical indexes have been proposed<sup>5,6,10,11</sup>, with different cut-off for WC and TG levels used in detecting this phenotype; therefore, it is expected that the prevalence of hypertriglyceridemic waists change according to cut-off values chosen and also according to individuals evaluated. Besides, Brazilian population –which is composed by different ethnicities– does not have a specific cut-off for indexes of abdominal obesity, such as WC. Thus, values suggested by the WHO are frequently used to detect higher risk for cardiovascular disease<sup>15</sup>.

Patients with CAD and hypertriglyceridemic waist phenotype seem to have a worse clinical condition, detected by higher coronary artery scores<sup>7</sup>. In addition, other population at higher risk for cardiovascular disease and with EWET showed impaired glycidic and lipidic profile when compared to those without EWET<sup>9</sup>. Despite some studies conclude that hypertriglyceridemic waist phenotype is associated with modified lipid parameters independently of gender<sup>6,10</sup>, data regarding glycidic indexes are controversial<sup>8,11</sup>, mainly when evaluated separately according to age and gender. It is known that women have increased levels of subcutaneous adipose tissue, and older individuals seem to have higher levels of visceral adiposity. In our study, age and gender were used as controlling factors such as BMI (representing overall adipose tissue), and we did not include WC (representing visceral obesity) in our statistical models to avoid overadjustment.

Some limitations of this exploratory study are the sample size and its cross-sectional design, which differently from a longitudinal study does not detect the real risk between EWET and the worsening of glycidic and lipidic profile. Besides, despite data regarding cholesterol and glucose lowering drugs be available and all inpatients be treated as the same protocol, we cannot discard that this medications may influence our

results. However, we emphasize that our data are very informative since hypertriglyceridemic phenotype is an easy and practical tool to detect an impaired metabolic profile, including in patients at very high cardiovascular risk, and it could be used on hospital setting.

In conclusion, we found a positive relation between EWET and lipidic profile but not with glycidic parameters in hospitalized patients with newly diagnosed HA, independently of age, gender and BMI. Our data need to be confirmed in other populations, but this simple tool for assessment of cardiovascular risk should be considered in the clinical practice.

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#### Conflict of interest

None.

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