

CARDIOMETABOLIC RISK IN SOUTH ASIAN INHABITANTS OF CALIFORNIA: HYPERTRIGLYCERIDEMIC WAIST VS HYPERTRIGLYCERIDEMIC BODY MASS INDEX

Fahim Abbasi, MD¹; Ashish Mathur, MS²;
Gerald M. Reaven, MD¹; César R. Molina, MD²

Objective: Hypertriglyceridemic waist (HTG-waist), an increased waist circumference (WC) with an elevated triglyceride (TG) concentration, can identify increased cardiometabolic risk in apparently healthy individuals. Since WC and BMI are highly correlated, we examined whether an HTG-BMI would be as effective as an HTG-waist in identifying cardiometabolic risk in apparently healthy South Asians.

Design, Setting and Participants: In this cross-sectional study, we classified South Asian women (n=1156) and men (n=1842) without diabetes mellitus as having an HTG-waist (TG \geq 150 mg/dL and a WC \geq 80 cm in women or \geq 90 cm in men) and an HTG-BMI (TG \geq 150 mg/dL and a BMI \geq 23 kg/m²).

Outcome Measures: We measured cardiometabolic risk factors, including blood pressure and fasting lipid profile, glucose, insulin, fibrinogen, and high-sensitivity C-reactive protein.

Results: An HTG-waist was present in 670 individuals, of whom 648 (97%) had an HTG-BMI. The cardiometabolic profile was significantly more adverse in those in whom an HTG-waist was present vs absent; and the same was true when individuals with an HTG-BMI were compared with those without.

Conclusions: Essentially every individual with an HTG-waist also had an HTG-BMI. An HTG-BMI identified cardiometabolic risk as effectively as an HTG-waist in a population composed entirely of South Asians. *Ethn Dis.* 2016;26(2):191-196; doi:10.18865/ed.26.2.191

Keywords: Hypertriglyceridemic Waist; Cardiometabolic Risk; South Asians

INTRODUCTION

South Asians have a higher incidence of coronary heart disease (CHD) than individuals of European descent¹ and present with first acute myocardial infarction at younger ages.² In the study by Joshi et al,² among the several CHD risk factors that differentiated native South Asians from those living in other countries was an increase in abdominal obesity. Of interest in this context is the suggestion by Lemieux and colleagues³ that the combination of abdominal obesity and an elevated triglyceride concentration comprise an entity designated as hypertriglyceridemic waist (HTG-waist) that identifies individuals with an “atherogenic metabolic triad,” characterized by “hyperinsulinemia, elevated apo B, small, dense

LDL.” The association between an HTG-waist and abnormal coronary angiography has been confirmed in both men and women,³⁻⁵ and prospective studies have shown that an HTG-waist is a predictor of CHD.^{6,7} The cardiometabolic abnormalities subsumed under the rubric of HTG-waist are similar to the cluster of abnormalities associated with insulin resistance; and insulin resistance in nondiabetic individuals is associated with glucose intolerance, hyperinsulinemia, and an atherogenic lipoprotein profile, consisting of: hypertriglyceridemia; low high-density lipoprotein cholesterol (HDL-C) concentrations; small, dense low-density lipoprotein particles; and changes in apolipoprotein A-1 and apolipoprotein B concentrations.⁸⁻¹³

Abdominal obesity, as ascertained by determining waist circumference (WC), is associated with decreased insulin sensitivity and an increase in cardiometabolic risk factors.¹⁴⁻¹⁶ However, it appears that this is also the case if body mass index (BMI) is used as the index of excess adiposity.¹⁴⁻¹⁶ Furthermore, BMI and WC are themselves highly correlated; an obese WC in most individuals is accompanied by an obese BMI, and the correlation between a direct

¹Division of Cardiovascular Medicine, Stanford University School of Medicine, Stanford, California

²South Asian Heart Center, El Camino Hospital, Mountain View, California

Address correspondence to Fahim Abbasi, MD; Falk Cardiovascular Research Center, Stanford University School of Medicine; 300 Pasteur Drive, Stanford, CA 94305-5406; 650.724.0954; fahim@stanford.edu

measure of insulin resistance and the two indices of obesity is essentially identical.¹⁴⁻¹⁶ Thus, at a clinical level, it does not seem self-evident that the ability to identify apparently healthy individuals at increased CHD risk will differ substantially if hypertriglyceridemia were combined with BMI vs WC. In that context, it has been argued that insulin resistance and increased CHD risk in South Asians is related to their greater degree of abdominal vs overall obesity.¹⁷⁻²⁰ Thus, if an HTG-waist more effectively identified apparently healthy individuals at increased CHD risk than an HTG-BMI, it should be most clearly shown in a population of South Asians. Our current analysis was initiated to see if this prediction was borne out.

METHODS

Study Population

Our analysis is based on measurements in 2998 individuals (1156 women and 1842 men) who had volunteered to be screened for cardiovascular disease risk factors at the South Asian Heart Center, a not-for-profit organization in Mountain View, California. The participants were part of a larger group of individuals, aged >18 years, who were seen at the South Asian Heart Center between 2006 and 2014. Patients were excluded from this analysis if they had a diagnosis of diabetes mellitus, CHD, or cerebrovascular disease or were taking drugs that would affect carbohydrate or lipid metabolism. The Institutional Review Board at El Camino Hospital approved the

study protocol, and all participants gave written informed consent.

Experimental Measurements

Height and weight were determined with participants in light clothing and without shoes, and BMI was calculated by dividing weight (kilograms) by height (meter squared). WC was determined according to the National Health

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and Nutrition Examination Survey III protocol during normal minimal respiration by placing a measuring tape around the waist just above the uppermost lateral border of the iliac crest.²¹ The anthropometric measurements were performed consistently throughout the study.

After an overnight fast, blood samples were drawn for measurement of glucose, insulin, total cholesterol, low-density lipoprotein cholesterol, triglyceride (TG), HDL-C, fibrinogen, and high-

sensitivity C-reactive protein (hs-CRP) concentrations. Lipid and lipoprotein measurements were performed using standardized methods approved by the Centers for Disease Control and Prevention; these methods remained consistent throughout the study. Homeostasis model assessment of insulin resistance (HOMA-IR) was calculated from fasting glucose and insulin concentrations using the formula: $([\text{fasting insulin } (\mu\text{U/ml})] \times [\text{fasting glucose } (\text{mmol/L})]) / 22.5$.²²

BMI, WC, and fasting TG concentration values were used to create the following two basic clinical categories: 1) HTG-waist and 2) HTG-BMI. An HTG-waist was defined as TG concentration ≥ 150 mg/dL and a WC ≥ 80 cm (women) or ≥ 90 cm (men). An HTG-BMI was defined as TG concentration ≥ 150 mg/dL and a BMI ≥ 23 kg/m². The BMI cut-point was based on the suggestion that South Asians whose BMI exceeds this value should be considered at high risk of an undesirable health state.²³

Statistical Analysis

Summary statistics are reported as arithmetic mean (SD), median (interquartile range), geometric mean (95% CI), or proportions. Fasting insulin, HOMA-IR, TG, TG/HDL-C ratio, and hs-CRP values were log-transformed for statistical tests. Pearson's chi-square was used to test for differences in proportions and independent sample t test to compare means. All statistical tests were performed using statistical software IBM-SPSS version 23.0.

RESULTS

Clinical and metabolic characteristics of the study participants are presented in Table 1. There was a greater proportion of men than women; and as a group, participants were relatively young and somewhat overweight, with a mean BMI of 25.5 kg/m². The mean values of the cardiometabolic variables measured were within conventional normal limits.

The magnitude of overlap between the two indices of obesity is shown in Table 2. Thus, of the 670 individuals with an HTG-waist, 648 (97%) also had an HTG-BMI. The degree of overlap was not quite as great in the 862 persons with an HTG-BMI, with 648 (75%) also having an HTG-waist. Put more simply, essentially anyone with an HTG-waist also had an HTG-BMI, whereas approximately one-fourth of individuals with an HTG-BMI did *not* have an HTG-waist.

Table 3 displays demographic characteristics and cardiometabolic risk factors, comparing those in whom an HTG-waist was present vs absent, and making a similar comparison between those with vs without an HTG-BMI. To begin with, fewer participants had an HTG-waist (n=670) than an HTG-

Table 1. Clinical and metabolic characteristics of the study participants, N = 2998

Variable	Summary statistic
Age, years	43 (10)
Women	38.6%
BMI, kg/m ²	25.5 (3.6)
Waist circumference, cm	88 (10)
Systolic blood pressure, mm Hg	120 (16)
Diastolic blood pressure, mm Hg	75 (10)
Heart rate, beats/min	68 (10)
Fasting glucose, mg/dL	89 (10)
Fasting insulin, μU/mL	9.0 (7.0 – 13.0) ^a
HOMA-IR	2.02 (1.39 – 2.97) ^a
Total cholesterol, mg/dL	191 (36)
TG, mg/dL	123 (85 – 171) ^a
HDL cholesterol, mg/dL	47 ± 13
LDL cholesterol, mg/dL	116 ± 31
TG/HDL cholesterol ratio	2.69 (1.69 – 4.26) ^a
TC/HDL cholesterol ratio	4.3 ± 1.3
Fibrinogen, μmol/L	11.5 ± 2.4
hs-CRP, mg/L	1.20 (.60 – 2.60) ^a

Data are mean (SD) unless otherwise noted.

a. Median (interquartile range).

BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; HOMA-IR, homeostasis model assessment of insulin resistance; hs-CRP, high-sensitivity C-reactive protein; LDL, low-density lipoprotein; TG, triglycerides; WC, waist circumference.

BMI (n=862). It can be seen that every cardiometabolic risk factor, except age, was significantly different in those in whom an HTG-waist was present compared with those in whom it was absent. Essentially similar findings were seen when comparing those with an HTG-BMI with those lacking that designation.

Given the enormous degree of overlap, we cannot statistically compare the HTG-waist and HTG-BMI groups. However, it is possible to see

what the characteristics would be of a population identified as being at high cardiometabolic risk on the basis of having either an HTG-waist or an HTG-BMI. When the actual data in the “Present” columns of Table 3 are viewed, it appears that the values in these two columns are almost identical, irrespective of whether the group was selected on the basis of having an HTG-waist or an HTG-BMI.

DISCUSSION

The goal of our analysis was to question the putative unique ability of using a measure of central obesity (WC) and an elevated fasting TG concentration to identify individuals as having an HTG-waist, and consequently at increased cardiometabolic risk. The hypothesis was

Table 2. Overlap between HTG-waist and HTG-BMI phenotypes in South Asians, N = 2998

		HTG-waist ^a	
		Present, n = 670	Absent, n = 2328
HTG-BMI ^b	Present, n = 862	648	214
	Absent, n = 2136	22	2114

a. HTG-waist: TG ≥150 mg/dL and WC ≥80 cm (women) or ≥ 90 cm (men).

b. HTG-BMI: TG ≥150 mg/dL and BMI ≥23.0 kg/m².

BMI, body mass index; HTG, hypertriglyceridemic; WC, waist circumference.

Table 3. Clinical and metabolic characteristics of the subjects divided into HTG-waist and HTG-BMI phenotypes

Variable	HTG-waist ^b			HTG-BMI ^c		
	Present, n = 670	Absent, n = 2328	P	Present, n = 862	Absent, n = 2136	P
Age, years	44 (9)	43 (10)	.34	43 (9)	43 (10)	.31
BMI, kg/m ²	27.4 (3.0)	24.9 (3.5)	<.001	26.9 (2.9)	24.9 (3.7)	<.001
WC, cm	95 (8)	86 (10)	<.001	93 (8)	86 (10)	<.001
Systolic BP, mm Hg	124 (16)	118 (16)	<.001	123 (16)	118 (16)	<.001
Diastolic BP, mm Hg	79 (10)	74 (10)	<.001	78 (10)	74 (10)	<.001
Heart rate, beats/min	70 (10)	68 (10)	<.001	69 (10)	68 (10)	<.001
Fasting glucose, mg/dL	91 (10)	88 (10)	<.001	91 (10)	88 (10)	<.001
Fasting insulin, μU/mL ^a	12.9 (12.4 – 13.5)	8.4 (8.2 – 8.6)	<.001	12.2 (11.8 – 12.6)	8.3 (8.1 – 8.4)	<.001
HOMA-IR ^a	2.87 (2.75 – 2.99)	1.81 (1.77 – 1.85)	<.001	2.70 (2.60 – 2.81)	1.77 (1.73 – 1.81)	<.001
Total cholesterol, mg/dL	206 (36)	186 (35)	<.001	206 (36)	185 (34)	<.001
TG, mg/dL ^a	210 (204 – 217)	103 (102 – 105)	<.001	211 (206 – 216)	97 (95 – 98)	<.001
HDL cholesterol, mg/dL	40 (9)	49 (13)	<.001	40 (9)	50 (13)	<.001
LDL cholesterol, mg/dL	123 (32)	114 (30)	<.001	122 (33)	114 (30)	<.001
TG/HDL cholesterol ratio ^a	5.37 (5.15 – 5.60)	2.18 (2.13 – 2.23)	<.001	5.39 (5.21 – 5.57)	2.00 (1.96 – 2.05)	<.001
TC/HDL cholesterol ratio	5.3 (1.1)	4.0 (1.1)	<.001	5.3 (1.2)	3.9 (1.0)	<.001
Fibrinogen, μmol/L	11.8 (2.3)	11.5 (2.5)	.01	11.5 (2.3)	11.5 (2.5)	.83
hs-CRP, mg/L ^a	1.66 (1.53 – 1.81)	1.22 (1.16 – 1.27)	<.001	1.47 (1.37 – 1.59)	1.24 (1.18 – 1.30)	<.001

Data are arithmetic mean (SD) unless otherwise noted.

a. Geometric mean (95% CI). FPI, HOMA-IR, TG, TG/HDL cholesterol ratio, and hs-CRP were log-transformed for statistical tests. Means were compared by independent sample t test.

b. HTG-waist: TG ≥150 mg/dL and WC ≥80 cm (women) or ≥ 90 cm (men).

c. HTG-BMI: TG ≥150 mg/dL and BMI ≥23.0 kg/m².

BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; HTG, hypertriglyceridemic; LDL, low-density lipoprotein; TG, triglycerides; WC, waist circumference.

that such an approach would be no more clinically effective than using a measure of overall obesity (BMI) and an elevated fasting TG concentration to accomplish the same goal. The data presented seem to support this hypothesis at several levels. Perhaps the most surprising result was that essentially every participant with an HTG-waist also had an HTG-BMI (Table 2). We purposefully performed this study in South Asians, in whom differences in regional fat distribution, specifically the accumulation of central obesity, has been viewed as a major factor in explaining their accentuated risk of insulin resistance, type 2 diabetes mellitus, and CHD.¹⁷⁻¹⁹ Obviously, in our reasonably large experimen-

tal population, South Asian individuals who had an HTG-waist also had an HTG-BMI. In view of this simple demographic finding, there was no reason to expect that the cardiometabolic risk profile would be different in apparently healthy South Asians identified on the basis

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of an HTG-waist vs an HTG-BMI.

Data in Table 3 clearly indicate that apparently healthy individuals, identified as having either an HTG-waist or an HTG-BMI, have a significantly more adverse cardiometabolic profile as compared with those persons who do not merit that designation. Thus, at a clinical level either approach seems able to stratify risk. Given the dramatic degree of overlap, we cannot compare the actual values of individual risk factors in those identified on the basis as having an HTG-waist vs an HTG-BMI. However, direct comparisons of values indicate that in many instances the mean values in the two groups are identical, and in no instance does there seem to be a substantial quantitative difference.

Based on the findings presented, it seems reasonable to conclude that the combination of an elevated TG concentration and overall obesity (HTG-BMI) can identify cardiometabolic risk in apparently healthy individuals as effectively as the combination of an elevated TG concentration and abdominal obesity (HTG-waist). On the other hand, two caveats should be made. First, the fact that either measure of adiposity provided comparable clinical information does not necessarily detract from the potential importance of abdominal obesity (WC) as an important contributor to cardiometabolic risk. Use of WC to identify individuals at increased cardiometabolic risk is based on the observation that it is a useful indicator of visceral adiposity,¹⁹ and the premise that excessive visceral adiposity plays a crucial role in modulation of cardiometabolic risk.^{3-7,17-19} Furthermore, there are outcome data demonstrating the ability of an HTG-waist to predict CHD,³⁻⁷ and similar information does not exist as to whether this would be the case with an HTG-BMI. Second, by selection, the experimental population was composed entirely of South Asians, based on previous findings of the putative importance of central obesity in the increased cardiometabolic risk in this racial/ethnic group.¹⁷⁻²⁰ Thus, our findings may not apply to other racial/ethnic groups.

CONCLUSION

Based on our findings, we conclude that the combination of an elevated TG concentration and overall obesity (HTG-BMI) can identify

cardiometabolic risk in apparently healthy individuals as effectively as the combination of an elevated TG concentration and abdominal obesity (HTG-waist). In this context, we hope that a research group with an appropriate database will evaluate the relative abilities of an HTG-BMI and an HTG-waist to predict CHD outcome in South Asians, as well as other racial/ethnic populations.

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CONFLICT OF INTEREST

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: Abbasi, Mathur, Reaven, Molina; Acquisition of data: Mathur, Molina; Data analysis and interpretation: Abbasi, Mathur, Reaven, Molina; Manuscript draft: Abbasi, Mathur, Reaven, Molina; Statistical expertise: Abbasi, Reaven; Acquisition of funding: Mathur, Molina; Administrative: Abbasi, Mathur; Supervision: Mathur, Reaven, Molina

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