Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Supplementary material

Supplementary methods

Clinical and laboratory measurements

Data collection included demographic information, marital status, education level, smoking habits, family history of diabetes and cardiovascular disease (CVD), past medical history, and medication use, all gathered using standardized TLGS questionnaires. Participants' weights were measured using digital scales (Seca 707, Seca Corp., with a range of 0.1-150 kg and a sensitivity of 0.1 kg) while they were minimally clothed. Height was measured using a tape measure while participants stood upright without shoes and with relaxed shoulders. Waist circumference (WC) was measured at the level of the umbilicus, and height circumference (HC) was taken at the broadest section of the hips over light clothing, without applying pressure to the body. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) was measured twice on the right arm after a 15-minute seated rest, with 5-minute intervals between the readings, using a mercury sphygmomanometer. The average of the two readings for SBP as well as for DBP was used for analysis. Pulse rate was measured using radial palpation over 60 seconds. For biochemical analyses, blood samples were collected from all participants between 7:00 and 9:00 AM after an overnight fast of 12 to 14 hours. These samples were processed on the same day at the TLGS research laboratory. Parameters measured included fasting plasma glucose (FPG), creatinine, and lipid profile components such as total cholesterol (TC), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-C). In participants not on glucose-lowering medication, 2-hour post-challenge glucose (2h-PG) levels were evaluated after the intake of a solution containing 82.5 grams of glucose monohydrate, with blood samples collected 2 hours later. Both FPG and 2h-PG were analyzed using an enzymatic colorimetric method with glucose oxidase. Regarding insulin, serum samples were stored at −70 °C and then transferred to the hormone laboratory at the Research Institute for Endocrine Sciences for analysis. Fasting insulin levels were measured using the electrochemiluminescence immunoassay technique, employing Roche Diagnostics kits and analyzed on the Roche/Hitachi Cobas e-411 analyzer (Roche Diagnostics, GmbH, Mannheim, Germany) (1). The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) was calculated as [FPG (mmol/L) × fasting serum insulin (mU/L) / 22.5] (2). Serum creatinine concentrations were measured using the kinetic colorimetric Jaffe method. The estimated glomerular filtration rate (eGFR) was calculated using the 2021 CKD-EPI equations (3). Lipid profile measurements, including TC, TG, and HDL-C, were performed using enzymatic colorimetric methods. TC was determined using cholesterol esterase and oxidase, while HDL-C was measured after apolipoprotein B-containing lipoproteins were precipitated with phosphotungstic acid. TG levels were assessed using glycerol phosphate oxidase. Low-density lipoprotein cholesterol (LDL-C) was determined using a modified version of the Friedewald formula, which minimizes interference from high triglyceride levels (4). All biochemical analyses, except insulin, were performed at the TLGS research laboratory on the day of blood collection using commercial kits (Pars Azmoon Inc., Tehran, Iran) and a Selectra 2 chemistry auto-analyzer (Vital Scientific, Spankeren, The Netherlands).

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S1. Characteristics of the respondents versus non-respondents: Tehran Lipid and Glucose Study 1999-2018

Variables	Respondents n = 5,845	Non-Respondents n = 1,700	*P* value
Continuous variables, Mean (SD)			
Age, mean (SD), year	44.53 (11.13)	44.85 (12.26)	0.30
BMI, mean (SD), kg/m^2	27.21 (4.43)	27.04 (4.89)	0.21
WC, mean (SD), cm	89.45 (11.26)	88.99 (11.74)	0.17
WHtR, mean (SD)	0.55 (0.07)	0.54 (0.08)	0.26
WHpR, mean (SD)	0.88 (0.08)	0.88 (0.08)	0.91
FPG, mean (SD), mg/dL	90.55 (9.59)	90.55 (10.08)	0.99
2h-PG, mean (SD), mg/dL	108.48 (29.30)	108.52 (29.86)	0.96
SBP, mean (SD), mm Hg	117.97 (17.26)	118.64 (18.80)	0.18
DBP, mean (SD), mm Hg	77.68 (10.49)	77.77 (10.66)	0.75
Pulse rate, mean (SD), beats/min	78.63 (11.29)	78.45 (11.46)	0.58
eGFR, mean (SD), mL/min/1.73 m^2	83.13 (12.42)	83.61 (12.95)	0.19
TC, mean (SD), mg/dL	208.61 (43.14)	208.16 (43.86)	0.73
HDL-C, mean (SD), mg/dL	41.55 (10.90)	41.99 (11.43)	0.18
LDL-C, mean (SD), mg/dL	133.30 (34.80)	132.54 (35.24)	0.46
TG, median [IQR], mg/dL	147 (101-207)	144 (101-206)	0.64
Tyg, mean [SD]	8.79 (0.56)	8.79 (0.56)	0.78
TyG-BMI, mean [SD]	240.14 (45.89)	239.65 (49.60)	0.74
TyG-WC, mean [SD]	789.34 (126.97)	786.52 (129.49)	0.48
TyG-WHtR, mean [SD]	4.87 (0.81)	4.87 (0.85)	0.98
TyG-WHR, mean [SD]	7.78 (1.02)	7.77 (1.01)	0.68
Categorical variables, number (%)			
Women	3,158 (54.03)	915 (53.82)	0.88
Married	5,275 (90.25)	1,483 (87.29)	<0.001
Educational level (y)			0.14
- <6	1,989 (34.03)	618 (36.65)	
- 6-12	3,035 (51.92)	840 (49.82)	
- >12	821 (14.05)	228 (13.52)	
Family history of CVD	935 (16.00)	251 (14.76)	0.22
Family history of diabetes	1,550 (26.52)	429 (25.24)	0.29
Lipid-lowering drug use	124 (2.12)	42 (2.47)	0.39
Anti-hypertension drug use	272 (4.65)	86 (5.06)	0.49
Smoking status			<0.001
- Never	4,410 (75.45)	1,064 (69.18)	
- Former	440 (7.53)	106 (6.89)	
- Current	995 (17.02)	368 (23.93)	
General obesity	1,408 (24.09)	591 (34.76)	<0.001
Central obesity	1,918 (32.81)	718 (42.24)	<0.001
Prediabetes	1,445 (24.72)	355 (24.89)	0.90
Dyslipidemia	3,921 (67.08)	971 (57.12)	<0.001
Hypertension	2,711 (46.38)	716 (47.07)	0.62

Data were given as mean ± SD or number (%), except for skewed variables (i.e., TG).
Abbreviations: TyG, triglyceride-glucose index; BMI, body mass index; WC, waist circumference; WHtR, waist-height ratio; WHR, waist-hip ratio; FPG, fasting plasma glucose; 2h-PG, 2-hour post-challenge glucose; SBP, systolic blood pressure; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; TC, total cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglycerides; and CVD, cardiovascular disease.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S2. Subtype-specific associations of TyG and TyG-obesity indices with incident cardio-renal-metabolic multimorbidity

CRMM subtype	TyG		TyG–BMI		TyG–WC		TyG–WHtR		TyG–WHR	
	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
CVD + T2DM	1.48 (1.26–1.75)	<0.001	1.44 (1.25–1.67)	<0.001	1.49 (1.27–1.75)	<0.001	1.52 (1.29–1.79)	<0.001	1.47 (1.23–1.76)	<0.001
CKD + T2DM	1.58 (1.25–1.98)	<0.001	1.71 (1.42–2.07)	<0.001	1.75 (1.41–2.16)	<0.001	1.66 (1.33–2.06)	<0.001	1.35 (1.06–1.72)	0.014
CVD + CKD	1.10 (0.86–1.40)	0.445	1.24 (1.01–1.53)	0.045	1.25 (1.00–1.56)	0.050	1.21 (0.96–1.52)	0.101	1.12 (0.88–1.43)	0.356
CVD + CKD + T2DM	1.51 (1.05–2.16)	0.025	1.40 (1.02–1.93)	0.038	1.39 (0.98–1.96)	0.065	1.30 (0.91–1.86)	0.154	1.21 (0.82–1.78)	0.345

Adjusted for the same set of covariates as Model 2 in the main analysis, including age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes.

Abbreviations: CRMM, cardiometabolic multimorbidity; CVD, cardiovascular disease; CKD, chronic kidney disease; T2DM, type 2 diabetes mellitus; TyG, triglyceride-glucose index; BMI, body mass index; WC, waist circumference; WHtR, waist-to-height ratio; WHR, waist-to-hip ratio; HR, hazard ratio; CI, confidence interval.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S3. Comparison of the Effect Sizes of TyG-BMI, TyG-WHtR, and TyG-WHR Versus TyG in Predicting Incident Cardiometabolic Multimorbidity

	HR (95% CI)	*P* value	$P_{difference}$
TyG-BMI	1.43 (1.26–1.63)	<0.001	0.10
TyG	1.18 (1.02–1.36)	0.03	
TyG-WC	1.48 (1.27–1.72)	<0.001	0.05
TyG	1.12 (0.96–1.32)	0.15	
TyG-WHtR	1.47 (1.25–1.71)	<0.001	0.06
TyG	1.14 (0.97–1.33)	0.11	
TyG-WHR	1.23 (1.02–1.48)	0.02	0.99
TyG	1.24 (1.04–1.47)	0.02	

Models were adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes. *P*-value for difference ($P_{difference}$) was estimated by performing a Wald test comparing effect sizes of TyG-BMI, TyG-WC, TyG-WHtR, and TyG-WHR with TyG for incident CRMM. A significant $P_{difference}$ indicates that effect sizes of insulin-resistant indices (i.e., TyG-BMI, TyG-WC, TyG-WHtR, and TyG-WHR) differed significantly from TyG.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S4. Incremental predictive value of TyG and TyG-related indices for cardio-renal-metabolic multimorbidity

Analysis 1	Harrell's C (95% CI)	ΔC	*P* value	IDI (95% CI)	*P* value
Base model [1]	0.824 (0.803-0.845)	…	…	…	…
Base model + TyG	0.829 (0.808-0.850)	0.005	0.040	0.007 (-0.001 to 0.016)	0.068
Base model + TyG-BMI	0.833 (0.812-0.854)	0.008	0.013	0.016 (0.005-0.031)	0.018
Base model + TyG-WC	0.834 (0.814-0.855)	0.010	0.009	0.015 (0.005-0.030)	0.023
Base model + TyG-WHtR	0.832 (0.812-0.853)	0.008	0.022	0.014 (0.005-0.029)	0.021
Base model + TyG-WHR	0.831 (0.811-0.852)	0.007	0.019	0.004 (-0.001 to 0.012)	0.153
Analysis 2	**Harrell's C (95% CI)**	**ΔC**	***P* value**	**IDI (95% CI)**	***P* value**
Base model [2]	0.829 (0.808-0.850)	…	…	…	…
Base model + TyG-BMI	0.834 (0.813-0.855)	0.004	0.069	0.009 (- 0.001 to 0.022)	0.119
Base model + TyG-WC	0.835 (0.814-0.855)	0.005	0.051	0.008 (- 0.001 to 0.020)	0.093
Base model + TyG-WHtR	0.833 (0.813-0.854)	0.004	0.132	0.008 (-0.001 to 0.019)	0.102
Base model + TyG-WHR	0.831 (0.811-0.852)	0.002	0.244	-0.001 (-0.002 to 0.003)	0.982

[1] Base model included age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes.
[2] Base model further included TyG.
abbreviations: CI, confidence interval; C-index, Harrell's concordance statistic; IDI, integrated discrimination improvement; TyG, triglyceride-glucose index; BMI, body mass index; WC, waist circumference; WHtR, waist-height ratio; WHR, waist-hip ratio.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S5. Subgroup analysis of the association between TyG and incident cardio-renal-metabolic multimorbidity

Subgroup	HR (95% CI)	*P* value	*P* for interaction
Age			
30-44	1.54 (1.18-2.02)	0.002	0.075
45-59	1.45 (1.18-1.79)	<0.001	
>60	1.18 (0.94-1.48)	0.143	
Sex			
Man	1.42 (1.21-1.68)	<0.001	0.915
Woman	1.42 (1.14-1.78)	0.002	
Current smoking			
No	1.37 (1.18-1.58)	<0.001	0.737
Yes	1.63 (1.22-2.18)	0.001	
Dyslipidemia			
No	1.48 (1.00-2.18)	0.047	0.459
Yes	1.46 (1.28-1.67)	<0.001	
Prediabetes			
No	1.43 (1.17-1.75)	<0.001	0.529
Yes	1.41 (1.18-1.67)	<0.001	
Hypertension			
No	1.27 (1.00-1.60)	0.044	0.611
Yes	1.46 (1.25-1.71)	<0.001	
Obesity			
No	1.60 (1.31-1.94)	<0.001	0.005
Yes	1.24 (1.03-1.48)	0.020	

Adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes, was performed in subgroups defined by age, sex, smoking status (current vs. former/never), dyslipidemia, prediabetes, and obesity (general or central obesity vs. non-obese).
Abbreviations: HR, hazard ratio; CI, confidence interval; TyG, triglyceride glucose index.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S6. Subgroup analysis of the association between TyG-BMI and incident cardio-renal-metabolic multimorbidity.

Subgroup	HR (95% CI)	*P* value	*P* for interaction
Age			
30-44	1.45 (1.13-1.86)	0.003	0.212
45-59	1.50 (1.26-1.78)	<0.001	
>60	1.39 (1.13-1.71)	0.002	
Sex			
Man	1.53 (1.30-1.80)	<0.001	0.875
Woman	1.51 (1.28-1.79)	<0.001	
Current smoking			
No	1.52 (1.34-1.73)	<0.001	0.843
Yes	1.56 (1.21-2.01)	0.001	
Dyslipidemia			
No	1.79 (1.40-2.29)	<0.001	0.045
Yes	1.48 (1.31-1.69)	<0.001	
Prediabetes			
No	1.54 (1.30-1.83)	<0.001	0.955
Yes	1.52 (1.31-1.77)	<0.001	
Hypertension			
No	1.45 (1.15-1.83)	0.001	0.567
Yes	1.56 (1.37-1.78)	<0.001	
Obesity			
No	1.82 (1.35-2.43)	<0.001	0.283
Yes	1.64 (1.38-1.94)	<0.001	

Adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes, was performed in subgroups defined by age, sex, smoking status (current vs. former/never), dyslipidemia, prediabetes, and obesity (general or central obesity vs. non-obese).
Abbreviations: HR, hazard ratio; CI, confidence interval; TyG-BMI, triglyceride glucose-body mass index.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S7. Subgroup analysis of the association between TyG-WC and incident cardio-renal-metabolic multimorbidity.

Subgroup	HR (95% CI)	*P* value	*P* for interaction
Age			
30-44	1.55 (1.18-2.03)	0.001	0.128
45-59	1.54 (1.27-1.86)	<0.001	
>60	1.45 (1.16-1.82)	0.001	
Sex			
Man	1.55 (1.31-1.84)	<0.001	0.807
Woman	1.59 (1.32-1.91)	<0.001	
Current smoking			
No	1.55 (1.35-1.78)	<0.001	0.853
Yes	1.75 (1.29-2.39)	<0.001	
Dyslipidemia			
No	2.04 (1.52- 2.73)	<0.001	0.006
Yes	1.51 (1.32-1.73)	<0.001	
Prediabetes			
No	1.60 (1.32-1.95)	<0.001	0.605
Yes	1.57 (1.33-1.85)	<0.001	
Hypertension			
No	1.52 (1.19-1.94)	0.001	0.896
Yes	1.61 (1.39-1.86)	<0.001	
Obesity			
No	2.01 (1.50-2.70)	<0.001	0.132
Yes	1.78 (1.45-2.20)	<0.001	

Adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes, was performed in subgroups defined by age, sex, smoking status (current vs. former/never), dyslipidemia, prediabetes, and obesity (general or central obesity vs. non-obese).
Abbreviations: HR, hazard ratio; CI, confidence interval; TyG-WC, triglyceride glucose index-waist circumference.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S8. Subgroup analysis of the association between TyG-WHtR and incident cardio-renal-metabolic multimorbidity.

Subgroup	HR (95% CI)	*P* value	*P* for interaction
Age			
30-44	1.60 (1.19-2.14)	0.002	0.134
45-59	1.52 (1.25- 1.83)	<0.001	
>60	1.48 (1.18-1.86)	0.001	
Sex			
Man	1.60 (1.33-1.91)	<0.001	0.705
Woman	1.55 (1.29-1.86)	<0.001	
Current smoking			
No	1.55 (1.34-1.78)	<0.001	0.413
Yes	1.75 (1.28-2.40)	<0.001	
Dyslipidemia			
No	1.88 (1.41-2.51)	<0.001	0.029
Yes	1.54 (1.34-1.77)	<0.001	
Prediabetes			
No	1.58 (1.30-1.92)	<0.001	0.619
Yes	1.58 (1.34-1.87)	<0.001	
Hypertension			
No	1.53 (1.18-1.96)	0.001	0.927
Yes	1.61 (1.39-1.87)	<0.001	
Obesity			
No	1.95 (1.45-2.56)	<0.001	0.135
Yes	1.72 (1.40-2.12)	<0.001	

Adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes, was performed in subgroups defined by age, sex, smoking status (current vs. former/never), dyslipidemia, prediabetes, and obesity (general or central obesity vs. non-obese).
Abbreviations: HR, hazard ratio; CI, confidence interval; TyG-WHtR, triglyceride glucose index-waist to height ratio.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S9. Subgroup analysis of the association between TyG-WHR and incident cardio-renal-metabolic multimorbidity.

Subgroup	HR (95% CI)	*P* value	*P* for interaction
Age			
30-44	1.76 (1.27-2.42)	0.001	0.066
45-59	1.43 (1.17-1.76)	0.001	
>60	1.26 (1.00-1.60)	0.045	
Sex			
Man	1.49 (1.24-1.80)	<0.001	0.429
Woman	1.40 (1.14-1.72)	0.001	
Current smoking			
No	1.39 (1.20-1.62)	<0.001	0.566
Yes	1.63 (1.18-2.26)	0.003	
Dyslipidemia			
No	1.46 (1.06-2.00)	0.018	0.464
Yes	1.47 (1.27-1.71)	<0.001	
Prediabetes			
No	1.40 (1.14-1.73)	0.001	0.504
Yes	1.46 (1.22-1.75)	<0.001	
Hypertension			
No	1.51 (1.15-1.97)	0.002	0.121
Yes	1.42 (1.21-1.67)	<0.001	
Obesity			
No	1.84 (1.45-2.34)	<0.001	**<0.001**
Yes	1.16 (0.95-1.43)	0.149	

Adjusted for age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes, was performed in subgroups defined by age, sex, smoking status (current vs. former/never), dyslipidemia, prediabetes, and obesity (general or central obesity vs. non-obese).
Abbreviations: HR, hazard ratio; CI, confidence interval; TyG-WHR, triglyceride glucose index-waist to hip ratio.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S10. Risk of cardio-renal-metabolic multimorbidity associated with TyG and TyG-obesity indices in the multiply imputed dataset*

	Analysis 1		Analysis 2	
	HR (95% CI)	***P* value**	**HR (95% CI)**	***P* value**
TyG	1.42 (1.25–1.61)	<0.001	1.37 (1.20–1.56)	<0.001
TyG-BMI	1.52 (1.36–1.70)	<0.001	1.47 (1.30–1.67)	<0.001
TyG-WC	1.57 (1.39–1.77)	<0.001	1.52 (1.32–1.75)	<0.001
TyG-WHtR	1.57 (1.38–1.78)	<0.001	1.51 (1.31–1.74)	<0.001
TyG-WHR	1.44 (1.26–1.65)	<0.001	1.38 (1.19–1.58)	<0.001

* 6,073 eligible individuals with imputed missing data (20 datasets).

Analysis 1: Adjusted for the same set of covariates as Model 2 in the main analysis, including age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes.

Analysis 2: Incorporated the Analysis 1 covariates plus HOMA-IR in a subsample (n = 3,197) with available serum insulin data.

Abbreviations: TyG, triglyceride-glucose index; BMI, body mass index; WC, waist circumference; WHtR, waist-height ratio; WHR, waist-hip ratio; HR, hazard ratio; CI, confidence interval; CVD, cardiovascular disease; HOMA-IR, homeostasis model assessment of insulin resistance.

Association of the triglyceride-glucose index and its combination with obesity indices with cardio-renal-metabolic multimorbidity: Two decades of follow-up in the Tehran Lipid and Glucose Study

Soroush Soraneh, Navid Ebrahimi, Soroush Masrouri, Maryam Tohidi, Fereidoun Azizi, Farzad Hadaegh

Table S11. Risk of Cardio-Renal-Metabolic Multimorbidity for TyG and TyG-Obesity Indices in the Worst-Best Sensitivity Analysis *

	WCS-day 1†		WCS-last day		BCS-day 1		BCS-last day	
	HR (95% CI)	*P* value	HR (95% CI)	*P* value	HR (95% CI)	*P* value	HR (95% CI)	*P* value
TyG	1.04 (0.98–1.10)	0.202	1.07 (1.01–1.13)	0.014	1.42 (1.25–1.61)	<0.001	1.47 (1.30–1.67)	<0.001
TyG-BMI	1.05 (1.00–1.11)	0.050	1.08 (1.03–1.14)	0.002	1.53 (1.37–1.72)	<0.001	1.53 (1.37–1.70)	<0.001
TyG-WC	1.03 (0.98–1.09)	0.229	1.09 (1.03–1.15)	0.002	1.57 (1.39–1.78)	<0.001	1.59 (1.40–1.79)	<0.001
TyG-WHtR	1.05 (0.99–1.11)	0.129	1.09 (1.03–1.15)	0.002	1.58 (1.39–1.79)	<0.001	1.60 (1.41–1.82)	<0.001
TyG-WHR	1.03 (0.97–1.09)	0.359	1.07 (1.01–1.14)	0.023	1.44 (1.26–1.64)	<0.001	1.46 (1.28–1.68)	<0.001

* Analysis of 7,545 individuals aged ≥30 years and free of CVD, T2DM, and CKD at baseline, with imputed values for the main exposures and covariates, including participants with and without missing outcome data.

† All models were adjusted for the same set of covariates as Model 2 in the main analysis, including age, sex, marital status, educational level, smoking status, systolic blood pressure, antihypertensive medication use, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, lipid-lowering medication use, estimated glomerular filtration rate, pulse rate, family history of diabetes, family history of premature CVD, and prediabetes.

Abbreviations: WCS, Worst-case scenario (all events assigned to the specified day); BCS, Best-case scenario (no events assigned to the specified day); TyG, triglyceride-glucose index; BMI, body mass index; WC, waist circumference; WHtR, waist-height ratio; WHR, waist-hip ratio; HR, hazard ratio; CI, confidence interval; CVD, cardiovascular disease; HOMA-IR, homeostasis model assessment of insulin resistance.

References

1. Tohidi M, Ghasemi A, Hadaegh F, Derakhshan A, Chary A, Azizi F. Age- and sex-specific reference values for fasting serum insulin levels and insulin resistance/sensitivity indices in healthy Iranian adults: Tehran Lipid and Glucose Study. Clin Biochem. 2014;47(6):432–8.
2. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia. 1985;28(7):412–9.
3. Inker LA, Eneanya ND, Coresh J, Tighiouart H, Wang D, Sang Y, et al. New Creatinine- and Cystatin C-Based Equations to Estimate GFR without Race. N Engl J Med. 2021;385(19):1737–49.
4. Ghasemi A, Asgari S, Hadaegh F, Kheirandish M, Azimzadeh I, Azizi F, et al. New modified Friedewald formulae for estimating low-density lipoprotein cholesterol according to triglyceride levels: extraction and validation. Endocrine. 2018;62(2):404–11.