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The Triglyceride-Glucose Index: An Affordable Tool for Cardiovascular Risk Assessment in Taxi-Motorbike Drivers in Cotonou, Benin

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Abstract

Background: Cardiovascular disease (CVD) risk assessment is particularly challenging in low-resource settings, especially among high-risk occupational groups such as taxi-motorbike drivers (TMDs) in Cotonou, Benin. This population faces a heightened CVD burden attributable to prolonged sedentary behavior and chronic exposure to traffic-related air pollution. The triglyceride-glucose (TyG) index is a promising surrogate marker of insulin resistance (IR) and cardiometabolic risk, but its utility has not been evaluated in this unique population in Benin. This study aimed to investigate the association between the TyG index and cardiometabolic risk factors and determine its predictive utility for 10-year CVD risk in TMDs. **Methods:** A cross-sectional study was conducted among male, non-smoking TMDs (n = 137). Fasting blood samples were analyzed for glucose, lipids, and insulin. The TyG index was calculated as Ln[fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2]. Anthropometric measurements, blood pressure, and medical history were collected. Participants were stratified into TyG index tertiles. IR was assessed by HOMA-IR, and 10-year CVD risk was estimated using the Framingham Risk Score. Associations between the TyG index and cardiovascular risk factors were analyzed using correlation coefficients and logistic regression. Predictive capacity was evaluated using Area Under the Receiver Operating Characteristic (AUROC) curve analysis. **Results:** Among the participants, higher TyG index tertiles showed significant progressive increases in BMI, blood pressure, fasting glucose, insulin, HOMA-IR, triglycerides, LDL-C, and uric acid (all $p < 0.05$). The prevalence of hypertension and IR rose markedly across tertiles. The 10-year CVD risk (FRS) was twice as high in the top tertile (6.7% vs. 3.3%, $p < 0.001$), with fourfold more individuals exceeding the 10% risk threshold. The TyG index correlated strongly with BMI (r = 0.385), systolic BP (r = 0.317), LDL-C (r = 0.292), and uric acid (r = 0.414), with all $p < 0.001$. The TyG index was significantly associated with an increased 10-year CVD risk (AUROC = 0.662). The optimal population-specific TyG index cut-off for identifying intermediate/high risk was 7.73, demonstrating high sensitivity (78.6%) but moderate specificity (52.3%). Logistic regression identified BMI (OR = 1.28 per 1-unit increase, $p < 0.001$) and Framingham Risk Score (OR = 1.21 per 1% increase, $p = 0.047$) as strong, modifiable predictors of a high TyG index. **Conclusions:** The TyG index is strongly associated with an adverse metabolic profile and elevated estimated cardiovascular risk in TMDs. The identified cut-off of 7.73 is lower than in other populations but demonstrates consistent predictive value, highlighting the necessity for population-specific thresholds. The TyG index is a simple, cost-effective tool that should be integrated into occupational health screening programs in resource-limited settings to enable early detection and targeted interventions to mitigate the CVD burden in this high-risk Beninese workforce.

Keywords

Cotonou, Cardiovascular Disease Risk (CVD), Framingham Risk Score (FRS), Triglyceride-Glucose Index (TyG), Taxi-Motorbike Drivers (TMDs)

1. Introduction

Urban transportation workers in low- and middle-income countries (LMICs) face disproportionate exposure to traffic-related air pollution (TRAP), a complex mixture of harmful pollutants including benzene, ultrafine particulate matter, and polycyclic aromatic hydrocarbons (PAHs). In Cotonou, Benin, taxi-motorbike drivers (TMD)—a critical workforce for urban mobility—are particularly vulnerable due to prolonged, unprotected exposure to TRAP during daily commutes. Emerging evidence from our group has documented significant health burdens in this population, including elevated DNA damage, increased DNA adduct formation, and hematologic alterations compared to rural counterparts [1] [2]. Furthermore, cardiovascular risk factors such as hypertension, dyslipidemia, and hyperuricemia cluster disproportionately among TMD, suggesting a syndemic interaction between occupational exposures and metabolic dysregulation [3].

Despite these findings, critical gaps persist in understanding the mechanistic pathways linking TRAP exposure to cardiometabolic dysfunction in this high-risk group. The triglyceride-glucose index (TyG), calculated as Ln[fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2], a validated surrogate marker of insulin resistance (IR), has gained prominence as a predictor of diabetes [4] [5], cardiovascular disease (CVD) and metabolic syndrome in general populations [6]-[8].

While validated in Western and Asian cohorts [9] [10], its utility in Beninese occupational groups with high environmental exposures remains unexamined.

No studies have investigated whether TyG correlates with the identified cardiovascular risk factor cluster in pollution-exposed workers, nor whether it serves as an integrative biomarker of metabolic dysregulation in this context. This omission is striking given that IR may serve as a key mediator between chronic TRAP exposure and cardiovascular morbidity, via oxidative stress, systemic inflammation, and endothelial dysfunction.

This study utilizes previously collected biomonitoring and clinical data from TMDs residing and working in Cotonou to address this evidence gap. By examining the TyG index in relation to clustered cardiovascular risk factors, we aimed to: 1) elucidate its association with cardiometabolic risk factors in a TRAP-exposed occupational cohort, and 2) evaluate its potential as a low-cost, scalable biomarker for early CVD risk stratification in resource-limited settings.

2. Method

2.1. Study Design and Population

This cross-sectional study utilized data from a community health initiative targeting taxi-motorbike drivers (TMDs) in Cotonou, Benin—a population with chronic occupational exposure to TRAP, including benzene and ultrafine particulate matter [1] [3] [11]. The study population consisted of 148 actively working TMDs aged ≥ 18 years who underwent comprehensive health evaluations during the campaign. Inclusion criteria mandated current professional engagement as a TMD and being an apparently healthy, non-smoking man with no prior diagnosis of CVD. This selection of non-smoking men was intentional to eliminate the potent confounding effects of tobacco smoke on insulin sensitivity, lipid metabolism, and vascular function. This approach allows for a clearer assessment of the relationships between the TyG index and cardiovascular risk (FRS) within a population that is occupationally characterized by chronic exposure to TRAP. After excluding 11 participants due to incomplete demographic or laboratory data, the final analytical sample comprised 137 TMDs, representing the maximum number of eligible participants available during the study period. While an a priori power calculation was not conducted, the sample size proved sufficient for robust statistical analysis, as evidenced by the statistically significant and clinically meaningful associations detected for key outcomes—including hypertension prevalence, and TyG index—in both stratified and multivariate models.

The study protocol received ethical approval from the Benin Environmental Agency and was conducted in full compliance with the Declaration of Helsinki principles, with all participants providing written informed consent prior to enrollment.

2.2. Data Collection and Definition of Variables

Data on demographic (age, education level), health-related behavior (smoking status, and alcohol consumption), health condition (hypertension, diabetes, hyperlipidemia, cardiovascular disease, chronic kidney disease, and medications), occupational factors (years of driving, daily work hours) as well as physical measurements data (height and weight, with BMI calculated as weight (Kg)/height (m^2)) were collected by trained staffs according to standardized questionnaires. Blood pressure (BP) was measured twice using a calibrated mercury sphygmomanometer after participants rested for 5 minutes in a seated position. The average of two readings was used for analysis. Hypertension was defined as systolic BP ≥ 140 mmHg, diastolic BP ≥ 90 mmHg, or participants self-reported use of antihypertensive medications.

Fasting venous blood samples were collected after an 8-hour overnight fast. The samples were analyzed for a comprehensive panel of parameters, including glucose, triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), creatinine, and uric acid using standardized methods on automated clinical analyzers (Roche Diagnostics) to ensure reliability. Insulin concentrations were determined using a commercial radioimmunoassay (RIA) kit. IR was assessed using the homeostatic model assessment-insulin resistance (HOMA-IR) formula [3] [11], and defined as a value greater than 2.9, in accordance with established cut-offs used in prior epidemiological studies [12].

The triglyceride-glucose index (TyG) was derived as Ln[(Fasting triglycerides (mg/dL) × Fasting glucose (mg/dL))/2], serving as a surrogate marker of IR. All assays followed standardized laboratory protocols to ensure reproducibility.

2.3. Framingham Risk Score Assessment

The 10-year cardiovascular disease (CVD) risk was estimated using the Framingham Risk Score (FRS), calculated as previously described [13]. The FRS incorporates weighted points for sex, age (20 - 34, 35 - 39, ..., 75 - 79 years), systolic blood pressure (SBP; <120, 120 - 129, ..., ≥160 mmHg), total cholesterol (<160, 160 - 199, ..., ≥280 mg/dL), and HDL-C (≥60, 50 - 59, ..., <40 mg/dL). Smoking status and diabetes—exclusion criteria in our study—were included in the FRS framework but contributed zero points to the total score. Points from each component were summed to derive individual 10-year CVD risk scores, which were then categorized as low (<10%), intermediate (10% - 20%), or high (>20%). Higher FRS values indicate elevated CVD risk, consistent with validated prognostic thresholds [14].

2.4. Statistical Analyses

All statistical analyses were conducted using IBM SPSS Statistics, version 27.0. Continuous variables were summarized as medians with interquartile ranges (IQRs), and categorical variables as frequencies and percentages. Group comparisons were performed using the Mann-Whitney U test, with the first two TyG index tertiles compared against the highest tertile. Associations between the triglyceride-glucose (TyG) index and individual cardiovascular risk factors were assessed using Pearson's correlation coefficient. Optimal TyG cutoff values for predicting intermediate or high 10-year CVD were determined through receiver operating characteristic (ROC) curve analysis, with thresholds selected based on maximization of Youden's index; corresponding sensitivity and specificity values were calculated. Predictors of an elevated TyG index were assessed using multivariable logistic regression, with adjustments made for potential confounders including age, BMI, and blood pressure. The results are presented as adjusted odds ratios (aORs) with their corresponding 95% confidence intervals (CIs). All statistical tests were two-tailed, and a p-value < 0.05 was considered indicative of statistical significance.

3. Results

3.1. Clinical and Metabolic Characteristics of Participants Stratified by Triglyceride-Glucose (TyG) Index Tertiles

Table 1 compares demographic, clinical, metabolic and cardiovascular risk parameters across three tertiles of the triglyceride-glucose (TyG) index in a cohort of 137 TMDs. The median (IQR) TyG index in the study population was 7.8 (7.5 - 8.1). Medians of age (38 - 40 years, p = 0.128), length of occupational exposure (9.5 - 11 years, p = 0.371), creatinine (11.4 - 11.8 mg/L, p = 0.821), HDL-C (1.4 - 1.2 mmol/L, p = 0.107), alcohol use (37.0% - 50.0%, p = 0.167) were similar across tertiles, but significant differences were observed in BMI, blood pressure, and metabolic markers. Notably, BMI, systolic and diastolic blood pressure (SBP/DBP), fasting blood glucose, insulin, HOMA-IR (a measure of IR), and lipid profiles (TG, LDL-C) increased progressively across TyG tertiles, with p-values < 0.05, suggesting a strong association between higher TyG index and adverse metabolic parameters.

Critically, higher TyG correlates with increased prevalence of hypertension (p = 0.043) and IR (p = 0.036). The 10-year cardiovascular disease (CVD) risk, assessed by FRS, was also higher in the upper TyG tertiles (median 6.7% in tertile 3 vs. 3.3% in tertile 1, p < 0.001), with a greater proportion of individuals exceeding a 10% 10-year CVD risk in tertiles 2 and 3 (p = 0.015) (Table 1).

3.2. Correlations between the TyG Index and Cardiovascular Risk Factors

The correlation between the TyG index and cardiovascular risk factors examined by Pearson correlation analysis was shown in Table 2. The TyG index was positively correlated to BMI (r = 0.385, p < 0.001), SBP (r = 0.317, p < 0.001), DBP (r = 0.222, p < 0.001), TC (r = 0.334, p < 0.001), LDL-C (r = 0.292, p = 0.001), 10-year CDV risk (r = 0.285, p = 0.001), HOMA-IR (r = 0.297, p < 0.001), and uric acid (r = 0.414, p < 0.001). No significant correlation between the TyG index and age or creatinine was observed (Table 2).

3.3. Diagnostic Value of the TyG Index and Predictors of Elevated TyG

The area under the ROC (AUROC) of the TyG index for predicting intermediate

Table 1. Baseline clinical and metabolic characteristics of participants stratified by triglyceride-glucose (TyG) index tertiles.

	Study cohort (n = 137)	Tertile 1 (n = 46) ≤7.6	Tertile 2 (n = 45) 7.61-7.98	Tertile 3 (n = 46) >7.98	p-value*
Age (years)	39.0 (34.0 - 44.0)	38 (31.8 - 43.0)	38 (33.5 - 45.0)	40 (36.5 - 43.5)	0.128
BMI (Kg/m²)	22.5 (20.7 - 25.7)	21.5 (19.4 - 23.5)	22.9 (20.9 - 25.5)	24.1 (21.7 - 27.8)	<0.001
SBP (mmHg)	130.0 (120.0 - 150.0)	125.0 (120.0 - 140)	130 (120 - 145)	140 122,5 - 155.0)	0.006
DBP (mmHg)	80.0 (80.0 - 90.0)	80.0 (70.0 - 90.0)	80.0 (80.0 - 90.0)	90.0 (80.0 - 100.0)	0.008
Exposure length (years)	10.0 (7.0 - 16.0)	9.5 (5.0 - 16.3)	10.0 (7.0 - 17.0)	11.0 (9.0 - 16 - 0)	0.371
FBG (mmol/L)	4.3 (3.9 - 4.6)	4.1 (3.6 - 4.3)	4.3 (4.0 - 4.6)	4.5 (4.1 - 4.7)	<0.001
Insulin (μU/mL)	19.3 (14.0 - 31.6)	17.1 (13.1 - 22.9)	18.0 (13.3 - 23.6)	28.0 (19.0 - 42.8)	<0.001
HOMA-IR	3.6 (2.5 - 5.7)	3.1 (2.1 - 4.0)	3.4 (2.1 - 4.7)	5.5 (3.6 - 8.8)	<0.001
Creatinine (mg/L)	11.6 (10.5 - 12.5)	11.4 (10.3 - 12.8)	11.7 (10.5 - 12.4)	11.8 (10.8 - 12.3)	0.821
Uric acid (mg/L)	59.0 (50.0 - 66.0)	56.0 (46.8 - 64.3)	54.0 (48.0 - 62.0)	65.0 (60.0 - 72.0)	<0.001
TC (mmol/L)	4.4 (3.6 - 4.9)	3.7 (3.2 - 4.5)	4.5 (3.8 - 5.1)	4.6 (4.0 - 5.2)	<0.001
TG (mmol/L)	0.7 (0.5 - 1.0)	0.5 (0.4 - 0.5)	0.7 (0.6 - 0.8)	1.1 (0.9 - 1.3)	<0.001
HDL-C (mmol/L)	1.3 (1.1 - 1.6)	1.4 (1.2 - 1.6)	1.3 (1.1 - 1.6)	1.2 (1.1 - 1.4)	0.107
LDL-C (mmol/L)	2.5 (2.0 - 3.0)	2.0 (1.7 - 2.7)	2.7 (2.3 - 3.2)	2.8 (2.3 - 3.0)	<0.001
TyG index	7.8 (7.5 - 8.1)	7.4 (7.3 - 7.5)	7.8 (7.7 - 7.8)	8.3 (8.1 - 8.5)	<0.001
FRS 10-year CVD (%)	5.6 (3.3 - 7.9)	3.3 (2.8 - 6.7)	4.7 (3.3 - 11.2)	6.7 (4.7 - 11.2)	<0.001
Hypertension, n (%)	65 (47.4)	16 (34.8)	21 (46.7)	28 (60.9)	0.043
Alcohol use, n (%)	54 (39.4)	17 (37.0)	14 (31.1)	23 (50.0)	0.167
10-year CVD > 10%, n (%)	28 (20.4)	3 (6.5)	13 (28.9)	12 (26.1)	0.015
Insulin resistance, n (%)	87 (63.5)	25 (54.3)	26 (57.8)	36 (78.3)	0.036

Values are expressed as median (interquartile range). BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; FBG: fasting blood glucose; TC: total cholesterol; TG: triglyceride; LDL-C: high-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; FRS: Framingham Risk Score: HOMA-IR: homeostatic model assessment-insulin resistance: DBP: diastolic blood pressure; SBP: systolic blood pressure. *p-values were derived from Mann-Whitney U tests comparing the combined first and second TyG index tertiles against the third (highest) tertile.

Table 2. Correlations between the TyG index and cardiovascular risk factors.

Variables	Correlation coefficient	p-value
Age (years)	0.160	0.060
BMI (Kg/m²)	0.385	<0.001
SBP (mmHg)	0.317	<0.001
DBP (mmHg)	0.222	0.009
TC (mmol/L)	0.334	<0.001
HDL-C (mmol/L)	−0.181	0.035
LDL-C (mmol/L)	0.292	0.001

Continued

FRS 10-year CVD (%)	0.285	0.001
HOMA-IR	0.297	<0.001
Uric acid (mg/L)	0.414	<0.001
Creatinine (mg/L)	0.099	0.249

BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; FBG: fasting blood glucose; TC: total cholesterol; TG: triglyceride; LDL-C: high-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; FRS: Framingham Risk Score, HOMA-IR: homeostatic model assessment-insulin resistance; DBP: diastolic blood pressure; SBP: systolic blood pressure.

or high 10-year CVD risk was 0.662 (95% CI 0.556 - 0.768, $p < 0.001$) in TMDs and the optimal cut-off point for the TyG index was 7.73 (sensitivity: 78.6%, specificity: 52.3%) (Figure 1).

The logistic regression analysis reveals two powerful, modifiable predictors of an elevated TyG index. Specifically, for every 1% increase in estimated 10-year CVD risk, the odds of having a high TyG index increase by 21% (OR = 1.21, 95% CI: 1.01 - 1.45, $p = 0.047$). Additionally, every one-unit increase in BMI (Kg/m^2) raises the odds of elevated TyG index by 28% (OR = 1.28, 95% CI: 1.12 - 1.45, $p < 0.001$, Table 3).

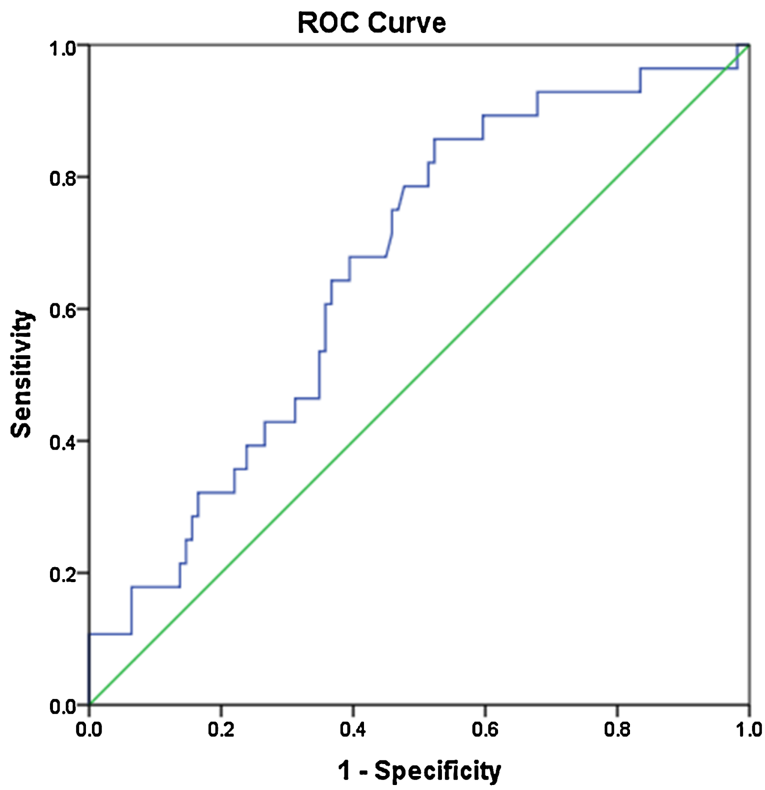

Figure 1. The area under the ROC of the TyG index for predicting 10-CVD risk in TMDs.

Table 3. Independent predictors of elevated triglyceride-glucose index in taxi-motorbike drivers.

Dependent determinant	Residual determinant	aOR	95% CI	p value
TyG > 7.73	10-year CVD risk	1.21	1.01 - 1.45	0.047
	BMI	1.28	1.12 - 1.45	< 0.001

TyG: Triglyceride-glucose index; CVD: Cardiovascular disease, aOR: adjusted odd ratio; CI: Confidence interval.

4. Discussion

This study is, to our knowledge, one of the first to provide evidence that the triglyceride-glucose (TyG) index, a simple surrogate marker of IR, is strongly associated with key metabolic and cardiovascular risk factors in a high-risk occupational group of taxi–motorbike drivers (TMDs) in Cotonou, Benin. Our findings—showing progressive increases in BMI, blood pressure, fasting glucose, insulin, HOMA-IR, triglycerides and LDL-C across TyG tertiles—are consistent with the growing literature linking the TyG index to adverse cardiometabolic profiles and future cardiovascular disease (CVD) events in diverse populations [15]-[17]. Notably, the magnitude of the association between the TyG index and predicted 10-year CVD risk remained significant even after adjustment for confounding factors (including age, BMI, and blood pressure), highlighting its utility as a robust and independent marker of cardiovascular risk.

4.1. Metabolic Deterioration, Hypertension, and Cardiovascular Risk

Our findings demonstrate a clear gradient of cardiometabolic risk across rising TyG index tertiles. The strong positive correlations between the TyG index and key parameters—including BMI, systolic/diastolic blood pressure, LDL-C, total cholesterol, and most notably, uric acid ($r = 0.414$)—align with established mechanistic pathways. An elevated TyG index reflects the core pathophysiological duo of IR and atherogenic dyslipidemia [18] [19]. IR drives endothelial dysfunction, oxidative stress, and chronic inflammation, processes that impair vascular remodeling and elevate the risk of cerebrovascular events [20]. Concurrently, hypertriglyceridemia—a fundamental component of the TyG index—promotes a pro-atherogenic environment characterized by low-grade inflammation, small, dense LDL particles, and hyperuricemia, all of which accelerate atherosclerotic burden [21]. The robust association with uric acid is particularly significant, as hyperuricemia is increasingly recognized as both a marker and active mediator of metabolic syndrome-related cardiovascular risk.

This metabolic deterioration translated directly into significant clinical outcomes. The prevalence of hypertension increased from approximately one-third of participants in the lowest TyG tertile to over 60% in the highest, a progression that closely mirrored the stepwise increase in HOMA-IR and the prevalence of IR. This supports the role of the TyG index as a unifying marker that captures integrated glycemic and lipid abnormalities, often identifying at-risk individuals before formal metabolic syndrome criteria are met [22]. Most critically, this metabolic dysregulation culminated in a substantially elevated absolute risk of future cardiovascular events. The median Framingham 10-year CVD risk score nearly doubled from the lowest to the highest TyG tertile, and the proportion of TMDs exceeding the 10% risk threshold was fourfold higher in the upper tertiles. This powerful association underscores the TyG index's dual utility.

4.2. Predictive Utility and Population-Specific TyG Index Thresholds

The TyG index demonstrated modest yet statistically significant predictive capacity for identifying individuals at intermediate/high 10-year CVD risk (AUROC = 0.662), consistent with findings from the Kerman coronary artery disease risk factors study (KERCADRS) which reported comparable discriminatory power for incident 10-year CVD [23]. In our cohort, the optimal TyG cut-off of 7.73 showed high sensitivity (78.6%), making it particularly valuable for screening programs prioritizing detection of at-risk individuals, despite moderate specificity.

The TyG index threshold identified for intermediate/high CVD risk in our TMD cohort was notably lower than values reported in other populations. These include a value of 10.0 in diabetic patients for coronary heart disease risk [24], 8.73 for CVD likelihood in older US adults [25], and a range from 9.72 in Chinese populations to 8.51 in UK cohorts for coronary heart disease risk escalation [26]. This trend extends to a regional context; a study of healthy Ghanaian adults established a higher cut-off of 8.70 for predicting metabolic syndrome [27], and a Nigerian study in hypertensive patients reported a threshold of ≥8.7 for predicting 10-year CVD risk [28]. Notably, while Nigerian's established threshold was higher than our value, the key predictive performance metrics across these West African studies are remarkably consistent, showing nearly identical AUC, sensitivity, and specificity estimates. This dual observation—of varying cut-offs but concordant accuracy—powerfully validates the existence of population-specific TyG thresholds but also emphasizes the critical need for developing tailored cardiovascular risk stratification approaches that account for ethnic, occupational, and regional risk factor variations.

Reinforcing the clinical significance of the TyG index, our logistic regression analysis identified two powerful, modifiable predictors of an elevated TyG index. Each 1% increase in the predicted 10-year CVD risk was associated with a 21% rise in the odds of having a high TyG index (OR = 1.21, 95% CI: 1.01 - 1.45, $p = 0.047$). More substantially, every one-unit increase in BMI (kg/m^2) increased the likelihood of elevated TyG by 28% (OR = 1.28, 95% CI: 1.12 - 1.45, $p < 0.001$). This robust relationship with BMI highlights the central importance of adiposity and IR in the development of cardiometabolic risk, emphasizing the TyG index's value as a practical marker for both metabolic health and cardiovascular risk assessment.

4.3. Public Health and Occupational Policy Implications for High-Risk Workers in LMICs

Taxi-motorbike drivers in Cotonou share several CVD risk factors: long sedentary workhours, high exposure to TRAP, occupational stress, and potentially unhealthy dietary habits. In the absence of organized health surveillance, integrating TyG screening into occupational health programs could allow for early identification of workers with subclinical cardiometabolic dysfunction. Given that TyG can be derived from routine fasting glucose and triglyceride tests—both widely available and inexpensive—this marker is particularly suited for resource-limited settings, unlike more sophisticated insulin resistance assessments that are costly and often inaccessible in low-income countries.

Targeted lifestyle interventions, periodic blood pressure and lipid monitoring, and, for those above the TyG cut-off, tailored counseling or pharmacologic intervention, could help reduce the future burden of CVD in this economically important workforce. Furthermore, public health authorities could use the data to argue for policies that address occupational determinants of cardiometabolic risk—such as reducing work-related air pollution exposure, regulating shift duration, and promoting access to preventive care.

4.4. Strengths, Limitations, and Future Directions

This study offers several strengths, including its focus on a previously understudied Beninese occupational cohort and the complementary use of both clinically measured parameters and validated risk scores to evaluate the TyG index's utility. However, several limitations warrant consideration: the cross-sectional design precludes causal inferences, and residual confounding may persist from unaccounted dietary patterns, physical activity levels, or socioeconomic determinants. The observed associations between TyG levels and predicted 10-year CVD risk might have been more robust with actual cardiovascular outcome data.

Crucially, the generalizability of our findings is constrained by key methodological choices. As the TMD profession in Benin is exclusively male, our results are inherently specific to this demographic. Furthermore, to control for the significant confounding effect of smoking, smokers were not included in the study. While this was methodologically necessary, it means our results cannot be extrapolated to TMDs who smoke—a group that may experience a compounded risk from the interaction of tobacco use and TRAP exposure. Consequently, the identified TyG cut-off value and associated risk factors are specifically applicable to non-smoking, male TMDs in similar contexts.

Future longitudinal investigations should examine whether elevated TyG values predict incidental CVD events in this population and assess the clinical impact of TyG-lowering interventions. Furthermore, incorporating biomarkers of inflammation (e.g., hs-CRP, IL-6) and oxidative stress (e.g., MDA) could provide mechanistic insights into the metabolic-cardiovascular pathway in this high-risk population.

5. Conclusions

This study demonstrates that the TyG index is a robust marker of cardiometabolic risk in TMDs in Cotonou, Benin. By showing consistent associations of high TyG with obesity, hypertension, IR, adverse lipid profiles, and elevated 10-year CVD risk, our findings underscore the TyG index's potential as an integrated indicator of both metabolic and vascular health. Importantly, the optimal threshold of 7.73—lower than those reported in other settings—emphasizes the existence of population- and context-specific cut-offs that must be considered in clinical and public health practice.

In resource-limited environments where advanced diagnostic tools are impractical, the TyG index offers a simple, cost-effective strategy for early risk identification. Its implementation within occupational health frameworks could facilitate targeted interventions, enhance preventive cardiometabolic care, and ultimately mitigate the growing burden of CVD among high-risk workers in sub-Saharan Africa. Longitudinal studies are warranted to validate its predictive capacity for future cardiovascular events and to explore whether interventions targeted at lowering TyG can meaningfully reduce long-term morbidity and mortality.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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