ORIGINAL ARTICLE

Assessment of Triglycerides and Anthropometric Measures Associated with Cardiovascular Risk in Thai Blood Donors with Lipemic Plasma

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Background: Cardiovascular diseases (CVDs) are a leading global health concern, and identifying early risk factors in asymptomatic populations is crucial for prevention and management.

Objective: To assess the relationship between triglycerides, anthropometric measures, and cardiovascular risk among Thai blood donors with lipemic plasma, with implications for blood bank efficiency and donor health.

Materials and Methods: The present study was a cross-sectional study conducted over a one-year period, between November 2022 and November 2023. Thirteen thousand eight hundred eighteen blood donors were screened, and 160 donors with lipemic plasma were included for analysis. Anthropometric data such as height, weight, and body mass index, and biochemical parameters including triglycerides and cholesterol were analyzed. Cardiovascular risk was assessed using the Thai CV risk score and 10-year CVD risk scores.

Results: The significant correlations among triglycerides (r_s=0.193, p=0.014), height (r_s=0.189, p=0.017), and weight (r_s=0.165, p=0.038) with cardiovascular risk. However, no significant associations were found for cholesterol or body mass index.

Conclusion: Triglycerides emerged as a critical determinant of elevated cardiovascular risk among lipemic plasma donors, emphasizing their dual impact on donor health and blood bank operations.

Keywords: Triglycerides; Cardiovascular risk; Blood donors; Lipemic plasma; Anthropometric measures

Received 3 March 2025 | Revised 23 September 2025 | Accepted 30 September 2025

J Med Assoc Thai 2025;108(11):879-83

Website: http://www.jmatonline.com

Cardiovascular diseases (CVDs) remain a leading cause of morbidity and mortality worldwide, accounting for approximately 32% of global deaths in 2019[1]. While traditionally associated with older populations, the rising prevalence of CVD risk factors among younger and healthy individuals have raised concerns about their detection and management[2]. Blood donors, often presumed to be a healthy subset of the population due to stringent eligibility criteria, present a unique population group for studying early markers of cardiovascular risk. Regular health screenings conducted during donor recruitment offer an opportunity to assess predictors of cardiovascular health, such as triglycerides (TGs) and anthropometric indices, while ensuring blood safety and donor welfare.

TGs, a type of lipid found in the blood, are a well-established biomarker for dyslipidemia, which significantly contributes to atherosclerosis and subsequent cardiovascular events[3]. Elevated TG levels are often linked with metabolic syndrome, a cluster of conditions including abdominal obesity, hypertension, and insulin resistance, which collectively exacerbate CVD risk[4]. Given that metabolic syndrome prevalence is rising globally, including in Thailand[5], there is an increasing need to monitor TGs and related risk factors among asymptomatic populations, such as blood donors, to inform preventive strategies[6].

Anthropometric measures, including body mass index (BMI), waist circumference (WC), and waist-

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How to cite this article:

Narkpetch S, Kooltheat N, Hongmeng W, Rattanapan Y. Assessment of Triglycerides and Anthropometric Measures Associated with Cardiovascular Risk in Thai Blood Donors with Lipemic Plasma. J Med Assoc Thai 2025;108:879-83.
DOI: 10.35755/jmedassocthai.2025.11.879-883-02714

to-hip ratio (WHR), are widely used, cost-effective tools for predicting cardiovascular risk. These indices are particularly valuable in resource-limited settings where advanced diagnostic techniques may not be accessible[7]. Among these, WC and WHR are superior predictors of central obesity, a critical component of metabolic syndrome, compared to BMI, which does not differentiate between fat and lean mass[8]. Incorporating such measures into routine blood donor assessments could enhance the identification of individuals at heightened risk of CVD, potentially improving donor health management and retention.

In Thailand, CVD poses a significant public health challenge, with ischemic heart disease and stroke ranking among the top causes of death, based on the Institute for Health Metrics and Evaluation[9]. Despite the growing burden, studies on CVD risk factors within the Thai population remain limited, particularly among blood donors. Blood banks, as crucial stakeholders in public health, could play a dual role in safeguarding donor health while maintaining a robust and efficient blood supply. By assessing TG levels and anthropometric predictors of cardiovascular risk, blood banks could identify at-risk donors, counsel them on lifestyle modifications, and contribute to the broader public health goal of CVD prevention.

The present study aimed to evaluate the relationship of TGs, anthropometric indices, and cardiovascular risk among Thai blood donors. By analyzing these predictors, the research seeks to uncover their implications for both donor health and blood bank efficiency. The findings would inform strategies to integrate cardiovascular risk assessment into blood donation processes, enhancing the overall safety and sustainability of blood banking operations.

Materials and Methods

Study design and population

The present study was a laboratory-based study was conducted as a cross-sectional study at the Blood Bank Laboratory of Maharaj Nakhon Si Thammarat Hospital, Thailand, over one year, between November 2022 and November 2023. Thirteen thousand eight hundred eighteen blood donors were screened during this period, and 160 donors with lipemic plasma were included in the study. The inclusion criteria required voluntary donors with sufficient blood volumes for analysis. Samples exhibiting hemolysis or icteric plasma were excluded. Ethical approval was obtained from the Walailak University Ethics Committee in Human Research (WUEC-22-334-01) and adhered to the Declaration of Helsinki. Informed consent was obtained from all participants.

Data collection

Data were collected from donor application forms and laboratory records, including demographic information such as gender and age, anthropometric measurements such as weight and height, which were used to calculate BMI, physiological parameters such as pulse rate, and biochemical data including cholesterol (CHO) and TG levels. Additional information gathered included smoking behavior within 24 hours, diabetes status, and number of donations. Cardiovascular risk was assessed using 10-year CVD risk scores and the Thai CV risk score, with relative risk values calculated based on age- and gender-matched controls.

Blood sample handling and laboratory analysis

Whole blood specimens were collected into CAT Serum Clot Activator tubes of 6 mL. Samples were processed immediately after collection to minimize degradation. TG levels were analyzed using an automated biochemical analyzer, ensuring high accuracy and reproducibility. Plasma lipemia was visually assessed, and donors with cloudy plasma were categorized as having lipemic plasma.

Statistical analysis

Descriptive statistics were used to summarize demographic, anthropometric, and biochemical data. Continuous variables were reported as means and standard deviations, while categorical variables were expressed as frequencies and percentages. Relationships between cardiovascular risk and study variables were analyzed using Spearman's rank correlation. This non-parametric test was chosen due to the potential for non-normal distribution of some variables. Significance levels were set at p-value less than 0.05.

Results

The present study included 160 participants, with a mean age of 40.08 years (SD 10.97) and a wide age range from 19 to 66 years. The study participants consisted of males at 64.375%, with females comprising 35.625%. Anthropometric measurements revealed an average weight of 73.72 kg (SD 16.55), and an average height of 166.56 cm, (SD 8.85), resulting in a mean BMI of 26.34 kg/m² (SD 5.02). The pulse rate ranged from 57 to 121 beats per minute, with a mean of 87.18 (SD 12.38).

Biochemical analysis showed an average CHO level of 209.53 mg/dL (SD 36.44) and a mean TG level of 286.01 mg/dL (SD 205.39), with a wide variability at TG level of 42 to 1,154 mg/dL. The number of donations among participants ranged from 1 to 130, with a mean of 23.23 (SD 26.89). The prevalence of diabetes mellitus (DM) was low, with only 1.875% of participants being diabetic. Smoking within 24 hours was reported by 15.625% of participants. Regarding the 10-year CVD risk, the average risk was 4.23% (SD 4.83), ranging from 0.52% to 30%. The Thai CV risk score revealed that 92.5% of participants fell into level 1 (low risk), 5% were in level 2 (moderate risk), and 2.5% were in level 3 (high risk). No participants were classified as level 4 (very high risk) or level 5 (critical risk). The relative risk of participants compared to individuals of the same gender and age without risk factors ranged from 0 to 5.3, with a mean of 1.23 (SD 0.9) (Table 1).

The present study investigated the relationships between cardiovascular risk and several physiological and biochemical parameters, including CHO, TG, Height, Weight, and BMI. Using Spearman's rank correlation (r_s), the analysis identified significant positive correlations for TG, height, and weight with cardiovascular risk, suggesting their potential influence on CV. Specifically, TGs (r_s=0.193, p=0.014) were strongly associated with elevated CV, underscoring their role as a major cardiovascular risk factor. Similarly, significant correlations were observed for height (r_s=0.189, p=0.017) and weight (r_s=0.165, p=0.038), emphasizing the importance of these anthropometric measures in predicting cardiovascular health. In contrast, no significant relationships were detected between cardiovascular risk and CHO (r_s=0.095, p=0.235) or cardiovascular risk and BMI (r_s=0.131, p=0.102), indicating a limited role for these parameters in the present study. The results highlight the need for further exploration of these variables within diverse populations and their inclusion in comprehensive cardiovascular risk assessment models (Figure 1).

Analysis of other factors among the characteristics of participants were positive or negative correlations with no significant value (data not shown).

Discussion

The present study demonstrated that TGs, height, and weight were significantly associated with cardiovascular risks among Thai blood donors with lipemic plasma. These findings highlight the potential value of incorporating anthropometric

Table 1. Characteristics of the study participants (n=160)

Characteristic	
Age (years); mean±SD (range)	40.08±10.97 (19 to 66)
Sex; n (%)	
Male	103 (64.4)
Female	57 (35.6)
Weight (kg); mean±SD (range)	73.72±16.55 (48 to 129)
Height (cm); mean±SD (range)	166.56±8.85 (140 to 187)
BMI (kg/m^2); mean±SD (range)	26.34±5.02 (17.65 to 46.09)
Pulse rate (beats/minute); mean±SD (range)	87.18±12.38 (57 to 121)
CHO (mg/dL); mean±SD (range)	209.53±36.44 (118.3 to 314)
TG (mg/dL); mean±SD (range)	286.01±205.39 (42 to 1154)
Number of donations; mean±SD (range)	23.23±26.89 (1 to 130)
Diabetes mellitus; n (%)	
No	157 (98.1)
Yes	3 (1.9)
Smoking within the past 24 hours*; n (%)	
No	135 (84.4)
Yes	25 (15.6)
10-year CVD risk (%); mean±SD (range)	4.23±4.83 (0.52 to 30)
Thai CV risk score; n (%)	
Level 1: Low risk	148 (92.5)
Level 2: Moderate risk	8 (5.0)
Level 3: High risk	4 (2.5)
Level 4: Very high risk	0 (0.0)
Level 5: Critical risk	0 (0.0)
Relative risk (times); mean±SD (range)	1.23±0.90 (0 to 5.3)

BMI=body mass index; CHO=cholesterol; TG=triglyceride; CVD=cardiovascular disease; SD=standard deviation

* Smoking status was assessed by self-report within 24 hours prior to donation

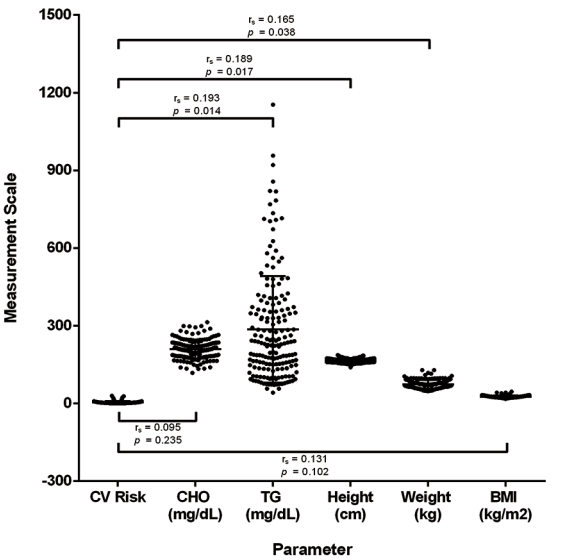

Figure 1. Spearman's correlation analysis between cardiovascular risk scores and triglycerides, height, weight, cholesterol, and BMI among lipemic plasma donors.

and biochemical measures into donor screening to improve both donor health assessment and blood bank efficiency.

TGs emerged as a critical predictor of cardiovascular risk and a determinant of lipemic plasma, which impacts both donor health and blood bank operations[10]. Unlike previous studies, the present research found no significant associations among CHO or BMI and cardiovascular risk, challenging their utility in this context. The findings underscore the potential for integrating cardiovascular risk assessments into routine blood donor screenings, which could enhance donor health management, improve the quality of donated blood, and reduce wastage due to lipemic plasma. The present study also highlighted the need for targeted interventions and future research incorporating diverse populations and comprehensive risk models.

No significant associations were observed between cardiovascular risk and CHO levels or BMI in the present study. This difference from the previous studies, which often identified BMI as a cardiovascular risk factor, may reflect the limitations of BMI in distinguishing lean from fat mass[11,12]. In addition, the relatively homogeneous CHO levels among participants reduced variability and limited the ability to detect significant associations[13].

The findings emphasize the dual role of TGs in affecting both cardiovascular health and blood bank operations. Elevated TG levels lead to lipemic plasma, which not only compromises the reliability of laboratory diagnostics but also increases the likelihood of blood donation wastage due to sample rejection[14,15]. This highlights the necessity for targeted interventions to address TG-related challenges in blood donation processes.

The exclusion of WC and WHR from the study, due to concerns about donor comfort, represents a limitation. These measures are well-established predictors of central obesity and could have provided more comprehensive insights into the relationship between body composition and cardiovascular risk[8,16]. Future studies should consider incorporating these parameters, using methods that minimize disruption to the donation process.

Additionally, the low prevalence of DM at 1.875% and smoking behavior at 15.625% in the study population suggests that other unmeasured factors, such as genetic predispositions and dietary habits, may influence cardiovascular risk[17,18]. Incorporating these variables into future research could enhance the understanding of cardiovascular risk in this population.

From a practical standpoint, integrating cardiovascular risk assessment into routine donor screening could yield benefits among lipemic plasma donors. Identifying at-risk individuals would improve donor health and reduce wastage of donated blood due to lipemic plasma, while basic lifestyle counseling could further mitigate these risks[19-21].

Future research should focus on expanding the study population to include more diverse demographic and health profiles, which would enhance the generalizability of the findings. Longitudinal studies investigating the long-term cardiovascular outcomes of donors with elevated TG levels could provide valuable insights into the progression of cardiovascular risk. Additionally, incorporating advanced risk prediction models that combine anthropometric, biochemical, genetic, and lifestyle factors would enable a more holistic assessment of cardiovascular health in blood donors. Overall, TG assessment may enhance donor health management and reduce wastage in blood banking.

Conclusion

This cross-sectional study found that TG levels, height, and weight were significantly associated with cardiovascular risk among Thai blood donors with lipemic plasma. Incorporating TG screening into routine donor assessments may enhance donor health and reduce wastage in blood banking. The present study findings were limited to a single-site cross-sectional design and could not establish causality. Larger, longitudinal studies are needed to validate these results in more diverse populations.

What is already known about this topic?

CVDs are a leading cause of global mortality, with elevated TGs recognized as a key risk factor associated with metabolic syndrome and cardiovascular events. Anthropometric measures, including BMI, are commonly used to assess cardiovascular risk, though limited research exists on these risk factors among blood donors, often perceived as a healthy population.

What does this study add?

This study demonstrates that TG levels, height, and weight are significant predictors of cardiovascular risk among Thai blood donors, while CHO and BMI show no significant associations. These findings highlight the importance of integrating TG assessments into routine donor screening to enhance

blood bank efficiency, donor health management, and reduce wastage caused by lipemic plasma.

Acknowledgment

The present research was supported by a student research grant from the Medical Technology Program, School of Allied Health Sciences, Walailak University, Nakhon Si Thammarat, Thailand.

Conflicts of interest

The authors declare that there are no conflicts of interest associated with this publication.

References

1. World Health Organization (WHO). Cardiovascular diseases (CVDs) [Internet]. 2021 [cited 2024 Dec 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds).
2. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global burden of cardiovascular diseases and risk factors, 1990-2019: Update from the GBD 2019 study. J Am Coll Cardiol 2020;76:2982-3021.
3. Nordestgaard BG, Varbo A. Triglycerides and cardiovascular disease. Lancet 2014;384:626-35.
4. Grundy SM, Brewer HB Jr, Cleeman JI, Smith SC Jr, Lenfant C. Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition. Circulation 2004;109:433-8.
5. Kristensen FPB, Christensen DH, Mortensen MB, Maeng M, Kahlert J, Sørensen HT, et al. Triglycerides and risk of cardiovascular events in statin-treated patients with newly diagnosed type 2 diabetes: a Danish cohort study. Cardiovasc Diabetol 2023;22:187. doi: 10.1186/s12872-023-03217-8.
6. Lertsakulbunlue S, Mungthin M, Rangsin R, Kantiwong A, Sakboonyarat B. Trends in predicted 10-year risk for cardiovascular diseases among patients with type 2 diabetes in Thailand, from 2014 to 2018. BMC Cardiovasc Disord 2023;23:183. doi: 10.1186/s12933-023-01921-5.
7. Abarca-Gómez L, Abdeen ZA, Hamid ZA, Abu-Rmeileh NM, Acosta-Cazares B, Acuin C, et al. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet 2017;390:2627-42.
8. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev 2012;13:275-86.
9. Sakboonyarat B, Rangsin R. Hospital admission and mortality rates for ischemic heart disease in Thailand: 2012-2021. BMC Res Notes 2024;17:142. doi: 10.1186/s13104-024-06803-x.
10. Abe C, Decicco E, Eason S, Compton F, Sayers M, Makhnoon S, et al. Non-fasting triglyceride screening in volunteer blood donors: A pilot program. J Clin Lipidol 2025;19:369-71.
11. Hu J, Xu H, Zhu J, Zhang J, Li J, Chen L, et al. Association between body mass index and risk of cardiovascular disease-specific mortality among adults with hypertension in Shanghai, China. Aging (Albany NY) 2021;13:6866-77.
12. Gallagher D, Visser M, Sepúlveda D, Pierson RN, Harris T, Heymsfield SB. How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? Am J Epidemiol 1996;143:228-39.
13. Gupta S, Gudapati R, Gaurav K, Bhise M. Emerging risk factors for cardiovascular diseases: Indian context. Indian J Endocrinol Metab 2013;17:806-14.
14. de Oliveira M, Antunes M, Amil M. Plasma lipemia: When the blood donor becomes a patient. Transfus Apher Sci 2022;61:103294. doi: 10.1016/j.transci.2021.103294.
15. Fernández Prendes C, Castro Castro MJ, Sánchez Navarro L, Rapún Mas L, Morales Indiano C, Arrobas Velilla T. Handling of lipemic samples in the clinical laboratory. Adv Lab Med 2023;4:5-27.
16. Lear SA, Humphries KH, Kohli S, Chockalingam A, Frohlich JJ, Birmingham CL. Visceral adipose tissue accumulation differs according to ethnic background: results of the Multicultural Community Health Assessment Trial (M-CHAT). Am J Clin Nutr 2007;86:353-9.
17. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 1972;18:499-502.
18. Tian F, Chen L, Qian ZM, Xia H, Zhang Z, Zhang J, et al. Ranking age-specific modifiable risk factors for cardiovascular disease and mortality: evidence from a population-based longitudinal study. EClinicalMedicine 2023;64:102230. doi: 10.1016/j.eclinm.2023.102230.
19. Claas SA, Arnett DK. The role of healthy lifestyle in the primordial prevention of cardiovascular disease. Curr Cardiol Rep 2016;18:56. doi: 10.1007/s11886-016-0728-7.
20. Mensink RP, Zock PL, Kester AD, Katan MB. Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: a meta-analysis of 60 controlled trials. Am J Clin Nutr 2003;77:1146-55.
21. Kebalo AH, Gizaw ST, Gnanasekaran N, Areda BG. Lipid and haematologic profiling of regular blood donors revealed health benefits. J Blood Med 2022;13:385-94.