Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Association of the preoperative triglyceride-glucose index with 5-year all-cause mortality after colorectal cancer surgery: a retrospective cohort study

Runyu Chen
Wuhan University of Science and Technology
Sheng Cheng
Wuhan University of Science and Technology
Dongming Han
Wuhan University of Science and Technology
Zhanyu Zhang
Wuhan University of Science and Technology
Mengyang Cheng
Wuhan University of Science and Technology
Zehao Liu
Wuhan University of Science and Technology
Dandan Ma
General Hospital of Central Theater Command of the Chinese People's Liberation Army
Zhiyong Zhang
ptwkzzy@163.com

General Hospital of Central Theater Command of the Chinese People's Liberation Army

Research Article

Keywords: triglyceride–glucose index, colorectal cancer, surgery, all-cause mortality, prognosis, insulin resistance

Posted Date: November 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11411286/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

The association between the preoperative triglyceride-glucose (TyG) index and survival after colorectal cancer (CRC) surgery remains uncertain because recent studies have reported opposite associations. We examined the association between preoperative TyG and 5-year all-cause mortality after CRC surgery.

Methods

This retrospective cohort study included 492 patients with pathologically confirmed colorectal adenocarcinoma who underwent surgery at Central Theater Command General Hospital between 2015 and 2020. The TyG index was calculated from preoperative fasting triglyceride and fasting plasma glucose concentrations. The primary analysis used TyG per 1-standard deviation (SD) increase, and secondary analyses used TyG quartiles. Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs). Restricted cubic splines were used to assess nonlinearity. We also performed subgroup analyses, proportional hazards tests, and sensitivity analyses.

Results

During the 5-year follow-up period, 121 deaths occurred among 492 patients. In the fully adjusted model, each 1-SD increase in TyG was associated with a higher hazard of all-cause mortality (HR 1.29, 95% CI 1.06–1.57; P = 0.011). Compared with the lowest TyG quartile, the highest quartile had a higher mortality hazard (HR 1.90, 95% CI 1.08–3.35; P = 0.026), and the trend across quartiles was significant (P for trend = 0.027). Restricted cubic spline analysis showed no evidence of nonlinearity (P for nonlinearity = 0.829). Similar estimates were seen after restricting the analysis to elective surgery, stratifying the Cox model by sex, and adding inflammatory or nutritional measures one at a time. No subgroup interaction was statistically significant.

Conclusions

Higher preoperative TyG was associated with a higher hazard of 5-year all-cause mortality after colorectal cancer surgery. Similar estimates were seen in the sensitivity analyses. Larger prospective multicenter studies are needed to confirm these findings.

1. Background

Colorectal cancer (CRC) is a major global health problem. In 2022, there were more than 1.9 million new CRC cases and about 904,000 CRC-related deaths worldwide, making CRC the third most commonly diagnosed cancer and the second leading cause of cancer death (1). Surgery remains a main curative

treatment for resectable CRC and is part of multidisciplinary care based on tumor site, stage, and patient characteristics (2, 3). Outcomes still vary after surgery. Prognostic assessment mainly uses clinicopathological factors such as tumor stage and pathological features, and host metabolic status may provide additional information(4) .

Insulin resistance and related metabolic changes may contribute to cancer development and progression through hyperinsulinemia, insulin and insulin-like growth factor signaling, changes in glucose and lipid metabolism, and chronic inflammation (5). The triglyceride-glucose (TyG) index is calculated from fasting triglyceride and fasting glucose concentrations and is widely used as a simple surrogate marker of insulin resistance (6, 7). Recent epidemiological studies and meta-analyses have linked higher TyG levels with a higher risk of CRC (8–10). However, the association with CRC-related mortality is less clear .

The prognostic value of TyG after CRC diagnosis and surgery is also uncertain. A previous single-center study from our institution found that higher TyG was associated with poorer postoperative prognosis after CRC surgery (11). A recent multicenter study of 1,893 patients who underwent radical CRC surgery, with an external validation cohort of 493 patients, reported the opposite result: higher TyG was associated with better long-term survival (12). A study of 644 patients with synchronous colorectal liver metastases also found that lower TyG was associated with shorter overall survival(13). These different findings suggest that the prognostic meaning of TyG may vary across CRC populations. Patient selection, disease burden, metabolic and nutritional status, and analysis methods may all contribute. The shape of the association and whether it remains after adjustment for inflammatory and nutritional factors are also not well defined.

Given these conflicting findings, we examined whether preoperative TyG was associated with 5-year all-cause mortality after CRC surgery. We also evaluated the exposure-response shape and the robustness of the association in sensitivity, subgroup, and additional-adjustment analyses. We hypothesized that higher preoperative TyG would be associated with a higher mortality hazard. We present this article in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting checklist.

2. Methods

2.1 Study design and participants

This retrospective cohort study included adults who underwent surgery for pathologically confirmed colorectal adenocarcinoma at Central Theater Command General Hospital between 2015 and 2020. All patients meeting the eligibility criteria during this period were screened; because the study used an existing retrospective cohort, no a priori sample-size calculation was performed. Eligibility required age ≥ 18 years, preoperative fasting laboratory measurements sufficient to calculate TyG, and follow-up

information suitable for time-to-event analysis. Patients with missing data required for TyG calculation or incomplete survival follow-up were excluded.

Demographic, clinical, pathological, laboratory, and follow-up variables used in this analysis were extracted from the study database. Survival status and follow-up time were based on the follow-up information available in that database. Both elective and emergency procedures were included in the primary cohort. To assess whether emergency presentation influenced the findings, the main analyses were repeated after restricting the cohort to elective surgery.

2.2 Assessment of the triglyceride–glucose index

Fasting blood samples obtained during routine preoperative evaluation were used to measure triglyceride and fasting plasma glucose concentrations. The TyG index was calculated as ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL) / 2] (6, 8).

The primary exposure was TyG per 1-standard deviation (SD) increase. The SD of TyG in the full cohort was 0.565. The corresponding HR therefore shows the change in mortality hazard for each 1-SD increase in TyG. In secondary analyses, patients were divided into cohort-specific TyG quartiles, with 123 patients in each quartile.

2.3 Outcome and follow-up

The primary outcome was death from any cause within 5 years after surgery. Survival time was calculated from the date of surgery to death or censoring. Patients who were alive at their last available follow-up were censored on that date. Follow-up was capped at 60 months after surgery.

Observed follow-up ranged from 0.5 to 60 months, with a median of 45.25 months.

2.4 Covariates

Covariates were chosen before modeling based on clinical relevance and known prognostic factors for CRC, not on statistical significance in univariable analyses.

The primary multivariable model included age, sex, body mass index (BMI), diabetes mellitus, hypertension, emergency surgery, tumor site, Eastern Cooperative Oncology Group (ECOG) performance status, TNM stage, and tumor differentiation.

For multivariable modeling, ECOG performance status was grouped as 0–1 versus ≥ 2. Because only two patients had stage IV disease, TNM stage was grouped as stage I, stage II, and stage III-IV to avoid unstable estimates from a very small stage IV group. Tumor differentiation was grouped as well/moderately differentiated versus poorly differentiated/undifferentiated.

Preoperative inflammatory and nutritional status was also assessed using C-reactive protein (CRP), neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), prognostic nutritional index (PNI), and modified Glasgow Prognostic Score (mGPS). The selected cut-points were based on values

used in previous colorectal cancer studies. CRP was categorized as ≤ 5 mg/L versus > 5 mg/L (14), NLR as < 3.0 versus ≥ 3.0(15), PLR as < 150 versus ≥ 150, and PNI as ≥ 45 versus < 45 (16). For the additional-adjustment analysis, original mGPS scores of 0 and 1 were combined as the reference group, while a score of 2 was classified as the high-risk group(17). Each inflammatory or nutritional measure was added separately to the primary fully adjusted model. The Nutritional Risk Screening 2002 (NRS-2002) score (18) was included as a descriptive baseline measure and was not part of the primary adjustment model.

2.5 Statistical analysis

Continuous variables are shown as medians with interquartile ranges (IQRs), and categorical variables are shown as numbers and percentages. Baseline characteristics were compared across TyG quartiles with the Kruskal-Wallis test for continuous variables and Pearson's chi-squared test for categorical variables. For ECOG performance status, TNM stage, tumor differentiation, and mGPS, chi-squared tests with Monte Carlo simulation based on 50,000 replicates were used because of sparse cell counts.

The association between preoperative TyG and 5-year all-cause mortality was examined with Cox proportional hazards regression. TyG per 1-SD increase was the primary exposure measure. The crude model included TyG only. Model 1 adjusted for age, sex, BMI, diabetes mellitus, and hypertension. Model 2 was the primary fully adjusted model and also included emergency surgery, tumor site, ECOG performance status, TNM stage, and tumor differentiation. Results are reported as HRs with 95% CIs.

TyG was also analyzed in quartiles, with the lowest quartile (Q1) as the reference. For the trend test, the median TyG value in each quartile was assigned to patients in that quartile and entered as a continuous variable.

Restricted cubic splines with four knots were fitted using the Model 2 covariates to examine the shape of the TyG-mortality association. The median TyG value (8.36) was the reference, and nonlinearity was tested using the nonlinear spline terms. For presentation, the plot was limited to the 5th to 95th percentile of TyG (about 7.60–9.38) to reduce the visual influence of sparse tail values.

The proportional hazards assumption was assessed with scaled Schoenfeld residuals. When a covariate showed evidence of non-proportionality, an appropriate stratified Cox model was fitted as a sensitivity analysis.

The main analyses were repeated in the elective-surgery subgroup. The TyG SD and quartile cut points from the full cohort were retained to preserve comparability with the primary analysis.

Prespecified subgroup analyses were performed by age (< 70 versus ≥ 70 years), sex, BMI (< 25 versus ≥ 25 kg/m²), diabetes mellitus, tumor site (colon versus rectum), TNM stage (I-II versus III-IV), and ECOG performance status (0–1 versus ≥ 2). Effect modification was tested by adding a TyG-by-subgroup interaction term to each multivariable Cox model. P values for interaction were obtained with likelihood ratio tests. These subgroup analyses were exploratory.

For additional-adjustment analyses, CRP, NLR, PLR, PNI, and mGPS were entered separately into Model 2.

Kaplan-Meier curves were generated for TyG quartiles and compared with the log-rank test. These analyses were descriptive and unadjusted.

No imputation was performed. After cohort assembly, there were no missing values in variables included in the primary Cox models, and all 492 participants were retained in those models. To reduce data-driven model selection, adjustment variables were prespecified on clinical grounds rather than selected by univariable statistical significance, and TyG per 1-SD increase was used as the primary exposure instead of an outcome-derived cutoff.

All tests were two-sided, and $P < 0.05$ was considered statistically significant. Analyses were performed with R version 4.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

3. Results

3.1 Patient characteristics

A total of 510 potentially eligible patients were screened, and 18 were excluded because preoperative fasting laboratory data and/or follow-up information were incomplete. The final cohort included 492 patients (Fig. 1), of whom 461 (93.7%) underwent elective surgery and 31 (6.3%) underwent emergency surgery. During 5 years of follow-up, 121 patients died (24.6%). Observed follow-up ranged from 0.5 to 60 months, with a median of 45.25 months.

The median TyG index was 8.36 (IQR, 8.08–8.76), and each TyG quartile included 123 patients. There were no missing values for variables included in Table 1 or the primary Cox models. Baseline characteristics are presented in Table 1. BMI, diabetes mellitus, hypertension, PNI category, and white blood cell count differed significantly across TyG quartiles. No statistically significant differences were observed for age, sex, smoking history, drinking history, heart disease, surgery status, ECOG performance status, NRS-2002 score, tumor site, TNM stage, tumor differentiation, CRP status, NLR, PLR, mGPS, or serum creatinine.

3.2 Association between TyG and 5-year all-cause mortality

Higher preoperative TyG was associated with a higher hazard of 5-year all-cause mortality in Cox models (Table 2). In the unadjusted model, each 1-SD increase in TyG was associated with a 19% higher mortality hazard (HR 1.19, 95% CI 1.00-1.42; P = 0.049). After adjustment for age, sex, BMI, diabetes mellitus, and hypertension, the HR was 1.29 (95% CI 1.06–1.57; P = 0.010). After further adjustment for emergency surgery, tumor site, ECOG performance status, TNM stage, and tumor differentiation, the HR remained 1.29 (95% CI 1.06–1.57; P = 0.011).

When TyG was analyzed in quartiles, the adjusted HRs increased across higher quartiles. In Model 2, compared with Q1, the HR was 1.49 (95% CI 0.87–2.56; P = 0.147) for Q2, 1.62 (95% CI 0.95–2.76; P = 0.076) for Q3, and 1.90 (95% CI 1.08–3.35; P = 0.026) for Q4. The trend across quartiles was significant (P for trend = 0.027).

In the unadjusted Kaplan-Meier analysis, survival did not differ significantly across TyG quartiles (log-rank P = 0.368; Supplementary Figure S1).

3.3 Dose–response relationship

Restricted cubic spline analysis showed no evidence of nonlinearity (P for nonlinearity = 0.829), and the overall spline test was not statistically significant (P = 0.078). The estimated curve did not clearly depart from a linear shape across the central TyG range (Fig. 2).

For display, the curve was limited to the 5th to 95th percentile of TyG (about 7.60–9.38), although the model was fitted to the full cohort.

3.4 Sensitivity and additional adjustment analyses

The main estimate was similar in the sensitivity analyses (Supplementary Table S1). In the sex-stratified Cox model, each 1-SD increase in TyG was associated with a higher mortality hazard (HR 1.29, 95% CI 1.06–1.58; P = 0.011). In the 461 patients who underwent elective surgery, the HR was 1.31 (95% CI 1.07–1.60; P = 0.009).

In the elective-surgery analysis, the quartile results were also similar to the primary analysis. Compared with Q1, the HR was 1.51 (95% CI 0.87–2.63; P = 0.145) for Q2, 1.70 (95% CI 0.98–2.93; P = 0.058) for Q3, and 1.88 (95% CI 1.05–3.38; P = 0.034) for Q4.

Adding inflammatory and nutritional measures one at a time did not materially change the TyG estimate (Supplementary Table S2). The adjusted HRs per 1-SD increase in TyG ranged from 1.28 to 1.32 after additional adjustment for CRP, NLR, PLR, PNI, or mGPS.

For the proportional hazards assumption, there was no evidence of non-proportionality for TyG (P = 0.175) and the global test was not significant (P = 0.168). Sex showed evidence of non-proportionality (P = 0.041). The sex-stratified model gave almost the same TyG estimate, and its global proportional hazards test was not significant (P = 0.339; Supplementary Table S3).

3.5 Subgroup analyses

Subgroup estimates are shown in Fig. 3.

No subgroup interaction was statistically significant. The P values for interaction were 0.298 for age, 0.147 for sex, 0.887 for BMI, 0.147 for diabetes mellitus, 0.088 for tumor site, 0.834 for TNM stage, and 0.724 for ECOG performance status.

4. Discussion

Three findings are noteworthy. First, higher preoperative TyG was associated with a higher hazard of 5-year all-cause mortality after multivariable adjustment. Second, the association was stable in the elective-surgery and sex-stratified analyses and after separate adjustment for inflammatory and nutritional markers. Third, the spline analysis did not show evidence of nonlinearity, and no prespecified subgroup interaction was statistically significant. The unadjusted Kaplan-Meier comparison across quartiles was not significant, which is compatible with the difference between a global unadjusted comparison and covariate-adjusted Cox regression.

These findings add to an inconsistent literature on TyG after CRC diagnosis. The direction of association agrees with our earlier single-center report(11) but differs from a recent multicenter surgical cohort, in which higher TyG was associated with better survival (12), and from a cohort of patients with synchronous colorectal liver metastases, in which lower TyG was associated with shorter overall survival(13). The contrast across studies suggests that the prognostic meaning of TyG may depend on disease setting, patient selection, and the balance between metabolic dysfunction and nutritional reserve.

One possible explanation for the adverse association in our cohort is that higher TyG reflects insulin resistance and metabolic dysregulation. Hyperinsulinemia and altered glucose and lipid metabolism may influence insulin-like growth factor signaling, cell survival pathways, oxidative stress, and chronic inflammation (5–7). Metabolic syndrome has also been associated with poorer CRC outcomes(4). However, the TyG estimate changed little after separate adjustment for CRP, NLR, PLR, PNI, or mGPS. These analyses suggest that the measured inflammatory and nutritional markers did not account for the observed association, but they were not mediation analyses and cannot establish mechanistic independence.

The opposite association seen in some recent cancer cohorts may be related to nutritional reserve and disease burden. Cancer-related malnutrition and cachexia can involve loss of body weight and muscle, systemic inflammation, and major metabolic changes, especially in advanced cancer(19). In this setting, changes in glucose and lipid metabolism may alter the prognostic meaning of the TyG index. A recent prospective multicenter study of 5,221 patients with cancer found that higher TyG-BMI was associated with lower malnutrition risk and better overall survival, especially in gastrointestinal cancers (20). This evidence is indirect because TyG-BMI is not the same as TyG alone. The inverse association reported in colorectal liver metastases has also been described as a possible prognostic paradox (13). One possible explanation is that the balance between metabolic dysfunction and nutritional reserve differs by cancer stage and clinical setting. This remains a hypothesis. Differences in patient selection, TyG calculation or grouping, disease stage, treatment, and covariate adjustment may also explain differences between studies.

Strengths of this study include treating TyG primarily as a standardized continuous exposure rather than selecting a data-driven cutoff, evaluating the exposure-response shape with restricted cubic splines,

formally testing proportional hazards and subgroup interactions, and examining robustness in elective-surgery, sex-stratified, and additional-adjustment analyses.

This study also has limitations. First, it was retrospective and conducted at one center, so selection bias, measurement error, and residual confounding are possible. The results cannot establish causality. The direction and magnitude of residual confounding cannot be quantified; unmeasured factors could either attenuate or exaggerate the observed association. Second, the recruitment period of the present cohort (2015–2020) partly overlaps with the calendar periods used in a previous study from our institution [11]. Patient-level identifiers from the previous study were not available for linkage; therefore, the exact number of overlapping participants could not be determined. Some patient overlap is consequently possible, and the present study should not be interpreted as an independent replication of the previous cohort. However, the present analysis addressed a different research question and extended the previous work by treating TyG primarily as a standardized continuous exposure, evaluating the exposure–response relationship, formally assessing proportional hazards and subgroup interactions, and performing elective-surgery and inflammatory/nutritional additional-adjustment analyses. Third, only all-cause mortality was available, so we could not study CRC-specific mortality, recurrence-free survival, or disease-free survival. Fourth, TyG came from one preoperative fasting measurement, and the exact time between blood sampling and surgery was not available. We therefore could not study changes in metabolic status over time. Fifth, follow-up was capped at 60 months, and some patients were censored before 60 months. Informative loss to follow-up cannot be ruled out. Finally, the single-center setting may limit the generalizability of the findings. Studies in independent multicenter cohorts are needed to assess whether the observed association can be reproduced in other populations.

5. Conclusions

In this retrospective cohort, higher preoperative TyG was associated with a higher hazard of 5-year all-cause mortality after colorectal cancer surgery. The association was stable across several sensitivity and additional-adjustment analyses, while the spline analysis showed no clear evidence of nonlinearity. These findings support further evaluation of TyG as a readily available metabolic marker, but independent prospective multicenter validation is required before clinical implementation.

Abbreviations

BMI
body mass index
CI
confidence interval
CRC
colorectal cancer
CRP
C-reactive protein

ECOG
Eastern Cooperative Oncology Group
HR
hazard ratio
IQR
interquartile range
mGPS
modified Glasgow Prognostic Score
NLR
neutrophil-to-lymphocyte ratio
NRS-2002
Nutritional Risk Screening 2002
PLR
platelet-to-lymphocyte ratio
PNI
prognostic nutritional index
SD
standard deviation
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
TNM
tumor-node-metastasis
TyG
triglyceride-glucose index
TyG-BMI
triglyceride-glucose index–body mass index.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of Central Military Region General Hospital (approval No. [2024] 076 – 01). The requirement for individual informed consent was waived because of the retrospective nature of the study. The study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was received for this study.

Author Contribution

Conception and design: Runyu Chen and Sheng Cheng. Administrative support: Zhiyong Zhang. Provision of study materials or patients: Sheng Cheng, Dongming Han, Zhanyu Zhang, Mengyang Cheng, Zehao Liu, Dandan Ma, and Zhiyong Zhang. Collection and assembly of data: Runyu Chen, Sheng Cheng, Dongming Han, Zhanyu Zhang, Mengyang Cheng, Zehao Liu, and Dandan Ma. Data analysis and interpretation: Runyu Chen, Sheng Cheng, Dandan Ma, and Zhiyong Zhang. Manuscript writing: all authors. Final approval of manuscript: all authors.

Acknowledgements

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because they contain clinical information that may compromise participant privacy. De-identified data may be available from the corresponding author on reasonable request, subject to institutional and ethical approval.

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–63. 10.3322/caac.21834 . PubMed PMID: 38572751.
2. Benson AB, Venook AP, Adam M, Chang G, Chen YJ, Ciombor KK, et al. Colon cancer, version 3.2024, NCCN clinical practice guidelines in oncology. J Natl Compr Cancer Netw JNCCN. 2024;22(2 D):e240029. 10.6004/jnccn.2024.0029 . PubMed PMID: 38862008.
3. Hofheinz RD, Fokas E, Benhaim L, Price TJ, Arnold D, Beets-Tan R, et al. Localised rectal cancer: ESMO clinical practice guideline for diagnosis, treatment and follow-up. Ann Oncol Off J Eur Soc Med Oncol. 2025;36(9):1007–24. 10.1016/j.annonc.2025.05. .528 PubMed PMID: 40412553.

4. Lu B, Qian JM, Li JN. The metabolic syndrome and its components as prognostic factors in colorectal cancer: a meta-analysis and systematic review. J Gastroenterol Hepatol. 2023;38(2):187–96. 10.1111/jgh.16042 . PubMed PMID: 36287138; PubMed Central PMCID: PMC10100176.
5. Jacobo-Tovar E, Medel-Sánchez A, Durán-Castillo C, Guardado-Mendoza R. Insulin resistance in cancer risk and prognosis. Semin Cancer Biol. 2025;114:73–87. 10.1016/j.semcancer.2025. 06.006 PubMed PMID: 40517920.
6. Kurniawan LB. Triglyceride-glucose index As a biomarker of insulin resistance, diabetes mellitus, metabolic syndrome, and cardiovascular disease: a review. Ejifcc. 2024;35(1):44–51. PubMed PMID: 38706737; PubMed Central PMCID: PMC11063788.
7. Yin JL, Yang J, Song XJ, Qin X, Chang YJ, Chen X, et al. Triglyceride-glucose index and health outcomes: an umbrella review of systematic reviews with meta-analyses of observational studies. Cardiovasc Diabetol. 2024;23(1):177. 10.1186/s12933-024-02241-. y PubMed PMID: 38783270; PubMed Central PMCID: PMC11118729.
8. Kityo A, Lee SA. Triglyceride-glucose index, modifiable lifestyle, and risk of colorectal cancer: a prospective analysis of the korean genome and epidemiology study. J Epidemiol Glob Health. 2024;14(3):1249–56. 10.1007/s44197-024-00282-w . PubMed PMID: 39103728; PubMed Central PMCID: PMC11442717.
9. Omer HFE, Alghazali M, Ibrahim MY, Abdalla NMY, Hassan AHM, Yousif EAS, et al. Association between the triglyceride-glucose index (TyG index) and risk of colorectal cancer: a systematic review and meta-analysis. World J Surg Oncol. 2025;23(1):280. 10.1186/s12957-025-03930-y . PubMed PMID: 40665300; PubMed Central PMCID: PMC12261805.
10. Luo L, Liu Z, Gan Q, Feng J, Wang L, Ouyang W. Relationships of triglyceride-glucose-related indices with colorectal cancer incidence and mortality in an American population: a dose-response meta-analysis and cohort study. Lipids Health Dis. 2025;24(1):151. 10.1186/s12944-025-02574-x . PubMed PMID: 40269839; PubMed Central PMCID: PMC12016320.
11. Cheng S, Long D, Kuang P, et al. Triglyceride-glucose index and surgical prognosis in patients with colorectal cancer: a clinical study. Abdom Surg. 2024;37(6):431–41.
12. Liang L, Zhang Y, He X, Alburiahi TAH, Kou Z, Yang J, et al. Triglyceride-to-glucose index and lymphocyte-to-monocyte ratio enhance prognostic accuracy for colorectal cancer patients: a multicenter machine learning cohort study. Transl Cancer Res. 2026;15(3):199. 10.21037/tcr-2025-1-2893 . PubMed PMID: 41969510; PubMed Central PMCID: PMC13067021.
13. Yi T, Li X, Lin Z, Lin Z, Liang Y, Jin H, et al. Paradoxical prognostic role of the TyG index and a novel machine learning-derived nomogram for colorectal cancer liver metastases. Front Nutr. 2026;13:1842975. 10.3389/fnut.2026.1842975 . PubMed PMID: 42516240; PubMed Central PMCID: PMC13402184.
14. Bert M, Devilliers H, Orry D, Rat P, Facy O, Ortega-Deballon P. Preoperative inflammation is an independent factor of worse prognosis after colorectal cancer surgery. J Visc Surg. 2021;158(4):305–11. .001 PubMed PMID: 33446466.

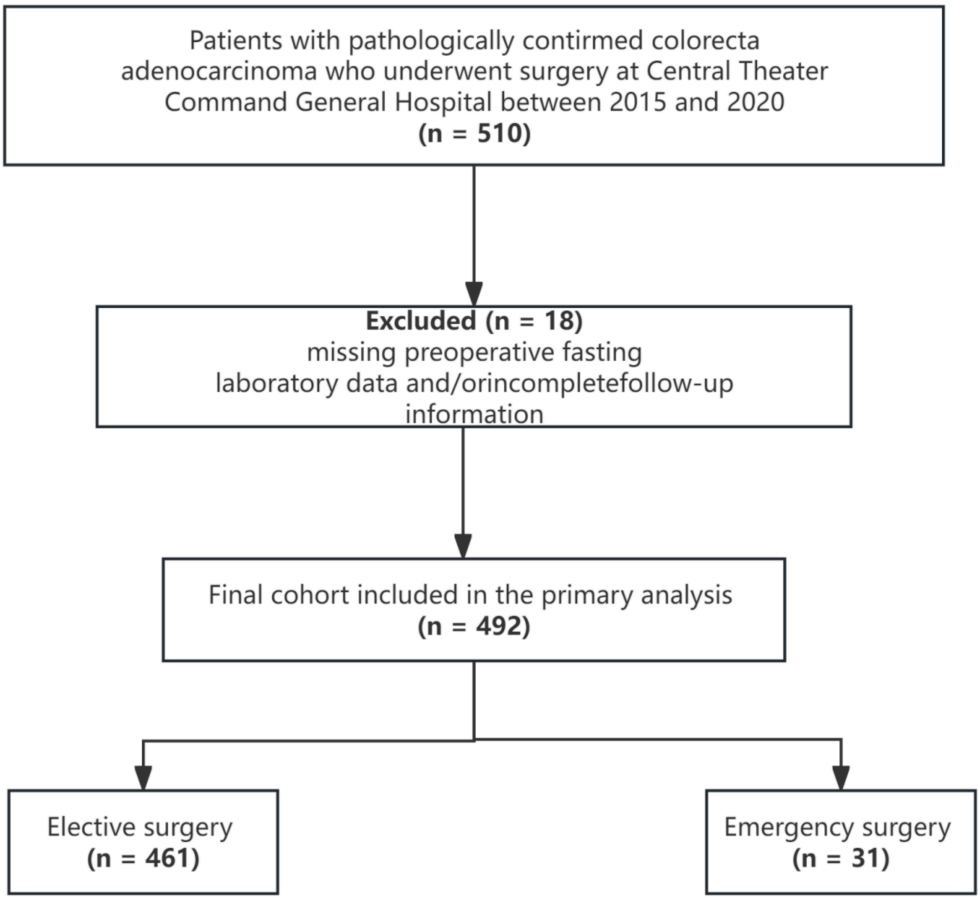
15. Mazaki J, Katsumata K, Kasahara K, Tago T, Wada T, Kuwabara H, et al. Neutrophil-to-lymphocyte ratio is a prognostic factor for colon cancer: a propensity score analysis. BMC Cancer. 2020;20(1):922. 10.1186/s12885-020-07429-5 . PubMed PMID: 32977767; PubMed Central PMCID: PMC7519490.
16. Lee SY, Lee SI, Min BW, Oh SC. Prognostic implication of systemic inflammatory markers in young patients with resectable colorectal cancer. Ann Surg Treat Res. 2021;100(1):25–32. 10.4174/astr.2021.100. .1.25 PubMed PMID: 33457394; PubMed Central PMCID: PMC7791188.
17. Kishiki T, Masaki T, Matsuoka H, Kobayashi T, Suzuki Y, Abe N, et al. Modified glasgow prognostic score in patients with incurable stage IV colorectal cancer. Am J Surg. 2013;206(2):234–40. 10.1016/j.amjsurg.2012.07.051 . PubMed PMID: 23827511.
18. Wu T, Xu H, Li W, Zhou F, Guo Z, Wang K, et al. The potential of machine learning models to identify malnutrition diagnosed by GLIM combined with NRS-2002 in colorectal cancer patients without weight loss information. Clin Nutr. 2024;43(5):1151–61. 10.1016/j.clnu.2024.04. .001 PubMed PMID: 38603972.
19. Koh K, Scott R, Cespedes Feliciano EM, Janowitz T, Goncalves MD, White EP, et al. Cancer-associated cachexia: bridging clinical findings with mechanistic insights in human studies. Cancer Discov. 2025;15(8):1543–68. 10.1158/2159-8290.CD-25-0293 . PubMed PMID: 40298389; PubMed Central PMCID: PMC12794921.
20. Gong YZ, Zhang BM, Liao C, Zhu LC, Ruan GT. Association of TyG-BMI and malnutrition with reduced survival outcomes in patients with cancer: a prospective study. Front Nutr. 2026;13:1887549. 10.3389/fnut.2026.1887549 . PubMed PMID: 42597479; PubMed Central PMCID: PMC13467991.

Tables

Tables 1 and 2 are available in the Supplementary Files section.

Figures

Figure 1. Flowchart of patient selection in the hospital surgical cohort

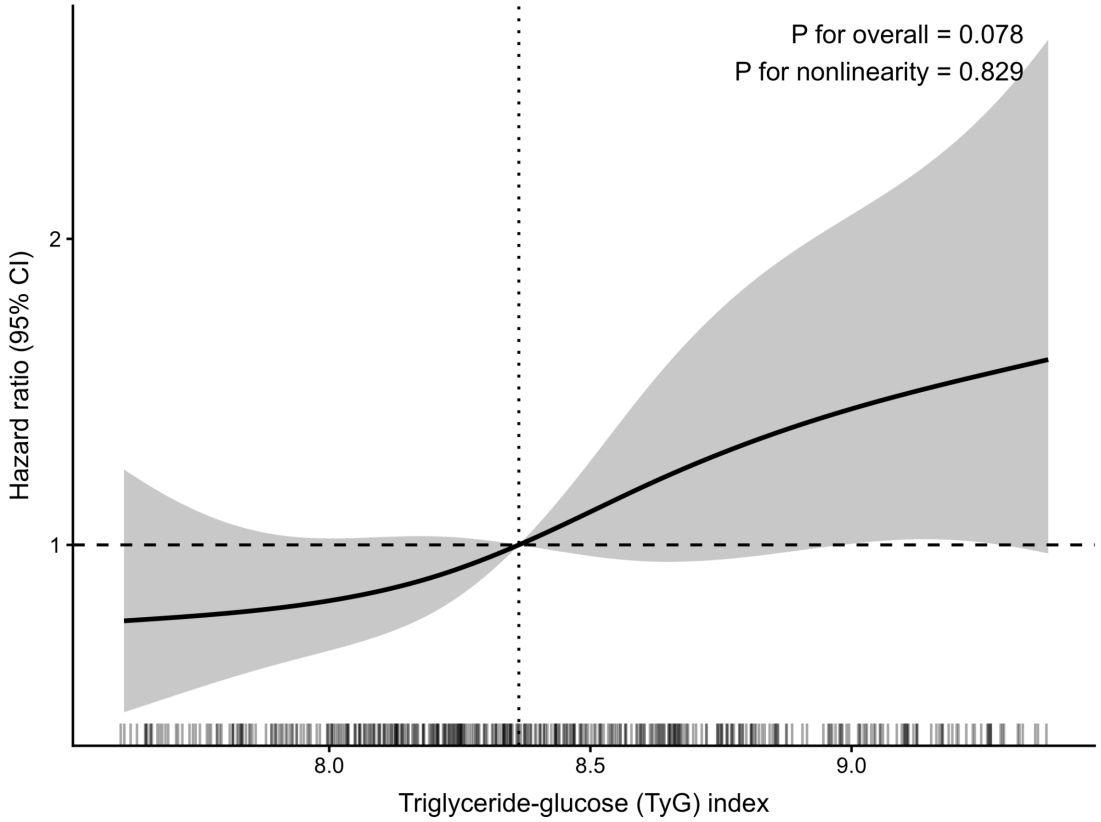


A total of 510 patients with pathologically confirmed colorectal adenocarcinoma who underwent surgery at Central Theater Command General Hospital between 2015 and 2020 were screened. After excluding 18 patients with missing preoperative fasting laboratory data and/or incomplete follow-up information, 492 patients were included in the primary analysis, including 461 elective surgery cases and 31 emergency surgery cases.

Figure 1

See image above for figure legend

Figure 2. Restricted cubic spline analysis of the association between the preoperative triglyceride–glucose index and all-cause mortality.

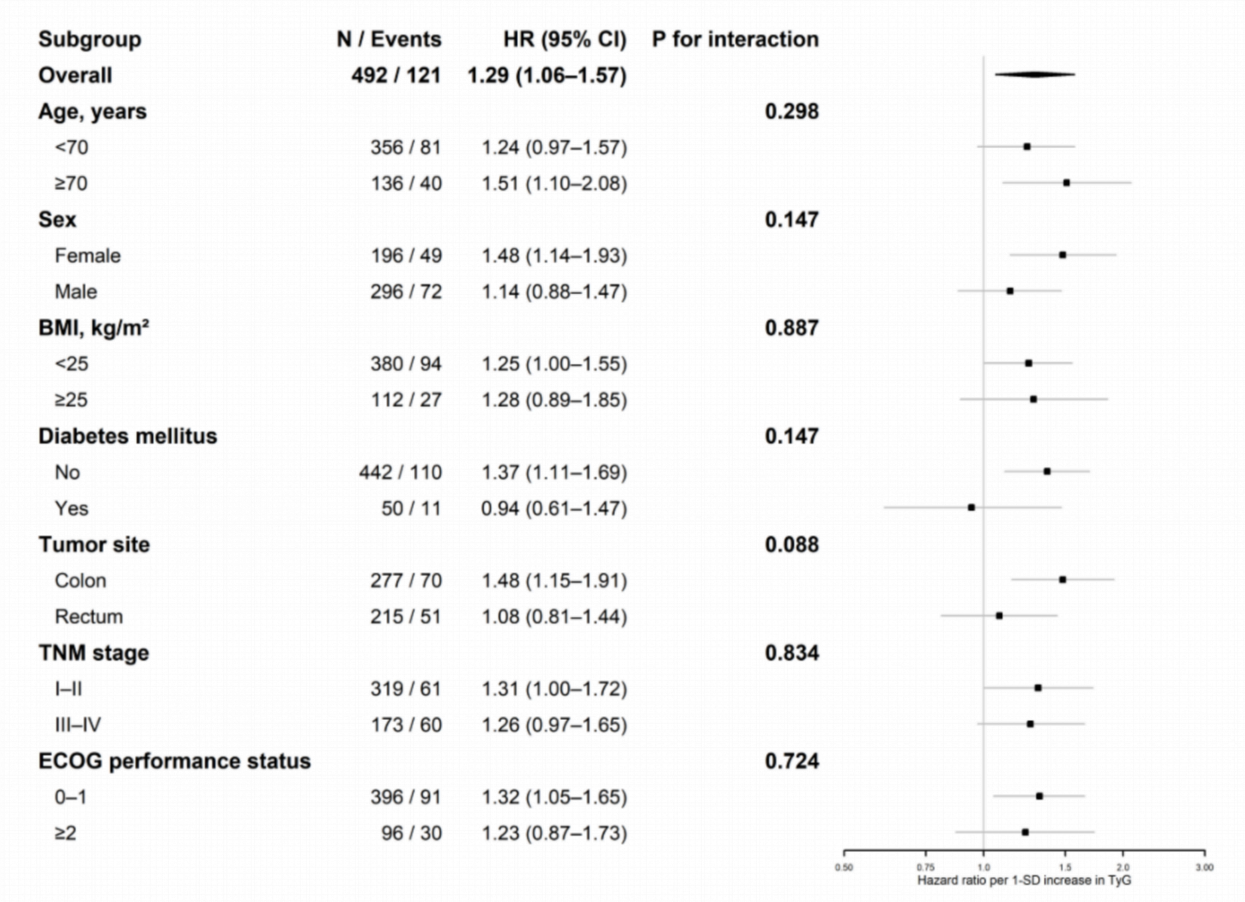


Hazard ratios and 95% confidence intervals were estimated using a multivariable Cox proportional hazards model adjusted for age, sex, body mass index, diabetes mellitus, hypertension, emergency surgery, tumor site, ECOG performance status, TNM stage, and tumor differentiation. The median TyG value (8.36) was used as the reference (HR = 1.00). The solid line represents the estimated hazard ratio and the shaded area represents the 95% confidence interval. The rug plot indicates the distribution of observed TyG values. For visualization, the curve is displayed from the 5th to the 95th percentile of TyG (7.60–9.38), while all 492 participants were included in the model. No significant evidence of nonlinearity was observed (P for nonlinearity = 0.829).

Figure 2

See image above for figure legend

Figure 3. Subgroup analyses of the association between the preoperative triglyceride–glucose index and all-cause mortality



Hazard ratios represent the change in mortality hazard per 1-SD increase in TyG. Models were adjusted using the covariates included in the primary multivariable model, excluding the corresponding stratification variable. P values for interaction were obtained from models containing multiplicative interaction terms between TyG and each prespecified subgroup variable. No statistically significant evidence of effect modification was identified across the examined subgroups.

Figure 3

See image above for figure legend

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1FINALNRS2002CRP5mg..pdf
- Table2TyGCoxfinal.html.pdf
- figureS1.png
- SupplementaryTableS1ASensitivityperSD.html.pdf
- SupplementaryTableS1BElectivequartiles.html.pdf
- SupplementaryTableS2FINAL1.html.pdf
- SupplementaryTableS3FINAL.html.pdf