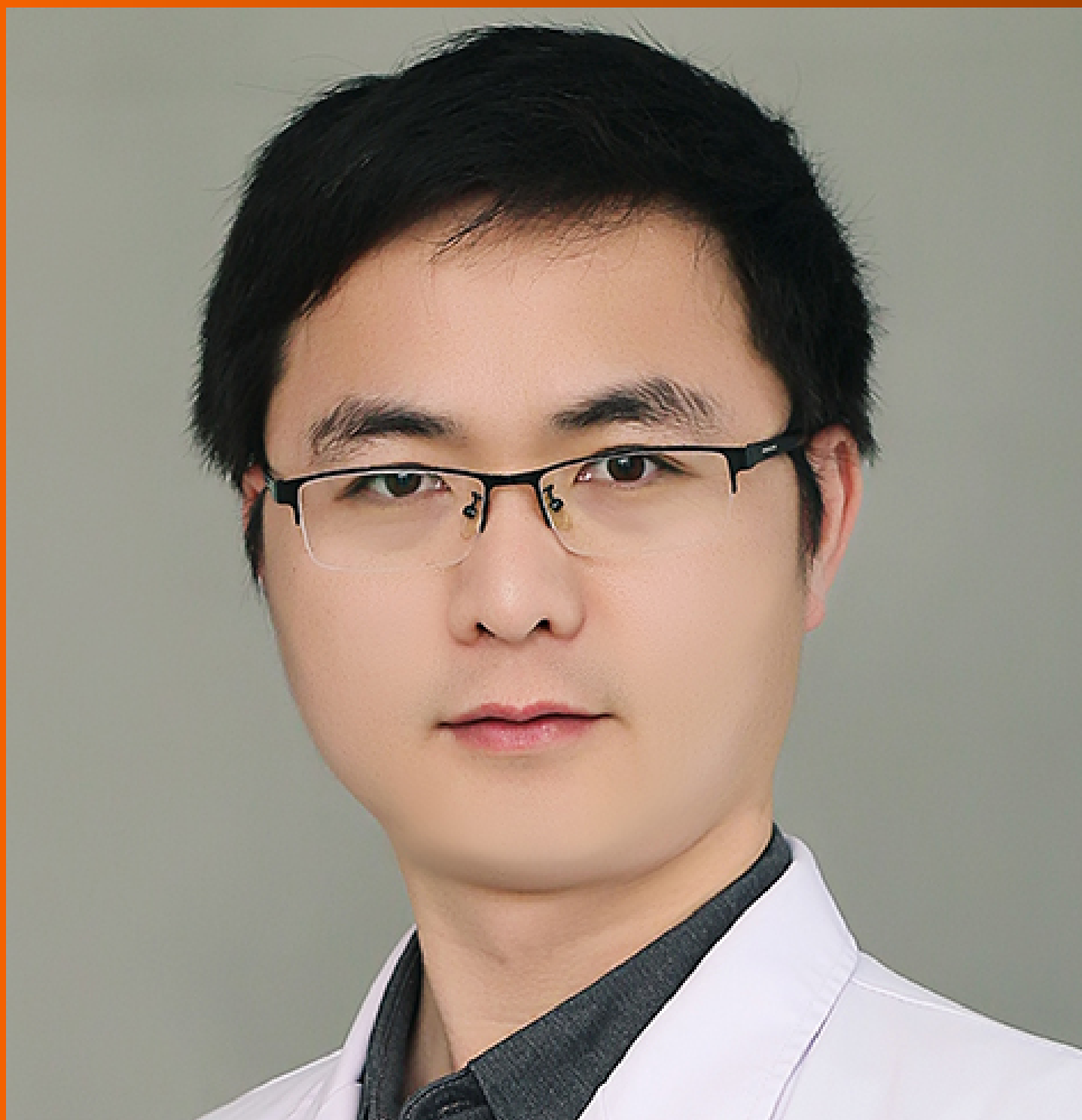


# World Journal of *Clinical Oncology*

Monthly Volume 16 Number 12 December 24, 2025



**EDITORIAL**

Calibasi-Kocal G. Inflammatory cytokine-associated cisplatin resistance in non-small cell lung cancer and re-sensitization through interleukin-6 receptor blockade. *World J Clin Oncol* 2025; 16(12): 114275 [DOI: [10.5306/wjco.v16.i12.114275](https://doi.org/10.5306/wjco.v16.i12.114275)]

**REVIEW**

Ansari S, Ahmed N. Pathogenicity of *Helicobacter pylori*-associated gastric cancer. *World J Clin Oncol* 2025; 16(12): 110909 [DOI: [10.5306/wjco.v16.i12.110909](https://doi.org/10.5306/wjco.v16.i12.110909)]

Youssef J, Yehya A, Salhab Z, Bitar R, Ghamlouche F, Bahmad HF, Abou-Kheir W. Liquid biopsy in genitourinary cancers: Diagnostic and prognostic implications. *World J Clin Oncol* 2025; 16(12): 113578 [DOI: [10.5306/wjco.v16.i12.113578](https://doi.org/10.5306/wjco.v16.i12.113578)]

**MINIREVIEWS**

Zhang XM, Zhao FY, Gao LF, Xu T, Yang F, Qian NS. Immune therapy-related hyperprogressive disease: Molecular mechanisms, biomarkers, and clinical strategies. *World J Clin Oncol* 2025; 16(12): 110351 [DOI: [10.5306/wjco.v16.i12.110351](https://doi.org/10.5306/wjco.v16.i12.110351)]

Pernomian LS, Teixeira MF, Araujo RL, Serrano Uson Junior PL. Perioperative immunotherapy in gastric cancer in the spotlight. *World J Clin Oncol* 2025; 16(12): 110988 [DOI: [10.5306/wjco.v16.i12.110988](https://doi.org/10.5306/wjco.v16.i12.110988)]

Shalini T, Sudhandiran G. Provoking myofibroblast death: Strategies to resolve fibrosis and remodel tumor microenvironment. *World J Clin Oncol* 2025; 16(12): 111086 [DOI: [10.5306/wjco.v16.i12.111086](https://doi.org/10.5306/wjco.v16.i12.111086)]

Zhao HY, Yu CY, Ye XT, Qian ST, Huang Y, Liu QS. Relevance and application of sirtuin 3-activated mitophagy in gastric cancer treatment. *World J Clin Oncol* 2025; 16(12): 111175 [DOI: [10.5306/wjco.v16.i12.111175](https://doi.org/10.5306/wjco.v16.i12.111175)]

Madarasz B, Balazs MA, Palfi E, Konczos J, Toth A, Szentmartoni G, Herold Z, Dank M. Ultra-processed foods and dietary habits of oncology patients: Risk factor or survival strategy. *World J Clin Oncol* 2025; 16(12): 111372 [DOI: [10.5306/wjco.v16.i12.111372](https://doi.org/10.5306/wjco.v16.i12.111372)]

Gao F, Jiao Y, Wang HL. Metabolic syndrome and colorectal cancer: Mechanisms, epidemiological evidence, and clinical implications. *World J Clin Oncol* 2025; 16(12): 112639 [DOI: [10.5306/wjco.v16.i12.112639](https://doi.org/10.5306/wjco.v16.i12.112639)]

Meng LL, Di YP, Ma L, Qu BL. Advances in prostate cancer treatment with moderate and ultra-hypofractionated radiotherapy. *World J Clin Oncol* 2025; 16(12): 112735 [DOI: [10.5306/wjco.v16.i12.112735](https://doi.org/10.5306/wjco.v16.i12.112735)]

**ORIGINAL ARTICLE****Case Control Study**

Liu L, Shi DY, Tan J, Xu S, Liu CR. Group-specific component and 25-hydroxylase gene polymorphisms in nasopharyngeal carcinoma: Associations with susceptibility and radiotherapy response. *World J Clin Oncol* 2025; 16(12): 111544 [DOI: [10.5306/wjco.v16.i12.111544](https://doi.org/10.5306/wjco.v16.i12.111544)]

**Retrospective Cohort Study**

Framarini M, D'Acapito F, Lippolis PV, Di Giorgio A, Di Pietrantonio D, Sommariva A, Sammartino P. Expanding the role of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy: A multicenter study on uncommon peritoneal malignancies. *World J Clin Oncol* 2025; 16(12): 112443 [DOI: 10.5306/wjco.v16.i12.112443]

**Retrospective Study**

Lee J, Seigel Q, Lee S, Green E, Chitlik S, Lobova V, Eastvold P, Gresens C, Kaya EA. Stem cell collection from peripheral blood of multiple myeloma patients. *World J Clin Oncol* 2025; 16(12): 103683 [DOI: 10.5306/wjco.v16.i12.103683]

Qiao XY, Shen XJ, Lv YH, Chen RB, Weng J, Xu GL, Wen G, Bai KH. Endoscopic submucosal dissection and hybrid endoscopic submucosal dissection for stage 1 rectal neuroendocrine tumors. *World J Clin Oncol* 2025; 16(12): 112871 [DOI: 10.5306/wjco.v16.i12.112871]

**Observational Study**

Wang GY, Chen YN, Sun YL, Zhou B, Zhang FQ, Yan JF, Hu K. Impact evaluation of intra-fractional variation on online adaptive radiotherapy for postoperative cervical and endometrial cancer. *World J Clin Oncol* 2025; 16(12): 111601 [DOI: 10.5306/wjco.v16.i12.111601]

**Basic Study**

Mo BY, Wen JY, Chen GQ, Ling JW, He H, Qin ZL, Tian FY, Li Q, Li B, Li JD, He RQ, Qin DY, Li ZY, Chen G, Mo CH, Chen C, Yin SH, Yang L. Expression patterns and clinical implications of chaperonin subunit 3 mRNA and protein in laryngeal squamous cell carcinoma. *World J Clin Oncol* 2025; 16(12): 112161 [DOI: 10.5306/wjco.v16.i12.112161]

Chen JW, Ouyang JJ, Wang ZH, Ma DM, Zhang Z, Teng Q, Yu G, Li XY. Yin Yang 1 activates JAK-STAT3-mediated epithelial-mesenchymal transition in *Helicobacter pylori*-induced gastric cancer progression. *World J Clin Oncol* 2025; 16(12): 112626 [DOI: 10.5306/wjco.v16.i12.112626]

**CASE REPORT**

Shan BW, Yu JH, Ren T. Intrathyroidal thymic carcinoma comprising squamous cell and small cell carcinoma components: A case report. *World J Clin Oncol* 2025; 16(12): 111701 [DOI: 10.5306/wjco.v16.i12.111701]

Li ZM, Wang YC, Wang KY, Xie NJ, Zhou J, Chang XN, Chen Q, Wang G, Zhang S, Zhou R. Radiotherapy for large ruptured hemorrhagic axillary lymph node metastasis from anaplastic lymphoma kinase-positive lung adenocarcinoma: A case report and review of literature. *World J Clin Oncol* 2025; 16(12): 112140 [DOI: 10.5306/wjco.v16.i12.112140]

**LETTER TO THE EDITOR**

Bouayad A. Ectonucleoside triphosphate diphosphohydrolase 6: A double-edged sword in cancer prognosis and therapy. *World J Clin Oncol* 2025; 16(12): 115789 [DOI: 10.5306/wjco.v16.i12.115789]

**ABOUT COVER**

Editorial Board Member of *World Journal of Clinical Oncology*, Xing-Liang Dai, MD, Assistant Professor, Chief Physician, Department of Neurosurgery, The First Affiliated Hospital of Anhui Medical University, Hefei 230022, Anhui Province, China. daixingliang@ahmu.edu.cn

**AIMS AND SCOPE**

The primary aim of *World Journal of Clinical Oncology* (*WJCO*, *World J Clin Oncol*) is to provide scholars and readers from various fields of oncology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

*WJCO* mainly publishes articles reporting research results and findings obtained in the field of oncology and covering a wide range of topics including art of oncology, biology of neoplasia, breast cancer, cancer prevention and control, cancer-related complications, diagnosis in oncology, gastrointestinal cancer, genetic testing for cancer, gynecologic cancer, head and neck cancer, hematologic malignancy, lung cancer, melanoma, molecular oncology, neurooncology, palliative and supportive care, pediatric oncology, surgical oncology, translational oncology, and urologic oncology.

**INDEXING/ABSTRACTING**

The *WJCO* is now abstracted and indexed in PubMed, PubMed Central, Emerging Sources Citation Index (Web of Science), Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2025 Edition of Journal Citation Reports® cites the 2024 journal impact factor (JIF) for *WJCO* as 3.0; JIF without journal self cites: 3.1; 5-year JIF: 3.2; JIF Rank: 129/326 in oncology; JIF Quartile: Q2; and 5-year JIF Quartile: Q2.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: *Yu-Qing Zhao*; Production Department Director: *Xiao-Mei Zheng*; Cover Editor: *Jin-Lei Wang*.

**NAME OF JOURNAL**

*World Journal of Clinical Oncology*

**ISSN**

ISSN 2218-4333 (online)

**LAUNCH DATE**

November 10, 2010

**FREQUENCY**

Monthly

**EDITORS-IN-CHIEF**

Hiten RH Patel

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/2218-4333/editorialboard.htm>

**PUBLICATION DATE**

December 24, 2025

**COPYRIGHT**

© 2025 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjgnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjgnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjgnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjgnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>

## Metabolic syndrome and colorectal cancer: Mechanisms, epidemiological evidence, and clinical implications

Fei Gao, Yan Jiao, He-Lei Wang

**Specialty type:** Oncology

**Provenance and peer review:**

Invited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's classification**

**Scientific Quality:** Grade A, Grade C

**Novelty:** Grade A, Grade D

**Creativity or Innovation:** Grade B, Grade C

**Scientific Significance:** Grade B, Grade C

**P-Reviewer:** Cortés-Rojo C, PhD, Professor, Mexico; Wang RT, PhD, China

**Received:** August 4, 2025

**Revised:** September 4, 2025

**Accepted:** November 14, 2025

**Published online:** December 24, 2025

**Processing time:** 144 Days and 1.7 Hours



**Fei Gao**, The Anesthesia Recovery Room, The First Hospital of Jilin University, Changchun 130021, Jilin Province, China

**Yan Jiao**, Center of General Surgery, Department of Hepatobiliary and Pancreatic Surgery, The First Hospital of Jilin University, Changchun 130021, Jilin Province, China

**He-Lei Wang**, Center of General Surgery, Department of Gastrointestinal Surgery, The First Hospital of Jilin University, Changchun 130021, Jilin Province, China

**Co-corresponding authors:** Yan Jiao and He-Lei Wang.

**Corresponding author:** He-Lei Wang, Center of General Surgery, Department of Gastrointestinal Surgery, The First Hospital of Jilin University, No. 1 Xinmin Street, Changchun 130021, Jilin Province, China. [helei@jlu.edu.cn](mailto:helei@jlu.edu.cn)

### Abstract

Metabolic syndrome (MetS), characterized by central obesity, insulin resistance, dyslipidemia, and hypertension, has been increasingly recognized as a significant contributor to the development and progression of colorectal cancer (CRC). This review comprehensively summarizes current evidence linking MetS to CRC risk and outcomes from mechanistic, epidemiological, and clinical perspectives. Mechanistic studies suggest that hyperinsulinemia, activation of the insulin-like growth factor axis, chronic systemic inflammation, and adipokine dysregulation create a tumor-promoting environment. Epidemiological data from large-scale cohort studies and meta-analyses consistently demonstrate a positive association between MetS and CRC incidence, with abdominal obesity and hyperglycemia identified as key components. Mendelian randomization studies further support a causal relationship between visceral adiposity and CRC risk. Clinically, MetS is associated with increased risk of recurrence and reduced overall and disease-free survival in CRC patients. Emerging evidence also indicates that persistent metabolic abnormalities may contribute to early-onset CRC. Interventions targeting metabolic health - including lifestyle modification and bariatric surgery - have shown potential in reducing CRC risk and improving outcomes. Despite these advances, heterogeneity in MetS definitions and a paucity of prospective interventional studies limit the generalizability of current findings. Further research is warranted to establish standardized diagnostic criteria, elucidate sex- and age-specific mechanisms, and integrate metabolic profiling into risk stratification frameworks for CRC prevention and management.

**Key Words:** Metabolic syndrome; Colorectal cancer; Insulin resistance; Chronic inflammation; Abdominal obesity; Hyperglycemia

©The Author(s) 2025. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** This comprehensive review highlights the emerging role of metabolic syndrome (MetS) as a critical modifiable risk factor in colorectal cancer (CRC) initiation, progression, and prognosis. It synthesizes mechanistic evidence involving insulin resistance, chronic inflammation, and adipokine dysregulation, and consolidates global epidemiological data linking MetS - especially abdominal obesity and hyperglycemia - to increased CRC incidence and mortality. The review also discusses the adverse impact of MetS on CRC outcomes, including recurrence and survival, and evaluates the potential of lifestyle and surgical interventions in mitigating these risks. This article underscores the importance of integrating metabolic health assessment into personalized CRC prevention and management strategies.

**Citation:** Gao F, Jiao Y, Wang HL. Metabolic syndrome and colorectal cancer: Mechanisms, epidemiological evidence, and clinical implications. *World J Clin Oncol* 2025; 16(12): 112639

**URL:** <https://www.wjgnet.com/2218-4333/full/v16/i12/112639.htm>

**DOI:** <https://dx.doi.org/10.5306/wjco.v16.i12.112639>

## INTRODUCTION

Colorectal cancer (CRC) remains one of the leading causes of cancer-related morbidity and mortality worldwide. The increasing prevalence of metabolic syndrome (MetS) has drawn significant attention due to its potential contribution to colorectal carcinogenesis. MetS is characterized by a combination of risk factors, including abdominal obesity, insulin resistance, hyperglycemia, hypertension, and dyslipidemia, which collectively lead to systemic inflammation and metabolic disturbances[1,2]. According to widely accepted criteria, the diagnosis of MetS is established when three or more of these five components are present. The growing global burden of both CRC and MetS highlights the urgent need to explore the intersection of these two conditions, especially given that MetS affects 25%-40% of adults in developed countries[1,2].

Epidemiological studies have increasingly pointed to MetS as a significant risk factor for CRC, with its components, especially abdominal obesity and hyperglycemia, being closely linked to CRC initiation and progression[3]. This review aims to examine the molecular mechanisms, epidemiological associations, and clinical implications of MetS in CRC, while addressing existing controversies and knowledge gaps in the current literature[1,4].

## MECHANISTIC INSIGHTS: LINKING METABOLIC DYSFUNCTION TO COLORECTAL TUMORIGENESIS

The mechanisms by which MetS contributes to CRC development are multifactorial, with insulin resistance, chronic inflammation, and altered lipid metabolism representing key mechanistic pathways, whereas abdominal obesity and hyperglycemia are the major clinical phenotypes most consistently linked to CRC risk. Insulin resistance, commonly seen in MetS, leads to elevated levels of insulin and activation of the insulin-like growth factor pathway, promoting cellular proliferation and inhibiting apoptosis[1,5]. Additionally, chronic low-grade inflammation is a hallmark of MetS and contributes to CRC through increased secretion of pro-inflammatory cytokines such as tumor necrosis factor- $\alpha$ , interleukin-6, and C-reactive protein, which enhance tumor growth and survival[1,5].

Furthermore, adipokine dysregulation, particularly the imbalance between elevated leptin and reduced adiponectin levels, plays a significant role in CRC development[1,6]. Elevated leptin can stimulate cellular proliferation, angiogenesis, and pro-inflammatory signaling, while reduced adiponectin diminishes anti-inflammatory and pro-apoptotic pathways, thereby synergistically fostering a pro-tumorigenic environment. Dysregulated lipid metabolism, commonly seen in MetS, has also been shown to promote CRC by altering cell membrane dynamics and generating oxidative stress[1,6]. These mechanisms collectively create a tumor-promoting environment that enhances the risk of CRC in individuals with MetS (Figure 1).

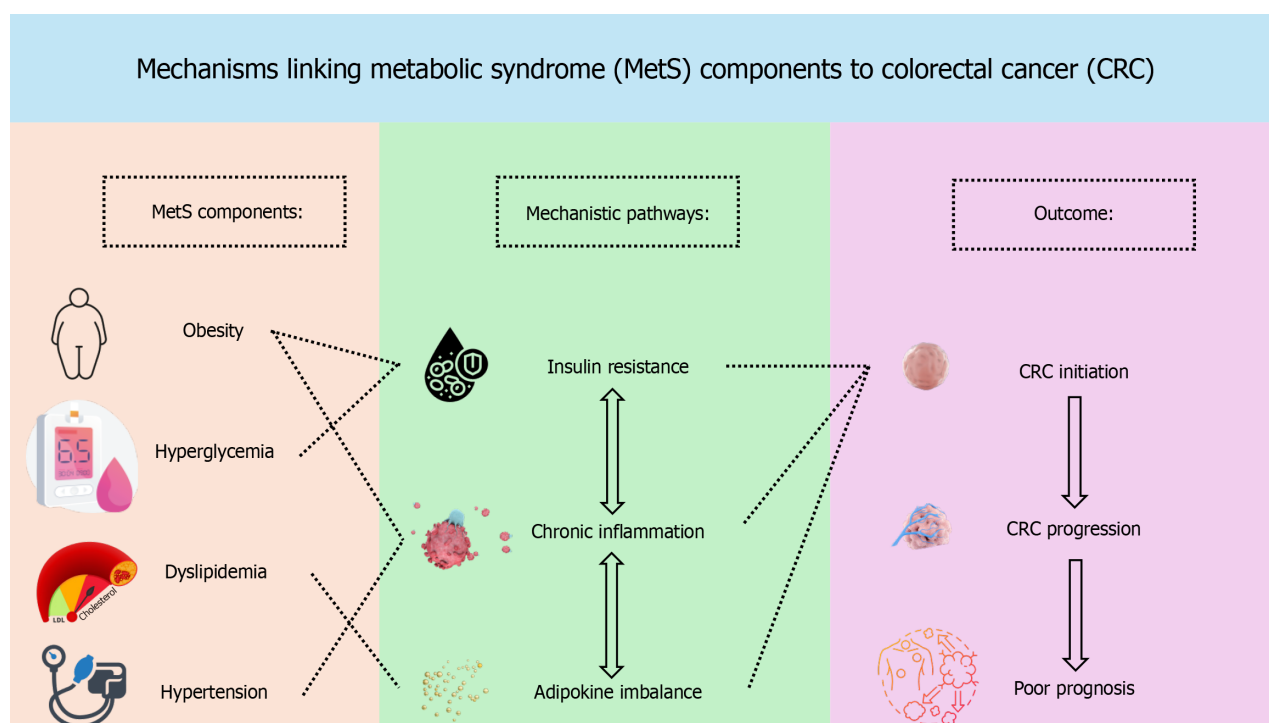
## EPIDEMIOLOGICAL ASSOCIATIONS: A CONSISTENT AND GLOBAL RISK PATTERN

Epidemiological data consistently show that MetS is a major risk factor for CRC (Table 1). Meta-analyses and large cohort studies have demonstrated that individuals with MetS have a 25%-70% increased risk of developing CRC compared to those without MetS, with risk rising proportionally to the number of MetS components present[7,8]. Among the components of MetS, abdominal obesity and hyperglycemia have emerged as the most influential factors in CRC risk,

**Table 1 Summary of key epidemiological studies evaluating the association between metabolic syndrome components and colorectal cancer risk**

Ref.	Year	Study design/population	MetS definition/components analyzed	Main findings on CRC risk
Han <i>et al</i> [2]	2021	Systematic review and meta-analysis (17 studies)	NCEP ATP III/multiple components	MetS associated with approximately 30% increased CRC incidence; abdominal obesity and hyperglycemia strongest drivers
Shen <i>et al</i> [4]	2021	Systematic review and meta-analysis (25 cohorts)	Mixed definitions	MetS increased CRC risk (RR approximately of 1.37); stronger effect in men; heterogeneity by region
Zhan <i>et al</i> [7]	2024	Meta-analysis (31 cohorts + MR)	Standardized criteria	MetS and abdominal obesity causally linked to CRC; hyperglycemia consistently associated
Wang <i>et al</i> [8]	2024	Prospective cohort, China (number approximately 100000)	Chinese criteria	MetS significantly increased CRC incidence; abdominal obesity main contributor
Yuan <i>et al</i> [9]	2024	Mendelian randomization	Genetic instruments for MetS	Causal effect of abdominal obesity on CRC risk confirmed
Stocks <i>et al</i> [13]	2008	Prospective cohort, Europe (number approximately 560000; men and women)	MetS components separately analyzed	Abdominal obesity and hyperglycemia increased CRC risk in both sexes; stronger in men
Bhome <i>et al</i> [14]	2021	Prospective cohort, United Kingdom ( <i>n</i> = 1006 CRC patients)	Clinical diagnosis of MetS	MetS predicted higher recurrence risk, especially liver-specific recurrence

MR: Mendelian randomization; CRC: Colorectal cancer; MetS: Metabolic syndrome; NCEP: National Cholesterol Education Program; ATP III: Adult Treatment Panel III; RR: Relative risk.



**Figure 1 Mechanisms linking metabolic syndrome components to colorectal cancer.** MetS: Metabolic syndrome; CRC: Colorectal cancer.

with several studies identifying visceral fat as a key contributor[3].

Despite methodological variations across studies, abdominal obesity and hyperglycemia consistently emerge as the strongest predictors of CRC risk in diverse populations, including Asian, European, and United States cohorts. For example, large cohort studies from Europe and the United States have reported similar associations between abdominal obesity and CRC risk, even though the definitions of MetS components and measurement techniques varied[2]. This consistency across different populations and study designs highlights the robustness of these risk factors and underscores the need for targeted prevention strategies.

Mendelian randomization studies have provided causal evidence supporting the role of abdominal obesity in increasing CRC risk, reinforcing the need to target abdominal fat in CRC prevention strategies[9,10]. Furthermore, early-onset CRC, which is becoming increasingly prevalent, is also associated with MetS, highlighting the importance of

addressing metabolic health in younger populations[11,12].

---

## PROGNOSTIC IMPLICATIONS: METS AND CLINICAL OUTCOMES IN CRC

---

In addition to increasing CRC risk, MetS has a significant impact on CRC prognosis. Studies have shown that MetS is associated with higher recurrence rates and poorer overall survival in CRC patients, particularly those with liver-specific recurrence after surgical resection[13]. The adverse effect of MetS on prognosis is independent of traditional oncological factors such as tumor stage and grade, underscoring the importance of managing metabolic dysfunction in CRC care[3].

For instance, several studies have shown that metformin, a commonly used medication for managing hyperglycemia in diabetic patients, improves survival outcomes in CRC patients with diabetes[14]. Specifically, metformin has been associated with reduced CRC recurrence and improved overall survival in patients with coexisting diabetes, suggesting its potential as an adjunctive treatment in MetS-related CRC management. Furthermore, weight reduction through bariatric surgery has been shown to significantly reduce the incidence of CRC in patients with severe obesity. Bariatric surgery, by improving metabolic health and reducing visceral fat, has led to favorable long-term outcomes in terms of both metabolic control and cancer prevention.

Lifestyle factors, such as obesity, smoking, and sedentary lifestyle and poor dietary patterns affecting glucose metabolism, are significant contributors to survival outcomes in MetS patients with CRC, suggesting that interventions targeting MetS components could improve long-term survival[3,14]. Furthermore, the integration of inflammatory markers, such as CRP, into MetS assessment may help identify high-risk individuals for CRC recurrence and poor prognosis[15].

---

## COMPONENT-SPECIFIC EFFECTS: THE CENTRAL ROLE OF OBESITY AND HYPERGLYCEMIA

---

Among the individual components of MetS, abdominal obesity and hyperglycemia consistently show the strongest associations with CRC risk. Numerous studies have found that abdominal obesity, measured by waist circumference or waist-to-hip ratio, is a robust predictor of CRC risk, with combined obesity and hyperglycemia marking the highest risk for CRC[16-18]. In addition, evidence from European cohorts has demonstrated that these associations are not limited to Asian male populations; for example, Stocks *et al*[16] reported that abdominal obesity and hyperglycemia significantly increased CRC risk in both men and women, although the effect sizes varied between sexes. This indicates that while men may experience higher absolute risks, abdominal obesity and hyperglycemia are also important determinants of CRC risk in women.

Other components of MetS, such as hypertension and dyslipidemia, have also been implicated in CRC risk, although their associations are less consistent across studies[6,8]. Studies suggest that the combination of obesity and hyperglycemia with hypertension and dyslipidemia significantly amplifies CRC risk, even though the individual effects of hypertension and dyslipidemia may be weaker. These interactions highlight the complex nature of MetS and its contribution to CRC risk, suggesting that multi-component MetS profiles, rather than individual components, are more strongly associated with poor prognosis and higher CRC incidence[7,17].

---

## CLINICAL AND PREVENTIVE IMPLICATIONS

---

The strong association between MetS and CRC highlights the need for incorporating metabolic health into CRC prevention strategies. Given the modifiable nature of MetS, interventions aimed at improving metabolic function, such as weight loss, increased physical activity, and dietary changes, are crucial in reducing CRC risk[14,19]. Pharmacological treatments, including metformin for glucose control and statins for dyslipidemia, may also contribute to reducing CRC risk and improving outcomes in MetS patients[14].

Bariatric surgery has also emerged as a promising intervention for MetS-related CRC prevention, particularly in individuals with severe obesity[20]. Given the rising incidence of both MetS and CRC, integrating metabolic health assessments into CRC screening protocols could significantly improve early detection and personalized treatment strategies[3].

---

## CONTROVERSIES AND KNOWLEDGE GAPS

---

Although growing evidence supports the association between MetS and CRC, important controversies and gaps remain. The lack of uniform diagnostic criteria for MetS leads to heterogeneity in prevalence estimates and complicates cross-study comparisons. Moreover, the potential influence of sex-specific and age-specific factors is insufficiently understood, as some studies suggest stronger associations in men and younger adults, yet results remain inconsistent. In addition, prospective interventional studies directly addressing whether control of MetS components reduces CRC risk or improves prognosis are scarce. Finally, the integration of metabolic and inflammatory profiling into CRC risk stratification frameworks is still in its early stages, requiring further validation.

## FUTURE DIRECTIONS

The association between MetS and CRC underscores the need for personalized approaches to prevention and treatment. Future research should focus on metabolic profiling and biomarker discovery to better understand the unique metabolic signatures that contribute to CRC development in MetS patients. These efforts could enable the identification of novel biomarkers for early detection, risk stratification, and treatment selection in CRC patients with metabolic abnormalities.

In addition, precision prevention approaches that tailor interventions based on an individual's metabolic profile, genetic background, and environmental factors could hold great promise in reducing CRC risk. Personalized treatment strategies, such as the use of pharmacological agents (e.g., metformin) or lifestyle interventions (e.g., bariatric surgery), could be optimized based on metabolic and genetic assessments, leading to more effective outcomes in patients with MetS.

Moreover, addressing sex-specific and age-specific mechanisms in MetS-related CRC is critical. Subgroup analyses, including those focused on early-onset CRC, could offer valuable insights into the differential impact of MetS components across different populations. Integrating multi-omics technologies, including genomics, proteomics, and metabolomics, could further refine personalized prevention and treatment strategies.

## CONCLUSION

MetS is a significant and modifiable risk factor for CRC, with compelling evidence linking its components, particularly abdominal obesity and hyperglycemia, to increased CRC risk and poorer clinical outcomes. Mechanistically, MetS promotes CRC development through insulin resistance, chronic inflammation, and adipokine imbalance. Epidemiological studies consistently show a higher risk of CRC in individuals with MetS, especially those with multiple metabolic disturbances. Clinically, MetS is associated with higher CRC recurrence rates and reduced survival, underscoring the importance of managing metabolic health in CRC prevention and treatment. Lifestyle interventions and pharmacological treatments targeting MetS components may help mitigate CRC risk and improve outcomes. Future research should focus on refining MetS definitions, identifying metabolic biomarkers for CRC prediction, and evaluating the effectiveness of interventions to reduce CRC risk in MetS patients.

## FOOTNOTES

**Author contributions:** Gao F wrote the initial draft, contributed to literature review; Jiao Y and Wang HL contributed to the study design; Jiao Y and Wang HL contributed equally to this manuscript and are co-corresponding authors. All authors approved the final version to be published.

**Conflict-of-interest statement:** All the authors report no relevant conflicts of interest for this article.

**Open Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

**Country of origin:** China

**ORCID number:** Yan Jiao 0000-0001-6914-7949; He-Lei Wang 0009-0008-1911-1954.

**S-Editor:** Zuo Q

**L-Editor:** A

**P-Editor:** Wang CH

## REFERENCES

- 1 **Mendonça FM**, de Sousa FR, Barbosa AL, Martins SC, Araújo RL, Soares R, Abreu C. Metabolic syndrome and risk of cancer: which link? *Metabolism* 2015; **64**: 182-189 [RCA] [PMID: 25456095 DOI: 10.1016/j.metabol.2014.10.008] [FullText]
- 2 **Han F**, Wu G, Zhang S, Zhang J, Zhao Y, Xu J. The association of Metabolic Syndrome and its Components with the Incidence and Survival of Colorectal Cancer: A Systematic Review and Meta-analysis. *Int J Biol Sci* 2021; **17**: 487-497 [RCA] [PMID: 33613107 DOI: 10.7150/ijbs.52452] [FullText] [Full Text(PDF)]
- 3 **Zhu C**, Mao C, Cai W, Zheng J, Yang H, You T, Chen J, Yu Y, Shen X, Li L. The effect of metabolic syndrome on postoperative complications and long-term survival of patients with colorectal cancer. *Front Oncol* 2023; **13**: 1036458 [RCA] [PMID: 37434983 DOI: 10.3389/fonc.2023.1036458] [FullText]
- 4 **Shen X**, Wang Y, Zhao R, Wan Q, Wu Y, Zhao L, Wu X. Metabolic syndrome and the risk of colorectal cancer: a systematic review and meta-analysis. *Int J Colorectal Dis* 2021; **36**: 2215-2225 [RCA] [PMID: 34331119 DOI: 10.1007/s00384-021-03974-y] [FullText]
- 5 **Colloca A**, Donisi I, Anastasio C, Balestrieri ML, D'Onofrio N. Metabolic Alteration Bridging the Prediabetic State and Colorectal Cancer.

- Cells* 2024; **13**: 663 [RCA] [PMID: 38667278 DOI: 10.3390/cells13080663] [FullText]
- 6 **Takayama T**, Sato Y, Muguruma N. Role of Alcohol and Metabolic Diseases in Colorectal Carcinogenesis. In: Yoshiji H, Kaji K, editors. *Alcoholic/Non-Alcoholic Digestive Diseases*. Singapore: Springer, 2019: 43-52 [DOI: 10.1007/978-981-13-1465-0\_5] [FullText]
  - 7 **Zhan ZQ**, Chen YZ, Huang ZM, Luo YH, Zeng JJ, Wang Y, Tan J, Chen YX, Fang JY. Metabolic syndrome, its components, and gastrointestinal cancer risk: a meta-analysis of 31 prospective cohorts and Mendelian randomization study. *J Gastroenterol Hepatol* 2024; **39**: 630-641 [RCA] [PMID: 38230882 DOI: 10.1111/jgh.16477] [FullText]
  - 8 **Wang Z**, Chen R, Zhang L, Chen Y, Li J, Li S, Xu L, Hu Y, Bai Y. Association between metabolic syndrome and the risk of colorectal cancer: a prospective study in China. *Eur J Cancer Prev* 2024; **33**: 347-354 [RCA] [PMID: 38375832 DOI: 10.1097/CEJ.0000000000000863] [FullText]
  - 9 **Yuan C**, Shu X, Hu Z, Jie Z. Genetic prediction of the relationship between metabolic syndrome and colorectal cancer risk: a Mendelian randomization study. *Diabetol Metab Syndr* 2024; **16**: 109 [RCA] [PMID: 38773583 DOI: 10.1186/s13098-024-01351-7] [FullText]
  - 10 **Chen Y**, Kong W, Liu M, Li Q, Wang Y, Zheng Y, Zhou Y. Metabolic syndrome and risk of colorectal cancer: A Mendelian randomization study. *Heliyon* 2024; **10**: e23872 [RCA] [PMID: 38223733 DOI: 10.1016/j.heliyon.2023.e23872] [FullText] [Full Text(PDF)]
  - 11 **Seki H**, Kaneko H, Yano Y, Itoh H, Morita K, Kiriyama H, Kamon T, Fujii K, Michihata N, Jo T, Takeda N, Morita H, Yasunaga H, Komuro I. Association between metabolic syndrome and incident colorectal cancer in young adults: analysis of a nationwide epidemiological database. *Eur Heart J* 2021; **42**: ehab724.3130 [RCA] [DOI: 10.1093/eurheartj/ehab724.3130] [FullText]
  - 12 **Jin EH**. Alteration of metabolic syndrome and the risk of colorectal cancer in individuals younger than 50 years. *J Clin Oncol* 2024; **42**: 81 [DOI: 10.1200/JCO.2024.42.3\_suppl.81] [FullText]
  - 13 **Bhorne R**, Peppia N, Karar S, McDonnell D, Mirmezami A, Hamady Z. Metabolic syndrome is a predictor of all site and liver-specific recurrence following primary resection of colorectal cancer: Prospective cohort study of 1006 patients. *Eur J Surg Oncol* 2021; **47**: 1623-1628 [RCA] [PMID: 33483238 DOI: 10.1016/j.ejso.2020.12.016] [FullText]
  - 14 **Jeon JY**, Meyerhardt JA. Can we change the past for colorectal cancer patients and how do we move forward? *Cancer* 2014; **120**: 1450-1452 [RCA] [PMID: 24591002 DOI: 10.1002/cncr.28567] [FullText]
  - 15 **Liu T**, Fan Y, Zhang Q, Wang Y, Yao N, Song M, Zhang Q, Cao L, Song C, Shi H. The combination of metabolic syndrome and inflammation increased the risk of colorectal cancer. *Inflamm Res* 2022; **71**: 899-909 [RCA] [PMID: 35715516 DOI: 10.1007/s00011-022-01597-9] [FullText] [Full Text(PDF)]
  - 16 **Stocks T**, Lukanova A, Johansson M, Rinaldi S, Palmqvist R, Hallmans G, Kaaks R, Stattin P. Components of the metabolic syndrome and colorectal cancer risk; a prospective study. *Int J Obes (Lond)* 2008; **32**: 304-314 [RCA] [PMID: 17878894 DOI: 10.1038/sj.ijo.0803713] [FullText]
  - 17 **Li X**, Chen H, Gang W, Feng X, Lyu Z, Wei L, Wen Y, Chen S, Wu S, Dai M, Li N, He J. IDDF2019-ABS-0179 The association between components of metabolic syndrome and colorectal cancer risk in chinese males. *Gut* 2019; **68**: A17-A18 [DOI: 10.1136/gutjnl-2019-IDDFabstracts.33] [FullText]
  - 18 **Li X**, Chen H, Wang G, Feng X, Lyu Z, Wei L, Wen Y, Chen S, Wu S, Hang D, Dai M, Li N, He J. Metabolic Syndrome Components and the Risk of Colorectal Cancer: A Population-Based Prospective Study in Chinese Men. *Front Oncol* 2019; **9**: 1047 [RCA] [PMID: 31681585 DOI: 10.3389/fonc.2019.01047] [FullText] [Full Text(PDF)]
  - 19 **Deng L**, Liu T, Liu CA, Zhang Q, Song MM, Lin SQ, Wang YM, Zhang QS, Shi HP. The association of metabolic syndrome score trajectory patterns with risk of all cancer types. *Cancer* 2024; **130**: 2150-2159 [RCA] [PMID: 38462898 DOI: 10.1002/cncr.35235] [FullText]
  - 20 **Wu PN**, Liu JL, Fang MJ, Fu XS, Wei JL, Wang Y, Qian HH, Zhang D. Global trends in colorectal cancer and metabolic syndrome research: a bibliometric and visualization analysis. *Int J Surg* 2024; **110**: 3723-3733 [RCA] [PMID: 38498393 DOI: 10.1097/JS9.0000000000001342] [FullText] [Full Text(PDF)]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
**Telephone:** +1-925-3991568  
**E-mail:** [office@baishideng.com](mailto:office@baishideng.com)  
**Help Desk:** <https://www.f6publishing.com/helpdesk>  
<https://www.wjgnet.com>

