



Oxidative balance scores and colorectal cancer; a systematic review and meta-analysis

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Abstract

Introduction: Colorectal cancer (CRC) is the third most common carcinoma around the world, and oxidative stress may play a role in the occurrence of colorectal cancer. Accordingly, the purpose of the present study was to investigate the association between oxidative balance score (OBS) and the risk of CRC occurrence.

Materials and Methods: In this systematic review and meta-analysis article, databases Scopus, PubMed, Web of Science, Cochrane, Embase, and Google Scholar Search Engine were conducted for articles published until November 1, 2025. Data was analyzed using STATA 14.

Results: A total of 9 observational studies were examined, and the results revealed that high OBS levels reduced the risk of CRC and colorectal adenoma by 17% and 34%, respectively. Furthermore, high OBS levels in the US (29%), UK (24%), China (6%), case-control studies (9%), and cohort studies (25%) reduced the risk of CRC. Additionally, increased OBS levels in men (32%) and women (22%) reduced the risk of CRC, and high dietary oxidative balance scores (DOBS) and lifestyle oxidative balance scores (LOBS) levels decreased the risk of CRC by up to 23% and 24%, respectively.

Conclusion: High OBS levels significantly lowered the risk of CRC occurrence, and high OBS levels in men were more likely to prevent CRC compared with women. Additionally, the difference between the effect of DOBS and LOBS on reducing the risk of CRC was insignificant.

Registration: This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO (ID: [CRD420251230751](https://doi.org/10.34172/ipp.2026.44019)) and Research Registry (UIN: [reviewregistry2061](https://doi.org/10.34172/ipp.2026.44019)) websites.

Introduction

Colorectal cancer (CRC) is the third leading cause of cancer death in the world (1). As in 2020, more than 1.9 million cases of CRC and 935 thousand cases of mortality due to CRC (2), and in 2022, a total of 1.926.118 cases of CRC were reported around the world (1). According to estimates, approximately 1.6 million deaths caused by CRC will be reported by 2040 (3).

Oxidative stress refers to an imbalance between pro-oxidants and antioxidants in favor of pro-oxidants (4,5). Lifestyle, diet, and environmental factors can lead to oxidative stress, consequently increasing reactive oxygen species (ROS), and contribute to cancer progression (6). Furthermore, oxidative stress may play a critical role in the etiology of CRC. The oxidative balance score (OBS) reflects the balance of exposure to pro-oxidants and antioxidants (7). Higher OBS levels increase antioxidant capacities, and lower OBS levels mean higher pro-oxidant values (8-10).

The current study aimed to examine the relationship between OBS and the risk of CRC

occurrence. As published articles reported inconsistent results. For instance, some studies (11,12) indicated that high OBS levels lowered the risk of CRC. In comparison, another study (13) demonstrated that the reduction in CRC risk caused by the second one-third OBS was not significantly different from the CRC reduction reported in the first one-third. Moreover, a previous study (14) indicated that the second and third OBS quartiles had no significant effect in lowering the risk of CRC occurrence compared with the first quartile (Q1). The present study was carried out using the systematic review and meta-analysis methods to address inconsistencies reported in previous studies.

Materials and Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was conducted to design the present article (15), and its protocol was registered at the websites PROSPERO (International Prospective Register of Systematic Reviews) and Research Registry.

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Key point

Findings of the present study demonstrated that high oxidative balance score (OBS) (17%), dietary oxidative balance scores (DOBS) (23%), and lifestyle oxidative balance scores (LOBS) (24%) reduced the risk of colorectal cancer (CRC). Furthermore, higher OBS levels, compared with lower levels in men (32%) and women (22%), decreased the risk of CRC.

Search strategy

The databases Cochrane, Embase, PubMed, Web of Science, Scopus, and Google Scholar search engine were used to search for articles published by November 1, 2025, without any language or publication time restrictions. The Medical Subject Headings (MeSH) and their equivalents were employed during the searching process. Boolean Operators (AND, OR) were used to combine the keywords. Manual search was also conducted independently (Supplementary file 1).

PECO framework

- Population: Articles designed with the purpose of investigating the effect of OBS on the risk of CRC.
- Exposure: High OBS.
- Comparison: People who had low OBS.
- Outcomes: Risk of CRC.

Inclusion criteria

Articles designed to examine the effect of OBS on the risk of CRC.

Exclusion criteria

Abstracts without accessible full text, systematic reviews, studies with low qualitative score, duplicate studies, reviews, meta-analysis, and those that did not provide our required data were excluded.

Quality assessment

The quality of studies was considered using the Newcastle-Ottawa scale. This tool assigns a maximum of one star to each question, except for the comparative question. Therefore, a score of zero indicated the lowest quality, and a score of ten showed the highest quality. Then, studies with scores lower than five were considered low-quality (16).

Data extraction

Two researchers extracted data, including number of samples, OBS level, country, year, author's name, type of study, and type of cancer. Then, the third researcher addressed the discrepancies.

Statistical analysis

The logarithm of relative risk (RR), odds ratio (OR) and hazard ratio (HR) were utilized. Then, the analysis of all studies were combined. The I^2 index was used to examine

the heterogeneity between studies. A randomized effects model was employed to combine the studies. Subgroup analysis was used to investigate the causes of heterogeneity. Data analysis was conducted using STATA 14 software. Tests with P values < 0.05 were considered statistically significant.

Results

A search of the databases and Google Scholar identified 136 articles, of which 53 were duplicate that were subsequently removed. The abstracts were reviewed, and 6 studies without accessible full texts were removed. Out of the 77 remaining articles, 18 lacked the required data for analysis and were excluded. Among the 59 articles that proceeded to the next step, 50 studies were removed due to other exclusion criteria, and 9 articles remained (Figure 1).

Table 1 presents a portion of the information obtained from the nine examined observational studies.

The current meta-analysis investigated five case-control and four cohort studies, four of which were conducted on patients with colorectal adenoma. The findings obtained from combining the mentioned studies revealed that high OBS levels reduced the risk of CRC occurrence by 17% (Figure 2).

High OBS levels in the countries USA (29%), UK (24%), China (6%), case-control studies (9%), and cohort studies (25%) lowered the risk of CRC. In addition, high OBS levels reduced the risk of colorectal adenoma and colorectal carcinoma by 34% and 15%, respectively. However, findings revealed that higher OBS levels did not enhance the decreasing effect on the risk of CRC (Table 2).

High OBS levels in men (32%) and women (22%) lowered the risk of CRC. Accordingly, the preventive effect of high OBS levels on CRC risk was greater in men than in women (Figures 3 and 4).

High dietary oxidative balance scores (DOBS) and high lifestyle oxidative balance scores (LOBS) prevented the risk of CRC occurrence by up to 23% and 24%, respectively. Furthermore, the difference between the effect of DOBS and LOBS on reducing the risk of CRC was insignificant (Figures 5 and 6).

Discussion

Based on the findings of the present study, high OBS levels reduced the risk of CRC, and the preventive effect was more significant in men than in women. Additionally, no significant difference was observed between the effects of DOBS and LOBS on decreasing the risk of CRC occurrence.

According to a case-control study by Lin et al, high OBS levels were associated with a lower risk of CRC occurrence. As the highest OBS quartile significantly reduced the risk of CRC compared with the lowest quartile (OR: 0.42, 95% CI: 0.35, 0.50) (11). Similarly, the results obtained in the present study by combining case-control studies using a random effects model indicated that increased OBS levels

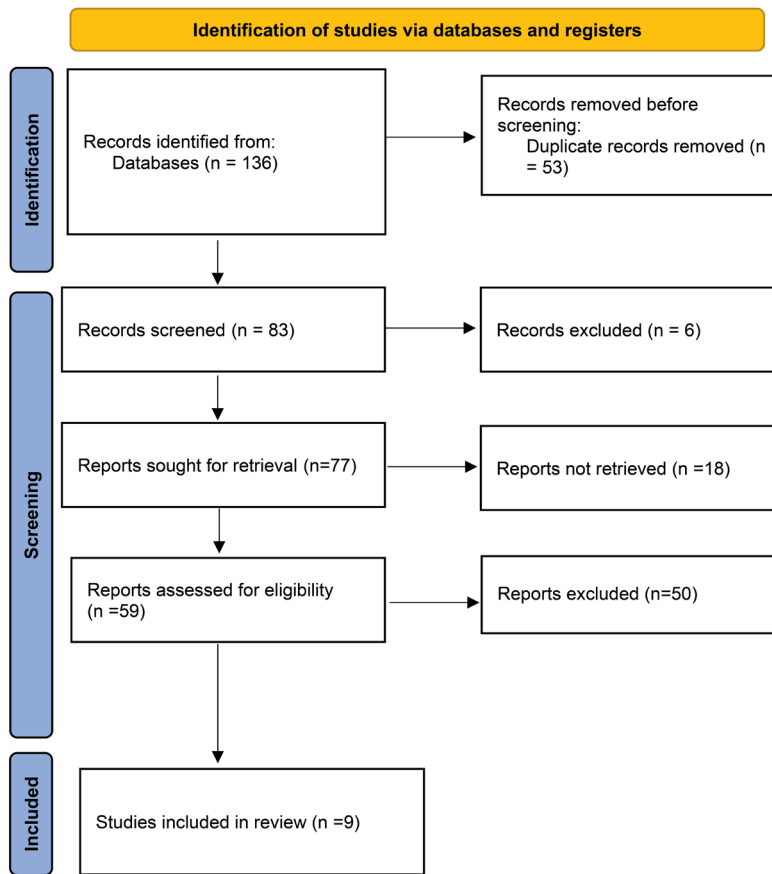


Figure 1. The PRISMA flowchart of study selection.

Table 1. Summarized information of the studies

Author, year	Country	Type of study	Duration of study	Type of cancer	Stage
Lin F, 2025 (11)	China	Case-control	In July 2010	Colorectal carcinoma	Quartile2
					Quartile3
					Quartile4
Chang Y, 2024 (12)	UK	Cohort	from 2006 to 2010	Colorectal carcinoma	Quartile2
					Quartile3
					Quartile4
Gu H, 2023 (17)	USA	Cohort	from 1993 to 2001	Colorectal carcinoma	Quintile 2
					Quintile 3
					Quintile 4
					Quintile 5
					Quintile 2
Mao Z, 2021 (14)	USA	Cohort	1986-2012	Colorectal carcinoma	Quintile 3
					Quintile 4
					Quintile 5
					Quartile2
					Quartile3
Dash C, 2015 (18)	USA	Cohort	1999–2009	Colorectal carcinoma	Quartile4
					Quartile3
Kong SY, 2014 (19)	USA	Case-control	NR	Colorectal Adenoma	Total
Dash C, 2013 (20)	USA	Case-control	1991–2002	Colorectal Adenoma	Tertile 2
					Tertile 3
Goodman M, 2010 (13)	USA	Case-control	NR	Colorectal Adenoma	Tertile 2
					Tertile 3
Goodman M, 2008 (21)	USA	Case-control	between Apr 1, 1991 and Apr 1, 1994	Colorectal Adenoma	Total

NR: Not reported.

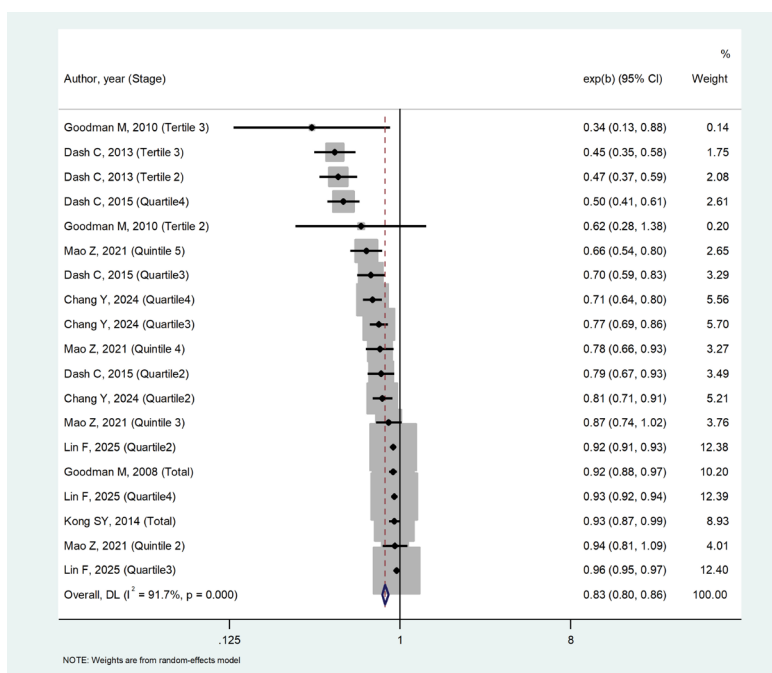


Figure 2. Forest plot showing the association between oxidative balance score and risk of CRC.

were associated with reduced CRC risks.

In a cohort study by Chang et al, increased OBS levels showed a significant association with lower CRC occurrence risks (HR: 0.97, 95% CI: 0.96, 0.98) (12). Similarly, combining the findings of cohort studies in the present research revealed that compared with lower OBS levels, high OBS levels significantly reduced the risk of CRC.

A cohort study by Gu et al reported an inverse relationship between OBS levels and the risk of CRC in women (HR: 0.72, 95% CI: 0.52, 0.99); however, this relationship was not observed among men (17). Similarly, in our study, high OBS levels reduced the risk of CRC both in men and women. Accordingly, our results regarding

women were consistent with the aforementioned research. However, regarding men, our findings were not consistent with the previous study. This discrepancy may be related to differences in sample size and study design.

In a cohort study by Mao et al conducted among women, aiming to examine the association between DOBS and LOBS and the risk of CRC occurrence, the results revealed that the highest OBS level compared with the lowest OBS level indicated an inverse relationship with the risk of CRC (HR: 0.66, 95%CI: 0.54, 0.80). Additionally, the highest DOBS (HR: 0.77, 95% CI: 0.63, 0.9) and LOBS (HR: 0.61, 95% CI: 0.52, 0.71) levels, compared with their lowest levels, were associated with reduced CRC risk (14). The aforementioned study supports the present study's

Table 2. Subgroup analysis by country, type of cancer, type of study, and stage

Subgroups		Odds ratio (95% CI)	P value	I ² (%)
Country	USA	0.71 (0.63, 0.80)	<0.001	89.5
	UK	0.76 (0.71, 0.82)	0.339	7.6
	China	0.94 (0.91, 0.96)	<0.001	94
Type of cancer	Colorectal adenoma	0.66 (0.54, 0.82)	<0.001	92.5
	Colorectal carcinoma	0.85 (0.82, 0.88)	<0.001	91.6
Type of study	Case-control	0.91 (0.87, 0.94)	<0.001	92.5
	Cohort	0.75 (0.69, 0.82)	<0.001	72.9
Stage	Tertile 2	0.48 (0.39, 0.60)	0.513	0
	Tertile 3	0.44 (0.35, 0.56)	0.579	0
	Quartile 2	0.85 (0.76, 0.96)	0.020	74.5
	Quartile 3	0.81 (0.66, 1.00)	<0.001	92.8
	Quartile 4	0.70 (0.51, 0.96)	<0.001	96.5
	Quintile 2	0.94 (0.81, 1.09)	---	100
	Quintile 3	0.87 (0.74, 1.02)	---	0
	Quintile 4	0.78 (0.66, 0.93)	---	100
	Quintile 5	0.66 (0.54, 0.80)	---	0

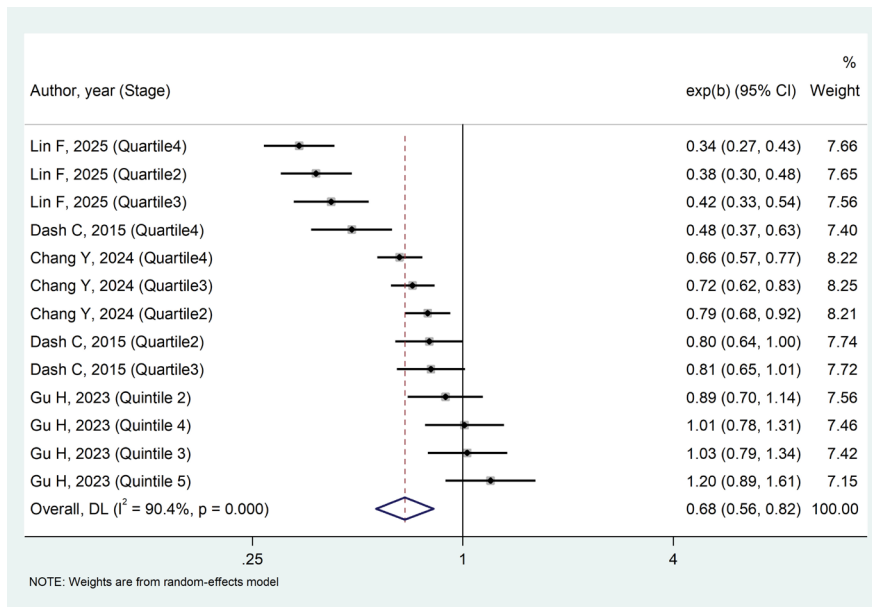


Figure 3. Forest plot showing the association between oxidative balance score and risk of CRC in males.

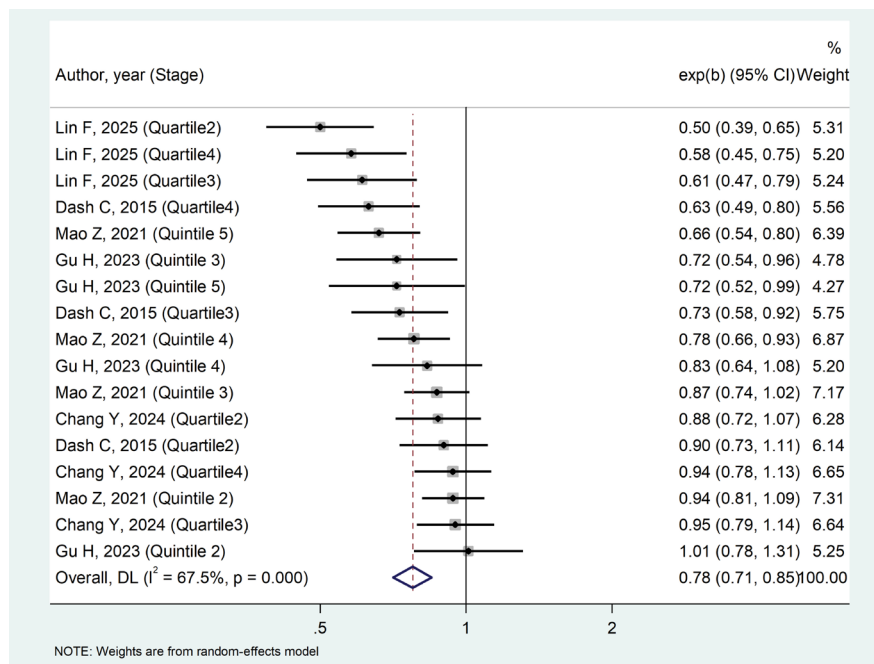


Figure 4. Forest plot showing the association between oxidative balance score and risk of CRC in females.

findings, as our results demonstrated that high DOBS and LOBS levels reduced the risk of CRC occurrence to a great extent.

In a cross-sectional study by Li et al, high DOBS (OR: 1.56, 95% CI: 0.84, 2.91) and LOBS (OR: 1.57, 95% CI: 0.91, 2.71) levels, compared with their low levels, indicated no significant relationship with the risk of prostate cancer (22). The findings of a cohort study by Agalliu et al demonstrated that high OBS levels compared with low levels had no effect in reducing the risk of prostate cancer (HR: 1.00, 95% CI: 0.99, 1.01) (23). The results of the

mentioned studies were inconsistent with those of the present study. However, the type of cancer investigated in these studies was not identical to that in our study, which may explain the inconsistency of the results.

Meanwhile, Yan et al in a cross-sectional study reported that OBS level had an inverse relationship with cancer in women (OR: 0.98, 95% CI: 0.97, 0.99), especially ovarian (OR: 0.95, 95% CI: 0.91, 0.99) and cervical (OR: 0.97, 95% CI: 0.95, 0.99) cancers (24). Kim et al, in their case-control study, examined the association between OBS level and the risk of stomach cancer and concluded that higher OBS

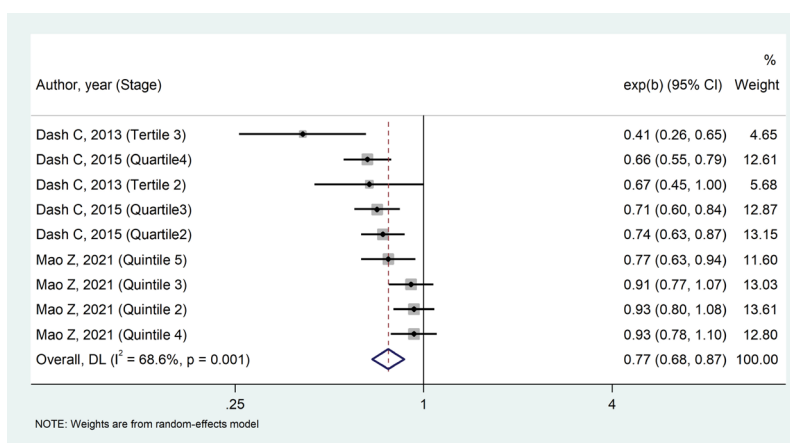


Figure 5. Forest plot showing the association between dietary oxidative balance scores and risk of CRC

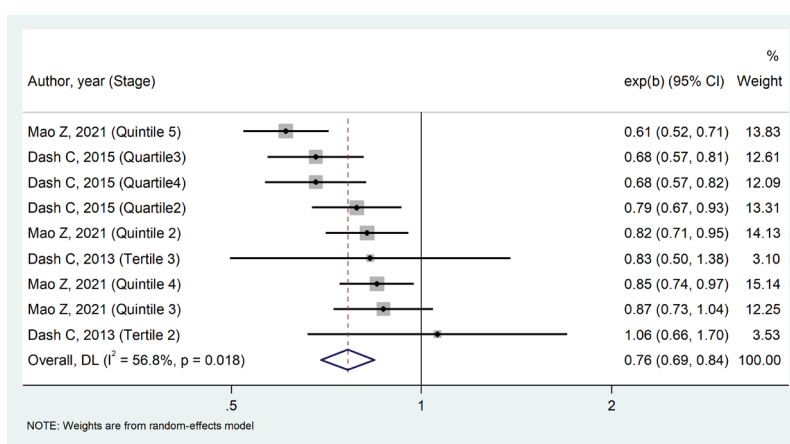


Figure 6. Forest plot showing the association between lifestyle oxidative balance scores and risk of CRC

levels were associated with reduced risk of stomach cancer (OR: 0.49, 95% CI: 0.33, 0.71) (25). These studies were consistent with the findings of the present study. As in our study, high OBS levels conferred a significant protective effect against cancer.

Conclusion

The findings of the present study demonstrated that high OBS (17%), DOBS (23%), and LOBS (24%) levels reduced the risk of CRC. High OBS levels in the USA (29%), UK (24%), China (6%), as well as in case-control studies (9%), and cohort studies (25%) were associated with a lower risk of CRC. Furthermore, higher OBS levels, compared with lower levels in men (32%) and women (22%), decreased the risk of CRC. Accordingly, increased OBS levels may reduce the risk of CRC.

Limitations of the study

It was not possible to assess the results based on the patients' sex. The studies were not identical regarding the study location and the grouping of the OBS level.

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Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

This study was conducted based on the PRISMA checklist, and its protocol was registered on the PROSPERO (ID: [CRD420251230751](#)) and Research Registry (Unique Identifying Number (UIN) [reviewregistry2061](#)) websites. Besides, ethical issues (including plagiarism, data fabrication, double publication) were completely observed by the authors.

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Supplementary files

Supplementary file 1. Search strategy in databases.

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