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THE RELATIONSHIP BETWEEN INFLAMMATORY BOWEL DISEASE, CARDIOVASCULAR RISK FACTORS, AND OUTCOMES: AN UMBRELLA REVIEW

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ABSTRACT

Background: Inflammatory bowel disease (IBD) affects nearly 5 million individuals worldwide, with increasing incidence and prevalence over the past few decades. Emerging evidence suggests an association between IBD, and cardiovascular diseases (CVD), potentially due to shared inflammatory pathways and immune-mediated mechanisms. However, existing systematic reviews and meta-analyses investigating this association have yielded inconsistent results. We conducted an umbrella review to systematically assess and synthesize the available evidence on the relationship between IBD and cardiovascular factors. **Methods:** We adhered to the PRISMA Statement 2020 guidelines and performed a comprehensive literature search in PubMed, Web of Science, and Scopus. We included systematic reviews and meta-analyses published in peer-reviewed journals that investigated the association between IBD, cardiovascular risk factors, and CVD. Data extraction was performed using a standardized form, and we conducted a narrative synthesis of the included studies, focusing on the associations between IBD, cardiovascular risk factors and outcomes. **Results:** Our search identified nine studies, which reported an increased risk of adverse cardiovascular outcomes, including myocardial infarction, stroke, heart failure, and thrombotic events among IBD patients compared to non-IBD controls. IBD patients demonstrated increased arterial stiffness and endothelial dysfunction. However, the primary studies within these reviews were mainly observational. The JBI appraisal scores of the included studies ranged from 4 to 9; the majority of the included studies had high or moderate JBI Appraisal Scores, suggesting that the overall quality of the evidence was relatively good. The findings from these studies were more likely to be reliable and can be used to inform evidence-based decision-making in healthcare. However, the lower-quality study (score: 4) should be carefully considered and corroborated with additional research before drawing any strong conclusions. **Conclusion:** This umbrella review provides strong evidence for an association between IBD and increased cardiovascular risk/associated CVD outcomes. Further research is needed to elucidate the underlying mechanisms, identify potential risk factors, and develop effective prevention and management strategies for IBD patients. Future studies should investigate the role of IBD treatments, disease duration, and severity on cardiovascular outcomes, as well as explore the potential interactions between IBD and other cardiovascular risk factors.

KEYWORDS: Inflammatory bowel disease; Cardiovascular factors; Umbrella review; Crohn's disease; Ulcerative colitis; Cardiovascular risk; Thrombotic events; Inflammation.

INTRODUCTION

Inflammatory bowel disease (IBD), a chronic inflammatory condition of the gastrointestinal tract, encompasses two main subtypes: Crohn's disease (CD) and ulcerative colitis (UC).[1] IBD affects nearly 5 million individuals worldwide as of 2019[2] and is associated with a significant burden on patients' quality of life, healthcare systems, and society at large. The exact etiology of IBD remains unclear, but it is believed to result from a complex interplay between genetic, environmental, immunological, and microbial factors.[3] The crude incidence of IBD has shown a consistent increase over the past three decades. Specifically, from 1980-1989, the mean incidence was 0.36 per 100,000 person-years, which increased to 0.48 per 100,000 person-years from 1990-1999, and further to 0.63 per 100,000 person-years from 2000-2009.[4] In the most recent period of 2010-2018, the mean crude incidence has doubled to 1.46 per 100,000 person-years.[4] These trends suggest that over the past few decades, the incidence and prevalence of IBD have been increasing in both developed and developing countries, making it a major public health concern.

Emerging evidence suggests that IBD may be associated with an increased risk of cardiovascular diseases (CVD), which are among the leading causes of morbidity and nearly 18 million deaths annually across the world.[5] The potential link between IBD and CVD can be partly explained by the shared inflammatory pathways and immune-mediated mechanisms involved in the pathogenesis of both conditions.[6] Moreover, chronic inflammation in IBD patients may contribute to endothelial dysfunction, atherosclerosis, and arterial stiffening, which are established risk factors for CVD.[7] Additionally, IBD patients often exhibit altered gut microbiota and increased intestinal permeability, which can result in systemic inflammation and metabolic dysregulation, further increasing the risk of CVD.[8]

Several systematic reviews and meta-analyses have been conducted to investigate the association between IBD and various cardiovascular outcomes, such as myocardial infarction, stroke, heart failure, and thrombotic events. However, the results of these studies have been inconsistent, with some reporting a significant association between IBD and increased cardiovascular risk, while others finding no or modest associations. These discrepancies may be attributed to differences in study designs, populations, exposure definitions, and outcome measures.

Given the rising prevalence of IBD and the significant burden of CVD on global health, there is a need to synthesize and summarize the existing evidence on the relationship between IBD and cardiovascular factors. An umbrella review, which is a systematic review of systematic reviews and meta-analyses, can provide a comprehensive and critical appraisal of the current knowledge on this topic. By integrating the findings of multiple systematic reviews and meta-analyses, this review will offer a broader perspective on the associations between IBD, cardiovascular risk factors and cardiovascular outcomes, as well as the potential mechanisms underlying these associations.

This umbrella review aims to systematically assess and synthesize the available evidence on the relationship between IBD and cardiovascular factors, focusing on the associations between IBD and the risk of developing cardiovascular diseases, thrombotic events, and related morbidity and mortality. This review will discuss the methodological quality of the included studies and the implications of the findings for future research in this area.

METHODS

In this comprehensive umbrella review, we adhered to the 2020 PRISMA Statement guidelines[9], aiming to consolidate and summarize existing evidence on the relationship between inflammatory bowel disease (IBD) and cardiovascular factors and outcomes. Our research question centered on the association between IBD and the risk of developing cardiovascular diseases, thrombotic events, and related morbidity and mortality.

We conducted an extensive literature search up to April 25, 2023, in the following electronic databases: PubMed, Web of Science, and Scopus. Our search strategy employed the keywords "Inflammatory bowel disease," "Cardiovascular," and "Systematic review OR Meta-analysis." We included systematic reviews and meta-analyses published in peer-reviewed journals that explored the association between IBD and cardiovascular factors.

Two independent reviewers screened titles and abstracts of the identified articles, assessing the full-text versions of potentially eligible studies for inclusion. Disagreements were resolved through discussion or consultation with a third reviewer when needed. We included studies that fulfilled the following eligibility criteria: (1) systematic review or meta-analysis on the association between IBD and cardiovascular factors; (2) data reported on IBD participants, including Crohn's disease (CD) and ulcerative colitis (UC); (3) information on cardiovascular outcomes of interest, such as myocardial infarction, stroke, heart failure, and thrombotic events; and (4) quality assessment of included primary studies using a validated appraisal tool, like the Joanna Briggs Institute (JBI) Appraisal Score.

We excluded narrative reviews, case reports, case series, editorials, commentaries, or conference abstracts and studies lacking sufficient information on primary studies, participants, interventions or exposures, comparators or controls, outcomes, findings, or appraisal scores.

Two independent reviewers extracted data using a standardized form, including Sr. No., author, year,

number of primary studies included, type of review, included sample characteristics, participants, intervention(s)/exposure(s), comparator(s)/control(s), outcome(s), findings, and JBI appraisal score.

We carried out a narrative synthesis of the included systematic reviews and meta-analyses in this umbrella review. Due to the heterogeneity of the studies in terms of population, exposure, and outcome measures, we did not perform inferential statistics or meta-analysis. Instead, we focused on summarizing the main findings and conclusions, the associations between IBD and various cardiovascular factors, and the potential mechanisms underlying these associations. We also assessed the methodological quality of the included studies using their reported JBI Appraisal Scores and discussed the implications of the findings for clinical practice and future research.[10]

RESULTS

Of the 337 studies identified from the databases, 51 duplicates were removed; 286 records were screened for title/abstract, of which 35 full-text studies were assessed for eligibility. Of these, a total of 9 studies were included in the umbrella review with 26 removed against the exclusion criteria. The PRISMA flowchart is depicted in Figure 1. The characteristics of included studies, sample characteristics and key findings are listed in Tables 1-2.

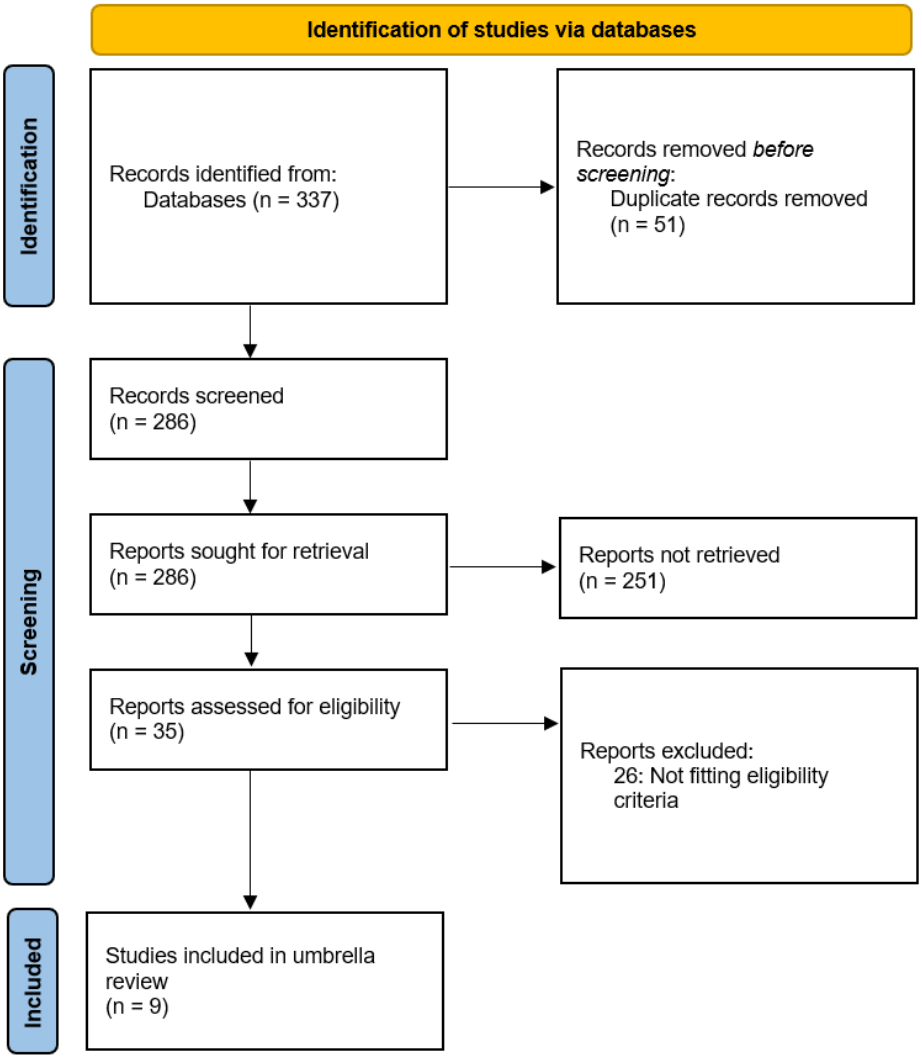

Figure 1: PRISMA flowchart depicting the study selection/inclusion process.

D'Ascenzo et al. (2023) published a meta-analysis including eight primary studies.[11] The sample consisted of 515,455 controls and 77,140 IBD patients, including 34.8% Crohn's disease (CD) and 65.2% ulcerative colitis (UC) patients. The study compared IBD patients to controls and found an increased risk of myocardial infarction (MI), death, and stroke in CD and UC patients after a 5-year follow-up. The JBI Appraisal Score for this study was 9.

Jaiswal et al. (2023) conducted a systematic review in Medicine (Baltimore) that included 16 primary studies.[12] The sample comprised 2,029,941 patients, with a mean age of 45.6 years. The study evaluated the association between IBD and adverse cardiovascular risk

factors/outcomes and mortality, finding increased rates of MI, CVD events, heart failure, and stroke among IBD patients. The JBI Appraisal Score for this study was 9.

Wu et al. (2022) published a systematic review and meta-analysis incorporating 41 primary studies.[13] The sample included 2,330 IBD patients and 2,032 matched controls. The study investigated the association between IBD and endothelial dysfunction and arterial stiffness. Findings were significantly increased carotid intima-media thickness test (cIMT), carotid-femoral pulse wave velocity, and augmentation index in IBD patients. The JBI Appraisal Score for this study was 8.

Patel et al. (2021) conducted a systematic review, including 39 primary studies. The sample consisted of 36 patients with IBD.[14] The study examined the cardiovascular and extraintestinal manifestations of IBD, finding pericarditis complications related to drug therapy and recommending drug cessation or a corticosteroid regimen for management. The JBI Appraisal Score for this study was 4.

Sun et al. (2018) did a meta-analysis including 27 primary studies.[15] The study assessed the association between IBD and cardiovascular disease incidence and mortality. Pooled relative risks were found for cerebrovascular disease, coronary heart disease, and myocardial infarction, with CD patients having higher standardized mortality ratios than UC patients. The JBI Appraisal Score for this study was 8.

Feng et al. (2017) conducted a meta-analysis, including ten primary studies.[16] The sample comprised 105,583 IBD patients and 871,902 controls. The study evaluated the risk of ischemic heart disease in IBD patients compared to non-IBD controls, finding an increased risk for both CD and UC patients. The JBI Appraisal Score for this study was 7.

Zanoli et al. (2017) published a meta-analysis which included 4 primary studies.[17] The sample consisted of 151 UC patients, 159 CD patients, and 227 controls. The study examined the association between IBD and arterial stiffness, measured by pulse wave velocity, finding increased arterial pulse wave velocity (aPWV) in CD and UC patients compared to controls. The JBI Appraisal Score for this study was 8.

Fumery et al. (2014) conducted a meta-analysis including 33 individual studies.[18] The sample included 207,814 IBD patients and 5,774,898 controls. The study assessed the risk of thrombotic events and cardiovascular disease in IBD patients compared to controls, finding an increased risk of venous thromboembolism (VTE), deep venous thrombosis, pulmonary embolism, ischemic heart disease, and mesenteric ischemia in IBD patients. However, there was no increased risk of arterial thromboembolism. The JBI Appraisal Score for this study was 7.

Singh et al. (2014) included nine primary studies in a meta-analysis.[19] The study investigated the risk of cardiovascular morbidity, including cerebrovascular accidents (CVA), ischemic heart disease (IHD), and peripheral arterial thromboembolic events in IBD patients compared to non-IBD controls. The study found a modest increase in the risk of CVA in IBD patients, particularly in women and young patients, and a 19% increased risk of IHD. However, there was no increased risk of peripheral arterial thromboembolic events. The JBI Appraisal Score for this study was 9.

Table 1: Characteristics of the Included Studies (N=9). Abbreviations- IBD - Inflammatory bowel disease; CD - Crohn's disease; UC - Ulcerative colitis; MI - Myocardial infarction; NS - Not specified; HR - Hazard ratio; CI - Confidence interval; IHD - Ischemic heart disease; RR - Relative risk; OR - Odds ratio; SMR - Standardized mortality ratio; CVA - Cerebrovascular accident.

No.	Author, Year	Title	Participants	Intervention(s)/Exposure(s)	Comparator(s)/Control(s)	Outcome(s)	JBI Appraisal Score
1	D'Ascenzo, 2023	Patients with inflammatory bowel disease are at increased risk of atherothrombotic disease: A systematic review with meta-analysis	IBD, including CD and UC	None	Comparison group consisted of controls without IBD	Risk of MI in patients with IBD; all causes of death and stroke	9
2	Jaiswal, 2023	Inflammatory bowel disease and associated cardiovascular disease outcomes: A systematic review	Adults (>18 years)	Definitive diagnosis of IBD, CD, or UC	NS	Adverse cardiovascular outcomes and mortality	9
3	Wu. 2022	Endothelial Dysfunction and Arterial Stiffness in Patients with Inflammatory Bowel Disease: A Systematic Review and Meta-Analysis	Adults and/or juvenile subjects either inflammatory bowel disease patients or healthy controls who evaluation for either endothelial function and/or arterial stiffness was performed	To have inflammatory bowel disease condition as potential risk factor for either endothelial dysfunction and/or arterial stiffness	No diagnosis of IBD	Endothelial dysfunction and arterial stiffness	8
4	Patel, 2021	Cardiovascular Manifestations in Inflammatory Bowel Disease: A Systematic Review of the Pathogenesis and Management of Pericarditis	Individuals of any age group with IBD	Any, otherwise NS	NS	Cardiovascular, extraintestinal manifestations	4
5	Sun, 2018	Inflammatory bowel disease and cardiovascular disease incidence and mortality: A meta-analysis	Patients with IBD	NS	Non-IBD controls	Association between IBD and cardiovascular disease incidence/mortality; reported as HR, RR, 95% CI	8
6	Feng, 2017	Inflammatory Bowel Disease and Risk of Ischemic Heart Disease: An Updated Meta-Analysis of Cohort Studies	Patients with IBD	NS	Non-IBD controls	Risk estimates for the incidence of IHD in patients with IBD compared to non-IBD controls, as measured by relative risk (RR), hazard ratio (HR), or other measures with 95% CIs	7

7	Zanoli, 2017	Inflammation and Aortic Stiffness: An Individual Participant Data Meta-Analysis in Patients With Inflammatory Bowel Disease	Adults with IBD	Marker for increased cardiovascular risk: Arterial stiffness (pulse wave velocity)	Healthy adults; adults matched for cardiovascular risk factors, blood pressure and/or heart rate	Carotid-femoral pulse wave velocity; whether inflammation is associated with aortic stiffening	8
8	Fumery, 2014	Thromboembolic events and cardiovascular mortality in inflammatory bowel diseases: a meta-analysis of observational studies	Adult patients with IBD (Crohn's disease or ulcerative colitis)	Presence of thrombotic events or cardiovascular disease	Control group without IBD	RR or ORs with 95% CIs for thrombotic events or cardiovascular disease-specific SMR with 95% CI	7
9	Singh, 2014	Risk of cerebrovascular accidents and ischemic heart disease in patients with inflammatory bowel disease: a systematic review and meta-analysis	Patients witth IBD [CD and/or UC]	None	Non-IBD controls	Risk of cardiovascular morbidity (CVA, IHD, and peripheral arterial thromboembolic disease)	9

Table 2. Included Sample Characteristics and Key Findings of the Included Studies (N=9). Abbreviations- CD - Crohn's disease; UC -Ulcerative colitis; IBD - Inflammatory bowel disease; MI - Myocardial infarction; HR - Hazard ratio; CVD - cardiovascular disease; cIMT - Carotid intima-media thickness; CHD - Coronary heart disease; CVA - Cerebrovascular accident; TE - Thromboembolism; CV – Cardiovascular.

No.	Author, Year	Included Sample Characteristics	Findings
1	D'Ascenzo, 2023	• A total of 515,455 controls and 77,140 Inflammatory bowel disease (IBD) patients were included in the study, with 26,852 (34.8%) Crohn's disease (CD) patients and 50,288 (65.2%) ulcerative colitis (UC) patients. • The mean age was similar for both controls and IBD patients. • CD and UC patients had lower rates of hypertension, diabetes, and dyslipidemia than the control group.	• At the 5-year follow-up, both Crohn's disease (CD) and ulcerative colitis (UC) patients had an increased risk of myocardial infarction (MI), death, and stroke. • The hazard ratio (HR) for MI was 1.36 for CD patients and 1.24 for UC patients, while the HR for death was 1.55 for CD patients and 1.29 for UC patients. • The HR for stroke was 1.22 for CD patients and 1.09 for UC patients.
2	Jaiswal, 2023	• The study population consisted of 2,029,941 patients, with a mean age of 45.6 years, 57% females, and 43% males. • Common cardiovascular disease (CVD) risk factors included smoking (24.19%) and alcohol consumption (4.60%). • Common comorbidities in the study population were hypertension (30%), diabetes (14.41%), dyslipidemia (18.42%), previous CVD (22%), and renal disease (10%).	• IBD patient outcomes included an all-cause mortality rate of 1.66%, with 15.92% for UC patients and 0.30% for CD patients. • The rate of MI was 1.47% for IBD patients, with 30.96% for UC patients and 34.14% for CD patients. • CVD events occurred in 1.95% of IBD patients, heart failure events in 5.49% of IBD patients, and stroke events in 0.95% of IBD patients, with 2.63% for UC patients and 2.41% for CD patients.

3	Wu. 2022	• The study compared 2,330 IBD patients with 2,032 matched controls, who were well-matched in terms of age and sex. • The mean age was 37.4 years for IBD patients and 37.7 years for the control group. • The percentage of females was 45.4% for IBD patients and 48.6% for the control group. • Smoking was reported in 0-35.8% of patients, hypertension in 0-38.1%, and diabetes in 0-10%.	• IBD patients exhibited significantly increased carotid intima-media thickness (cIMT), carotid-femoral pulse wave velocity (aPWV), and augmentation index. In addition, there was a significantly decreased brachial artery flow-mediated dilatation in IBD patients.
4	Patel, 2021	• The study included 36 patients (12 females and 24 males) with an age range of 9-76 and an average age of 30.8 years. • Among the patients, 11 had CD, and 25 had UC.	• Pericarditis complications were associated with drug therapy, specifically 5-aminosalicylic acid derivatives. Management of these complications involved drug cessation or a corticosteroid regimen.
5	Sun, 2018	• The study included seven studies on CVD risk in CD, six in UC, five studies on coronary heart disease (CHD) risk in CD, and five in UC, as well as three studies on myocardial infarction (MI) risk in both CD and UC. • There were over 3,243 cerebrovascular accidents (CVA), 9,424 CHD, and 1,059 MI events reported.	• Pooled relative risks were 1.25 for cerebrovascular disease, 1.17 for coronary heart disease, and 1.12 for myocardial infarction. • Pooled standardized mortality ratios were 1.01 for CD patients and 0.93 for UC patients.
6	Feng, 2017	• The study involved 105,583 IBD patients and 871,902 controls, with most studies controlling for traditional cardiac risk factors.	• There was an increased risk of ischemic heart disease in IBD patients, CD patients, and UC patients.
7	Zanoli, 2017	• The study included 151 UC patients, 159 CD patients, and 227 controls.	• Increased aPWV was observed in both CD and UC patients compared to controls.
8	Fumery, 2014	• The study population consisted of 207,814 IBD patients, 5,774,898 controls, 3,253,639 IBD hospitalizations, and 936,411,223 control hospitalizations. • The risk of arterial and/or venous thromboembolism (TE) or cardiovascular mortality was included in the analysis.	• IBD patients were found to have an increased risk of venous thromboembolic events (TE), deep venous thrombosis, pulmonary embolism, ischemic heart disease, and mesenteric ischemia. • However, there was no increased risk of arterial TE.
9	Singh, 2014	There were 2,424 CVA events reported in five studies and 6,478 ischemic heart disease (IHD) events in six studies.	• IBD was associated with a modest increase in the risk of cerebrovascular accidents (CVA), with a higher risk in women and young patients. • There was a 19% increased risk of ischemic heart disease in IBD patients, but no increased risk of peripheral arterial thromboembolic events.

DISCUSSION

In this umbrella review, we synthesized the findings of nine studies investigating the relationship between IBD and cardiovascular factors. The studies consistently reported an increased risk of adverse cardiovascular outcomes, including myocardial infarction, stroke, heart failure, and thrombotic events among IBD patients compared to non-IBD controls. Moreover, IBD patients demonstrated increased arterial stiffness and endothelial dysfunction. These findings suggest that the shared inflammatory pathways and immune-mediated mechanisms may contribute to the heightened cardiovascular risk in IBD patients.[20–23]

The included studies were predominantly systematic reviews and meta-analyses, which are considered high-level evidence. However, the primary studies within these reviews were mainly observational, limiting the ability to establish causality or rule out potential confounding factors. The JBI Appraisal Scores of the included studies ranged from 4 to 9, indicating variable methodological quality. Despite these limitations, the consistency of the findings across studies lends credence to the association between IBD and cardiovascular risk.

The findings of this umbrella review have important implications for clinical practice and public health. For IBD patients, healthcare providers should consider regular cardiovascular risk assessment, prevention, and management strategies. This may include lifestyle modifications, pharmacological therapies, and regular monitoring to reduce the risk of adverse cardiovascular events.[24–26] The results also emphasize the need for interdisciplinary collaboration between gastroenterologists and cardiologists in managing patients with IBD and comorbid cardiovascular conditions.

Recent literature has further elucidated the potential mechanisms underlying the relationship between IBD and cardiovascular risk. For instance, research suggests that chronic inflammation in IBD may lead to endothelial dysfunction, oxidative stress, and increased production of pro-inflammatory cytokines, which can promote atherosclerosis and thrombosis.[27] Current literature has also provided further insight into the relationship between IBD and cardiovascular risk. Several potential mechanisms have been proposed to explain the heightened cardiovascular risk observed in IBD patients. One key area of focus in recent research is the role of chronic inflammation in promoting atherosclerosis and thrombosis. Studies have shown that IBD patients exhibit elevated levels of pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and C-reactive protein (CRP).[28] These pro-inflammatory markers can contribute to endothelial dysfunction, oxidative stress, and the development of a pro-thrombotic state, which in turn can increase the risk of cardiovascular events.[29] Another aspect of the current literature addresses the impact of IBD treatments on cardiovascular risk. IBD therapies, such as corticosteroids, may exacerbate cardiovascular risk factors, including hypertension and dyslipidemia.[30] In addition, anti-TNF agents, may have potential cardioprotective effects by reducing inflammation.[31] Therefore, a careful evaluation of the potential benefits and risks of IBD treatments, as well as their potential impact on cardiovascular outcomes, is essential for individualized patient management.[32]

Furthermore, studies have highlighted the importance of addressing traditional cardiovascular risk factors in IBD patients. For example, smoking has been associated with both an increased risk of IBD development and exacerbation of disease activity, as well as an elevated risk of cardiovascular events.[33] As such, targeted interventions to promote smoking cessation and address other modifiable risk factors, such as obesity and physical inactivity, should be considered in the overall management of IBD patients.[34] Recent research has explored the potential benefits of incorporating non-invasive markers of cardiovascular risk, such as carotid intima-media thickness (cIMT) and pulse wave velocity (PWV), into the routine assessment of IBD patients.[35] These markers may help to identify IBD patients with subclinical atherosclerosis or arterial stiffness, allowing for earlier intervention and more effective cardiovascular risk reduction strategies.

The aforementioned trends in current literature have expanded our understanding of the complex relationship between IBD and cardiovascular risk. Further exploration is needed to clarify the underlying mechanisms, evaluate the impact of IBD treatments on cardiovascular outcomes, and optimize prevention and management strategies for IBD patients with an elevated cardiovascular risk.

Limitations

There are several limitations to consider. First, the included studies had heterogeneous designs, populations, exposure definitions, and outcome measures, which may have contributed to the variability in the reported associations between IBD and cardiovascular factors. Second, the primary studies included in the systematic reviews and meta-analyses were mainly observational, limiting the ability to infer causality or rule out potential confounding factors. Third, there was a lack of data on the differential effects of IBD subtypes (Crohn's disease and ulcerative colitis) on cardiovascular outcomes, as well as the potential moderating role of IBD treatments, disease duration, and severity. Lastly, the umbrella review focused on narrative synthesis without conducting inferential statistics, which may have limited the ability to quantify the overall effect sizes and assess the presence of publication bias or other biases.

Recommendations for Future Research

Future studies should investigate the role of IBD treatments, disease duration, and severity on

cardiovascular outcomes, as well as explore the potential interactions between IBD and other cardiovascular risk factors, such as obesity, hypertension, and dyslipidemia.[36–38] Longitudinal and intervention studies could help establish causality and determine the effectiveness of prevention and management strategies for IBD patients. Lastly, research should focus on the underlying mechanisms linking IBD and cardiovascular factors, which may inform the development of targeted interventions and therapies to reduce the burden of both IBD and cardiovascular diseases.

CONCLUSION

In sum, this umbrella review provides compelling evidence for an association between IBD and increased cardiovascular risk, underscoring the need for further research to elucidate the underlying mechanisms, identify potential risk factors, and develop effective prevention and management strategies for IBD patients. Future studies should investigate the role of IBD treatments, disease duration, and severity on cardiovascular outcomes, as well as explore the potential interactions between IBD and other cardiovascular risk factors, such as obesity, hypertension, and dyslipidemia. Ultimately, a better understanding of the complex interplay between IBD and cardiovascular factors will contribute to improved patient care and outcomes, as well as inform public health policies and interventions aimed at reducing the burden of both IBD and cardiovascular diseases.

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