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THE EFFICACY OF STATINS IN REDUCING CARDIOVASCULAR EVENTS IN PATIENTS WITH CORONARY ARTERY DISEASE: A COMPREHENSIVE SYSTEMATIC REVIEW

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ABSTRACT

Background: *Statins significantly reduce cardiovascular events in individuals with coronary artery disease (CAD) by lowering LDL-C levels and modulating inflammatory pathways. Long-term adherence to statin therapy is crucial for sustained cardiovascular protection, preventing disease progression, and reducing the risk of adverse outcomes.*

Methods: *This systematic review adhered to PRISMA 2020 principles and focused exclusively on full-text papers published in English between 2015 and 2025. Editorials and review articles without a DOI were eliminated to preserve the integrity of high-quality sources. A literature review was conducted with esteemed databases like ScienceDirect, PubMed, and SagePub to discover relevant studies.*

Result: *The initial database search yielded over 1000 relevant publications on the topic. Following a comprehensive three-stage screening process, eight studies met the specified inclusion criteria and were selected for in-depth analysis. Each study was subjected to a thorough critical evaluation, enabling a comprehensive analysis of the efficacy of statins in reducing cardiovascular events in patients with coronary artery disease. This systematic method ensured that the analysis relied on high-quality evidence, aligned with the study's objectives, and was capable of providing significant insights into this complex association.*

Conclusion: *Statins show significant effects in reducing cardiovascular events in CAD patients, providing anti-inflammatory benefits, endothelial protection, and vascular function improvement. However, adherence remains a barrier, necessitating future research to enhance patient compliance and explore individualized statin therapy and lipid-lowering strategies for improved long-term outcomes.*

Keyword: *Coronary artery disease, cardiovascular events, statin therapy.*

INTRODUCTION

Statins, or HMG-CoA reductase inhibitors, are widely prescribed to lower low-density lipoprotein cholesterol (LDL-C), a key contributor to atherosclerosis and subsequent cardiovascular events.[1] Their efficacy in both primary and secondary prevention of cardiovascular disease (CVD) has been extensively documented. In individuals with established coronary artery disease (CAD), statins have demonstrated significant reductions in major adverse cardiovascular events (MACE), including myocardial infarction and stroke.[2] A comprehensive meta-analysis of observational studies highlighted that statin therapy not only decreases LDL-C levels but also substantially lowers the incidence of MACE in this high-risk population.[3]

The anti-inflammatory properties of statins further enhance their therapeutic benefits in CAD patients.[4] Beyond lipid-lowering effects, statins modulate inflammatory pathways implicated in atherosclerotic plaque stability. This pleiotropic action contributes to a reduction in cardiovascular events, as evidenced by studies showing decreased levels of inflammatory biomarkers in patients undergoing statin therapy.[5,6] Such findings underscore the multifaceted role of statins in mitigating the progression of atherosclerosis and preventing subsequent cardiovascular complications.[4-6]

Long-term adherence to statin therapy is crucial for sustained cardiovascular protection in CAD patients. Discontinuation or non-compliance can lead to a rebound effect, increasing the risk of adverse cardiovascular outcomes.[7] A recent systematic review emphasized that continuous statin use is associated with a significant reduction in all-cause mortality and cardiovascular events.[8] These findings highlight the importance of patient adherence to prescribed statin regimens to maintain optimal cardiovascular health and prevent disease progression.

METHODS

PROTOCOL

This study was rigorously conducted in strict accordance with the PRISMA 2020 guidelines, ensuring methodological precision and adherence to the highest standards of research quality. By following these established protocols, the review maintains transparency, reproducibility, and scientific integrity. Each phase of the process—including an extensive literature search, meticulous data extraction, and systematic synthesis of findings—was executed with precision to minimize bias and uphold analytical rigor. This comprehensive and methodologically sound approach not only enhances the study's credibility but also reinforces its contribution to the advancement of evidence-based research in the field.

CRITERIA FOR ELIGIBILITY

This systematic review aims to comprehensively evaluate the efficacy of statins in reducing cardiovascular events in patients with CAD by synthesizing findings from a diverse range of research studies. By identifying key patterns, emerging trends, and existing gaps in the literature, this study seeks to generate valuable insights into the clinical benefits of statin therapy. By providing a robust evidence base, the review aims to enhance understanding of statins' role in cardiovascular risk reduction, ultimately informing clinical decision-making and optimizing patient care.

To uphold methodological rigor, this study employs strict inclusion and exclusion criteria. Only peer-reviewed articles published in English between 2015 and 2025 are considered, with each study's validity verified through DOI authentication. Non-research materials, including editorials, reviews, and duplicate entries, are excluded to maintain a focused and high-quality dataset. This meticulous selection process ensures that the analysis is based on credible, high-quality sources, thereby strengthening the reliability of the findings and their contribution to evidence-based practice.

By adopting a systematic and comprehensive approach, this study ensures that its conclusions are firmly grounded in empirical evidence. The anticipated findings aim to refine the current understanding of statin therapy in CAD management, providing a foundation for improving clinical protocols and optimizing patient outcomes. Ultimately, this research aspires to contribute to advancements in cardiovascular medicine by reinforcing the role of statins in reducing cardiovascular events and enhancing the quality of life for individuals with coronary artery disease.

SEARCH STRATEGY

A comprehensive and systematic search strategy was employed to identify relevant studies for this review, utilizing key terms such as "statin," "efficacy," "cardiovascular events," and "coronary artery disease." To ensure a thorough and well-rounded analysis, the search was conducted across three major academic databases—PubMed, SagePub, and ScienceDirect—allowing access to a diverse range of high-quality, peer-reviewed literature. This rigorous approach strengthened the evidence base by incorporating studies from multiple reputable sources, enhancing both the depth and breadth of the review. By prioritizing methodological precision and scholarly rigor, this strategy ensures the reliability and validity of the findings, ultimately contributing to a more comprehensive understanding of statin efficacy in reducing cardiovascular events in patients with coronary artery disease.

Table 1. Search Strategy

Database	Search Strategy	*Hits*
Pubmed	*("statin" AND "efficacy" AND "cardiovascular events" AND "coronary artery disease")*	33
Science Direct	*("statin" AND "efficacy" AND "reduced cardiovascular events" AND "coronary artery disease")*	1025
Sagepub	*("statin" AND "efficacy" AND "reduced cardiovascular events" AND "coronary artery disease")*	18

DATA RETRIEVAL

The authors conducted a meticulous preliminary screening of each article, systematically evaluating titles and abstracts to determine their relevance before proceeding with an in-depth review. Only studies that directly aligned with the research objectives and met the predefined inclusion criteria were selected for further analysis. This structured and methodical approach facilitated the identification of key themes and significant trends across the literature, ensuring that the review remained focused on studies that provided meaningful insights into the efficacy of statins in reducing cardiovascular events in patients with coronary artery disease.

To ensure consistency and enhance comparability, only full-text articles published in English were included in the final dataset. A rigorous screening process was implemented to confirm that all selected studies met the established inclusion criteria and effectively addressed the study's objectives. Articles that failed to meet these standards were excluded, maintaining a high-quality dataset that was both precise and relevant to the scope of the research. This careful selection process minimized potential biases and strengthened the reliability of the review, ensuring that the findings were based on robust and credible evidence.

The evaluation process encompassed a comprehensive assessment of various factors, including study titles, authorship, publication dates, research settings, and methodologies. This thorough review ensured the inclusion of only the most relevant and methodologically sound studies, enhancing the credibility and rigor of the research. By employing a systematic and stringent selection strategy, the authors reinforced the reliability of the findings, providing a strong foundation for drawing evidence-based conclusions that contribute meaningfully to the understanding of statin efficacy in reducing cardiovascular events in patients with coronary artery disease.

QUALITY ASSESSMENT AND DATA SYNTHESIS

The authors implemented a meticulous initial screening process, systematically reviewing the titles and abstracts of each article to identify studies that met the predefined relevance and quality criteria. Only those that aligned closely with the research objectives and demonstrated methodological rigor were selected for comprehensive, in-depth analysis. This structured approach ensured the inclusion of high-quality studies that contributed meaningful insights to the review. By refining the selection process, the authors curated a dataset composed of contextually significant and scientifically robust studies. This strategy not only enhanced the precision and focus of the analysis but also reinforced the overall validity, reliability, and scholarly rigor of the systematic review.

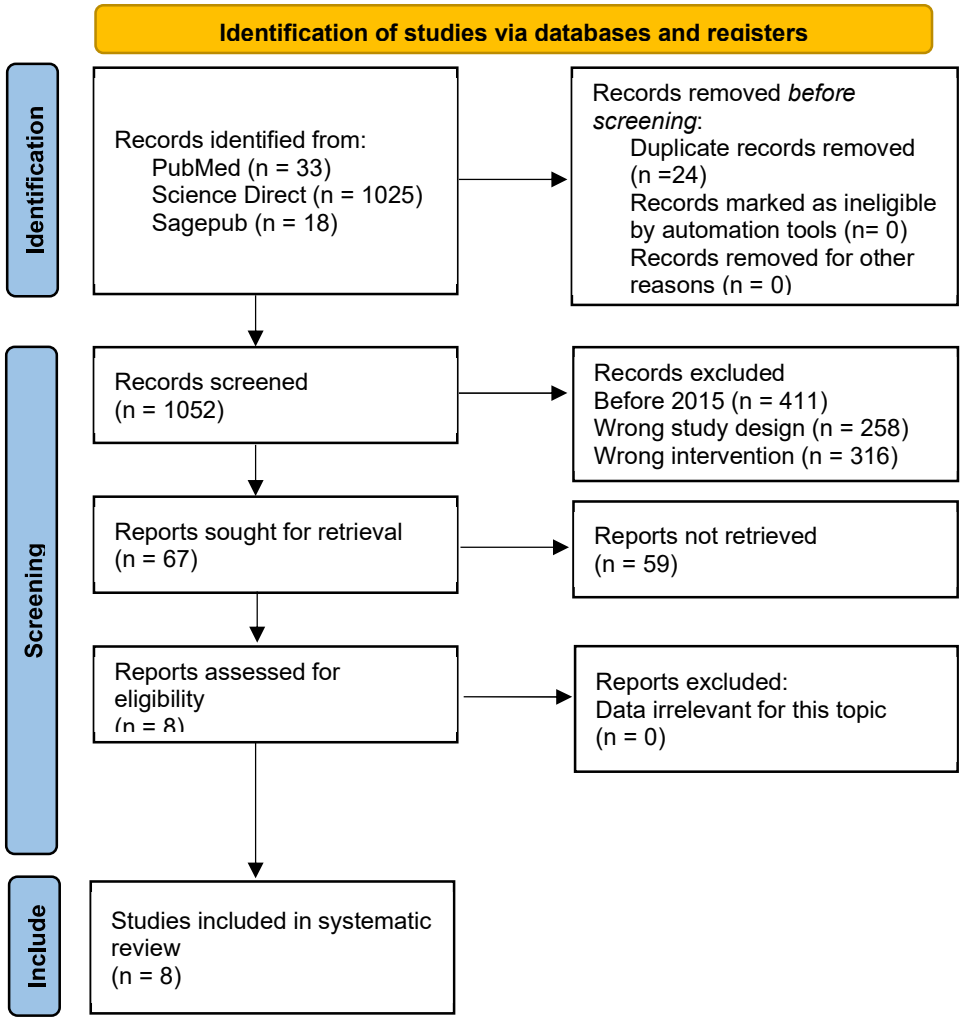

Figure 1. Article search flow chart

Table 2. Critical appraisal of Study

Parameters	(Lu et al., 2016)	(Armitage et al., 2019)	(Yebyo et al., 2019)	(Zhai et al., 2020)	(Fatima et al., 2023)	(Jaam et al., 2023)	(Lee et al., 2023)	(Hafiz et al., 2025)
1. Bias related to temporal precedence								
Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation								
Was there a control group?	No	No	No	No	No	No	Yes	No
3. Bias related to confounding factors								
Were participants included in any comparisons similar?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
4. Bias related to administration of intervention/exposure								

Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Yes.	Yes.	Yes.	Yes.	No.	Yes.	Yes.	Yes.
5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	No	No	No	No	No	No	Yes	No
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	No	No	No	No	No	No	Yes	Yes
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

RESULT

The investigation commenced with a systematic search across reputable academic databases, including ScienceDirect, PubMed, and SagePub, to identify studies relevant to the review. A rigorous three-stage screening process was implemented to meticulously filter and select the most pertinent studies, ultimately narrowing the selection to eight papers that met the predefined inclusion criteria. These studies underwent a comprehensive analysis, with key themes and findings carefully extracted for in-depth examination. To enhance clarity and ensure a structured presentation of the results, the synthesized data is concisely summarized in Table 3, providing a clear and organized overview of the analyzed information.

Table 3. The literature included in this study

Author	Origin	Method	Sample	Result
Lu et al.[9] (2016)	China	Meta Analysis	88 studies	Statins significantly reduced blood lipid levels, with high doses of atorvastatin being most effective in reducing CHD mortality and all-cause mortality. However, statins increased the risk of muscle disease and kidney damage, highlighting the need for further research on their efficacy and safety.

Armitage et al.[10] (2019)	Australia	Meta Analysis	28 studies	The study observed a significant reduction in major vascular events and coronary events with statin therapy or a more intensive regimen. However, with increasing age, the trend towards smaller proportional risk reductions per 1·0 mmol/L reduction in LDL cholesterol per 1·0 mmol/L reduction in LDL cholesterol persisted. Statin therapy had no effect on non-vascular mortality, cancer death, or cancer incidence.
Yebyo et al.[11] (2019)	Switzerland	Systematic Review	40 studies	Statins significantly reduce events such as non-fatal MI, CVD mortality, all-cause mortality, stroke, unstable angina, and composite major cardiovascular events. However, they increase risks of myopathy, renal dysfunction, and hepatic dysfunction. atorvastatin and rosuvastatin are most effective in reducing CVD events, with atorvastatin having the best safety profile.
Zhai et al.[12] (2020)	China	Meta Analysis	17 studies	Statins, when used for secondary prevention, are associated with reduced risk of cardiovascular events, all-cause mortality, and stroke. However, they do not significantly affect other outcomes in primary prevention. Intensive atorvastatin showed the greatest benefits for secondary prevention, but differences in effects did not significantly affect therapy for the elderly.
Fatima et al.[13] (2023)	Pakistan	Review	-	Statins, a class of drugs, are associated with a significant reduction in the risk of cardiovascular events, including all-cause mortality, cardiovascular mortality, CHD mortality, and fatal Myocardial Infarction. However, the efficacy of statins in reducing these events remains to be determined.
Jaam et al.[14] (2023)	Qatar	Systematic Review	44 studies	Statins show similar effectiveness in reducing LDL levels, with similar adverse drug reactions. High-intensity

				statins reduce LDL by ≥50%, favoring rosuvastatin over atorvastatin. Further data is needed to confirm clinical significance on cardiovascular outcomes.
Lee et al.[15] (2023)	Korea	RCT	4,400 participants	The study compared the daily dose of rosuvastatin and atorvastatin among 4400 participants, with rosuvastatin showing a higher incidence of new onset diabetes mellitus and cataract surgery. The primary outcome was a higher LDL cholesterol level in the rosuvastatin group, while the atorvastatin group had a lower incidence. Other safety endpoints did not differ between the two groups.
Hafiz et al.[16] (2023)	Saudi Arabia	Retrospective Study	1,011 participants	The study analyzed 1011 ischemic heart disease patients, primarily male, and found that adherent patients had lower baseline LDL-C levels and were more likely to be on cardiovascular medications. Adherence was associated with lower non-fatal MI rates and fewer revascularizations. However, lipid management in IHD patients remains sub-optimal, highlighting opportunities for further enhancement.

DISCUSSION

Statins have been extensively studied for their role in reducing cardiovascular events among patients with CAD. Their primary mechanism of action involves lowering low-density lipoprotein cholesterol (LDL-C) levels, a well-established risk factor for atherosclerosis and cardiovascular complications.[17] A landmark meta-analysis conducted by the Cholesterol Treatment Trialists' (CTT) Collaboration, which included data from 28 randomized trials involving many participants, demonstrated a direct correlation between LDL-C reduction and cardiovascular risk reduction. Specifically, for every 1 mmol/L decrease in LDL-C achieved through statin therapy, there was a corresponding 22% reduction in major vascular events, including myocardial infarction and stroke.[18] These findings provide compelling evidence supporting the widespread use of statins as a cornerstone therapy in the secondary prevention of cardiovascular disease.

Beyond their lipid-lowering effects, statins exert additional cardioprotective benefits through their anti-inflammatory and endothelial-stabilizing properties. Chronic inflammation plays a crucial role in the progression of atherosclerosis, and elevated inflammatory markers, such as C-reactive protein (CRP), have been linked to an increased risk of cardiovascular events. Statins have been shown to reduce CRP levels and improve endothelial function, contributing to enhanced vascular health.[4,19] Several studies investigating the impact of statins on vascular structure and function have reported improvements in arterial stiffness and endothelial nitric oxide bioavailability, suggesting that these pleiotropic effects may contribute significantly to the reduction in cardiovascular risk beyond cholesterol lowering alone.[20,21] These findings highlight the multifaceted mechanisms by which statins exert their protective effects, reinforcing their role as an essential therapy in CAD management.

The safety profile of statins has been a topic of extensive research, particularly concerning their long-term effects. While statins have been associated with a slight increase in the risk of new-onset diabetes, particularly in high-risk populations, multiple large-scale studies have demonstrated that the cardiovascular benefits of statins substantially outweigh this risk.[22,23] Moreover, concerns regarding a potential link between statin use and cancer incidence have not been substantiated

by clinical evidence. A meta-analysis of randomized controlled trials found no significant association between statin therapy and cancer-related mortality or the incidence of non-cardiovascular death.[24] These findings underscore the overall favorable risk-benefit ratio of statin therapy, reinforcing their safety and efficacy in long-term cardiovascular prevention.

Despite their well-documented benefits, adherence to statin therapy remains a critical challenge. Suboptimal adherence, whether due to perceived side effects, lack of awareness, or patient reluctance, has been linked to an increased risk of adverse cardiovascular outcomes. Studies have shown that discontinuing statin therapy within the first year of initiation significantly elevates the risk of cardiovascular mortality and recurrent events.[25] One study found that patients who discontinued statin therapy prematurely had a substantially higher risk of myocardial infarction and stroke compared to those who adhered to treatment protocols.[26] These findings emphasize the importance of patient education and structured interventions to improve adherence and persistence with statin therapy. Strategies such as shared decision-making, patient counseling, and minimizing unnecessary discontinuation due to perceived statin intolerance can play a vital role in optimizing therapeutic outcomes.

CONCLUSION

Robust evidence supports the efficacy of statins in reducing cardiovascular events in patients with CAD. Their benefits extend beyond cholesterol reduction, encompassing anti-inflammatory effects, endothelial protection, and vascular function improvement. While concerns regarding potential adverse effects, such as new-onset diabetes, exist, the overall benefit-risk profile of statins remains overwhelmingly positive. However, adherence remains a significant barrier to maximizing these benefits. Future research should focus on strategies to enhance patient compliance and explore the full spectrum of statins' pleiotropic effects in cardiovascular disease prevention. As the field continues to evolve, individualized statin therapy and complementary lipid-lowering strategies may further refine treatment approaches, ultimately improving long-term cardiovascular outcomes.

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