Review

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Posted Date: 13 January 2025

doi: 10.20944/preprints202501.0909.v1

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Effects of Dietary Intervention on Lipid Profile: A Systematic Review

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Abstract: Background: Dietary interventions significantly influence lipid profiles, which are key risk factors for cardiovascular disease. Understanding the impact of various dietary patterns can guide effective strategies to improve lipid profiles and reduce cardiovascular risk. **Objectives**: This systematic review aims to evaluate the effectiveness of dietary interventions in improving lipid profiles. **Methods**: 1. **Search Strategy**: Articles published up to July 31, 2023, were identified using PubMed and Google Scholar. 2. **Inclusion Criteria**: Studies examining the relationship between dietary interventions and lipid profiles. 3. **Review Process**: The review followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. **Results**: 1. **Impact of Dietary Composition**: (1) Diets high in saturated fats and cholesterol were linked to elevated low-density lipoprotein (LDL) cholesterol levels. (Sacks et al., 2017). (2) Diets rich in fruits, vegetables, whole grains, and lean proteins were associated with reduced LDL cholesterol and increased high-density lipoprotein (HDL) cholesterol. (Rodríguez-López et al., 2021). (3) Ketogenic diets, characterized by low carbohydrate and high fat, showed a potential increase in LDL cholesterol. (Schwingshackl & Hoffmann, 2014). 2. **Effectiveness of Specific Diets**: (1) The Mediterranean diet and the Dietary Approaches to Stop Hypertension (DASH) diet emerged as effective dietary patterns for improving lipid profiles. (Davis et al., 2017; Rodríguez-López et al., 2021). (2) These diets prioritize plant-based foods, lean proteins, and healthy fats while minimizing saturated and trans fats. (Sacks et al., 2017). 3. **Individual Variability**: (1) The effectiveness of dietary interventions varies based on factors such as age, sex, and medical history. (Berryman et al., 2017; Maki et al., 2018). **Conclusion**: Dietary interventions are non-invasive and cost-effective strategies to improve lipid profiles and reduce cardiovascular disease risk. However, these interventions should be tailored to individual needs and conducted under the guidance of healthcare professionals. Further research is required to assess the long-term effects of dietary modifications on lipid profiles.

Keywords: Dietary interventions; lipid profile; cardiovascular disease; Mediterranean diet; DASH diet; LDL cholesterol; HDL cholesterol

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Introduction

Cardiovascular diseases (CVD) remain the leading cause of death worldwide, with dyslipidemia—abnormal levels of cholesterol and triglycerides—being a critical modifiable risk factor. Elevated levels of low-density lipoprotein (LDL) cholesterol and triglycerides, along with reduced levels of high-density lipoprotein (HDL) cholesterol, have been strongly associated with the development of atherosclerosis and subsequent heart disease (Sacks et al., 2017). Dietary interventions are widely recognized as an accessible and non-pharmacologic approach to managing lipid levels and reducing

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cardiovascular risk. However, the effectiveness of these interventions remains a topic of debate due to inconsistencies in findings across studies. (Schwing Hackl & Hoffmann, 2014).

This systematic review aims to evaluate the impact of dietary interventions on lipid profiles by synthesizing evidence from the existing literature. The review seeks to clarify the role of dietary modifications, including changes in fat, carbohydrate, and fiber intake, in managing cholesterol and triglyceride levels to reduce the risk of CVD.

Background

The lipid profile encompasses key biomarkers, such as total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides, that are commonly used to assess cardiovascular risk. High levels of LDL cholesterol and triglycerides have been implicated in the progression of atherosclerosis, while HDL cholesterol is believed to exert protective effects by facilitating cholesterol efflux from arterial walls. (Berryman et al., 2017).

Consequently, improving the lipid profile is a critical target for preventing heart disease and stroke. Dietary modifications have been extensively studied as a primary intervention for improving lipid profiles. These interventions range from reducing saturated fat intake to adopting dietary patterns like the Mediterranean or DASH diets, which emphasize the consumption of fruits, vegetables, whole grains, lean proteins, and healthy fats. For example, low-carbohydrate diets have been linked to significant reductions in total cholesterol, LDL cholesterol, and triglycerides, as demonstrated by a meta-analysis of randomized controlled trials (RCTs) conducted by Schwing Hackl and Hoffmann (2014). However, other dietary approaches, such as altering fat intake alone, have yielded inconclusive results. A systematic review by Sacks et al. (2017) reported no significant changes in lipid profiles following fat-modifying dietary interventions.

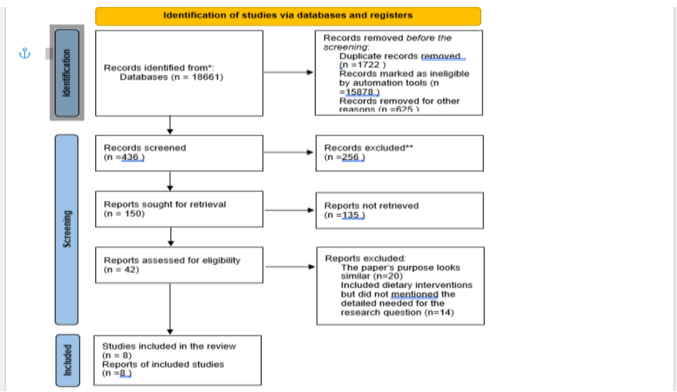
These conflicting outcomes underscore the need for a comprehensive review that integrates findings across diverse dietary interventions and study populations. This systematic review employs the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure methodological rigor, transparency, and reproducibility. By consolidating the available evidence, this review aims to identify the most effective dietary strategies for improving lipid profiles and reducing cardiovascular risk.

Methods

Objective

The primary objective of this systematic review is to analyze existing research to determine the relationship between dietary interventions and lipid profile improvement. This study was conducted in adherence to the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility (Figure 1). As this study relied exclusively on publicly available data, ethical clearance was not required.

Figure 1. 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines



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Systematic Literature Search and Study Selection

A comprehensive literature search was performed using PubMed and Google Scholar databases to identify relevant studies. On PubMed, studies cited within reviews, editorials, and commentaries were examined, and further searches were conducted to find additional papers meeting our inclusion criteria.

Inclusion and Exclusion Criteria

To ensure the studies addressed the research objective, precise inclusion and exclusion criteria were developed. The criteria are summarized in Table 1:

Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Clinical trials, meta-analyses, randomized controlled trials, reviews, and systematic reviews	Books, documents, or non-peer-reviewed sources
Free full-text availability	Studies with only abstracts available
Published between 2013–2023	Studies published before 2013
Human studies	Non-human studies
English-language publications	Non-English publications
Gender: Male and female	Gender not specified
Age ≥ 19 years	Age ≤ 19 years

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Search Strategy

The literature search was conducted using the PICO (Population, Intervention/Condition, Comparison, Outcome) framework to guide the selection of studies. Relevant MeSH terms and Boolean operators were used in database queries. Table 2 summarizes the search strategies and results from each database:

Table 2. Search Strategy and Results.

Database	Search Strategy	Search Results
PubMed	Effects lipid OR LDL OR cholesterol OR diet modification	1,761
Google Scholar	Diet lipid, LDL, HDL, cholesterol AND diet OR diet modification	16,900

Quality Appraisal

To ensure the validity and reliability of the selected studies, several quality assessment tools were employed based on the study design. The tools used and their corresponding applications are detailed in Table 3:

Table 3. Quality Appraisal Tools.

Quality Appraisal Tool	Study Design
Cochrane Bias Tool Assessment	Randomized Controlled Trials
Newcastle-Ottawa Tool	Non-Randomized and Observational Studies
PRISMA Checklist	Systematic Reviews
SANRA (Scale for the Assessment of Narrative Review Articles)	Narrative Reviews
CASP (Critical Appraisal Skills Program) Checklist	Qualitative Studies

By employing these quality appraisal tools, the systematic review ensured the inclusion of high-quality studies while minimizing bias and ambiguity.

Data Extraction and Synthesis

Data were extracted from the selected studies using a standardized form. Key variables included study design, population characteristics, dietary interventions, lipid profile outcomes, and reported limitations. The results were synthesized narratively, supplemented by quantitative summaries where applicable.

This comprehensive methodology ensures the systematic identification, selection, and evaluation of literature to address the research objectives effectively.

Results

Study Selection Process

The systematic search using PubMed and Google Scholar initially identified 18,661 results. After carefully applying the inclusion and exclusion criteria, the number of studies was narrowed down to 1,761. Duplicate removal further reduced the number to 1,722 studies. Abstract screening and preliminary quality assessment resulted in 61 studies for detailed evaluation. Finally, eight studies were selected based on their quality, number of citations, and alignment with the inclusion criteria.

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Summary of Selected Studies

The key details of the eight studies included in this systematic review are summarized in Table 4:

Table 4. Summary of Selected Studies.

Author/Year	Country	Study Design	Database Used	Conclusion
Apetakmann, N.P. (Year)	England	Clinical Trial	Google Scholar	Long-term orange juice users had reduced total cholesterol, LDL cholesterol, apo B, and LDL/HDL ratios, as well as higher intakes of folate and vitamin C.
Armah, C.N. (Year)	Germany	Randomized Controlled Trial	PubMed	High-glucoraphanin broccoli consumption significantly lowered plasma LDL-C in two independent investigations.
Bamberger, C. (Year)	Switzerland	Randomized Controlled Trial	PubMed	Walnut consumption reduced non-HDL-C, apo B, TC, LDL-C, VLDL-C, TG, and VLDL-TG levels.
Berryman, C.E. (Year)	USA	Randomized Controlled Trial	PubMed	A diet low in saturated fat that includes almonds enhanced HDL subspecies, specifically halting declines in -1 HDL caused by a low-fat diet.
Buren, J. (Year)	Switzerland	Randomized Controlled Trial	PubMed	A low-carbohydrate, high-fat diet rich in healthy fatty acids reduced blood lipids in young women after four weeks of consumption.
Davis, C.R. (Year)	Australia	Randomized Controlled Trial	PubMed	Older Australians following the Mediterranean diet for six months exhibited significant reductions in TG and F2-IsoP levels.
Maki, K.C. (Year)	USA	Randomized Crossover Trial	PubMed	Adults with high cholesterol consuming less than 54 grams of corn oil per day had a better plasma lipid profile than those consuming coconut oil.
Rodriguez-Lopez, C.P. (Year)	Switzerland	Clinical Trial	PubMed	The DASH diet improved glucose levels, total cholesterol, LDL-C, TG, waist circumference, and systolic blood pressure.

Key Findings

1. **Dietary Patterns**: Several dietary interventions, such as the Mediterranean diet, DASH diet, and low-carbohydrate, high-fat diets, demonstrated improvements in lipid profiles, including reductions in LDL-C, total cholesterol, triglycerides, and non-HDL-C.(Davis et al., 2017; Rodríguez-López et al., 2021).
2. **Specific Foods**: Incorporating foods such as walnuts, almonds, high-glucoraphanin broccoli, and corn oil contributed to better lipid profiles. (Bamberger et al., 2017; Maki et al., 2018).

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3. **Nutrient Composition**: Diets emphasizing healthy fatty acids, reduced saturated fats, and increased intake of micronutrients like folate and vitamin C showed consistent benefits.(Berryman et al., 2017; Aptekmann & Cesar, 2013).

These results suggest that specific dietary interventions and nutrient-dense foods play a significant role in improving lipid profiles and reducing cardiovascular risk. Further studies are recommended to confirm long-term effects and establish standardized dietary recommendations.

Discussion

This systematic review highlights the critical role of dietary interventions in modulating lipid profiles, a key factor in cardiovascular disease (CVD) prevention. Elevated levels of lipoproteins containing apolipoprotein B (apoB), particularly LDL cholesterol (LDL-C), are established risk factors for CVD (Bamberger et al., 2017). Thus, therapeutic approaches to reduce LDL-C are essential for mitigating cardiovascular risks.

The **Dietary Approaches to Stop Hypertension (DASH)** diet has demonstrated consistent benefits in lipid profile improvements. Studies show significant reductions in triglycerides, glucose, total cholesterol, and LDL-C, along with increases in HDL cholesterol, following adherence to the DASH diet over an eight-week period (Rodríguez-López et al., 2021). These findings align with long-term studies indicating the DASH diet's potential to lower cardiovascular risk through improved metabolic parameters.

Similarly, the **Mediterranean Diet (MedDiet)**, characterized by high consumption of fruits, vegetables, whole grains, and olive oil, has shown promise, particularly among older adults. Research demonstrates reductions in LDL-C and triglyceride levels while enhancing HDL-C concentrations, making it an optimal dietary strategy for lipid modulation and reducing inflammation (Davis et al., 2017; Sacks et al., 2017)

Contrastingly, the **low-carbohydrate, high-fat (LCHF) diet** led to significant increases in LDL-C levels, a recognized cardiovascular risk factor(Schwingshackl & Hoffmann, 2014). This highlights the need to weigh the potential risks of diets rich in saturated fats against their metabolic benefits, including increased ketogenesis and improved glucose homeostasis (Burén et al., 2021).

Specific foods also demonstrated notable lipid-modulating effects. For instance, the incorporation of **corn oil** instead of coconut oil in the diet resulted in favorable changes in plasma lipid profiles, particularly LDL-C reduction (Maki et al., 2018). Similarly, consumption of **walnuts** was associated with reductions in fasting cholesterol, non-HDL cholesterol, LDL-C, triglycerides, and apoB, suggesting their broad lipid-lowering effects (Bamberger et al., 2017). These benefits were observed regardless of macronutrient composition, underscoring walnuts' unique properties.

Almond consumption, on the other hand, improved HDL subpopulation profiles and cholesterol efflux, particularly in individuals with elevated LDL-C levels (Berryman et al., 2017). Other studies highlighted the lipid-lowering effects of **broccoli**, attributed to its high glucoraphanin content (Armah et al., 2015), and the hypolipidemic effects of **orange juice**, driven by its hesperidin content (Aptekmann & Cesar, 2013).

Limitations

This review has several limitations. The analysis was restricted to studies published in English over the past ten years, potentially excluding relevant data. Moreover, the review focused on individuals aged 19 years or older, limiting its applicability to younger populations. Further research is needed to confirm these findings across diverse populations and settings.

Conclusion

The findings of this systematic review underscore the nuanced impact of dietary interventions on lipid profiles. The DASH diet and MedDiet consistently demonstrated significant benefits, while

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the LCHF diet revealed potential risks associated with elevated LDL-C levels. The lipid-lowering effects of specific foods, including broccoli, orange juice, almonds, and walnuts, further highlight the importance of dietary composition in cardiovascular health.

These results emphasize the need for personalized dietary approaches tailored to individual metabolic profiles and cardiovascular risks. Future research should focus on long-term outcomes and explore the interaction of various dietary components to optimize cardiovascular health outcomes.

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