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NUT CONSUMPTION AND CARDIOVASCULAR DISEASE RISK AMONG ADULTS IN LOW- AND MIDDLE-INCOME COUNTRIES - A SCOPING REVIEW

Braimoh OD¹, Nxusani ZN¹, Tambe A^{1,3}, Zuma MK^{1,2} and Mbhenyane XG^{1*}



Braimoh Omoyeni Deborah

Corresponding author email: xgm@sun.ac.za

¹Department of Human Nutrition, Faculty of Medicine and Health Sciences, Stellenbosch University, Tygerberg Drive 7505, Cape Town 8000, South Africa

²Agriculture Research Council, 1134 Park Street, Hatfield Pretoria, PO Box 8783, Pretoria, 0001

³Department of Public Health and Hygiene, Faculty of Health Sciences, University of Buea, Buea, Cameroon

ABSTRACT

Cardiovascular disease remains the leading cause of death worldwide, with more than eighty percent of fatalities occurring in low- and middle-income countries. Dietary strategies, such as the inclusion of nuts, have attracted attention because nuts are nutrient-dense foods rich in healthy fats, proteins, vitamins, minerals, and bioactive compounds that influence cardiovascular risk factors. This review synthesises evidence from low- and middle-income countries on the effects of different types of nuts on major cardiometabolic indicators. Nineteen studies published over the past decade were identified through four major databases: PubMed, CINAHL, Scopus, and EBSCOhost. The analysis revealed that almonds were the most frequently studied nut, with three studies exclusively focused on almonds and two on Baru almonds. Mixed nuts featured in seven studies, while cashews appeared in two. Walnuts, pistachios, pecans, hazelnuts, and peanuts were each examined in only one study, indicating a significant research gap in these settings. The findings demonstrated varied effects of nut consumption on cardiovascular risk factors. Overall, nuts were associated with improved glycemic control, lower fasting blood glucose, and a reduced risk of type 2 diabetes mellitus. Frequent nut intake, whether short- or long-term, was linked to reduced prevalence and severity of metabolic syndrome and improved reversal rates. One study reported that pistachio-enriched diets lowered systolic blood pressure and improved vascular stress response, while cashew consumption specifically reduced systolic blood pressure without significant changes in lipid profiles or diastolic pressure. Evidence on lipid modulation was mixed: some studies reported increases in high-density lipoprotein cholesterol, whereas others found no significant effect. These findings suggest that incorporating nuts into diets in low- and middle-income countries may provide cardiometabolic benefits without adverse outcomes. In conclusion, this review highlights the potential of nuts as a potentially beneficial dietary strategy for reducing cardiovascular risk factors in resource-limited settings. However, the limited diversity of nuts studied and inconsistent findings on lipid profiles underscore the need for further research across different nut types and populations in low- and middle-income countries.

Key words: cardiovascular disease, diabetes, dyslipidaemia, high blood pressure, nuts, risk factors

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INTRODUCTION

Cardiovascular diseases (CVDs) are a significant cause of death and disability in low- and middle-income countries (LMICs) [1]. Cardiovascular diseases increase the number of years spent in disability and exert a high financial cost on individuals, families and nations. In 2022 alone, CVD was implicated in the death of over 19.8 million people worldwide, representing approximately 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke [2].

Nearly 80% of global CVD deaths occurred in LMICs [3]. These countries are often characterised by fragile economies, limited healthcare infrastructure, inadequate diagnostic capacity, and low research productivity [4]. LMICs have low economies, inadequate health services, limited diagnostic capacity, and low research output. The risk factors associated with CVD have been identified and outlined, and studies to alter these risk factors in ways favourable to reduction have been ongoing in different parts of the world. For instance, high blood pressure and dyslipidaemia have long been found to be the most frequent and essential risk factors for CVD [3]. According to the World Health Organisation, the incidence of hypertension globally rose to over one billion people in 2008, with the African region, whose countries belong to the LMIC groups, having the highest prevalence of about 46% in adults aged 25 years and above [5].

Tree nuts include almonds, Brazil nuts, cashews, chestnuts, hazelnuts, macadamias, pecans, pine nuts, pistachios, and walnuts, while peanuts (groundnuts) are also classified within the broader unit category. Nuts are highly nutrient-dense, providing monounsaturated and polyunsaturated fatty acids, proteins, soluble fibre, and a range of essential vitamins and minerals [5,6]. Nuts also contain phytochemicals, including phenolic acids, phytosterols, and flavonoids, in reasonable quantities, which have been shown to have favourable effects on cardiovascular risk factors [7].

Extensive research has predominantly examined the relationship between nut consumption and CVD mortality, as well as associated risk factors, particularly in high-income countries [8–12]. Several of these studies have addressed the impact of nut consumption on various disease outcomes, associated risk factors, and overall mortality rates.

Given the prevalence of CVDs in LMICs, the application of evidence-based medicine is particularly important in these areas. Therefore, mapping the existing evidence in this field is extremely important, as it enables the effective use of available evidence and highlights important gaps for future research. This paper reviews empirical studies and synthesises findings on nut consumption and its association with CVD risk among adults in LMICs.

METHODS

The study employed a scoping review, a systematic literature search designed to determine the number and characteristics of studies on a particular topic [13]. The resulting eligible evidence can be synthesised as an evidence map to identify patterns or future research needs [14]. This review was conducted in accordance with the PRISMA extension for scoping reviews reporting guidelines and the Joanna Briggs Institute scoping review framework [13,14].

Search strategies and study selection

The literature was searched across multiple databases to identify relevant studies for the review. Four databases were used to identify articles: PubMed/Medline, EBSCOhost, CINAHL, and Web of Science. The search and screening were conducted between June and September 2021. In each database, the following combination of keywords was used: [(“nut consumption OR cashews OR pistachios OR groundnut OR hazelnuts OR macadamias OR pine nuts OR peanuts OR Brazil nuts OR almonds OR walnuts”) AND (“cardiovascular disease OR coronary heart disease OR heart disease OR CVD OR lipid profile OR metabolic disease OR fasting blood sugar OR diabetes OR stroke OR heart attack OR high blood pressure OR hypertension”) AND (“low-middle-income countries OR “LMICs” OR “developing countries”)]. In addition to using the term LMICs, efforts were made during screening to identify studies conducted in specific LMICs, even when not explicitly indexed under LMICs’ terminology. To enhance the comprehensiveness of searches, citations selected for full-text review were also utilised for reference list searches (backwards reference search) and cited reference searches (forward reference search). A total of 3020 articles were retrieved from all databases. Following the application of filters, 1404 articles were retained for title and abstract screening. Of these, only 247 articles were subsequently selected for full-text review. The search was limited to articles published in English.

Inclusion and exclusion criteria

The inclusion criteria for the reviewed studies included studies published between 2011 and 2021. These studies were: 1) Research conducted in low- and middle-income countries on unprocessed nuts and cardiovascular health diseases and their risk factors; 2) Reviews on the effects of nuts on CVD or its risk factors in low- and middle-income countries; 3) Publications on nuts consumption and CVD and its risk factors in LMICs since 2011.

The review excluded the following: 1) Publications on nuts that did not focus on the direct risk factors of CVD; 2) Studies on nuts conducted in animals; 3) Studies that utilised processed nuts such as peanut butter; and 4) Studies that lacked publication dates.



Data screening

According to the eligibility criteria, all records were independently screened by two reviewers (B.D.O and B.A.T). Screening was conducted in two stages: first at the title and abstract level, where one reviewer (B.D.O) performed the initial selection of potentially relevant articles, which was then verified by the second reviewer (B.A.T). Articles deemed relevant underwent full-text screening, during which both reviewers conducted a thorough assessment. The screening protocol was piloted on six articles to ensure consistency. Any disagreements were resolved by the third reviewer (X.G.M).

Data charting and information assessment

The primary author created a data charting form. The chart box was developed and tested in several studies to ensure that the essential information needed to answer the review questions was extracted (Table 1). The variables included the author's name, year of publication, the country of origin where the study was conducted, the study's aim or purpose, the study population and sample size, the design or type of study, the methods used, types of interventions, control group, duration of the study or intervention, and the outcomes along with key findings that relate to the review questions.

Selection of sources of evidence

Figure 1 provides a visual representation of the methodological and screening process. The systematic search of the literature yielded 1404 studies [PubMed: (n = 644), CINAHL: (n = 164), Scopus: (n = 263), and EBSCOhost: (n = 333)], with 28 excluded as duplicates or not relevant to the current study. After all filters were applied, 1404 studies remained and underwent abstract and title screening. Of these, 1316 studies were excluded, leaving 91 studies for full-text screening. Of these, 72 were excluded for various reasons, as shown in Figure 1. Thus, only 19 studies were eligible for review.

Description and characteristics of included studies

The review yielded 19 studies from four different databases. A summary of the descriptive characteristics of these datasets and studies is presented in Table 1. The included studies were from Iran (n = 7), followed by China (n = 4), Brazil (n = 3), India (n = 2), and one study each from Pakistan, Turkey, and Tunisia. The participants in these studies ranged in age from 19 to 95 years. The duration of the studies ranged from 6 to 13 years for observational studies and from 6 to 24 weeks for intervention studies. More than half of the studies (58%) employed RCTs as interventions.

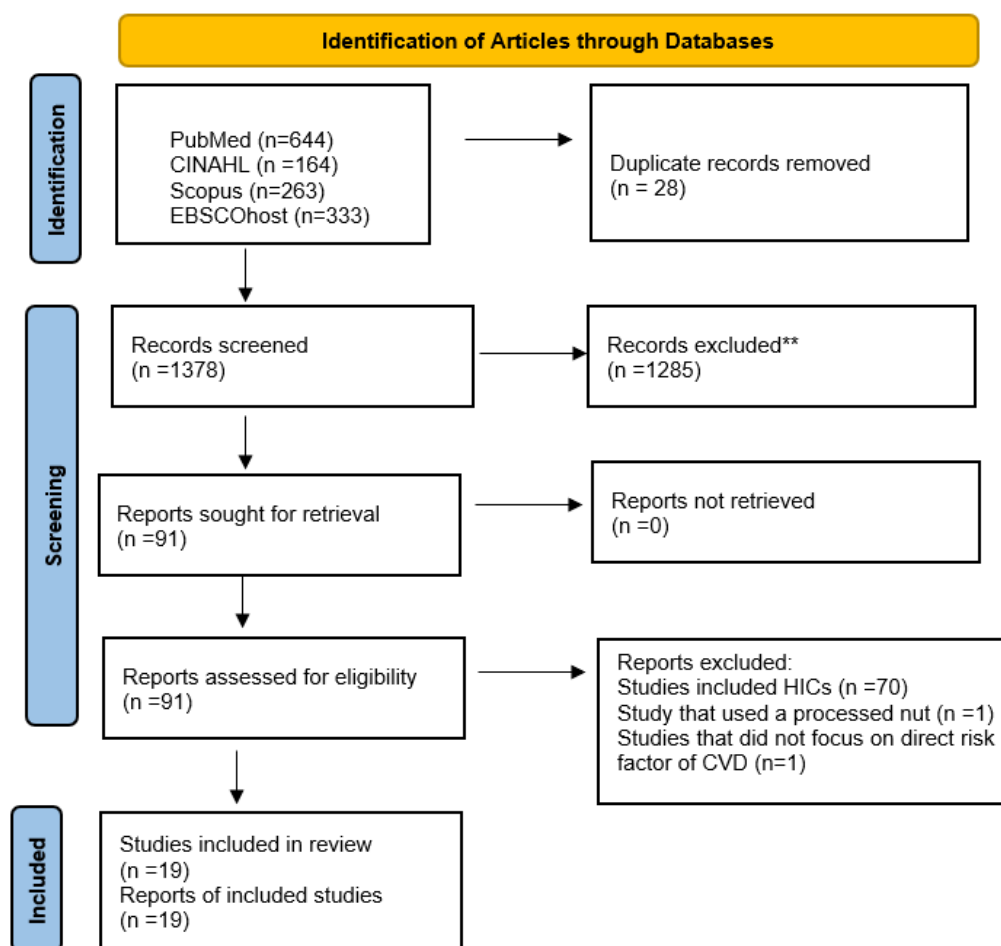


Figure 1: Prisma flow diagram showing identification, screening and inclusion of articles in the study

RESULTS AND DISCUSSION

Characteristics of included studies

Table 2 shows that six observational studies and 13 intervention studies were conducted in LMICs on nuts and CVD risk factors between 2011 and 2021. The review shows almonds as the most consumed nut in LMICs over the past ten years, with three of the included studies exclusively on almonds and an additional two on Baru almonds. In contrast, cashews, pecans, pistachios, hazelnuts, and walnuts have been the least studied nuts in LMICs during the same period (Figure 2).

Number of studies	Types of nuts	Studied countries
1	Hazelnuts	Turkey
1	Pecan	Brazil
1	Pistachios	Iran
1	Walnuts	Tunisia
2	Peanuts	China
2	Baru almonds	Brazil
2	Cashew nuts	India & Iran
3	Almonds	India, China & Pakistan
6	Mixed nuts	1 in China & 5 in Iran

Figure 2: Types of nuts used in the reviewed studies

The effect of nuts consumption on diabetes in LMICs had the most research studies (42%) compared to other risk factors such as lipid, metabolic syndrome and high blood pressure. One cohort study [15] and seven randomized trials [10,17 - 20] have explored the effects of various nuts on type 2 diabetes mellitus (T2DM). All but one of these studies reported a positive impact of nuts on diabetes and overall glycemic index [15]. The findings of this study on nuts and diabetes align with those from similar research conducted in the United States and China [22, 23].

Effects of nuts consumption on diabetes in low- and middle-income countries

Several studies have linked nut consumption to a reduced risk of T2DM [18,19,22,24]. A study by Asghari *et al.* [24] found an association between nut consumption and a low risk of T2DM. Similarly, Li *et al.* [22] reported that almond intake positively affected glycemic control and CVD risk factors in China. In contrast, Gulati *et al.* [19] reported notable improvements in the glycemic index among T2DM patients after 24 weeks of nut consumption in India. In Iran, Parham *et al.* [21] reported that 24-week pistachio supplementation substantially decreased blood glucose concentrations in patients with T2DM. In India, an RCT evaluating the inclusion of 30g/day of cashew nuts in a standard diabetic diet found a 16-fold increase in high-density lipoprotein cholesterol (HDL-C) compared to the control group [10]. Another RCT in Iran studied patients with T2DM aged 30–75 years who consumed 10% of their total daily calories from cashews, reporting reductions in serum insulin levels and the low-density lipoprotein cholesterol (LDL-C)/HDL-C ratio [17].

While diabetes is the most frequently studied CVD risk factor concerning nut intake, further research is still needed to strengthen recommendations on their potential role in managing diabetes. Expanding studies across diverse regions would help clarify their effects on glycemic control and metabolic health.

Effects of nuts on lipid profiles in low -and middle-income countries

Lipid profiles are among the most extensively researched CVD risk factors in relation to nut consumption in LMICs, accounting for 32% of the reviewed studies [15,16,25-29]. While this focus is expected, studies examining the link between nut consumption and lipid profiles have also been widely conducted in high-income countries (HICs).

This review includes one observational study [16] and six RCTs [15,25-29] that explore the effects of nut intake on lipid profiles. Although similar methodologies were used, the findings vary. Some studies reported an inverse relationship between nut consumption and total cholesterol (TC), triglycerides (TG), and LDL-C [25,28,29], whereas others found a direct correlation between nut intake and HDL-C [16,26,27].

Askari *et al.* [16] investigated nut consumption and lipid profiles among Iranian adults, revealing that higher nut intake was associated with lower TC, TG, and LDL-C in females and lower TG and LDL-C in males. However, no significant association was found between nut consumption and HDL-C. These findings align with studies conducted in HICs, which demonstrated reductions in TC, TG, and LDL-C with increased nut consumption [11,12]. However, other studies observed decreases in only one or two lipid parameters, with no significant changes in HDL-C [6,7]. Some studies reported increases in HDL-C over time [8,10], while others found no noticeable effect [9,13]. These inconsistencies suggest that additional factors may influence the effects of nut consumption on lipid profiles, warranting further investigation.

Regional variations in the prevalence of dyslipidemia may contribute to differences in study outcomes. For instance, Nigerian research indicates that low HDL-C is the most common form of dyslipidemia, whereas high TG levels are the least prevalent [29]. Globally, hypercholesterolemia remains widespread, with elevated LDL-C being a significant contributor to ischemic heart disease and stroke. Jamshed *et al.* [27] examined the impact of almonds on low HDL-C in patients with coronary artery disease in Pakistan, finding that HDL-C levels increased by 12–14% after six weeks and 14–16% after twelve weeks. Similarly, an eight-week diet enriched with 20g of Baru almonds was shown to raise HDL-C levels in overweight and obese Brazilian women [26]. In Brazil, an RCT comparing a diet enriched with pecan nuts to one supplemented with extra-virgin olive oil in individuals with stable coronary artery

disease found that pecan nuts did not significantly improve LDL-C levels after 12 weeks [15].

Effects of nuts consumption on metabolic syndrome in low- and middle-income countries

Metabolic syndrome (MetS) comprises a cluster of conditions that heighten the risk of CVD and other serious health issues. It is characterized by abdominal obesity, high blood pressure, (HBP) elevated blood sugar levels, and abnormal lipid profiles [30]. Over the past decade, three studies have explored the relationship between nut consumption and the incidence, severity, and reversal of MetS in LMICs: two prospective studies [31,32] and one RCT [33].

Hosseinpour-Niazi *et al.* [32] investigated the association between nut intake and the incidence of MetS among 1,265 Iranian adults. Their findings demonstrated that frequent nut consumption, more than five servings per week, was associated with a 32% lower risk of MetS, even after adjusting for confounding factors. A population-based study in 1,387 Iranian adults aged 35 and older, followed for 13 years, reported that higher nut intake was associated with a lower likelihood and severity of MetS [31]. Additionally, an RCT evaluated the impact of replacing white rice bars with peanuts as snacks in individuals with MetS or at risk of developing it. After 12 weeks of intervention, participants in the peanut group demonstrated a higher MetS reversal rate than those in the control group [33].

This review highlights that nut consumption has been studied three times in LMICs regarding the incidence, severity, and reversal of MetS. Findings from these studies suggest that frequent nut intake, whether over a short or extended period, reduces the risk of developing MetS, mitigates its severity, and enhances its reversal rate. The prospective studies lasted six and 13 years, respectively, while the RCT spanned 12 weeks. Despite differences in study design and duration, their results were consistent.

These findings align with research conducted in HICs. A U.S. study revealed that nut consumption improved MetS in adolescents [34]. In contrast, another study in Spain demonstrated a significant association between nut intake and a reduced risk of developing MetS after six years of follow-up among Spanish graduates [35]. The similarities in research findings across LMICs and HICs suggest that nut consumption may be universally effective in mitigating the risk of MetS. Establishing recommended intake levels for nuts may help manage MetS in LMICs, ultimately reducing the prevalence of CVD and its associated morbidity and mortality.

Effects of nut consumption on high blood pressure in low- and middle-income countries

This review found that only two studies have examined the relationship between nut consumption and blood pressure in LMICs [10,36]. One was a cross-sectional survey in Iran involving 9,660 participants that assessed the association between nut intake and blood pressure among Iranian adults. After accounting for confounding factors, the study revealed an inverse correlation between nut consumption and both systolic and diastolic blood pressure in men and women [36]. These findings align with a review by Jalal *et al.* [37], which shows that nut consumption has beneficial effects on HBP.

The second study was a parallel-arm RCT conducted in India, focusing on patients with T2DM [10]. Participants consumed 30g of cashew nuts daily alongside a standard diabetic diet. Results indicated that cashew nut intake led to a reduction in systolic blood pressure (SBP) but had no significant effect on diastolic blood pressure (DBP) [10]. Additionally, a systematic review and meta-analysis assessing the effects of cashew nut consumption on HBP. The study shows that diets containing pistachios reduce SBP and peripheral vascular response to stress in adults. The review confirmed that cashew nuts specifically lowered SBP, with no observed impact on the lipid profile and DBP [37]. Similarly, a study by Feng *et al.* [38] in China, involving 11,130 (72.9%) participants who consumed <35g/day of nuts, showed that cashew nuts reduced SBP but had no effect on DBP.

Cashew nuts and cardiovascular disease risk factors in low- and middle-income countries

Cashew nuts are particularly noteworthy in this study due to their exclusion from the United States Food and Drug Administration list of healthy nuts. This decision was based on insufficient research regarding their lipid-lowering effects and their saturated fat content, which exceeded the Food and Drug Administration's threshold [39]. In response, Mah *et al.* [40] conducted a randomized isocaloric, crossover-controlled feeding trial in the United States in 2016 to evaluate the impact of cashew nut consumption on lipid profiles. The study involved 25 adults with or at risk of dyslipidemia, who consumed between 28 and 64 grams of cashew nuts daily alongside a typical American diet. The trial included two 28-day intervention periods with a two-week washout phase. Findings revealed a significant reduction in TC, LDL-C, and non-HDL-C following cashew nut intake [40].

Similarly, Baer and Novotny [41] conducted a randomized crossover study in 2018 to examine the effects of cashew nuts on CVD risk factors. This study recruited 42 healthy adults in Washington, DC, who consumed 42 grams of cashew nuts daily for four weeks. Unlike the study from Mah *et al.* [40], the results showed no significant impact on HBP or lipid profile components. Given that both studies were conducted

in the same country with similar participant groups, diets, and cashew nut intake, these findings suggest that additional, yet unclear, factors influence the effects of cashew nuts on CVD risk factors. Despite widespread cashew nut consumption in LMICs, there remains a gap in empirical research regarding their specific effects on CVD risk factors. Further studies are necessary to address this uncertainty.

The gaps existing in the knowledge of nuts and cardiovascular disease risk factors in low- and middle-income countries

Although the relationship between nuts and CVD risk factors has been studied in LMICs, it has not been extensively studied in Africa. No systematic, scoping, or traditional review that synthesised the effects of nuts and CVD risk factors in LMICs was located during the review. Apart from Iran, where extensive observational studies have examined the relationship between nuts and CVD, no similar studies have been conducted in other countries. No study was found to have examined the association between nuts and CVD morbidity and mortality in LMICs.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

This scoping review mapped the available evidence on nut consumption and CVD risk factors in LMICs. The studies identified were limited in number and varied in design, but generally reported associations between nut intake and positive outcomes for risk factors such as diabetes, lipid profiles, blood pressure, and MetS. Given the limited evidence and heterogeneity across studies, these findings should be interpreted cautiously and not as proof of effectiveness or universal benefit. Further research is necessary, especially in LMICs' regions where studies are scarce, to strengthen the evidence base and support to future systematic reviews and meta-analyses with a more inclusive list of country names. Research on cashew nut consumption is particularly limited in Africa and globally; more studies examining its relationship with CVD risk factors could help address existing knowledge gaps and clarify current uncertainties.

STUDY LIMITATIONS

The primary limitations of this scoping review include the timeframe of analysis, the number of electronic databases consulted, the synthesis of existing evidence without in-depth critical appraisal, language restrictions, and limited stakeholder consultation. The search strategy relied primarily on general LMICs' terms, related terms and may have excluded studies indexed solely under individual country names, potentially limiting comprehensiveness. Notably, only one study has been conducted in Africa, highlighting the urgent need for broader research efforts in LMICs. Expanding investigations on nut consumption and its effects on cardiovascular health could strengthen dietary recommendations and interventions, ultimately helping to reduce CVD-related morbidity and mortality in these regions.

The review was restricted to English-language publications, which may have resulted in the exclusion of relevant studies published in other languages, particularly from LMICs. This may have introduced language bias.

CONFLICT OF INTEREST

The authors declare no conflict.

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N/A.

AUTHOR CONTRIBUTIONS

D.B.O, A.B.T, M.K.Z & X.G.M were responsible for the study concept. D.B.O and X.G.M designed the review. D.B.O designed methods and performed the literature search. D.B.O and A.B.T selected articles that met the inclusion criteria. D.B.O performed data extraction. D.B.O, Z.N.N, M.K.Z and A.B.T analysed the data. All authors drafted the manuscript, performed critical revisions, and read and approved the final manuscript.

Table 1: Characteristics of the included articles

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
1	Hou <i>et al.</i> [18]	China	Assess the impact of peanuts and almonds in a low-carb diet on cardio-metabolic and inflammatory markers in T2DM patients.	Diabetes mellitus patients aged 40-80 years. 32	Participants were randomly divided into peanut and almond groups, with males consuming 60g and 55g, respectively, and females consuming 50g and 45g. Both groups followed a low-carb diet, with measurements taken at baseline and post-intervention.	Randomized Controlled Trial. 12 weeks	The intervention showed no significant differences in FBG or PPG levels between the peanut and almond groups. Consumption of peanuts or almonds did not affect BMI or the blood lipid profile.	Peanuts and almonds have positive and similar effects on blood glucose in people with diabetes, but they have no effect on lipid profile parameters.
2	Campos <i>et al.</i> [15]	Brazil	Assess the effect of a healthy diet, enriched or not with pecan nuts or extra-virgin Olive oil, on the lipid profile of patients with	Patients with stable coronary artery disease for more than 60 days. Aged 40-80 years.	Participants were randomized into three groups: control, pecan nut, and olive oil. All followed healthy diets, with the Pecan group adding 30g of pecans and the Olive Oil group adding 30 ml of extra-virgin olive oil. Measurements were taken	Randomized clinical trial. 12 weeks	The study found no differences in LDL-C, HDL-C, LDL/HDL, or HDL/TG ratios between groups, but the pecan nut group showed a significant decrease in non-HDL-C levels and the TC/HDL ratio.	Pecan nuts may improve lipid components except LDL-C in Brazilian adults with stable coronary artery disease.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			stable coronary artery disease.	204	at baseline and post-intervention.			
3	Mohan <i>et al.</i> [10]	India	Investigate the effects of cashew nuts supplementati on on glycemia, body weight, blood pressure and lipid profile in Asian Indians with T2DM.	Asian Indian adults diagnosed with T2DM, aged 51 +9.3 years. 300	Participants were assigned to follow a standard diabetic diet (control) or the same diet plus 30g of raw cashew nuts daily. Measurements were taken at baseline and after 12 weeks to compare group changes.	Parallel-arm randomized controlled trial 12 weeks	Participants in the intervention group had a 1.9-fold greater reduction in SBP compared to controls and a 16-fold increase in HDL-C compared to controls. However, the two groups had no changes in other lipid parameters, such as FBG, body weight, BMI, or waist circumference.	Intake of 30g of cashew nuts per day in addition to a standard diabetic diet in Asian Indians with T2DM for 12 weeks, significantly increases HDL-C and reduces SBP.
4	Hassan nejad <i>et al.</i> [31]	Iran	Assess the associations between nut intake and the risks and severity of metabolic syndrome.	Iranian adults aged 35 years and above	A 48-item FFQ collected dietary data during face-to-face interviews at three study times. Participants were followed for 13 years to analyze the link between nut intake and metabolic syndrome.	A prospective, community-based cohort study.	Nut's intake was negatively related to the long-term risk of developing metabolic syndrome. The odds ratios for the risk and severity of metabolic syndrome (MetS) decreased with higher nut	Frequent nut consumption has a beneficial effect on the risk and severity of MetS in Iranian adults. A LMICs.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
				1387		13 years	intake compared with lower intake.	
5	Gulati <i>et al.</i> [19]	India	Investigate the effects of daily consumption of almonds for 24 weeks in T2DM patients on glycemic control and cardiovascular risk factors.	Indian Adults with T2DM, aged 25-70 years 63	Participants completed a 3-week exercise run-in period and received raw almonds (20% energy intake) and diet and activity counselling. Assessments included anthropometry, blood pressure, glycemia, lipid profiles, and atherosclerosis markers at baseline and post-intervention.	Pre-post intervention design 24 weeks	After the intervention, anthropometrics, glycemic and lipid parameters were significantly improved.	Almond supplementation for 24 weeks improved cardiovascular disease risk factors in Asian Indians who have T2DM
6	Parham <i>et al.</i> [21]	Iran	Evaluate the effectiveness of pistachio nut supplementation on glycemic and inflammatory	Iranian adults with T2DM 48	Participants were divided into Groups A and B. Group A consumed 25g of pistachios twice daily for 12 weeks, while Group B received a nut-free control meal. After a 12-week intervention and 8-week washout, the groups	Double-blind, randomized, placebo-controlled, crossover trial	There was a marked decrease in Hemoglobin A1c (HbA1c) (-0.4%) and FBG concentrations (-16mg/dl) in the pistachio group compared to the control. However, there was no significant change in	Dietary consumption of pistachio nuts as a snack has beneficial effects on glycemic control and no significant effect on blood pressure in diabetic patients

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			measures in T2DM.		swapped diets. Measurements were taken at the start and end of each study period for comparison.	24 weeks	BMI, blood pressure, and C- reactive proteins	
7	Bento <i>et al.</i> [28]	Brazil	Evaluate the effect of Baru almonds supplementati on on lipid profile and oxidation in mildly hyper- cholesterolemi c subjects.	Mildly hypercholest erolemic adults aged 21-57 years. 25	A randomized, controlled, 2 period cross-over design was used with 2 treatments: 20g of Baru almonds and placebo. Participants were randomly assigned to receive 1 of the 2 treatments in alternating periods for six weeks, and 4-week washout period was incorporated. The treatment effect was determined by estimating the difference between the baseline and the end of each treatment.	A randomize controlled cross-over trial 16 weeks	Compared to placebo, supplementation of Baru almonds reduced TC ($-8.1 \pm 2.4\%$ $p=0.007$), LDL-C ($-9.4 \pm 2.4\%$ $P=0.006$) and non-HDL-C ($-8.1 \pm 30\%$ $P=0.013$)	Supplementation of almonds mildly Hypercholesterolemic adults improved serum lipid parameters.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
8	de Souza <i>et al.</i> [26]	Brazil	Evaluate the effects of a baru-almond enriched diet on body composition and Markers of lipid metabolism in overweight and obese women.	Obese and Overweight Brazilian women 46	Participants were randomly assigned to a baru almond-enriched diet or a baru almond-free diet. Both groups received dietary instructions. Body composition, blood pressure, glucose level, lipid profile, and plasma fatty acids were determined at Baseline and post-intervention.	Randomized, Placebo-controlled clinical trial 8 weeks	The baru almond group participants had a reduced waist circumference, cholesteryl ester transfer protein expression and increased HDL-C compared with the control.	A Baru almond-enriched diet for 8 weeks improved HDL-C in overweight and obese women in Brazil, a LIMC.
9	Li <i>et al.</i> [22]	China	Investigate the effect of almond consumption on glycemic control and risk of cardiovascular disease on 20 Chinese	Chinese Adults with T2DM 20	Participants followed a control or almond diet for 4 weeks after a 2-week run-in period, with a 2-week wash-out between diets. During run-in and wash-out, they consumed their habitual diets. Four fasting blood samples and anthropometric data were	Randomized cross-over trial	The almond group showed higher plasma α -tocopherol, reduced TC, LDL-C, LDL-C/HDL-C ratio, fasting insulin, fasting glucose, and insulin resistance compared to the control diet.	Almond consumption decreased TC, LDC-C, and ratio of LDL-c to HDL-C as well as FBG in Chinese Adults with T2DM.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			patients with T2DM		collected before and after each diet.	12 weeks		
10	Wang <i>et al.</i> [33]	China	Assess the impact of replacing white rice bars with peanuts on fasting glucose, lipid profile, body weight, and metabolic syndrome status in individuals with or at risk of MetS.	Chinese adults with or at risk of metabolic syndrome. 224	Participants were randomly assigned to intervention and control groups. The intervention group consumed 2 packs of roasted, lightly salted peanuts daily, while the control group consumed energy-matched white rice snacks. Outcomes were measured at baseline and after 12 weeks.	Parallel arm Randomized controlled trial 12 weeks	At the end of the study, no between-group differences were found for improvements in fasting glucose, HDL-C, waist circumference, and body weight. However, participants in the peanuts group had a significantly higher MetS reversion rate than those in the control group.	Consumption of peanuts for 12 weeks did not significantly affect FBG and HDL-C in Chinese adults with or at risk of MetS.
11	Kamoun <i>et al.</i> [25]	Tunisi a	Investigate the effect of walnut consumption on lipid profile,	Healthy elderly men undergoing a resistance and	Participants were divided into two matched groups and trained three times weekly. The intervention group added 15g of walnuts	Randomized controlled Trial. (a pilot study)	Concurrent training with 15g of walnut daily for six weeks significantly decreased TC, LDL, and TG at 13%, 18%, and 18.5%, respectively, at	Six weeks of moderate walnut supplementation improved lipid profile in aged men performing

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			steroid hormones and inflammation in trained elderly men performing concurrent training.	endurance training. 20	daily, while the control group followed their habitual diet without walnuts. Fasting blood samples were collected 48 hours pre- and post-intervention for analysis.	6 weeks	($P < 0.01$ for all). Testosterone increased after the training compared to pre-training only for the walnut group.	concurrent training in Tunisia.
12	Darvish <i>et al.</i> [17]	Iran	Investigate the effect of cashew nut intake on oxidative stress and atherogenic indices in patients with T2DM.	Iranian adults aged 30-75 years with T2DM 50	Participants were randomly assigned to experimental and control groups. The experimental group consumed 10% of daily calories from cashews for 8 weeks, while the control group had none. Blood samples were taken after 10–12 hours fasting at baseline and 8 weeks.	Randomized Controlled Feeding Trial. 8 weeks	At the end of the 8 th week, there was no significant change in weight, BMI, and waist circumference in the two groups. However, Serum insulin and LDL-C to HDL-C ratio decreased significantly in the cashew group compared with the control.	Daily intake of cashew nut reduced serum insulin and LDL-C to HDL-C ratio in Iranian adults with T2DM.
13	Asim <i>et al.</i>	Turkey	Investigate the antiatherogenic effect of	Hypercholesterolemic	This was a double control sandwich model intervention with a single	Double control Sandwich	Hazelnut-enriched diet significantly improved FMD, TC, Triacylglycerol, HDL-C	A hazelnut-enriched diet may exert a lipid-lowering effect on

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
	[29]		hazel nut before and after consumption in hypercholesterolemic patients.	adults in Turkey 21	group and three isoenergetic diet periods. Diet period I (control diet) Diet period II (18-20% of daily energy intake enriched with hazelnut). Diet period III (control diet period II). Each diet period lasted for 4 weeks. CVD risk biomarkers, such as endothelial function and LDL oxidation, were monitored. The effect of hazelnut-enriched diet was compared with control diet I and II.	model intervention 12 weeks	compared with the control diets. Oxidised-LDL, hs-CRP, and SVCAM-1 levels were significantly lower in a hazelnut-enriched group compared with control diets I and II.	hypercholesterolemic patients in Turkey.
14	Jamshe d <i>et al.</i> [27]	Pakistan	Test the effect of almond supplementation on HDL-C in coronary	Coronary Artery Patients in Pakistan	Participants were randomly assigned to the control, Pakistan almond, and American almond groups. The almond groups consumed 10g/day before	Randomized Controlled Trial	Almonds significantly increased HDL-C. At week 6 and week 12, HDL-C was 12-14% and 14-16% higher respectively in the two	A low dose of almonds at 10g/day consumed before breakfast, can increase HDL-C in coronary artery disease patients in Pakistan.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			artery disease patients.	150	breakfast. Vital signs, physical activity, blood pressure, weight, and blood samples were measured at baseline, week 6, and week 12.	12 weeks	intervention groups than their respective baseline.	
15	Sun <i>et al.</i> [20]	China	Examine the associations between nut consumption and cardiovascular risk in the non-Western setting of southern China.	Chinese elders aged 50-95 years. 11,728	Nut consumption was assessed using a validated 300-item FFQ covering five standard nuts from southern China, reported as weekly portions. Linear regression analyzed associations with Framingham score, blood pressure, lipids, and fasting glucose.	Cross-sectional study. 11,728	No association was found between nut consumption and Framingham score, SBP, DBP, HDL-C, LDL-C, or fasting blood sugar.	Nut consumption does not significantly affect blood pressure, or lipids in elderly men from southern China.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
16	Hossein pour- Niazi et al. [32]	Iran	Assess the association of various types of nuts and total nut consumption on the incidence of metabolic syndrome.	Adults from Iran, aged 19-74 years. 1265	Part of the Tehran Lipid and Glucose Study followed participants for 6.2 ±0.7 years (phase III to V). Nut consumption data was collected using a 168-item FFQ, and blood samples were taken at baseline and follow-up after 12–14 hours of fasting. Anthropometric measurements, lipids, and FBG were also measured.	Prospective population- based study. 6.2± 0.7 years	During follow-up, 276 new cases of MetS emerged among the participants. Walnut consumption was associated with reduced risk of MetS independent of confounders. Those who consumed more than 5 portions weekly had a 32% lower risk of MetS than non- consumers.	Walnut is associated with a reduced risk of MetS in Iran.
17	Sun <i>et al.</i> [20]	Iran	Investigate the association between nut consumption and the incidence of T2DM in a Middle Eastern population.	Adults from Iran aged ≥ 20. 1984	Part of the Tehran Lipid and Glucose Study followed 1,984 diabetes-free participants for 6.2 years (phase III to V). Dietary data were collected using a validated 168-item FFQ, and blood samples were taken at baseline and	Cohort Study	Nut consumption was associated with a lower risk of T2DM, which suggested that consuming ≥ 4 servings per week of nuts, reduced the risk of T2DM compared to < 1 serving/week.	Nut consumption is associated with lower risk of T2DM in adults in Iran.

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
					follow-up for analysis. Logistic regression calculated odds ratios and confidence intervals.	6.2± 0.7 years		
18	Yazdekh asti <i>et al.</i> [36]	Iran	Investigate the relationship between nut consumption and blood pressure in an Iranian adult population.	Adults from Iran. 1660	Data from the Isfahan Healthy Heart Program employed a cross-sectional design. Nut consumption frequency was assessed via FFQ, and blood pressure was measured twice using standard procedures. Regression analyses examined the link between nut consumption, blood pressure, and hypertension.	Cross- sectional study	After adjusting for confounders in the fully multivariable-adjusted model, more frequent nut consumption was associated with a lower risk of SBP and DBP in men and women.	Frequent nut consumption is inversely related to hypertension in Iranian adults.
19	Askari <i>et al.</i> [16]	Iran	Assess the relationship between nut consumption and lipid	Adults from Iran, aged ≥ 19 years.	The Isfahan Healthy Heart Program used a cross- sectional design to assess nutritional behaviours through a validated 48-item FFQ, focusing on walnut,	Cross- sectional survey	This study reported a significant link between high nut consumption and lower TC, and LDL-C in female	Frequent nut consumption is associated with reduced TC, LDL-C and TG levels in Iranian adults

S/N	Author (Year)	Country of Origin	Aims/ Purpose	Study population & sample size	Methodology	Intervention type & duration of study	Outcomes and details	Key findings relating to the review questions
			profile among Iranian adults.	9660	almond, pistachio, and hazelnut intake. Analysis of Covariance and logistic regression determined hyperlipidemia odds and 95% confidence intervals across nut consumption patterns in unadjusted and adjusted models.	9660	subjects and lower TG and LDL-C in male subjects	

FBG: fasting blood glucose; PPG: post-prandial glucose; BMI: body mass index; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol

Table 2: Effects of nuts on cardiovascular disease risk factors in LMICs

Number	Author/ Year	Risks examined	Effects of nuts on CVD risk factors
	Campos <i>et al.</i> [15]	Lipid profile	A healthy diet plus 30g of pecan nuts per day did not significantly improve LDL [Primary outcome], HDL, LDL/HDL ratio, and HDL/TG ratio, but it significantly reduced non-HDL-C levels [114.9 (31) mg /dL; P = 0.033] and the TC/HDL-c ratio [3.7 (0.7) P = 0.044] compared to the control in patients with stable CAD
	de Souza <i>et al.</i> [26]	Markers of lipid metabolism	A diet enriched with Baru almonds increased HDL concentrations (+4.82mg/dL; 95%ci,0.03-8.88; P=0.04) compared with a Baru almond-free diet.
	Bento <i>et al.</i> [28]	CVD risk factors	Supplementation of 20 g Baru almonds in mildly hypercholesterolemic patients reduced TC (- 8.1 ± 2.4%, P = 0.007), LDL-C (-9.4 ± 2.4%, P= 0.006) and non-HDL-C (-8.1 ± 3.0%, P = 0.013)
	Wang <i>et al.</i> [33]	FBG, lipid profile, MetS	The isocaloric substitution of white rice bars with peanuts did not produce significant changes in FBG and lipid profiles different from the control group. However, participants in the peanut group had a significantly higher Mets reversion rate (no longer meeting Mets criteria after the 12-week trial) than those in the control group (Relative Risk RR: 2.33; 95% Confidence Interval CI: 1.10, 4.89; P = 0.026)
	Hou <i>et al.</i> [18]	Glycaemic control, Lipid profile.	Peanut and almond nuts independently decreased FBG and PPG levels (p < 0.05). No statistically significant differences between peanuts and almonds concerning the FBG and PPG levels were found. Almonds and peanuts did not affect any lipid parameter
	Sun <i>et al.</i> [23]	Lipid profile, BP, FBG	Nut consumption, mostly peanuts, was not associated with TC, TG, HDL, LDL, SBP, or DBP). However, nuts were said to have a positive association with FBG, as those who consumed nuts >3 portions/week had FBG 0.2 mmol/L higher than people who never consumed nuts on average in older Chinese aged >50 years

Number	Author/ Year	Risks examined	Effects of nuts on CVD risk factors
	Li <i>et al.</i> [22]	Glycaemic control, lipid profile	Almond intake at 20% of the total calorie daily decreased TC, LDL-C, and HDL-C ratio by 6.0% (1.6-9.4), 11.6% (2.8-19.1), and 9.7% (0.3-20.9), respectively in T2DM patients compared with those in the control diet, those in the almond diet had lower levels of fasting insulin 4.1% (0.9-12.5), FBG 0.8% (0.4-6.3), and homeostasis model assessment of IRI 9.2% (4.4-13.2)
	Mohan <i>et al.</i> [10]	Lipid profile, BP, FBG.	A standard diabetic diet plus 30 g of cashew nut daily in T2DM patients SBP from baseline to 12 weeks than did controls (-4.9 ± 13.7 compared with -1.7 ± 11.6 mm Hg; $P = 0.04$) and a greater increase in plasma HDL-C compared with controls ($+1.7 \pm 5.6$ compared with $+0.1 \pm 4.6$ mg/dL; $P = 0.01$). but did not affect other lipid parameters
	Gulati <i>et al.</i> [19]	Lipid profile, measures of glycemia. BP	Daily consumption of raw almonds at 20% of energy in T2DM patients showed statistically significant improvements in levels of TC ($P = 0.002$), TG ($P = 0.004$), LDL-C ($P = 0.01$), very low-density lipoproteins cholesterol VLDL-C ($P = 0.007$), and high sensitivity C-reactive protein (hs-CRP ($P = 0.01$) postintervention. HDL-C did not change. FBG levels did not show a significant change throughout the study. Statistically significant improvement was seen in levels of HbA1c ($P = 0.04$) compared with the control diet
	Hassannejad <i>et al.</i> [31]	MetS	Nut intake showed a significant inverse association with the risk and severity of MetS after a 13-year follow-up in Iranian adults; a significant inverse association was found in the severity of MetS (the number of positive criteria) in the second quartile of nuts compared with the lowest quartile (OR: 0.77, 95% PI: 0.63e0.96; P trend: 0.03), and with MetS risk among participants in the second quartile compared with the lowest quartile (OR: 0.76, 95% PI: 0.59e0.96; P trend: 0.14)
	Damavandi <i>et al.</i> [17]	Glycaemic control, lipid profile	Substitution of 10% of daily total energy intake with cashew nuts in T2DM patients significantly reduced serum insulin and (LDL-C/HDL-C) ratio compared with the controls ($P = 0.01$ & $P = 0.04$)

Number	Author/ Year	Risks examined	Effects of nuts on CVD risk factors
	Hosseinpour-Niazi <i>et al.</i> [23]	Incidence of MetS	Walnut consumption showed a significant, inverse association with MetS risk; associations for other nut varieties were insignificant. For each additional serving/week of walnuts consumed, the incidence of Mets decreased by 3% (Odds Ratios: 0.97, Confidence Interval: 0.93–0.99), after adjusting for confounders
	Asghari <i>et al.</i> [25]	Incidence of T2DM	After 6.2 ± 0.7 years of follow-up, comparing those who consumed ≥ 4 servings/week with those who consumed < 1 serving/week, the age-/energy-adjusted OR of incident T2DM for total nut consumption was 0.64 (95% CI: 0.36–1.12; <i>P</i> for trend = 0.03). In a fully adjusted model, nut consumption was associated with a lower risk of T2DM. The ORs (95% CIs) of risk for those consuming 2–3.99 and ≥ 4 servings/week of nuts were 0.51 (0.26–0.97) and 0.47(0.25–0.90), respectively, compared with those consuming < 1 serving/week (<i>P</i> < 0.001 for trend)
	Parham <i>et al.</i> [21]	FBG and HbA1c	Pistachio nut consumption at 50 g/day in T2DM patients for 12 weeks decreased FBG from 151.36 ± 39.22 to 137.28 ± 28.65 mg/dl (-14 mg/dl) and HbA1c decreased from 7.42 ± 0.97 to 7.15 ± 0.68 mg/dl (-0.28%, <i>p</i> = 0.013 and <i>p</i> = 0.033, respectively), and reduced SBP (<i>p</i> = 0.007)
	Yazdekhosti <i>et al.</i> [36]	BP	After adjusting for potential confounders in the fully multivariable-adjusted model, more frequent nut consumption was associated with lower SBP and DBP in men and women. The prevalence of hypertension was 27.6% and 14.3% in participants who belonged to the lowest and highest categories of nut consumption, respectively
	Askari <i>et al.</i> [16]	Lipid profile	Frequent consumption of walnuts, almonds, pistachios and hazelnuts is significantly associated with reduced TC, TG, and LDL-C levels and apo B/apo A ratio (<i>P</i> < 0.05) in female subjects and lower TG, LDL-C and apo B/apo A ratio in male subjects ((<i>P</i> <0.05) but did not affect HDL-C in Iranian adults

Number	Author/ Year	Risks examined	Effects of nuts on CVD risk factors
	Jamshed <i>et al.</i> [27]	Lipid profile	Daily intake of 10 g of almonds significantly increased HDL-C. At weeks 6 and 12, HDL-C was 12–14% and 14–16% higher, respectively, compared to the baseline
	Kamoun <i>et al.</i> [25]	BG, Lipid profile	Concurrent training plus 15 g of walnut per day for six weeks significantly decreased TC, LDL-C, TG at the rate of 13%, 18%, and 18.5% respectively at ($P < 0.01$ for all) and increased the level of HDL-C compared to baseline at 19.8%, ($p < 0.01$)
	Asim <i>et al.</i> [29]	Lipid profile	Consumption of a hazelnut-enriched diet significantly improved flow-mediated dilation (FMD) (56.6%), TC (-7.8%), triacylglycerol (-7.3%), LDL-C (-6.17%), and HDL-C (6.07%) compared with the control diet

FBG= fasting blood glucose, CI= confidence interval, RR= relative risk, OR= odd ratios, HDL= high-density lipoprotein, MetS= metabolic syndrome, TG=triglycerides, LDL=low-density lipoproteins, TC=total cholesterol, VLDL-C= very low density lipoproteins cholesterol, PPG=postprandial glucose, T2DM=type 2 diabetes mellitus, FMD= flow-mediated dilation, SBP=systolic blood pressure, DBP=diastolic blood pressure, IRI= insulin resistance index, HbA1c=glycated haemoglobin, CAD= coronary artery disease

REFERENCES

1. **Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, Barengo NC, Beaton AZ, Benjamin EJ, Benziger CP and A Bonny** Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. *Journal of the American college of cardiology*. 2020 Dec 22; **76(25)**: 2982-3021. <https://doi.org/10.1016/j.jacc.2020.11.010>
2. **World Health Organization**. Cardiovascular diseases (CVDs) fact sheet. Geneva: WHO; 2023. Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)) Accessed on 5 May 2024.
3. **Guasch-Ferré M, Liu X, Malik VS, Sun Q, Willett WC, Manson JE, Rexrode KM, Li Y, Hu FB and SN Bhupathiraju** Nut consumption and risk of cardiovascular disease. *Journal of the American College of Cardiology*. 2017 Nov 14; **70(20)**:2519-32. <https://doi.org/10.1016/j.jacc.2017.09.035>
4. **Mensah GA, Fuster V, Murray CJ, Roth GA, Abate YH, Abbasian M, Abd-Allah F, Abdollahi A, Abdollahi M, Abdulah DM and A Abdullahi** Global burden of cardiovascular diseases and risks, 1990-2022. *Journal of the American College of Cardiology*. 2023; **82(25)**: 2350-2473. <https://doi.org/10.1016/j.jacc.2023.11.007>
5. **Mills KT, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, Chen J and J He** Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation*. 2016 Aug 9; **134(6)**:441-50. <https://doi.org/10.1161/CIRCULATIONAHA.115.018912>
6. **Gonçalves B, Pinto T, Aires A, Morais MA, Bacelar E, Anjos R, Ferreira-Cardoso J, Oliveira, O, Vilela A and C Fernanda** Composition of nuts and their potential health benefits—An overview. *Foods*. 2023; **12(5)**: 942. <https://doi.org/10.3390/foods12050942>
7. **United States Department of Agriculture**. FoodData Central: Nuts and seeds. Washington, DC: USDA. 2024 Available from: <https://fdc.nal.usda.gov>. Accessed October 2024.

8. **Alina MR, Mureşan CC, Pop A, Martiş GS, Mureşan AE, Puşcaş A, Postolache AN, Stoica F, Crivei IC, Veleşcu ID and RN Raţu** An Overview of the Characteristics, Advantages, and Uses of Nuts. *Food Science and Nutrition. IntechOpen*. 2024. <http://dx.doi.org/10.5772/intechopen.1006492>
9. **Nishi SK, Paz-Graniel I, Ni J, Valle-Hita C, Khoury N, Garcia-Gavilán JF, Babio N and J Salas-Salvadó.** Effect of nut consumption on blood lipids: An updated systematic review and meta-analysis of randomized controlled trials. *Nutrition, Metabolism and Cardiovascular Diseases*. 2025 May 1; **35(5)**:103771. <https://doi.org/10.1016/j.numecd.2024.10.009>
10. **Mohan V, Gayathri R, Jaacks LM, Lakshmi priya N, Anjana RM, Spiegelman D, Jeevan RG, Balasubramaniam KK, Shobana S, Jayanthan M and V Gopinath** Cashew nut consumption increases HDL cholesterol and reduces systolic blood pressure in Asian Indians with type 2 diabetes: a 12-week randomized controlled trial. *The Journal of Nutrition*. 2018 Jan 1; **148(1)**: 63-9. doi: <https://doi.org/10.1093/jn/nxx001>
11. **Guasch-Ferré M, Tessier AJ, Petersen KS, Sapp PA, Tapsell LC, Salas-Salvadó J, Ros E and PM Kris-Etherton** Effects of nut consumption on blood lipids and lipoproteins: A comprehensive literature update. *Nutrients*. 2023 Jan 23; **15(3)**:596. <https://doi.org/10.3390/nu15030596>
12. **Ghanavati M, Alipour Parsa S and J Nasrollahzadeh** A calorie-restricted diet with nuts favourably raises plasma high-density lipoprotein-cholesterol in overweight and obese patients with stable coronary heart disease: A randomised controlled trial. *International Journal of Clinical Practice*. 2021 Sep; **75(9)**:e14431. <https://doi.org/10.1111/ijcp.14431>
13. **Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher, D, Peters MDJ, Horsley T, Weeks L, Hempel S, Akl EA, Chang C, McGowan J, Stewart L, Hartling L, Aldcroft A, Wilson MG, Grimshaw JM, Gagnon MP, MacDonald H, Tetzlaff J, Moqadam S, Straus SE and EV Langlois** PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. 2018 *Annals of Internal Medicine*. **169(7)**: 467-473. <https://doi.org/10.7326/M18-0850>
14. **Peters MDJ, Godfrey CM, McInerney P, Munn Z, Tricco AC and H Khalil** Chapter 11: Scoping Reviews. 2020. In: Aromataris, E. and Munn, Z. (eds.) *JBI Manual for Evidence Synthesis*. Adelaide: Joanna Briggs Institute. Available at: <https://jbi-global-wiki.refined.site/space/MANUAL/3283910771/Scoping+reviews> Accessed March 2024.

15. **Campos VP, Portal VL, Markoski MM, Quadros AS, Bersch-Ferreira AC, Garavaglia J and A Marcadenti** Effects of a healthy diet enriched or not with pecan nuts or extra-virgin olive oil on the lipid profile of patients with stable coronary artery disease: a randomised clinical trial. *Journal of Human Nutrition and Dietetics*. 2020 Jun; **33(3)**: 439-50. <https://doi.org/10.1111/jhn.12727>
16. **Askari G, Yazdekhashti N, Mohammadifard N, Sarrafzadegan N, Bahonar A, Badiei M, Sajjadi F and M Taheri** The relationship between nut consumption and lipid profile among the Iranian adult population; Isfahan Healthy Heart Program. *European Journal of Clinical Nutrition*. 2013 Apr; **67(4)**:385-9. <http://dx.doi.org/10.1038/ejcn.2013.21>
17. **Damavandi RD, Mousavi SN, Shidfar F, Mohammadi V, Rajab A, Hosseini S and J Heshmati** Effects of daily consumption of cashews on oxidative stress and atherogenic indices in patients with type 2 diabetes: a randomized, controlled-feeding trial. *International Journal of Endocrinology and Metabolism*. 2019 Jan 23; **17(1)**: e70744. <https://doi.org/10.5812/ijem.70744>
18. **Hou YY, Ojo O, Wang LL, Wang Q, Jiang Q, Shao XY and XH Wang A** randomized controlled trial to compare the effect of peanuts and almonds on the cardio-metabolic and inflammatory parameters in patients with type 2 diabetes mellitus. *Nutrients*. 2018 Oct 23; **10(11)**:1565. <https://doi.org/10.3390/nu10111565>
19. **Gulati S, Misra A and RM Pandey** Effect of almond supplementation on Glycemia and cardiovascular risk factors in Asian Indians in North India with type 2 diabetes mellitus: a 24-week study. *Metabolic syndrome and related disorders*. 2017 Mar 1; **15(2)**:98-105. <https://doi.org/10.1089/met.2016.0066>
20. **Sun Y, Jiang CQ, Cheng KK, Zhang WS, Leung GM, Lam TH and CM Schooling** Nut consumption and cardiovascular risk in older Chinese: the Guangzhou biobank cohort study. *PLOS one*. 2015 Sep 2; **10(9)**: e0137178. <https://doi.org/10.1371/journal.pone.0137178>
21. **Parham M, Heidari S, Khorramirad A, Hozoori M, Hosseinzadeh F, Bakhtyari L and J Vafaeimanesh** Effects of pistachio nut supplementation on blood glucose in patients with type 2 diabetes: a randomized crossover trial. *The review of diabetic studies: RDS*. 2014 Aug 10; **11(2)**:190. <https://doi.org/10.1900/RDS.2014.11.190>

22. **Li SC, Liu YH, Liu JF, Chang WH, Chen CM and CY Chen** Almond consumption improved glycemic lipid profiles in patients with type 2 diabetes mellitus. *Metabolism*. 2011 Apr 1;**60(4)**:474-9.
<https://doi.org/10.1016/j.metabol.2010.04.009>
23. **Pan A, Sun Q, Manson JE, Willett WC and FB Hu** Walnut consumption is associated with lower risk of type 2 diabetes in women. *The Journal of Nutrition*. 2013 Apr 1;**143(4)**:512-8. <https://doi:10.3945/jn.112.172171>
24. **Asghari G, Ghorbani Z, Mirmiran P and F Azizi** Nut consumption is associated with lower incidence of type 2 diabetes: The Tehran Lipid and Glucose Study. *Diabetes & Metabolism*. 2017 Feb 1;**43(1)**:18-24.
<https://doi.org/10.1016/j.diabet.2016.09.008>
25. **Kamoun A, Hammouda O, Turki M, Maaloul R, Chtourou M, Bouaziz M, Driss T, Souissi N, Chamari K and F Ayadi** Moderate walnut consumption improved lipid profile, steroid hormones and inflammation in trained elderly men: a pilot study with a randomized controlled trial. *Biology of Sport*. 2021 Jan 1;**38(2)**:245-52. <https://doi.org/10.5114/biolsport.2020.97676>
26. **de Souza RG, Gomes AC, de Castro IA and JF Mota A** Baru almond-enriched diet reduces abdominal adiposity and improves high-density lipoprotein concentrations: a randomized, placebo-controlled trial. *Nutrition*. 2018 Nov 1; **55**:154-60. <https://doi.org/10.1016/j.nut.2018.06.001>
27. **Jamshed H, Sultan FA, Iqbal R and AH Gilani** Dietary almonds increase serum HDL cholesterol in coronary artery disease patients in a randomized controlled trial. *The Journal of Nutrition*. 2015 Oct 1;**145(10)**: 2287-92.
<https://doi-org/10.3945/jn.114.207944>
28. **Bento AP, Cominetti C, Simões Filho A and MM Naves** Baru almond improves lipid profile in mildly hypercholesterolemic subjects: A randomized, controlled, crossover study. *Nutrition, Metabolism and Cardiovascular Diseases*. 2014 Dec 1;**24(12)**:1330-6.
<https://doi.org/10.1016/j.numecd.2014.07.002>
29. **Oguejiofor OC, Onwukwe CH and CU Odenigbo** Dyslipidemia in Nigeria: prevalence and pattern. *Annals of African Medicine*. 2012 Oct 1;**11(4)**:197-202. <https://10.4103/1596-3519.102846>

30. **Swarup S, Ahmed I, Grigorova Y and R Zeltser** Metabolic syndrome. InStatPearls [internet] 2024 Mar 7. StatPearls Publishing.
<https://www.ncbi.nlm.nih.gov/books/NBK459248/> Accessed November 2024.
31. **Hassannejad R, Mohammadifard N, Kazemi I, Mansourian M, Sadeghi M, Roohafza H and N Sarrafzadegan** Long-term nuts intake and metabolic syndrome: a 13-year longitudinal population-based study. *Clinical Nutrition*. 2019 Jun 1;**38**(3):1246-52. <https://doi.org/10.1016/j.clnu.2018.05.006>
32. **Hosseinpour-Niazi S, Hosseini S, Mirmiran P and F Azizi** Prospective study of nut consumption and incidence of metabolic syndrome: Tehran lipid and glucose study. *Nutrients*. 2017 Sep 23;**9**(10):1056.
<https://doi.org/10.3390/nu9101056>
33. **Wang D, Sun L, Liu X, Niu Z, Chen S, Tang L, Zheng H, Chen X, Li H, Lu L and V Malik** Replacing white rice bars with peanuts as snacks in the habitual diet improves metabolic syndrome risk among Chinese adults: a randomized controlled trial. *The American Journal of Clinical Nutrition*. 2021 Jan 1;**113**(1):28-35. <https://doi.org/10.1093/ajcn/nqaa307>
34. **Kim RJ, Wang L, Worley S and D Leonard** Nut consumption and metabolic syndrome in US adolescents. *Public Health Nutrition*. 2018 Nov;**21**(17):3245-52. <https://doi.org/10.1017/S1368980018002070>
35. **Fernández-Montero A, Bes-Rastrollo M, Beunza JJ, Barrio-Lopez MT, de la Fuente-Arrillaga C, Moreno-Galarraga L and MA Martínez-González** Nut consumption and incidence of metabolic syndrome after 6-year follow-up: the SUN (Seguimiento Universidad de Navarra, University of Navarra Follow-up) cohort. *Public Health Nutrition*. 2013 Nov;**16**(11):2064-72.
<https://doi.org/10.1017/S1368980012004442>
36. **Yazdekhesti N, Mohammadifard N, Sarrafzadegan N, Mozaffarian D, Nazem M and M Taheri** The relationship between nut consumption and blood pressure in an Iranian adult population: Isfahan Healthy Heart Program. *Nutrition, Metabolism and Cardiovascular Diseases*. 2013 Oct 1;**23**(10):929-36. <https://doi.org/10.1016/j.numecd.2013.04.014>

37. **Jalali M, Karamizadeh M, Ferns GA, Zare M, Moosavian SP and M Akbarzadeh** The effects of cashew nut intake on lipid profile and blood pressure: a systematic review and meta-analysis of randomized controlled trials. *Complementary therapies in medicine*. 2020 May 1; **50**:102387. <https://doi.org/10.1016/j.ctim.2020.102387>
38. **Feng Y, Bi Y, Tang X, Zhang P, Tong J, Peng X, Tian J and X Liang** Protective effects of appropriate amount of nuts intake on childhood blood pressure level: a cross-sectional study. *Frontiers in Medicine*. 2022 Jan 18; **8**:793672. <https://doi.org/10.3389/fmed.2021.793672>
39. **International Nut & Dried Fruit Council**. Labelling Update: January 2025 – FDA guidance on tree nuts and food allergens. INC; 2025. <https://inc.nutfruit.org/labeling-update-january-2025/> Accessed April 2025.
40. **Mah E, Schulz JA, Kaden VN, Lawless AL, Rotor J, Mantilla LB and DJ Liska** Cashew consumption reduces total and LDL cholesterol: a randomized, crossover, controlled-feeding trial. *The American Journal of Clinical Nutrition*. 2017 May 1; **105(5)**:1070-8. <https://doi.org/10.3945/ajcn.116.150037>
41. **Baer DJ and JA Novotny** Consumption of cashew nuts does not influence blood lipids or other markers of cardiovascular disease in humans: a randomized controlled trial. *The American Journal of Clinical Nutrition*. 2019 Feb 1; **109(2)**:269-75. <https://doi.org/10.1093/ajcn/nqy242>