

## Pistachios are an Effective Nut for Human Health;Assessment and Review

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Information	Abstract
<p><b>Article Type:</b> Review Article</p>	<p>The pistachio is considered a valuable source of biologically active components. Compared to other nuts, it has a healthier nutritional profile with low-fat content consisting mainly of monounsaturated fatty acids. It is also a rich source of vegetable protein, dietary fiber, and minerals. While pistachio has been less studied than other nuts like walnuts, almonds, and hazelnuts, numerous studies provide evidence of its beneficial effects on cardiovascular disease. These effects are not limited to its ability to lower lipids. Several studies have shown the positive impact of pistachio on human health. This review aims to gather and categorize recent data (2017-2023) on the most beneficial effects of pistachio on lipid and glucose homeostasis, blood pressure, and weight control.</p>
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## 1. Introduction

Nuts are considered to be a beneficial source of nutrition for human health, and nutrition researchers have recommended incorporating a healthy diet that includes an adequate amount of fruits, vegetables, and nuts in order to improve overall well-being. However, according to dietary guidelines, humans often do not consume enough essential nutrients through their food intake [1]. A study conducted in 2017 found that consuming around 20 grams of nuts per day is optimal and sufficient for meeting nutritional needs, but the actual consumption falls short of the recommended amount, reaching only 12% of the recommended level [2].

In a survey conducted in 2019, the consumption of different types of nuts was assessed, and the results showed that almonds (30%) and walnuts (20%) were the most commonly consumed tree nuts worldwide. After almonds and walnuts, cashews (18%), pistachios (15%), and hazelnuts (11%) were found to be the most widely consumed nuts globally, according to the International Nut & Dried Fruits report [3].

Some well-known plants in the Anacardiaceae family include pistachio, cashew, mango, sumac, and poison ivy. Pistachio

(*Pistacia vera L.*) is the main edible nut in this family and is known for its nutritional value [4]. Historical studies on agriculture have confirmed that pistachios were initially discovered in western Asia and later spread to other parts of the world, including the United States, the Mediterranean region, and Iran [5]. Based on global agricultural research, the United States is the leading producer of pistachios, followed by Turkey and Iran (accounting for 30% and 19% respectively) [6].

Pistachios contain various natural micronutrients, making them a nutritious choice. They are particularly rich in  $\gamma$ -tocopherol, phytosterols, carotenoids, and minerals [7]. The majority of fatty acids in pistachios are unsaturated. Furthermore, biochemical analysis has demonstrated that pistachios contain essential amino acids, with protein constituting about 20% of their total weight [8]. Consequently, pistachios have a higher protein content compared to other nuts [8]. They also have a high fiber content (Table 1). The nutritional components of pistachios have been summarized in Table 1 based on several studies [9, 10].

**Table 1:** pistachio components

g/100 g	
Water	1.85
Energy (Kcal)	572
Lipids	45.82
Saturated fatty acid (SFA)	5.64
Poly unsaturated fatty acid (PUFA)	13.35
Mono unsaturated fatty acid (MUFA)	24.53
C16:0	8.0–13.0
C18:0	0.5–2.0
C16:1	0.5–1.0
C18:1	45.0–70.0

C18:2	16.0–37.0
C18:3	0.1–0.4
Proteins	21.05
Carbohydrates	28.28
Fiber	10.30
Sugars	7.74

Among the important phenolic compounds found in pistachios [11], flavonoids, particularly isoflavones, are present in the highest concentration (approximately 3.63 mg/100 g). These compounds contribute to the antioxidant effects of pistachios [12].

Clinical studies have shown that the polyphenols present in pistachios, whether consumed raw or roasted, can be digested and absorbed in the stomach and small intestine. As a result, there is a positive correlation between pistachio consumption and various health parameters in humans [13, 14]. According to in-vivo and in-vitro studies, the antimicrobial and anti-inflammatory properties of pistachio are related to its phenolic micronutrient components, including flavonols and flavanones [15]. Pistachio intake may play an important role in the elevation of the total human antioxidant capacity and beneficial effects on cardiovascular disease (CVD) [6, 7, 16], hypertension [17], type 2 diabetes mellitus (T2DM) [18], obesity [19], and blood lipid [20], as well as immune [21], reproduction [22] and nervous [14, 23, 24] systems.

Oxidative stress (OS) occurs when there is an imbalance between the production of free radicals and the scavenging of oxygen reactive species (ROS) in the human body. The presence of elevated ROS in cells and tissues has harmful effects on the entire biological system [25]. Antioxidants, including both natural and artificial types, help the biological system defend against the activity of ROS. Pistachios are a rich source of antioxidants and have

positive effects on the human body [26]. Gentile et al. demonstrated that the dietary antioxidants found in pistachios contribute to their health-promoting properties [27]. Recently, Falahati-pour et al. (2024) reported that the antioxidant effects of pistachios are effective in reducing OS in anemic mice [15].

In this paper, we conducted a literature review to assess the relationship between pistachios and various health parameters, such as lipid profile, glucose metabolism, body weight control, and blood pressure.

## 2. Materials and methods

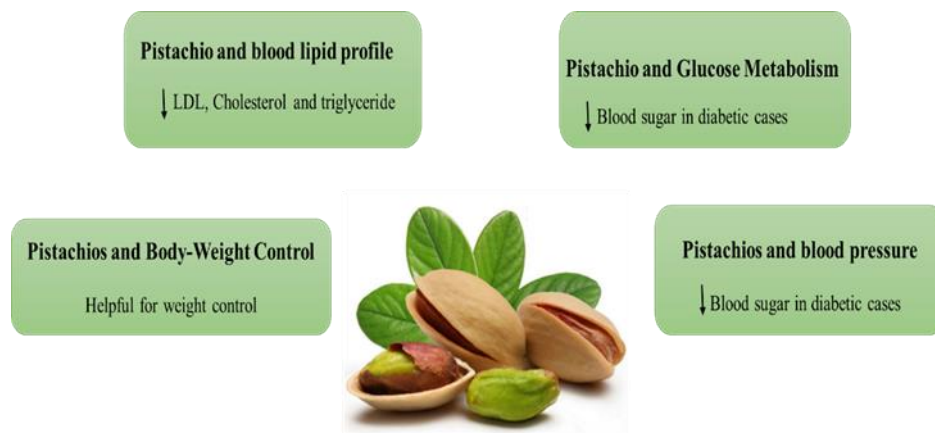
A search was conducted in the MEDLINE/PubMed and Google Scholar databases using the keywords "Pistacia vera," "blood pressure," "diabetes," "body weight," "lipid profile," and "systematic disease." Articles published between 2017 and 2023 were identified and reviewed. The total number of articles was assessed, and the main subjects of each article were selected.

### 1. Pistachio and blood lipid profile

Hyperlipidemia is defined as the condition when a high level of lipids and fats is present in the blood. This condition is known as a main factor for metabolic disorders [28]. According to studies, hyperlipidemia is a risk factor for CVD. Liu et al. [20], in 2020, showed that diets with high amounts of two tree nuts (pistachio and walnut) would possibly be better options for decreasing the level of triglycerides (TGs), low-

density lipid (LDL), cholesterol, and total cholesterol (TC) in blood compared to others. In 2022 [28], Hadi and colleagues assessed randomized controlled trials (RCTs) and suggested that pistachio consumption has positive effects on some blood lipids, including TC, LDL, and TG, and can prevent the risk of cardio-metabolic disorders. In another review

study, Gunathilake (2022) assessed the relationship between nut intake and blood lipid profile and reported no general (positive or negative) effect of nut intake on lipid profile; however, daily intake of pistachio could be effective for reduction in the TC level [29] (Fig. 1).



**Fig. 1.** The effects of pistachio on human health parameters

In a randomized crossover study, Burns-Whitmore et al. studied the effects of a 70-day rich pistachio diet on normal-weight women. According to their results, the diet did not affect the blood lipid profile [30]. A decrease in blood lipid levels after pistachio intake is controversial among researchers. Based on several studies, the high level of unsaturated fatty acids in pistachio is possibly responsible for decreased lipid profile after pistachio consumption [31, 32]. Elise North and colleagues, in 2022, suggested that pistachio intake (3.0 oz daily), besides routine and continuous exercise, decreased blood lipid profile, thus positively affecting body health. They also reported that pistachio and exercise alone did not significantly affect

blood lipid profile [33]. Baghery et al. reviewed the pistachio impact on lipid profile, showing that pistachio intake can reduce triglycerides and increase HDL-C [34]. Jenkins and his colleagues, in 2018, assessed the effects of nuts in the daily diet on diabetic cases. Their results showed that among nuts, pistachio has a powerful ability to decrease blood lipids and help prevent systematic human disease [35].

## 2. Pistachio and glucose metabolism

Based on epidemiological evidence, approximately one in eleven people worldwide have diabetes, and it is projected that by 2045, the number of people with diabetes will reach around 700 million [36]. Diabetes is a systemic

and metabolic disease that occurs when there is a disruption in glucose homeostasis, leading to elevated blood glucose levels [37].

Pregnancy is a critical period for women, during which the health of both the mother and fetus is important. Dietary factors play an important role in developing the embryo, and nutritional specialists suggest adequate consumption of vitamins and minerals during pregnancy. Gestational diabetes mellitus (GDM) occurs when the maternal system cannot decrease the absorbed glucose, harming the embryo. A healthy diet with adequate fat and carbohydrate is helpful for women with GDM. Pistachio is a rich fat and carbohydrate source that effectively manages GDM. Feng et al. [38], in 2019, investigated the pistachio effects on glycemic response, metabolism, and gut hormone in diabetic pregnant women. Their results showed that daily consumption of 42 g pistachio is more effective than 100 g whole-wheat bread in decreasing insulin levels and glucose tolerance. They also indicated that pistachio is a good source of nutrition elements during pregnancy. Melero et al. [39] assessed a Mediterranean diet-based nutritional intervention. They reported that diabetes decreases in their study population (600 pregnant women) after pistachio consumption (25-30 g at least 3 days a week) (Fig. 1).

Interestingly, Canudas et al. [40] reported that continuous intake of pistachio led to a decrease in oxidative stress (OS), DNA fragmentation, and pre-diabetic symptoms. In a more recent study, Bageetta et al. (2020) highlighted pistachio as a rich source of nutritional agents among Mediterranean products and recommended it as an effective product for protecting against systematic disease [41]. An RCT published in 2017 [42] indicated that an alternative

Mediterranean diet supplemented with pistachio could reduce the risk of diabetes. Multiple studies have also shown that pistachio has beneficial effects on glucose metabolism in diabetic and GDM cases [32, 43-45].

#### 4. Pistachios and blood pressure

Blood pressure is defined as a heart-pumping force (mmHg) to circulate the blood in the whole body. It is reported as systolic and diastolic pressures. High blood pressure occurs when blood pressure is  $\geq 140/90$  mmHg [46]. Baghery et al. (2022) assessed 17 RCTs concerning the relationship between pistachio and human health. According to their report of reviewed studies, pistachio had a reduction effect on blood pressure. Systolic blood pressure significantly decreased, while there were no changes in diastolic blood pressure [34].

In 2020, Ghanavati and colleagues reviewed 11 RCTs with 506 participants, showing that pistachios intake significantly could reduce systolic blood pressure (WMD: -3.10, 95 % CI: -5.35, -0.85, I<sup>2</sup> = 63 %). Importantly, they found no negative relationship between pistachio intake and blood pressure (32). In their study, Mahjoub et al. (2018) conducted a clinical trial to evaluate the effects of pistachio intake on patients with diabetic gastroparesis. The findings revealed that after 8 weeks of pistachio consumption, there was a significant reduction in systolic blood pressure when compared to the placebo group [47]. Burns-Whitmore (2017) reported that 20% of the energy provided by pistachio intake for 10 weeks did not show any association with blood pressure [30].

Cheryl L et al. assessed the rich pistachio diet, reporting that pistachio intake has a positive relationship with decreased blood pressure in overweight and obese cases [48] (Fig. 1).

A meta-analysis by Asbaghi et al. (2021) showed pistachio intake as a good parameter for systolic blood pressure reduction. Furthermore, they indicated no relationship between pistachio intake and diastolic blood pressure changes [43].

### 3. Pistachios and bodyweight control

Pistachios have a high fiber content, which could help decrease BMI [49]. Ke Xia et al. (2020) indicated that an adequate amount of pistachio supplementation lowered BMI without increasing body weight, confirming pistachio's beneficial effect on human health [44].

In 2020, Fantino et al. [50] concluded that the daily intake of 44 g of pistachio improved the quality of the diet without disturbing body weight in healthy women. In contrast, Rock et al. [48] evaluated the impact of consuming 42 g/d pistachio by non-diabetic overweight/obese adults assigned to a four-month behavioral weight loss intervention compared to a similar group without consuming pistachios, observing a similar reduction in weight, BMI, and waist circumference.

In 2019, a randomized controlled pilot study assessed the effects of a daily pistachio afternoon snack on next-meal energy intake, satiety, and anthropometry in 30 healthy French women instructed to consume either 56 g of pistachios or 56 g of isoenergetic/equi protein savory biscuit as an afternoon snack. Results revealed that both afternoon snacks provided a similar subjective feeling of satiety, and pistachios consumption did not affect body weight or composition [51].

According to a meta-analysis of RCTs by Xia et al. [44], a diet with pistachios reduced BMI and had no significant effects on body weight and waist circumference. Higgs J. et al. (2021) focused on pistachio intake as a plant-based

snack for appetite control and healthy weight management [52] (Fig. 1).

In a randomized crossover study with 10-week intervention periods, the inclusion of 20 % of daily energy as pistachios in the diet of forty-eight healthy normal-weight women did not lead to changes in body weight. However, diet quality improved in the pistachio condition, including increased unsaturated fat and dietary fiber intake [30].

Cheryl L et al. (2020) found that regularly eating pistachios was linked to lower weight, BMI, and waist circumference, as well as positive dietary changes, in overweight/obese men and women compared to the control group [48].

A randomized clinical trial examined the effects of a daily 56-g pistachio snack compared to an isoenergetic biscuit for four weeks on body weight, dietary intake, and meal satiety in 60 healthy normal-weight (BMI 18.5–25 kg/m<sup>2</sup>) women [51]. In this study, the pistachio snack did not affect body weight or meal satiety but was associated with a higher intake of selected micronutrients [51]. In a crossover study in 2017, with 10-week treatment periods, prescribing 20% of energy from pistachios in 48 healthy normal-weight women was not associated with changes in body weight, although diet quality improved, including increased unsaturated fat and dietary fiber intake [30].

A further study in 2019 showed that adding pistachios to ordinary diets did not induce weight gain [53]. In a randomized controlled study (2020) among non-diabetic overweight/obese adults, regular consumption of pistachios was reported to be associated with weight loss and BMI and waist circumference



reduction [48]. Furthermore, Fantino M et al. (2020) showed that daily intake of pistachios (44 g) improved nutrient intake without affecting body weight in healthy women [50].

## 5. Conclusion

The pistachio is highly valued for its bioactive components, making it a healthier choice compared to other nuts. It has a low-fat content, mainly consisting of monounsaturated fats (MUFA), and is a rich source of vegetable protein, dietary fiber, minerals (especially potassium), and vitamins (such as C and E). While pistachios have been studied less extensively than other nuts like walnuts, almonds, and hazelnuts, some research suggests that they have beneficial effects on cardiovascular disease risk factors beyond their ability to lower cholesterol levels. Several studies have shown that incorporating pistachios into the diet can have a preventive effect on type 2 diabetes mellitus (T2DM) by improving

markers of glucose regulation, reducing oxidative stress, mitigating postprandial hyperglycemia, and decreasing the risk of gestational diabetes. Recent findings also indicate that consuming pistachios does not lead to weight gain or obesity; in fact, it may even contribute to weight loss or weight maintenance. This could be attributed to pistachios' ability to control appetite and promote feelings of fullness. However, further research is needed to fully evaluate this aspect. Overall, this review provides comprehensive information and evidence regarding the health benefits of regular pistachio consumption.

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## Conflicts of interest

All authors declare that they have no conflict of interest.

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