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Review Article

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The Impact of Nut Consumption on Lipid and Lipoprotein Profiles of Patients at High Cardiovascular Risk

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Abstract

Background: Recently, there has been renewed interest for the role of dietary modifications and supplements in dyslipidemia management. Among naturally occurring foods, daily nut intake has been shown to have a beneficial effect on lipid profiles that have been attributed to its antioxidant and anti-inflammatory properties. However, to the best of our knowledge, no studies have been conducted on patients at high cardiovascular risk.

Aims: We aimed to study the impact of daily nut consumption on serum lipid and lipoprotein levels in cardiovascular high-risk patients who have not reached their target goals, despite optimal medical treatment and adherence to lifestyle changes.

Methods:We conducted a prospective study from February to May 2019 in Habib Bourguiba University Hospital of Medenin to assess the impact of nut consumption on lipid profile of 21 patients at high cardiovascular risk and having a Low Density Lipoprotein-Cholesterol (LDL-cholesterol) value greater than 1.81 mmol/L.

Results: Our results showed significant total cholesterol, triglycerides and LDL-cholesterol lowering-effects of regular nut's consumption ($p<0.05$). We further found a significant increase in High Density Lipoprotein-Cholesterol (HDL-cholesterol) levels by 25.6% ($p=0.000$).

On multivariate analysis, initial high cholesterol levels, non-familial dyslipidemia, non-smoking and, non-obesity were predictive factors of good response to nuts consumption while advanced age and initial high HDL-cholesterol levels were predictors of poor response.

Conclusion: The regular intake of nuts is a promising preventive approach against the development of cardiovascular diseases and may be recommended for patients at high cardiovascular risk in addition to the proposed drug therapies.

Keywords

High cardiovascular risk; Dyslipidemia; Lipid profile; Nuts

Introduction

Over the past 20 years, the management of dyslipidemia has gradually evolved and actually the new guidelines provide a real roadmap of treatment and prevention strategies for patients at different levels of cardiovascular disease risk [1]. Patients care involves lifestyle changes and possibly medications to maintain a balanced lipid profile. Despite adherence to these measures, a considerable proportion of patients fail to reach target lipid ranges [2]. Recently, there has been renewed interest in the role of dietary modifications and supplements in dyslipidemia management. Among naturally occurring foods, daily nut intake has been shown to have a beneficial effect on lipid profile that have been attributed to their antioxidant and anti-inflammatory properties [3]. In addition to that, by lowering the LDL-cholesterol, it reduces significantly the incidence of cardiovascular events [3]. Hence, we aimed to study the impact of daily nut consumption on serum lipid and lipoprotein levels in cardiovascular high-risk patients who have not reached their target goals despite optimal medical treatment and adherence to lifestyle changes.

Patients and Methods

We conducted a prospective study from February 2019 to May 2019 in Habib Bourguiba University Hospital Center (UHC) of Medenin in collaboration with the Research Unit of Active Biomolecules Valorization of the Higher Institute of Applied Biology of Medenin.

Subjects

During the study period we have examined a total number of 1474 patients. Following inclusion criteria only 29 patients were enrolled. 21 of them have completed the study protocol until the end.

Inclusion Criteria: We included patients considered at high cardiovascular risk according to the European society of cardiology guidelines [4], Patients who had been receiving the maximum tolerated dose of lipid-lowering therapy during at least 3 months, Patients who have had LDL-cholesterol blood level greater than 1.81 mmol/l and patients who didn't consume nuts frequently and with no previous history of nuts allergy.

Exclusion criteria: We excluded, Patients with hepatic, pancreatic, renal, endocrine or gynecologic disorder, breastfeeding and Pregnant women and women using oral contraceptives.

They were also excluded from this study, patients who drink alcohol, patients with missing data and patients who were lost to follow-up.

Prior to study enrolment, all participants gave their written informed consent in accordance with the protocol approved by the medical committee of Habib Bourguiba university hospital.

Study design

Our study consisted of two phases.

In the first phase, all participants were invited to follow carefully our instructions about medical treatment and lifestyle adjustments. We took and analyzed 4 blood samples (on day 1, day 31, day 61 and day 91) to check lipid panel. 3 months later, we conducted a medical consultation to ensure patients 'adherence to the protocol and check blood tests' results.

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During the second phase, in addition to medical therapy and lifestyle interventions, patients consumed nuts daily during a month. Laboratory tests were performed on day 1, day 15 and then on day 31.

Epidemiological, clinical and biological data were collected for each patient and updated throughout the study period. Daily telephone calls were made to remind and encourage patients or their relatives.

Diets

Nuts were weighed and apportioned for patients who received an amount of 10 portions every 10 days. Each patient consumed a daily dose of 45 g around 10 am during one month. We chopped then grinded nuts for 3 subjects with dental problems and we gave extra portions to the family members of all participants to avoid sharing the ones reserved for them. Nuts were well tolerated by all participants and were without adverse effects.

Measurements

Double blood samples were drawn from each participant in the morning, after 12 hours of fasting. One sample was frozen at – 80°C and had been stored to be analyzed at the end of the study. The second one was immediately used to determine blood serum lipid levels.

Blood tests were performed under standard conditions, using the same machine (PLC BA 400 of Bio Systems, reference SN 834 000 228, certified quality management system according to EN ISO 13485 and EN ISO 9001) and with the same parameters.

Statistical analysis

Statistical analysis was performed using SPSS Version 23. Microsoft Excel 2016 was used to study relationships between variables and for multivariate analysis. A p-value<0.05 was considered as statistically significant. To reduce variability, an average result of all the parameters tested during and by the end of each phase has been established. As for descriptive values, they were expressed as mean value with standard deviation.

Results

Our study population consisted of 21 patients, with a mean age of 60.24 years old. 52.4% (n=11) of patients were aged between 55 and 75 years old and 81% (n=17) of patients were males (Table 1).

The average number of Cardiovascular Risk Factors (CVRF) per patient was 3.86. 47.6% of our patients (n=10) had at least 4 major CVRF (Figure 1). Diabetes was the most frequent (81%, n=17), followed by hypertension (71.4%, n=15), obesity (52.4%, n=11), family history of cardiovascular disease (47.6%, n=10) and smoking.

As for the nut consumption's impact on various biological parameters, the initial average level of blood total cholesterol was 5.13 mmol/L. [0.13–10] and nut consumption showed its decrease by 0.65 mmol/L (12.9%).

Our study showed also a significant drop of triglyceride (TG) levels by an average percentage of 30.1%. Average TG levels at the beginning were at 2.06 mmol/L [1.3–2.83], against 1.44 mmol/L [0.80–2.13] after nut consumption.

High density lipoprotein-cholesterol (HDL-Cholesterol)'s mean serum level increased by 25.6% after consuming nuts and final LDL-cholesterol levels were 2.26 mmol/L [1.50 – 3.02] which represents a remarkable reduction by 20.4% (Table 2).

To determine the main factors influencing lipid-lowering effects of nut consumption we only concentrated on its consequences on LDL-cholesterol levels.

Comparison of the outcomes of nut consumption on LDL-cholesterol among different age groups helped to find a significant difference (p<0.05).

Table 1: Patients' Characteristics.

Patient	Age (yearsold)	Sex	BMI	NSTEMI	STEMI	Stroke	HTN	Diabetes	Dyslepidemia	Smoking	Family history of cardiovascular disease
1	53	F	33,984375	Yes	No	No	Yes	Yes	Yes	No	No
2	57	F	29,3877551	Yes	No	No	Yes	Yes	Yes	No	Yes
3	71	M	25,3515414	Yes	No	No	No	Yes	Yes	No	No
4	77	M	25,5354464	Yes	No	No	Yes	Yes	Yes	No	No
5	72	M	33,7565746	Yes	No	No	Yes	Yes	Yes	No	No
6	50	M	20,8307032	Yes	No	No	Yes	Yes	Yes	No	No
7	64	M	23,7812128	Yes	No	No	Yes	Yes	Yes	No	No
8	52	M	29,0606071	Yes	No	No	No	No	Yes	Yes	Yes
9	75	M	28,4090909	Yes	No	No	No	Yes	Yes	No	Yes
10	65	M	25,8805706	Yes	No	No	Yes	Yes	Yes	Yes	Yes
11	57	M	31,3469388	Yes	No	No	No	Yes	Yes	Yes	Yes
12	48	M	26,122449	Yes	No	No	Yes	Yes	Yes	Yes	No
13	34	M	33,8736318	Yes	No	No	Yes	No	Yes	Yes	Yes
14	74	M	22,0385675	Yes	No	No	Yes	No	Yes	No	No
15	58	M	24,8409801	Yes	No	No	No	No	Yes	Yes	Yes
16	65	M	38,28125	Yes	No	No	Yes	Yes	Yes	No	No
17	42	M	33,7924702	Yes	No	No	Yes	Yes	Yes	Yes	Yes
18	66	F	31,9660311	Yes	No	No	Yes	Yes	Yes	No	Yes
19	54	M	25,6055363	Yes	No	No	Yes	Yes	Yes	No	No
20	61	M	23,4585624	Yes	No	No	Yes	Yes	Yes	No	No
21	52	F	35,562909	Yes	No	No	No	Yes	Yes	No	Yes

BMI: Body Mass Index, F: Female, HTN: Hypertension, M: Male, NSTEMI: Non ST Segment Elevation Myocardial Infarction, STEMI: ST Segment Elevation Myocardial Infarction

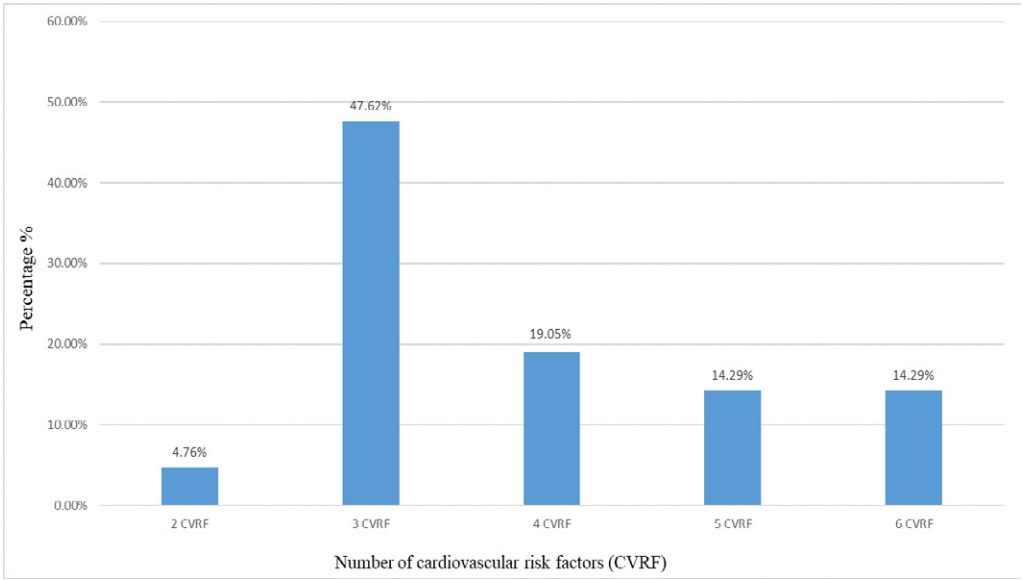

Figure 1: Distribution of the study population by the number of cardiovascular risk factors (CVRF).

Table 2: Lipid and lipoprotein levels before and after nuts consumption.

Variables	Concentrations before nut consumption mmol / L g / L	Concentrations after nut consumption mmol / L g / L	% Variations	p
Totalcholesterol	5.13 [0.13 – 10] 2.00 [1.57 – 2.43]	4.47 [3.25 – 5.69] 1.70 [1.23 – 2.17]	12.9% (↓)	0.001
Triglycerides	2.06 [1.3 – 2.83] 1.82 [1.14 – 2.50]	1.44 [0.80 – 2.13] 1.27 [0.68 – 1.86]	30.1% (↓)	0.001
HDL-cholesterol	1.13 [0.86 - 1.4] 0.43 [0.33 – 0.53]	1.42 [1.18 – 1.66] 0.55 [0.46 – 0.64]	25.6% (↑)	0.001
LDL-cholesterol	2.84 [2.12 – 3.56] 1.10 [0.82 – 1.38]	2.26 [1.50 – 3.02] 0.87 [0.59 – 1.15]	20.4% (↓)	0.001

Table 3: Predictors of responses to nuts consumption using multivariate analysis.

Source	Value	Standard error	t	Pr > |t|	Lower Limit (95%)	Upperlimit (95%)
Age	-0,5113	0,1211	-4,2227	0,0010	-0,7729	-0,2497
cholesterollevels	1,1399	0,1284	8,8756	< 0,0001	0,8625	1,4174
Triglycerides	0,0000	0,0000				
HDL-CT	-0,2128	0,1084	-1,9626	0,0715	-0,4470	0,0214
LDL-CT	0,0000	0,0000				
Sex (Male)	0,0000	0,0000				
Sex (Female)	0,0000	0,0000				
Family history (No)	0,6653	0,1400	4,7521	0,0004	0,3628	0,9678
Family History (Yes)	0,0000	0,0000				
Diabetes (No)	0,0000	0,0000				
Diabetes (yes)	0,0000	0,0000				
HTN (No)	-0,1195	0,1065	-1,1225	0,2820	-0,3496	0,1105
HTN (yes)	0,0000	0,0000				
Obesity (No)	0,3234	0,0973	3,3224	0,0055	0,1131	0,5337
Obesity (Yes)	0,0000	0,0000				
Smoking (No)	0,3032	0,1330	2,2804	0,0401	0,0160	0,5904
Smoking (Yes)	0,0000	0,0000				
HDL-CT: High Density LipoproteinCholesterol, HTN: Hypertension, LDL-CT: Low Density LipoproteinCholesterol						

According to multivariate analysis, predictors of a good response were initial high cholesterol levels, no family history of dyslipidemia, non-smoking and absence of obesity (Table 3).

Correlates of poor response according to multivariate analysis were advanced age, initial high HDL-cholesterol levels and absence of hypertension (Figure 2).

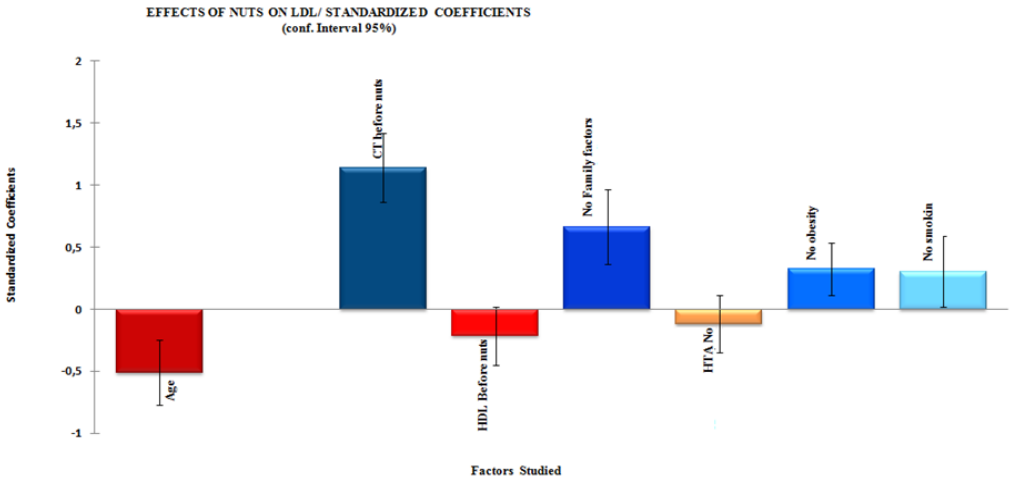

Figure 2: Predictors of response to nuts consumption.

Discussion

The average age in our study was 60.24 years, it is superior to the 56 years-old found by Daniel Zambòn et al. [5] and the 54 years-old in the study of Garg. et al. [6]. This is due to the fact that in our study we focused on high cardiovascular risk patients that are often represented by older groups. Most of the patients are male with a significant difference (p=0.005 <0.05), which is similar to several other studies [5,6]. This predominantly male representation (81%) could be explained by the protective role of estrogens in females along with a less pronounced cardiovascular risk factor exposure. In fact, the probability of a major event is delayed by 7 to 10 years in pre-menopausal women compared to men [7]. Daniel et al. [5] in their study enrolled patients on the basis of gender while integration was arbitrary in our study.

The average number of risk factors in our population was 3.86. 47.6% (n= 10) of our patients had at least 4 major CVRF which was significantly higher than other studies [5,8].

The results of our study showed a significant cholesterol-lowering effect (p=0.001) with a decrease by 12.9%. This fits well with the results of studies evaluating the effect of nuts, in which reduction of total cholesterol levels varied between 9 to 12.4% [5,8,9]. This may be due to the beneficial effects of unsaturated fats and fibers.

At the end of the study, we were able to highlight a significant beneficial effect (p=0.001) of nuts consumption on TG. Our results confirmed those of previous studies [8,10]. In fact, a decrease of 12% was obtained by Sabaté et al. [8] in 18 men. But this decrease in TG is lower than that obtained in our population where it reached 30%. This may be due to the fact that their population consisted of participants who did not have dyslipidemia. Furthermore, the results of Zambón et al. [5] neglected the beneficial effect of nuts on TG after 6 weeks of dieting but their study population consisted of 56 patients with congenital hypercholesterolemia. This is verified in part by our study which suggests that congenital factors diminish the beneficial effect of nuts.

Regular consumption of nuts caused also a significant increase (p=0.000) in HDL-cholesterol levels by 25.6%. This is in good agreement with the results of previous studies. Indeed, S. Rajaram showed an HDL-cholesterol increase by 5.6% (P = 0.001) [10]. In contrast, other studies have reported no difference in HDL-cholesterol [11-13].

Our results showed a decrease by 20.4% in LDL-cholesterol levels. These results are consistent with the literature [8,14]. According to statistical analysis, the effect of walnuts on LDL-cholesterol is the same in both genders. These results are consistent with those of Daniel Zambòn et al. [5].

Statistical analysis demonstrated that high initial cholesterol levels are correlated with a good response. This result can be explained by the reverse relationship already demonstrated between levels of essential fatty acids and cholesterol.

Absence of smoking is also correlating with a good response to nuts. This is consistent with other studies showing that smoking is reversely associated with the effects of omega [14,15].

It has been shown by means of statistical studies that age is associated to a poor LDL-cholesterol response to nuts consumption [5]. This may be due, in part, to aging or to metabolic deficiency of nuts digestibility in the elderly.

It has been well established that non-obese subjects have a higher response to nuts consumption, this conclusion was already demonstrated by Joan Sabaté et al. [8]. This probably comes from the fact that obesity is characterized by elevated endogenous production of bad cholesterol and the association of obesity with a significant reduction of intestinal absorption of cholesterol [16].

Conclusion

The results of our study indicate that regular consumption of nuts, is associated with beneficial physiological effects in addition to its nutritional characteristics. It favorably alters lipid and lipoprotein profiles of patients at highest cardiovascular risk. The regular intake of nuts is a promising preventive approach against the development of cardiovascular diseases and may be recommended for patients at high risk in addition to the proposed drug therapies. In perspective, it will be interesting to study the modes of action of various nuts components on lipid and lipoprotein profiles in order to formulate nutritional recommendations for patients at very high cardiovascular risk based on evidence.

Study's strength

This study brings additional data on the benefit of diet in dyslipidemia management.Our study concentrates on the benefit of nuts on patients with cardiovascular risk factors.

Study's limitation

The main limitation is the small sample size. Other bigger studies may be needed to confirm our results.

What is already known on this topic?

Nut intake lowers total cholesterol and LDL-cholesterol blood levels.

Nuts consumption reduces cardiovascular disease incidence.

What this study adds

Regular intake of nuts may be recommended for patients at high cardiovascular risk in addition to the proposed drug therapies in order to reach target lipid ranges**.**

Competing interest

The authors declare that they have no competing interests.

Authors' contributions

All authors contributed to design, acquisition of data, interpretation of data, editing of the draft and approval of final manuscript for publication.

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