IMPACT OF NUTS CONSUMPTION ON BLOOD PRESSURE, GLYCEMIC STATUS, LIPID PROFILE AND TOTAL PROTEIN IN HEALTHY HUMAN VOLUNTEERS

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Abstract

Objective:

To investigate the advantage of consumption of a mixture of almond and pistachio on blood pressure, lipid profile, sugar and protein levels in healthy volunteers.

Subjects and Methods:

This dietary intervention study was carried out during the period from February to March 2013. A total of 48 apparently healthy males students from Military Academy / Zakho, Kurdistan Region of Iraq participated in this study. All the students were living in a controlled environment. Blood samples were taken and analyzed for the determination of serum glucose, lipid profile, total protein, albumin and globulin. Parameters were obtained at baseline, 3 and 6 weeks after daily consumption of 50gm of almond and pistachio mixture.

Results:

The results of the current study demonstrated that daily consumption of 50 gs of almond and pistachio mixture for 3-6 weeks significantly (P<0.05 – 0.001) decreased the diastolic blood pressure and the level of blood glucose , whereas body mass index (BMI) was not influenced at all. Serum total protein, albumin and globulin levels were significantly increased (P<0.05-0.005).
Finally, Total cholesterol (TC), triglycerides (TG), low density lipoprotein-cholesterol (LDL-ch), very low density lipoprotein cholesterol (VLDL-ch), TC/HDL and LDL/HDL were significantly decreased (P<0.05-0.005) after 6 weeks of nuts consumption, where as high density lipoprotein-cholesterol, was significantly increased (P<0.01).

Conclusion:

This dietary intervention trial, demonstrated that almonds and pistachio mixture improved blood glucose , total protein, and lipid profile to much better levels than that obtained previously using each one separately in healthy volunteers.

Introduction:

Epidemiologic studies showed that frequent nut consumption decreases the risk of coronary heart disease (CHD) (López-Uriarte et al, 2010). Compared with people who consumed nuts less than one time per week, people who eat nuts at least five times per week showed 50% reduction in the risk of CHD. Furtherer more, it also represents a good source of dietary fiber, vitamins, micronutrients, antioxidants, and the amino acids arginine (Sari et al, 2010). Studies have shown that a diet low in saturated fatty acids (SFAs) and cholesterol tends to decrease the risk of heart disease (Vadivel et al, 2012). Foods, such as nuts, are rich in monounsaturated (MUFAs) or polyunsaturated fatty acid (PUFAs) have been recommended as substitutes for high SFAs food to reduce risk of coronary heart disease by favorably altering cholesterol levels in the body (Srinath, 2003). Nuts have been shown to decrease biomarkers of oxidative stress (such as oxidized LDL cholesterol) and improve the blood lipid profile (Vadivel et al, 2012) and have a significant role in decreasing inflammation processes, improving endothelial function, and insulin sensitivity (Salas-Salvadó et al, 2011). In addition to antioxidant-rich foods, HDL-ch has been associated with improvement of lipid oxidation, as well as anti-inflammatory and antithrombotic activities (Salas-Salvado´ et al, 2011). Elevated HDL-C level is associated with reduced oxidative stress (Chiavaroli, 2010).

Consumption of nuts has not been linked to weight gain despite increases in caloric intake caused by its consumption (McBride, 2011). Since an inverse relationship was observed between the frequency of nut consumption and

body mass index (BMI) (Fitschen, 2010), and its consumption, have shown to help in maintaining body weight (Tsantili et al, 2011). It was found that nuts reduce the glycaemic impact of ingested carbohydrate rich foods, due to their high fibre and unsaturated fat content (Salas-Salvadó et al, 2008). Nuts are potentially protective foods against high blood pressure (BP) because they are low in sodium, and contain significant amounts of mono- and polyunsaturated fatty acids, minerals (such as magnesium, potassium and calcium), dietary fiber, and antioxidants, and all these components might interact to improve blood pressure (Kleopatra and Katsilambros, 2011). Nuts such as almonds and pistachios are rich in several beneficial compound, such as omega-3- fatty acids. Also it has been proposed that the bioactive compounds in nuts may help in lowering the risk factors of cardiovascular disese by improving endothelial function and BP, in addition to lowering oxidative stress and inflammation (Soliman, 2012).

In this study we therefore investigated the effect of a mixture of almond and pistachio on lipid parameters, total protein, glucose, blood pressure and oxidative status in healthy volunteers living in a controlled environment."

Subjects and Methods :

Subjects:

Forty-eight male volunteers, mean age 22 years between 18 and 36y old, they are student from Military Academy / Zakho, Kurdistan Region of Iraq under controlled environment, having the same diet and living in the same place.

Also they have a regular wake/sleep hour and same daily activity. They were not provided by any additional food other than the dietary recommendations given to the volunteer, with free access to water.

The enrolled subjects were healthy and free of acute or chronic medical disorders with no family history (father and / or mother) of heart diseases. Their bodies were also normal. Furthermore, all subjects underwent a detailed physical examination by the physician and the detailed medical history for each was taken. Exclusion criteria were smoking, consumption of alcohol, history of eating nuts frequently (more than once a week), a history of food or nut allergy, and regular use of any medications including vitamin supplements. The volunteers were informed about the nature of the study and a written consent was then obtained from each subject.

Study Design:

The study design included hree controlled-feeding periods. The first group, a run-in period preceded the test diet to establish a baseline for regular meals prepared in the Academy kitchen. These included all major food groups but did not include nuts. The amount of food was standardized for each volunteer. The second and third groups, included the addition of 50 gm of a mixture of almond and pistachios (25gm of each) consumed with controlled diet for three and six weeks, respectively. The students were instructed to eat their daily ratio of nuts in the morning with or after breakfast. During the six week of the study, the students were allowed to go outside the academy for only a single day. Since the academy programme and the activities of the volunteers have been pre-planned for the entire year of education, threre was no change in their daily activities during the study period. Parameters were obtained at baseline, three and six weeks after daily consumption of 50gm of a mixture of nuts.

Data Collection:

A pre-tested questionnaire was designed to obtain information on age, anthropometric measurements, smoking, alcohol and nut consumption, type of diet (vegetarian or mixed), family history of diseases, past medical history and any medication if available. Blood pressure was measured, fasting serum glucose, lipid profile, total protein, albumin and globulin were assayed and body mass index was calculated.

Collection of blood samples:

Venous blood samples (10 ml) were collected between 7.00- 9.00 a.m after12-14 hour fasting by using sterile disposable syringe. Care was taken to avoid venous stasis during sample withdrawing and the blood was added into a clean capped disposable tube and transferred in cooling ice bag to Zakho Hospital Laboratories for biochemical analysis. The blood samples were then centrifuged (HITASHI model O5P-21) at 3000 rpm for 10 minutes to separate serum from the clot. The obtained serum was divided into 5 parts in eppendorf capped tubes frozen at -28 oC until the time of analysis.

Biochemical Analysis:

Total protein and serum albumin levelsd were measured colorimetrically using standard kit (Biolabo reagent, France). Globulin level was estimated mathematically by subtracting albumin from total protein. Total cholesterol, serum TG and serum HDL-ch were determined by an enzymatic colorimetric method using commercial kits (Biolabo, Maizy, France). Very low density lipoprotein cholesterol VLDL cholesterol concentration was calculated and LDL-C was calculated mathematically from the total cholesterol, the TG and HDL-ch concentration by the Friedewald,s formula.

Serum glucose was determined by an enzymatic colorimetric method using a commercial kit supplied by Biolabo (Maizy, France).

Statistical Analysis:

All data were analyzed using the statistical package for social sciences SPSS version 20 software for windows 7. The results were expressed as mean ± standard deviations (mean ± SD). One way ANOVA-test was used to compare parameters in different studied groups. P-values ($P \leq 0.05$) were considered to be statistically significant.

Results:

The results of the effect of consumption of a mixture of almond and pistachio on BMI, blood pressure, glucose and proteins levels are shown in (Table 1 and Figures1,2,3). As the results indicate, the BMI values were slightly, but non- significantly ($P > 0.05$) reduced after nuts consumption for three and six weeks.

Nuts consumption influenced the systolic and diastolic blood pressure to a different extent. Thus, nuts consumption for 3 and 6 weeks non-significantly ($P > 0.05$) reduced the systolic blood pressure, whereas the diastolic blood pressure was significantly ($P<0.001$) reduced after 3 weeks of nuts consumption which remains more or less stable after further extension of nuts consumption to 6 weeks.

Nuts consumption for 3 weeks non-significantly ($P > 0.05$) reduced the level of serum glucose, while extension of the period of nuts consumption to 6 weeks significantly ($P < 0.001$) reduced the level of serum glucose (table 1). Nuts consumption for 3 weeks significantly ($P < 0.001$) increased the level of serum albumin, where as nuts consumption for 6 weeks produced significant ($P< 0.05$) elevation in the levels of serum total serum protein and globulin (Table 1).

Table.1: The effect of consumption of a mixture of almond and pistachio at baseline , three weeks and six weeks on Body Mass index, Blood Pressure, serum Glucose and Proteins.

Variables	Baseline N=48 Mean ±SD Group 1	3 weeks N=4 8 Mean ±SD	6 weeks N=4 8 Mean ±SD	P –value
BMI (kg/m^2)	25.34±3.00	24.29±2.57	24.23±2.22	0.067
Systolic BP (mm Hg)	120.8±6.27	119.8±6.40	118.8±4.68	0.2 4
Diastolic BP (mm Hg)	79.8±3.99	76.7±4.63	76.3±2.16	0.001*
Serum glucose (mg/dl)	91.28±7.29	88.33±7.17	85.90±6.36	0.001*
Serum total protein (g/dl)	7.16±0.41	7.27±0.33	7.33±0.31	0.050*
Serum Albumin (g/dl)	4.61±0.10	4.67±0.11	4.69±0.08	0.001*
Serum Globulin (g/dl)	2.55±0.31	2.6±0.22	2.64±0.23	0.02*

*Means the presence of a significant difference (one way ANOVA).

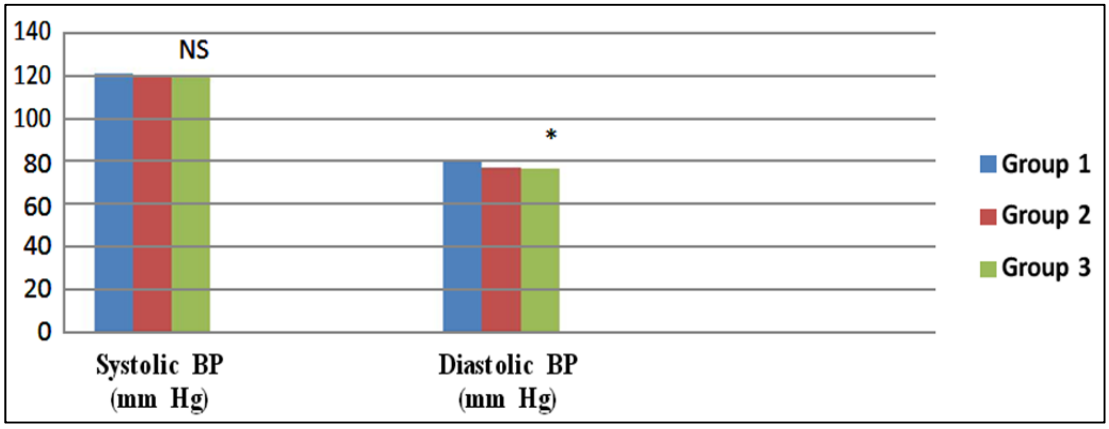

Figure .1: The relationship between the period of nuts consumption and the percent of change in Blood pressure.
*= significant according to one way ANOVAs test.
NS= non- significant according to one way ANOVAs test.

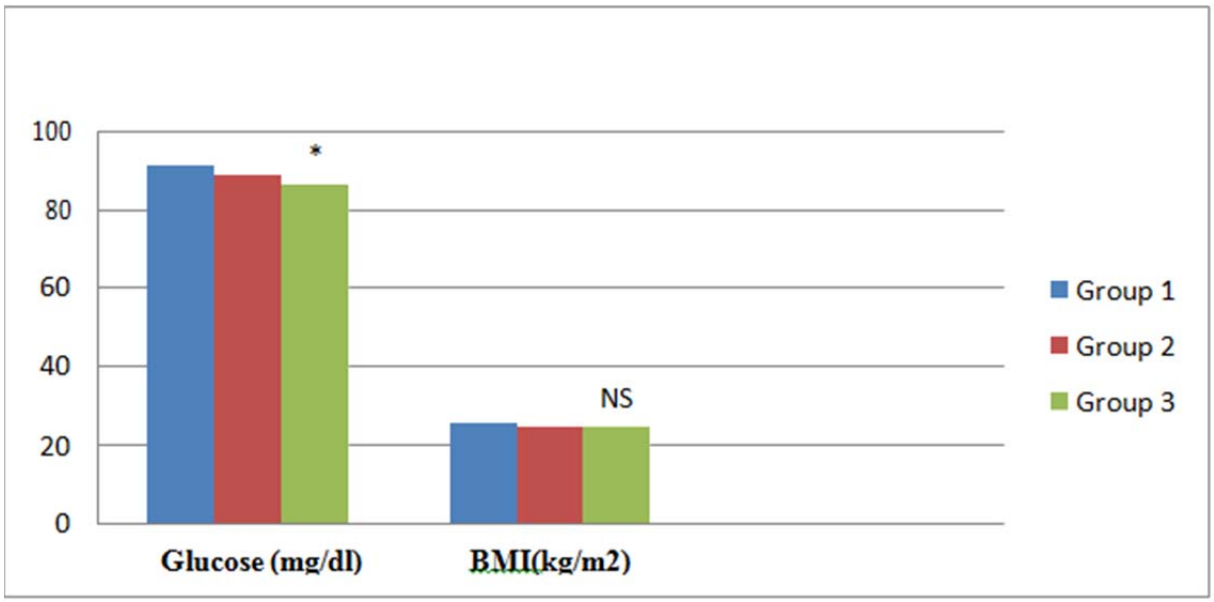

Figure .2: The relationship between the period of nuts consumption and the percent of change glucose and BMI
*= significant according to one way ANOVAs test.
NS= non- significant according to one way ANOVAs test.

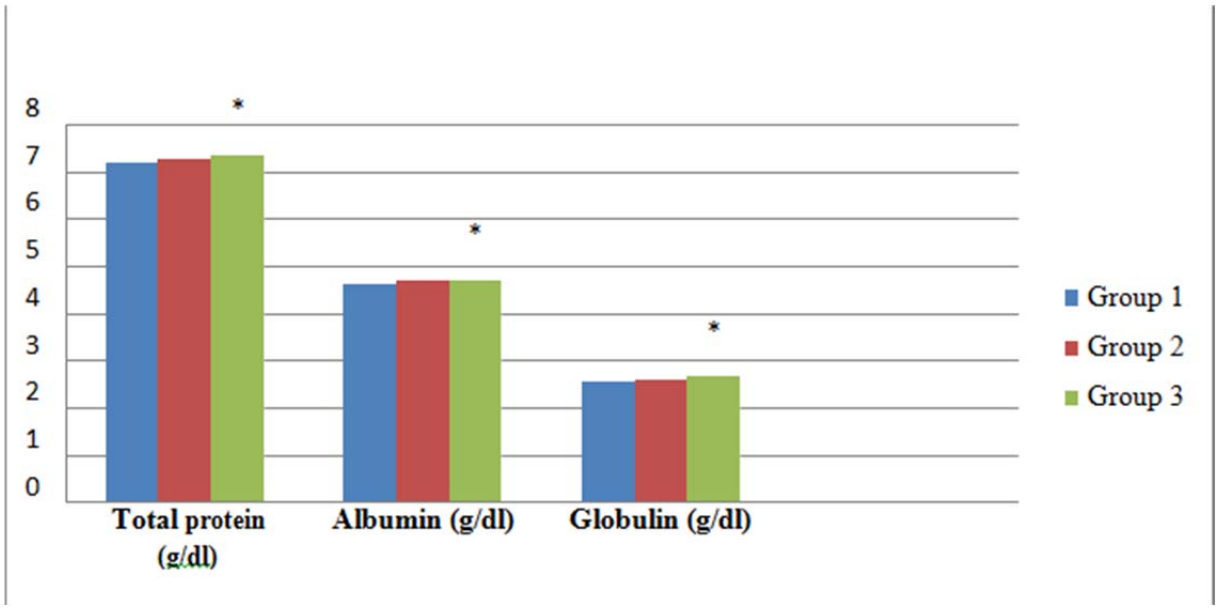

Figure.3: The relationship between the period of nuts consumption and the percent of change in Protein parameters
*Means the presence of a significant difference (one way ANOVA).

Serum Lipids:

The effect of nuts consumption baseline, three and six weeks on serum lipid profile are shown in Table 2 and Figure 2. The effect of nuts consumption on lipid profile parameters was not in the same direction. Thus, the levels of triglycerides, total cholesterol, LDL-ch, VLDL, the ratios of TC/HDL and LDL/HDL were significantly (P< 0.05 - 0.01) reduced after 6 weeks of nuts consumption, where as the level of HDL- ch was significantly (P < 0.05) increased from 50.87±6.82 to 54.75±6.06 after six weeks of nuts consumption. However, the levels of change in the above parameters after three weeks of nuts consumption were statistically not significant.

Table 2: The effect of consumption of a mixture of almond and pistachio at Baseline , 3 and 6 weeks on lipid profile parameters (Mean ± SD) in human subjects.

Variables	Baseline N= 48 Mean ±SD Group 1	3 week N= 48 Mean ±SD Group 2	6 week N=48 Mean ±SD Group 3	P –value
Total cholesterol (mg/dl)	180.71±18.95	174.74±19.27	169.03±18.37	0.012*
Triglyceride (TG) (mg/dl)	103.96±17.71	100.83±17.13	95.29±15.09	0.039*
HDL-ch (mg/dl)	50.87±6.82	52.74±6.21	54.75±6.06	0.013*
LDL-ch (mg/dl)	109.04±10.95	101.82±10.7	95.18±8.25	0.015*
VLDL-ch (mg/dl)	20.79±5.34	20.18±5.11	19.10±4.18	0.008*
T.C/HDL (mg/dl)	3.75 ± 2.77	3.51±3.10	3.08±3.03	0.002*
LDL/HDL (mg/dl)	2.34 ± 1.60	2.03±1.72	1.73±1.36	0.004*

*Means the presence of a significant difference (one way ANOVA).

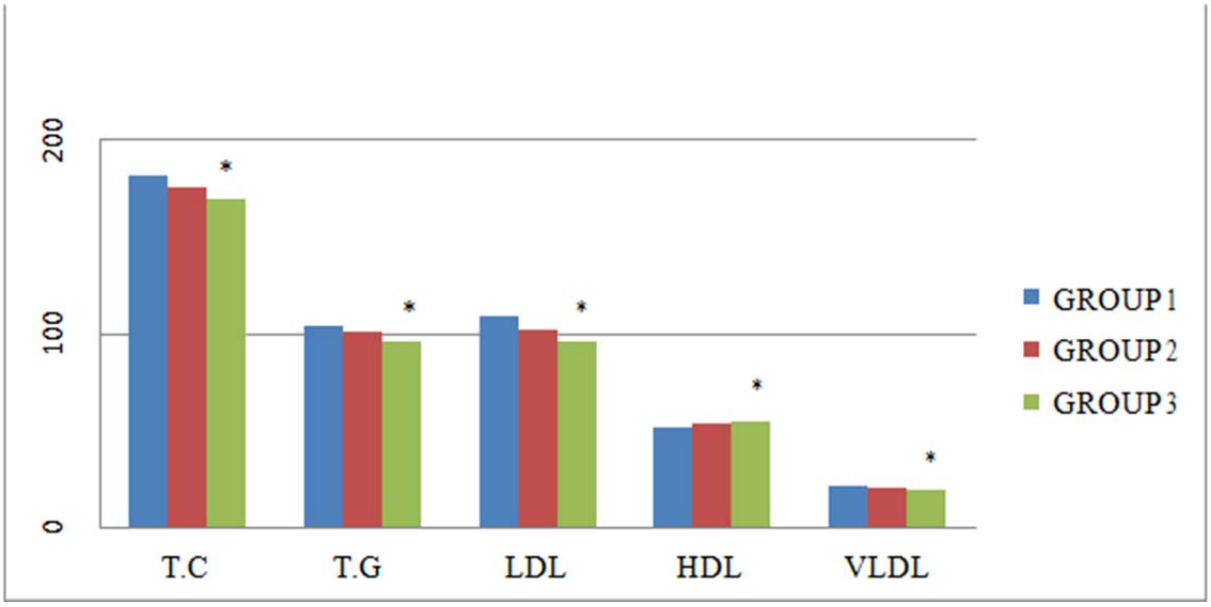

Figure 4: The relationship between the period of nuts consumption and the percent of change in lipid profile parameters.
* Means the presence of a significant difference (one way ANOVA).

DISCUSSION

Recent nutritional research had focused on the consumption of nuts, including almond and pistachio, as a part of heart healthy diet due to its protective effect by reducing the risk of heart disease and coronary risk factor (Griel and Kris-Etherton, 2006). Most nuts are rich in monounsaturated fatty acids, essential polyunsaturated fatty acids, linoleic acid and α – linolenic acid. Furthermore, they also contain bioactive components such as plant proteins, fibers, tocopherols, phytosterols, phenolic compounds, arginine and other bioactive compounds that collectively contribute to their cardioprotective, antiobesity, antioxidant and anticancer effects (Kris- Etherton, et al, 2008).

The results of the current study showed that consumption of a mixture of almond and pistachio for 6 weeks did not produced any body weight gain with no changes in BMI. These results are consistent with those reported by (Jaceldo-Siegl et al, 2011; Vadivel et al, 2012; Wang et al, 2012).

Martinez-Gonzalez and Bes-Rastrollo, (2011) reported that high or recommended doses of daily consumption of pistachio for 12 weeks resulted no changes in BMI. Furthermore, it has been indicated that nuts consumption produced beneficial effects against body weight gain and adiposity (Mattes et al, 2008). Several physiological mechanisms may explain the lack of body weight gain observed in association with nut consumption, since it induce satiation (reduction in total amount of food eaten in a single meal) and satiety (reduction of the frequency of meals) (Martinez- Gonzalez and Bes- Rostroll, 2011). High energy provided with nuts can be compensated by a lower energy intake in meals (Cyril et al,2010). In addition, the presence of certain bioactive compounds in nuts, including polyphenols, is assumed to have beneficial roles in body weight control (Richard et al, 2008).

The results of the current study showed that consumption of a mixture of almond and pistachio for six weeks had favorable effects on blood pressure, especially diastolic blood pressure which was significantly reduced. These results are in agreement with those of Casas-Agustench et al, (2011a and b). The later indicated that due to pistachio contain high level of potassium, clinical studies suggested that increased potassium intake may help in controlling blood pressure in normal and hypertensive subjects (Baer et al, 2012). Reduction in diastolic blood pressure indicates that the active ingredients of nuts caused significant vasodilatation which ultimately lowers the diastolic blood pressure. This vasodilatation effects may be partly attributed to the presence of high potassium which usually cause vasorelaxation (Al-Surchi, 2010).

Nuts consumption reduces the overall glycemic index of the diet, when added to meals

rich in carbohydrate. Nuts also slow down the passage of the meal through the gut and reduce blood glucose levels following the meal (Cyril et al,2010). The results of the present study showed that consumption of a mixture of almonds and pistachio for six weeks significantly decreased the level of blood glucose. This finding is compatible with other studies (Cohen and Johnston, 2011).

Wang et al,(2012) indicated that, when pistachio nuts taken together with high carbohydrate foods, it decreased the absorption of carbohydrate and lowered postprandial blood glucose. Furthermore, the addition of almonds or pistachios to a meal can reduce blood glucose and insulin levels following the meal (Kendall et al,2011).

The results of the present study showed significant increase in total protein, albumin and globulin after consumption a mixture of almond and pistachio with meals for six weeks. Comparison of the studied groups with each other, showed that albumin level was significantly increased during the 1st period by 1.3%, globulin fraction increased when group2 and 3 compared to group 1 by 1.3% and 1.7%, respectively. Total protein was also increased when group 3 was compared with group 1 by 2.3%. These data are considered as new one since it represent the first attempt to study the effect of a mixture of almond and pistachio on total protein, albumin and globulin. Thus these results cannot be compared since no previous studies have been carried out in any of the intervention trial on the effect of nuts consumption especially those studies which related to almond or pistachio.

In the present study, consumption of a mixture of almond and pistachio for six weeks significantly reduced the levels of TG, TC, LDL-cholesterol, VLDL- cholesterol, TC/HDL and LDL/HDL, where as, the level of HDL-Cholesterol was significantly elevated. These results are in agreement with those of Karen et al, (1999) who found a significant decrease in total cholesterol, total cholesterol/HDL cholesterol, LDL/HDL cholesterol and an increase in HDL cholesterol after pistachio nuts ingestion. The favorable fatty acid composition and lipid lowering effect of nuts have been demonstrated in experimental studies with almonds and pistachios (Yang et al,2009).

The effect of the nuts mixture on lipid profile parameters take longer time than that is needed for antioxidants and pro-oxidants to exert their effects (Shih et al,2010). The results of the present study are unique with respect to the improvement of TG level which was significantly decreased by following nuts consumption. Furthermore, it also showed that the percent change for any parameters were more than that obtained from other studies (Sari et al,2010). Finally, the ratios of TC/HDL and LDL/HD were decreased by 17.8% and 26%, respectively. This percent of change is much higher than that obtained by others researchers (McBride,2011), which can be considered as better predictors of coronary heart disease than changes in LDL alone. Accordingly, it can be concluded that the selected mixture of nuts is good and can be considered as a favorable heart healthy mixture.

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کورتی

ئارمانجا ڤەکولینێ:

ئارمانجێن ڤێ ڤەکولینێ لە سەر خارنا تیکەلێ ژ باهیڤا و فستقا سەر ئاستێ دوهنی و کلوکوز و پروتین لناڤ خوینا ئەوان کەسێن ساخلەم خو بەخشکرین.

کەرستە و ریکین شولی:

ئەڤ ڤەکولینە هاتیە ئەنجامدان ل شوباتێ و ئاداریّ ل سالا ٢٠١٣ێ. پشکدارێن ل ڤێ ڤەکولینێ دا ٤٨ قوتابیێن ئەکادیمیا ئەسکەری / زاخو ل هەرێما کوردستانا عیراقێ، هەمی ژی ئەو کەسە بین ئەوێن باریّ تەندروستیت باش و دژین ل هەمان ژینگەهدا. سمپل (عینات) هاتنە وەرگرتن ژ خوینێ بودیارکرنا ئاستێن کلوکوز و جورێن دوهنی و پروتینێ و البومین و کلوبیولین ژ بەری خارنا تێکەل ژ باهیڤا و فستقا (گروپێ ئیکێ). دووبارە پشکنین کرن پشتی خارنا تێکەل ژ ماوەیێ ٣ حەفتیا (گروپێ دووێ) و ٦ حەفتیا (گروپێ سیێ) ل دویڤ ئێك.

ئەنجام:

دیاربوو ل ڤێ ڤەکولینێ دا ئەگەر خارن پێك بێت ژ ٥٠ گرام ژ تێکەل باهیڤا و فستقا بریژا ١/١ کارتێکرنێن پوزێتیڤ هەنە ل سەر فشارا خوینێ و بتایبەتی فشارا خوینا (الانبساگی) کو نزم بیە بشێوەیەکێ بەرچاڤ (معنوی .(p<0.05) (پشتی بورینا سێ – شەش حەفتیا ژ خارنا ئەوی تێکەلی کو چ کارتیکرن نە کریە سەر گرانیا لەشی. نزم بوونا ئاستێ کلوکوزێ ل ناڤ خوینێ دا پشتی بورینا شەش حەفتیا ژ خارنا تێکەلی، و بەروڤاژی زیدەبوونا ئاستێ پروتینێ و البومین و کلوبیولین ل ناڤ خوینێ دا بشێوەکێ (معنوی) بەرچاڤ-P<0.05) (0.001کو هاتینە بەراوورد کرن ئەڤ گروپە دگەل ئێك.

و ل دوماهیکێ نزم بوونا ئاستێ کلولستیرول و دوهنێ سیێ و پروتینێ رونێ یێ کێم (الکپافە) و پروتینێ رونێ گەلەك کێم (الکپافە) و ریژا کلولستیرول ل پروتین رونێ بلند (الکپافە) و ریژا پروتینێ رونی یا نزم (الکپافە) / پروتینێ رونێ بلند (الکپافە) بشێوەکێ بەرجاڤ ((P<0.05-0.001)و سەرەرایی هندێ زیدەبوونا پروتینێ رونی یێ بلند (الکپافە) بشێوەکێ بەرچاڤ P<0.01)) پشتی بورینا شەش حەفتییا ژ خارنا تێکەلی.

یێ هاتیەدیارکرن (استنتاجات) : کو مە دیار کر ل ڤێ ڤەکولینێ دا کو خارنا تێکەلی ژ فستقا و باهیڤا بو ماوێ ٣ – ٦ حەفتیا کارتێکرنێن پوزێتیڤ هەنە لە سەر ئاستێ کلوکوزێ و جورێن پروتینا و دوهنا ل وان کەسێن ساخلەم خو بەخشکرین.

ملخص

هدف الدراسة:

استهدف البحث دراسة تناول مزيج من اللوز والفستق على مستويات الدهون والكلوكوز و البروتينات في دم المتطوعين ألا صحاء.

المواد و طرق العمل :

أجريت هذه الدراسة خلال شهري شباط واذار ٢٠١٣. اشترك في الدراسة ٤٨ من طلبة الأكاديمية العسكرية / زاخو في إقليم كردستان العراق.وكان جميعهم ذكور اصحاء و يعيشون في بيئةمتماثله. أخذت عينات من الدم لتحديد مستويات الكلوكوزوانواع الدهون والبروتين الكلي والألبومين و الكلوبيولين قبل تناول المكسرات(المجموعه الاولى). اعادة الفحص بعد تناول المكسرات لمدة ٣ اسابيع (المجموعه الثانيه) و ٦ اسابيع (المجوعه الثالثه) على التوالي.

النتائج:

اوضحت الدراسة الحاليه أن احتواء الغذاء على ٥٠غم من مزيج اللوز و الفستق بنسبة ١\١ له آثار إيجابية على ضغط الدم وخاصة ضغط الدم الأنبساطي الذي انخفض بشكل معنوي .($p<0.05$)بعد مرور ثلاثة و ستة أسابيع من تناول المزيج كما أنه لم يؤثر على مؤشر كتلة الجسم. انخفض مستوى الكلوكوز في الدم بعد مرور ستة أسابيع من تناول المزيج .وعلى العكس من ذلك ازدادت مستويات البروتين الكلي والألبومين و الكلوبيولين في مصل الدم بصوره معنويه ($P<0.05-0.001$)عند مقا رنة المجاميع مع بعضها.

وأخيرااانخفضت مستويات الكلولستيرول الكلى والدهون الثلاثية و البروتينات الدهنية قليلة الكثافة و البروتينات الدهنية قليلة الكثافة جدآ ونسبة الكلولستيرول الكلى الى البروتين الدهني عالى الكثافة ونسبة البروتين الدهني واطي الكثافة/ البروتين الدهني عالى الكثافة بشكل معنوي ($P<0.05-0.001$) بينما ازداد البروتين الدهني العالي الكثافة بشكل معنوي ($P<0.01$)) بعد مرور ستة أسابيع من تناول المزيج

استنتاجات:

نستنتج من هذه الدراسه أن تناول مزيج من اللوز والفستق لمدة ٣ و ٦ اسابيع تاثيرات ايجابيه على مستويات الكلوكوزوانواع البروتينات و الدهون في المتطوعين الاصحاء .