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COMPARATIVE STUDY OF REGULAR ALMOND CONSUMPTION'S EFFECT ON LIPID PROFILE IN NORMAL, OVERWEIGHT AND OBESE ADULTS.

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ABSTRACT… Objectives: Obesity is a globally pervasive health concern linked to a plethora of cardiometabolic complications such as hypertension, dyslipidemia and hyperglycemia. Poor dietary proclivity contributes to dyslipidemia, however daily intake of nuts has previously been shown to improve abnormal blood lipid levels. The present study evaluated the effect of almond intake on the lipid profiles of normal, overweight and obese adults to discern which group benefits the most. **Study Design:** A prospective non-randomized comparative study design was employed. **Setting:** Institute of Molecular Biology and Biochemistry, University of Lahore and Department of Biochemistry, Central Park Medical College, Lahore. **Period:** May 2018 and December 2018. **Material & Methods:** A total of 34 adult subjects (males and females) were recruited for the study with an age range from 21 to 60 years. Participants were categorized into normal, overweight and obese groups based on their Body Mass Index (BMI) values. Baseline fasting blood samples were drawn from each subject and stored. The subjects were then asked to consume 50g/day almonds (without peel) for 30 days after which blood samples were again collected from each subject. Both baseline and post-supplementation serum samples were subjected to lipid profile analysis. **Result:** Almond supplementation resulted in lowered cholesterol, LDL and VLDL levels (p-values of 0.0001, 0.001 and 0.003, respectively) in Group 1 (normal weight). Lowered cholesterol levels were also observed (p-value 0.007) in Group 2 (overweight). There was no significant change in lipid profile in Group 3 (overweight), upon supplementation. **Conclusion:** Regular almond supplementation offers improvement in lipid profile and such beneficial effects of almond consumption on lipid profile are more pronounced in normal weight individuals than overweight or obese ones.

Key words: Dyslipidemia, Lipid Profile, Obesity, Supplementation.

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INTRODUCTION

Obesity is a serious medical condition marked by the accumulation of body fat to an unhealthy degree.[1] Multiple factors contribute to the onset of obesity including genetics, sedentary lifestyle, endocrine disorders, anti-psychotic drug therapy etc.[2,3] Obese individuals are at a greater risk of developing serious and potentially life-threatening disorders such as type 2 diabetes mellitus, cardiovascular diseases, osteoarthritis, cancer etc.[4] These co-morbidities are further associated with higher mortality rates in obese individuals.[5,6]

Obese and overweight individuals are generally more prone to metabolic disruptions such as hyperglycemia, insulin resistance and dyslipidemias.[7-9] Dyslipidemias are common in developed countries where obesity is more prevalent.[10] Dyslipidemias are a primary risk factor for cardiovascular and metabolic disorders.[11] Lifestyle modifications and/or medical intervention are necessary for obese and dyslipidemic individuals. In the United States, more than one-quarter of adults are dyslipidemic or are prescribed lipid-lowering medication.[12]

In addition to pharmaceutical therapy, lipid levels can be controlled by modifying dietary factors; best results are exhibited by reducing saturated and trans-fat intake and increasing polyunsaturated and monounsaturated fat intake.[13] Tree nuts such as almonds are low in saturated fats and rich in unsaturated fats, α-tocopherols and phytochemicals. Current studies have demonstrated improvement in blood LDL and serum cholesterol levels with the addition of almonds to diet.[14-16] Some studies have also demonstrated weight loss with almond intake, possibly due to its satiating properties and boosting of metabolism.[17-19] Therefore, almond intake could possibly reduce the risk of lethal disease in obese and overweight individuals and prove beneficial in preventing / mitigating dyslipidemia and obesity.

To our knowledge, no adequately designed study has been conducted locally to observe the effect of almond intake on lipid profile in obese, overweight and normal weight individuals. The present study was aimed at determining the potential positive impact of almond consumption on lipid profile in the local population and to observe which weight group benefited the most.

MATERIALS AND METHODS

A prospective non-randomized comparative study design was employed for this research study. The study was carried out at Institute of Molecular Biology and Biochemistry, University of Lahore and Department of Biochemistry, Central Park Medical College, Lahore. The study was conducted between May 2018 and December 2018. The study was approved by the Central Park Research Committee.

A total of 34 subjects were recruited for the study. Written informed consent was procured from each participant prior to enrollment. Individuals with hypertension, diabetes mellitus, hypersensitivity to almonds, peptic ulcer, kidney disease, cardiovascular disorders, malignancy, urinary tract infections or taking lipid-lowering medications were excluded from the study. Pregnant females were also excluded. Participants' body mass index (BMI) values were calculated after measuring their height (in meters) and weight (in kilograms) by using the formula: weight in kilograms divided by height in meters squared. Based on their BMI values, participants were divided into three groups; Group 1 (n=16) normal weight (BMI 18.5 -24.9), Group 2 (n=11) overweight (BMI 25-29.9) and Group 3 (n=7) obese (BMI > 30).

After recruitment and group allocation, subjects were provided instructions about the dose of almonds (50 grams per day) and timing of intake. Subjects were asked to stop the consumption of potential lipid lowering ingredients like garlic, ginger etc. for a period of one month. American variety of almonds weighing 50 grams were packed into plastic bags and 30 packets were given to each subject. Subjects were advised to take one packet daily (for a dose of 50grams/day) before breakfast. The subjects were advised to continue with their usual diet and physical activity for the study period of one month.

Blood samples were collected from each subject at two separate instances; once at baseline i.e. prior to almond consumption and once on the 31st day i.e. subsequent to almond intake. Fasting blood samples were collected for which the subjects were advised not to eat or drink anything except water for a period of 12 hours before sample collection. Early morning samples were collected after an overnight fast. 5ml blood was drawn into a vacutainer tube without anticoagulant using standard sterile venipuncture technique. The collected blood samples were incubated at room temperature for half an hour in upright position and then they were centrifuged for 15 minutes at 2000 revolutions per minute. The supernatant containing serum was collected in clean Eppendorf tubes and stored at 4^{o}C. Lipid profile assays were performed for serum cholesterol, LDL, HDL, VLDL and triglycerides using commercially available kits.

The data were entered into an excel sheet (Microsoft Office) and then imported into SPSS version 23 for analysis. Mean + SD were calculated for quantitative variables. One-way ANOVA was performed to assess group mean differences followed by employment of paired sample t test within groups for determination of differences with in groups where p-values < 0.05 were regarded as significant.

RESULTS

The age of subjects (Mean + S.D.) was 36.08 + 11.45 years. Upon applying ANOVA, no significant difference was observed in the values of any of the studied lipid profile parameters between the three groups, either at baseline or after supplementation (Table-I). This finding reflected that the lipid profile status in each group were well-matched. The following results were obtained on applying paired sample t-test on individual lipid profile parameters in each of the three groups (Tables-II-IV). Group 1 showed significant reduction in post-supplementation fasting serum cholesterol levels (Mean + SD mg/dl; Baseline 213.41 + 45.7 vs. Post-supplementation 179.11 + 38.18; p = 0.0001) (Table-II). Similarly, significantly lowered serum fasting LDL levels were observed (Mean + SD mg/dl; Baseline 128.97 + 38.01 vs. Post-supplementation 110.82 + 29.56; p=0.001) (Table-II) Amelioration in serum fasting VLDL was also observed (Mean + SD mg/dl; Baseline 33.02 + 15.65 vs. Post-supplementation 27.94 + 12.7; p=0.003). Some beneficial effects of almond supplementation were also reflected through the results observed in Group 2. Cholesterol levels were reduced after almond intake with a significant difference in serum levels before (Mean + SD mg/dl; 222.36 + 57.69) and after almond supplementation (Mean + SD mg.dl; 192.72 + 42.68) (p=0.007 (Table-III). There was no improvement in any other parameter. Group 3 displayed no significant difference in any of the studied parameters of lipid profile pre- and post-almond supplementation (Table-IV).

Parameter	Group 1 (n=16) Mean + S.E.M.	Group 2 (n=11) Mean + S.E.M.	Group 3 (n=7) Mean + S.E.M.	P-Value
Cholesterol before supplementation (mg/dl)	200.81 + 9.99	222.36 + 17.39	228.14 + 12.71	0.316
Cholesterol after supplementation (mg/dl)	171.18 + 7.24	192.72 + 12.86	175.85 + 18.38	0.354
HDL before supplementation (mg/dl)	38.81 + 1.48	43.54 + 1.94	39.42 + .89	0.101
HDL after supplementation (mg/dl)	42.37 + 3.12	39.36 + 2.32	44.71 + 2.93	0.550
LDL before supplementation (mg/dl)	124.0 + 8.88	134.00 + 12.41	132.42 + 16.20	0.780
LDL after supplementation (mg/dl)	103.81 + 7.87	120.72 + 7.74	111.28 + 11.43	0.355
TAG before supplementation (mg/dl)	153.81 + 17.96	120.72 + 7.74	117.71 + 29.40	0.735
TAG after supplementation (mg/dl)	151.25 + 14.31	173.18 + 26.55	183.57 + 38.41	.606
VLDL before supplementation (mg/dl)	31.43 + 3.06	34.36 + 5.33	34.57 + 7.91	.863
VLDL after supplementation (mg/dl)	26.62 + 3.05	29.18 + 3.39	29.00 + 6.53	.859

Table-I. Multiple group comparisons of lipid profile parameters

Parameter	Before (Mean + S.D.)	After (Mean + S.D.)	P-Value
Cholesterol (mg/dl)	213.41 + 45.7	179.11 + 38.18	.0001*
HDL (mg/dl)	40.47 + 5.85	41.82 + 10.19	.481
LDL (mg/dl)	128.97 + 38.01	110.82 + 29.56	.001*
TAG (mg/dl)	165.00 + 77.15	164.00 + 73.66	.880
VLDL (mg/dl)	33.02 + 15.65	27.94 + 12.7	.003*

Table-II. Effect of almond supplementation on lipid profile in normal weight subjects.
***Difference is significant at p-value < 0.05**

Parameter	Before (Mean + S.D.)	After (Mean + S.D.)	P-Value
Cholesterol (mg/dl)	222.36 + 57.69	192.72 + 42.68	.007
HDL (mg/dl)	43.54 + 6.45	39.36 + 7.69	.154
LDL (mg/dl)	134.00 + 41.16	120.72 + 25.70	.144
TAG (mg/dl)	173.18 + 88.07	170.09 + 78.85	.800
VLDL (mg/dl)	34.36 + 17.68	29.18 + 11.26	.143

Table-III. Effect of almond supplementation on lipid profile in overweight subjects.
***Difference is significant at p-value < 0.05**

Parameter	Before Mean + S.D.	After Mean + S.D.	P-Value
Cholesterol (mg/dl)	228.14 + 33.64	175.85 + 48.64	.012
HDL (mg/dl)	39.42 + 2.37	44.71 + 7.76	.083
LDL (mg/dl)	132.42 + 42.86	111.28 + 30.25	.336
TAG (mg/dl)	177.71 + 79.11	183.57 + 101.64	.697
VLDL (mg/dl)	34.57 + 20.44	29.0 + 17.30	.280

Table-IV. Effect of almond supplementation on lipid profile parameters in obese subjects.
***Difference is significant at p-value < 0.05**

DISCUSSION

Obesity and its related metabolic complications are considered a grave health concern globally. Adverse lipid changes associated with weight gain are implicated in the development cardiovascular complications with a high mortality and morbidity.[8] Nutritional manipulation of lipid profile is an emerging modality with therapeutic and preventive value. The present study looked at the effect of almond supplementation on serum lipid values in obese and overweight individuals and compared them with adults having normal weight.

On assessment of the various parameters of fasting lipid profile, prominent beneficial effects were revealed in normal weight subjects. Almond supplementation was associated with decrease in serum total cholesterol, LDL and VLDL levels, with the effect being highly contingent on individuals' BMI values as demonstrated by Abazarfard et al.[20] A decline in serum cholesterol levels was also observed in both overweight and lean subjects after the month-long almond intervention in addition to the decrease observed in serum LDL and VLDL in normal weight individuals. The observed improvement in lipid profile associated with almond supplementation in normal weight individuals may be more marked because of better metabolism seen in such individuals as documented by Kanwar et al.[21] Previously, life style modifications such as regular exercise and almond supplementation have shown noticeable increase in BMI in children under the age of 14, as described by Kelishadi et al.[22] Conversely, decrease in BMI and waist-to-hip ratios have been reported in adults after supplementation with almonds, which has been attributed to metabolic differences between adults and children.[23] Thus, nutritional modifications such as almond supplementation are more likely to influence the biochemical and anthropometric measures in a positive way in metabolically healthy individuals with weight within the normal range.

The current negative results on serum TAG levels are consistent with a previous study by Liu et al. that exhibited no change in TAG levels subsequent to almond intake.[19] The present study did not show any effect on HDL levels in any of the groups which is in accordance with Wein et al. who reported that almond supplementation has no effect over HDL values in overweight individuals. The probable reason for this may be the compromised efficacy of lipoprotein lipase owing to insulin insensitivity, which is now regarded as an attribute of obesity.[24]

The present study was limited by the small sample size and apparently uneven age/sex distribution between the groups. Larger future studies with appropriately matched groups are warranted to ensure that findings are robust enough for their generalization to local population.

CONCLUSION

Almond supplementation results in improvement of lipid profile, but the effect is more marked in normal weight individuals as compared to overweight and obese individuals. Caloric restriction, exercise and similar lifestyle modifications aimed at weight reduction may be advised to obese and overweight subjects to augment the beneficial impact of almond supplementation on serum lipid profile.

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