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Short Communication

Comparative Study of Vitamin C on Serum Lipid Profile in Healthy Male and Female Human Subjects

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Abstract

This study aims to assess the comparative effects of vitamin C supplementation on lipid profiles in male and female human subjects. A total of 60 healthy individuals (male and female) were selected randomly, instructed and given the understanding of the purpose of study. The test group comprising 30 individuals were given 500mg vitamin C tablets one daily for 30 days and control group of 30 individuals were given placebo capsules(glucose 500mg) one daily for 30 days. Fasting blood samples were collected in the morning for estimation of cholesterol, triglycerides, HDL-C, LDL-C and VLDL-C on first day of the commencement of the study and second blood samples were taken after thirty days of supplementation and same estimations were carried out. Vitamin C caused reduction in serum total cholesterol and LDL cholesterol significantly but it did not have any statistically significant effect on HDL-C, VLDL-C and triglycerides. As far as gender is concerned the effect of vitamin C on lipid profile in males was not significantly different from those in females.

Keywords: Lipid profile; Ascorbic acid; Gender.

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1. Introduction

Vitamin C helps in slowing down and prevention of cell damage. It is needed to maintain healthy body tissues and the immune system. Vitamin C also helps in the absorption of iron from plant foods in the gastrointestinal tract. Vitamin C or ascorbic acid, also known as antiscorbutic vitamin is, an “enediolactone” of an acid similar to L-glucose, which is an important antioxidant in humans [1], capable of scavenging oxygen-derived free radicals [2].

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Important sources of vitamin C in diet consist chiefly of vegetables and fruits. These include citrus fruits, orange, lemon, lime, pineapple and strawberry, vegetable sources include cabbage, cauliflower, green peas, potatoes and tomatoes, with "Amla" as the richest source. This vitamin is concerned with synthesis of muco-polysaccharides of basement membranes of epithelial tissues. The activity of this vitamin is also significant in vital metabolic activities including tryptophan metabolism, formation of active tetrahydrofolate, formation of ferritin. Scurvy is the classical syndrome of vitamin C deficiency. It is related to defective collagen synthesis which is indicated by subcutaneous and other hemorrhages, muscle weakness, soft swollen gums and loose teeth; and is cured by consumption of fruits and vegetables rich in vitamin C. The normal stores of vitamin C are sufficient to last for 3-4 months before a sign of scurvy appears. Vitamin C is the most essential water-soluble antioxidant in human serum. The antioxidant activity of vitamin C is considered to be the major defense mechanism, in the aqueous phase, against the harmful effect of free radicals [3,4]. Vitamin C is structurally similar to glucose and can replace it in many chemical reactions, and thus is effective in prevention of non-enzymatic glycosylation of proteins [5]. In addition, vitamin C acts as a regulator of catabolism of cholesterol to bile acid in guinea pigs and has been demonstrated to be an important factor for the regulation of lipids [6].

The absence of L-gulonolactone oxidase enzyme in biosynthesis pathway of ascorbic acid in primates, guinea pigs and humans is a metabolic defect [7,8]. Storage forms of vitamin C in human tissues are not found but there are high concentrations in "metabolically highly active" organs such as adrenal cortex, liver and corpus luteum. It is also plays an important role in electron transport system, catecholamine synthesis, omega-oxidation of fatty acids and coenzyme for cathepsin and liver esterases and also act as cellular antioxidant [9]. It is concerned with collagen synthesis and wound healing as well as antibody synthesis and healthy dentition [10]. Relationship of association between vitamin C and atherosclerosis has been suggested in many studies that evaluated the relationship between vitamin C and cholesterol levels [11-16]. The aim of present study is to compare effect of vitamin C intake on serum lipid profile in healthy male with those of healthy female subjects.

2. Materials and Methods

This study was performed at G. R. Medical College, Gwalior, Madhya Pradesh. Sixty normal healthy individuals of both the sex (30 each), which included medical students, doctors, class III, class IV Government servants of the hospital and also some relatives and friends participated in the present study. Criteria laid down by W.H.O were followed for the selection of normal subject. All subjects were seemingly healthy, were not taking any vitamin supplements or medication, and none

was on any special diet and also had lipid profile within normal range. All individuals were given the understanding of the purpose of the study and instructed accordingly.

5 ml of blood samples were collected with disposable syringe from antecubital vein and delivered into a clean sterilized test-tube. Serum was separated by centrifugation at 3000 RPM for 10 minutes and tested for different fractions of lipids viz total cholesterol (TC), LDL-C, HDL-C, VLDL-C, and total triglycerides (TG), before the initiation of supplementation with vitamin C and after 30 days of vitamin C supplementation. Reagents and kits for enzymatic estimation of lipid components were supplied by Boehringer Mannheim (Mannheim, W.Germany). Serum cholesterol was estimated by monotest cholesterol and CHOD-PAP method [17,18] and triglycerides by GPO-PAP method [19]. Estimation of VLDL-C was done by using Friedewald formula [20] LDL-C by CHOD-PAP Monotest and PVS method [21,22] and HDL-C by precipitation method [23,24].

The treatment, diet and physical activity of the patients remained unchanged during the course of study. Patients' compliance to the prescribed drug was monitored by a dairy checklist and continuous contact by phone. After 30 days of supplementation with vitamin C, patients were examined again and the tests repeated. All patients were informed about the study and a written consent was taken from all participants at the beginning of the study. These individuals were divided randomly into four groups of 15 control and 15 test males and 15 control and 15 test female each, individual of each control groups were given one placebo capsules (Glucose 500 mg) daily for 30 days . The identity of these capsules was kept secret and individuals of test groups were supplemented with 500 mg of ascorbic acid tablets daily for 30 days.

The data were analyzed statistically and results are expressed as mean ± SD. Differences between the two groups before and after supplementation were tested by the Student's *t*-test. All statistical tests were two-tailed, and Person's correlation coefficient was used to determine relationship between the variables. *P* value lower than 0.05 was considered as significant.

3. Result and Discussion

In males the mean values of serum cholesterol, TG, HDL-C, LDL-C and VLDL-C before therapy were (in mg/dl) 221.46±33.92, 112.92±25.26, 43.62±10.52, 150.84±28.73 and 21.81±4.60, respectively. While the mean values became (in mg/dl) 206.38±34.65, 107.61±25.97, 45.92±12.95, 132.08±32.98 and 21.50±5.19, respectively after vitamin C therapy for 30 days.

The mean values of serum cholesterol, TG, HDL-C, LDL-C and VLDL-C in female before therapy were (in mg/dl) 211.33±38.72, 109.75±22.51, 43.66 ±6.48, 132.9±34.66 and 21.90±4.51, respectively. While the mean values became 196.67±30.54, 113.16±24.52, 44.08±10.18, 117.75±39.31 and 22.63±4.90, respectively after vitamin C therapy for 30 days in females (Table 1).

Table 1. Comparative statistical analysis of values of various parameters in normal human male and female subject before and after vitamin C intake.

Parameter mg/dl	Subject	time	Mean	S.d.	Range	Average	*'t'*	d SDd	*P*	S/I
Choleterol	M	Before	221.46	33.92	138-274	206	0.03	15.08	> 0.05	I
		After	206.38	34.65	124-247	185.5		12.53		
	F	Before	211.33	38.72	162-287	224.5		14.67		
		After	196.67	30.54	147-237	192		19.85		
Triglyceride	M	Before	112.92	25.26	72-156	114	0.16	5.30	> 0.05	I
		After	107.61	25.97	50-138	94		31.40		
	F	Before	109.75	22.51	73-150	111.5		3.50		
		After	113.16	24.52	58-147	102.5		20.73		
HDL	M	Before	43.62	10.52	33-66.9	48.45	0.52	2.25	>0.05	I
		After	45.92	12.95	29-63.5	46.25		8.98		
	F	Before	43.66	6.48	31-53	42		0.38		
		After	44.08	10.18	26-61	43.5		8.82		
LdL	M	Before	150.84	28.73	93-183	138	0.35	18.76	>0.05	I
		After	132.08	32.98	65-172	118.5		14.90		
	F	Before	132.91	34.66	69-193	131		15.16		
		After	117.75	39.31	66-191	129.5		31.07		
VLdL	M	Before	21.81	4.60	14.4-31.2	22.8	0.15	1.06	>0.05	I
		After	21.50	5.19	10-28	19		6.38		
	F	Before	21.9	4.51	15.8-30	22.9		0.73		
		After	22.63	4.90	11.6-29.4	20.5		4.09		

S = significant, I = Insignificant., d SDd = Standard deviation of the mean difference.

When data of both male and female groups were pooled together and compared for their before and after values (Table 2), vitamin C supplementation of 500 mg per day was found to be effective in reducing the serum total cholesterol and LDL-C levels significantly while found to be ineffective in changing the serum levels of TG, HDL-C, and VLDL-C. As expected the placebo capsules (Glucose 500mg) one daily for 30 days did not have any significant effect on any of the parameters of lipid profile.

Earlier studies shows that vitamin C supplementation to normal healthy individual is effective but not statistically significant [15,25]. But short term vitamin C supplementation to diabetic type 2 patients helps in improving plasma glucose and lipid profile [26], similar results were observed in studies on Guinea pigs [27]. Robert et al. demonstrated that physiological concentrations of vitamin C inhibit Cu^{2+}-mediated lipid oxidation in HDL and preserve the cardio-protective ability of this lipoprotein fraction to prevent atherogenic modification of LDL [28]. Low dose of vitamin C and E (combined) had favorable effect on lipid profile [29] and can be considered as a preventive strategy in progression of CVD in patients.

Table 2. Statistical analysis of values of various parameters of lipid profile after pooling the data of study group of both the genders before and after vitamin C intake.

Parameter mg/dl	Time	MEAN	S D	RANGE	P value	Significance
Cholestrol	Before	216.6	35.01	138-274	<0.001	Highly significant
	After	201.72	32.44	155-247		
Triglycerides	Before	111.4	23. 52	72-150	> 0.05	Insignificant
	After	104.2	20.28	50-147		
HDL	Before	43.64	8.59	30.6-66.9	> 0.05	Insignifcant
	After	45.00	11.51	26.5-73.4		
LDL	Before	142.24	32.35	60-193	< 0.02	Significant
	After	125.2	36.13	56-180		
VLDL	Before	22.26	4.73	14.4-31.2	> 0.05	Insignifcant
	After	22.05	4.99	10.2-29.4		

Vitamin C (> 200 mg/day) was significantly associated in modifying the HDL-C, HDL2-C, and HDL3-C in males, and with HDL-C and HDL3-C in females [30] . Studies on albino rats of both sexes [10] indicated insignificant change in the values of HDL and TG but significant decrease in total serum cholesterol, VDLD and LDL as compared to control group. In present study vitamin C caused reduction in serum total cholesterol and LDL-C significantly but it did not have any statistically significant effect as far as HDL-C, VLDL-C and triglycerides are concerned in both the genders.

Vitamin C activates the enzyme 7 α-hydroxylase which enhances the conversion of plasma cholesterol into bile acid, resulting in a decrease in serum levels of cholesterol. In fact deficiency of vitamin C inhibits 7 α-hydroxylase leading to the block in bile acid synthesis and accumulation of cholesterol in serum with subsequent athereosclerosis in scorbutic Guinea pigs [31].

Steroid hormones synthesis requires cholesterol as the precursors and vitamin C plays a role in hydroxylating the steroid hormone in the adrenal glands. It also directly meditates through a rate limiting hydroxylation of side chains, the conversion of cholesterol into steroid hormones [32]. The reduction in LDL-cholesterol points to the fact that adequate vitamin C intake can reduce the incidence of atherosclerosis. Anderson et al. [33] noted that animal fed on vitamin C had reduced risk of coronary Heart disease. The observed decrease in total cholesterol, VLDL and most significantly the ability to lower the levels of the atherogenic predisposing factor (serum – LDL cholesterol) yet desirably increasing the level of HDL implies that dietary vitamin C on account of its effect on lipid profile may have a protective effect against atherosclerosis. Prolonged vitamin C supplementation which is also an important constituent of the antioxidant system may help in keeping lipid profile in normal limits [34].

4. Conclusion

Moderate intake of vitamin C may produce a hypocholesterolaemic effect which is not significantly different in males than in females. The action of vitamin C on cholesterol and other lipid profile parameters appears to be similar as far as gender is concerned. Thus, it may have protective action against atherosclerosis and may attenuate coronary heart disease (CHD) and long term supplementation of vitamin C may be used to keep the lipid profile within normal limits in both the sexes without any gender bias.

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