

SERUM VITAMIN C AND TOTAL CHOLESTEROL LEVELS IN HEALTHY ADULTS

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SYNOPSIS

One hundred and ninety eight healthy adults of both sexes (95 males and 103 females) were investigated for serum levels of total cholesterol and ascorbic acid to examine if these two parameters were associated. The males with serum ascorbic acid level higher than 1.0 mg/dl had a significantly higher level of serum total cholesterol level (193.6 ± 42.0 mg/dl) compared to those with ascorbic acid level less than 1.0 mg/dl ($P < 0.05$). The serum total cholesterol level in the latter group was (172.9 ± 25.7 mg/dl). There was a positive correlation of serum total cholesterol with ascorbic acid level ($P < 0.02$). However no such association of these two serum parameters was observed in women. This positive association of serum total cholesterol and ascorbic acid was independent of the influence of age, weight and ponderal index.

INTRODUCTION

The role of vitamin C in lipid metabolism and experimental atherosclerosis has been suggested as: i) Accumulation of total cholesterol in many tissues (1,2,3); ii) Lowered cholesterol catabolism (4); iii) Stimulation of intraperitoneally injected [$^{26-14}$ cholesterol to $^{14}\text{CO}_2$; oxidation of 7-hydroxycholesterol in vitro (5,6) and iv) Stimulation of formation of bile acids from cholesterol in liver of scorbutic guinea-pigs (7,8). However the relationship of vitamin C status with serum cholesterol in man has been reported to be conflicting and inconclusive. Bronte-Stewart et al (9), first reported that ascorbic acid replacement in scorbutic Bantu caused an immediate increase of serum total cholesterol inspite of a low cholesterol intake. Similar positive correlation of vitamin C status and serum cholesterol has been observed by Gatenby Davies and Newson (10) in pastoral peoples in Kenya and by Hodges et al (11) in scorbutic Caucasian subjects. On the contrary many authors have reported lack of any correlation (12,13,14,15,16), or presence of negative correlation (3,17,18). Bates et al (16), observed an association of plasma vitamin C status and HDL cholesterol in males but not in females. The serum cholesterol level of individuals is dependent on several factors like age, sex, body-weight, body-fat, etc. There is also a great deal of variation of blood ascorbic acid levels in different seasons depending on seasonal variations of ascorbic acid intake (19,3). In many of the above-mentioned studies these variables, which might have confounded the expected relationship have not been considered.

In view of the above we present in this communication the result of serum ascorbic acid and total cholesterol levels in a group of 198 healthy adults of Indian origin studied under controlled conditions to re-examine the question of the relationship of these two parameters.

MATERIALS AND METHODS

One hundred ninety eight adults (95 males and 103 females) were investigated. The subjects were all healthy as judged by clinical and laboratory investigation. Height and nude weight of the subjects were recorded in the morning. The ponderal index was calculated by the formula H^3/\sqrt{W} (20). Fasting blood samples were collected by venepuncture in the morning after a period of rest to avoid the effect of stress. Blood samples of females were collected at the mid-menstrual cycle. Blood was collected in plain tubes. Clotted blood was centrifuged after the clot has retracted and serum was separated. Serum total cholesterol was determined on the same day by following ferric chloride method. Serum ascorbic acid was determined immediately by the dichlorophenolindophenol method of Mindlin and Butler (21).

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**Table 1: SERUM TOTAL CHOLESTEROL LEVELS (mg per dl)
IN RELATION TO ASCORBIC ACID LEVELS IN HEALTHY ADULTS**

Serum Ascorbic Acid Level	Sex	n	Age (Yrs) Mean + S.D.	Weight (Kg) Mean + S.D.	Ponderal Index ¹ Mean + S.D.	Blood Ascorbic Acid Mean + S.D.	Total Cholesterol Mean + S.D.
< 1.00 mg/dl	M	36	25.5 ± 7.0	63.1 ± 9.3	43.0 ± 1.9	0.84 ± 0.14	172.9 ± 25.7
	F	33	21.5 ± 5.0	49.5 ± 6.7	42.3 ± 1.9	0.84 ± 0.13	154.5 ± 33.6
> 1.00 mg/dl	M	59	26.2 ± 8.5	63.6 ± 8.5	42.8 ± 2.1	1.29 ± 0.11	193.6 ± 42.0
	F	70	23.2 ± 6.0	49.9 ± 6.4	42.7 ± 1.9	1.34 ± 0.16	162.5 ± 31.0

$$^1\text{Ponderal Index} = \text{Height}^3 / \text{Weight}$$

RESULTS AND DISCUSSION

The results of serum total cholesterol level and ascorbic acid in 198 individuals are presented in Table 1. The total serum cholesterol level was higher in men having higher serum ascorbic acid level. The mean level of serum total cholesterol was 172.9 ± 25.7 mg/dl in 36 men having serum ascorbic acid lower than 1.00 mg/dl, while 59 men with a serum ascorbic acid level higher than 1.00 mg/dl had a mean serum total cholesterol level of 193.6 ± 42.0 mg/dl. The difference in the mean levels between these two groups was significant ($P < 0.05$). The age, height, weight and ponderal index of these two groups of men were almost identical suggesting that the difference was real. However there was no significant difference in serum total cholesterol levels between women with higher and lower levels of serum ascorbic acid. Bates et al (16) had also observed a positive association of plasma vitamin C with HDL cholesterol only in men. The present group of volunteers was investigated under controlled conditions and collection of samples was limited to only the mid-menstrual period. There may be some individual variations of endocrine profiles which might have confounded the expected association in females by their action on lipid metabolism.

Further, the serum total cholesterol was also found to be positively correlated with serum ascorbic acid level in men when they were analysed by linear regression analysis ($P < 0.02$). This correlation, was independent of age, height, weight and ponderal index. No such correlation was observed in women. It may therefore be concluded that there is a positive association of serum total cholesterol level with ascorbic acid, at least in men. Further studies are required in women with simultaneous determination of endocrine profiles in them to explain the lack of such an association in women in our studies and study of Bates et al (16).

This study confirms the observation of Bronte-Stewart et al (9); Hodges et al (11) and Gatenby Davies et al (10). However these two studies detected an association in scorbutic Bantu and Caucasian subjects respectively with a rise of serum total cholesterol level with ascorbic acid supplementation while Gatenby Davies observed the association in pastoral peoples of Kenya with seasonal variation of plasma and leucocytes ascorbic acid levels. Bradley et al (15) had also observed a positive association in Mexican-American children with extreme high and low level of vitamin C.

The experimental observation of the role of ascorbic acid in increasing catabolism of cholesterol in tissues and augmented transformation into bile acids is however contrary to the present observation of positive correlation of these two parameters.

In experimental studies usually ascorbic acid is administered in high pharmacological doses which is quite different from the low vitamin level of blood in healthy individuals. Further the metabolism of lipids and experimental athero-

sclerosis in guinea-pigs are quite different from those in man.

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