Vitamin C in Cardiovascular Health

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Introduction

There is now suggestive evidence that vitamin C may be essential to the welfare of many systems. Accordingly, an attempt will be made in this report to answer the following five questions:

1. What is the frequency of reported cardiovascular findings in a presumably healthy population?
2. What is the daily ascorbic acid intake in this same group?
3. Is there any relationship between the frequency of reported cardiovascular symptoms and signs and daily vitamin C consumption?
4. What changes in this frequency of reported cardiovascular symptoms and signs occur following a one year experimental period during which group nutritional improvement instruction sessions were conducted?
5. What are the possible significances of these findings?

Method of Investigation

In 1965, a multiple testing health program for members of the health professions was inaugurated under the auspices of the Southern Academy of Clinical Nutrition. In 1969, the project was extended to include a group designated as the Southern California Academy of Nutritional Research, and a third group was organized under the aegis of the Ohio Academy of Clinical Nutrition. In 1971, a fourth segment was added under the direction of the Northeast Academy of Clinical Nutrition. Finally, in 1972, a fifth group was started under the guidance of the Northern California Academy of Nutritional Research.

Six hundred fifty-seven dental practitioners and their wives were evaluated initially and at each annual subsequent visit between 1965 and 1972 in terms of reported dietary patterns and clinical state. A clinical score for cardiovascular symptoms and signs was derived from the Cornell Medical Health Questionnaire (CMI). Section C (13 questions) relates to the cardiovascular system. The distribution of positive (pathologic) responses for the five examination sessions is summarized in **Table 1** (p.167). The daily vitamin C intake was also obtained from a food frequency query at each visit. This pattern is shown in **Table 2**, (p.168). It became clear that many of the participants were consuming large amounts of refined carbohydrate foodstuffs, suboptimal amounts of protein and relatively small quantities of vitamins and minerals. The therapeutic regimen consisted of several brief nutritional seminars showing the dietary deficits and measures for dietary improvement

Results

Question One: **Table 1** summarizes the frequency of reported cardiovascular findings for the entire sample at the initial examination and for all patients at the four subsequent periods. For the moment, it will be noted that on average, each subject initially reported 1.21 positive cardiovascular responses. Hence, in answer to the first question, reported cardiovascular symptoms and signs range from zero to nine with a mean of 1.21 in this particular and unique sample of the population.

Question Two: Table 2 outlines the daily vitamin C consumption for the entire sample at the first analysis and for those at the four subsequent examinations. The average intake initially is 294 mg/day. According to the Food and Nutrition Board of the National Research Council, the recommended intake for the male is 60 mg/day and the requirement for the female (at that

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time) was 55 mg/day. On this basis, about 95% of the subjects are consuming adequate amounts. Hence, according to the Recommended Dietary Allowances, and in answer to the second question, this group is consuming approximately four to five times more vitamin C than is officially recommended.

Question Three: Table 2 shows that 657 subjects participated at the initial examination and 225, 116, 64 and 12 at subsequent annual sessions, making a total of 1074 experiences. Figure 1, (p.170) pictures the association between the frequency of reported cardiovascular symptoms and signs (on the abscissa) versus the daily ascorbic acid intake (on the ordinate). On a mean basis, there is a progressive decline in cardiovascular findings which parallels an increase in daily vitamin C consumption. It is clear, in answer to the third question, that there is a low but statistically significant negative correlation coefficient ($r=-0.096$, $p<0.01$), meaning that the higher the daily vitamin C intake, the fewer the cardiovascular findings.

Question Four: Following the initial survey, as previously noted, health education lectures were provided to the group, and these were repeated annually. This included discussions of the existing dietary patterns and possible changes that could and should be instituted. On an annual basis, the entire group was reexamined by the techniques (clinical and dietary) previously mentioned

It is relevant to point out that well over three-fourths, actually 77.8% of the group,

Table 1. Reported cardiovascular findings.

Number of Cardiovascular Findings	First visit	Second Visit	Third visit	Fourth visit	Fifth visit
.0	273	108	53	27	7
1	186	65	40	23	3
2	97	32	16	9	2
3	47	7	6	3	0
4	22	10	0	1	0
5	18	2	1	1	0
6	7	1	0	0	0
7	5	0	0	0	0
8	1	0	0	0	0
9	1	0	0	0	0
Total	657	225	116	64	12
Mean	1.21	0.91	0.82	0.92	0.58
t	3.018	0.783	0.626	1.026	
p	<0.005*	>0.400	>0.500	>0.200	
Minimum	0	0	0	0	0
Maximum	9	6	5	5	2
Range	9	6	5	5	2

*Statistically significant difference of the means. March 1973

increased the daily vitamin C intake between the first and second visit (**Table 3**, p. 169). The changes between subsequent visits are also shown.

Table 1 tabulated the cardiovascular scores at each examination period. It will be noted that, initially, the mean cardiovascular score was 1.21; one year later, the average score was 0.91. The mean values were 0.82, 0.92 and 0.58 for the third, fourth and fifth annual examinations, respectively. Thus, overall, there was a statistically significant decline in clinical symptoms and signs between the first and second examinations.

For these and other reasons, it was thought expedient to reexamine the data in terms of the changes in reported cardiovascular findings with regard to changes in vitamin C consumption. Specifically, 290 subjects (Group 1), for whatever reason, decided to increase their daily ascorbic acid intake (Figure 2, p.171). For this group, the mean initial daily vitamin C ingestion was 239 mg. One year later, the amount was 423 mg. Obviously, in this Group 1, the t value (22.159) is highly significant ($p<0.001$). It will be noted in **Figure 2** that in this same group, the mean cardiovascular score decreased from 1.19 to 0.89 during the same experimental year. It is evident that this change is statistically significant ($t=3.939$, $p<0.001$).

In contrast, 88 individuals (Group II), for whatever reason, decided to reduce or, at least, not increase daily vitamin C intake. Figure 2 shows that the average daily ascorbic acid consumption decreased from 409 to 318 mg/day. Obviously, by selection, this is a statistically significant change ($t=10.566$, $p<0.001$). Interestingly enough, there was no statistically significant alteration in the reported cardiovascular picture ($t=1.884$, $p>0.050$). Thus, in answer to the fourth question, the addition of vitamin C appears to contribute to the reduction in

Table 2. Daily vitamin C consumption.

Daily Vitamin C intake (mg)	First visit	Second visit	Third visit	Fourth visit	Fifth visit
<55	18	2	0	0	0
55-60	8	0	0	0	0
>60	631	223	116	64	12
Total	657	225	116	64	12
Mean	294	351	387	4 72	550
S.D.	180	179	201	157	116
t		4.075	t.644	3.094	1.602
p		<0.001	>0.100	<0.005*	>0.100
Minimum	15	42	71	139	297
Maximum	881	923	1120	885	719
Range	866	881	1049	746	422

*Statistically significant difference of the means. March 1973

cardiovascular symptoms and signs.

Question Five: Two interdependent points bear on the response to this final question. First, in the final analysis, health or disease is a function of the environment and the organism's capacity to cope with the external milieu. The latter ingredient is termed host resistance and susceptibility. Analytically, resistance may be viewed as any agent (in this case, vitamin C) which, when administered, tends to discourage the development of disease. When absent, however, it encourages disease. For instance, vitamin B_1 (thiamin) may also be regarded as a resistance agent for its administration tends to minimize the development of beri-beri, and its absence causes it. In a sense, therefore, resistance agents are pluses. In contrast, a susceptibility agent invites disease when present and discourages the development of disease when it is withdrawn. Thus, sugar, for example, is to be viewed as a susceptibility agent or a minus. Parenthetic mention should be made that an agent is never a resistance factor for one disease and a susceptibility factor for another. Since vitamin C is known As a resistance agent for scurvy, it would seem that it should be a resistance agent for other syndromes. If sugar is a susceptibility agent in the mouth, it is likely the same for the whole body.

It is well to evaluate ascorbic acid as a resistance or susceptibility agent with regard to the early development of cardiovascular pathosis. **Figure 3**, p.172 attempts to pictorially portray this situation. Shown on the ordinate is the mean daily vitamin C consumption. This group characterized by no cardiovascular findings consumed, on the average, 338 mg vitamin C daily (the darker bar). In contrast, the group characterized by one or more cardiovascular symptoms and signs consumed a mean of 323 mg vitamin C per day. The difference is statistically not significant ($t=1.406$, $p>0.100$). A restudy (**Figure 4**, p.172) of 0 versus 2+ cardiovascular symptoms and signs shows a significant distinction ($t=2.196$, $p<0.050$). Thus, in answer to the final question, the evidence suggests that vitamin C may be viewed as a resistance agent for cardiovascular disease because its addition tends to reduce the possibility of pathosis.

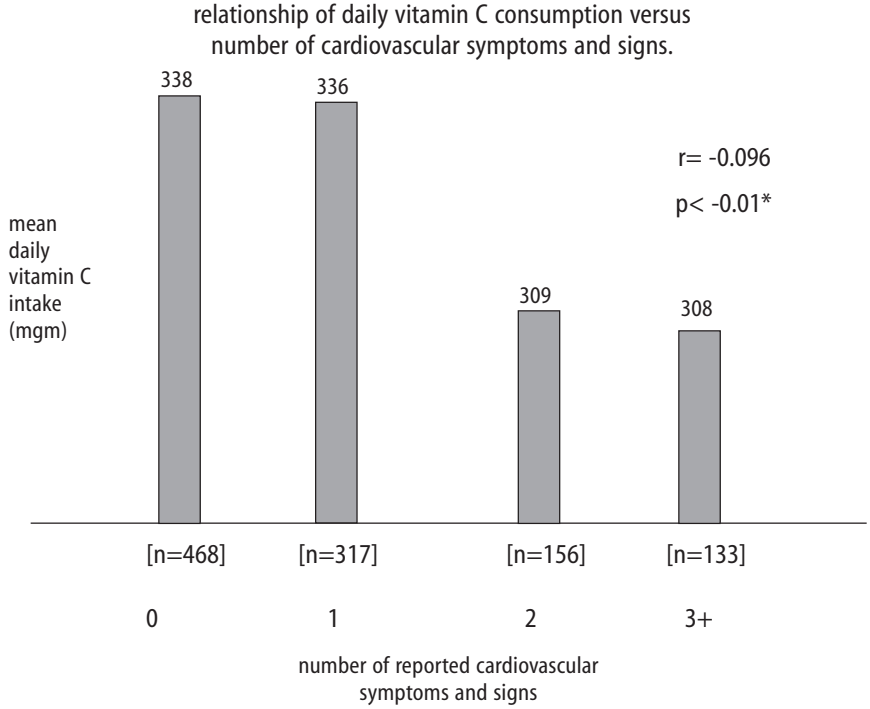
Table 3. Changes in Reported Daily Vitamin C Consumption.

Between	Increased Intake [Percentage]	Decreased Intake [Percentage]
First and second examination	77.8	22.2
Second and third examination	84.3	15.7
Third and fourth examination	71.0	29.0
Fourth and fifth examination	54.5	45.5

Summary and Conclusions

Six hundred fifty-seven dental practitioners and their wives were studied on one occasion in terms of reported daily vitamin C consumption and reported cardiovascular symptoms and signs. A portion of this group was reexamined annually over a five-year period. From this group it was learned that 290 subjects were found to increase their ascorbic acid intake while 88 reduced their vitamin C consumption. Five points are apparent. First, there is a low but statistically significant negative correlation between daily ascorbic acid intake and cardiovascular findings. In other words, as vitamin C intake rises, cardiovascular symptoms and signs decline. Second, following group nutritional seminars, cardiovascular symptoms and signs decline during subsequent years. Third, during this same time period, ascorbic acid consumption rises. Fourth, a significant reduction in cardiovascular findings occurred in the group characterized by an increase in vitamin C intake. In contrast, the group demonstrating a decrease in ascorbic acid consumption did not show a statistically significant reduction in cardio-

Figure 1. The relationships of the number of reported cardiovascular symptoms and signs (horozontal axis) versus mean daily reported vitamin C consumption (vertical axis). There is a low but statistically significant (r= -0.096, P <0.01) negative correlation coefficient, meaning that the greater the vitamin C consumption, the fewer the cardiovacular findings.



vascular findings. Finally, the evidence suggests that vitamin C may be viewed as a resistance agent for cardiovascular disease because its introduction tends to discourage the appearance of cardiovascular symptomatology. The point should be made that in this demonstration, the dominant change was one of ascorbic acid. Other nutrients may be similarily involved.

Reference

1. Cheraskin, E., Ringsdorf, W.M., Jr. and Hicks, B.S. Daily Vitamin C Consumption and Reported Cardiovascular Findings. *J Internat Acad Prevent Med,* 1974: 1, Spring; 31-44.

Figure 2. The relationships of change in daily vitamin C intake to change in cardiovascular state. In Group 1, 'characterized by an increase in daily ascorbic acid There is a significant reduction in cardiovascular symptoms and signs. In contrast, in Group II characterized by a decrease in vitamin C during the experimental period, there is no significant change in cardiovascular state.

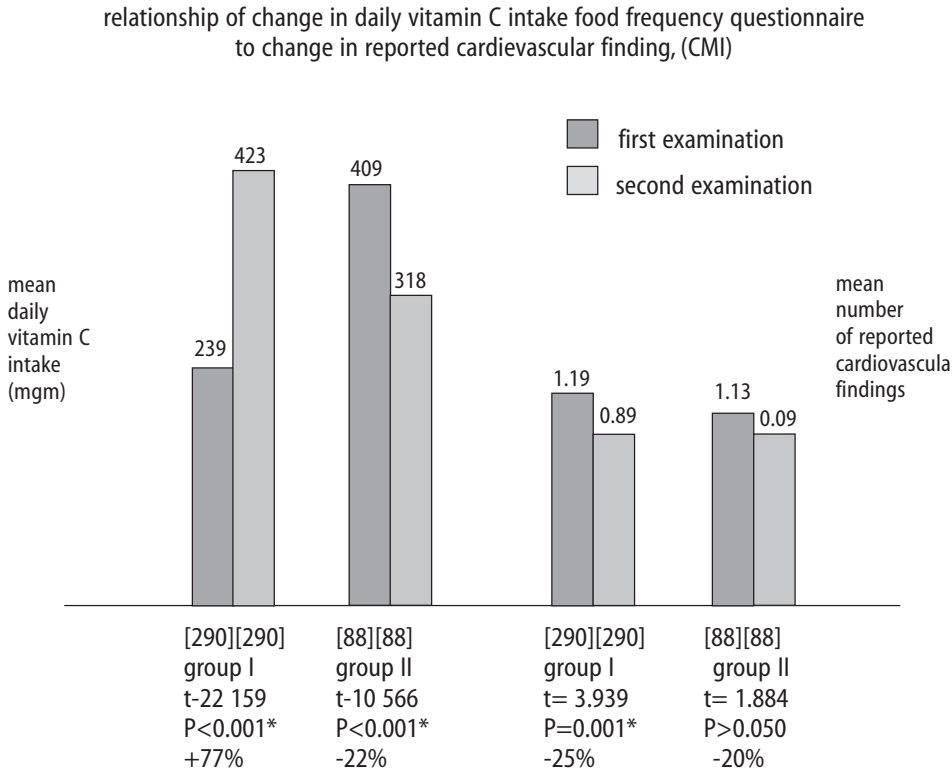


Figure 3. The relationship of reported daily vitamin C consumption (as judged by the food frequency technique) and the frequency of reported cardiovascular findings. The group of subjects with no cardiovascular symptoms or signs (darker column) shows a higher daily mean vitamin C intake (338 mg) than the group with 1+ cardiovascular findings (lighter column). However, the distinction is not statistically significant.

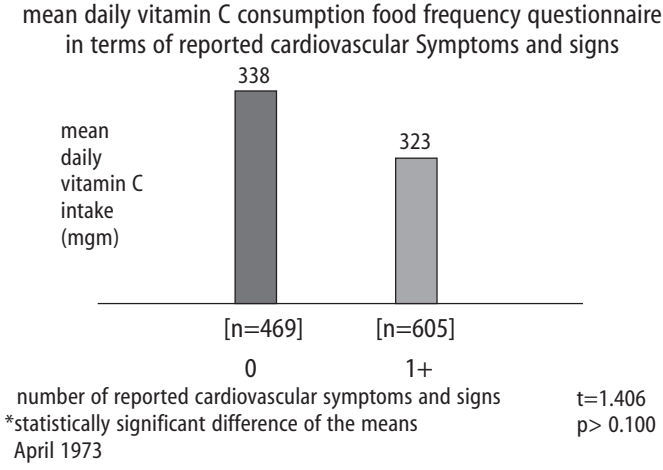


Figure 4. The relationship of reported daily vitamin C consumption (as judged by the food frequency technique and the frequency of reported cardiovascular findings. The group of subjects with no cardiovascular symptoms or signs (darker column) shows a higher daily mean vitamin C intake (338 mg) than the group with 2+ cardiovascular findings (lighter column). Hence, by definition, vitamin C may be regarded as a resistance agent since its addition discourages disease.