Vitamin C Symptoms and Respiratory Symptoms

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Introduction

The staff of *Nutrition Reviews,* a technical journal, searched the medical and scientific literature and concluded in an article which appeared in the August 1967 issue that, "There is no conclusive evidence that, in the absence of severe ascorbic acid depletion, ascorbic acid has any effect on the incidence, course, or duration of the common cold."

This citation from the *National Observer* reflects the present state of confusion regardIng vitamin C and pulmonary findings. The purpose of this report is to analyze the relationship of reported daily ascorbic acid intake and reported respiratory symptoms and-signs in a presumably healthy sample of individuals with the hope that the findings may cast some light on the resolution of the present controversy. Accordingly, an attempt will be made in this paper to answer the following seven questions: (1) What is the frequency of reported respiratory findings in a presumably healthy population? (2) What is the dail y vitamin C consumption in this same group? (3) Is there any relationship between the frequency of reported respiratory symptoms and signs and daily ascorbic acid intake? (4) What changes in the frequency of reported respiratory symptoms and signs occur during a one- and two-year experimental period following group nutritional improvement instruction sessions? (5) What alterations in daily' ascorbic acid intake occurred during this same interval? (6) Are there any parallelisms between the reported respiratory findings and the daily vitamin C consumption? (7) 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 as described in an earlier report.

Five hundred and twenty-seven dental practitioners and their wives were studied initially between 1965 and 1971 in terms of reported dietary and clinical states.[1] A clinical score for respiratory symptoms and signs was derived from the Cornell Medical Index Health Questionnaire (CMI) which was completed at each visit. Specifically, Section B (18 questions) relates to the respiratory system. The distribution of positive (pathologic) responses for the five examination sessions is summarized in Table 1. (p. 219) On each occasion, every participant also completed a dietary questionnaire based upon food consumption frequency. It became clear that many of the subjects were consuming large amounts of refined carbohydrate foodstuffs suboptimal amounts of protein, and relatively small quantities of vitamins and minerals. For purpose of this study, only the daily vitamin C intake was utilized. The pattern at each examination is shown in Table 2 (p. 220).

Results

Question One: Table 1 summarizes the frequency of reported respiratory findings for the entire sample of 527 subjects at the initial examination and for all participants at the four subsequent

Statistically significant difference of the means. examination periods. It will be noted that, on the average, each subject initially reported 1.36 positive respiratory responses. Hence, in answer to the first question, reported respiratory symptoms and signs range from zero to 11 with a mean of 1.36.

Question Two: Table 2 outlines the daily vitamin C consumption for the entire sample of 527 individuals at the first analysis and for those at the four subsequent examinations. The average intake initally is 237 mg/day. According to the Food and Nutrition Board of the National Council, the recommended intake for the male is 60 mg/day and the requirement, at that time,

1. Note: This paper was accepted for publication prior to the author's death in August, 2001. Correspondence: Park Tower, 904/906, 2717 Highland Ave. S., Birmingham AL, 35205-1725.

for the female was 55 mg/day. On this basis, about 95% of the group are taking 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 C than is officially recommended.

Question Three: Table 2 shows that 527 subjects participated at the initial examination and 171, 116, 64 and 12 at subsequent annual sessions, making a total of 890 experiences. Figure 1 (p.221) pictures the relationship between the frequency of reported respiratory symptoms and signs (on the abscissa) versus the daily vitamin C intake (on the ordinate). On a mean basis, there is a progressive decline in respiratory findings in parallel with an increase in daily ascorbic acid consumption. It is clear, in answer to the third question, that there is a low but statistically significant negative correlation coefficient ($r=-0.089$, $p<0.01$) meaning that the higher the daily vitamin C intake, the fewer the respiratory findings. This confirms and emphasizes the conclusions described earlier.

Question Four: Following the initial survey, as previously noted, health education lectures were provided to the group. 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 78.8% of the group increased the daily vitamin C intake between the first and second visit (Table 3, p. 221). The changes be-

Table 1: Reported respiratory findings

Number of respiratory findings	First visit	Second visit	Third visit	Fourth visit	Fifth visit
0	219	81	71	31	8
1	131	46	25	17	1
2	77	23	15	8	3
3	41	10	0	3	0
4	28	5	3	3	0
5	11	3	0	0	0
6	11	1	1	0	0
7	3	0	1	0	0
8	3	1	0	1	0
9	2	1	0	1	0
10	0	0	0	0	0
11	1	0	0	0	0
Total	**527**	**171**	**116**	**64**	**12**
Mean	1.36	1.05	0.69	1.11	0.58
S. D .	1.73	1.48	1.19	1.74	0.81
t	2.236	2.296	1.687	1.015	
P	< 0.050*	< 0.005*	> 0.050	> 0.200	
Minimum	0	0	0	0	0
Maximum	11	9	7	9	2
Range	11	9	7	9	2

*Statistically significant difference of the means.

tween subsequent visits are also shown.

Table 1 lists the respiratory scores at each examination period. It will be observed that, initially, the mean respiratory score was 1.36; one year later the average score was 1.05. The mean values were 0.69, 1.11, 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 and the second and third examinations. It was thought desirable to examine those subjects (n=83) who participated in each of the first three examination periods. Figure 2 (p.222) summarizes the mean reported respiratory symptoms and signs (on the ordinate) at the first, second and third examination periods (on the abscissa). Additionally, the sample has been divided into those who, at the third visit, were consuming less than 400 mg of vitamin C per day (37 subjects pictured on the dotted line) versus those who were ingesting 400+ mg of ascorbic acid per day (46 participants shown by a continuous line).

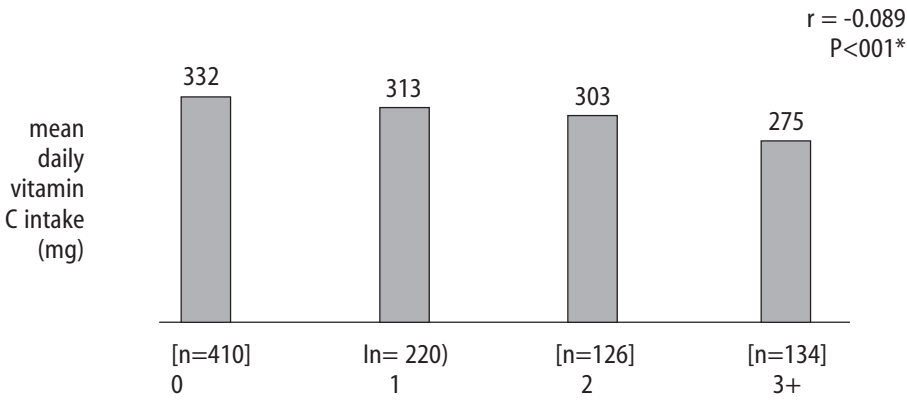
Five points warrant special mention. First, on a mean basis, there is a reduction in respiratory complaints in both subgroups. This, it should be recalled, is consistent with the observations reported earlier in Table 1. Second, on an average basis, the reduction in respiratory findings is greater in those who, at the third examination, are consuming the greater amounts (400+ mg) of vitamin C. Third, there appears to be no statistically significant difference ($t=1.507$, $p>0.100$) at the start of the study. Fourth, while the groups are not substantially different at the start, they become progressively more different at the second ($t=2.831$, $p<0.010$) and at the third examination ($t=3.905$, $p<0.001$). Finally, there are no statistically significant differences in the lower (<400 mg) ascorbic acid intake group between visits as shown by a $t=1.535$, $p>0.100$ and a $t=1.303$, $p>0.200$. In sharp contrast, there are very clear-cut decrements in the group characterized by the greater daily vitamin C consumption at the third visit. This is underlined by the $t=2.963$, $p<0.005$ and a $t=3.490$, $p<0.001$. Thus, in answer to the fourth question, the most notable reduction

Table 2. Daily vitamin C consumption

Daily vitamin C intake (mg)	First visit	Second visit	Third visit	Fourth visit	Fifth visit
<53,	17	2	0	0	0
55-60	5	0	0	0	0
>60	505	169	116	64	12
Total	**527**	**171**	**116**	**64**	**12**
Mean	237	320	388	472	550
S. D.	1 714	177	200	158	111
t		8.046	2.931	3.114	2.061
P		< 0.005*	< 0.005*	< 0.005*	> 0.050
Minimum	15	42	71	139	297
Maximum	881	923	1120	885	719
Range	866	881	1049	746	422

*Statistically significant difference of the means.

Figure1. Relationship of daily vitamin C intake versus number of respiratory symptoms and signs



*statistically significant correlation coefficient August 1972

Table 3. Changes in reported daily vitamin C consumption

Between	Increased intake (percentage)	Decreased intake (percentage)
First and second examination	78.8	21.2
Second and third examination	84.8	15.7
Third and fourth examination	71.0	29.0
Fourth and fifth examination	54.5	45.5

in respiratory symptoms and signs seems to occur in the group characterized by the greater daily ascorbic acid intake.

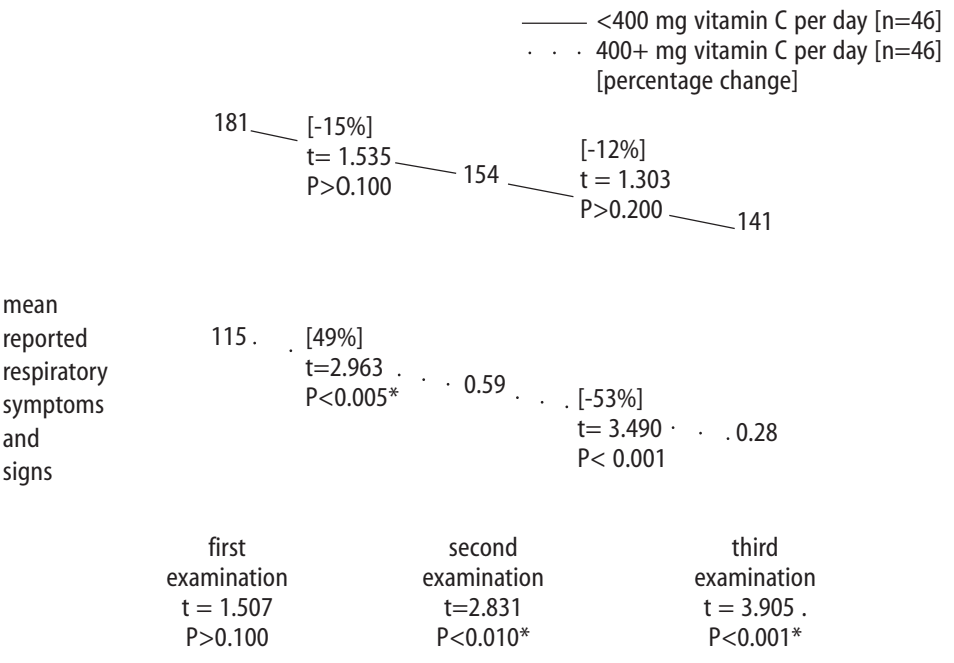
Question Five; The obvious next point is to ascertain the changes in vitamin C intake during the same experimental periods. Figure 3 (p. 223) pictorially portrays the daily ascorbic acid consumption (on the y-axis) at the three visitation periods (the x-axis).

Five points warrant special consideration. First, there is a progressive increase in the reported daily vitamin C intake in both groups. This supports the earlier reported data in Table 2. Interestingly enough, this is also quite in accord with clinical findings just reported in Figure 2. Second, on an average basis, the increase in daily vitamin C intake is greater in those who, at the third examination are consuming the greater amounts (400+ mg) of ascorbic acid. This is also in parallel with the observation reported elsewhere (Figure 2). Thus, the greater reduc-

tion in-respiratory findings occurred in the group with the final higher vitamin C intake (400+mg/ day). Third, there appears to be no statistically significant difference (t=1.591, p>0.100) at the start of the study. It should be noted that this follows a similar pattern earlier mentioned (**Figure 2**). Fourth, while the groups are not substantially different at the start, they diverge at the second (t=2.581, p<0.025) and at the third examination (t=11.568, p<0.001). Again, it should be underlined that this corresponds to previous clinical observations (**Figure 2**). Finally, there are statistically significant differences in the lower (<400 mg C daily) group between visits as shown by a t=4.141, p<0.001 and a t=3.078, p<0.005. However, greater statistically significant differences are shown in the group consuming 400+ mg of vitamin C daily. This is represented by a t=5.118, p<0.001 and a t=9.901, p<0.001. Hence, in response to question five, the more significant increase in ascorbic acid consumption appears to occur in the group who, at the third examination, is consuming the greater amounts of daily vitamin C.

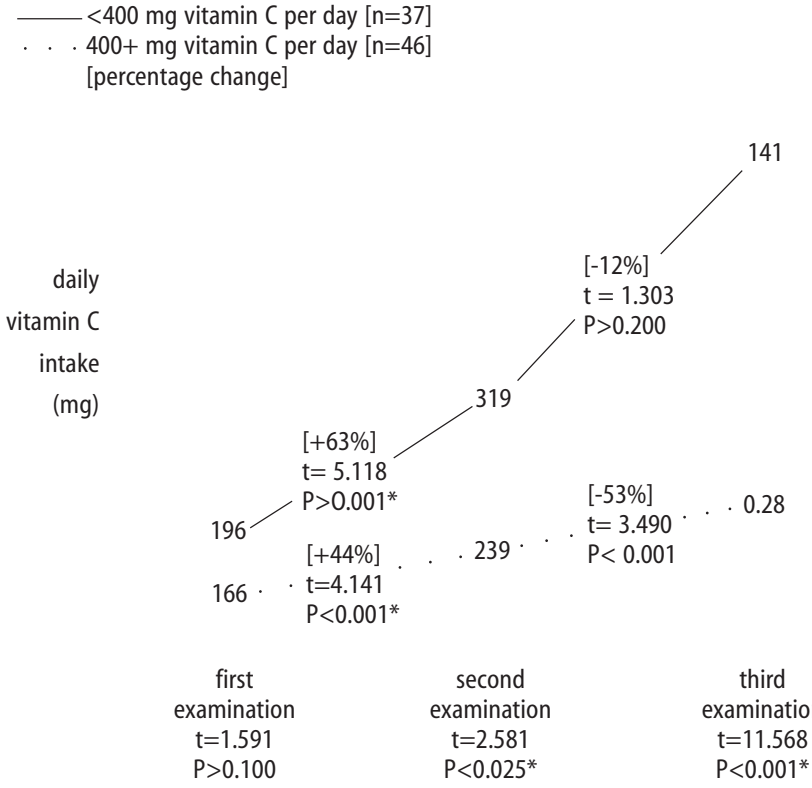
Question Six: It is not easy to provide a quick and simple answer to this particular

Figure 2. The changes in reported respiratory symptoms and signs (in the vertical axis) at three annual examination periods (on the horizontal axis) in. those who, at this third examination, arc consuming < 400 (dotted line) versus 400+ (continuous line) milli grains vitamin C per day. On a mean basis, there is a decline in respiratory findings in both groups. However, the decrements are statistically significant only in the group characterized by the greater vitamin C intake.



*statistically significant difference of the means August 1972

Figure 3. The changes in reported vitamin C intake (on the ordinate) at three annual examination periods (on the abscissa) in those who, at the third examination, are con suming < 400 (dotted line) versus 400+ (continuous line) milligrams vitamin C per day. On a mean basis, there is a rise in vitamin C consumption in both groups. However, the increments are more statistically significant in the group characterized by the greater vitamin C intake.



*statistically significant difference of the means August 1972

question for a number of reasons. First, this is not basically a vitamin C study but rather a multiple testing program in which diet and clinical state have be en related. Second, while many individuals increased their ascorbic acid intake, some of these subjects also altered their diets in other ways. For example, it was learned that the refined carbohydrate consumption in the group was very high and that a significant number of the participants reduced their refined carbohydrate intake. Hence, the dietary changes were multifactorial. Notwithstanding, in answer to the sixth question, the evidence presented (Figures 2 and 3) suggests extraordinary parallelisms between the initial clinical and dietary patterns and their subsequent courses.

Question Seven: It is well to evaluate vitamin C as a resistance or susceptibility agent with regard to the early development of respiratory pathosis. Figure 4 (below) attempts to pictorially portray this situation. Shown on the ordinate is the mean daily ascorbic acid consumption. The group characterized by no respiratory findings consumed, on the average, 332 mg vitamin C daily (the lighter bar). In contrast, the category characterized by respiratory symptoms and signs consumed a mean of 299 mg of ascorbic acid per day. This difference is statistically significant ($t=2.585$, $p<0.010$). Thus, in answer to the final question, the evidence suggests that vitamin C must be viewed as a resistance agent for respiratory disease because its addition tends to reduce the possibility of pathosis.

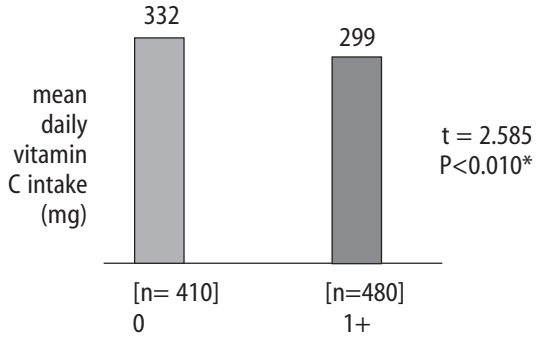
Summary and Conclusions

Five hundred and twenty-seven dental practitioners and their wives were studied on one occasion in terms of reported daily vitamin C consumption and respiratory symptoms and signs. From this group, 83 subjects were reexamined one and two years later following group nutritional seminars. Several points are apparent. First, there is a statistically significant negative correlation between daily vitamin C intake and respiratory findings. In other words, as ascorbic acid consumption rises, respiratory symptoms and signs decline. Second, following group nutritional seminars, respiratory findings decreased during the next two years. Third, during this same time period, vitamin C consumption rises. Fourth, the most significant change in respiratory symptoms and signs occurred in the group characterized by the greater increase in ascorbic acid intake. Finally, the evidence suggests that vitamin C may be viewed as a resistance agent for respiratory disease because its introduction tends to minimize the appearance of respiratory symptomatology.

References

1. Cheraskin E, Ringsdorf WM Jr, Michael DW, Hicks BS: Daily vitamin C consumption and reported respiratory findings. *Int J Vit Nutr Res,* 1973; 43/1: 42-55.

Figure 4. Relationship of reported daily vitamin C consumption.



*statistically significant difference of the means August 1972.