

## Vitamin C load test in elderly subjects

*Rosemary M. Pinto, María do Rosario D.L. Unamuno, Margareth M.P. Rodrigues, J. Ernesto dos Santos,  
J. Sergio Marchini and J.E. Dutra de Oliveira*

Division of Nutrition, School of Medicine of Ribeirão Preto-USP 14049 - Ribeirao Preto, SP, Brazil

**SUMMARY.** Ascorbic acid fasting serum levels and levels after a test dose were carried out in a group of elderly subjects: nine men with  $70 \pm 6$  years and six women  $74 \pm 7$  years old. They live in the same old folks home and ate similar food. Their ascorbic acid intake was found to be around 20 mg/day. Fasting serum levels found lower values in the women. A load test showed a small increase in the hourly samples, supporting low tissue reserves of the vitamin. Factors such as low intake, absorption, metabolism, body mass and/or excretion of the vitamin in elderly population could explain these results. A marginal vitamin C deficiency is believed to be present in the group and extra ascorbic acid food supply seems to be recommended for these subjects.

**RESUMEN.** Prueba de sobrecarga de vitamina C en personas de edad avanzada. Los niveles de ácido ascórbico en ayuno y después de una dosis de prueba, fueron determinados en un grupo de individuos de edad: nueve hombre de  $70 \pm 6$  años y seis mujeres de  $74 \pm 7$  años de edad. Ellos tenían los mismos hábitos alimentarios y costumbres. Su ingestión de ácido ascórbico era de 20 mg/día. Los niveles séricos en ayuno fueron más bajos en las mujeres. La prueba de sobrecarga mostró un pequeño aumento en las muestras horarias, evidenciando bajas reservas tisulares de vitamina C. Factores tales como baja ingestión, absorción, metabolismo, masa corporal y/o excreción de la vitamina en los sujetos estudiados, podrían explicar estos resultados. Una deficiencia marginal de vitamina C parece estar presente, por lo cual es pertinente la administración de suplementos de ácido ascórbico en estos individuos.

### INTRODUCTION

Most higher species can synthesize and regulate endogenous production of ascorbic acid. Only some birds, flying mammals, guinea pigs and primates have a dietary requirement of vitamin C due to loss of synthetic capacity (1). The clinical manifestations of ascorbic acid deficiency are inanition, debility, anemia, edema of extremities, hemorrhagies at level of capillaries and abnormal osteoid and dentin formation. Loosening of teeth eventually occurs (1,2).

Vitamin C is widely distributed in vegetable dietary sources (3). Consequently, vitamin C deficiency is unusual in economically developed countries and is most commonly associated with chronic illness, food fadism or chronic use of alcohol or drugs. On the other hand, deficiencies are found in economically under developed countries (2) and among poor elderly of developed countries (15,16) but unusually coexist with protein calorie deficiency.

There is evidence that plasma, leukocyte and platelet vitamin C levels decline with advancing age (4,8). This could be linked to a decreased vitamin intake (5,9) or to poor absorption (13). Differences is gender, vitamin C intake and

plasma serum levels of vitamin C is reported in the elderly (6,8). The assessment of ascorbic acid nutriture is made by its serum or leukocyte levels, urinary excretion, fragility tests or load test (7). Serum fasting levels alone are considered a reflex of the previous recent vitamin C intake and low levels may be found in scorbutic as well as nonscorbutic patients. Hourly levels after a load test dose express better tissue stores. They are kept very close to zero in scurvy, increase little in depleted subjects and reach high values in normal persons (7).

This study investigated the vitamin C nutriture of old persons, analysing fasting blood values and their response to an ascorbic acid load test.

### SUBJECTS AND METHODS

Volunteers 60 years of age and older were recruited from Ribeirão Preto City Elderly Homes between January and September 1989 by community contacts. They were middle income nine men and six women, eating self-selected diet. No one was taking vitamins. All female subjects were housewives. Male subjects were still active in a variety of occupations. The experimental design was approved by the Ethical Committee

of our Ribeirão Preto University Hospital. Dietary intakes were assessed by analyses of individual records. Dietitians instructed, previously, the volunteers on how to keep accurate food records of each meal and/or snacks eaten on the previous day immediately before the day of load tests. All food records were estimated for nutrient intakes through a food composition table (10).

Venous blood samples were obtained for the study and the general health-nutritional status were assessed through clinical examination and anthropometric indices. Routine serum and urine analyses were carried out in all subjects through usual methods of our Hospital laboratories.

The vitamin C load tests performed, after overnight fast, were carried out as follows: blood samples (3 ml each) were drawn, hourly, between 07:00 and 11:00 a.m. After the first sample blood collection each subject received by mouth 15 mg/kg of ascorbic acid in 150 ml of water. Four other hourly samples were taken. Total ascorbic acid in serum was measured through a 2,4 dinitrophenylhydrazine method (11).

Analyses of variance for repeated measurement was used to demonstrate statistical significance among hourly samples and between men and women (12).

## RESULTS

Food intake of the group showed usual Brazilians habits. All the subjects eat rice and beans, some meat, milk and little vegetables. The average daily intake of vitamin C was calculated to be around 20 mg.

Table 1 shows the anthropometric and laboratory data from the elderly men and women. The women had a higher body mass index (kg/m<sup>2</sup>) and skinfold thickness. Since there was no cardiac failure, renal disease or edema in the sample, the physical examination and data from Table 1 shows women to be fatter than men. None of them, men or women, could be diagnosed as having poor nutritional status.

TABLE 1  
MEAN VALUES FOR ANTHROPOMETRIC AND  
LABORATORY DATA

	Men		Women	
Number	9		6	
Age (years)	70.0	(7.5)*	74.4	(6.6)
Weight (kg)	55.5	(9.5)	62.2	(16.3)
Height (m)	1.63	(0.91)	1.51	(0.14)
Weight/Height (kg/m <sup>2</sup> )	20.9	(3.7)	27.2	(5.3)
Triceps skinfold (mm)	7.6	(2.8)	20.0	(8.8)
Braquial circumference (cm)	23.9	(2.1)	28.6	(5.1)
Muscular circumference (cm)	21.4	(1.8)	27.9	(4.8)
Albumin (g/dl)	4.2	(0.4)	4.1	(0.4)
Hemoglobin (g/dl)	14.5	(1.2)	13.1	(1.6)

\* Mean ± (SD)

Vitamin C fasting levels below 0.25 mg/dl was found in several of the subjects. This was mainly true in women. Results of the loading test of vitamin C are shown in Figure 1 for men and Figure 2 for women. The figures show the mean values and their upper and lower 95% tolerance limit. Few women values are outside this limit. The same was not true for men.

FIGURE 1  
Mean and 95% tolerance limit of serum ascorbic acid in  
nine old men after a vitamin C load test

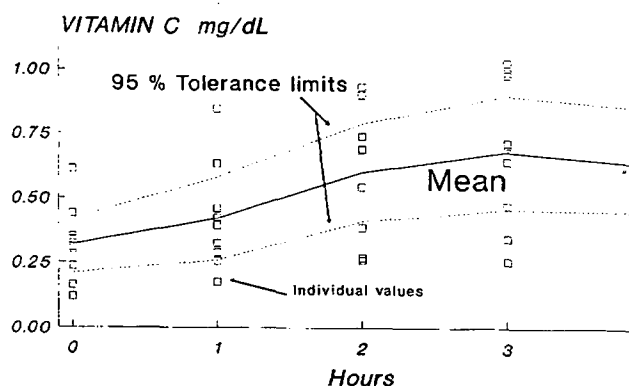
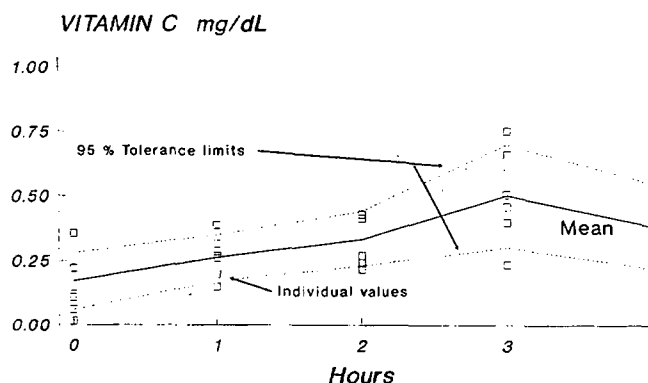


FIGURE 2  
Mean and 95% tolerance limit of serum ascorbic acid in six  
old women after a vitamin C load test



## DISCUSSION

Our findings show low fasting serum levels of vitamin C in our subjects, with a higher mean levels in men than in women. These results could be explained by the low vitamin intake of our patients. Impaired absorption and/or increased urinary excretion were not considered in our studies.

Jacob et al. described body mass index to be inversely related to the plasma levels of ascorbic acid (14). This could, eventually, be another factor to explain the present results considering that our old women sample were heavier than the men.

It is to be noted that most of the elderly serum vitamin C literature data shows higher values in old women than men (6,8,9). The ascorbic acid sex differences have been explained by distinct intakes of vitamin C of free eating population, smoking or even dissimilarities in the metabolism of ascorbic acid. There was no clear differences in the home vitamin intake of our subjects. The fact that most men worked outside could eventually be responsible for a higher intake of vitamin C.

The vitamin C blood curve after a load test reflects tissue stores. An usual finding is a high rise in the first 2/3 hours and a decline after 4 hours, reaching values close to the initial ones. This was not found in our study, there was a moderate increase over fasting values. Highest values were found by the third hour and kept around this level till the last sample. This could also mean an impaired/delayed absorption or a deficient retarded excretion of the vitamin in these elderly persons (13). The simultaneous determination of the urinary vitamin C excretion could certainly help the interpretation of these data.

The low vitamin C blood level increase of our women, after the test dose, confirms the lower fasting samples vitamin C levels found in our study. Only 2 women had vitamin C values higher than 0.5 mg/ml after 3 hours of the load dose. They seem to be more vitamin C depleted than the men studied.

#### REFERENCES

1. Chatterjee, I.B.. Ascorbic acid metabolism. *Wld. Rev. Nutr.* 30:69-82. 1978.
2. Moran, R. & H.L. Greene. The B vitamins and vitamin C in human nutrition. I. General considerations and obligatory B vitamins. *Am. J. Dis. Child.* 133:192-199. 1979.
3. Sauberlich, H.E. Bioavailability of vitamins. *Prog. Food Nutr. Sci.* 9:1-33, 1985.
4. List, N.D. Perspectives in cancer screening in the elderly. *Clin. Geriatr. Med.* 3:433-439. 1987.
5. Morley, J.E. Nutrition and aging. In: *Principles of Geriatric Medicine and Gerontology.* W.R. Hazzard, R. Andres, E.L. Berman, J.P. Blass (Eds.), 2nd ed. Mc Graw-Hill, Inc, New York, 1990.
6. Itoh, r., K. Yamada, J. Ola, H. Echizen & K. Murakami, Sex as a factor in levels of serum ascorbic acid in healthy elderly population. *Inter. J. Vit. Nutr. res.* 59:365-372. 1989.
7. Dutra de Oliveira, J.E., W.N. Pearson & W.J. Darby. clinical usefulness of the ascorbic acid tolerance test in acurvy. *Am. J. Clin. Nutr.* 7:630-633. 1959.
8. Sasaki, R., T. Kurokawa, T. Kobayasi & T. Tero-Kubota. Influences of sex and age on serum ascorbic acid. *Tohoka J. Exp. Med.* 140:97-104, 1983.
9. Burr, M.L., J.E. Milbank & D. Gibbs. The nutritional status of the elderly. *Age Ageing*, 11:89-96, 1982.
10. Azzoubel, L.M.D., R.W.D. Garcia & M.M.V. Naves. Tabela de composição dos alimentos. In: J.E. Dutra de Oliveira (Ed.). *Nutrição básica.* 1ra. Ed. São Paulo, Sarvier, 1982, 168-249.
11. Bessy, D.A. Ascorbic acid, microchemical methods. *Vitamin Methods.* New York, Academic Press, 1950, vol. 1, p. 303.
12. Zar, J.H. *Biostatistical analysis.* Englewood Cliffs, USA, Prentice-Hall, INC, Second Edition, 1984.
13. Davies, H.E.F., J.E.W. Davies, R.E. Hughes & E. Jones. Studies on the absorption of L-xyloascorbic acid (vitamin C) in young and elderly subjects. *Hum. Nutr. Clin. Ntr.* 38C:463-471, 1984.
14. Jacob, R.A., C.L. Otradovec, R.M. Rusell, H.N. Munro, S.C. Hartz, R.B. McGrandy, E.D. Morrow & J.A. Sadowski. Vitamin C status and nutrient interactions in a healthy elderly population. *Am J. clin. Nutr.* 48:1436-1442, 1988.
15. Porrini, M., P. Simonetti, S. Ciappellano & G. Testolin. Vitamin A, E. and C nutriture of elderly people in North Italy. *Internat. J. Vit. Nutr. Res.* 57:349-355, 1987.
16. Bowman, B.B. & I.H. Rosenberg. Assessment of the nutritional status of the elderly. *Am. J. clin. Nutr.* 35:1142-1151, 1982.
17. Sasaki, R., T. Kurokawa & S. Tero-Kubota. Ascorbate radical and ascorbic acid level in human serum and age. *J. Gerontol.*, 38:26-30, 1983.