

# Influence of Smoking on Folate Intake and Blood Folate Concentrations in a Group of Elderly Spanish Men

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**Key words:** folate, smoking, elderly people

**Objective:** To investigate the relationship between smoking habits and folate status in a group of elderly Spanish men.

**Design:** We studied folate intake, serum and erythrocyte folate concentrations, hematological and biochemical data in 72 elderly males (comparing 24 smokers data with 44 nonsmokers ones).

**Results:** Percentage deficiencies for folate intake, serum and erythrocyte levels were higher in smokers. Serum folate levels were significantly higher in nonsmokers. Smokers had higher mean corpuscular volume than did nonsmokers.

**Conclusions:** Smoking could be harmful to the intake and folate status. For smokers who will not give up the habit, improved dietary intake or a folate supplement is advisable.

## INTRODUCTION

Several dietary and biochemical studies have shown that folate deficiency is a frequent nutritional problem, specifically among elderly persons [1-3]. This deficiency has serious repercussions [3-5], because it can lead to macrocytic megaloblastic anemias; it also can play a role in the preneoplastic modification of lung, cervix and mammary glands [3,6,7]. Today, the relationship between folate status and cardiovascular disease (CVD) is the subject of extensive research, because this vitamin deficiency leads to an increase in plasma levels of homocysteine, which can lead to atherosclerosis [3,7].

Some studies have found poor folate status in smokers [6,8,9]. With smoking as a known risk factor in cancer and CVD, we wondered if increased folate deficiency among smokers could be contributing to increased incidence of these pathologies in them. Studying the influence of smoking on folate status is important from a public health point of view, because it can permit us to correct the deficiencies and contribute to disease prevention.

## MATERIALS AND METHODS

We evaluated total intake, serum and erythrocyte levels of folate in 72 elderly males (16 institutionalized, 56 free-living), aged 65-89 years, living in the Comunidad Autónoma de Madrid, Spain. Twenty-four of them smoked habitually (12 institutionalized, 12 free-living) an average of  $13.3 \pm 8.3$  ( $\bar{X} \pm SD$ ) cigarettes/day, whereas 48 (4 institutionalized, 44 free-living) never smoked. Only males took part in this study, because smoking is not common among Spanish elderly women.

The study was conducted at the Spanish Social Security. After presentation of the study protocol, written consent was obtained from interested subjects. The institutionalized elderly who took part in the study were 80% of all the residents living in the institution. Selection of the free-living elderly was made in October and November 1990, and the selected subjects were 75% of all the subjects aged >65 years who attended the physician's surgery during these 2 months. Those who suffered from a disease associated with folate malabsorption or who were taking ther-

Abbreviations: CVD = cardiovascular disease, MCV = mean corpuscular volume, RDI = recommended dietary intakes

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**Table 1.** Personal, Anthropometric and Dietary Data of Study Subjects (Mean  $\pm$  SD)

	Total (n = 72)	Smokers (n = 24)	Nonsmokers (n = 48)
<b>Personal data</b>			
Age (years)	73.8 $\pm$ 6.4	75.4 $\pm$ 7.5	72.9 $\pm$ 6.2
Weight (kg)	69.1 $\pm$ 9.7	66.6 $\pm$ 11.44	70.4 $\pm$ 8.5
Height (cm)	164.0 $\pm$ 7.8	160.6 $\pm$ 7.74*	165.7 $\pm$ 7.3*
BMI (kg/m <sup>2</sup> )	25.8 $\pm$ 3.5	25.7 $\pm$ 3.58	25.8 $\pm$ 3.5
<b>Dietary data</b>			
Folate intake ( $\mu$ g/day)	221.4 $\pm$ 85.1	213.4 $\pm$ 82.7	225.5 $\pm$ 86.9
RDI ( $\mu$ g/day)	200	200	200
Contribution to RDI (%)	110.7 $\pm$ 42.5	106.7 $\pm$ 41.3	112.7 $\pm$ 43.4
Density ( $\mu$ g/1000 kcal)	116.3 $\pm$ 50.2	122.7 $\pm$ 56.9	113.1 $\pm$ 46.8
% cases folate intake < RDI	42	52.2	37

BMI = body mass index (weight/height<sup>2</sup>). RDI = recommended dietary intake.

\*  $p < 0.01$ .

apeutic drugs or supplements containing folic acid which could affect folate status were excluded from the study. The study was approved by the Human Research Review Committee of the University Complutense of Madrid, Faculty of Pharmacy.

Dietary data were collected for all subjects, using a 5-day (including Sunday) questionnaire of "register of all foodstuffs consumed" for free-living people and the weighed food intake method for institutionalized elderly. Energy and nutrient content of all the food ingested was determined using the Food Composition Table for Spain [10]. The Tables of Recommended Intakes of Energy and Nutrients for the Spanish population, issued by the Institute of Nutrition [11], were followed to estimate compli-

ance with the recommended dietary intakes (RDI) for this population group. Comparing intakes with the RDI permits assessment of the adequacy or inadequacy of the diet.

Blood tests were run on a group of 59 elderly persons (16 smokers, 43 nonsmokers) who volunteered to give samples. Blood was drawn without stasis by venipuncture (antecubital fossa) after an overnight (12-hour) fast. Serum and erythrocyte folate concentrations and serum cyanocobalamin levels were quantified using radioimmunoassay [12]. Hematological data as hemoglobin, hematocrit and mean corpuscular volume (MCV) were quantified using a Model S Coulter Counter [13].

We calculated mean values, standard deviation and significance of the differences between smokers and non-

**Table 2.** Biochemical and Hematological Data of Study Subjects (Mean  $\pm$  SD)

	Total (n = 72)	Smokers (n = 24)	Nonsmokers (n = 48)
<b>Biochemical data</b>			
Serum folate (ng/mL)	4.91 $\pm$ 1.7	4.10 $\pm$ 1.56*	5.23 $\pm$ 1.66*
Erythrocyte folate (ng/mL)	120.6 $\pm$ 43.4	110.4 $\pm$ 41.3	124.2 $\pm$ 44.1
Deficient values (%)			
Serum folate			
<6 ng/mL	74.5	76.9	73.5
<3 ng/mL	14.9	38.4	5.9
Erythrocyte folate			
<150 ng/mL	70.2	83.3	65.7
<100 ng/mL	40.4	50.0	37.1
<b>Hematological data</b>			
Hemoglobin (g/100 mL)	15.8 $\pm$ 1.2	15.9 $\pm$ 1.8	15.7 $\pm$ 1.0
Deficient values (%) (<14 g/100 mL)	5.1	6.3	4.7
Hematocrit (%)	47.6 $\pm$ 4.1	47.8 $\pm$ 5.5	47.6 $\pm$ 3.5
Deficient values (%) (<40%)	1.7	0	2.3
MCV ( $\mu$ m <sup>3</sup> )	95.8 $\pm$ 4.6	97.2 $\pm$ 5.2	95.3 $\pm$ 4.3
Deficient values (%) (<80 $\mu$ m <sup>3</sup> )	0	0	0
Excess values (%) (>100 $\mu$ m <sup>3</sup> )	22.4	37.5	16.7

MCV = mean corpuscular volume.

\*  $p < 0.01$ .



**Table 3.** Effect of Smoking on Folate Levels (Mean  $\pm$  SD)

	n	Folate levels (ng/mL)		Reference
		Serum	Erythrocytes	
Nonsmokers	25	8.0 $\pm$ 1.0	322 $\pm$ 27	[6]
Smokers	69	5.5 $\pm$ 0.4	261 $\pm$ 13	
Smokers without metaplasia	27	6.3 $\pm$ 0.6	277 $\pm$ 18	
Smokers with metaplasia	42	4.9 $\pm$ 0.5	251 $\pm$ 17	
Male nonsmokers	7	6.7 $\pm$ 2.1		[8]
Male smokers	8	4.7 $\pm$ 0.9		
Female nonsmokers	73	7.1	160	[16]
Female smokers	50	4.7	110	
Female nonsmokers	185	7.7 $\pm$ 4.0	320 $\pm$ 123	[15]
Female smokers	227	7.6 $\pm$ 3.1	319 $\pm$ 106	
Male nonsmokers	660	6.1 $\pm$ 2.9	304 $\pm$ 116	
Male smokers	1308	5.6 $\pm$ 2.4	293 $\pm$ 125	

smokers by Student's t-test. In those cases where the distribution of results was not homogeneous, we used a Mann-Whitney test. Differences were considered statistically significant at  $p < 0.05$ .

## RESULTS

Table 1 shows personal, anthropometric and dietary data of study participants. Our results show that folate deficiency is frequent among our population, because 42% of the elderly had folate intakes below the recommended amounts (200  $\mu$ g/day) (Table 1) [11] and 74.5% had serum levels  $< 6$  ng/mL (Table 2). Smokers had lower folate intakes than did nonsmokers (Table 1). This can contribute to the serum differences observed between the two groups (Table 2).

Results of the biochemical study (Table 2) show that serum and erythrocyte folate concentrations were higher among nonsmokers, with the difference being statistically significant for serum levels ( $p < 0.01$ ). Deficiency percentage values were higher among smokers. Hematological data (Table 2) were not significantly affected by smoking and showed a quite satisfactory situation, with a few deficient data.

MCV is affected by folate status, and tends to increase as folate decreases [1,5]. In our study, smokers had higher MCV than did nonsmokers (Table 2). Of the smokers, 37.5 vs 16.7% of nonsmokers had MCV  $> 100 \mu\text{m}^3$ . This macrocytosis could be related to folate deficiency, because none of elderly people had deficient B<sub>12</sub> serum levels ( $< 100$  pg/mL).

In keeping with other reports (Table 3), we observed a

less satisfactory folate status among the elderly who smoked than in those who did not (Table 2). In the smoker group, those who smoked  $\leq 15$  cigarettes/day had lower serum (3.8  $\pm$  1.9 ng/mL) and erythrocyte (84.5  $\pm$  15.6 ng/mL) folate levels than did those who smoked  $< 15$  cigarettes/day (4.7  $\pm$  1.5 and 128.3  $\pm$  46.6 ng/mL for serum and erythrocytes levels, respectively) ( $p < 0.05$ ) (Fig. 1).

## DISCUSSION

Folate deficiency is a frequent problem in different groups of elderly Spanish people, as we have observed in another study [14]. Serum and erythrocytes folate levels reported here (Table 2) are lower than in some studies [6,15], but similar to those other authors [8,16] have shown.

Our results, like those of others (Table 3), suggest that smokers may be at greater risk of folate deficiency than are nonsmokers. This deficiency can contribute to increased risk of disorders such as neoplasia [3,6,7] or CVD [3,7], which are frequently related to smoking.

Heimbürger et al [6] found significantly lower folate levels in plasma and erythrocytes of smokers who suffered from bronchial metaplasia than in those who did not suffer from metaplasia (Table 3). It seems that exposure to tobacco smoke triggers a folate deficiency which affects principally the bronchial epithelium, which is then more susceptible to the carcinogens contained in smoke.

Preliminary results indicate a significant improvement of atypical bronchial metaplasia in smokers on folate supplementation (10 mg/day) for 4 months, when compared to a control group supplemented with a placebo [17-19]. Though the most reasonable advice is to quit smoking, the



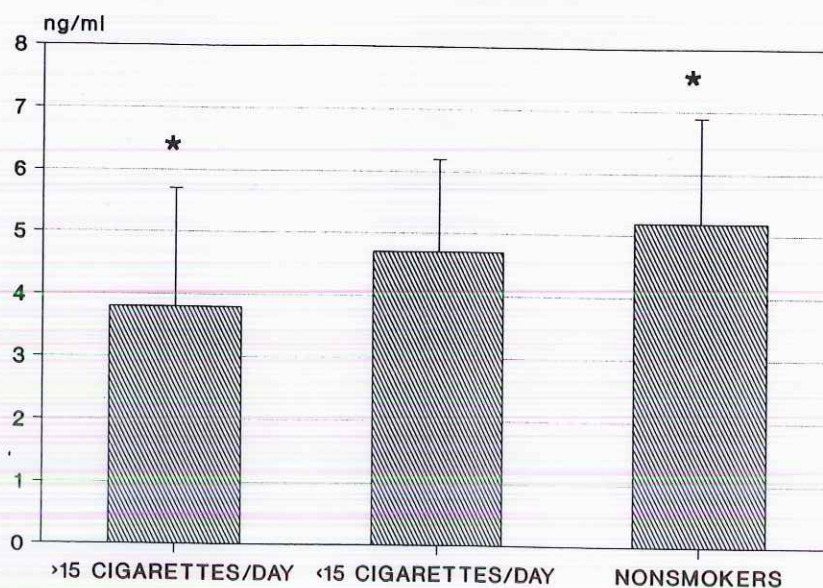


Fig. 1. Folate serum levels and smoking, \* $p < 0.05$ .

correction of nutritional folate deficiencies by means of supplementation or improved dietary intake could contribute to the health of those subjects who do not want to give up the habit.

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