

Original

Iron, folate and vitamins B₁₂ & C dietary intake of an elderly institutionalized population in León, Spain

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Abstract

Aging is associated with increased risk of developing anaemia and micronutrient deficiencies. The purpose of this study was to evaluate the daily intake of micronutrient whose deficient in diet could cause anaemia (iron, folic acid, vitamin B₁₂) and vitamin C to establish the prevalence of anaemia in a group of institutionalized of 124 elderly subjects residing in five nursing homes in León (Spain). A precise weighing method was used to conduct the control of food intake covering seven days. Energy, alcohol, iron, folate, vitamin B₁₂ and vitamin C intake were obtained. Weight, and Height also were measured. Serum iron, serum ferritin, haemoglobin and hematocrit were also measured. Average daily iron intake was higher than the 10 mg recommended by the National Academy of Science although significantly higher ($p < 0.05$) in males (17.0 ± 7.4 mg) than in females (11.8 ± 1.5 mg). Moreover, vitamin C intake in all subjects is high (118.8 ± 43.7 mg) and higher than Spanish RDA (198%). Average intakes of folate and vitamin B₁₂ in the present study exceeded the RDA, (103% and 144%). However, 45.83% of males and 5.97% of females showed deficiencies in vitamin B₁₂ and 53.91% of the subjects showed deficiencies in folic acid. The average haemoglobin concentration (14.28 ± 1.33 g/dL), hematocrit percentage (43.71 ± 6.31), ferritin concentration (87.01 ± 59.74 ng/mL) and serum iron (85.36 ± 33.98 µg/dL) showed similar figures to the results obtained in other studies carried out on elderly populations. It would be necessary to adequately compose the menus given in nursing homes, decreasing energy contribution, and supplying micronutrient rich foods or fortified foods.

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Keywords: Anaemia. Elderly. Iron. Folate. Vitamin B₁₂. Vitamin C.

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APORTE DE HIERRO, ÁCIDO FÓLICO Y VITAMINAS B₁₂ Y C A UNA POBLACIÓN DE ANCIANOS DE UNA RESIDENCIA DE LEÓN, ESPAÑA

Resumen

El envejecimiento comporta un mayor riesgo de anemia y deficiencias de micronutrientes. El objetivo de este estudio consistió en evaluar el aporte diario de micronutrientes, cuya carencia dietética podría ocasionar anemia (hierro, ácido fólico, vitamina B₁₂), así como de vitamina C para conocer la prevalencia de anemia entre un grupo de 124 ancianos que vivían en cinco residencias de León (España). Se utilizó un método preciso de pesaje para controlar la ingestión de alimentos durante 7 días. Se midieron el aporte de energía, alcohol, hierro, ácido fólico, vitamina B₁₂ y vitamina C. También se registraron el peso y la talla. Además, se analizaron el hierro sérico, la ferritina sérica, la hemoglobina y el hematocrito. El aporte diario medio de hierro resultó mayor que los 10 mg recomendados por la Academia Nacional de Ciencias, si bien la cantidad recibida por los varones ($17,0 \pm 7,4$ mg) era significativamente superior ($p < 0,05$) a la de las mujeres ($11,8 \pm 1,5$ mg). Es más, el aporte de vitamina C de todos los sujetos fue alto ($118,8 \pm 43,7$ mg) y superior a la cantidad diaria recomendada (CDR) en España (198%). El aporte medio de ácido fólico y de vitamina B₁₂ en este estudio excedió las CDR pertinentes (103% y 144%). Sin embargo, el 45,83% de los varones y el 5,97% de las mujeres manifestaron carencias de vitamina B₁₂, mientras que el 53,91% de la población presentaba una deficiencia de ácido fólico. La concentración media de hemoglobina ($14,28 \pm 1,33$ g/dl), el porcentaje del hematocrito ($43,71 \pm 6,31$), la concentración de ferritina ($87,01 \pm 59,74$ ng/ml) y el hierro sérico ($85,36 \pm 33,98$ µg/dl) se asejaron a los de otros estudios sobre poblaciones ancianas. Sería necesario organizar adecuadamente los menús de las residencias para la tercera edad, disminuyendo el aporte energético y suministrando alimentos ricos en micronutrientes o fortificados.

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Palabras clave: Ácido fólico. Ancianos. Anemia. Hierro. Vitamina B₁₂. Vitamina C.

Introduction

Malnutrition is known to have significant adverse effects on morbidity and mortality in the elderly¹. Specifically, vitamin and mineral deficiencies have been repeatedly documented, due, among other factors, to lower energy requirements of the elderly and a reduced food intake, and the consumption of foods poor in micronutrient density². Micronutrient malnutrition has an adverse impact on nutritional status of the elderly. So deficiencies of folic acid and vitamin B₁₂ have been shown to impair cognitive function and immune status³.

The causes of micronutrient deficiencies are of a multifactorial origin and in particular iron, folic acid and vitamin B₁₂ deficiencies including achlorhydria and lower secretion of intrinsic factor⁴, chronic disease and inflammation⁵, chronic polypharmacy, gastro-intestinal bleeding as well as poverty, physical inability to prepare food, alcoholism and inadequate dietary intake⁶.

The purpose of this study was to evaluate the daily intake of micronutrients which cause anaemia (Fe, folic acid and vitamin B₁₂ and vitamin C) and to establish the prevalence of nutritional anaemia in a group of institutionalized elderly subjects.

Subjects and methods

Subjects

Dietary consumption was evaluated in a group of 124 elderly people (60 males and 64 females), aged between 65 and 98 residing in five nursing homes in León (Spain). Subjects were excluded according to the following categories detailed in a medical chart: Overt conditions of liver disease, chronic renal failure, inflammatory disease, active peptic ulcer, anaemia, consumption of medications known to affect intestinal absorptions, consumption of glucocorticoids, or consumption of micronutrient tablets. Each participant was given an explanation as to the nature, purpose, and possible benefits of the study, and approved their participation by signing a written form of consent.

Dietary Intake Data Collection

The dietary intake was determined for the menus supplied to subjects over a 7-day food intake period, by using a precise weighing method. Soehnle kitchen scales (max. 2000 g, 0-1000 g ± 1 g, 1000-2000 g ± 2 g), were used to weigh the food used in the meals, the portions and the leftovers. The dietary records were analysed using a nutritional program (using a macro procedure of a spreadsheet) with Spanish sources⁷. Components measured included total energy, iron, and vitamins (folic acid, B₁₂, C) and alcohol.

The data were compared with the Spanish Recommended Dietary Allowances (RDA)⁸ for males and females of 70 years of age and over. The nutrient intake was converted into a percentage of the RDA to provide a standard score (% I/RDA).

Biochemical measurements

A non-fasting, venous blood sample was used for the assessment of serum iron (ng/ml) (SMA II), serum ferritin (Ferrozine method) (ng/ml), haemoglobin (g/dl) and hematocrit (%).

Data Analysis

Statistical analyses were carried out using the Statistical Package for the Social Sciences SPSS/PC+ (Ver. 9.0.) personal computer package. The results are shown as mean and standard deviation (SD). Analysis of covariance was used. Two-tailed P values were considered statistically significant at P < 0.05.

Results

The average age of the subjects was 80.5 years (SD = 6.5, range 65-98 y). The age distribution was similar in both sexes, although the number of females was higher. Average weight and body mass index was 71.4 ± 10.2 kg and 27.8 ± 3.8 kg/m² for males and 58.6 ± 10.8 kg and 27.7 ± 4.9 kg/m² for females.

The estimated average daily energy, alcohol, iron, folate, vitamins C and B₁₂ intakes of both males and females are presented in table 1. Energy and alcohol

Table I
Daily dietary intakes of energy, alcohol, iron, folate, vitamin B₁₂ and vitamin C

	Mean ± SD	All subjects Range	Females Mean ± SD	Males Mean ± SD
Energy (kcal)	2304.1 ± 848.0	2544.5-1001.2	1965.4 ± 96.0	2740.5 ± 728.3
Alcohol (g)	20.3 ± 8.3	43.9 ± 0.0	6.5 ± 1.9	35.5 ± 10.1*
Iron (mg)	14.1 ± 8.4	117.4 ± 7.1	11.8 ± 1.5	17.0 ± 7.4*
Folate (µg)	206.6 ± 35.5	372.3 ± 127.8	202.5 ± 44.7	211.9 ± 47.0
Vitamin B ₁₂ (µg)	2.9 ± 1.1	9.1-1.1	3.0 ± 0.7	2.7 ± 1.4
Vitamin C (mg)	118.8 ± 43.7	283.0-55.0	118.6 ± 35.7	119.2 ± 53.5

* P < 0.05.

intakes were 2304.1 ± 848.0 kcal and 20.3 ± 8.3 g respectively. Alcohol intake showed significant differences ($p < 0.05$) between males and females (18.2 ± 16.3 g/day with regard to 7.7 ± 11.1 g/day). However, there were no cases of alcohol abuse. Elderly institutionalized people studied consumed adequate amounts of iron (14.1 ± 8.4 mg), vitamin B₁₂ (2.9 ± 1.1 µg), vitamin C (118.8 ± 43.7 mg) and folate (206.6 ± 35.5 µg). The percentage of daily energy and micronutrients intakes with regard to Spanish Recommended Dietary Allowances are shown in figure 1.

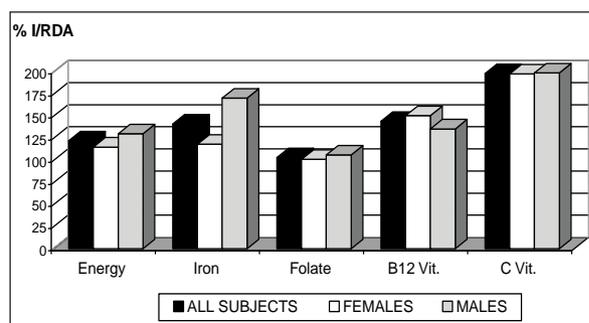


Fig. 1.—Daily energy and micronutrients intakes with regard to Spanish Recommended Dietary Allowances (%).

The average haemoglobin concentration (14.3 ± 1.3 g/dL), hematocrit percentage (43.7 ± 6.3), ferritin concentration (85.2 ± 25.2 ng/ml) and serum iron (85.4 ± 34.0 µg/dL) showed similar figures to the results obtained in other studies carried out on elderly populations^{9,10}, however, these values tended to be lower in women than in men (table 2).

Discussion

The average age of the subjects was 80.5 y, higher than that described in other studies^{1,11,12}. Mean Body Mass Index value of the subjects studied, 27.7 ± 4.5 kg/m², was high according to the classification of obesity¹³. So, subjects of this study showed overweight grade I.

Average total energy intake (2304.1 ± 848.0 kcal) (table 1) was higher than Spanish RDA, similar to some studies^{14,15} but higher than those reported by others^{1,16}.

Prevalence of anaemia based in the WHO criteria (Hb < 13 g/dL in men; < 12 g/dL in women) was of 2.8%, lower than that reported in studies on aged subjects^{16,17}. The low serum ferritin result was nevertheless higher than that reported in other studies^{16,17} and significantly higher, $p < 0.05$, in males (114.2 ± 65.1 ng/ml) with regard to females (72.1 ± 49.2 ng/ml). The average hematocrit was within the same range as that reported in other studies in Europe^{9,18,19} (Table 2).

Iron deficiency is the main cause of anaemia worldwide¹⁷. Anaemia is mostly due to a low iron intake and/or a low bioavailability of dietary iron. Ascorbic acid, among other factors, enhance dietary iron absorption. Average daily iron intake was higher than the 10 mg recommended by the National Academy of Sciences²⁰ although significantly higher ($p < 0.05$) in males (17.0 ± 7.4 mg) than in females (11.8 ± 1.5 mg) (table 1). Moreover, vitamin C intake in all subjects is high (118.8 ± 43.7 mg) and higher than RDA (198%) (figure 1).

Folate and vitamin B₁₂ deficiency in aged subjects may result from low dietary intake, decreased absorption or chronic pharmacotherapy to affect the metabolism of these vitamins, or a combination of these factors. Regarding inadequate dietary intake as a cause of anaemia, average intakes of folate and vitamin B₁₂ in the present study exceeded the Spanish RDA, 103% and 144% respectively (figure 1). However, 45.83% of males and 5.97% of females showed deficiencies in vitamin B₁₂ and 53.91% of the individuals showed deficiencies in folic acid. This high percentage of subjects with a deficient intake of these two vitamins is higher than that obtained in other studies on the free-living elderly^{10,17,21}.

Moreover, if we take into account that alcohol abuse is a further factor known to adversely affect folate absorption²², in our study alcohol intake in institutionalized elderly males could affect the absorption of folate. In fact, 50% of the individuals have an intake of, folic acid, inferior to the recommended intake (P50: 195.89 µg and 198.07 µg, for males and females respective).

Conclusion

To sum up, anaemia is not prevalent in institutionalized elderly subjects when iron intake is adequate.

Table II
Ferritin, Iron, Haemoglobin and Hematocrit concentrations

	All subjects		Females	Males
	Mean ± SD	Range	Mean ± SD	Mean ± SD
Serum Ferritin (ng/mL)	85.2 ± 25.2	253.0-8.0	64.3 ± 20.2	94.4 ± 27.9*
Serum Iron (µg/dL)	85.4 ± 34.0	184.0-14.0	82.0 ± 28.4	93.8 ± 40.7
Haemoglobin (g/dL)	14.3 ± 1.3	17.3-9.5	14.0 ± 1.2	14.8 ± 1.3
Hematocrit (%)	43.7 ± 6.3	80.0-27.0	43.8 ± 6.7	43.8 ± 5.4

* $P < 0.05$.

This group has a diet with a high energy content and an increased risk of developing folate and vitamin B₁₂ deficiencies. It would be necessary to adequately compose the menus given in the nursing homes, decreasing energy intakes, and supplying micronutrient rich foods or food fortification or the supplementation of intervention programs.

References

- Rissanen PM, Laakkonen EI, Suntioinen S et al.: The Nutritional Status of Finnish Home-living Elderly People and the Relationship between Energy Intake and Chronic Diseases. *Age and Ageing*, 1996, 25:133-138.
- Munro HN, McGandy RB, Hartz SC et al.: Protein nutriture of a group of free-living elderly. *Am J Clin Nutr*, 1987, 46:586-592.
- Rosenberg IH and Miller JW: Nutritional factors in physical and cognitive functions of elderly people. *Am J Clin Nutr*, 1992, 55:1237-1243.
- Bogden JD, Bendich A, Kemp FW, et al.: Daily micronutrient supplements enhance delayed hypersensitivity skin test responses in older people. *Am J Clin Nutr*, 1994, 60:437-447.
- Dallman PR, Yip R and Johnson C: Prevalence and causes of anaemia in the United States, 1976 to 1980. *Am J Clin Nutr*, 1984, 39:437-445.
- Hoffman N: Diet in the elderly. *Med Clin North Am*, 1993, 77:745-756.
- Moreiras O, Carbajal A and Cabrera ML: La composición de los alimentos. Dpto. Nutr. Universidad Complutense de Madrid, 1996.
- Departamento de Nutrición: Universidad Complutense de Madrid. Ingestas recomendadas de energía y nutrientes para la población española. Madrid, 1996.
- Gámez C, Ruiz MD, Artacho R, Puerta A and López C: Estado nutricional en hierro en ancianos institucionalizados: estudio de la ingesta e índices hematológicos. *Nutr Hosp*, 1998, XIII(2):81-84.
- Moreiras O, Carbajal A, Perea I, Varela-Moreiras G and Ruiz-Roso B: Nutrición y salud de las personas de edad avanzada en Europa: EURONUT SENECA. Estudio en España. I. Estilo de vida, estado de salud, modelo dietético, hábitos alimentarios, valoración de la ingesta. *Rev Geriatr y Gerontol*, 1993, 28:209-229.
- Virtanen SM, Feskens EJM, Räsänen L et al.: Comparison of diets of diabetic and non-diabetic elderly men in Finland, The Netherlands and Italy. *Eur J Clin Nutr*, 2000, 54:181-186.
- Ortega RM, Redondo MR, Zamora MJ, López-Sobater AM, Andrés P and Encinas-Sotillos A: Balance energético y perfil calórico en ancianos obesos o con sobrepeso en comparación con los de peso normal. *Med Clin (Barc)*, 1995, 104:526-529.
- Consenso SEEDO'2000 para la evaluación del sobrepeso y la obesidad y el establecimiento de criterios de intervención terapéutica. *Nutrición y Obesidad 2000*, 2000, 3:285-299.
- Pérez Berbejal R, Moreno García N and Tuells Hernández J: Estimación del aporte energético y nutritivo de los menús ofertados en las residencias de tercera edad existentes en el área de Baix Vinalopo (Elche). *Nutr Clin*, 2000, XX:21-29.
- Portillo MP, Guijarro J, Martín M, Rozas E and Abecia C: Estimación del aporte energético y nutritivo de las dietas en una residencia de ancianos del País Vasco. *Nutr Clin*, 1996, 16:29-37.
- Charlton KE, Kruger M, Labadarios D, Wolmarans P and Aronson I: Iron, folate and vitamin B₁₂ status of an elderly South African population. *Eur J Clin Nutr*, 1997, 51:424-430.
- Olivares M, Hertrampf E, Capurro MT and Wegner D: Prevalence of anaemia in elderly subjects living at home: role of micronutrient deficiency and inflammation. *Eur J Clin Nutr*, 2000, 54:834-839.
- SENECA investigators, Longitudinal changes in iron and protein status of elderly Europeans. *Eur J Clin Nutr*, 1996, 50(2):16-24.
- de Groot LCPGM, Beck AM, Schroll M and van Staveren WA: Evaluating the DETERMINE Your Nutritional Health Checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. *Eur J Clin Nutr*, 1998, 52:877-883.
- N.R.C. (National Research Council), Recommended Dietary Allowances 10th edn. Washington DC, National Academy of Sciences, 1989: 224-230.
- Quinn K and Basu TK: Folate and vitamin B₁₂ status of the elderly. *Eur J Clin Nutr*, 1996, 50:340-342.
- Jacobs P, Richards JDM and Ben-Arie O: The Coloured elderly in Cape Town - a psychosocial, psychiatric and medical community survey. *S Afr Med*, 1984, 65:16-18.