

Nutrición Hospitalaria

Nutrición Hospitalaria

ISSN: 0212-1611

ISSN: 1699-5198

Grupo Arán

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de-Lourdes; Ruiz, Emma; Varela-Moreiras, Gregorio
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population: a review of the findings from the ANIBES study
Nutrición Hospitalaria, vol. 35, no. 6, Extra., 2018, pp. 20-24
Grupo Arán

DOI: <https://doi.org/10.20960/nh.2282>

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Assessment of micronutrients intakes in the Spanish population: a review of the findings from the ANIBES study

Evaluación de la ingesta de micronutrientes en la población española: una revisión de los resultados del estudio ANIBES

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Abstract

Introduction: micronutrients are essential compounds present in foods and diets should provide adequate quantities to maintain growth, development and metabolic functions in men.

Objectives: to review the adequacy to micronutrient recommendations amongst the population from the ANIBES study.

Material and methods: published data from the ANIBES Study was reviewed to assess intakes in relation to the Recommended Dietary Intakes (RDI) for each age group including total, plausible and non-plausible reporters.

Results: throughout all age groups, folates and vitamin D were the vitamins with the lowest proportion of subjects having intakes above 80% the RDI. Zinc intake was lower in children, adults and the elderly but not in adolescents. Nevertheless, vitamin D consumption increased with age.

Conclusion: our results show inadequate intakes for at least three key micronutrients across all age groups. Authorities should promote nationwide nutritional policies to address unbalanced diets focusing on reaching vulnerable populations in order to overcome this major public health problem.

Key words:

Micronutrient.
Intakes. Deficiencies.
Spanish population.

Resumen

Introducción: los micronutrientes son compuestos esenciales presentes en los alimentos, y las dietas deben proporcionar cantidades adecuadas para mantener el crecimiento, el desarrollo y las funciones metabólicas del hombre.

Objetivos: revisar la adecuación a las recomendaciones de micronutrientes en la población del estudio ANIBES.

Material y métodos: se revisaron los datos publicados del estudio ANIBES para evaluar las ingestas en relación con las ingestas dietéticas recomendadas (IDR) para cada grupo de edad, incluida la población total, plausibles y no plausibles.

Resultados: en todos los grupos de edad, los folatos y la vitamina D fueron las vitaminas con la menor proporción de sujetos con ingestas superiores al 80% de la IDR. La ingesta de zinc fue menor en niños, adultos y ancianos, pero no en adolescentes. Sin embargo, el consumo de vitamina D aumentó con la edad.

Conclusión: nuestros resultados muestran una ingesta inadecuada de al menos tres micronutrientes claves en todos los grupos de edad. Las autoridades deberían promover políticas nutricionales a nivel nacional para abordar las dietas desequilibradas que se centran en llegar a las poblaciones vulnerables a fin de superar este importante problema de salud pública.

Palabras clave:

Micronutrientes.
Ingestas.
Deficiencias.
Población española.

Conflicts of Interest: The study was financially supported by a grant from Coca-Cola Iberia through an agreement with the Spanish Nutrition Foundation (Fundación Española de la Nutrición (FEN)). The funding sponsor had no role in the design of the study, the collection, analysis nor interpretation of the data, the writing of the manuscript, or in the decision to publish the results. The authors declare no conflict of interest.

Partearroyo T, Samaniego-Vaesken ML, Ruiz E, Varela-Moreiras G. Assessment of micronutrients intakes in the Spanish population: a review of the findings from the ANIBES study. Nutr Hosp 2018;35 (N.º Extra. 6):20-24

DOI: <http://dx.doi.org/10.20960/nh.2282>

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INTRODUCTION

Micronutrient deficiency has been the cause of a number of diseases and deaths in hunger periods. From the second half of the 20th century, vitamins started to be identified and synthesized, providing the possibility of overcoming and preventing deficiency related diseases (1). During the second half of the 20th and the start of the 21st century, research targeted the understanding of their “new functions”, related to optimum intakes, on preventing chronic degenerative diseases like cardiovascular (CVD) and neurodegenerative diseases and cancer. At present, micronutrient deficiencies are of great public health and socioeconomic importance worldwide. They affect low-income countries but are also a significant factor in health problems in industrialized societies with impacts among wide vulnerable groups in the population, including women, children, the middle-aged, and the elderly (2). The health benefits provided by the adherence to the Mediterranean Diet, such as the reduction of the risk of certain pathologies as cancer or CVD, have been demonstrated in numerous studies (3). Adequate consumption of micronutrients is one of the key elements of the quality of this diet. Therefore, it should be promoted by public health nutrition policies in order to prevent deficiencies in the most vulnerable population groups (4). Although historically the Spanish diet encompassed the patterns of the Mediterranean diet, it is questioned that at present the evolution of our diet might be showing a quite different model (5,6).

In order to improve micronutrient intakes, an increasing number of countries worldwide implement mandatory fortification of staple foods, such as flours and dairy products with key micronutrients (7). The World Health Organization defines food fortification as the practice of deliberately increasing the content of an essential micronutrient, i.e., vitamins and minerals in a food, in order to improve the nutritional quality of the food supply and provide a public health benefit with minimal health risk. However, this measure has important controversies related to potential excess of intakes and therefore mandatory fortification is not implemented in Europe and most countries only practice voluntary fortification of selected food products (i.e. breakfast cereals, fat spreads, etc.) (8).

In the present work, our objective was to review the adequacy to micronutrient recommendations amongst the population from the ANIBES study.

MATERIALS AND METHODS

The complete design, protocol and methodology have been described in detail elsewhere (9). In summary, it is a cross-sectional study conducted using stratified multistage sampling, performed at 128 points across Spain and is representative of all individuals living in Spain, aged 9-75 years, and living in municipalities of at least 2,000 inhabitants. The final sample comprised 2,009 individuals (1,013 men, 50.4%; 996 women, 49.6%). Study participants were provided with a tablet device (Samsung Galaxy Tab 2 7.0, Samsung Electronics, Suwon, Korea) and trained in recording information by taking photos of all food

and drinks consumed during the three days of the study, both at home and outside.

Available data from the ANIBES Study (10-13) was used to assess intakes using the Recommended Dietary Intakes (RDI) for each age group as reference (14). Results were expressed as the percentage of the population that had micronutrient intakes above 80% of the RDIs for the total, but also for plausible and non-plausible reporters. Misreporting was calculated by the method of Goldberg (15) and Black (16).

OVERVIEW OF THE MICRONUTRIENT INTAKE OF THE SPANISH POPULATION

CHILDREN (9-12 YEARS)

Our results show that in the case of calcium, 52.5% of plausible reporters had intakes above 80% RDI when compared to total (38.5%) and non-plausible reporters (20.4%) (Fig. 1). We observed a similar distribution for iron and magnesium intakes. Children reported dietary intakes are controversial as under or overestimation is frequent and generally depends on parents input for accuracy. Zinc, folates and vitamin D showed the lowest adequacy within this population group as less than 35% of plausible reporters had intakes above 80% RDI. Noteworthy, only 1.7% of children had intakes above 80% RDI of vitamin D. Conversely, iodine, phosphorous, selenium and vitamin B₁₂ had the highest proportion of population with an adequate micronutrient intake.

Calcium, phosphorus, magnesium and vitamin D play a key biological role in bone metabolism (17). These minerals are the main components in bone structure inorganic matrix. Among others, these nutritional factors can be determinant for achieving an optimum peak of bone mass during childhood and adolescence and, in turn, preventing osteoporosis development at later stages

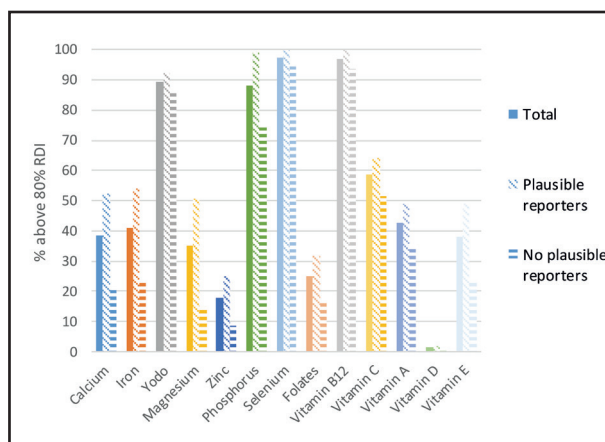


Figure 1.

Prevalence of adequacy of several micronutrients in children (percentage above 80% RDI) in ANIBES study by reporting.

RDI: Recommended Dietary Intakes (14).

of life (18). In this group, calcium and magnesium intakes above 80% were only observed in 52.5 and 50.8% of the population respectively, indicating a clear need for improvement.

Vitamin D is found naturally in a limited number of foods; and therefore, endogenous synthesis of vitamin D, which occurs when skin is exposed to UVB radiation from sunlight, is a principal determinant of vitamin D status (17). In the studied population, an extremely low percentage of individuals present an adequate vitamin D intake, which is of particular concern given that sun exposure is considered harmful due to potential pathologies derived from it.

Children and adolescents constitute a vulnerable group with a high risk for nutritional deficiencies. A number of factors determine this situation: an increased need of micronutrients for growth; during this period, nutritional requirements are high, but vitamin and mineral intakes tend to be reduced, as there is a greater consumption of foods and beverages with low nutrient density. In addition, frequent meal skipping, reluctance to try new foods and flavours, adoption of inappropriate weight control behaviours and decreased vegetable and fruit intake, have to be considered. All of these elements can also contribute to an increased prevalence of obesity (19).

ADOLESCENTS (13-17 YEARS)

A low proportion of plausible reporters presented intakes above 80% RDI for calcium (36.4%), iron (27.6%), magnesium (27.6%), zinc (25%) and vitamin A (31.6%) (Fig. 2). Furthermore, folates and vitamin D showed the lowest proportion amongst adolescents, with only 9.2% and 6.9% of subjects with intakes above 80% RDI, respectively. Highest proportion of subjects reached adequate intakes for iodine, phosphorous, selenium, vitamin B₁₂ and C.

In the EnKID study, conducted in Spain between 1998 and 2000, results indicated that amongst 11–14 year old adolescents

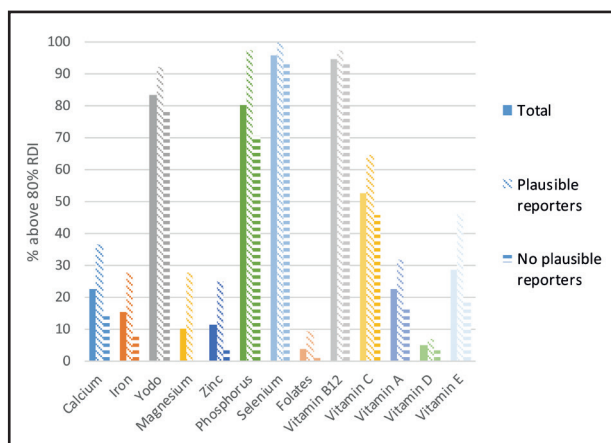


Figure 2.

Prevalence of adequacy of several micronutrients in adolescents (percentage above 80% RDI) in ANIBES study by reporting.

RDI: Recommended Dietary Intakes (14).

more than 50% of males had intakes below the RDI for magnesium, calcium, folate and vitamins A, B₆, D and E. Additionally, more than 50% of females had intakes below the RDI for magnesium, calcium, folate and vitamins A, B₆, D and E (20).

More recently, in the ENALIA study (The National Dietary Survey on the Child and Adolescent Population in Spain) (19) the usual micronutrient intake among a representative sample of Spanish infants, children and adolescents (six months-17 years) (n = 1,862) was assessed (November 2012-July 2014). Their results also showed that usual intake of vitamin D was insufficient in practically all individuals. Vitamin E, folate and calcium were insufficient, especially from nine years of age, and magnesium and iodine from 14 years of age.

ADULTS (18-64 YEARS)

Adult plausible reporters had higher proportions of intakes above 80% RDI for iodine (84.1%), phosphorous (99.5%), selenium (95.8%) and vitamin C (80.8%) (Fig. 3). Zinc, folates and vitamin D were the micronutrients with lowest adequacy among plausible reporters (< 20% of subjects).

Results from the latest evaluation of food consumption and dietary patterns in Spanish households by the Spanish Ministry of Agriculture, Fisheries and Food found that nutrients that did not reach 80% of the RDI for adults aged 20-40 years were zinc and folic acid in both sexes, and iron in women only. Other nutrients with a potentially insufficient intake were vitamin B₆ and magnesium (21).

The methionine cycle is regulated by folic acid and vitamins B₁₂ and B₆ (22) acting as cofactors of a molecule which acts as the universal methyl group donor and is involved in more than a hundred key reactions related to methylation. Folic acid intakes are also compromised in the studied population, as insufficient

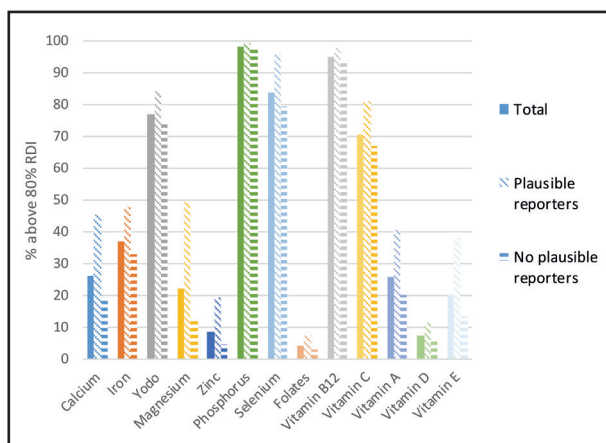


Figure 3.

Prevalence of adequacy of several micronutrients in adults (percentage above 80% RDI) in ANIBES study by reporting.

RDI: Recommended Dietary Intakes (14).

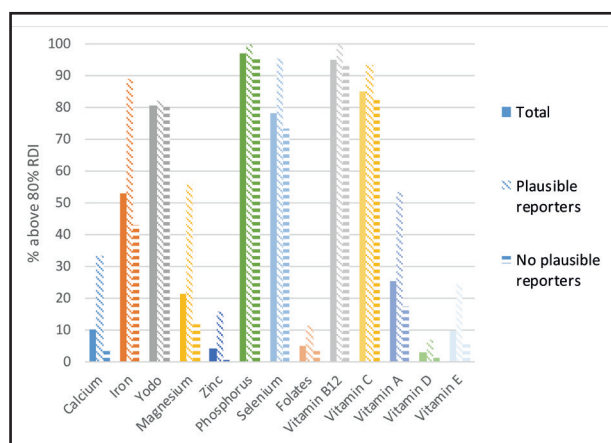


Figure 4.

Prevalence of adequacy of several micronutrients in the elderly (percentage above 80% RDI) in ANIBES study by reporting.

RDI: Recommended Dietary Intakes (14).

intakes were found in all population groups, especially adolescents and adults. Impairment of the methionine metabolism can lead to hyperhomocysteinemia, an independent risk factor for CVD (23) which are a major cause of mortality and morbidity in industrialized countries (24). In addition, the role of folic acid in the prevention of neural tube defects is well established so that women of childbearing age are encouraged to supplement their diets due to scarce intakes (25).

ELDERLY (65-75 YEARS)

When studying elder individuals, zinc (15.6%), folates (11.1%) and vitamin D (6.7%) showed the lowest proportions of adequacy (Fig. 4). Conversely, iron, iodine, phosphorous, selenium, vitamin B₁₂ and vitamin C were amongst the highest.

Health, psychological, socioeconomic factors, in addition to the aging process *per se*, are closely related to nutritional status in elderly persons. An increasing number of studies demonstrate the inadequacy of micronutrient intakes in the elderly. Recently, a meta-analysis that summarized the data from 41 studies showed that, depending on the studied micronutrient, between 15% and 90% of elderly were at risk for deficiency (26). Malnutrition is present not only amongst institutionalized subjects but also amongst the free-living. This group is of great concern for health authorities because as life expectancy increases, the elder population will experiment an exponential growth in the next years in high-income countries, this will have an impact on healthcare costs and quality of life (27).

Micronutrients linked to oxidative stress and our antioxidant defense systems, like zinc, selenium and vitamins A, E and C participate in many biological functions involved in the antioxidant defense system of our organism and have important implications in chronic disease development (28,29). Zinc intakes are com-

promised in the elder group, as only 15.6% of individuals have intakes over 80% RDI.

In summary, our results show that throughout all age groups studied, folates and vitamin D were the vitamins with the lowest proportion of subjects having intakes above 80% the RDI. Zinc intake was lower in children, adults and the elderly but not in adolescents. Nevertheless, vitamin D consumption increased with age. The ANIBES study results underline the need for improving diet amongst all population groups.

CONCLUSIONS

Our results show inadequate intakes for at least three key micronutrients across all age groups. Authorities should promote nationwide nutritional policies to address unbalanced diets focusing on reaching vulnerable populations in order to overcome this major public health problem.

ACKNOWLEDGMENTS

The authors would like to thank Coca-Cola Iberia and IPSOS for its support and technical advice, particularly Rafael Urrialde and Javier Ruiz.

AUTHOR CONTRIBUTIONS

T.P., M.L.S.V. and E.R. analysed the data, contributed to the design of the manuscript and to the interpretation and discussion of the results. These authors also critically reviewed the manuscript. G.V.M., the Principal Investigator, was responsible for the design, protocol, methodology and follow-up/checking of the study. G.V.M. also revised the manuscript. All authors approved the final version of the manuscript.

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