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Original article

Evaluation of iron, zinc, copper, manganese and selenium in oral hospital diets☆

Daniele C.F. Moreira [a,*], Júlia S.M. de Sá [a], Isabela B. Cerqueira [b], Ana P.F. Oliveira [b], Marcelo A. Morgano [b], Késia D. Quintaes [a]

[a] Ouro Preto Federal University (UFOP), School of Nutrition, Ouro Preto, Minas Gerais, Brazil
[b] Institute of Food Technology (ITAL), Center of Foods Science and Quality, Campinas, São Paulo, Brazil

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SUMMARY

Background & aims: Many trace elements are nutrients essential to humans, acting in the metabolism as constituents or as enzymatic co-factors. The iron, zinc, copper, manganese and selenium contents of hospital diets (regular, blend and soft) and of oral food complement (OFC) were determined, evaluating the adequacy of each element in relation to the nutritional recommendations (DRIs) and the percent contribution alone and with OFC.
Methods: Duplicate samples were taken of six daily meals and of the OFC on two non-consecutive days from a hospital in Belo Horizonte (MG, Brazil) in May and September of 2010 and January of 2011. The elements were determined by ICP OES.
Results: Of the diets, the soft diet showed the highest elements content. Offering the OFC was insufficient to provide adequate levels of the trace elements.
Conclusion: The oral hospital diets were inadequate in relation to the RDAs for the trace elements studied and the use of the OFCs was insufficient to compensate the values.

1. Introduction

Since ancient times food has been recognized as an aid in the treatment of infirmities.[1] Thus amongst the objectives of the hospital diet is that of recovering and/or maintaining the nutritional status of the patient with an adequate provision of nutrients.[2] However in order to attend the special nutritional needs of patients with difficulties in chewing, swallowing and digesting food, the texture of hospital diets can be modified, an action that alters their physicochemical characteristics and also their energy and nutrient contents, including those of the minerals and trace elements.[3,4]

Mertz (1981)[5] defined as essential trace elements (ETE) those elements with daily requirements below 18 mg. Verdú & Marín (1995)[6] included as ETE those microminerals with daily requirements generally below 100 mg. Iron (Fe), zinc (Zn), copper (Cu), cobalt (Co), chrome (Cr), selenium (Se), molybdenum (Mo), manganese (Mn), fluorine (F) and iodine (I) are considered as ETE by the classical nutrition definition.[7]

The ETE have major immunological, endocrinological and antioxidant functions. Diets deficient in Zn gives rise to diarrhea, impaired appetite and immune functions,[8] which could be even more harmful for unhealthy or hospitalized patients. For surgical patients, individual requirements of ETE may vary considerably and will be particularly increased in case of prior deficiency, anabolic states, or increased losses (i.e. burns, diarrhea, gastric aspiration, intestinal fistulae). Some ETE deficiencies (Se, Cr, Mo) can initiate very serious complications and will require special caution in the perioperative period. Other deficiencies (Cu, Zn) result in more slowly evolving clinical pictures, with lesser life-threatening potential, resulting in infections and prolonged wound healing. In the case of depletion prior to surgery, isolated supplementation may be required.[9]

The U.S. Food and Nutrition Board of the Institute of Medicine has dealt with nutritional deficiency problems as well as toxicity by setting Dietary Reference Intakes (DRIs), which includes the Recommended Dietary Allowance (RDA), the Estimated Average Requirement (EAR), the Adequate Intake (AI), and the Tolerable Upper Intake Level (UL) for ETE.[10] However, there is disagreement

Non-standard abbreviations: B, Blend; G, General; Jan, January; OFC, Oral food complement; S, Soft; Sep, September.

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* Corresponding author. Street Zoroastro Franco de Carvalho, 183B, Santa Maria, Varginha, MG 37022-480, Brazil. Tel.: +55 35 98087567.
E-mail addresses: danielefariamoreira@gmail.com, danifm10@yahoo.com.br (D. C.F. Moreira).

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with respect to the parameter to be used for the recommended amounts of nutrients for hospitalized patients.[11,12] The use of the RDA, which represents values of nutrients that are required to maintain good health in healthy individuals, can be interpreted as promoting health, contrary to the idea of specific recommendations for the sick based on distinct nutritional demands resulting from the pathology and nutritional status of the patient.[10–12]

In Latin America, more than 90% of the hospitalized patients receive an oral diet.[13] However, studies on the chemical composition of diets have focused on enteral and parenteral diets and even on the dietary complements, and there is a lack of studies on the composition of oral hospital diets, especially with respect to their mineral and ETE contents.[3,4] The mineral and ETE contents of diets and meals are usually estimated using food composition tables, a procedure that has some limitations, such as the fact that it is impossible to accurately quantify the ingredients used in the recipes, especially the spices, fats and oils.[14]

The present study aimed to determine the total contents of Fe, Zn, Cu, Mn and Se in oral hospital diets with different consistencies (regular, blend and soft) and of an artisanal oral food complement (OFC), and to evaluate the percent contribution of the elements per meal and per OFC and their adequacy in relation to the dietary recommendations.[10]

2. Methodology

This study was exploratory and carried out in the Mário Penna Association Hospital (Belo Horizonte, MG, Brazil), a philanthropic institution with 300-hospital beds capacity for the treatment of non-institutionalized oncologic patients. The menus of the regular, blend and soft diets were valid for six weeks (42 days), being repeated at the end of this period, and consisted of six distinct meals: breakfast, mid-morning snack, lunch, mid-afternoon snack, dinner and bedtime snack. Appendices 1–3 respectively show the foods making up the menus of these diets.

On the days the diets were sampled, two additional units were prepared for the meals making up the menus of interest to the study, in a way similar to that carried out in the portioning of the meals destined for the patients. Samples were taken in duplicate for each meal per type of diet on two non-consecutive days (Tuesday and Thursday) on three occasions: May 2010, September 2010 and January 2011. Fig. 1 displays the total number of the hospitalized patients in each period and the nutritional prescription.

The samples were taken at the normal times the meals were offered and were weighed on an electronic Pluris Top balance (Filizola S.A. Pesagem e Automação, São Paulo, SP, Brazil). Each meal was homogenized in a food multiprocessor with a rigid plastic helix. Aliquots were collected, stored in duly identified zip-lock plastic bags and frozen at −18 °C until analyzed.

In addition a homogenous composition was prepared using 10% of each meal to obtain an aliquot corresponding to the total daily diet for each type of diet, and treated in the same way as the other samples, and was subsequently used in the determination of selenium.

The ETE content of the artisanal food complement (OFC) was analyzed. The morning and afternoon OFC samples were collected on the same days the meals were sampled, and treated similarly to the meal samples after homogenization. Appendix 4 shows the foods used to prepare the OFC on the six sampling days.

The daily values found for each mineral in all the diets, with and without the OFC, were compared with the DRIs for adults and elderly adults of both sexes.[10] The percent adequacy of the ETE provided by the diets and OFC in relation to the dietary recommendations was calculated based on the reference values of the DRIs, that is: RDA or AI and the UL for adults (19–59 years old) and elderly adults (>60 years old) of both sexes.[10] When there was a difference in the dietary recommendation between the two age ranges, the range with the greater reference value was adopted, so long as this did not exceed the UL value.

Analytical grade reagents and high purity de-mineralized water (resistivity 18.2 M Ω cm) were used in the assays. All glassware was cleaned by immersion in 20% (v/v) HNO_3 for three hours, washed three times with de-mineralized water and then dried before use.

A multi-element standard solution containing Fe, Zn, Cu, Mn and Se was prepared in 5% HCl (v/v) as from a stock solution containing 1000 mg/L (Merck, Darmstadt, Germany). The analytical curves were prepared using the standard solution in the following concentration intervals: 0.01–1 mg/L for Fe, Zn, Cu and Mn, and 0.01–0.5 mg/L for Se. The blank solutions were prepared in the laboratory for all the methodologies, in a way similar to that used for the field samples.[15,16]

2.1. Preparation of the samples for the mineral determinations

The minerals in the diet and in OFC samples were determined in duplicate.

- Iron: two grams of each sample were extracted using a 5 mL concentrated hydrochloric solution with agitation, and then diluted to 25 mL with de-mineralized water and filtered through quantitative filter paper.[15,17]

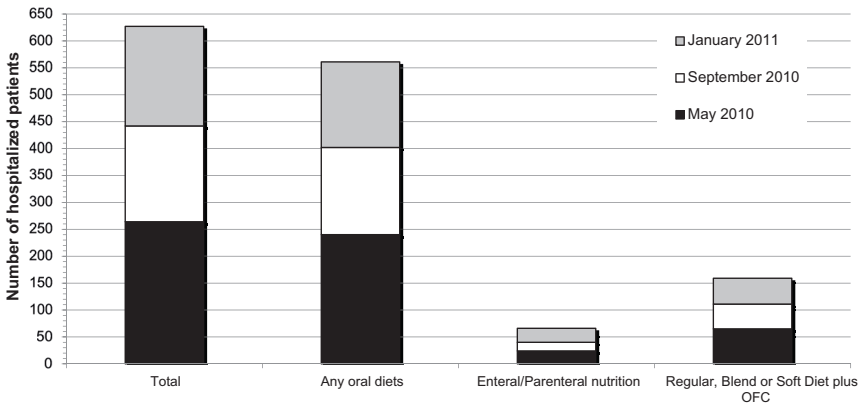

Fig. 1. Number of the total hospitalized patients in each period studied and the nutritional prescription. OFC: Oral Food Complement.

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