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Original article

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

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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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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]

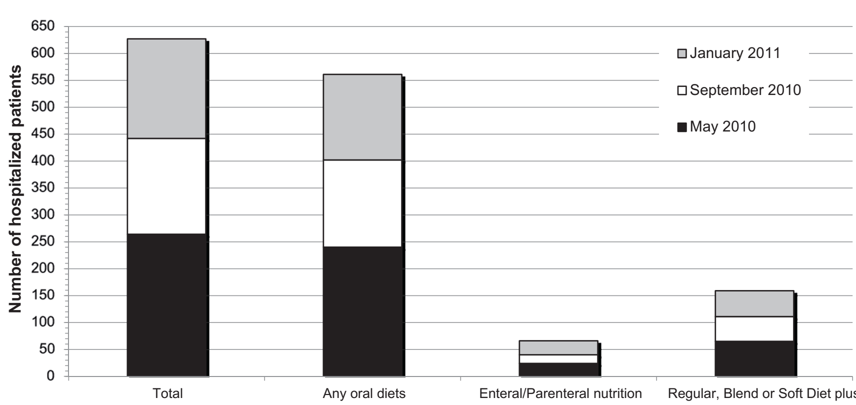

Fig. 1. Number of the total hospitalized patients in each period studied and the nutritional prescription. OFC: Oral Food Complement.

Table 1
Average content of the trace elements Fe, Zn, Cu, Mn (mg) and Se (mcg) offered daily for the diets regular, blend and soft diets and for the Oral Food Complements (OFC) during the months of January, May and September and the percent adequacy of the trace elements for the each diet alone or in the presence of the OFC during the sampling months in relation to the nutritional recommendations (RDA) for adults and elderly adults of both sexes.

Minerals	Months		January			May			September		
	Diet		Regular	Blend	Soft	Regular	Blend	Soft	Regular	Blend	Soft
	RDA*		Mean ± SD (mg/Day or mcg/Day for Se)								
Fe	TD	18*	$10.37^{b} \pm 2.3$	$8.56^{b} \pm 0.95^{y}$	$16.02^{a} \pm 2.4$	13.97 ± 3.91	10.71 ± 0.48^{x}	14.76 ± 3.52	$14.67^{a} \pm 1.99$	$8.50^{b} \pm 0.16^{y}$	$19.82^{a} \pm 7.55$
	%		57.61	47.56	89.00	77.61	59.50	82.00	81.50	47.22	110.11
	OFC			1.09 ± 0.8			1.4 ± 0.41			0.63 ± 0.08	
	%		63.67	53.61	95.06	85.39	67.28	89.78	85.00	50.72	113.61
Zn	TD	11*	$9.70^{b} \pm 0.60^{xz}$	$8.71^{b} \pm 1.80^{yz}$	$21.78^{a} \pm 1.30^{x}$	$7.76^{b} \pm 1.41^{y}$	$12.21^{a} \pm 0.81^{x}$	$13.98^{a} \pm 2.28^{y}$	$8.18^{b} \pm 1.33^{yz}$	$10.52^{b} \pm 1.07^{xz}$	$27.17^{a} \pm 5.26^{x}$
	%		88.18	79.18	198.00	70.55	111.00	127.09	74.36	95.64	247.00
	OFC			$1.28^{xz} \pm 0.09$			$1.35^{x} \pm 0.32$			$2.64^{xy} \pm 1.29$	
	%		99.82	90.82	209.64	82.82	123.27	139.36	98.36	119.64	271.00
Cu	TD	0.9	$1.05^{a} \pm 0.07^{x}$	$0.99^{a} \pm 0.21$	$0.65^{b} \pm 0.07^{y}$	$0.85^{a} \pm 0.03^{y}$	$0.93^{ab} \pm 0.05$	$0.66^{ac} \pm 0.09^{y}$	$1.01^{a} \pm 0.11^{x}$	$1.09^{a} \pm 0.18$	$0.82^{b} \pm 0.03^{x}$
	%		116.67	110.00	72.22	94.44	103.33	73.33	112.22	121.11	91.11
	OFC			$0.08^{y} \pm 0.01$			$0.13^{x} \pm 0.02$			$0.07^{y} \pm 0.02$	
	%		125.56	118.89	81.11	108.89	117.78	87.78	120.00	128.89	98.89
Mn	TD	2.3*	$3.52^{a} \pm 0.19$	$3.17^{a} \pm 0.64$	$1.76^{b} \pm 0.13$	$3.46^{a} \pm 0.54$	$2.87^{a} \pm 0.19$	$1.71^{b} \pm 0.13$	$3.04^{a} \pm 0.49$	$3.22^{a} \pm 0.54$	$1.68^{b} \pm 0.19$
	%		153.04	137.83	76.52	150.43	124.78	74.35	132.17	140.00	73.04
	OFC			$0.33^{y} \pm 0.11$			$0.66^{x} \pm 0.17$			$0.30^{y} \pm 0.02$	
	%		167.39	152.17	90.87	179.13	153.48	103.04	145.22	153.04	86.09
Se	TD	0.055	0.1 ± 0.04^{xy}	0.06 ± 0.02^{x}	0.08 ± 0.01	0.06 ± 0.03^{x}	0.07 ± 0.02^{x}	0.04 ± 0.03	0.05 ± 0.04^{xz}	0.03 ± 0.02^{y}	0.05 ± 0.04
	%		181.82	109.09	145.45	109.09	127.27	72.73	90.91	54.55	90.91
	OFC			0.012 ± 0.002			0.013 ± 0.004			0.011 ± 0.001	
	%		203.64	130.91	167.27	132.73	150.91	96.36	110.91	74.55	110.91

Statistical significance fixed at $p < 0.05$. The value for p adjusted for significance in the kwallis2 test was 0.008.
[a,b,c]Statistically significant difference between the diets for the contents of minerals offered.
[x,y,z]Statistically significant difference between the months for the contents of trace elements offered.
TD = total daily.
*The value considered for the recommended dietary allowance was the highest amongst the adults, elderly adults, men and women: Fe – females aged 19–50 y; Mn and Zn – males all ages.[11]

- Zinc, copper and manganese: five grams of each sample were incinerated at 450 °C and the ash obtained diluted to 25 mL with 5% (v/v) hydrochloric acid in a 25 mL volumetric flask.[15,16]
- Selenium: two grams of each sample were digested with nitric acid (25 mL) and hydrogen peroxide (7 mL) at 180 °C on a heating plate. After reducing the volume of the extract, it was diluted to 25 mL with a 5% (v/v) solution of HCl.[15,18]

2.2. Instrumentation and guarantee the results quality

After digestion and dilution of the samples, the elements were determined by inductive coupled plasma optical emission spectrometry (ICP OES) using a Varian model Vista MPX spectrometer (Mulgrave, Australia) equipped with a 40 MHz radio frequency source, charge coupled device solid state simultaneous multi-element detector, peristaltic pump, nebulizer chamber and sea spray type nebulizer, ICP Expert software and 99.996% pure liquid argon (Air Liquid, SP, Brazil) as the plasma gas.

The methodologies used were validated for the parameters of precision and exactness using certified diet reference material (CRM) for the inorganic elements studied in this work. The CRM used was the Typical Diet (1548a) obtained from the National Institute of Standards and Technology (NIST).[15]

2.3. Statistical analyses

The statistical analyses were carried out using the Stat 11.0 for Mac OS. The Shapiro–Wilk test was used to evaluate the normality of the data and the Bartlett test to evaluate homoscedasticity. The analysis of variance was used to evaluate the difference in the nutrient contents between the three diets and between the three samplings, followed by the Bonferroni post-test when the variables presented a parametric distribution, and the Kruskal–Wallis test (using the Kwallis2 function) for non-parametric variables. The difference between the periods of offering the OFC was verified using the Mann–Whitney U test. The differences were considered to be statistically significant when $p < 0.05$ for each comparison.[19]

3. Results

The sampling used in this study provides an analysis of 18 oral diets (6 Regular, 6 Blend and 6 Soft) or 36 meals (18 Regular, 18 Blend and 18 Soft), which represent analysis of 14.3% of the composition of the diets served to the hospitalized patients, for each of the three diets studied. There was good agreement between the certified and analytical values. For all the elements studied the results for exactness varied between 84 and 104% and precision oscillated between 3 and 10%.

Table 1 shows the mean contents of the ETE Fe, Zn, Cu, Mn and Se offered daily for the regular, blend and soft diets and for the OFC during the months of January, May and September. Also included in Table 1 is the percent adequacy of the ETE for the each diet alone, or in the presence of the OFC, during the sampling months in relation to the highest amongst nutritional recommendations (RDA) for adults and elderly adults of both sexes.

Meal contribution: the analysis of the various meals over time, shows that lunch and dinner contributed most for Zn (38.1% and 29.1%), Cu (38.9% and 27.2%) and Mn (45.5% and 32.1%). Iron was insufficient throughout the meals.

The mid-morning and bedtime snacks were the meals showing the lowest percent contribution to the provision of ETE, with mean values of 1.5% and 2.9% of the recommended dietary allowances, with the exception of the month of September for Cu and Mn.

4. Discussion

In the present research the regular and blend diets showed similar values for the majority of the minerals (Table 1), a standard also observed for the meals. In contrast to other scientific reports[4,20] the soft diet did not present a lower content of ETE in relation to the other diets. The soft diet showed the highest mineral contents, and as a consequence gave the best percent adequacies with respect to the corresponding RDA. The use of fortified industrialized foods and milk in this diet is a contributing factor to this result.

For all individuals except adult women, adequate iron requirements were provided by meals (Table 1). A different menu for this group, or the prescription of a specific nutritional complement, would increase iron content to RDA values. With respect to Fe, the soft diet showed higher values than the other diets (Table 1). While there was beef in the lunch and dinner meals, the other diets presented chicken or fish as the main dish, foods that contain 3–8 times less iron compared to beef.[21] In addition, the soft diet included industrialized foods fortified with iron (e.g. infant cereals and creamed rice).

The soft diet showed the highest Zn contents and was the only diet complying with the RDA for this mineral of all the groups in the study (Table 1). This is probably attributable to the use of fortified industrialized foods in the preparation of this diet. Passos & Ferreira[22] showed that the mineral contents provided by the meals in a long-term institution for the elderly were 14 mg/day for Fe and 8 mg/day for Zn, values analogous to those found in the present study. A evaluating the habitual dietary intake among patients with severe short bowel syndrome shows that for multiple micronutrients the intakes in a large percentage of patients were below the RDA for iron (37%) and zinc (68%).[23] Hospitalized patients can be more vulnerable to diarrhea, impaired appetite and reduced immune functions when deficient status of Zn is present.[8]

Noel et al.[24] analyzed 3 meals making up institutionalized diets and found Fe, Zn, Cu and Se contents similar levels to those found in the present study. The Cu content (0.93 mg/day) was similar to that offered by the regular and blend diets in January and September, and that of Fe (12.3 mg/day) was similar to the mean contents of all the diets (13 mg/day in the regular diet, 9 mg/day in the blend diet and 16 mg/day in the soft diet). The Zn content (10.2 mg/day) approximated that offered by the regular and blend diets in all sampling periods, and the Se content (0.07 mcg/day) with the diets in January and May.

The regular and blend diets contained similar Cu contents, higher than those in the soft diet (Table 1). These diets contained meat, with a significant Cu content for both frequency and volume, higher than that found in the soft diet menus. The presence of fish with shrimp sauce in the dinner meal of the regular and blend diets in January could explain the Cu content, since shrimp contains two to three times more Cu than beef, chicken or fish (Appendices 1–3).[25]

With respect to Mn, the regular and blend diets complied with the recommendation for all the months sampled, while the soft diet did not (Table 1), probably due to the fact that the soft diet contained the lowest cereal content. Foods showing higher Mn values are found in the cereal group, the regular and blend diets showing similar amounts and frequencies with respect to cereals. The Mn contents in hospital meals were analyzed by Velasco-Ryenold et al.[26] in Motril (Spain), the researchers reporting a total daily value of 3.05 mg/day, and in the present study a value of 3.03 mg/day was found in the regular diet in September.

The Se content provided by the diets varied from 0.03 to 0.10 mg/day. The content was above 0.055 mcg/day in January, this being the only period when the Se contents of the diets complied with the RDA (Table 1). The presence of a greater Se content in the menus in January could be associated with the greater content of high-protein foods such as ham, cheese and cream.[21,25]

Independent of the position of the American Dietetic Association (ADA) not to consider OFCs as food or full meals,[27] but to be an enrichment of either substrate, the provision of two daily OFCs has been reported to increase compliance.[28] The total amounts of ETE presented to the patients who received a combination of the OFC and an oral diet (Table 1) showed the RDA was achieved for the following: Zn (blend diet in September); Cu (regular diet in May); Mn (soft diet in May); Se (regular and soft diets in September). A recent study show that the patient oral diet consumption was lower when the regular (74.2 *vs* 79.7%) and soft (68.9 *vs* 74.2%) diets were combined with OFC.[29]

In general, the studied diets presented considerable variation in the ETE contents in the different sampling months (Table 1), but it was not possible to establish a pattern. The differences in the menus of the institution could in part be responsible for the fluctuations detected. Considering each mineral, each month and the compliance with the RDA, the month of January was adequate in 53% of the cases, compared to May and September with 47 and 33% respectively. This could be explained by the fact that the dinner menu in January for the regular and blend diets contained cereals, vegetables, meats and legumes. In the other months the dinner menu showed reduced amounts of vegetables and meat, and no legumes.

Lunch and dinner were the main meals providing the majority of the ETE, both including all the food groups (Appendices 1–3). The mid-morning and bedtime snacks were the meals that contributed least to providing minerals. These meals should include foods that are sources of the deficient ETE, to ensure the diets comply with the RDA. While the present study only considers ETE compositions provided by oral hospital diets in Brazil, the three oral diets analyzed make up part of the routine diets of hospitals and are consumed by the majority of hospitalized patients.

The limitations of this study include the reduced number of sampling days, the discrepancies in the compositions of the institutional menus, and the absence of specific nutritional recommendations for hospitalized patients. It should be emphasized that the dosage of minerals provided by the diets and OFCs represents the total daily offer of ETE but not their consumption, another limitation pointed out in other studies.[22,30] Thus if the patient does not consume all the foods making up the diet, the nutritional deficit could be correspondingly higher.

5. Conclusions

The Fe, Zn, Cu, Mn and Se contents provided by the three oral hospital diets (regular, blend and soft) were insufficient to comply with the recommended dietary allowances (RDA/AI) for both men and women, adults and elderly adults. Lunch and dinner were the meals that provided the greatest trace element contents, while the mid-morning and bedtime snacks contained minimal trace elements. The OFC was insufficient to compensate the trace elements deficit and to achieve values consistent with the nutritional recommendations. Substantial alterations to the menus should be considered, including the OFC, to ensure that the nutrient value of the meals complies with recommended values.

Statement of authors contributions

All authors participated in data collection and analysis; DCFM, KDQ, MAM participated in data interpretation and manuscript writing. All authors read and approved the final manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix 1. Menus of the regular diet.

Meal	Menu	January/2011		May/2010		September/2010	
		Tuesday	Thursday	Tuesday	Thursday	Tuesday	Thursday
Breakfast	French bread[M]	Yes	Yes	Yes	Yes	Yes	Yes
	Milk + coffee	Yes	Yes	Yes	Yes	Yes	Yes
	Fruit	Banana	Papaya	Mango	Papaya	Banana	Papaya
Mid-m. snack	Industrialized juice	Fruit nectar	Fruit nectar	Artificial fruit-flavored drink	Artificial fruit-flavored drink	Fruit nectar	Fruit nectar
Lunch	Rice & beans	Yes	Yes	Yes	Yes	Yes	Yes
	Main dish (meat)	Bovine*	Bovine*	Breaded chicken	Tripe & White beans	Chicken with cheese	Pork*
	Accompaniment	Squash & ham#	Breaded banana	Cooked cabbage + bacon	Cassava flour with egg	Cassava flour with egg, corn & olive	Grilled pineapple
	Salad	Cooked carrot + sultanas	Eggplant in French dressing	Cooked beetroot	Banana+	Cooked carrot and beetroot	Broccolis with egg
	Dessert	Watermelon	Pineapple	Pineapple	Mango	Watermelon	Avocado
Mid-afternoon snack	French bread[M]	Mini roll	Mini roll	Yes	Mini roll	Yes	Mini roll
	Milk	+banana + flaked cereal[B]	With coffee	With coffee	With coffee	With banana &papaya[B]	With coffee
	Other	Coffee	Mini cake chocolate	Milk[B] banana & papaya	Sweet biscuit	Coffee	Mini cake chocolate
Dinner	Rice & beans	Yes	Yes	No	Yes	Yes	Yes
	Main dish (meat)	Cooked chicken leg	Fish in shrimp sauce	Risotto with beef, carrot and runner beans	Pasta with meat & tomato sauce	Risotto with chicken, carrot and runner beans	Pasta with meat & tomato sauce
	Accompaniment	Potato + ham + mozzarella#	Squash#				
	Salad	Tomato + ham + mango + oregano	Potato & nuts	No	No	No	No
	Dessert	Papaya mousse	Watermelon	No	No	No	No
Bedtime snack	Thickened milk	No	No	No	Corn starch	No	No
	Dairy beverage	Chocolate	Fruits	No	No	Chocolate	No
	Yogurt	No	No	Yes	No	No	Yes

[B]Blended;[M]With margarine; #With white sauce; *With red sauce; Mid-m. snack = mid-morning snack.

Appendix 2. Menus of the blend diet.

Meal	Menu	January/2011		May/2010		September/2010	
		Tuesday	Thursday	Tuesday	Thursday	Tuesday	Thursday
Breakfast	Sweet bread roll[M]	Yes	Yes	Yes	Yes	Yes	Yes
	Milk with coffee	Yes	Yes	Yes	Yes	Yes	Yes
	Fruit	Banana	Papaya	Mango	Pineapple	Banana	Papaya
Mid-m. snack	Industrialized juice	Fruit nectar	Fruit nectar	Artificial fruit-flavored drink	Artificial fruit-flavored drink	Fruit nectar	Fruit nectar
Lunch	Rice and beans	Yes	Yes	Yes	Yes	Yes	Yes
	Main dish (meat)	Chicken meat balls*	Pork*	Bovine	Meat balls	Bovine**	Bovine**
	Accompaniment	Cassava flour with egg and runner beans	Pumpkin with bacon	Pasta with meat & tomato sauce	Pumpkin	No	Cooked potato with rosemary
	Salad	Cooked carrot + sultanas	Eggplant in French dressing	No	Banana+	Cooked carrot and beetroot	Broccoliwith egg
	Dessert	Melon	Mango	Pineapple	Mango	Melon	Avocado
Mid-afternoon snack	Sweet bread roll[M]	Yes	Mini bread roll	Yes	Mini bread roll	Yes	Mini bread roll
	Milk	+banana + flaked cereal[B]	With coffee	With coffee	With coffee	With banana &papaya[B]	With coffee
	Other	Coffee	Mini chocolate cake	Milk[B] banana &papaya	Sweet biscuit	Coffee	Mini chocolate cake
Dinner	Rice and beans	Yes	Yes	Yes	Yes	Yes	Yes
	Main dish (meat)	Cooked chicken leg.	Fish*	Ham & cheese omelette	Bovine	Bovinewith corn & carrot	Bovine
	Accompaniment	Potato + ham &mozarella#	Squash#		No	Arracacha	Carrot & bacon
	Salad	Tomato + ham + mango + oregano	Potato & nuts	Cooked chayote.	Cooked carrot & kale.	No	No
	Dessert	Papaya mousse	Watermelon	No	No	No	No

(*continued*)

Meal	Menu	January/2011		May/2010		September/2010	
		Tuesday	Thursday	Tuesday	Thursday	Tuesday	Thursday
Ceia	Thickened milk	No	No	No	Corn starch	No	No
	Dairy beverage	Chocolate	Fruits	No	No	Chocolate	No
	Yogurt	No	No	Yes	No	No	Yes

[B]Blended; MWith margarine; #With white sauce; *With red sauce; **With vegetables (corn, tomato, green peppers, olives); Col. = mid-morning snack.

Appendix 3. Menus of the soft diet.

Meal	Menu	January/2011		May/2010		September/2010	
		Tuesday	Thursday	Tuesday	Thursday	Tuesday	Thursday
Breakfast	Infant milk + cereal drink	Rice flavored	Corn flavored	Corn flavored	Corn flavored	Corn flavored	Corn flavored
	Fruit	Banana	Papaya	Papaya	Papaya	No	No
mid-m. snack	Industrialized juice	Fruit nectar	Fruit nectar	Artificial fruit-flavored drink	Artificial fruit-flavored drink	Fruit nectar	Fruit nectar
Lunch	Rice purée	Yes	Yes	Yes	Yes	Yes	Yes
	Beans blended with meat	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine
	Purée 1	Eggplant	Chayote	Pumpkin	Arracacha& pumpkin	Yam	Pumpkin
	Purée 2	Pumpkin	Potato & beetroot	Potato	Yam & potato	Potato	Beetroot
	Dessert	Mamão	Banana	Mamão	Banana	Mamão	Abacate
Afternoon snack	Infant milk + cereal drink	Corn flavored	Rice flavored	Rice flavored	Rice flavored	Rice flavored	Rice flavored
	Other	No	No	Milk[B] banana & papaya	No	No	No
Dinner	Rice purée	Yes	Yes	Yes	Yes	Yes	Yes
	Beans blended with meat	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine	Yes/Bovine
	Purée 1	Potato	Squash	Eggplant	Eggplant	Milk thickened with cornflour	Carrot
	Purée 2	Carrot	Pumpkin	Carrot	Pumpkin	Carrot	Pumpkin
	Dessert	Papaya mousse	Strawberrymousse	No	No	No	No
Bedtime snack	Thickened milk	No	No	No	Cornflour	No	No
	Dairy beverage	Chocolate	Fruits	No	No	Chocolate	No
	Yogurt	No	No	Yes	No	No	Yes

[B]Blended; Col. = mid-morning snack.

Appendix 4. Foods making up the oral food complements (OFC).

Period	Menu	January/2011		May/2010		September/2010	
		Tuesday	Thursday	Tuesday	Thursday	Tuesday	Thursday
Morning	Milk[B]	Yes	Yes	Yes	Yes	Yes	Yes
	Fruits	Banana	Avocado	No	No	Papaya	Banana & papaya
	Others	Protein modules	Powdered milk	Flaked cereals & powdered milk	Flaked cereals & powdered milk	Protein modules, carbohydrates & fiber	Powdered milk
Afternoon	Milk[B]	Yes	Yes	Yes	Yes	Yes	Yes
	Fruits	Banana & papaya	Banana	Banana & papaya	Banana & papaya	Banana	No
	Others	No	Protein modules	Flaked cereals	Oats	Protein modules, carbohydrates & fiber & oats	Powdered skimmed milk Flaked cereals

[B]Milk blended with the other ingredients.

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