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Full Length Research Paper

The influence of a nutritional supplement for undernourished elderly people

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The objective of this pilot study was to evaluate the effect of a food supplement on the nutritional status of malnourished or at risk of malnutrition elderly (84 ± 8.16 years), body mass index (BMI < 22 kg/m^2). The Mini Nutritional Assessment (MNA) was applied for subjects' selection. Dietetic, anthropometric and biochemical parameters were estimated for 90 days. Weight, height, triceps skinfold thickness, arm circumference, calf circumference, thigh circumference, corrected arm muscle area, waist circumference, hip circumference, BMI were measured. Body composition and fat-free mass were evaluated by the bioelectric impedance. Folic acid, calcium and magnesium were improved. Anthropometric measurements were not influenced. Weight (average 1.88 kg), serum total proteins and albumin, total cholesterol, folic acid and magnesium increased. Overall, the data suggest that the intervention had a positive effect on the nutritional status of the elderly.

Keywords: Aging, dietary supplementation, nutrition, weight loss, whey protein.

INTRODUCTION

Aging is a natural biological process rather than a pathologic one, characterized by a series of morpho-physiological, biochemical and psychological changes that take place throughout the lives of human beings (Wilmoth, 1998; Jeckel-Neto, 2000). The malnutrition in aged people is common, since with advanced age the daily food intake tends to reduce. The signs and symptoms of the aging process are easily mistaken for malnutrition; therefore, interventions are many times inadequate and less efficient than they could be (Guigoz et al., 1996; Wahlqvist et al., 1995). Suggested data on prevalence of malnutrition in communities is 1% to 15%; in hospitalized elderly the prevalence is 35% to 65% and, for those who live in a home for elderly, the prevalence is 25% to 60% (Omran, 2000). The oral supplementation is an efficient and viable strategy, being used to provide an appropriate nutritional intervention, mainly when the elderly group presents malnutrition problems (Miguel Mari and Peréz del Rio, 1981). The purpose of the present pilot study was designed to assess the effects of a dietetic product on anthropometric, biochemical and dietetic parameters in elderly population.

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ABBREVIATIONS

MNA, mini nutritional assessment; BMI, body mass index; WPI, whey protein isolate; BCH, bovine collagen hydrolysate; UL, upper level of intake; DRI, dietary reference intake; WC, waist circumference; HC, hip circumference; AC, arm circumference; TC, thigh circumference; TSF, triceps skinfold thickness; W, weight; CC, calf circumference; CAMA, corrected arm muscle area; FFM, fat-free mass; LDL-c, low-density lipoprotein cholesterol; HDL-c, high-density lipoprotein cholesterol; SEM, standard error of the mean; RDA, recommended dietary allowances; AI, adequate intakes

MATERIALS AND METHODS

Subjects and dietetic product

The selection criterion was elderly people of both sexes

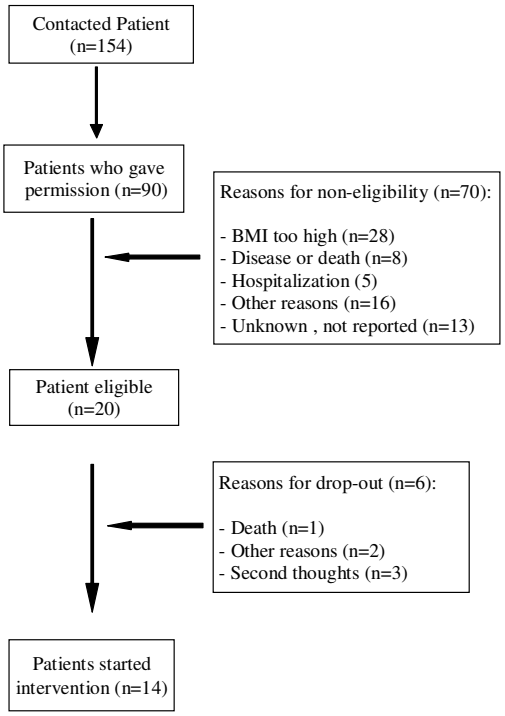

Figure 1: Flow chart of participants of an intervention

whose body mass index (BMI) was less than 22 kg/m^2 and who had mental status preserved. Subjects were selected by the MNA modified by Rubenstein et al. (2001) which identified elderly population with or at risk of malnutrition. MNA is a practical procedure, which takes into consideration nutritional status, health condition, frailty and possible illnesses of the elderly. In the MNA scale, 17 points indicates malnutrition; between 17.5 to 23.5 risk of malnutrition, above 24 eutrophic. In the present study, MNA was initialyy applied to 90 elderly individuals belonging to the age groups (84 ± 8.16 years). Subjects with diagnosed cancer, associated with renal illness, liver diseases, malabsorption, congestive heart failure, type 1 and 2 diabetes were not selected. After a written informed consent was obtained, diet supplement was offered to the participants. The study protocol was evaluated and approved by the Ethical Committee of the School of Medical Sciences, University of Campinas, SP, Brazil. The study, which lasted 3 months, was a prospective clinical trial with 14 elderly individuals between 68 and 95 years of age, who received the dietetic product orally as shown in Figure 1.

Supplement was provided in two flavors, milk and chocolate, in 60-g sachets suspended in 200 mL of skim milk. During 3 months, the drink was offered twice a day (morning and night) in addition to the normal food intake. The product was composed of whey protein isolate (WPI), bovine collagen hydrolysate (BCH), carbohydrates, inuline, fructooligosaccharides, vitamins and minerals, in amounts suggested to this age group by the DRI (*Dietary Reference Intakes*), considering the upper intake levels (UL) of each nutrient (Ziegler et al.,2008). Data were collected at baseline and after 3 months of intervention (Time 0 and Time 1).

Dietary Intake

A 3-day food intake (2 week days and 1 weekend day) estimated dietary record was collected according to the method described by Thompson and Byers (1994). Subjects filled out a diary which was checked by a nutritionist. Ingested carbohydrates, proteins, lipids, vitamin B_{12}, folic acid, calcium, magnesium, zinc and energy were calculated by software *Diet Pro 4.0* for *Windows* for data analysis. Estimated dietary intake was compared to standards established by DRI (*Dietary Reference Intakes*) (IOM, 1997; IOM, 1998; IOM, 2000; IOM, 2001; IOM, 2002).

Anthropometry

Anthropometric measurements were done with subjects barefoot, wearing light clothes and after they had defecated. Body weight was calculated to the nearest 0.1 kg in a calibrated sliding weighing scale (Welmy Inc., São Paulo, Brazil). Height was calculated in a stadiometer using Frisancho's technique (Frisancho, 1984). Knee height (measured in duplicate),

Table 1: Nutritional composition of the product (g/dose of 200 mL and % DRI[1])

Nutrient quantify	g/dose (200 mL)	% DRI/dose
Protein (WPI + BCH) (g)	7.5	14
Carbohydrates (g)	40.7	~ 30
Inuline (g)	4	-
Fructooligosaccharides (g)	2	-
Vitamin B_1 (mg)	0.2	17
Vitamin B_6 (mg)	0.7	43
Vitamin B_{12} (µg)	1.2	50
Vitamin C (mg)	60	73
Vitamin A (µg)	450.0	53
Vitamin E (mg)	15.0	100
Folic Acid (µg)	133.3	33
Calcium (mg)	400.0	33
Magnesium (mg)	140.0	38
Zinc (mg)	5.5	58
Selenium (µg)	18.3	33

1 Source: DRI (1997); DRI (1998); DRI (2000); DRI (2002).

circumferences of waist (WC), hip (HC), arm (AC), thigh (TC) were measured with an inelastic measuring tape. Hip circumference was measured to the nearest 0.1 cm as the maximum circumference over the buttocks usually at the level of the greater trochanters but not lower than the pubic symphysis. For the measurement of waist and hip circumferences, the subject wore light clothes and stood with their feet about 12 to 15 cm apart with the weight equally distributed between them. Waist circumference was measured at the level of the umbilicus to the nearest 0.1 cm at the end of normal expiration. Arm circumference was measured on the left side with the subject standing and the arm hanging relaxed just away from the trunk. The circumference was measured at the same level as the triceps skinfold to the nearest 0.1 cm without indenting the skin. Triceps skinfold thickness (TSF) measured with a LANGE caliper at constant pressure (10g/ mm^2). BMI measured as weight (kg) divided by squared estimated height (m). The cut-off points proposed by the Nutrition Screening Initiative (NSI, 1992) were used to diagnose the nutritional status. Mean values of triplicate measurements were used for analysis. HC and WC were measured as proposed by Callaway et al. (1991). For body composition bioletric impedance (BIA 450, Biodynamics Corporation, Seattle, Washington, USA) was used Fat-free mass (FFM) was calculated by the equations of Baumgartner et al. (1991):

Men: FFM (kg) = 0.28 (H^2/R) + 0.27 (W) + 0.31 (TC) + 2.768

Women: FFM (kg) = 0.28 (H^2/R) + 0.27 (W) + 0.31 (TC) – 1.732

Biochemistry

Levels of fasting glycemia and renal function (urea and creatinine) were used first as criterion of exclusion. Serum proteins (total and albumin), lipid profile (total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides), vitamin B12, folic acid, calcium, magnesium and zinc were determined at T0 (starting point) and T1 (90 days). Blood samples were collected from fasting subjects and samples were immediately put in ice before further processing. Blood was collected in 8-mL tubes and then separated by centrifugation and the plasma (or serum) was used for biochemical analysis.

Statistical analysis

The data were analyzed with the aid of the software BioEstat 3 (Ayres et al., 2003). Descriptive statistics of the variables are presented as means ± the standard error of the mean (SEM). To explain variability as a function of time repeated measures analysis of variance was used (Milliken, 2004; Montgomery, 2004). Tukey´s honestly significant difference test for post hoc comparisons of means ($P < 0.05$) was considered significant in all analysis.

RESULTS

By applying MNA, the subjects of the study were classified under three nutritional statuses: eutrophic, risk of malnutrition, and malnutrition. Average distribution among statuses were: malnourished 19.2%, under risk of malnutrition 44.5%, and eutrofic 36.3%.

At the beginning of the intervention, food intake was adequate for macronutrients (carbohydrates, proteins, lipids). Regarding micronutrients (vitamins and minerals),

Table 2: Dietetic parameters for men (04 participants), between Time 0 (T0) and Time 1 (T1) of the supplementation (means ± SEM). Age (y) 81.5 ± 7.23

Energy/Nutrients	T0	T1	*P*-value	DRI**
Energy (kcal/day) [1]	1592.4 ± 555.3	1792.89 ± 281.6	0.5478	2054 Kcal
Carbohydrate(g/day)[1]	228.7 ± 65.7	213.39 ± 46.7	- 0.7167	130 g
Protein (g/ day) [1]	65.2 ± 27.3	75.74 ± 6.9	0.5116	56 g
Fat (g/ day)	47.9 ± 25.9	39.47 ± 9.9	- 0.5709	_
Vitamin B12 (µg/ day) [1]	2.51 ± 1.9	2.48 ± 1.1	- 0.9809	2.4 µg
Folic Acid (µg/ day) [1]	5.1 ± 7.4	269.40 ± 0	0.000012*	400 µg
Calcium (mg/ day) [2]	490.2 ± 100.3	1348.66 ± 292	0.002*	1200 mg
Magnesium (mg/ day) [1]	6.7 ± 2.1	282.3 ± 1.9	0.00005*	420 mg
Zinc (mg/ day) [1]	7.5 ± 5.6	2.9 ± 1.9	- 0.1774	11 mg

* Statistical significance ($P < 0.05$).
** DRI: *Dietary Reference Intakes (> 51y);* [1]RDA: Recommended Dietary Allowances; [2]AI: Adequate Intakes.

Table 3: Dietetic parameters for women (10 participants), between Time 0 (T0) and Time 1 (T1) of the supplementation (means ± SEM). Age (y) 85.0 ± 8.65

Energy/Nutrients	T0	T1	*P*-value	DRI**
Energy (kcal/day) [1]	2074.9 ± 437	1828.9 ± 304.5	0.1584	1873 Kcal
Carbohydrate(g/day)[1]	320.8 ± 77.4	204.1 ± 37.8	- 0.0007*	130 g
Protein (g/day) [1]	75.3 ± 19.4	78.8 ± 11.3	0.6303	46 g
Fat (g/day)	56.5 ± 12.9	39.1 ± 12.8	- 0.0074	_
Vitamin B12 (µg□day) [1]	2.8 ± 1.4	2.7 ± 0.2	- 0.6926	2,4 µg
Folic Acid (µg□day) [1]	1.4 ± 1.1	282.9 ± 21.7	0.000012*	400 µg
Calcium (mg/day) [2]	735.1 ± 259.7	1379.8 ± 167.5	0.00003*	1200 mg
Magnesium (mg/day) [1]	4.5 ± 4.4	305.2 ± 26.7	0.000001*	320 mg
Zinc (mg/day) [1]	9.0 ± 4.1	2.4 ± 0.8	- 0.0002*	8 mg

* Statistical significance ($P < 0.05$).
** DRI: *Dietary Reference Intakes (> 51 y);* [1] RDA: Recommended Dietary Allowances; [2] AI: Adequate Intakes.

except for vitamin B12, a poor ingestion was found. An energy deficit was detected in men but in women the energy intake was adequate. At the end of the clinical trial (90 days), food intake was adequate for macronutrients according to the DRI *(Dietary Reference Intakes)*, but relatively low intake was observed for folic acid, zinc and magnesium, vitamin B12 and calcium. An energy deficit was detected in woman elderly subjects, but not in men. The dietetic supplement was well tolerated by all participants and no side effects were observed.

At the beginning of the study, it was confirmed that all the anthropometric parameters were in deficit, and some were an indication of malnutrition such as the BMI, the calf circumference (CC) and corrected arm muscle area (CAMA). After 90 days of the dietetic product supplementation there was some increase, although not significant, of some anthropometric indexes such as weight, BMI, CC, FFM, in both sexes, but there was a reduction of the CAMA in men and WC/HC in women.

The average weight gain in the elderly subjects was 1.88 kg. Despite not being statistically significant, the weight gain of this population group in such a short period seems important.

At time T0, the biochemical indexes of the elderly subjects were within normality, except for total proteins, which were below normality, characterizing malnutrition. After 90 days, a significant increase of the average values was observed in the total proteins and albumin, respectively, reaching normality. Some biochemical measurements, such as total cholesterol, total proteins, albumin, folic acid and magnesium, showed significant changes ($P < 0.05$). Correlations between the biochemical levels and the body mass index (BMI) and between the biochemical levels and the fat-free mass (FFM) were not found.

DISCUSSION

In this study the MNA was used as a tool for selecting from an elderly group subjects with malnutrition or at risk of malnutrition (Beck et al., 1999; Van Nes et al., 2001).

Table 4: Anthropometric indexes of the elderly group, means±SEM, at the beginning and end of study (n = 14, ♂4:♀10, age (y) 84.0 ± 8.16).

Characteristics	n Total (14)		n Total (14)	
	♂ T0	♀	♂ T1	♀
W (Kg)	52.42 ± 2.96	42.00 ± 8.23	55.45 ± 2.82	43.43 ± 8.00
BMI (Kg/m^2)	19.15 ± 1.21	18.97 ± 2.42	20.27 ± 2.29	19.92 ± 2.55
CC (cm)	29.87 ± 1.31	28.85 ± 3.48	30.25 ± 2.98	28.85 ± 3.77
CAMA (cm^2)	21.29 ± 8.06	19.24 ± 5.90	18.62 ± 8.24	19.88 ± 5.78
FFM (kg)	42.31 ± 2.57	30.54 ± 5.12	42.63 ± 2.60	30.89 ± 5.37
WC/HC	0.83 ± 0.01	0.84 ± 0.04	0.85 ± 0.02	0.76 ± 0.28

Weight (W), Body Mass Index (BMI), calf circumference (CC), corrected arm muscle area (CAMA), fat-free mass (FFM), waist circumference/hip circumference (WC/HC).

Table 5. Biochemical parameters in population elderly, means ± SEM, at the beginning and end of study (n = 14, ♂ 4:♀10, age (y) 84.0 ± 8.16).

Levels	T 0	T 1	*P*-value
Glycemia (mg/dL)	85.78 ± 6.31	87.07 ± 6.31	0.5900
Creatinine (mg/dL)	0.77 ± 0.27	0.89 ± 0.30	0.2927
Totals Proteins (g/dL)	5.11 ± 1.39	7.17 ± 0.44	0.0001*
Albumin (g/dL)	2.77 ± 0.74	4.01 ± 0.31	0.0001*
Cholesterol (mg/dL)	117.14 ± 36.51	165.28 ± 31.1	0.0012*
LDL-c (mg/dL)	68.98 ± 25.23	87.84 ± 30.42	0.1653
HDL-c (mg/dL)	46.86 ± 17.43	54.07 ± 14.57	0.5431
LDL-c/HDL-c	1.66 ± 0.82	1.74 ± 0.73	0.7961
Triglycerides (mg/dL)	97.5 ± 31.88	117.43 ± 42.23	0.1676
Vitamin B12 µg/mL	464.00 ± 227.07	558.00 ± 288.63	0.6509
Folic acid µg/mL	9.98 ± 4.49	15.09 ± 4.11	0.0044*
Calcium mg/dL	8.89 ± 0.61	8.95 ± 0.53	0.7896
Magnesium mg/dL	1.75 ± 0.24	1.98 ± 0.35	0.0049*
Zinc µg/mL	0.81 ± 0.12	0.89 ± 0.10	0.0874

* Statistical significance ($P < 0.05$)

Overall, 19.3% of the total elderly evaluated were malnourished, 44.5% under risk of malnutrition, and 36.2% eutrophic. Previous studies have shown risk of malnutrition at elderly homes between 0% and 6% (De Groot et al., 1998). A study reported, in hospitalized or sheltered elderly, malnutrition was registered between 30% and 60% (Vellas et al., 2001). A Finnish study (Soini et al., 2004) with 178 sheltered elderly revealed 3% malnourished, 48% at risk of malnutrition, and 49% eutrophic subjects.

It was observed (Delmi et al., 1990) that the administration of a supplement affected food intake, and, thus, it was suggested that supplementation should be taken between meals.

In the present study the product was well tolerated by all the participants and was offered at breakfast and at night before bed. The average of the elderly body weight gain of 1.88 Kg in the short period of 3 months was in accordance with average values from 1.4 to 1.6 Kg, in experiments ranging from 2 to 6 months (Wouters-Wesseling et al., 2003; Lauque et al., 2000; Payette et al., 2000).

No significant changes were measured in any of the anthropometric parameters evaluated. These results are in agreement with studies of other authors (Soini et al., 2004; Manders et al., 2006; Wielen et al., 1995), who also did not find significant influence of elderly diet supplementation for a short period on anthropometric parameters.

Results of research about change in biochemical parameters of elderly after dietary supplementation are contradictory. Some studies have shown broad nutrient changes in the blood, mainly for the values of pre-albumin and albumin.

In this research significant changes were measured in blood mineral, vitamins, total blood proteins and albumin, in agreement with the following investigators (Vellas et al., 2001; Lipschitz et al., 1985).

CONCLUSION

The elderly diet supplementation did not influence the anthropometric parameters, except for promoting an average body weight gain of 1.88 Kg, which was important considering the frail condition of the subjects

and the short supplementation period. Deficits of total blood proteins and albumin as well as in vitamins and some essential minerals were compensated, representing an overall improvement of the nutritional status of the elderly, under study.

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