

TEN-YEAR TRENDS IN DIETARY INTAKE, HEALTH STATUS AND MORTALITY RATES IN FREE-LIVING ELDERLY PEOPLE

E.D. TOFFANELLO, E.M. INELMEN, N. MINICUCI¹, F. CAMPIGOTTO¹, G. SERGI, A. COIN,
F. MIOTTO, G. ENZI, E. MANZATO

Department of Medical and Surgical Sciences, Division of Geriatrics; University of Padua, Italy. 1. National Research Council, Institute of Neuroscience, Padua Section; Italy. Address for correspondence: Giuseppe Sergi MD. Clinica Geriatrica - Ospedale Giustiniano (2° piano), via Giustiniani 2, 35128, Padova, Italy. Telephone number: 0039 049-8218492, Fax number: 0039 (0)49-8211218 e-mail: giuseppe.sergi@unipd.it

Abstract: *Objective:* To explore the trends of food preferences and nutrient intake over a 10-year follow-up in a group of successfully aging elderly. *Design:* Longitudinal study. *Setting:* City of Padua, Italy. *Participants:* Randomly stratified sample of 97 men and 94 women born between 1913 and 1918. *Measurements:* The study involved a dietary assessment conducted in 1988/89 and repeated in 1999. Data were collected by means of a modified validated dietary history. *Results:* Nutrient and energy intake remained fairly stable over a decade, despite changes in eating habits, with a higher intake of sweets and a lower consumption of soft drinks in both genders. All individuals significantly increased their daily intake of water. *Conclusion:* Despite changes in eating habits, no significant decline in total energy and macronutrient intake was recorded in a decade in our elderly. The increased daily consumption of water and decreased use of soft drinks would suggest that these people were still receptive to nutritional advice even in very old age, while the increase in their sweet-eating might be because aging itself increases a person's sweet tooth, and this could be regarded as an age-related effect on dietary habits.

Key words: Nutrition, dietary intake, health, elderly.

Introduction

It is broadly accepted that the rate of malnutrition increases with aging (1) as a consequence of a declining food intake (2), possibly due to physiological, environmental, and behavioral changes (3), as well as the physiological changes in body composition that occur with aging, inducing anthropometric variations (4). These changes reduce an individual's calorie requirement, prompting a decline in their food and energy intake, which results in a diminished nutrient intake too (2). Poor dietary habits are an even more important concern in old-old and very old age groups, since they encounter greater barriers to food intake, including rising rates of comorbidities and disabilities (5). According to some authors, malnutrition and a declining food and nutrient intake should be seen as inevitable consequences of the aging process (2).

People age differently, however, and the course of the aging process beyond 65 years old can be classified as successful, typical or accelerated (4, 6), and there is no agreement in the current literature as to whether a decline in food and nutrient intake unavoidably occurs in all elderly, even in those aging successfully (1).

Limited information is available on dietary changes among old-old and very old community-living adults (7), although some research has been conducted in the last two decades to explore the adequacy of nutrient intake in successfully-aging community-dwelling older adults. Only a few of these studies were prospective, however (8-11), and very few examined changes in old-old and very-old individuals (12, 7), and never over periods beyond 6 years. Changes in the intake of specific types of food were generally not investigated, moreover, so no conclusions could be drawn regarding changes in the quality of

these individuals' diet with age (7).

The question of whether the aging process is in itself responsible for a significant decline in energy intake and a tendency to acquire eating habits at risk of malnutrition is consequently still being debated. We started with the assumption that any changes in the quality of the food eaten by healthy old-old people would not induce any significant decline in their nutrient and energy intake, designing the present study to explore the trends of food preferences and nutrient intake over a decade in successfully aging old-old individuals.

Collecting essential data on the dietary patterns of old-old adults could shed light on any changes in their food intake and eating habits that might affect their energy and nutrient intake, exposing them to the risk of malnutrition. Moreover, information on any such dietary changes would contribute to the development of specific nutritional recommendations for this particular age group.

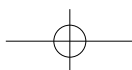
Methods

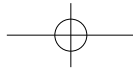
Subjects and Design

The study concerned the Italian participants in the SENECA multicenter project (for full details of the sampling procedure, design and methods, see the SENECA operations manual (3), for which 191 individuals were enrolled as full participants in Padua in 1988/89. Ten years later, in 1999, those who were still willing and able were invited to a reassessment, repeating all the baseline measurements, including their food and nutrient intake.

Dietary assessment

A modified method for recording the individuals' dietary history was used by a trained dietician to estimate their food





TEN-YEAR TRENDS IN DIETARY INTAKE IN THE ELDERLY

intake. This consisted of two parts, a 3-day food diary and a meal-based food list, to ascertain their typical consumption during the previous month. The usual food intake was converted into nutrients using a national food composition table (14). The EUROCODE system was used to arrange the foods into groups and subgroups based on their origin, composition and function in the diet (15). The validation of the method is described elsewhere (16, 17).

Background variables

Using structured interviews, information was obtained on marital and living status, previous occupation and years of schooling (see the SENECA operations manual for details (13)). The participants' standing height and weight were measured and their body mass index (BMI kg/m²) was calculated. Their state of health was assessed by questioning participants about the following chronic diseases: diabetes, hypertension, coronary heart disease, stroke, malignancies, arthritis/arthrosis, inflammatory bowel disease, chronic obstructive pulmonary disease (COPD), chronic liver diseases, and osteoporosis. Self-perceived health status was assessed by asking participants how they judged their present general health ("judgment of own health", classified as poor, fair, good or very good) and how they compared their level of physical activity with that of other people of the same age ("relative physically active compared to others", classified as worse, the same, or better). Functional impairment in activities of daily living (ADL) was measured according to Katz (18), except for continence not directly involved in upper and lower limb mobility impairment. For each of the 5 items (getting out, going to the toilet, bathing, dressing, and eating), the level of competence was measured on a 3-point scale: fully capable (level 1), capable with help (level 2), and completely incapable (level 3). According to Katz, individuals on level 1 for getting out and going to the toilet, but on level 1 or 2 for bathing, dressing and eating, scored 1 in each item. A total score of 5 indicated total independence in ADL.

Statistical analysis

The study population's socio-demographic characteristics, dietary and health details were reported as means, standard deviations (SD) and percentiles (P10, P90) for numerical values, and as percentages for categorical values. Differences between groups (responders, deceased and dropouts) were assessed using the chi-square test or Fisher's exact test for categorical data, and one-way ANOVA for quantitative variables. Changes in nutrient intake over time were presented as means, SD and percentiles of the relative variation since the baseline and expressed as percentages $[(1999 \text{ values} - 1988 \text{ values}) / 1988 \text{ values} * 100]$. The significance of changes was tested using McNamara's test for qualitative variables and Student's paired t-test for numerical data. All analyses were performed by gender. A p value of < 0.05 was considered statistically significant. Data were analyzed using the SAS statistical software package, rel. 8 (SAS Institute, Inc., Cary, NC).

Results

Participants

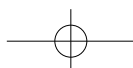
Of the 191 subjects (97M/94F) aged 70-75 y surveyed in the city of Padua, Italy, at the baseline, 78 (34M/44W) took part in the reassessment 10 years later, 55 (38M/17W) had died and 58 dropped out (25M/33W). The subjects' baseline characteristics were analyzed for gender distribution and the responders, deceased and dropouts were compared; the level of formal education was similar in the two genders (about 10 y of schooling in men, 8.1 in women); the men were mainly employed (66%) and the women were mainly housewives (49%); most of the men were married (69%), while the women were often divorced (52%) or widows (44.7%). The BMI averaged 26 in men and 25 in women. Almost all participants were independent in ADL at the baseline. The most prevalent diseases among the men were arthrosis (27%), hypertension (21%) and COPD (16%), while for women arthrosis was the most common health problem (49%). A decade later, the death and dropout rates were 28.8% and 30.4%, respectively. The percentage of deaths was higher among men (69.1% vs. 30.9% in women; $p < 0.01$). The subjects who dropped out or died were comparable with the responders in terms of their main baseline characteristics, except for the prevalence of COPD, which was higher among the deceased males ($p < 0.05$; details not shown).

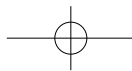
The reasons for dropping out were available for 36/58 cases: 15 elderly people were no longer able to answer the questions unassisted; 21 had moved away from Padua for health-related reasons.

As for the 55 who died, the mean age of death was 77.9 ± 3.5 y in men and 79.4 ± 3.4 y in women. The main causes of death were malignancies (18 men and 6 women) and coronary heart disease/heart failure (12 men and 6 women).

Changes in the characteristics of responders after a decade

No significant changes were recorded between 1988 and 1999 in BMI (25.8 kg/m² vs. 25.4 kg/m² in men and 24.7 kg/m² vs. 24.5 kg/m² in women) or independence in ADL (details not shown). More than 70% of participants reported having no chewing difficulties at either survey (details not shown). As for the chronic diseases considered at the baseline, there was a significant subsequent increase in the prevalence of osteoporosis among women ($p < 0.05$) and malignancies in men ($p < 0.05$). After a decade, the proportion of elderly people who rated their health as "poor" dropped from 2.9% to 0% in men and from 15.9% to 0% in women, with a significant increase in the percentage of women who considered their health as "good/very good" (which rose to 70% in 1999, $p < 0.05$). As for their physical activity, more than half of the responders considered themselves "more active" than people of the same age (the figure rose from 52.9% in 1988 to 76.4% in 1999 for men, and from 40.9% to 51.2% for women).





JNHA: NUTRITION

Trends in food intake

Tables 1a/1b show the mean intake (g/day) of various types of food in 1988 and in 1999, and the significance of any changes. The mean consumption of milk and dairy products in 1988 was lower than 200g/day in men and slightly higher than 200g/day in women. At the follow-up, the consumption of these products tended to be higher, but the difference was not significant in either gender. The mean combined intake of meat and poultry was less than 100 g/day in 1988, in both men and women. The slight decrease observed after 10 years was not significant. The mean daily intake of oils and fats was around 30 g/day in both genders, in both surveys. The mean consumption of cereals and cereal products in 1999 was still around 200 g/day in men and 150 g/day in women, showing no significant decline in 10 years. The baseline mean daily intake of vegetables (including pulses) was about 200 g in men and 180 g in women, corresponding to 3-4 servings of 50 g a day. Ten years later, the mean intake of vegetables had not declined significantly in either gender, remaining at a mean 3 servings a day at least. The mean fruit intake after 10 years was still above 300 g/day in both genders, equating to 2-3 pieces of fruit a day.

Table 1a

Food intake (g/caput/d) in 1988 and 1999 expressed as mean and SD and significant differences in trend from baseline values – Men

Men	1988	1999	Difference in trend p
	Mean ±SD	Mean ± SD	
Milk and dairy products	176.3±157.3	195.3±208.2	ns
Cheese	38.9±24.0	41.1±24.5	ns
Cream	0.0±0.0	0.4±1.3	ns
Eggs and egg products	6.8±7.5	7.6±5.9	ns
Meat	51.0±27.2	43.0±27.3	ns
Poultry	18.4±24.6	17.4±22.9	ns
Fish	22.5±17.3	16.9±17.2	ns
Oil and fats	33.7±12.5	29.3±13.4	ns
Cereals and products	249.6±81.8	198.7±76.3	ns
Vegetables	215.6±153.4	166.0±120.6	ns
Fruit	367.0±173.0	301.8±231.4	ns
Sugars	25.9±23.4	59.6±60.1	0.03
Seeds, nuts and pulses	17.6±20.0	27.4±22.0	ns
Wine	252.1±201.8	279.9±284.7	ns
Non-alcoholic beverages (except water)	295.0±250.4	172.4±225.6	0.002

By comparison with the baseline, both genders showed a tendency to consume more dairy products and less meat, poultry, vegetables, fruit and cereals, but the differences were after 10 years were not statistically significant. The people's eating habits had stayed pretty stable, apart from an increase in sweet eating and a decrease in the use of non-alcoholic beverages, recorded in both genders. The mean daily intake of sugars and products such as cakes, pies, pastries, biscuits, jam, marmalade, honey and chocolate rose significantly over the decade, from 20 to 60 g/day, in both genders.

Table 1b

Food intake (g/caput/d) in 1988 and 1999 expressed as mean and SD and significant differences in trend from baseline values – Women

Women	1988	1999	Difference in trend p
	Mean ± SD	Mean ± SD	
Milk and dairy products	229.7±149.3	267.7±255.3	ns
Cheese	34.8±18.4	38.9±24.0	ns
Cream	0.0±0.2	1.3±2.7	ns
Eggs and egg products	6.9±5.4	7.7±7.1	ns
Meat	48.9±39.8	38.4±42.8	ns
Poultry	33.6±28.8	23.2±22.0	ns
Fish	21.2±22.1	13.1±15.5	ns
Oil and fats	28.0±11.0	24.7±11.0	ns
Cereals and products	173.8±76.5	147.6±72.7	ns
Vegetables	183.2±136.1	143.5±67.1	ns
Fruit	379.5±191.2	306.5±216.2	ns
Sugars	21.8±19.0	64.4±45.3	0.002
Seeds, nuts and pulses	19.6±15.0	24.0±20.0	ns
Wine	126.1±128.3	103.1±94.3	ns
Non-alcoholic beverages (except water)	511±288.4	118.0±175.4	0.002

Trends in energy and macronutrient intake

At the reassessment, the estimated mean daily energy intake was 1997 Kcal in men and 1644 Kcal in women, with a marked scatter around the mean values, as indicated by the ranges between P10 and P90, and by the SD (Tables 2a/2b). The lowest energy intake (indicated by P10) was about 1200 Kcal in both genders. No significant decline in total energy intake was observed after 10 y.

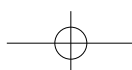
The absolute amounts (in g/day) of the main macronutrients remained stable at the follow-up. On average, the mean total protein intake met or exceeded the recommended dietary intake for Europe of 40 g/day in both men and women (19), and more than 60% of the protein came from animal sources.

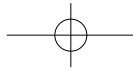
The mean percentage of energy from fat was around 28% and 32% in men and women, respectively, with no changes over time (details not shown). Monounsaturated fatty acids (MUFA) contributed largely to the total fat intake in both genders, as documented by the ratio of polyunsaturated and monounsaturated fatty acids (PUFA+MUFA) to saturated fatty acids (SFA), which was 1.6 in men and 1.5 in women. A significant decline in mean cholesterol intake was only seen in the women.

The proportion of energy deriving from carbohydrates in men and women averaged 51% and 53%, respectively, with no changes over time (details not shown). The contribution of mono-disaccharides to the total carbohydrate intake was a mean 46% in men and 54% in women.

The mean daily intake of fiber was 19 g and 17 g in men and women, respectively, which is lower than the European cut-off of 30 g/day.

Alcohol consumption was higher in men (32.3 g/day) than in women (11 g/day) and no significant longitudinal changes occurred.





TEN-YEAR TRENDS IN DIETARY INTAKE IN THE ELDERLY

Table 2a

Daily dietary intake of energy (Kcal) and macronutrients (g); follow-up values (mean, SD in 1999) and longitudinal changes after 10y, expressed as relative variations (%) with respect to baseline values (mean, SD, P10, P90 of the ratio: [1999– 1989/1988]*100) – Men

Men	1999			Change: 1999 – 1989		
	N°	Mean ± SD	P10-P90	N°	Mean ±SD (%)	P10 - P90 (%)
Energy intake, Kcal	34	1996.7 ± 539.8	1212-2768	34	-6.5 ±23.8	-30, 29
Total protein, g	34	60.1±15.7	42-76	34	-11.1±26.8	-37, 29
animal protein, g	34	37.0±13.5	24-46	34	-5.3±36.6	-49, 45
vegetal protein, g	34	25.0±7.7	17-38	34	-9.5±42.1	-51, 25
Total fat, g	34	62.8±22.2	33-87	34	- 4.8±38.1	-57, 48
SFA g	34	21.2±9.1	11-27	34	- 10.2±37.8	-49 , 46
PUFA g	34	6.3±2.9	4-10	34	-16.6±41.5	-64, 41
MUFA g	34	27.7±10.6	13-42	34	-1.4±47.5	-64, 64
Cholesterol, mg	34	174.3±76.0	86-248	34	-16.1±36.2	-62, 33
Total carbohydrates, g	34	253.4±74.3	170-353	34	-6.1±33.5	-38, 30
Mono/disaccharides, g	34	116.0±48.4	68-169	34	3.8±46.5	-47, 74
Polysaccharides, g	34	137.4±47.1	85-194	34	-7.8±51.7	-49, 30
Fiber, g	34	19.0±8.2	10-30	34	-4.4±42.5	-53, 67
Alcohol, g	34	32.3±30.6	0-69	27	75.4±304.6	-77 , 301
Water, ml	34	1977.2±641.3	1355; 2763	34	+88.7±70.3**	3, 188

SFA: saturated fatty acids; PUFA: polyunsaturated fatty acids; MUFA: monounsaturated fatty acids; ** p < 0.01 significant difference in trend of results between 1988 and 1999 (Student's paired t-test).

Table 2b

Daily dietary intake of energy (Kcal) and macronutrients (g); follow-up values (mean, SD in 1999) and longitudinal changes in 10y, expressed as relative variation (%) with respect to baseline values (mean, SD, P10, P90 of the ratio: [1999– 1989/1988]*100) - Women

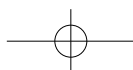
Women	1999			Change: 1999 – 1989		
	N°	Mean ± SD	P10-P90	N°	Mean ±SD (%)	P10 - P90 (%)
Energy intake, Kcal	44	1643.6±471.5	1182-2085	44	-3.5 ±28.2	-32,- 35
Total protein, g	44	55.3±17.0	35-73	44	-6.5±32.5	-41, 29
animal protein, g	44	36.2±12.9	21-50	44	-5.6±41.9	-46, 31
vegetal protein, g	44	19.9±6.7	14-28	44	-5.8±31.3	-41, 47
Total fat, g	44	58.1±19.4	34-79	44	- 1.3±46.4	-57, 70
SFA g	44	20.8±7.6	13-29	44	- 6.0±47.9	-56, 55
PUFA g	44	6.9±4.0	3-10	44	3.2±68.5	-64, 104
MUFA g	44	25.1±9.6	12-35	44	5.6±62.6	-57, 87
Cholesterol, mg	44	164.2±60.4	96-256	44	-19.3±33.9*	-58, 36
Total carbohydrates, g	44	217.4±74.7	150-291	44	1.1±28.8	-30, 45
Mono/disaccharides, g	44	118.5±49.6	78-151	44	12.2±39.0	-31, 60
Polysaccharides, g	44	98.9±42.2	54-140	44	-2.5±48.0	-48, 82
Fiber, g	44	17.1±6.5	10-26	44	2.0±50.3	-44, 72
Alcohol, g	44	11.0±10.0	0-27	30	105.6±424.7	-57, 308
Water, ml	44	1616.8±528.9	1031; 2387	44	+75.9±78.8***	-9, 196

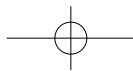
SFA: saturated fatty acids; PUFA: polyunsaturated fatty acids; MUFA: monounsaturated fatty acids. * p < 0.05; *** p < 0.001 significant difference in trend of results between 1988 and 1999 (Student's paired t-test).

In absolute terms, the mean water intake was 1977.2 ml (± 641.3 SD) in men and 1616.8 ml (± 528.9 SD) in women. All individuals had significantly increased their daily intake of water over the decade.

Discussion

An overall retrieval rate of 41% was reached in the present study, as in previous research (20). Achieving a 100% retrieval would be impossible due to mortality and individuals being lost to follow-up. Selectivity in favor of people in better physical and mental health can be assumed from the fact that the





JNHA: NUTRITION

prevalence of classic risk factors for malnutrition (e.g. chewing difficulties and impairment in ADL) were infrequent in our sample. In addition, the fact that our elderly had maintained a mean BMI around 24-26 and there were no cases of obesity (BMI > 30) or underweight conditions (BMI < 20) (21) would indicate a rather good nutritional status. Based on recent definitions of successful aging (6), we were clearly dealing with a healthier than normal group of very old subjects, as found in previous research (20).

Ten years on, our very old subjects were still eating adequate servings of cereals, vegetables and fruit, and small amounts of meat and saturated fats, a situation typical of the Mediterranean diet pyramid, accepted as a model of healthy eating at any age (22).

The elderly are generally thought to be rather stable in their likes and dislikes, so they are not expected to change their eating habits as they grow older. Our study showed, however, that changes in food consumption and diet quality still occur even in very old people. One of the most evident changes was a marked increase in sugar intake. Over a decade, our old-old responders had increased their consumption of confectionary from 20 to 60 g/day: similar data were reported in the DAFNE database (23) and in several countries participating in the EPIC-Elderly cohort study (24). The age-related increment in sugar intake is rather new in the literature; evidence of this trend emerged in other studies (25, 26), but methodological differences make it impossible to draw any conclusions. An increased sugar intake might be seen as an age-related effect on dietary habits and warrants further investigation to understand whether effects other than those strictly relating to age (i.e. an altered sense of taste) might be involved in this preference for softer, sweeter, more palatable foods (i.e. socio-economic or cultural features).

Another substantial change in dietary patterns over the decade was the more limited intake of non-alcoholic beverages (soft drinks, coffee, tea, herb teas, instant drinks, and so on), which confirms previous observations (11). Since non-alcoholic beverages contribute to daily fluid intake (27) a decline in their use might raise the risk of dehydration. On the other hand, a lower intake of some beverages (and particularly coffee, which was very common among our elderly subjects) might reflect a tendency towards healthier eating habits (11).

In contrast with the results of several longitudinal studies conducted on elderly people (28-30), no significant decline in total energy intake was apparent in our healthy but already elderly sample and more than half of our very old responders had an energy intake in compliance with the RDA. This picture was confirmed in the GISELA survey (11) and in Nicolas et al. (31): in both studies, the energy intake in the healthy and well performing elderly population remained stable throughout the follow-up. Unfortunately, the population in the GISELA study (11) was rather heterogeneous, including adults aged 60 and over, while Nicolas et al. (31) considered a follow-up of just 4 years.

Macronutrient intake also remained relatively stable in our

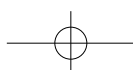
sample, who maintained an adequate protein intake (40 g/day) and a low fat intake after 10 y, consistent with dietary guidelines that recommend that fat should account for 30-35% of the total energy intake. The lower intake of cholesterol-rich foods in women confirms that changes towards healthier food preferences do occur even in older age (7). Overall, the daily intake of carbohydrates remained rather stable, but the mono-disaccharides accounted for only about half of the total carbohydrate intake, probably indicating a higher intake of added sugars, as confirmed by a significant increase in the consumption of confectionery.

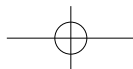
A moderate alcohol intake remained a constant feature at the follow-up and was common among the elderly in our sample: a remarkable number of our old-old and very old men exceeded the threshold of 20 g/day currently considered the mean alcohol intake that does not increase the risk of disease by comparison with non-drinkers. Although only 10% of men routinely drank more than 70g of alcohol (three times the cut-off), these findings highlight the alcohol abuse issue in elderly Italians, which deserves more attention (26).

An increase in total daily water intake is one of the main longitudinal changes observed in our study. This finding contrasts with the general assumption that fluid intake decreases with aging (32) due to a declining sensitivity to thirst (33), while it is consistent with observations reported in other recent studies (11, 34). Little is known about the average fluid intake and the motivation to drink in community-living well-performing elderly people. The increased total daily water intake observed in our very old subjects might reflect an increased consumption of water as a beverage, due to a greater health awareness prompted by recommendations, as reported elsewhere (24, 35). On the other hand, the increased total fluid intake (despite a reduction in soft-drink consumption) might be determined by a greater consumption of fluid foods such as stock or soups, which are very common in the diet of north-east Italy. Therefore, to guarantee an adequate hydration in the elderly, the average daily water intake should be more than two liters a day (36). By these standards, despite the increase in the water intake in our sample, our very old participants could still be at risk of dehydration and might benefit from nutritional counseling in order to improve their water intake.

The limited numbers in our sample make it unwise to extend our results to the Italian elderly population as a whole. Another drawback, for the specific issue of eating habits, concerns our use of the EUROCODE system, which does not distinguish between more and less healthy food choices within food groups (i.e. milk and dairy products) (37). Moreover, previous studies have shown that the dietary history recording method used in the SENECA study tends to overestimate water intake (g/day). On the other hand, any such bias would have affected the total daily intake in both surveys, so it does not influence the positive trend recorded in our sample's water intake.

In conclusion preferences still occur even in old-old and very old age groups, disproving the conviction that likes and dislikes are stable in elderly. Any such variations in food





TEN-YEAR TRENDS IN DIETARY INTAKE IN THE ELDERLY

preferences do not seem to affect the individual's total energy and macronutrient intake, however. The considerable increase seen in the use of confectionery seems to suggest that the aging process might per se increase people's tendency to prefer sweeter foods. The increased water intake and the reduced use of soft drinks might reflect a greater health awareness, confirming previous finding that even old-old subjects tend to be receptive to nutritional education and can benefit from information and education on dietary issues (1).

Acknowledgments: This work was not supported by any grant. The specific contribution of each author to the work was as follows: G Enzi and EM Inelmen designed the study, A Coin and F Miotto collected the data, N Minicuci and F Campigotto analyzed the data, ED Toffanello wrote the manuscript, E Manzato and G Sergi revised the manuscript. All authors have read and approved the final manuscript. The authors have no conflicts of interest to declare.

Financial disclosure: None of the authors had any financial interest or support for this paper.

References

- Keller HH. Promoting food intake in older adults living in the community: a review. *Appl Physiol Nutr Metab* 2007; 32: 991-1000.
- Drewnoski A, Evans WJ. Nutrition, physical activity, and quality of life in older adults: summary. *J Gerontol Ser A* 2001; 56A: 89-94.
- Payette H. Nutrition as a determinant of functional autonomy and quality of life in aging: a research program. *Can J Physiol Pharmacol* 2005; 83: 1061-70.
- Payette H, Shatenstein B. Determinants of healthy eating in community-dwelling elderly people. *Can J Public Health* 2005; 96: S27-S31.
- Callen B, Wells TJ. Views of community-dwelling, old-old people on barriers and aids to nutritional health. *J Nurs Schol* 2003; 35: 257-62.
- Inelmen EM, Sergi G, Toffanello ED et al. New approach to gerontology: building up "successful aging" conditions. *Aging Clin Exp Research* 2007; 2:160-4.
- Fernyhough LK, Horwath CC, Campbell AJ et al. Changes in dietary intake during a 6-year follow-up of an older population. *Eur J Clin Nutr* 1999; 53: 216-25.
- Wahlqvist ML, Davies L, Hsu-Hage BH-H et al. Food habits in later life: a cross-cultural study. Melbourne: Asia Pacific Journal of Clinical Nutrition and United Nations University (CD-ROM edition).
- Moreiras-Varela O, van Staveren WA, Amorim Cruz JA et al. Longitudinal changes in intake of energy and macronutrients of elderly Europeans. *Eur J Clin Nutr* 1996; 50 (Suppl.2): S47-S55.
- Amorim Cruz JA, Moreiras-Varela O, Brzozowska A. Longitudinal changes in the intake of vitamins and minerals of elderly Europeans. *Eur J Clin Nutr* 1996; 50: S77-S85.
- Jungjohann SM, Lüthmann PM, Bender R, Blettner M & Neuhäuser-Berthold M. Eight-year trends in food, energy and macronutrient intake in a sample of elderly German subjects. *Br J Nutr* 2005; 93: 361-68.
- Nydahl M, Andersson J, Sidenvall B et al. Food and nutrient intake in a group of self-managing elderly Swedish women. *JNHA* 2003; 7:67-73.
- de Groot LCPGM, van Staveren WA. Nutrition and the Elderly: Manual of Operations, Euronut Report 11, Wageningen, Netherlands, 1988.
- Carnovale E, Miuccio FC. Tabelle di composizione degli alimenti. Rome: Ministry of Agriculture and National Institute of Nutrition. 1989.
- Kohlmeier L, Pootvliet EJ. Eurocode 2 Food Coding System, version 92/1. Berlin: Institute for Social Medicine and Epidemiology, 1992.
- Nes M, van Staveren WA, Zajkas G, Inelmen EM, Moreiras O. Euronut SENECA study on nutrition and the elderly. Validity of the dietary history method in elderly subjects. *Eur J Clin Nutr* 1991; 45 (Suppl. 3): S97-S104.
- van Staveren WA, Burema J, Livingstone MBE, Kaaks R, van de Broek T. Evaluation of the dietary history method used in the SENECA study. *Eur J Clin Nutr* 1996; 50 (Suppl.2): S4-S8.
- Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. *Gerontologist* 1970; 10: 20-30.
- Trichopoulou A, Vassilakou T. Recommended dietary intakes in Europe. *Eur J Clin Nutr* 1990; 44 (Suppl 2): S51-S100.
- van't Hof MA, Burema J. Assessment of bias in the SENECA study. *Eur J Clin Nutr* 1996; 50 (Suppl 2): S4-S8.
- Sergi G, Perissinotto E, Pisent C et al. An adequate threshold for body mass index to detect underweight condition in elderly persons: the Italian Longitudinal Study on Aging (ILSA). *J Gerontol A Biol Sci Med Sci* 2005; 7: 866-71.
- Willett CW, Sacks F, Trichopoulou A et al. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr* 1995; 61 (6 Suppl): S1402-S1406.
- Naska A, Fouskakis D, Oikonomou E et al. Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. *Eur J Clin Nutr* 2006; 60: 181-90.
- Bamia C, Orfanos P, Ferrari P et al. Dietary patterns among older Europeans: the EPIC-Elderly study. *Brit J Nutr* 2005; 94: 100-13.
- Suzuki S, Kawado M, Hashimoto S et al. Change in food intake frequency at five years after baseline in the JACC study. *J Epidemiol* 2005; 15 (Suppl 1): S48-S55.
- Corrêa Leite ML, Nicolosi A, Cristina S et al. Dietary and nutritional patterns in an elderly rural population in Northern and Southern Italy: II. Nutritional profiles associated with food behaviours. *Eur J Clin Nutr* 2003; 57: 1522-29.
- Haveman-Nies A, de Groot LC, van Staveren WA. Fluid intake of elderly Europeans. *JNHA* 1997; 1: 151-55.
- Moreiras-Varela O, van Staveren WA, Amorim Cruz JA et al. Longitudinal changes in intake of energy and macronutrients of elderly Europeans. *Eur J Clin Nutr* 1996; 50 (Suppl.2): S47-55.
- Hallfrisch J, Muller D, Drinkwater T, Tobin J, Andres R. Continuing diet trends in men: the Baltimore Longitudinal Study on Aging. *J Gerontol* 1990; 45: M186-M191.
- Wakimoto P, Block G. Dietary intake, dietary patterns, and changes with age: an epidemiological perspective. *J Gerontol* 2001; 56A: 65-80.
- Nicolas AS, Faisant C, Lanzmann-Petithory D, Tome D, Vellas B. The nutritional intake of free-living healthy French population: a four year follow-up. *JNHA* 2000; 4: 77-80.
- Dunmeyer Stookey J, Pieper CF, Cohen HJ. Is the prevalence of dehydration among community-dwelling older adults really low? Informing current debate over the fluid recommendation for adults aged 70+ years. *Pub Health Nutr* 2005; 8:1275-85.
- Kenny WL, Chiu P. Influence of age on thirst and fluid intake. *Med Sci Sports Exerc* 2001; 33: 1524-32.
- Volkert D, Kreuel K, Stehle P. Fluid intake of community-dwelling elderly in Germany- a nationwide, representative study *JNHA* 2005; 9:305-9.
- Volkert D, Kreuel K, Stehle P. "Nutrition beyond 65"- amount of usual drinking fluid and motivation to drink are interrelated in community-living, independent elderly people *Z Gerontol Geriatr* 2004; 37: 436-43.
- Kleiner SM. Water, an essential but overlooked nutrient. *J Am Diet Assoc* 1999; 99: 200-6.
- van Staveren WA, de Groot LCPGM & Haveman-Nies A. The SENECA study: potentials and problems in relating diet to survival over 10 years. *Public Health Nutr* 2002; 5: 901-905.

