Predictors of Dietary Intake in a Functionally Dependent Elderly Population in the Community

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ABSTRACT

Objectives. The aim of this study was to describe dietary intake and identify predictors of energy and protein intake in a group of high-risk elderly people.

Methods. All elderly persons receiving publicly financed home care services in the area of Sherbrooke, Quebec, Canada, were eligible. Subjects (n = 145) 60 to 94 years of age from three home care programs were interviewed to measure sociodemographic, health, and food-related behavior variables. Three nonconsecutive 24-hour recalls were used to describe usual dietary intake. Independent predictors of energy and protein intake were derived from multiple regression analyses.

Results. Very low mean energy intakes were observed in this functionally dependent population. More than 50% of the study subjects did not meet the recommended levels of daily protein intake (0.8 g/kg body weight). Significant independent determinants of intake were burden of disease, stress, poor appetite, and vision.

Conclusions. Results suggest that community-living elderly people with loss of autonomy may have more nutritional problems than healthy elderly individuals. Surveillance of predictors of dietary intake may enable early detection and prevention of nutritional deficits. (*Am J Public Health.* 1995;85:677–683)

Introduction

It is now recognized that elderly people, particularly those suffering from chronic diseases or disabilities, are vulnerable to caloric and nutritional deficits. Nutritional deficiencies have been observed more frequently among institutionalized elderly people than in healthy free-living populations.[1–4] The improvement of the nutritional status of geriatric patients has been found to have an important, favorable impact on morbidity, functional capacities, and death rates.[5–10] The significance of good nutrition for the health and well-being of the elderly population is of great public interest because elderly individuals are disproportionately large consumers of health care resources.

Home care services are increasingly being used to help elderly people remain at home as long as possible and to reduce health care costs.[11,12] In Canada, more than 30% of those over 65 years of age are estimated to be affected by moderate or severe functional limitations or disabilities, and almost half of these afflicted people (48%) are receiving publicly financed home care services.[13] In the United States, the estimated proportions of functionally dependent elderly people residing in the community range from 1.6% to 16%, depending on the disability criteria on which the estimates are based.[14–16] Recent studies have associated the level of dependency in activities of daily living with dietary quality[17] and nutritional intake.[18]

The few nutritional surveys of free-living elderly subjects with functional disabilities or poor health that have been conducted suggest low dietary intakes[19–24] and below-normal indices of nutritional status.[25,26] Inadequate food intake leads to undernutrition that is difficult to reverse among elderly people.[27,28] Predictors of dietary intakes that have been studied in healthy elderly populations include living alone or social isolation,[18,29–31] limited financial resources,[18,29,30,32–34] declining physical and mental health,[18,31,34] and functional limitations.[17,18] However, because of their high prevalence in functionally dependent elderly people, these predictors discriminate less well between individuals in such populations.[21,24]

In the context of prevention in the current climate of financial restraint, understanding the factors associated with poor food intake is essential in order to intervene early and provide well-targeted community services to elderly people requiring such services. The cross-sectional study reported here described energy and protein intakes in such a group of elderly and identified sociodemographic, health-related, shopping, cooking, and eating behavior variables associated with low intakes.

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Methods

Subjects

Study subjects were recruited through publicly financed home care programs offered by three local community services centers in the area of Sherbrooke, Quebec, Canada, from among individuals receiving home help services (housework, personal hygiene, and/or food preparation). Client service lists were used to identify those for whom either the subjects themselves or available caregivers were able to provide a 24-hour dietary recall. No other exclusion criteria were used a priori. Two hundred six individuals were eligible for the study between June and November 1991; however, a small number of individuals (6.5%) were not asked to participate if, according to the home care team, their physical or mental health could be perturbed or worsened by an interview. Thirteen percent refused to participate, and another 11% could not be reached, were hospitalized, or were deceased. The final sample (n = 145) consisted of 42 men and 103 women. All participants provided informed written consent. The study was approved by the ethics committee of the Centre Hospitalier Universitaire de Sherbrooke.

Interviews

An experienced dietitian (V.B.) collected, at the participant's home, data on dietary habits and food beliefs, social network, and any recent occurrence of stressful life events. In addition, baseline information was collected on sociodemographic characteristics, medical history, current health status, medication use, and life-style habits, including tobacco and alcohol consumption. Self-reported weight and weight changes over the previous year were recorded. Height and weight were measured, and a 24-hour dietary recall was completed. During each of the 2 weeks following the home visit, each participant was contacted by telephone to obtain two further 24-hour food recalls. The cooperation of the subjects, even those who were very old, was good, and all measurements could be done without problem.

Determinants of Nutritional Intake

After an exhaustive literature review, a theoretical model of the determinants of nutritional intakes was developed on the basis of published data collected among community-living elderly populations.[17,18,21,24,29–35] The model, presented in the Appendix, grouped together the material, physical, psychological, and social characteristics related to the purchase, preparation, and consumption of food. It was used to construct the questionnaire intended to identify predictors of low dietary intake in the study population. The wording of most questions was derived from validated instruments previously used in large epidemiologic surveys.[36,37] The questionnaire was pretested on 20 free-living elderly patients visiting a day hospital.

Nutritional Evaluation

Height and weight were measured while subjects were wearing indoor clothing but were not wearing shoes. A level platform with an attached measuring tape and a portable scale (Health-O-Meter electronic digital strain gauge scale, Bridgeview, Ill) was used in these measurements.[38] Body mass index (weight in kilograms divided by height in meters squared) was calculated for each subject. A dietitian (V.B.) assessed usual dietary intake using three nonconsecutive 24-hour recalls (one face-to-face interview and two telephone recalls); two recalls represented weekdays, and one represented a weekend. A detailed description of all foods and beverages consumed during the previous 24-hour period was obtained, including cooking methods and brand names. Information was also obtained on nutrient supplement use. As a means of aiding in the estimation of portion sizes, the containers (e.g., bowls and glasses) usually used by participants were measured, and the size or capacity was recorded by the dietitian at the home visit. For the 24-hour recalls done by telephone, subjects described the quantity of foods consumed in relation to previously measured containers and by means of a 15.2-cm (6-in) ruler provided at the time of the home visit. Dietary data were coded by the interviewing dietitian, and nutrient analyses were conducted with Micronap (Northern Technical Data Inc, Winnipeg, Manitoba, Canada) and the Canadian nutrient file (1988 version). The intake for the 3 days was averaged. Dubois and Boivin[39] reported that telephone recalls provided a valid measure of actual observed intake in a similar elderly population. In addition, for elderly subjects, 3 days are sufficient to describe the usual intake of most nutrients except vitamin A, cholesterol, and fatty acids.[40]

Statistical Analysis

Chi-square statistics or Fisher's exact tests, where appropriate, were used to compare sociodemographic, medical, and food-related characteristics of study subjects by gender. Mean daily dietary intakes of energy and macronutrients and their distributions were compared with age- and gender-specific Canadian recommended nutrient intakes.[41] The intake of most nutrients was highly correlated with total energy intake; Pearson's correlation coefficients ranged from .35 to .95 ($P = .0001$), with the exception of folate ($r = .25$, $P = .003$). Energy and protein intakes were intercorrelated, and some important nutrients such as vitamins A, B_{12}, and C, while not significantly associated or only weakly associated with energy intake, were correlated with protein intake. For this reason, and because protein intake is often used as a measure of dietary quality, both protein intake and energy intake were used as dependent variables for the analyses of the determinants of dietary intake. Student's t tests, analyses of variance, and simple linear regression analyses, as appropriate, were used to investigate the relationships between each potential determinant and both intakes in male and female subjects separately. The Mann–Whitney test was used in instances in which data were not normally distributed. Multiple regression stepwise procedures were used to examine the effects of risk factors, identified in bivariate analyses, in two separate models with energy intake and protein intake as dependent variables. Collinearity diagnostics were done according to standard procedures, and residual analyses were used to assess the appropriateness of the regression assumptions and to detect outliers.[42] The statistical analyses were performed with SAS.[43]

Results

Table 1 summarizes the sociodemographic information for the study population. The overall average age was 78.8 years.

Even though most of the participants had children and/or friends and had frequent contact (more than once per week) with relatives, neighbors, or acquaintances, more than half (51%) reported feeling lonely most of the time; in fact, the more frequent their contact with others, the more lonely they felt (Fisher's exact test, $P = .0005$). There was little reported participation in clubs or civic activities, such as senior centers, and only

TABLE 1—Sociodemographic Characteristics of Functionally Dependent, Community-Residing Elderly Subjects, Sherbrooke, Quebec

	Men (n = 42), %	Women (n=103), %	P[a]
Age, y			NS
60–74	19	27	
75–84	69	53	
85+	12	19	
Marital status			<.0001
Married	67	18	
Divorced	7	10	
Widowed	26	61	
Single	0	12	
Education			.01
Elementary school	76	52	
High school	17	35	
Technical/college	2	12	
University	5	1	
Live alone	36	68	<.0001
Frequency of social contact			NS
More than once per week	83	80	
Once per week	10	11	
Once or less per month	7	10	
Have children	90	84	NS
Have friends	74	82	NS

[a]According to chi-square test.

TABLE 2—Health Characteristics of Study Subjects

	Men (n=42), %	Women (n=103), %	P[a]
Perceived health status			NS
Excellent	2	2	
Very good	24	15	
Good	31	29	
Fair	36	35	
Poor	7	20	
Most common disease(s)[b]			
Arthritis	50	70	NS
Cardiovascular disorder	50	58	NS
Digestive tract disorder	43	54	NS
Emphysema	45	13	<.0002
Vision (with glasses)			NS
Excellent	9	5	
Good	50	36	
Fair	24	30	
Weak	17	29	
Prescribed diet	10	29	.01
No. of daily prescribed medications			NS
None	12	9	
1–4	55	47	
5–8	33	45	
Level of stress			NS
High	14	21	
Moderate	45	45	
Low	41	34	

[a]According to chi-square test.
[b]More than one per subject was reported.

TABLE 3—Food-Related Characteristics of Study Subjects

	Men (n=42), %	Women (n=103), %	P[a]
Food shopping affected by			<.05
Functional limitations	36	39	
Fatigue	5	24	
Preparing meals affected by			<.05
Functional limitations	38	15	
Fatigue/boredom	21	23	
Good appetite			.06
Often	79	58	
Sometimes	12	20	
Never	10	23	
Company at mealtime			.04
Fewer than 5 times per week	69	51	
5 or more times per week	31	49	
Can afford to buy food	94	77	.21

[a]According to chi-square test.

five subjects, all women, participated in congregate meals.

Health Status and Life-Style Habits

Half of the study subjects stated that their health status was fair or poor relative to other persons their age (Table 2). Perception of health status was significantly related to reported burden of disease ($P = .006$), as represented by a score computed to summarize the presence of disease and its impact on daily activities. Each item of a list of 25 health problems was coded either as absent (0) or as present with no (1), little (2), or a large (3) perceived impact on the subjects' daily activities. The reported number of diseases was high; a large number of study subjects reported a low quality of vision, even with glasses; and the intake of prescribed drugs was extensive in both genders. However, psychotropic drugs were mainly prescribed for women. During the previous year, many participants had faced events perceived as stressful, such as death (n = 56) or illness (n = 16) of a close relative or severe personal illness (n = 46). Eighty-six percent of the men and 91% of the women wore dentures.

Forty-five percent of the men and 11% of the women were current smokers. Very few participants reported consuming alcohol; 31% of men reported one to two bottles of beer per week. Forty-one percent reported doing some kind of exercise (e.g., walking outside) every or almost every day. Most (88%) of the subjects were ambulatory.

Food-Related Characteristics

More women than men reported difficulties with food shopping, while the reverse was true for food preparation (Table 3). Forty-one percent of the men and 63% of the women reported never doing their own food shopping, and 69% of men and 26% of women reported never preparing their own meals. Help with food shopping and preparation was mainly provided by relatives and neighbors; only 12% of the subjects were receiving community services for these activities. Ninety percent of the participants reported regularly consuming three meals per day, and 62% usually added snacks during the day. In spite of that regular pattern, a large proportion of the population reported a poor appetite. Very few subjects (17%) reported regular use of vitamin or mineral supplements.

TABLE 4—Subjects' Daily Intake of Energy and Macronutrients

Nutrient	Mean ± SD	RNI, %	<RNI, %	Energy, %
Energy, MJ				
Men	6.49 ± 1.72	77	93	...
Women	4.90 ± 1.34	78	88	...
Energy, MJ/kg				
Men	0.09 ± 0.03	75	78	...
Women	0.08 ± 0.03	80	70	...
Protein, g				
Men	58.2 ± 18.0	99	57	15
Women	44.9 ± 13.2	82	80	15
Carbohydrate, g				
Men	201 ± 62	...	...	52
Women	158 ± 44	...	...	54
Total fat, g				
Men	58.4 ± 19.5	...	...	34
Women	41.7 ± 14.2	...	...	32
Saturated fatty acids, g				
Men	21.6 ± 7.8	...	...	13
Women	15.0 ± 5.8	...	...	12
Monounsaturated fatty acids, g				
Men	21.8 ± 7.8	...	...	13
Women	15.0 ± 3.4	...	...	12
Polyunsaturated fatty acids, g				
Men	8.0 ± 4.0	...	...	5
Women	6.0 ± 3.5	...	...	5

Note. Values for mean daily intake were derived from three nonconsecutive 24-hour recalls. RNI = recommended nutrient intake.[41]

TABLE 5—Predictors of Dietary Intakes in Study Subjects

Predictor	Estimated Regression Coefficient (SE)	
	Energy, MJ	Protein, g
Sex (0 = male, 1 = female)	−1.29 (0.26)***	...[a]
Age, y	...[a]	−0.14 (0.03)[b]***
Good appetite (often, sometimes, never)	0.39 (0.15)**	3.27 (1.52)*
Burden of disease (score)	−0.05 (0.02)*	...[a]
Vision (good, fair, poor)	0.23 (0.15)	3.33 (1.46)*
Level of stress (high, moderate, low)	...[a]	−3.29 (1.61)*
Intercept	8.93 (0.71)***	60.71 (5.17)***
Adjusted multiple R^2	0.28***	0.23***

[a]Nonsignificant.
[b]Statistically significant only among women.
*$P < .05$; **$P < .01$; ***$P < .0001$.

Weight and Weight Changes

The mean body mass index for men was 25.3 kg/m^2 (SD = 3.7, range = 19 to 34), and the mean body mass index for women was 27.7 kg/m^2 (SD = 7.6, range = 17 to 46). In terms of weight classifications according to body mass index criteria for elderly people,[44–46] 40% of the men and 32% of the women would be at high risk of health problems because of low body weight. Involuntary weight loss was reported in 42.1% of the study population and was considered excessive[47] in 33% of the men and 24% of the women.

Energy and Macronutrient Intake

Mean daily intakes of energy and macronutrients are shown in Table 4. The intakes of a large proportion of these elderly men and women were insufficient according to the Canadian recommendations.[41] Even though subjects followed the recommended distribution of macronutrients (15% protein, 30% fat, 55% carbohydrate)[41,48] fairly closely, their mean absolute protein intake was below the recommended quantity, probably as a result of their overall low energy intake. When protein intake was expressed as grams per kilogram of body weight, 48% of the men and 63% of the women did not consume the recommended amount per day (0.8 g/kg).[41] Intake of saturated fat was higher than recommended (13% for men and 12% for women), while mean polyunsaturated fat levels were low (8.0 g [SD = 4.0] for men and 6.0 g [SD = 3.5] for women). According to the Canadian recommendations, one's diet should provide 10% of total energy as saturated fat and should provide a minimum intake of polyunsaturated fat of 8.1 g per day.[41]

Among the determinants of intake listed in the Appendix, bivariate analyses conducted with the total population indicated that burden of disease ($P = .0006$), presence of arthritis ($P = .03$), and psychotropic drug use ($P = .04$) were negatively associated with energy intake, while quality of vision ($P = .03$) and appetite ($P = .002$) were positively associated with energy intake. Similarly, burden of disease ($P = .03$) and difficulties related to food shopping ($P = .02$) were negatively associated with protein intake, while quality of vision ($P = .01$) and appetite ($P = .02$) showed a positive association. Furthermore, in separate analyses of men and women, poor perceived health status ($P = .03$) and stressful events ($P = .08$) in men and aging in women ($P = .01$) were associated with lower protein intake. In contrast, having friends had a positive impact on energy intake ($P = .003$), and women on prescribed diets had higher protein intakes ($P = .02$). Neither the level of reported exercise nor body mass index was associated with estimated intakes.

The estimated regression coefficients for predictors of energy and protein intake are presented in Table 5. All determinants found to be significantly related to dietary intake in bivariate analyses were tested in the models in order to identify independent predictors. In this elderly population, a model including gender, reported appetite, quality of vision, and burden of disease accounted for 28% of the variance in energy intake. Those who reported a lack of appetite most of the time were estimated to

consume 0.78 MJ per day less than those generally reporting good appetite. Poor vision independently predicted a reduction of 0.46 MJ per day. The gap between the lowest and the highest quartile for the burden of disease score represented 2.5 MJ per day. With protein intake as the dependent variable, 23% of the variability in dietary intake observed could be accounted for by age, appetite, vision, and the level of stress experienced by the subjects. Again, the impact of these variables on intake was considerable; a mean difference of 6.66 g of protein per day was associated with the quality of the subject's vision (good vs poor), and a mean difference of 6.54 g was associated with whether or not the subject had a good appetite. Furthermore, the lower the level of stress, the higher the intake (reaching a difference of 6.58 g of protein per day between the highest and lowest of three levels). Age had a significant inverse relationship with protein intake in women but not in men.

Discussion

The goals of this study were to estimate the energy and macronutrient intake of a group of community-living elderly people with loss of autonomy and to relate energy and protein intake to socioeconomic indicators, food-related behaviors, and health status (affective, functional, and physical health).

Our study included a group of elderly subjects not often enrolled in nutritional surveys using a dietary method assessing usual intake. All subjects needed assistance in their activities of daily living, and most were suffering from one or more chronic diseases and were taking regular medications.

Previous studies have suggested that there are specific nutritional deficits in as many as 20% to 70% of community-dwelling, functionally dependent older persons. Deficits in protein, calcium, iron, and B vitamins are most frequently cited.[19–24, 26,49–52] The mean energy intakes in our study subjects were considerably lower than those reported for healthy and independent elderly populations[40,53–55] and even some institutionalized populations.[1–4] Also, they were lower than those previously reported in similar populations.[19,21–24,51] Low energy intakes were reflected in low body weight and high prevalence of involuntary weight loss. In our analyses, we were not able to control for energy expenditure because we were not able to accurately measure such expenditure; however, we found a strong correlation between rate of weight loss and total energy intake among our underweight subjects.[38]

More than 50% of our subjects did not meet the recommended level of daily protein intake (0.8 g/kg body weight) (as observed previously in a few studies[20,22,50]). Our subjects' mean absolute amount of daily protein intake was below that recommended for older Americans[56] (63 g for men, 50 g for women) and Canadians[41] (59 g for men, 55 g for women) and lower than that found in most[19,21,23,24,49] but not all[51] of the studies mentioned earlier. The optimal protein intake for healthy elderly people may, in fact, be higher than 0.8 g/kg of body weight if nitrogen balance is to be maintained in the long term.[57–59] In addition, low energy intakes and chronic illness may further increase protein requirements established for healthy elderly people.[41]

The high frequency of low energy and protein intakes observed in this study could be a result of the high participation rate achieved; recruitment bias tends to favor enrollment of healthier and better nourished subjects.[60,61] In addition, a reliable methodology for dietary data collection was used. The calculated precision[62] of the method used in this study for the estimation of usual dietary intake (i.e., recall of 3 nonconsecutive days of intake) was 85% for energy and 86% for protein.[38]

The determinants of dietary intake in this population were different from those that have been reported among relatively healthy and autonomous elderly populations. For example, financial resources, previously associated with dietary quality or quantity,[18,29,30,32–35] were not identified as a predictor of dietary intake among our study subjects. Similarly, social isolation (as measured by marital status, living alone, company during meals, frequency of contact with relatives or friends, loneliness) is considered a warning signal for malnutrition in elderly individuals.[18,29–31] In our study, none of the variables related to social or friendship networks were found to be predictors of dietary intake in the multivariate analyses. In contrast, the relationship between diet and the occurrence of stressful events supports previous results obtained in healthy elderly populations.[18,63]

Although dentition is often mentioned as a factor in nutrition of elderly people, no relationship was observed in our study or in a number of previous studies[17,64] in which neither wearing dentures nor masticatory ability were associated with nutritional quality of the diet. Chronic and acute diseases are clearly associated with increased nutritional deficiencies.[2,3,52] The relationships that we observed between diet and both burden of disease and perceived health status confirm these findings. Dependency in activities of daily living has also been identified as a risk factor for malnutrition.[17,18] However, to our knowledge, no previous study has specifically identified vision as a determinant of dietary intake in an elderly population.

Decline in visual function is of enormous importance. Hyman[65] found that, in the United States, one of five persons 75 years of age and older reported suffering from a visual deficiency. Furthermore, Wormald and colleagues[66] stressed that ocular disease is often undetected in elderly people in the community. Marx and colleagues,[67] after controlling for other conditions, established a strong link between poor vision and disabilities in activities of daily living among nursing home residents. In our study, the association of poor vision with lower energy and protein intakes was independent of other medical conditions.

This study has documented the high-risk nutritional status of a functionally dependent elderly population. Both total energy and total protein intakes were very low. The composition of subjects' diets with respect to macronutrients was well balanced (e.g., no overabundance of dietary fat), but total intakes were low. It is of utmost importance to recognize that this population's low energy and protein intakes place them at risk of deficiency for key nutrients. The findings of this study will further help identify community-residing, functionally dependent elderly individuals at risk for malnutrition. Apart from the expected factors of age and gender, it appears that those suffering from chronic diseases and disabilities, even among this high-risk group, are at particular risk of inadequate dietary intake, along with those reporting poor appetites, high levels of stress, and poor vision. It is worth mentioning that although these conditions frequently coexist, each has an independent role.

In view of these results, it seems advisable that nutrition surveillance be a component of home health services. A clear understanding of the determinants of inadequate dietary intake may be helpful in the early detection and prevention of malnutrition. Nutritious foods should be made available in sufficient quantity so that high-risk older persons

can maintain adequate energy and nutrient intake and prevent deterioration in health status. □

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APPENDIX—Theoretical Model of the Determinants of Nutritional Intake in Community-Living Elderly Populations

Category	Characteristic			
	Material	Physical	Psychological	Social
Purchase of food	Food expenditure Frequency of food shopping	Proximity of grocery store Moving capacity Chronic and acute disease Functional disability	Homebound because of boredom/depression Perceived buying capacity Taste for food shopping	Help (relatives, friends, neighbors) in purchasing foods Delivery services or assistance
Preparation of food	Kitchen installation Bowls/utensils Food availability	Chronic and acute disease Functional disability	Taste for preparing meals Loneliness Attitudes toward loneliness Cooking knowledge Health perception	Social isolation Help (meals on wheels, homemaker) in preparing meals Congregate meals
Consumption of food	Dentition Mineral/vitamin supplements	Allergy Physical determinants of appetite Smoking status Alcohol intake Medication Physical activity Chronic and acute disease Prescribed or nonprescribed diet Functional disability	Like/dislike Psychological determinants of appetite Boredom Depression Stress Bereavement Food beliefs and attitudes Loneliness	Social isolation Company during meals Congregate meals

Note. Model was based on data from references 17, 18, 21, 24, and 29–35.