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Abstract

Objective. The term 'culinary dependence' denotes a situation in which someone delegates all or part of their daily meal-related activities to a third party. The present study aimed to explore nutritional risk among older people (≥ 65 years) with culinary dependence. **Method.** The first survey included 559 people either living at home without help, with help unrelated to food activities, with help related to food activities, or living in nursing home. The second survey included 319 people with food help provided by a caregiver, by meals-on-wheels or by a nursing home. Nutritional status was assessed with the Mini-Nutritional Assessment. Sociological background and wellness variables (health, cognitive and mental status) were collected. **Results.** The first survey found a strong association between culinary dependence and nutritional risk. About half of the people who delegated their food-related activities were malnourished or at risk of malnutrition compared with only 4% for people with no help and 12% for people with help unrelated to food activity. According to the second survey, this prevalence varied slightly depending on who the tasks were delegated to (46% for those who

had the support of a caregiver; 60% for those who used a meals-on-wheels service; 69% for those living in nursing home). According to multivariate analyses, dependence categories, depressive symptoms and cognitive status were identified as independent determinants of malnutrition. **Conclusion.** Without inferring a causal relationship between dependence and malnutrition, there is a strong need for care structures to take into account the issue of malnutrition when developing services targeting older people.

Keywords

Aged; home care; home delivered meal; nursing homes; nutritional status; older people.

Keypoints:

- About half of the older people who delegated their food-related activities were at nutritional risk.
- The present study provides prevalence data for malnutrition in older French adults according to various living situation.
- Dependence, depressive symptoms and cognitive status were identified as independent determinants of malnutrition.
- Older people with help related to food display higher nutritional risk than those with help unrelated to food activity.

INTRODUCTION

Malnutrition is a deficiency in nutritional intake, in terms of calories and/or nutrients, and it is associated with numerous adverse outcomes. In older people, malnutrition increases the incidence of falls, fractures, disease and hospitalization, it causes or worsens a state of frailty or disability, and it affects quality of life. According to a meta-analysis which included 223 study samples from 24 European countries (1), the prevalence of malnutrition and malnutrition risk was 8.5% in community-dwelling older people, 17.5% in institutionalized older people, and 28.0% in hospitalized older people.

A few authors have explored the relationship between the loss of autonomy and nutritional risk in older adults. According to the literature review conducted by the French National Authority for Health (2), 4% of older people living at home are malnourished or at risk of malnutrition, and this prevalence increases up to 25-30% in people receiving home-care support. In a study by Kiessweter et al (3), conducted in Germany, the loss of autonomy as measured by the IADL (Instrumental Activities of Daily Living (4)) was found to be significantly associated with malnutrition risk (see also (5) for Turkey). In the French Three-City cohort including more than 9,000 community-dwellers, Torres et al (6) reported that loss of autonomy was significantly associated with poor nutritional status after controlling for possible confounding factors. In this study, respondents were considered to have a loss of autonomy when they presented at least one impairment in the following five activities: bathing, dressing, grooming, transferring from bed to chair, and eating.

However, to the best of our knowledge, no study has yet focused on the relationship between malnutrition and the loss of autonomy for food-related activities (food purchasing, cooking, meal preparation) compared to the loss of autonomy for activities unrelated to food (*e.g.* housekeeping, gardening, grooming). Cardon and Gojard (7) proposed the term “culinary dependence” to describe situations in which “people are unable to obtain and/or prepare food for their meals and are obliged to delegate these tasks to others”. Culinary dependence is often induced by “events of rupture”, which may have a social origin (*e.g.* widowhood) or a medical origin (*e.g.* onset of a disease) (8). These events may be accompanied by the onset of disability (lack of skills, physical disability, cognitive impairment) likely to affect the performance of everyday tasks and notably those related to meal (food purchasing, cooking). However, the onset of culinary dependence implies that the person has to adapt to the culinary practices, food habits, nutritional knowledge and sometimes food preferences of the caregivers (7).

Consequently, the loss of food autonomy may have a strong impact on the relationship that the individual has with his or her diet.

In the present study, two surveys were conducted. The AUPALESENS survey aimed to compare the malnutrition risk between older people who delegated all or part of meal-related activities (food purchasing, cooking) and older people who were still in charge of their meals. The RENESSENS survey aimed to compare the malnutrition risk when meals were delegated to different third parties: a caregiver, meals-on-wheels service or nursing home. In addition, the present surveys provides an updated overview of malnutrition in France compared to the review of the French Health Authority (2), which is frequently cited but included few French studies (7/24) and the studies were published from 1993 to 2006. Finally, these surveys provided insights on health and sociological factors associated with the malnutrition risk.

MATERIALS AND METHODS

AUPALESENS sample

In 2011, a sample of 559 people aged 65 and over were recruited in four French cities (Angers, Brest, Dijon, Nantes) among four categories: (1) people living independently at home; (2) people living at home with help unrelated to food activity (*e.g.* housekeeping, gardening, grooming); (3) people living at home with help related to food activity for at least 3 meals a week (*i.e.* food purchasing, cooking, meals-on-wheels); (4) people living in a nursing home. The recruitment criteria were as follows: no acute illness at the time of the survey; no food allergies; not on a prescribed diet; scoring at least 21 on the MMSE (Mini Mental State Examination (9)).

RENESSENS sample

In 2015, a sample of 319 adults aged 65 years and over were recruited in four French departments (Côte d'Or, Maine et Loire, Puy-de-Dôme, Paris) among three categories: (1) people living at home with help for food purchasing and/or cooking for at least 3 meals a week; (2) people living at home with meals-on-wheels for at least 3 meals a week; (3) people living in a nursing home. Participants suffering from an acute illness at the time of the survey were not included. For people living at home, participants had to score at least 21 on the MMSE to be included in the survey. No such criteria was set up for the nursing home in order to recruit a more representative sample of institutionalized people than in the previous AUPALESENS

survey (the percentage of people suffering from cognitive disability is quite high in French nursing homes).

Procedure

Recruitment was achieved through advertisements in local newspapers, flyers in local seniors associations, and support from local care service providers (in-home services, meals-on-wheels services, nursing homes). For each survey, the sampling plan was designed to ensure that each category of the sample was representative when compared to French national statistics. Different sampling criteria were used depending on the living situation: gender, age (65-75 yo; >75 yo) and marital status for people living at home; gender, age (65-80 yo; >80 yo) and cognitive status for institutionalised people.

Each participant underwent two face-to-face interviews of approximately 60-90 minutes each to collect nutritional, sociological and wellness data. The nutritional status was assessed with the MNA (Mini-Nutritional Assessment (10)), which has a maximum score of 30. A score below 17 indicates malnutrition, a score of 17-23.5 indicates a risk of malnutrition, and a score of 24 or higher indicates a satisfactory nutritional status. Sociological variables include age, gender, marital status, degree and self-perceived financial resources. Wellness variables included health status (comorbidities), mental status (depression) and cognitive status (dementia). During the interview, respondents were asked to describe any health problems and to specify their medical prescriptions. The responses and prescriptions were then analysed by a physician, who determined the number of comorbidities. Mental and cognitive status were inferred from the Geriatric Depression Scale (GDS (11)) and the Mini Mental State Examination (MMSE (9)). GDS scores that were lower than 5 points (out of 15) indicate no depressive symptoms. Higher scores can indicate moderate (5-10 points) or severe (≥ 10 points) depressive symptoms. MMSE scores 25 points or higher (out of 30) indicate normal cognition. Below this, scores can indicate moderate (21-25 points) or severe (<21 points) cognitive impairment.

Interviews were conducted in the individual's home (or nursing home) by six experimenters (all women) who had previously followed a 1-day training session. For the RENESSENS survey, institutionalized participants who scored lower than 21 on the MMSE were assisted by a relative (a child for n=15) or by the nursing staff (n=13) to complete the questionnaires. Experimental protocols were approved by the French Ethics Committee for Research

(AUPALESENS: #2010-A01079-30; RENESSENS: #2014-A00775-42). In accordance with ethics rules, all the participants (or their legal representative) gave their informed consent. The participants received compensation for their participation.

Data analysis

Descriptive data were presented as percentages or means (M) and standard errors (SE). Differences across dependence categories were tested with ANOVA for normally distributed variables and with χ^2 tests for categorical variables (Tables 1 and 2). Univariate logistic regression analyses were performed to compute the odds ratio and related 95% confidence interval for each variable (Table 3). To evaluate the independence of the observed associations, the variables with a p value <0.05 were simultaneously entered in a multivariate logistic regression analysis (Tables 4 and 5). Interaction effects were tested and removed as they were never significant. For the regression analyses, the independent variable for nutritional status was dichotomized into well-nourished (MNA>23.5) versus at risk of malnutrition or malnourished (MNA≤23.5). Indeed, the percentage of malnourished people was quite low which may affect data convergence in the logistic analysis. All statistical analyses were performed with SAS software (SAS Institute INC., Cary, NC, USA). The threshold for significance was set at 5%.

RESULTS

Characteristics of the study samples

The characteristics of the study sample in each category are presented in Table 1 (AUPALESENS) and Table 2 (RENESSENS). According to census, the French older population is 42% male, 51% aged 75 or over, and 56% in a couple (12). Regarding people living at home with care support, this population is 27% male, 69% aged 75 or over, and 35% in a couple (13, 14). In nursing home, the population is 25% male, 84% aged 80 or over and 42% suffered from dementia (15, 16). In both AUPALESENS and RENESSENS survey, the samples for the different categories were well representative of national statistics except for age, with more participants aged over 75 years in the survey compared to national statistics, in particular for the “at home with food help” category in the AUPALESENS survey.

The socio-economic status of the RENESSENS population was slightly lower than in AUPALESENS. RENESSENS had a higher percentage of people without a diploma than

AUPALESENS and a lower percentage of people who reported having a good income. The RENESSENS sample included people with fairly low socio-economic status (78% did not attend secondary school and 91% reported low to fair income). On the contrary, the AUPALESENS sample includes 61% people who completed secondary school level and 77% reported fair to good income.

Finally, and not surprisingly, the mean age was higher in all the categories of dependent people (mean age over 80) than in the category of people living independently at home (mean age below 75). The number of comorbidities and the proportion of people reporting depressive symptoms and cognitive impairment increased as dependence increased.

Tables 1 and 2 about here

Prevalence of malnutrition across dependence categories

Results of the AUPALESENS survey reveals an increase in malnutrition risk with increasing dependence, and in particular culinary dependence (Table 1). For those living at home, the rate of malnutrition risk ranges from 4% among people living independently to 11% among people with care support unrelated to food activities, and 37% among people receiving support for food activities. In these populations, the rate of malnutrition is very low, 0%, 1% and 4%, respectively. The prevalence of malnutrition and risk of malnutrition observed in nursing homes (42%) is close to the prevalence observed among people receiving support for food activities (41%). The results of the RENESSENS survey confirm these numbers (Table 2): 53% of participants living at home who delegated all or part of food-related activities were malnourished or at risk of malnutrition. However, the prevalence varied depending on the type of delegation: 46% among older people who depended on a caregiver for food purchasing and/or cooking (44% at risk and 2% malnourished) and 60% among those who received meals-on-wheels (54% at risk and 6% malnourished). The prevalence was higher in nursing homes, with 56% of institutionalized people at risk of malnutrition and 13% malnourished.

Factors associated with the risk of malnutrition

The characteristics associated with nutritional status were examined separately for each sample (Table 3). In AUPALESENS, being dependent or institutionalized, older age, being widowed, having a low level of education, having a low income, having more than one chronic disease, and suffering from depressive symptoms or cognitive impairment appeared to be significantly

associated with a higher risk of malnutrition. In RENESSENS, receiving meals-on-wheel or being institutionalized, having a low income, having more than one chronic disease or suffering from depressive symptoms or cognitive impairment appeared to be significantly associated with a higher risk of malnutrition.

Results from the multivariate analysis for AUPALESENS data showed that people living at home with help for food activities and institutionalized people were at higher risk of malnutrition than people living at home without help or with help unrelated to food activities (Table 4). No significant difference was observed between people living at home with food help and people living in a nursing home. Similarly, in the multivariate analysis carried on the RENESSENS data, no significant difference was observed between the three culinary dependence categories (Wald Chi Square=2.41; p=0.66) (Table 5). In both dataset, the GDS score remained significantly associated with the risk of malnutrition after controlling for other factors: being depressed was significantly associated with a higher risk of malnutrition. The income and MMSE variable remained significant only in the RENESSENS data: suffering from severe cognitive impairment or having a low/fair income was significantly associated with a higher risk of malnutrition.

Tables 3, 4 & 5 about here

DISCUSSION

The present results highlight a significant association between culinary dependence and malnutrition risk among the older French population. The AUPALESENS survey showed that the malnutrition risk at home was significantly higher among older people who received help for food activities (food purchasing, cooking, meals-on-wheels) than for those who received help for activities unrelated to food. In older people living autonomously at home, the prevalence of malnutrition risk (4%) was equivalent to the one reported by HAS (2007) on the basis of five studies (1989-1996; 4 French studies). However, the multivariate analysis of the RENESSENS data revealed no significant difference between people receiving help for food activities from a caregiver, people using a home-delivered meal service, and people living in nursing home.

The study conducted by Kiessweter et al. (3) showed that 57% of home-care receivers were at risk of malnutrition and 12% were malnourished. In this study, as in many others, the authors

did not distinguish between care related to food or not (17-19). In the AUPALESENS survey, the sample for people with help unrelated to food activity was too small to compare people receiving help for gardening, housekeeping or grooming. It may be hypothesized that the more a person needs help (in particular for personal care), the more the person is at risk of malnutrition. In fact, Kiessweter et al. (3) found that 55% of the respondents receiving 90-180 minutes of care per day were malnourished or at risk of malnutrition versus 88% in people receiving more than 180 min/day. However, further research is needed to decipher whether different types of help overlap to one another – whether there is a continuum, or whether dependence for related to food activity has a somehow specific impact on the nutritional status from dependence unrelated to food activity. Regarding people enrolled in a meals-on-wheels program, the prevalence rates observed in the present study are slightly higher than the rates observed in a similar population: 9.5% and 27% in the Irish study by O'Dwyer et al. (20); 5% and 38% in the Australian study by Walton et al. (21). Regarding the malnutrition risk in residential care, three studies conducted in France in 1996 through 1999 found that 13 to 27% of institutionalized older people were malnourished (2). The increase of malnutrition and risk of malnutrition rates observed in nursing home between AUPALESENS (3% and 39%) and RENESSENS (13% and 52%) may be due to the inclusion of participants suffering from cognitive impairment in RENESSENS. Cognitive impairment appears to be associated with higher prevalence of malnutrition (22) and with an increased risk of being malnourished (6, 23). Accordingly, our results show that severe cognitive impairment was significantly associated with higher risk of malnutrition when controlling for other variables.

To the best of our knowledge, there is currently no longitudinal data in the literature that deciphers the causal relationship between culinary dependence and malnutrition. On one hand, malnutrition has numerous adverse outcomes on health, and thus may cause or worsen a state of dependence. Charlton et al. (24) observed that 33% of malnourished patients moved to a higher level of care at discharge from hospital versus 17% of patients at risk of malnutrition and 5% of well-nourished patients. People who require homecare services are usually experiencing a decline in functional and/or cognitive capacities, which may have altered their nutritional status before the onset of culinary dependence. On the other hand, the onset of culinary dependence forces people to adapt to the meals provided by caregivers, meals-on-wheels services or the nursing home. These meals may depend less on the food habits of the individual and more on the current sanitary rules, organizational constraints, nutritional standards and culinary practices of the homecare provider. As such, culinary dependency may

weaken the link between an individual and his diet, which in turn may have a negative impact on appetite and food intake (25). However, the few studies that have assessed the long-term impact of meals-on-wheels showed an improvement in nutritional status over time among older recipients (26). For instance, Wright et al. (27) showed that 51% of newly enrolled meals-on-wheels recipients improved their nutritional status after 2 months of follow-up, while only 4% reported a decline in nutritional status (see also (28, 29)).

Finally, in both AUPALESENS and RENESSENS surveys, depressive symptoms were identified as an independent determinant for malnutrition, in line with previous studies (6, 30, 31). Depression has often been cited as a risk factor for anorexia and decline in food intake among older people (32-34). Interestingly, depression was associated with a decline in olfactory capacity (decline in the ability of detect and identify odors), which may contribute to food anhedonia, namely to an inability to feel pleasure when eating (35). Similarly, Bailly et al. (36) observed that depression and pleasure of eating were related to nutritional status. In particular, the pleasure of eating was affected by depression among older women.

Strengths and limitations. The present surveys addressed the issue of how different types of helps relate to malnutrition with a distinction of culinary dependence, which is definitively useful to identify and target at-risk populations. The sampling plans were carefully designed to ensure that the samples would be representative of French national statistics for the older population. However, the present results should be confirmed through other studies exploring culinary dependence and malnutrition prevalence, both in France and in other countries. Other food care services should also be taken under consideration such as grocery delivery services or congregate meals (37). In addition, the data are cross-sectional, which prevents any causal inference. The associations between the malnutrition risk and health or sociological variables may also suffer from residual confounding factors. As advocated by Mather (38), future researches in nutrition should go from association to causality to decipher the pathway leading to increased nutritional risk. Finally, malnutrition was assessed using the MNA following the French recommendations (2). However, this questionnaire is rather a screening tool than a diagnosis tool. In fact, the Global Clinical Nutrition Community (39) recently advocated for using phenotypic (weight loss, low body mass index, reduced muscle mass) and etiologic criteria (reduced food intake or assimilation, inflammation) to diagnose malnutrition. The use of these criteria may change the malnutrition prevalence in the various segments of older people.

Clinical implications. The results observed in the present surveys urge for the need of implementing systematic malnutrition screening in dependent older people (40), as well as periodic weight recording - at least once a month over 70 years old, as recommended by Fontaine (41). In addition, care staff (home caregivers, caterer, institution staff…) but also medical staff (family doctor, nurse…) should be trained to the specific needs of older people and the issue of malnutrition (42). Older people a risk of undernutrition / undernourished should be provided with dietary guidance and meals tailored to their nutritional needs while complying with their food habits and preferences. Finally, a straight communication should be promoted between care and medical staff to ensure the efficiency of care services provided to dependent older people.

CONCLUSION

The present study highlights a strong association between culinary dependence and nutritional risk, and found that about half of seniors who delegated all or part of their food activities were malnourished or at risk of malnutrition. Without inferring that there is a causal relationship between dependence and malnutrition, there is a strong need for care structures (home-care and catering services, nursing homes) to take into account this nutritional issue when developing services targeting older people in order to preserve the health and the quality of life of older people.

Declaration of Conflicts of Interest: None

Declaration of Sources of Funding

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Ethical standards

All procedures performed in the studies were in accordance with the ethical standards of the institutional research committee and with the declaration of Helsinki and its later amendments. Informed consent was obtained from all individual participants included in the studies.

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Table 1

Characteristics of the AUPALESENS population according to dependence categories

	At home, without help	At home, non-food help	At home, food help	Nursing home	*p* Value*
N	289	74	101	95	
Sex, % men	31%	27%	34%	28%	0.75
Age (yr) [a]	73.9 (0.3)	81.1 (0.7)	84.7 (0.6)	87.0 (0.7)	<0.001
60-75(80) yr [b]	57%	16%	5%	4%	
≥75(80) yr	43%	84%	95%	96%	
Marital status					<0.001
Single	20%	22%	12%	22%	
Couple	51%	35%	25%	18%	
Widow	29%	43%	63%	60%	
Education					<0.001
None	4%	11%	15%	17%	
Primary	25%	28%	41%	32%	
Secondary	43%	41%	31%	40%	
Graduate	28%	20%	12%	11%	
Income [d]					0.05
Low	19%	24%	33%	-	
Fair	53%	45%	46%	-	
Good	28%	31%	21%	-	
MNA [a]	27.6 (0.1)	26.4 (0.3)	24.3 (0.4)	23.4 (0.3)	<0.001
Well-nourished (>23.5)	96%	88%	59%	58%	
At risk (17-23.5)	4%	11%	37%	39%	
Malnourished (<17)	0%	1%	4%	3%	
Comorbidities [a]	2.3 (0.1)	3.6 (0.2)	4.0 (0.2)	4.1 (0.2)	<0.001
0-1 chronic disease	43%	8%	15%	13%	
2-3 chronic disease	37%	47%	25%	29%	
> 3 chronic diseases	20%	45%	60%	58%	
GDS [a]	2.5 (0.1)	3.7 (0.3)	5.0 (0.3)	4.8 (0.3)	<0.001
No depression (≤5)	89%	77%	62%	59%	
Mild depression (5-10)	9%	15%	31%	33%	
Severe depression (≥10)	2%	8%	7%	8%	
MMSE [a,c]	27.7 (0.1)	26.9 (0.3)	26.5 (0.2)	25.6 (0.3)	<0.001
Normal cognition (≥25)	91%	82%	73%	60%	
Mild impairment (21-25)	9%	18%	27%	40%	

MNA, Mini-Nutritional Assessment; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination.

[a] Mean ± Standard error; [b] the upper age limit was set up at 75 years old for older people living at home and at 80 years old for older people living in nursing home, depending on available French population statistics; [c] Participants who scored lower than 21 were not included in the survey to ensure reliable answers; [d] This question was not completed in nursing home. * P-value derived from either ANOVA or $\chi 2$ test.

Table 2

Characteristics of the RENESSENS population according to dependence categories

	At home, food help	At home, meals-on-wheel	Nursing home	*p* Value*
N	91	108	120	
Sex, % men	22%	35%	30%	0.12
Age (yr) [a]	83.5 (0.8)	83.9 (0.7)	85.8 (0.6)	0.05
60-75(80) yr [b]	13%	12%	6%	
≥75(80) yr	87%	88%	94%	
Marital status				0.18
Single	21%	32%	19%	
Couple	21%	19%	21%	
Widow	58%	49%	60%	
Education				<0.01
No	22%	13%	23%	
Primary	59%	52%	65%	
Secondary	4%	12%	5%	
Graduate	15%	23%	7%	
Income				<0.01
Low	28%	35%	46%	
Fair	68%	52%	44%	
Good	4%	13%	10%	
MNA [a]	23.4 (0.3)	22.5 (0.3)	21.2 (0.4)	<0.001
Well-nourished (>23.5)	54%	40%	31%	
At risk (17-23.5)	44%	54%	56%	
Malnourished (<17)	2%	6%	13%	
Comorbidities [a]	3.2 (0.3)	3.3 (0.2)	4.3 (0.2)	<0.001
0-1 chronic disease	26%	19%	3%	
2-3 chronic disease	27%	34%	32%	
> 3 chronic diseases	47%	47%	65%	
GDS [a]	4.5 (0.3)	5.4 (0.3)	5.1 (0.3)	0.08
No depression (≤5)	72%	53%	73%	
Mild depression (5-10)	21%	35%	23%	
Severe depression (≥10)	7%	12%	4%	
MMSE [a,c]	27.4 (0.3)	26.5 (0.2)	18.9 (1.1)	<0.001
Normal cognition (≥25)	88%	78%	53%	
Mild impairment (21-25)	12%	22%	10%	
Severe impairment (<21)	-	-	37%	

MNA, Mini-Nutritional Assessment; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination.

[a] Mean ± Standard error; [b] the upper age limit was set up at 75 years old for older people living at home and at 80 years old for older people living in nursing home, depending on available national French statistics; [c] Participants at home who scored lower than 21 were not included in the survey to ensure reliable answers.

* *P*-value derived from either ANOVA or χ^2 test.

Table 3

Results of the univariate logistic regression analysis+.

	AUPALESENS sample (n=559)		RENESSENS sample (n=319)	
	OR	**95% CI**	**OR**	**95% CI**
Dependence category				
At home, non-food help vs autonomous	3.20	1.29 – 7.90	-	-
At home, food help vs autonomous	15.78	7.82 – 31.80	-	-
At home, food help vs non-food help	4.93	2.21 – 11.01	-	-
Nursing home vs autonomous	16.79	8.28 – 34.04	-	-
Nursing home vs at home, food help	1.06	0.60 – 1.88	-	-
At home, meals-on-wheel vs food help	-	-	1.76	1.01 – 3.10
Nursing home vs at home, food help	-	-	2.62	1.49 – 4.61
Nursing home vs at home, meals-on-wheels	-	-	0.67	0.39 – 1.16
Gender				
Men vs Women	0.77	0.48 – 1.25	0.94	0.58 – 1.53
Age	1.11	1.08 – 1.15	1.00	0.97 – 1.03
Marital status				
Single vs couple	1.54	0.80 – 2.96	1.22	0.62 – 2.39
Single vs widow	0.61	0.34 – 1.096	1.04	0.60 – 1.80
Widow vs couple	2.51	1.51 – 4.20	1.17	0.66 – 2.09
Education				
No vs primary	2.28	1.13 – 4.63	0.99	0.54 – 1.81
No vs secondary	2.14	1.09 – 4.20	1.08	0.40 – 2.91
No vs university	4.55	1.97 – 10.50	2.00	0.91 – 4.39
Primary vs secondary	0.94	0.56 – 1.57	1.09	0.45 – 2.66
Primary vs university	1.99	0.97 – 4.08	2.03	1.05 – 3.89
Secondary vs university	2.12	1.07 – 4.20	1.85	0.67 – 5.13
Income				
Low vs fair	1.84	1.01 – 3.39	1.98	1.19 – 3.29
Low vs good	2.71	1.25 – 5.90	3.21	1.38 – 7.44
Fair vs good	1.47	0.71 – 3.06	1.62	0.73 – 3.61
Comorbidities				
[2-3] vs [0-1] chronic diseases	2.10	1.02 – 4.42	3.20	1.42 – 7.20
[> 3] vs [0-1] chronic diseases	5.98	3.03 – 11.81	3.58	1.68 – 7.64
[> 3] vs [2-3] chronic diseases	0.35	0.21 – 0.59	0.89	0.51 – 1.57
GDS				
Moderate vs no depression	5.36	3.24 – 8.89	2.43	1.41 – 4.19
Severe vs no depression	14.26	6.17 – 33.00	22.35	2.96 – 168.56
Severe vs moderate depression	2.66	1.10 – 6.40	9.20	1.18 – 71.99
MMSE				
Mild vs no cognitive impairment	2.40	1.48 – 3.91	2.20	1.11 – 4.32
Severe vs no cognitive impairment			7.27	2.77 – 19.11
Severe vs mild cognitive impairment			3.31	1.08 – 10.16

OR, Odd ratio; CI, Confidence Interval. GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination.

Table 4

Results of the multivariate logistic regression analysis to identify factors associated with malnutrition risk in the AUPALESENS sample (Likelihood ratio=104.83; p<0.001)

	Odds ratio	95% Confidence interval
Dependence category (Wald Chi-square = 18.90; p<0.001)		
At home, non-food help vs autonomous	1.63	0.59 – 4.51
At home, food help vs autonomous	8.49	3.48 – 20.72
At home, food help vs non-food help	5.20	2.10 – 12.89
Nursing home vs autonomous	7.45	2.83 – 19.61
Nursing home vs at home, food help	0.88	0.45 – 1.69
Age (Wald Chi-square = 2.13; p=0.14)	1.02	0.98 – 1.07
Marital status (Wald Chi-square = 0.17; p=0.92)		
Single vs couple	0.83	0.37 – 1.87
Single vs widow	0.97	0.46 – 2.05
Widow vs couple	0.86	0.45 – 1.65
Education (Wald Chi-square = 1.48; p=0.69)		
No vs primary	1.68	0.68 – 4.10
No vs secondary	0.86	0.36 – 2.09
No vs university	1.49	0.52 – 4.24
Primary vs secondary	0.51	0.27 – 0.97
Primary vs university	0.89	0.38 – 2.10
Secondary vs university	1.73	0.75 – 3.96
Income (Wald Chi-square = 1.32; p=0.52)		
Low vs fair	1.26	0.59 – 2.70
Low vs good	1.78	0.67 – 4.78
Fair vs good	1.41	0.59 – 3.39
Comorbidities (Wald Chi-square = 3.04; p=0.22)		
[2-3] vs [0-1] chronic diseases	1.67	0.72 – 3.86
[> 3] vs [0-1] chronic diseases	2.63	1.19 – 5.83
[> 3] vs [2-3] chronic diseases	0.63	0.34 – 1.17
GDS (Wald Chi-square = 16.41; p<0.001)		
Moderate vs no depression	3.65	1.25 – 10.67
Severe vs no depression	12.38	4.42 – 34.65
Severe vs moderate depression	3.65	1.25 – 10.67
MMSE (Wald Chi-square = 0.11; p=0.74)		
Mild vs no cognitive impairment	0.87	0.45 – 1.67

GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination. All the variables with a *p* value <0.05 in the univariate regression analyses were simultaneously entered in a multivariate logistic regression analysis.

Table 5

Results of the multivariate logistic regression analysis to identify factors associated with malnutrition risk in the RENESSENS sample (Likelihood ratio=93.56; p<0.001)

	Odds ratio	**95% Confidence interval**
Dependence category (Wald Chi-square = 0.67; p=0.71)		
At home, meals-on-wheel vs food help	1.35	0.63 – 2.89
Nursing home vs at home, food help	1.27	0.58 – 2.77
Nursing home vs at home, meals-on-wheels	1.06	0.49 – 2.31
Income (Wald Chi-square = 8.43; p=0.01)		
Low vs fair	1.39	0.73 – 2.64
Low vs good	6.17	1.81 – 21.08
Fair vs good	4.45	1.36 – 14.57
Comorbidities (Wald Chi-square = 5.26; p=0.07)		
[2-3] vs [0-1] chronic diseases	3.04	1.15 – 8.03
[> 3] vs [0-1] chronic diseases	2.46	1.00 – 6.07
[> 3] vs [2-3] chronic diseases	1.24	0.62 – 2.44
GDS (Wald Chi-square = 6.71; p<0.05)		
Moderate vs no depression	2.48	1.25 – 4.94
MMSE (Wald Chi-square = 17.10 p<0.001)		
Mild vs no cognitive impairment	2.78	1.19 – 6.47
Severe vs no cognitive impairment	12.36	3.13 – 48.83
Severe vs mild cognitive impairment	4.45	0.95 – 20.87

GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination. All the variables with a *p* value <0.05 in the univariate regression analyses were simultaneously entered in a multivariate logistic regression analysis.