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Original Article

Predictors of Incident Malnutrition in Older Irish Adults from the Irish Longitudinal Study on Ageing Cohort—A MaNuEL study

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Abstract

Older adults are at increased risk of malnutrition, which is associated with poorer health, quality of life, and worse disease outcomes. This study identifies predictors of incident malnutrition using data from a subsample (n = 1,841) of The Irish Longitudinal Study on Ageing. Participants were excluded if they were less than 65 years, missing body mass index data at baseline or follow-up, missing baseline weight loss data or malnourished at baseline (body mass index <20 kg/m^2 or unplanned weight loss ≥4.5 kg in the previous year). Logistic regression analysis was performed with incident malnutrition (body mass index <20 kg/m^2 and/or calculated weight loss >10% over follow-up) as the dependent variable. Factors showing significant (p < .05) univariate associations with incident malnutrition were entered into a multivariate model. The analysis was then repeated, stratified by sex. The 2-year incidence of malnutrition was 10.7%. *Unmarried/separated/divorced* status (vs *married* but not *widowed*), *hospitalization in the previous year*, *difficulties walking 100 m*, or *climbing stairs* independently predicted incident malnutrition at follow-up. When examined by sex, *hospitalization in the previous year*, *falls during follow-up*, and *self-reported difficulties climbing stairs* predicted malnutrition in males. *Receiving social support* and *cognitive impairment* predicted malnutrition in females. The development of malnutrition has a range of predictors. These can be assessed using simple questions to identify vulnerable persons.

Keywords: Undernutrition, Community-dwelling, Protein–energy malnutrition

Older adults are at increased risk of protein–energy malnutrition (1) with the prevalence of this condition in older, community-dwelling populations being approximately 5%–10% (2,3). In 2016, 19% of the population of Ireland was 65 years or older; this is projected to reach 29% by 2041 (4,5). On both a societal and individual level, it is important that older adults remain healthy, functional, and independent for as long as possible (6). As malnutrition is associated with poorer health, lower quality of life, worse outcomes from disease, and dependency (7,8), its predictors need to be determined to identify those at risk (9). Early identification of those most vulnerable

to developing malnutrition would result in significant cost savings because malnutrition among those in the community is associated with more frequent visits to general (medical) practitioners and outpatient clinics, and more admissions to hospital (10,11). Previously reported factors associated with malnutrition are multifactorial in nature and occur across seven domains: psychological (eg, depressive symptoms (12) and cognitive impairment (13)), demographic (eg, age (13), sex (14), education level (15), and marital status (14)), social (eg, social support (16) and living alone (17)), lifestyle (eg, alcohol consumption (18), smoking status (19), and activity level (15)), disease-related (eg, polypharmacy (20), recent hospitalization (16), number of chronic diseases (21), self-rated health status (12), and pain (22)), physical functioning (eg, falls (23), mobility (20), and handgrip strength (12)), and food intake (eg, appetite (20)).

Research published in this area is predominantly cross-sectional in design. Furthermore, thus far, no longitudinal studies have been conducted in Ireland to investigate predictors across all domains in older, community-dwelling adults (12,16,20,24). Therefore, the aim of this research was to determine the incidence of malnutrition in a subset of a nationally representative, community-dwelling population of adults aged 65 years or older living in Ireland, and to explore the predictors of incident malnutrition at 2-year follow-up using data from The Irish Longitudinal Study on Ageing (TILDA). A secondary aim was to assess sex-specific predictors of incident malnutrition. This study was carried out as part of the European Union Joint Programming Initiative "A Healthy Diet for a Healthy Life MalNutrition in the ELderly (MaNuEL) Knowledge Hub" (25).

Materials and Methods

Study Design and Population

Data from Wave 1 (October 2009–July 2011) and Wave 2 (March–December 2012) of TILDA were used in this analysis. TILDA is a nationally representative, prospective study of 8,175 adults aged 50 years and older, living in the Republic of Ireland. The full sampling procedure and study design has previously been described (26). In summary, the Irish Geodirectory, an up-to-date list of all residential addresses in the Republic of Ireland from "an Post" (the Irish postal service), was used as a sampling frame. A sample of addresses was selected from this directory using a random sampling design for Ireland sampling. The addresses were assigned to clusters based on geographical location, and a sample of clusters was then selected stratified by socioeconomic status and by geographical location to ensure the sample was nationally representative. Face-to-face interviews were conducted by trained professionals using Computer-Aided Personal Interview, representing a response rate of 62%. In addition, self-completion questionnaires were distributed (with a response rate of 84.6%). Seventy-two percent participated in a health assessment, conducted by trained research nurses in nominated health centers or the participant's home. TILDA was approved by the Trinity College Dublin Research Ethics Committee, with all participants providing written informed consent, and the study was conducted according to the Declaration of Helsinki.

Participants

Exclusion criteria in TILDA included medical diagnosis of dementia or inability to provide informed consent. For the current analysis, participants less than 65 years of age, missing data on body mass index (BMI) (at baseline or follow-up), missing self-reported weight loss (WL) data (at baseline) or lost to follow-up were excluded. Participants who were malnourished at baseline, defined as a BMI less than 20 kg/m^2 or with unintentional WL of at least 4.5 kg in the previous year (27), were also removed. A detailed description of the exclusion criteria is presented in Figure 1. The final sample comprised 1,841 participants (n = 916 men, n = 925 women).

Anthropometric Assessment

Weight and height were measured at baseline using standard techniques. BMI was calculated using kg/m^2. WL before baseline was assessed by asking: "In the past year have you lost 10 pounds (4.5 kg) or more in weight when you weren't trying to, for example, because of illness?". Malnutrition at follow-up was defined using a combination of low BMI (<20 kg/m^2) and/or WL (>10% calculated over the 2-year follow-up) adapted from the European Society of Clinical Nutrition and Metabolism diagnostic criteria for malnutrition (27). BMI at follow-up was calculated using measured height from baseline and self-reported weight at follow-up.

Categorization of Potential Predictors of Malnutrition

The categorization of the TILDA data for this study is described in Supplementary Table 1. All variables were assessed at baseline, except for falls and hospitalization, which were assessed for the year before baseline. At follow-up, in addition to the variables measured at baseline, hospitalization in the year before follow-up and falls during the follow-up period were assessed. Age (years) was presented as a continuous variable. Respondents over 80 were coded as "aged 80 years." Physical activity was measured using the International Physical Activity Questionnaire and categorized as high, moderate, or low (28). Appetite was assessed using the following question from the Center for Epidemiological Studies Depression (CES-D) scale (29): "In the past week, I did not feel like eating; my appetite was poor." The responses were categorized as follows: rarely/none of the time as having a "good" appetite and 1–7 days as having a "fair/poor" appetite. Cognitive impairment was assessed using the mini-mental state examination (30); this is scored from 0 to 30 points, whereby a score less than 24 infers impairment (31). The CES-D scale (29) was used to assess depressive symptomology. Scores range from 0 to 60, and a score of more than or equal to 16 suggests depressive symptoms (32). Mobility was assessed by asking participants (i) whether they have difficulty walking 100 m and (ii) whether they have difficulty climbing one flight of stairs without resting (33). Handgrip strength of the dominant hand was assessed using a

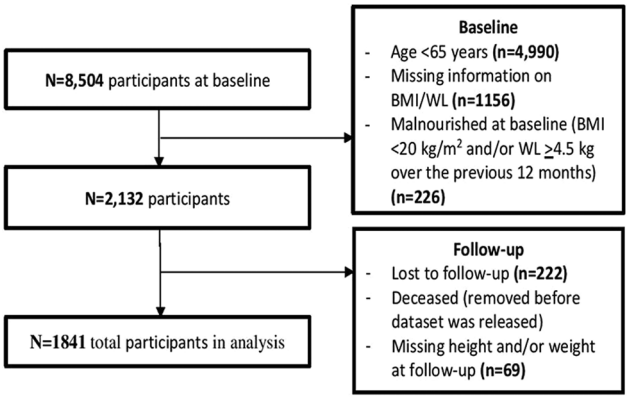

Figure 1. Baseline and follow-up inclusion and exclusion criteria

baseline hydraulic hand dynamometer (Fabrication Enterprises Inc, White Plains, NY). The score was calculated to the nearest kilogram and the highest score from two attempts was used. Participants self-reported previous physician diagnosis of the following chronic conditions: diabetes, lung disease, asthma, arthritis, osteoporosis, and cancer. Polypharmacy was defined as using at least five medications daily, excluding dietary supplements (34).

Statistical Analyses

Statistical analyses were performed using SPSS, version 20.0 (IBM Corporation). Baseline characteristics of the cohort were analyzed using descriptive statistics for demographic, anthropometric, and other clinically relevant data. BMI had a non-normal distribution; therefore, the non-parametric Wilcoxon signed-rank test was used to assess BMI change between baseline and follow-up. Missing values were less than or equal to 1.1% for all variables except alcohol consumption (7.8% total population, 8% males, 7.7% females), depressive symptoms (1.5% total population, 1.4% males, 1.5% females), and handgrip strength (1.4% females). Univariate logistic regression analysis was conducted across all variables with incident malnutrition at follow-up as the dependent variable. Variables significantly associated with incident malnutrition were included in a multivariate backward stepwise regression model. The analysis was repeated, stratified by sex. For all tests, significant results were determined by a p value of less than .05.

Results

The mean age of the population was 72 years (± 4.99) at baseline and approximately half were male (49.8%). The baseline characteristics of the study population are presented in Table 1. Incidence of malnutrition at 2-year follow-up was 10.7% (10.4% in males, 11% in females, $p = .649$). The malnourished proportion comprised 0.3% with a low BMI (<20 kg/m^2), 10.1% with WL, and 0.3% with low BMI and WL. Mean BMI decreased from 28.8 kg/m^2 at baseline to 27.9 kg/m^2 at follow-up ($p < .001$). Ten percent were current smokers and 56% consumed alcohol. Females were more likely to be widowed (32% vs 13%, $p < .001$), live on their own (35% vs 20%, $p < .001$), receive social support (6% vs 3%, $p = .003$), report a fair/poor appetite (11% vs 8%, $p = .007$), have at least two chronic diseases (32% vs 22%, $p < .001$), have depressive symptoms (9% vs 4%, $p < .001$), and self-reported pain (43% vs 29%, $p < .001$) than men. Functionally, women were more likely to report falling ($p = .010$ at baseline, $p < .001$ at follow-up), difficulties climbing stairs ($p < .001$), and having a low handgrip strength ($p < .001$) than men. However, women were less likely to be hospitalized during the follow-up period ($p = .003$).

The associations between potential predictors of malnutrition and incident malnutrition within the total sample are shown in Table 2. Following univariate analyses, advancing age, being unmarried/divorced/separated, receiving social support, having a low level of physical activity, polypharmacy (≥5 drugs), hospitalization in the year before follow-up, fair or poor self-rated health, depressive symptoms, cognitive impairment, difficulties walking 100 m, and difficulties climbing stairs were associated with malnutrition at follow-up ($p < .05$). Following multivariate analysis, being unmarried or divorced or separated, hospitalization in the year before follow-up, difficulties walking 100 m, and difficulties climbing stairs were the independent predictors of incident malnutrition at follow-up.

When examining determinants by sex, within males, univariate associations ($p < .05$) with incident malnutrition were observed for being unmarried or divorced or separated, low level of physical activity, fair or poor self-rated health, hospitalization (in the year before baseline and before follow-up), polypharmacy, difficulties walking 100 m, difficulties climbing stairs, and falls during the follow-up period (Table 3). Among the female participants, associations with incident malnutrition were observed for advancing age, receiving social support, polypharmacy, cognitive impairment, difficulties walking 100 m, and difficulties climbing stairs (Table 3). Following multivariate analyses, for men, hospitalization in the year before follow-up, falling during the 2-year follow-up period and difficulties climbing stairs remained as significant predictors of incident malnutrition. For females, cognitive impairment and receiving social support remained as predictors of incident malnutrition.

Discussion

In this large subset that was part of a nationally representative sample of community-dwelling older adults in the Republic of Ireland, the 2-year incidence of malnutrition was 10.7%. This study used data from a nationally representative sample of older adults in the Republic of Ireland (35) and from this dataset, selected malnutrition-free older adults aged at least 65 years at baseline. The sample comprised 916 males and 925 females, a ratio of males: females of 0.990. The ratio of older males to females in Ireland was 0.871 in 2016 (4).

The incidence rate of 10.7% observed here is similar to a 9-year incidence rate of 13.9% observed in a Dutch prospective study where incident malnutrition was defined as a BMI less than 20 kg/m^2 or unintentional weight loss more than or equal to 5% over 6 months (20). The main predictors of incident malnutrition in this sample were being unmarried or divorced or separated, hospitalization in the year before follow-up, and difficulties walking 100 m, and climbing stairs. All potential predictors were assessed at baseline, when all participants were adequately nourished, to ensure that the predictors of malnutrition could be clearly distinguished from the consequences of the condition. Moreover, the identified predictors differed between men and women.

Those who are unmarried or divorced or separated were more likely to develop malnutrition in our study. Being widowed, however, was not associated with malnutrition. This is in contrast to studies from New Zealand and Poland (14,36). However, our study did not evaluate how long participants had been widowed. Older adults who are recently widowed could potentially be at greater risk compared to those who have been widowed for many years (37). Being married is linked to better health behaviors throughout life, with more pronounced effects among men (38); however, in our cohort, married people were less likely to become malnourished regardless of sex.

Self-reported difficulties walking 100 m and climbing stairs are indicators of mobility limitations and imply declining physical function. Similarly, difficulty climbing stairs also predicted incident malnutrition in a large study (n = 1,120) of Dutch community-dwelling older adults (20). As poor physical function is a known outcome of malnutrition (39), these predictors are unsurprising.

Consistent with previous research (16), recent hospitalization predicted malnutrition in our study (40) indicating that hospitalization and/or the underlying cause for hospitalization may cause nutritional status to deteriorate and malnutrition to develop. Malnutrition among hospitalized older adults is associated with longer stay,

Table 1. Baseline Characteristics of The Irish Longitudinal Study on Ageing (TILDA) Participants Aged ≥65 Years at Risk of Developing Incident Malnutrition[1]

	Total population (n = 1,841)		Males (n = 916)		Females (n = 925)		
	Mean	SD	Mean	SD	Mean	SD	p Value
Demographic							
Age[a] (years)	71.7	4.99	71.7	4.96	71.7	5.03	.488
BMI (kg/m^2)							
Baseline	28.8	4.26	29.2	3.91	28.5	4.56	<.001*
At 2-year FU	27.9	3.98	28.2	3.42	27.5	4.44	<.001*
Marital status (%)							<.001*
Married	65.8		75.5		56.2		
Unmarried/divorced/separated	11.7		11.7		11.8		
Widowed	22.4		12.8		32.0		
Education level (%)							<.001*
Tertiary	28.4		28.6		28.2		
Secondary	35.3		31.3		39.3		
Primary/none	36.3		40.1		32.5		
Social (%)							
Living alone	27.4		20.2		34.5		<.001*
Receiving social support	4.4		2.9		5.8		.003*
Lifestyle (%)							
Physical activity							<.001*
High	32.1		39.0		25.3		
Moderate	36.2		36.2		36.3		
Low	31.7		24.8		38.4		
Alcohol consumers	56.1		65.7		46.6		<.001*
Current smokers	10.2		11.0		9.4		.251
Disease-related (%)							
≥2 chronic diseases	26.9		22.1		31.7		<.001*
Polypharmacy (≥5 drugs)	27.7		27.4		28.0		.780
Hospitalization							
1 y before baseline	14.3		14.4		14.3		.924
1 y before follow-up	19.1		21.8		16.4		.003*
Fair/poor SR health	22.7		22.1		23.4		.506
SR pain	35.9		28.7		43.0		<.001*
Food Intake (%)							
Fair/poor appetite	9.5		7.6		11.4		.007*
Psychological (%)							
Cognitive impairment	5.1		5.8		4.3		.152
Depressive symptoms	6.7		4.2		9.2		<.001*
Physical function (%)							
Difficulties walking 100 m	7.3		6.7		8.0		.270
Difficulties climbing stairs	36.8		28.8		44.8		<.001*
Falls- ≥1							
1 y before baseline	21.8		19.3		24.3		.010*
During 2 y follow-up	26.3		22.6		29.8		<.001*
Low HGS (M < 30 kg/F < 20 kg)	53.9		44.1		63.7		<.001*

Notes: FU = follow up; HGS = Handgrip strength; SR = self-reported Continuous data are presented as mean (SD = standard deviation). Categorical data are presented as percentages. p Values represent differences between males and females.

[1]Data from TILDA waves 1 (2009–2011) and 2 (2012) meeting inclusion criteria for this study. [a]Age was top-coded at 80 so mean may be slightly skewed to the left. *Indicates a statistically significant result (p < .05).

risk of readmission, institutionalization, and mortality (41). Thus, the identification of malnutrition or risk of malnutrition among this vulnerable group should be prioritized before discharge with appropriate monitoring and/or intervention programs put in place following discharge (40).

Surprisingly, having two or more chronic diseases was not associated with incident malnutrition. The evidence for comorbidity as a determinant of malnutrition is mixed, mainly due to the use of different cut-offs (some studies use up to six diseases as the cut-off) (14,20). However, a 2014 systematic review also concluded there was no evidence to support number of chronic diseases as a determinant of malnutrition (19). Evaluating the total number of chronic diseases may be too crude an estimate of malnutrition as the impact of specific conditions on risk of malnutrition can vary greatly (eg, asthma vs cancer) and the development of malnutrition may relate to an individual's ability to manage the comorbidities rather than the number *per se*. Furthermore, in our study, polypharmacy was not a significant predictor of incident malnutrition.

Table 2. Predictors of 2-Year Incident Malnutrition Using Univariate and Multivariate Binary Logistic Regression Models in Participants of The Irish Longitudinal Study on Ageing (TILDA)[1] (*n* = 1,841)

	Univariate model		Multivariate model*	
	OR	95% CI Lower–upper	OR	95% CI Lower–upper
Age (years, continuous)	**1.04**	**1.01 to 1.07**		
Female (ref: male)	1.07	0.80 to 1.44		
Fair/poor appetite (ref: good)	1.07	0.66 to 1.72		
Marital status (ref: married)				
Unmarried/divorced	**1.64**	**1.09 to 2.47**	**1.84**	**1.21 to 2.81**
Widowed	1.29	0.92–1.82	1.20	0.82 to 1.73
Education (ref: tertiary)				
Secondary	0.95	0.67 to 1.36		
Primary/none	0.90	0.63 to 1.28		
Living situation (ref: lives with others)				
Lives alone	1.21	0.88 to 1.65		
Social support (ref: no support)				
Receives support	**2.50**	**1.47 to 4.28**		
Physical activity (ref: high)				
Moderate	1.26	0.87 to 1.82		
Low	**1.56**	**1.08 to 2.25**		
Alcohol consumption (ref: non-consumer)	0.93	0.69 to 1.26		
Smoking (ref: non-smoker)	0.97	0.60 to 1.56		
Chronic diseases (ref: none/one)				
≥ 2 diseases	0.98	0.71 to 1.36		
Medication (ref: < 5 drugs)				
Polypharmacy (≥ 5 drugs)	**1.80**	**1.34 to 2.43**	1.34	0.96 to 1.88
Hospitalization 1 y before baseline (ref: no)	1.42	0.97 to 2.06		
Hospitalization 1 y before FU (ref: no)	**1.63**	**1.17 to 2.27**	**1.62**	**1.14 to 2.30**
SR pain (ref: no)	1.08	0.80 to 1.45		
Self-rated health (ref: good)				
Fair/poor	**1.65**	**1.21 to 2.26**		
Cognitive impairment (MMSE < 24) (ref: no)	**1.80**	**1.04 to 3.11**		
Depressive symptoms (CES-D ≥ 16) (ref: none)	**1.68**	**1.03 to 2.76**		
SR ability to walk 100 m (ref: no difficulties)				
Difficulties walking	**2.41**	**1.56 to 3.72**	**1.83**	**1.13 to 2.97**
SR ability to climb stairs (ref: no difficulties)				
Difficulties climbing stairs	**1.99**	**1.49 to 2.66**	**1.56**	**1.12 to 2.17**
Falls 1 y before baseline (ref: none)	1.06	0.75 to 1.49		
Falls during 2 y FU (ref: none)	1.29	0.94 to 1.76		
HGS (ref: normal (M ≥ 30 kg/ F ≥ 20 kg))				
Low (M < 30 kg/ F< 20 kg)	1.09	0.81 to 1.45		

Notes: CI = confidence interval; CES-D = center for epidemiologic studies depression scale; FU = follow-up; HGS = handgrip strength; MMSE = mini mental state examination; OR = odds ratio; SR = self-reported. Physical activity determined using the International Physical Activity Questionnaire. HGS determined using a baseline hydraulic hand dynamometer (Fabrication Enterprises Inc, White Plains, NY). Significant odds ratios ($p < .05$) are denoted in bold font.

[1]Data from TILDA waves 1 (2009–2011) and 2 (2012) meeting inclusion criteria for this study. *Binary logistic regression (method= backward stepwise), Nagelkerkes $R^2 = 0.052$

A recent systematic review reported the evidence (including seven papers on polypharmacy) to support an association was inconclusive (19). However, the majority of studies included in this review were cross-sectional in design.

Contrary to previous research investigating appetite (19), this was not associated with incident malnutrition in the TILDA sample. This may be due to the manner in which appetite was assessed; TILDA participants were questioned on how many days in the week before baseline they had a "poor" appetite or did not feel like eating. Assessing subjective appetite in tandem with questions that capture meal portion sizes, for example, using pictures (42), may provide a more accurate view of overall appetite and its impact on dietary intake.

This is one of the first studies to examine predictors of incident malnutrition by sex and, interestingly, the predictors differed between men and women. Among men, incident malnutrition was influenced by recent hospitalization and falls, and by difficulties climbing stairs. These male-specific predictors seem to be indicative of declining physical function and health which are also known consequences of malnutrition. Malnutrition is a predictor of falls in older community-dwelling adults (43); nonetheless, malnutrition is not routinely incorporated into falls-prevention programs (44,45). In contrast to our results, recent hospitalization was reported as a predictor of malnutrition risk in women but not men in a Swedish study (16). However, the Swedish study assessed malnutrition risk whereas we used incident malnutrition as the outcome variable in our study.

Table 3. Sex-Specific Predictors of 2-Year Incident Malnutrition Using Univariate and Multivariate Binary Logistic Regression Models in Men and Women in The Irish Longitudinal Study on Ageing[1]

	Males (n = 916)				Females (n = 925)			
	Univariate model		Multivariate model*		Univariate model		Multivariate model†	
	OR	95% CI Lower–upper	OR	95% CI Lower–upper	OR	95% CI Lower–upper	OR	95% CI Lower–upper
Age (years, continuous)	1.03	0.99 to 1.08			**1.05**	**1.01** to **1.09**		
Fair/poor appetite (ref: good)	0.93	0.42 to 2.10			1.12	0.61 to 2.04		
Marital status (ref: married)								
Unmarried/divorced	**1.92**	**1.09** to **3.38**			1.37	0.76 to 2.49		
Widowed	1.19	0.63 to 2.23			1.25	0.81 to 1.92		
Education (ref: tertiary)								
Secondary	0.94	0.55 to 1.61			0.95	0.59 to 1.52		
Primary/none	0.93	0.56 to 1.55			0.88	0.53 to 1.46		
Lives alone (ref: lives with others)	1.18	0.71 to 1.96			1.17	0.78 to 1.76		
Receives social support (ref: no support)	1.49	0.50 to 4.40			**3.00**	**1.60** to **5.64**	**2.44**	**1.19** to **4.99**
Physical activity (ref: high)								
Moderate	1.08	0.64 to 1.83			1.39	0.81 to 2.37		
Low	**1.79**	**1.06** to **3.02**			1.37	0.80 to 2.32		
Alcohol consumption (ref: non-consumer)	1.18	0.73 to 1.88			0.79	0.52 to 1.21		
Smoking (ref: non-smoker)	1.16	0.61 to 2.20			0.81	0.39 to 1.65		
≥2 diseases chronic diseases (ref: none/one)	1.11	0.68 to 1.83			0.86	0.56 to 1.33		
Polypharmacy (≥ 5 drugs) (ref: < 5 drugs)	**1.93**	**1.25** to **2.97**			**1.70**	**1.13** to **2.56**		
Hospitalization 1y before baseline (ref: none)	**1.76**	**1.04** to **2.97**			1.15	0.67 to 1.97		
Hospitalization 1 y before FU (ref: none)	**1.91**	**1.21** to **3.01**	**1.73**	**1.08** to **2.77**	1.42	0.87 to 2.32		
SR pain (ref: no)	1.54	0.99 to 2.40			0.78	0.52 to 1.16		
Fair/poor self-rated health (ref: good)	**2.44**	**1.57** to **3.81**			1.14	0.72 to 1.79		
Cognitive impairment (MMSE < 24) (ref: none)	1.32	0.58 to 3.02			**2.50**	**1.19** to **5.26**	**2.29**	**1.04** to **5.03**
Depressive symptoms (CES-D ≥ 16) (ref: none)	1.64	0.67 to 4.02			1.64	0.90 to 2.97		
SR difficulty walking 100 m (ref: no difficulties)	**2.49**	**1.29** to **4.78**			**2.32**	**1.30** to **4.15**	1.89	0.96 to 3.71
SR difficulty climbing stairs (ref: no difficulties)	**2.61**	**1.70** to **4.00**	**2.25**	**1.44** to **3.50**	**1.56**	**1.05** to **2.31**		
Falls 1 y before baseline (ref: none)	1.17	0.70 to to 1.96			0.96	0.61 to 1.52		
Falls during 2 y FU (ref: none)	**1.71**	**1.08** to **2.71**	**1.62**	**1.01** to **2.59**	1.00	0.65 to 1.53		
HGS (ref: normal (M ≥ 30 kg, F ≥ 20 kg))								
Low (M < 30 kg, F < 20 kg)	1.33	0.88 to 2.03			0.85	0.57 to 1.28		

Notes: CI = confidence interval; CES-D = center for epidemiologic studies depression scale; FU = follow-up; HGS = handgrip strength; MMSE = mini-mental state examination; OR = odds ratio; SR = self-reported. Significant odds ratios (p < .05) are denoted in bold font.

[1]Data from TILDA waves 1 (2009–2011) and 2 (2012) meeting inclusion criteria for the current study. *Binary logistic regression (method= backward stepwise), Nagelkerkes R^2 = 0.058. †Binary logistic regression (method= backward stepwise), Nagelkerkes R^2 = 0.044.

For women, assistance preparing meals or grocery shopping or completing household chores predicted those more likely to develop malnutrition; this may be a proxy for declining ability to self-care (and subsequent need for social support). Similar to our results, a perceived low level of social support was a predictor of nutritional risk among white older women but not men in an American cohort (46). Having a cognitive impairment also predicted malnutrition among participating women. Compared to our findings, different sex-specific associations were reported in Spanish and Swedish studies (12,47). However, these studies were cross-sectional in design and the outcome of interest was malnutrition risk as opposed to incident malnutrition in our study.

Strengths and Limitations

This is the first analysis of the predictors of incident malnutrition conducted among older adults in Ireland. Our study adds to the limited number of longitudinal studies investigating a full range of predictors of malnutrition in community-dwelling older adults.

A major strength of this study was that the analysis was conducted on a large subset from a longitudinal, nationally representative sample of older adults in Ireland. All variables were measured at baseline (falls and hospitalization were also assessed at follow-up), so the predictors of incident malnutrition were measured *before* malnutrition occurred. In previous cross-sectional studies, factors

associated with malnutrition cannot be distinguished from the consequences of being malnourished.

Some study limitations must be acknowledged. Self-reported body weight was used to calculate BMI at follow-up. Older adults may underestimate body weight (48) resulting in overestimation of the incidence of malnutrition (49). Over-reporting may also occur, in particular, following illness when unplanned weight loss has occurred (50). In this study, the difference between mean measured and mean self-reported BMI at baseline was 1.32 (± 0.06) kg/m^2 which is in line with the differences reported for the full TILDA sample (51). In our analyses, age was top-coded at 80 years, resulting in average age being lower than the true mean. Finally, dietary intake, which is commonly considered in the assessment of malnutrition (1,52), was not assessed in the study; however, dietary intake data are being collected in the current wave of TILDA so will be available for future use. Furthermore, previous assessment of a sample of community dwelling older Irish adults reported that their diets were nutritionally adequate (53).

Conclusions

It is evident from our data that malnutrition is an important and prevalent nutritional problem among older adults in Ireland. Marital status, recent hospitalization, and mobility difficulties predicted 2-year incidence of malnutrition. These predictors can be easily assessed through simple questions elicited opportunistically by allied health professionals within health and social care settings used by older adults. The findings can be exploited to identify older persons likely to develop malnutrition in the future and, hence, contribute to the prevention/early identification of the condition. Given the negative consequences of malnutrition, a national policy to identify and manage older adults vulnerable to malnutrition should be developed. This policy needs to be adequately resourced and provide healthcare practitioners with evidence-based care pathways.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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