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Prevalence and consequences of malnutrition and malnourishment in older individuals admitted to hospital with a hip fracture

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ABSTRACT

BACKGROUND/OBJECTIVES: Major causes of hip fractures are osteoporosis and falls, both of which are determined by nutrition. Information on the nutritional status of patients admitted to hospital with a hip fracture is lacking. In this study, we assessed determinants and adverse outcomes associated with malnutrition and malnourishment.

METHODS: Nutritional status, assessed using the Malnutrition Universal Screening Tool protocol, was compared to age and residency prior to admission, and outcomes during hospital stay and at discharge.

RESULTS: A total of 1239 patients admitted with a hip fracture (349 men, 890 women), aged 60-100yr. Compared with well-nourished individuals, the prevalences of malnutrition risk or malnourishment were higher in older age groups and those from residential or nursing care. Those with risk of malnutrition or malnourishment stayed in hospital longer by 3.0 days (95% confidence interval (CI), 1.5-4.5 days; $p<0.001$) and 3.1 days (95%CI, 0.7-5.5 days; $p=0.011$), respectively. Compared with the well-nourished group, malnourished individuals had increased: i) risk for failure to mobilise within 1-day of surgery (rates=17.9 *versus* 27.0%; odds ratio (OR)=1.6 (95%CI, 1.0-2.7), $p=0.045$); ii) pressure ulcers (rates=1.0% *versus* 5.0%; OR= 5.5 (95%CI, 1.8-17.1), $p=0.006$; iii) in-patient mortality (rates=4.5% *versus* 10.1%; OR=2.3 (95%CI, 1.1-4.8) $p=0.033$ and iv) discharge to residential/nursing care: rates=4.3% *versus* 11.1%; OR=2.8 (95%CI, 1.2-6.6), $p=0.022$.

CONCLUSIONS: Inadequate nutrition is common in patients admitted to hospital with a hip fracture, which in turn predisposes them to a number of complications. More research on nutritional support should be directed to this group to prevent or minimise hip fractures.

INTRODUCTION

The prevalence of hip fracture is common in high income countries, rising steeply with age [1, 2]. Hip fractures are associated with disability which imposes heavy personal and social costs [1-3]. Osteoporosis and frequent falls are interrelated predisposing factors of bone fractures [4]. Osteoporosis may arise from physical inactivity [5], drugs such as steroids and a decline in the levels of sex hormones [6], falls on the other hand, are primarily caused by frailty [7], poor vision and postural stability [8], cognitive decline [9], impaired mobility, urinary incontinence and a number of drugs [10]. Common conditions such as urinary [11] and lower respiratory tract infections often co-exist with frequent falls [12]. All of these risk factors are closely and reciprocally related to the nutritional status of the individual; poor nutrition leads to physical and mental impairment, predisposing an individual to osteoporosis and falls, and conversely these described conditions can often lead to inadequate nutritional intake. Despite medical and healthcare advances, and the understanding of the role of nutrition in the aetiology of chronic diseases, malnutrition and malnourishment remain highly prevalent in modern societies [13].

The nutritional status of an individual is undoubtedly an important indicator of their health status during the period leading to a hip fracture, and a prognostic marker for recovery potential. Previous studies on nutritional status in patients admitted with a hip fracture focussed primarily on mortality [14], while its association with other complications is surprisingly scarce and mostly based on small samples [15, 16]. In this study of older patients admitted with a hip fracture, we sought to measure the prevalence of risk of malnutrition and malnourishment in relation to age and the type of their residency before admission, and to evaluate the complications of malnutrition and malnourishment including mobility 1-day after surgery (an indicator of rapid

functional recovery), pressure ulcers, length of stay (LOS) and deaths in hospital, as well as discharge destination.

METHODS

Study design, participants and setting

We conducted a cross-sectional study of older individuals aged ≥60 years admitted with hip fractures as the principal diagnosis between 01/01/2016 and 06/06/2019 to a National Health Service hospital. This study does not require NHS Research Ethics Committee approval since it involves secondary analysis of anonymised data.

Measurement

Data were prospectively collected by a Trauma Coordinator for patients admitted with a hip fracture through our participation in the National Hip Fracture Database (NHFD) Audit Programme [17-20]. Information on clinical characteristics and care quality from the time of admission to discharge was documented including: age; sex; residency prior to admission; nutritional status on admission; mobility within 1-day after hip surgery; abbreviated mental test score (AMTS); pressure ulcers; LOS and mortality in hospital; new treatment with an antiresorptive agent and discharge destination. All data were updated regularly into a database managed by the lead orthogeriatrician who examined and corrected any error and ensured completeness of data collection as required by the NHFD Audit Programme. All patients with information on the variables described above were included in the present study. Patients whose primary diagnosis was other than hip fracture, or younger than 60 years were excluded.

Categorisation of variables

Nutritional status, assessed by the Malnutrition Universal Screening Tool (MUST) protocol, was stratified into overall scores of 0, 1, and ≥2 to indicate low, medium and high risk, respectively [21]. Mobilisation within 1-day after surgery was defined as those who were able to start rehabilitation no later than the day after surgery [22], pressure ulcers as the presence a new pressure ulcer (of grade 2 or above) acquired during the admission [20], and change in discharge destination as those who came from their own home before hospital admission but were transferred to places where increased care was provided, including residential care, nursing care, or rehabilitation units.

Nutritional support

All patients received nutritional assessment using MUST protocol and Fortisip® Compact (Nutritcia, The Netherlands) was prescribed for patients with medium (score = 1) or high risk (score ≥2) of malnutrition. For patients with medium risk, Fortisip® Compact was continued until reassessment on day 4, while patients with high risk were referred to dietitians for further assessment. The appropriate level of nutritional support depended on the level of deficiency, but in general, patients would be provided with Fortisip® Compact Protein (Nutritcia) if they were deemed to be protein deficient. Other supplements include Forticreme® Complete (Nutritcia), FortiJuice® (Nutritcia), Meritene® (Nestlé Health Science, UK) and Scandishakes® (Nutritcia) but these were generally determined by patient requirement and preference. Patients who were not able to tolerate or at risk of oral intake, enteral or parental nutrition would be considered if appropriate.

Rehabilitation programmes

Physiotherapy during hospital stay consisted of exercising in bed to improve the circulation, strengthen muscles around the hip and regain hip movement. This was done at least four times a day, progressing to daily walking exercises with crutches or sticks and then walking up and down stairs.

Statistical analysis

The minimum sample size was calculated based on the formula for cross-sectional studies: $n = [Z^2 \times P (1 - P)]/d^2$, where Z is the level of confidence (we chose Z = 1.96 for 95% CI), P is the expected prevalence (P for risk of malnutrition/malnourishment = 30% based on study by Lisk et al [18]), and d is precision (selected at 0.04, approximately 15% of P which is within the recommended precision of 10-20%) [23]. Thus, $n = [1.96^2 \times 0.3 \times (1- 0.3)]/0.04^2 = 504$. Group data are expressed as mean values ± standard deviation (SD). Differences in age and LOS between nutritional groups were tested by ANOVA with *post-hoc* analyses using a least-significant difference test where necessary. Differences between categorical variables were assessed by chi-squared tests. Logistic regression was performed to assess the association of different nutritional status with outcome measures, unadjusted and adjusted for age and sex. Analyses were performed using IBM SPSS Statistics, v23.0 (IBM Corp., Armonk, NY).

RESULTS

From a total of 1239 patients admitted with a hip fracture (349 men and 890 women), 1011 (81.6%) patients came from their own home, 144 (11.6%) from residential care and 84 (6.8%) from nursing care. The mean age was 83.8 ±8.6 years and LOS was 13.5 ±11.5 days, and median AMTS was 9 (interquartile range = 6-10). During admission, 20.0% of all patients failed to mobilise within 1-day of hip surgery, 1.5%

developed a new pressure ulcer, and 5.2% died in hospital, *i.e.* 1174 (94.8%) survived to discharge (**Table 1**). Almost all received specialist falls (99.4%) and physiotherapy (96.5%) assessment while in hospital. There were only 3.3% of patients on an oral or injectable antiresorptive agent before admission. After the assessment in hospital 3.5% did not require treatment, whilst 67.3% were newly prescribed with an oral and 17.0% with an injectable antiresorptive agent: 8.9% of patients were waiting for results of dual X-ray absorptiometry assessment for a decision on antiresorptive treatment to be made. Of the survivors, 943 were originally from their own home, among whom 528 (56.0%) returned home; whilst 31 (3.3%) were transferred to residential care, 21 (2.2%) to nursing care, 333 (35.3%) to rehabilitation and 30 (3.2%) to other destinations (**Figure 1**). Subsequently, all 1239 patients were analysed, except for the study on discharge destination where only those who originally came from their own home and survived to the point of discharge were selected (n=943).

Association of age and residency prior to admission with nutritional status

Patients were aged between 60 and 100 years. Overall, 67.8% were well-nourished, 24.1% at risk of malnutrition and 8.1% malnourished on admission (**Table 1**). The risk of malnutrition and malnourishment increased with age (χ^2 = 43.1, p <0.001) and with residential and nursing care (χ^2 = 60.5, p <0.001). Within the 60-70yr, 70-79yr, 80-89yr and 90-103yr age bands, the prevalences of risk of malnutrition were 6.7, 26.5, 24.0 and 28.5% and the corresponding values of malnourishment were 5.8, 3.6, 7.7 and 13.2% (**Figure 2A**). Among those who came from their own home, residential care or nursing care prior to admission, the prevalences of the risk of malnutrition were 20.3, 41.7 and 40.5%, and malnourishment were 7.1, 10.4 and 15.5%, respectively (**Figure 2B**).

178

179 **Association of nutritional status and outcomes in hospital**

180 Within each of the three nutritional status categories (well-nourished, risk of
181 malnutrition and malnourishment), there was a significant rise in the proportions of
182 failure to mobilise within 1-day of hip surgery: 17.9, 23.7 and 28.6% (χ^2 = 8.1, *p* =
183 0.018), pressure ulcers: 1.0, 1.7 and 5.0% (χ^2 = 10.4, *p* = 0.006), and also of
184 mortality: 4.5, 6.2 and 10.1% (χ^2 = 6.0, *p* = 0.049), respectively (**Figure 3**).

185

186 The LOS was also significantly different between nutritional status (*F* = 11.1, *p*
187 <0.001). Compared with the LOS for the well-nourished group (mean 12.5 days
188 ±10.1), the LOS was longer for the risk of malnutrition group (mean 15.5 days ±14.0)
189 and the malnourished group (mean 15.6 days ±13.4), equating to a longer LOS in
190 hospital by 3.0 days (95% CI: 1.5-4.5 days, *p* <0.001) and 3.1 days (95% CI = 0.7-
191 5.5 days, *p* = 0.003), respectively (**Figure 4**). There were no significant differences in
192 LOS between risk of malnutrition and malnourishment groups.

193

194 **Table 2** shows that compared with those considered to be well-nourished on
195 admission, the age- and sex-adjusted risk in those with malnourishment for failure to
196 mobilise within 1-day of surgery was: OR=1.64 (95%CI = 1.01-2.65, *p* = 0.045); for
197 pressure ulcers was: OR = 4.88 (95%CI = 1.53-15.60, *p* = 0.007); and for inpatient
198 mortality was: OR = 2.26 (95%CI = 1.07-4.80, *p* = 0.033).

199

200 **Association of nutritional status and discharge destination**

201 Among the 943 patients admitted from their own home who survived to discharge,
202 there were 4.3, 8.0 and 11.1% in the well-nourished, risk of malnutrition and
203 malnourished groups, respectively, who were discharged to residential/nursing care

(χ^2 = 7.9, p = 0.019). Compared with the well-nourished group, the risk for a discharge to residential/nursing care was increased by 1.93-fold (95%CI = 1.01-3.65, p = 0.045) for those with risk of malnutrition, and by 2.76-fold (95%CI = 1.16-6.57, p = 0.022) for those with malnourishment.

DISCUSSION

In this study of older adults admitted with a hip fracture, risk of malnutrition and malnourishment were more prevalent with increasing age and in those from residential/nursing care. More of those identified with risk of malnutrition and malnourishment failed to mobilise within 1-day after surgery, pressure ulcers, longer LOS and mortality in hospital. Those who survived to the point of discharge from hospital were more likely to be transferred in a residency of high level of care.

Nutritional status mirrors the underlying health and well-being of an individual. The present study highlights the common and persisting occurrence of inadequate nutrition and its complications in older adults and those living in a care home, which helps raise greater awareness to healthcare professionals in order to prevent or minimise the risk of fractures. A recent review of 12 studies on nutritional status, assessed by Mini-Nutritional Assessment (MNA) and MNA short form (MNA-SF), showed that among patients admitted to hospital with a hip fracture showed the average prevalence of risk of malnutrition was 35.3% and malnourishment was 18.7% [14], which are higher than our figures of 24% and 8% respectively. However, the review included studies, from high income countries, dating back more than a decade ago. The prevalence of inadequate nutrition in individuals with a hip fracture living in an institution is less well documented. Using MNA to assess nutritional status, reports on non-hip fracture studies showed that among German home-care

receivers with functional impairments, 57% of these individuals were at risk of malnutrition and 12% were malnourished, [24]. Among Swedish older patients admitted to hospital, the corresponding figures were 55.1% and 9.4% [25], which are similar to figures reported from a multinational study of 1586 older adults from nursing home of 53.4% and 13.8%, both studies also used MNA [26]. In comparison, the prevalence of risk of malnutrition (40.5% from residential and 41.7% from nursing care) observed in our study was lower, but the prevalence of malnourishment was not too dissimilar (10.4% from residential and 15.5% from nursing care). The observations of the association of risk of malnutrition or malnourishment with older age in our study are similar to those reported in other studies [27].

Although the association between nutritional status in patients admitted with hip fracture and mortality has been established [14], less is known about its relationship with other clinical outcomes. The findings of this study showing an association of risk of malnutrition or malnourishment with a number of complications are in line with those of patients admitted to hospital for general conditions other than hip fractures [25, 28]. Overall, there were only 1.5% of our patients who developed a pressure ulcer, which is relatively low compared with a recently reported figure of 5.2% among patients admitted with a hip fracture in the US [29], and 12% in Europeans studied more than a decade ago [30]. Our study showed the important role of nutrition and risk of pressure ulcers and is supported by evidence from a smaller study of older adults with dementia living in nursing homes showing an association of inadequate nutrition with increased risk of developing pressure ulcers [31]. Findings from our study are also consistent with previous observations of the association of risk of malnutrition and malnourishment in non-hip fracture admissions with longer LOS and

discharge to high level of care in a study by Neuman et al [28], and risk of all-cause mortality in a five year follow-up study by Söderström et al [25].

Observations from our study suggest the need to gain further insights into ways that improve nutrition of older adults living in the community, particularly those from institutionalised residency, in order to lower the risk of fractures and their complications. For those who were admitted to hospital with a hip fracture and with evidence of malnutrition or malnourishment, early nutrition support is vital for adequate supply of energy and nutrients to prevent rapid loss of muscular and skeletal mass and strength arising from extreme physical inactivity. Interventional studies have been conducted to address malnutrition or malnourishment and showed mixed results [32], with some success reported in reducing LOS in hospital [33], functional recovery [34] and reducing [35] or delaying onset and progression of pressure ulcers [36], while some studies found little or no benefit [37, 38], probably due to non-compliance [37, 39] but may also be confounded by a number of other co-existing factors such as co-morbidities, medications and infections.

The relatively high prevalence of risk of malnutrition or malnourishment in the community and hospital, together with their adverse consequences observed in our study, lend support for routine nutritional assessment of older patients admitted to hospital. Oral nutritional supplement in adults admitted to hospital has been shown to reduce the hospital LOS by 2.3 days, and 30-day readmission by 2.3% [40], while enteral nutrition support for critically ill patients has been shown to reduce mortality by 56% [41]. A delay in a dysphagia screen (thus delay in nutrition support) for patients admitted with an acute stroke was shown to associate with a LOS on hyperacute stroke units, increased risk of urinary tract infection and pneumonia

within seven days of admission and greater in-patient mortality [42]. More research on the effect of early nutrition support for at-risk patients (*e.g.* those developed a new life-changing condition such as cognitive impairment) may be helpful to see if early intervention would prevent or reduce adverse clinical outcomes.

Limitations and strengths

The present study has certain limitations due to the nature of its study design. Although risk of malnutrition or malnourishment were identified on admission and routinely treated in our centre, we did not have information on their nutritional status afterwards. However, all those with evidence of risk of malnutrition or malnourishment were referred to dietitians. Previous studies have shown that patients with malnourishment on admission and without nutritional support lost 5.4% of body weight, whilst those referred for nutritional support gained 7.9% on discharge [43]. While only 3% of patients in our study was on an antiresorptive treatment, 84% received a new antiresorptive agent while in hospital and a further 9% were being considered after discharge. The strengths of the study include its relatively large sample with precise and detailed data collected according to the national guidelines [13-15]. We used the MUST protocol because it was selected by the Royal College of Physicians for the NHFD Audit Programme for its well-validated and widely applied in clinical practice for assessing nutritional status [21], and has been shown to be comparable with other nutritional assessment tools [44]. There exist a number of other methods for assessing nutritional status, including the Mini Nutritional Assessment instrument (MNA-SF) which is an effective tool for screening the nutritional status of geriatrics across settings. However, MUST and Nutrition Risk Screening (NRS-2002) proposed by the European Society for Clinical Nutrition and

306 Metabolism (ESPEN) for the hospital setting are applicable to all hospital patients,
307 irrespective of age [21].
308
309 In conclusion, inadequate nutrition is common in patients admitted to hospital with a
310 hip fracture from residential/nursing, which in turn predisposes patients to a number
311 of complications. More research on nutritional support should be directed in this
312 group to prevent or minimise hip fractures.

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Compliance with ethical standards The authors declare that they have no conflict of interest.

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463

45. **Table 1.** Characteristics of 1239 of older adults aged 60-100 years admitted with hip fractures.

	Mean ±SD
Age (years)	83.8 ±8.6
Length of stay in hospital (days)	13.5 ±11.5
	Median (IQR)
Abbreviated mental test score	9 (6-10)
	Proportion (%)
Sex distribution (women: men)	71.8: 28.2
Residence before admission	
Own home: residential care: nursing care	81.6: 11.6: 6.8
Mobility within 1-day after hip surgery	
Able to mobilise: failure to mobilise	88.0: 22.0
Pressure ulcers acquired in hospital	1.5
Death in hospital	5.2
Nutritional status on admission	
Well nourished: risk of malnutrition: malnourished	67.8: 24.1: 8.1
Specialist falls assessment	99.4
Physiotherapist assessment	96.5

46. SD, standard deviation; IQR, interquartile range.

Table 2. Rates and risk of failure to mobilise within 1-day after hip surgery, pressure ulcers and death in hospital, and discharge to residential/nursing care.

	Well-nourished (n=840)*†	Risk of malnutrition (n = 299)†			Malnourishment (n = 100)†		
Model 1: Unadjusted	**OR**	**OR**	**95% CI**	***p***	**OR**	**95% CI**	***p***
Failure to mobilise within 1-day of surgery	1	1.43	1.04-1.97	0.028	1.70	1.06-2.74	0.028
Pressure ulcers in hospital	1	1.77	0.57-5.45	0.321	5.47	1.76-17.07	0.003
Death in hospital	1	1.40	0.79-2.51	0.251	2.39	1.15-4.98	0.019
Discharge to residential/nursing care	1	1.93	1.01-3.65	0.045	2.76	1.16-6.57	0.022
Model 2: Age and sex adjusted							
Failure to mobilise within 1-day of surgery	1	1.42	1.03-1.96	0.033	1.64	1.01-2.65	0.045
Pressure ulcers in hospital	1	1.70	0.55-5.26	0.360	4.88	1.53-15.60	0.007
Death in hospital	1	1.43	0.80-2.58	0.230	2.26	1.07-4.80	0.033
Discharge to residential/nursing care	1	1.66	0.87-3.20	0.128	2.10	0.87-5.06	0.099

47. *Reference group; †For analysis of discharge to residential/nursing care, only those admitted from own home were selected (n = 943): Well-nourished = 693, risk of malnutrition = 187, malnourished = 63.

FIGURES and LEGENDS

Figure 1.

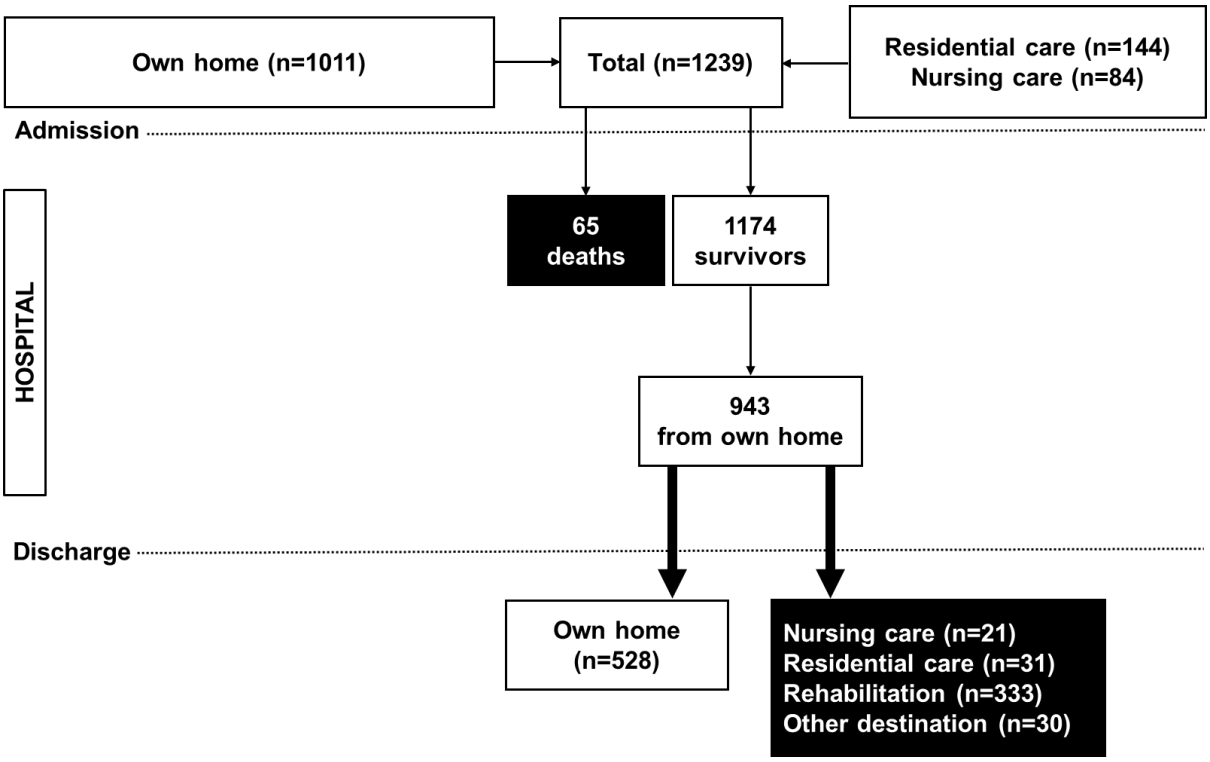
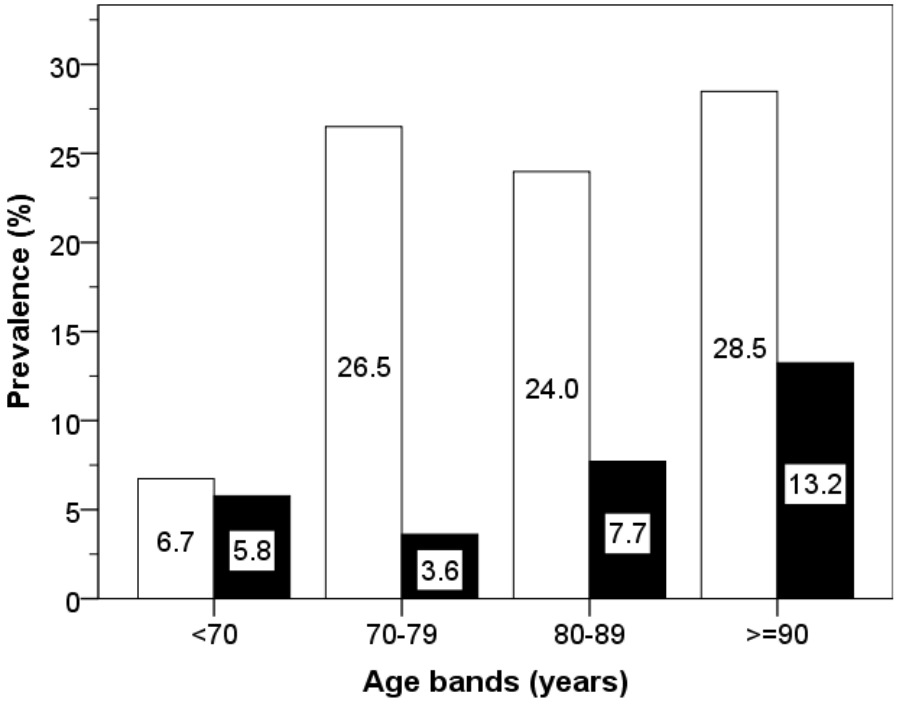


Figure 1. Flow chart showing the distribution of patients before, during and after hospitalisation.

Figure 2.

(**A**)



(**B**)

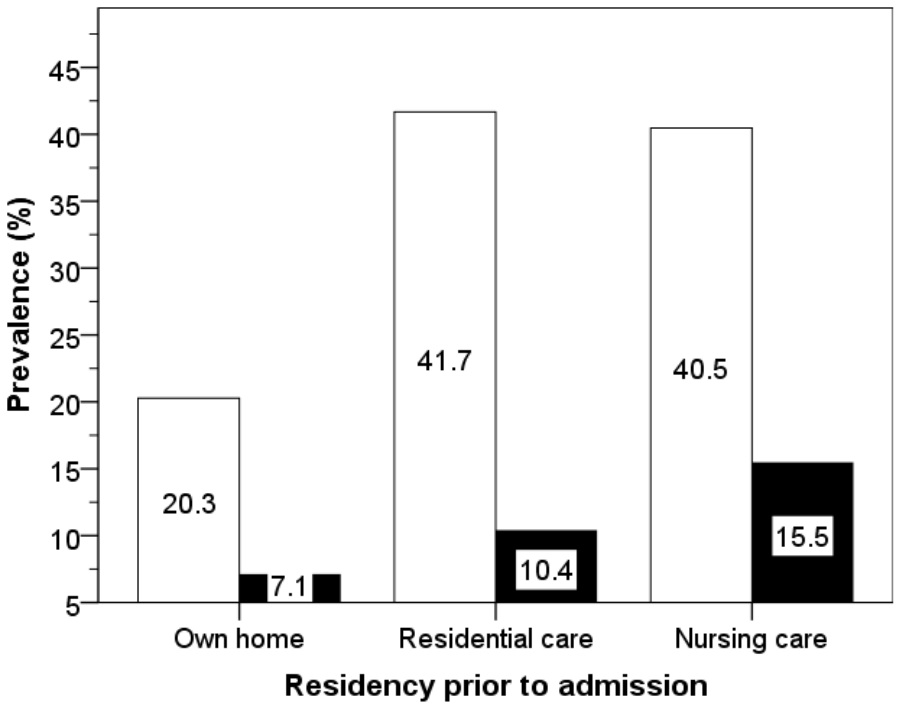


Figure 2. Prevalence of patients at risk of malnutrition (open bars) or malnourishment (solid bars) on admission to hospital with a hip fracture according to age (**A**) and residency prior to admission (**B**).

Figure 3

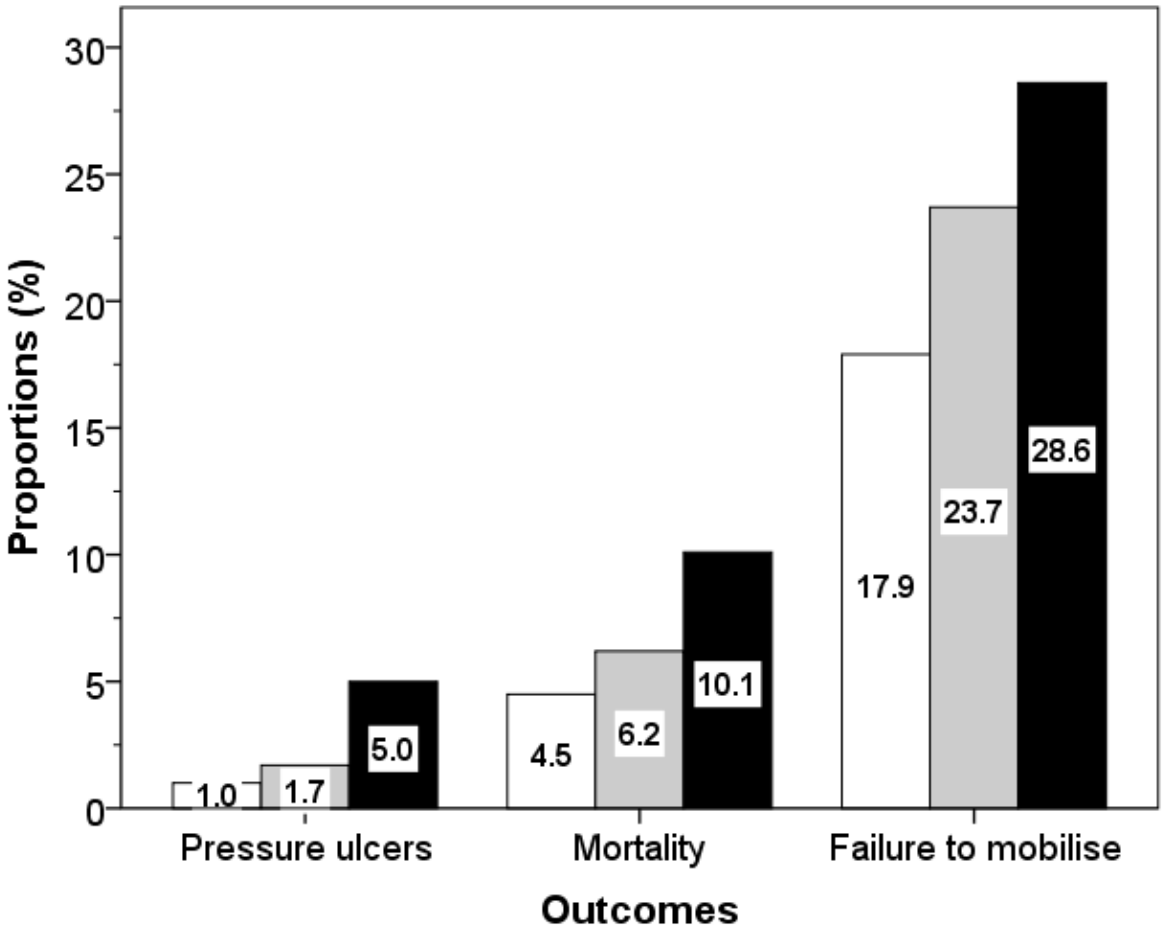


Figure 3. Proportions of patients with pressure ulcers, failure to mobilise within 1-day after hip surgery, and mortality according to nutritional status: white bars indicate well-nourished, grey bars indicate risk of malnutrition, and black bars indicate malnourishment.

Figure 4.

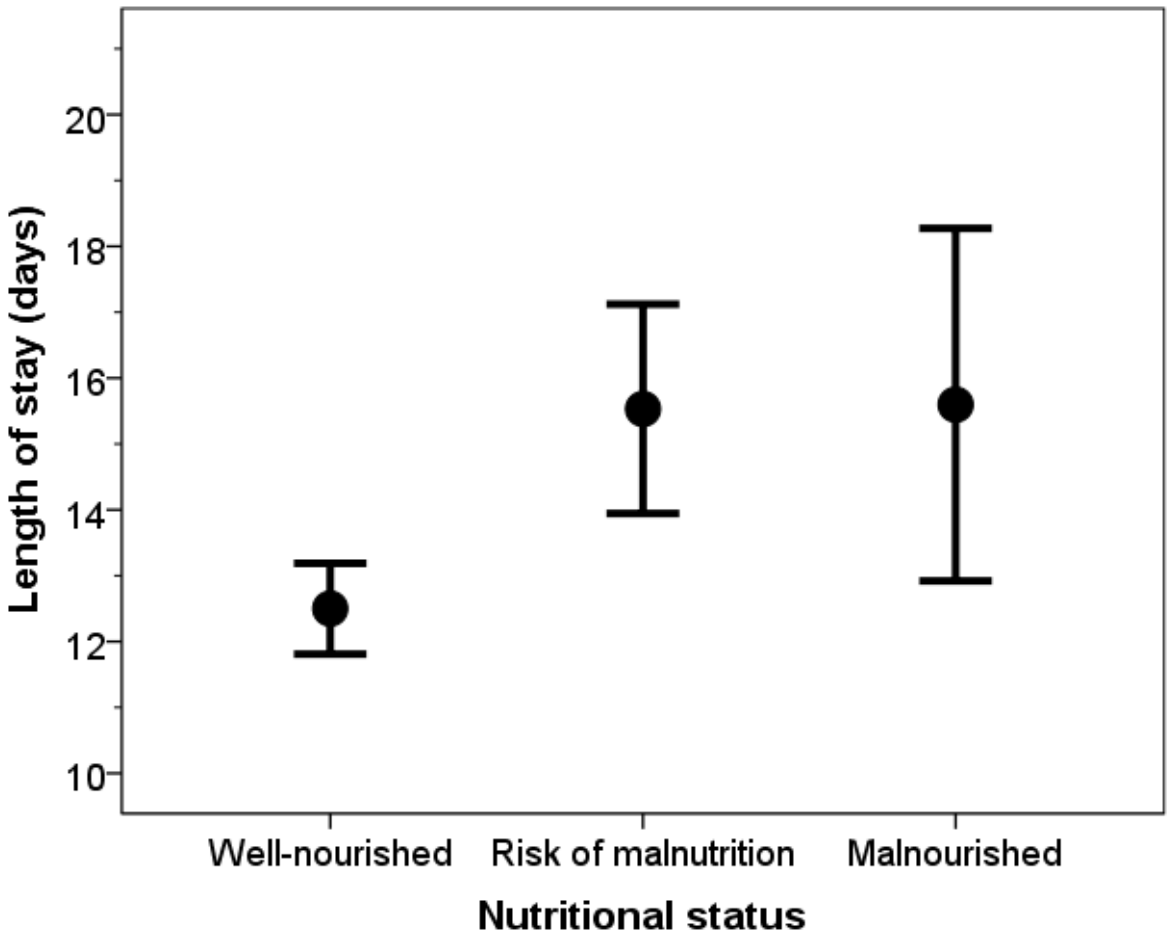


Figure 4. Length of stay in hospital among individuals with different nutritional status.