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Malnutrition risk and hospital-acquired falls in older adults: A cross-sectional, multicenter study

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Aim: To assess the relationship of malnutrition risk and in-hospital falls in a patient group of older hospitalized patients (65–79 and ≥80 years).

Methods: A cross-sectional, multicenter, point-prevalence study was conducted in 68 Austrian hospitals with 3702 hospitalized older patients. The relationship between malnutrition risk and falls was analyzed using univariate and multivariate binary logistic regression analyses. Data were analyzed separately for two age groups, patients were aged 65–79 years (n = 2320) and ≥80 years (n = 1382).

Results: Prevalence of hospital-acquired falls was 5.2%, and prevalence of risk of malnutrition was 24.3% (Malnutrition Universal Screening Tool) and 16.2% (definition using body mass index and weight loss). The univariate analysis showed significant associations of malnutrition risk and in-hospital falls for patients aged ≥80 years (odds ratio 2.1; 95% confidence interval 1.2–3.6) but not for patients aged 65–79 years. The multivariate logistic regression analysis did not show significant associations between malnutrition risk and hospital-acquired falls.

Conclusions: The results of this study show that malnutrition risk is a predictor for in-hospital falls in very old patients (≥80 years). In this patient group, the screening and assessment of nutritional status as well as nutritional interventions for the prevention/treatment of malnutrition risk should be considered as one important factor for successful fall prevention. Studies are necessary to assess the effect of nutritional interventions as part of a multifaceted fall-prevention program. **Geriatr Gerontol Int 2020; 20: 348–353**.

Keywords: association, falls, malnutrition, predictor, prevention.

Introduction

Falls are common in older adults and represent a major threat to the sense of independence and health of older persons.[1] A recently published study shows that about 28% of hospitalized patients report that they had fallen during the last 12 months, and about 15% of these patients experienced a fall in hospital.[2] More than half of the falls lead to fall-related injuries,[3,4] >20% of the falls in older adults require a hospital visit,[4] and falls even represent a major cause of death among very old persons.[5] Fall-related injuries can have a considerable negative impact on the patients' quality of life[1] and studies have confirmed high costs related to fall events and consequences, ranging from about 2000 to 26 000 USD per fallen person.[6]

Commonly mentioned risk factors for in-hospital falls, for example, are having a positive fall history, fear of falling, agitated confusion, urinary incontinence, psychotropic medication or instability while walking.[7,8] Walking difficulties in older adults are strongly related to muscle strength impairment, and several studies have shown that sarcopenia, which is defined as loss of muscle mass, strength and function, increases the risk of falls and fractures.[9] Sarcopenia is related to malnutrition, as many malnourished patients are concurrently sarcopenic.[10] These facts strongly suggest that malnutrition may be a predictor for in-hospital falls.

However, previous studies and systematic reviews that have summarized the risk factors for in-hospital falls and falls in general rarely mention malnutrition.[3,7,11] Some authors examined the association of malnutrition and falls in the community setting[12] or in long-term care institutions,[13] but the predictive value of malnutrition or malnutrition risk on hospital-acquired falls is still unclear.

Therefore, the aim of this study was to assess the relationship of malnutrition risk and in-hospital falls in a patient group of older hospitalized patients (≥65 years). The research questions asked were:

- Is the presence of malnutrition risk a predictor for in-hospital falls in older patients?
- Is there a difference among the predictors of in-hospital falls in older patients aged 65–79 and very old patients ≥80 years?

Methods

Design, participants and ethical considerations

This is a secondary data analysis of cross-sectional, multicenter, point-prevalence studies conducted during 2017 and 2018. All Austrian hospitals with >50 beds were invited to participate in the study, either with all or some of the wards in the respective hospitals. Participation in the study was voluntary. All patients who were admitted on the day of measurement (November 14, 2017 and November 13, 2018) were informed about the study and asked to participate. If they agreed, they received detailed information about the study, and they had to provide written informed consent. If the

patient was not able to provide informed consent, the legal representatives were asked to decide whether the patient should participate in the study. The ethics committee for each participating hospital approved the study (20–192 ex 08/09), and the study was conducted in accordance with the Code of Ethics issued by the World Medical Association and the Declaration of Helsinki.

Data collection

Each hospital nominated a coordinator who was responsible for the measurements. Furthermore, each participating ward appointed one person that organized the measurements on the respective ward. The coordinators and persons responsible at the ward level received training from members of the research team. Data were collected by two persons: one who was familiar to the patients and one who worked on another ward to ensure objectivity. Data were collected by questioning the patients and accessing relevant data in the patient records. All data was entered into a specifically programmed, password-protected data entry program with online security (https://at.lpz-um.eu/).

A standardized questionnaire was used to collect data on fall incidence and potential predictors of in-hospital falls, such as demographic characteristics, medical diagnoses, care dependency, use of psychotropic drugs, pain prevalence, incontinence and the patients' fall and malnutrition risk levels.[2,14] The patients' medical diagnoses were assessed by referring to the *International Classification of Diseases (ICD-10)*. A fall was defined as an event that resulted in the person coming to rest inadvertently on the ground or floor or other lower level.[15] To evaluate the fall incidence, the persons responsible for the study on the participating wards documented all falls that had occurred during the 30 days before the measurement. They also documented whether the most severe fall in the institution had caused physical injuries to the patient and, if so, indicated the severity of the injury or injuries. A risk of falling was considered present if the patient had experienced at least one fall during the last 12 months.

The *Care Dependency Scale (CDS)* was used to assess the care dependency of the patients.[16] The capabilities of patients were assessed on a five-point Likert scale, ranging from completely dependent to completely independent. The lower the total score, the more care-dependent the patients are. The CDS shows good validity and reliability in older hospitalized patients.[16]

To assess whether the patients were at risk of malnutrition, two methods were applied: the *Malnutrition Universal Screening Tool* (MUST)[17] and a malnutrition definition. The MUST is a valid tool that is very easy to use and requires about 3–5 min to complete.[18] The malnutrition definition included the body mass index (BMI) and unintentional weight loss; in particular, unintentional weight loss was considered >10% body weight over the previous 6 months or >5% body weight during the previous month with or without a BMI <18.5 kg/m^2 in patients <65 years and <20 kg/m^2 for patients ≥65 years.[19]

Data analysis

We analyzed the data using SPSS version 25 (IBM Corp., Armonk, NY, USA). For this study, we analyzed data collected from patients aged ≥65 years. Two persons performed the data cleaning and deleted invalid values (e.g., BMI >60). Patient characteristics were analyzed using descriptive statistics. The χ^2 and Student's *t*-test were used to show differences between the age groups as well as between fallers and non-fallers. The association between malnutrition risk, other patient characteristics and hospital-acquired falls was calculated using univariate and multivariate binary logistic regression analyses. Experiencing a fall in the hospital (yes/no) was used as the dependent variable. Fallers and non-fallers were compared based on the following variables: gender, age, number of medical diagnoses, CDS scale, different diagnoses (dementia, diseases of the nervous system, diseases of the spinal cord, diseases of the musculoskeletal system and connective tissue, diseases of the eye, stroke), use of psychotropic medication, pain during the last 7 days, incontinence, BMI, risk of malnutrition according to MUST and risk of malnutrition according to the definition, including BMI and weight loss. The significance level was set at $P < 0.05$. Variables that differed significantly between fallers and non-fallers in the univariate logistic regression analysis were included in the multivariate binary logistic regression analysis.

Results

Sample characteristics

In total, 68 Austrian hospitals participated in the study and 8637 hospitalized patients were asked to participate in the measurement during 2017 and 2018; 6271 patients accepted the invitation. Of those patients, 3702 were ≥65 years, 2320 were aged 65–79 years and 1382 were aged ≥80 years. The most frequently indicated reasons for non-participation were refusal (42.2%), cognitive impairment (16.8%), unavailability during the measurement (12.3%) or insufficient understanding of the German language (10.9%). Most of the patients were admitted to a surgical or internal ward (see Fig. 1).

The mean age of the patients was 77.6 years, and more than half were female (Table 1). In total, 54% were completely independent from care, whereas 4.1% were completely care dependent and 8.5% were to a great extent care dependent. More detailed patient characteristics are shown in Table 1.

Prevalence of falls, fall-related injuries and malnutrition risk

The overall prevalence of falls within the 30 days before the measurement in the hospital was 5.2% (n = 193). The highest prevalence rate of hospital-acquired falls was observed in geriatric wards (8.4%, 36) followed by internal medicine wards (6.2%, 124). The prevalence of the risk of falling, defined by the rate that a fall had been experienced within the last 12 months, was 31.6% (n = 1165) in the total sample and significantly higher in patients ≥80 years (39.5%, 544). The fall experienced in the hospital caused physical injuries to the patient in 42.0% (n = 81) of the cases. Of these injuries, 67.9% were minor injuries that did not need

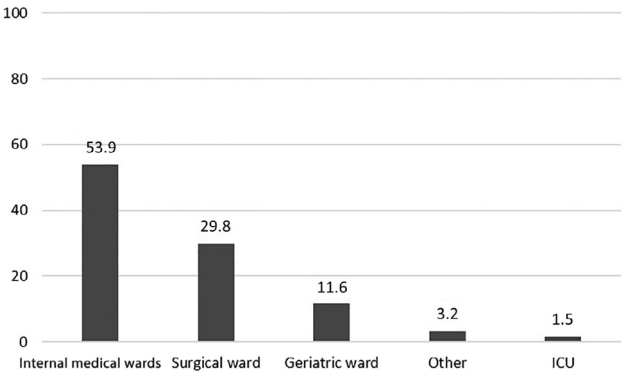

Figure 1 Percentage of patients admitted to the different types of wards on the day of measurement.

Table 1 Characteristics and differences between patients 65–79 and ≥80 years†

Characteristics	Total (n = 3702)	Patients 65–79 years old (n = 2320)	Patients ≥80 years (n = 1382)	P-value
Female	2026 (54.7)	1171 (50.5)	855 (61.9)	0.000
Age, years	77.6 ± 7.6	72.76 ± 4.3	85.6 ± 4.3	0.000
Number of ICD-10 diagnosis	3.2 ± 1.8	3.1 ± 1.7	3.5 ± 1.9	0.000
Patients completely dependent from care (CDS score ≤24)	153 (4.1)	69 (3.0)	84 (6.1)	0.000
Patients completely independent from care (CDS score >69)	2000 (54.0)	1461 (63)	539 (39.0)	0.000
CDS sum score	63.8 ± 15.2	66.5 ± 13.5	59.4 ± 16.7	0.000
BMI, kg/m^2	26.2 ± 5.2	26.8 ± 5.5	25.3 ± 4.6	0.000
Patients with a fall during last 30 days in hospital	193 (5.2)	110 (4.7)	83 (6.0)	0.094
Fallers with a fall injury	81 (2.2%)	42 (1.8)	39 (2.8)	0.220
Patients with a risk of falling	1165 (31.6)	621 (26.8)	544 (39.5)	0.000
Use of psychotropic drugs	1317 (35.9)	767 (33.2)	550 (40.4)	0.000
Patients with malnutrition risk, MUST	793 (24.3)	524 (25.2)	269 (22.7)	0.107
Patients with malnutrition risk due to BMI and weight loss	541 (16.2)	343 (16.1)	198 (16.3)	0.895
Most frequent ICD-10 diagnoses				
Circulatory diseases	2273 (61.4)	1295 (55.8)	978 (70.8)	0.000
Musculoskeletal diseases	1096 (29.6)	511 (26.3)	485 (35.1)	0.000
Genitourinary diseases	999 (27.0)	555 (23.9)	444 (32.1)	0.000
Respiratory diseases	937 (25.3)	602 (25.9)	335 (24.2)	0.248
Digestive diseases	900 (24.3)	551 (23.8)	349 (25.3)	0.302

BMI, body mass index; CDS, Care Dependency Scale; MUST, Malnutrition Universal Screening Tool.
†Values presented are n (%) for categorical data and mean (± SD) for metric data, according to the distribution.

medical interventions, such as bruises or abrasion. The injuries were moderate in 18.5% of the cases, including injuries such as contusions, cuts that needed stitching and abrasions that required wound care, while 13.6% were severe injuries, such as serious head injuries or fractures.

According to the MUST, 24.3% of the patients were at risk of malnutrition and according to the definition using the BMI and weight loss, 16.2% were at risk of malnutrition. The prevalence of the malnutrition risk did not significantly differ between old and very old patients (Table 1).

Table 2 Predictors for hospital-acquired falls in patients aged 65–79 and ≥80 years, analyzed with univariate analysis (χ^2 tests and Mann–Whitney U-tests)†

	Patients 65–79 years old (n = 2320)			Patients ≥80 years old(n = 1382)		
	Fallers	Non-fallers	P-value	Fallers	Non-fallers	P-value
Risk of malnutrition, BMI and weight loss	19 (20.4)	324 (16.0)	0.251	20 (28.2)	178 (15.6)	0.005
Risk of malnutrition, MUST	29 (31.9)	495 (24.9)	0.137	19 (27.5)	250 (22.4)	0.325
BMI	26.1 ± 4.8	26.8 ± 5.5	0.254	24.0 ± 4.3	25.3 ± 4.6	0.016
Female	50 (45.5)	1121 (50.7)	0.281	49 (59.0)	806 (62.0)	0.584
Dementia	9 (8.2)	60 (2.7)	0.001	20 (24.1)	122 (9.4)	0.000
Disease of the nervous system	20 (18.2)	274 (12.4)	0.075	19 (22.9)	165 (12.7)	0.008
Disease of the spinal cord	1 (0.9)	10 (0.5)	0.496	0 (0.0)	6 (0.5)	0.535
Disease of the eye	8 (7.3)	130 (5.9)	0.547	10 (12.0)	157 (12.1)	0.992
Stroke	23 (20.9)	178 (8.1)	<0.001	16 (19.3)	120 (9.2)	0.003
Musculoskeletal disease	31 (28.2)	580 (26.2)	0.653	30 (36.1)	455 (35.0)	0.836
Use of psychotropic drugs	66 (60.0)	701 (31.8)	<0.001	54 (65.9)	496 (38.8)	0.000
Pain in the last 7 days	64 (58.2)	1330 (60.2)	0.647	48 (57.8)	766 (59.0)	0.838
Incontinence	31 (28.2)	439 (19.9)	0.034	35 (42.2)	506 (39.0)	0.561
Number of medical diagnosis	3.9 ± 2.0	3.0 ± 1.7	<0.001	3.9 ± 1.7	3.5 ± 1.9	0.036
CDS sum score	60.2 ± 15.0	66.7 ± 13.4	<0.001	54.3 ± 15.3	59.7 ± 16.67	0.000

BMI, body mass index; CDS, Care Dependency Scale; MUST, Malnutrition Universal Screening Tool.
†Values presented are n (%) for categorical data and mean ± SD for metric data.

Table 3 Predictors of hospital-acquired falls in patients aged 65–79 and ≥80 years, analyzed with univariate and multivariate binary regression analyses

	Patients 65–79 years old (n = 2320)					
	Univariate linear regression			Multivariate linear regression		
	OR	95% CI	P-value	OR	95% CI	P-value
Dementia	3.2	1.5–6.6	0.002	1.4	0.6–3.2	0.400
Stroke	3.0	1.9–4.9	0.000	2.2	1.3–3.7	0.002
Use of psychotropic drugs	3.2	2.2–4.7	0.000	2.6	1.8–4.0	0.000
Incontinence	1.6	1.0–2.4	0.036	0.8	0.5–1.4	0.500
Number of medical diagnoses	1.3	1.2–1.4	0.000	1.2	1.1–1.3	0.007
CDS sum score	0.9	0.964–0.985	0.000	0.9	0.9–1.0	0.067
	Patients ≥80 years (n = 1382)					
	Univariate linear regression			Multivariate linear regression		
	OR	95% CI	P-value	OR	95% CI	P-value
Risk of malnutrition, definition with BMI and weight loss	2.1	1.2–3.6	0.006	1.6	0.84–3.21	0.150
BMI	0.9	0.88–0.98	0.012	0.98	0.92–1.04	0.510
Dementia	3.1	1.8–5.2	0.000	1.8	0.9–3.7	0.103
Disease of the nervous system	2.0	1.2–3.5	0.009	2.0	1.1–3.6	0.026
Stroke	2.3	1.3–4.2	0.004	1.7	0.85–3.41	0.131
Use of psychotropic drugs	3.0	1.9–4.9	0.000	2.2	1.3–3.7	0.004
Number of medical diagnosis	1.1	1.0–1.2	0.091	1.0	0.87–1.16	0.902
CDS sum score	0.9	0.97–0.99	0.005	1.0	0.97–1.0	0.360

BMI, body mass index; CI, confidence interval; CDS, Care Dependency Scale; OR, odds ratio.

Predictors for in-hospital falls

In patients ≥80 years a risk of malnutrition using the definition with the BMI and weight loss as well as a low BMI were significantly associated with falls during the hospital stay. Table 2 presents the association of potential predictors with hospital-acquired falls using univariate analysis.

The results of the univariate logistic regression analysis did not show significant associations between hospital-acquired falls and malnutrition risk for patients aged 65–79 years according to MUST or the definition including the BMI and weight loss. The analysis showed associations of hospital-acquired falls with the presence of dementia, stroke, incontinence, use of psychotropic drugs, incontinence, number of medical diagnoses and care dependency (Table 3).

The results of the univariate analysis showed significant associations of in-hospital falls and malnutrition risk for patients aged ≥80 years according to the definition using the BMI and weight loss ($P < 0.01$). Further significant associations were found for lower BMI, presence of dementia, diseases of the nervous system, stroke, use of psychotropic drugs, number of medical diagnoses and higher care dependency (see Table 3).

The results of the multivariate logistic regression analysis did not show significant associations between malnutrition risk and hospital-acquired falls. The final model of the multivariate regression analysis for the 65–79-year age group revealed previous stroke (odds ratio [OR] 2.2, 95% confidence interval [CI] 1.3–3.7), use of psychotropic drugs (OR 2.6, 95% CI 1.8–4.0) and number of medical diagnoses (OR 1.2, 95% CI 1.1–1.3) as the strongest predictors for in-hospital falls. The strongest predictors for in-hospital falls among patients aged ≥80 years in the final multivariate regression model were the presence of a disease of the nervous system (OR 2, 95% CI 1.1–3.6) and the use of psychotropic drugs (OR 2.2, 95% CI 1.3–3.7) (Table 3).

Discussion

In our sample, we found significant differences between fallers and non-fallers in terms of the risk of malnutrition, BMI, degree of care dependency, number of diagnoses, presence of incontinence, use of psychotropic drugs and some diseases, such as dementia or stroke. Malnutrition risk was identified as a predictor for hospital-acquired falls in the univariate analysis among very old patients, but not for patients in the 65–79-year age group. This means that hospitalized patients who are aged ≥80 years and at risk of malnutrition have a two-fold higher chance of experiencing a fall during their hospital stay than older hospitalized patients who are not at risk of malnutrition. Hence, the results of our study provide evidence that an impaired nutritional status is not only associated with falls in the community[12] or falls in the nursing home[20] but also in the hospital. Our results also showed that a low BMI was significantly associated with hospital-acquired falls in very old patients. In our sample, these associations were not found in patients aged 65–79 years.

The strength of the association between malnutrition risk and falls may be affected by several confounding factors that correlate with the occurrence of both malnutrition and falls. It is important to consider these factors in a multivariate analysis, which is underlined by the discrepancy of the results of the univariate and multivariate regression analyses in the current study.

Physical function, such as the balance function, muscle strength, muscle power or muscle mass, is one of the most important factors influencing the occurrence of falls in older adults, which we did not assess in this study.[21] Ramsey *et al.* showed an association of malnutrition and physical performance by means of dynamic measures such as the timed up and go test or chair stand test. This indicates that the nutritional status of older adults is more likely to be affected by muscle power than by muscle strength.[22]

In clinical practice, multifaceted interventions for fall prevention in older persons should be individualized to address the individual patient's risks.[23] If a person is at risk of malnutrition, it may be beneficial to include nutritional interventions such as energy and protein supplementation or dietary counseling in the prevention program for the respective patient. If a vitamin D deficiency or osteoporosis is diagnosed, supplementation with vitamin D and calcium should be considered. The relevance of vitamin D supplementation in fall and injury prevention is currently the subject of controversy in the scientific community, but the benefit of (moderate) vitamin D supplementation has been demonstrated in several recently published, randomized, controlled trials.[24,25]

Recent studies in which the effectiveness of fall prevention programs was assessed, revealed that interventions that cover multiple components are the most promising for preventing falls.[26] This is not surprising, as falls are a geriatric syndrome, and the causes for these are mostly multifactorial. The advantage of multifaceted interventions has also been reported in guidelines for fall prevention in older adults.[27–29] However, the administration of vitamin D is mentioned in some of the guidelines, but nutrition in general and the maintenance of a good nutritional status is usually not included in the recommendations.[27,29]

The best practice guideline published by the Registered Nurses' Association of Ontario includes recommendations for dietary intervention in fall prevention,[28] i.e., to optimize bone health in adults at risk for falls or fall injuries, and particularly those at risk for fractures. A recommendation is also made to refer the persons to dietitians so they can receive advice and individualized nutritional interventions. However, nutritional interventions are not only important to optimize bone health but also for muscle strength and physical function, as several studies have shown.[30] Nutritional interventions should be additionally carried out to provide exercise, environmental adjustments and education for patients and staff. These are fundamental interventions for fall prevention and should be recommended in several guidelines.

In conclusion, the results of this study show that malnutrition risk is a predictor for in-hospital falls in very old patients (≥80). Knowledge of this relationship is important for planning adequate interventions to prevent hospital-acquired falls. In this patient group, the screening and assessment of nutritional status as well as nutritional interventions for the prevention/treatment of malnutrition risk should be considered as one important factor for successful fall prevention. Referrals to nutrition experts such as dietitians so patients can receive advice and individualized interventions should be considered. High-quality studies are necessary to assess the effect of nutritional interventions as part of a multifaceted fall-prevention program. We recommend that researchers conduct pragmatic clinical trials in the future in real-world settings, individualizing the interventions to the patients' risk factors and needs.

Strengths and limitations

This was a cross-sectional study that included data collected at two time points. Therefore, the analyses of the data-generated information on associations between different risk factors rather than causalities of these. Participation in the study was voluntary and required the informed consent of the patients. This may have led to a selection bias in that patients with a very poor health status may have been more likely to refuse to participate in the study. Furthermore, >18% of the patients did not participate because of cognitive impairment. These patients are at particularly high risk of experiencing a fall or being malnourished; therefore, because these patients may not have participated in the study, the prevalence rates may be underestimated. The independent variables for the regression analysis were chosen based on the literature, but some other important variables may have been missed. However, we conducted the analysis using a rather large sample of older hospitalized patients and used standardized questionnaires and a standardized data collection procedure. The distinction made between old (65–79 years) and very old (≥80) patients allowed a deeper understanding of different risk factors for the different subgroups of fallers in the hospital setting to be obtained.

Disclosure statement

The authors declare no conflict of interest.

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