Title

Dysphagia and factors associated with malnutrition risk: A five-year multicentre study

Running Head

Factors associated with malnutrition risk

ABSTRACT

Aims: To describe the associations between dysphagia and malnutrition risk and to identify predictors for dysphagia in a group of persons at risk of malnutrition in hospitals and nursing homes.

Design: A secondary analysis of cross-sectional data from the years 2012-2016.

Methods: The risk of malnutrition was assessed using the Malnutrition Universal Screening Tool for Adults (MUST). The data were compared regarding malnutrition risk and dysphagia. Regression analyses was conducted to identify variables that were associated with the risk of malnutrition and dysphagia.

Results: 17,580 patients were included in the study sample. The prevalence of dysphagia was 6.6%, and the prevalence of malnutrition risk was 18.9%. A multivariable logistic regression analysis resulted in the identification of dysphagia and cancer as variables with the highest odds ratios with regard to malnutrition risk. Patients with cancer, stroke, or respiratory diseases represent a high-risk group for the co-occurrence of dysphagia and risk of malnutrition.

Conclusions: Screening for dysphagia should be carried out on patients at risk of malnutrition as an integral part of their admission to a healthcare institution, and especially on the higher risk group of patients with cancer, a stroke, or a respiratory disease.

Impact:

- **What problem did the study address?** This study identified the relationship between dysphagia and malnutrition risk and associated factors.
- **What were the main findings?** Dysphagia among patients in the research sample was associated with more than two times higher prevalence of the malnutrition risk.
- **Where and on whom will the research have an impact?** Thorough malnutrition risk and dysphagia screening lead to better nursing care.

Key words: nursing assessment, dysphagia, swallowing, deglutition, malnutrition, risk assessment, associated factors, determinants, prevalence.

Main paper

INTRODUCTION

Dysphagia and malnutrition in adults are health issues that result in lower quality of life and well-being (Hennessy & Goldenberg, 2016; Ney, Weiss, Kind, & Robbins, 2009; Tabor, Gaziano, Watts, Robison, & Plowman, 2016). Undiagnosed or untreated dysphagia and malnutrition may also cause various complications in clinical practice. Moreover, dysphagia may cause aspiration and pneumonia, which are serious complications of the patient's health status (Van der Maarel-Wierink et al., 2014). Patients who suffer from malnutrition without receiving proper treatment and interventions are hospitalized for longer periods, are at greater risk of complications and have higher mortality (Allard et al., 2016; Thomas et al., 2016).

Background

Dysphagia is defined as a condition in which the patient has a lower capacity to swallow, experiences difficulty while swallowing food and/or liquids, or is potentially unsafe while swallowing (Huppertz et al., 2018; Streicher et al., 2018; WHO, 2010). These are also sometimes mentioned as deglutition disorders in the scientific literature (Clavé et al., 2006). The swallowing process itself consists of several movements and operations, which can be divided into three phases: the oral phase, pharyngeal phase and oesophageal phase (Hennessy & Goldenberg, 2016; Mann, Heuberger, & Wong, 2013).

The prevalence of dysphagia in hospitalized patients ranges from 7 to 81%, depending on the group of patients and on cause of dysphagia (Eglseer, Halfens, Schols & Lohrmann, 2018; Holst, Rasmussen, & Unosson, 2009; Mandysova, Škvrňáková, Ehler, & Černý, 2011; Roy, Stemple, Merrill, & Thomas, 2007; Suttrup & Warnecke, 2016). However, one group of hospitalized patients displays an even higher prevalence. For example, in patients after laryngectomy, the prevalence of dysphagia ranges from 71 to 83% (Coffey, Tolley, Howard, Drinnan, & Hickson, 2018; MacLean, Cotton, & Perry, 2009). Factors associated with a higher prevalence of dysphagia are increased age, status after stroke, disorders of consciousness, neurological illnesses, impaired function of the cranial nerves, diseases of the respiratory tract, disorders of the digestive tract and head and neck cancer (Jager-Wittenaar et al., 2011; Ney et al., 2009; Schimmel, Ono, Lam, & Müller, 2017; Tabor et al., 2016). Higher levels of care dependency are

often connected with swallowing problems (Huppertz et al., 2018; Van der Maarel-Wierink et al., 2014).

Malnutrition represents a serious problem in nursing and medical care. The prevalence rates for malnutrition risk in institutions varies from 20 to 65% (Fávaro-moreira et al., 2016; Meier & Stratton, 2008). These varying prevalence rates can be explained by the different available definitions, screening instruments, spectrum of patients and settings. Well-known risk factors for malnutrition are forms of cancer, digestive system diseases, loss of appetite, restrictive diets, reduced mobility, comorbidity, higher dependency levels during daily activities, increased age or pain (Raynaud-Simon, Revel-Delhom, & Hébuterne, 2011; Volkert et al., 2018). According to Meier et al., (Meier & Stratton, 2008) psychosocial factors or diseases, including dementia, anxiety and depression, can also contribute to lower food intake.

Malnutrition and dysphagia often occur concurrently. The prevalence of malnutrition and dysphagia taken together ranges from 3% to 29% (Namasivayam-MacDonald, Morrison, Steele, & Keller, 2017; Namasivayam, 2017). People with dysphagia often have problems swallowing food that has a certain consistency or texture and must invest greater efforts during eating. Up to one-third of the people who are living in long-term care facilities receive a texture-modified diet. This often leads to reductions in the amount of food and fluids consumed, which is associated with an increase in the risk of malnutrition (Laguna, Hetherington, Chen, Artigas, & Sarkar, 2016; Ney et al., 2009).

The relationship between hospitalized patients at risk of malnutrition and dysphagia has been described in recent studies (Eglseer, Halfens, Schols, Lohrmann, et al., 2018; Huppertz et al., 2018; Mann et al., 2013; Streicher et al., 2018; Tamura, Bell, Masaki, & Amella, 2013; Van der Maarel-Wierink et al., 2014). However, the systematic review of Namasivayam & Steele (2015) revealed that malnutrition risk and dysphagia had been assessed together in less than half of the participants in the reviewed studies. This important insight indicates that an insufficient emphasis is being placed on the co-occurrence of malnutrition and dysphagia. No data are available for a large sample of patients regarding factors of or predictors for malnutrition risk and dysphagia, and the previous studies have mostly had small sample sizes. However, to identify patients with dysphagia and malnutrition risk at an early stage of the hospital stays, it is from utmost importance to also be aware of the associated risk factors.

THE STUDY

Aims

1. Describe the associations between dysphagia and malnutrition risk in a large sample.
2. Identify predictors for dysphagia in the group of patients at risk of malnutrition.

Design

A secondary analysis of data from the Austrian "Nursing Quality Measurement 2.0" database was used in this research. This research is performed annually as a multicentre, cross-sectional, national study in Austrian general or university hospitals, geriatric hospitals, nursing homes and other healthcare facilities. This measurement involves the acquisition of data on the institutional, department and patient levels. Data from the years 2012 – 2016 were used.

Participants

All Austrian inpatient institutions with more than fifty beds were invited to participate in the annual Nursing Quality Measurement 2.0 via e-mail. In the five-year time period from 2012 to 2016, data were collected from 237 departments in hospitals and nursing homes. Regarding the different settings, we use the term "patient" to refer to hospital patients and nursing home residents consistently throughout this paper.

Data from patients were used to conduct the secondary data analysis. Each patient who was older than 18 years of age and available in the departments on the day of measurement was asked to participate in the measurement (30,934 patients). The overall response rate was 76.6% (23,684 participants). The reasons 23.4% of patients did not participate included: refused to participate (11.2%), cognitive state of the patient was too poor (4.2%) and patient was not available on the department during measurement (3.2%). Patients with missing important data (e.g. information about dysphagia, MUST score, weight) were excluded from the analysis. The whole sample (17,580 persons) was used for the statistical analysis regarding the first research aim. To address the second research aim, a subsample of persons with MUST scores ≥ 1 ($n = 3321$) was included for the statistical analysis.

Data collection

Data were collected on one day of measurement once per year. To increase the objectivity of the measurements, data were collected concurrently by two nurses. One worked in the patient's department and was familiar with the patient. The second nurse worked in a different department. If there were any disagreements between the two nurses, they tried to reach a consensus, and if this was not possible, the data collected by the second nurse from the different department were used. Each nurse who took part in the data collection process attended a training workshop prior to the data collection.

Instruments

The Austrian version of the "National Prevalence Measurement Quality of Care" questionnaire was used for data collection. This is a standardized questionnaire that is used to assess the most important health care issues related to nursing and medical care, such as the presence of pressure ulcers, incontinence, malnutrition, falls and physical restraints. This questionnaire includes different psychometrically tested instruments (see the section on validity and reliability). The questions placed a focus on one of three areas: structure, process and outcome according to Donabedian's conceptual model (Donabedian, 1988) for assessing the quality of care. This design of questions allowed us to identify associations and differences between characteristic aspects of health care. During this analysis, only questions from the malnutrition module were used from 2012 – 2016, and no changes were made during the research period.

Patient information and demographic data were collected as well as height, weight, and the medical diagnosis according to ICD-10 (WHO, 2010). Dysphagia was assessed by two nurses, who asked the patient if she/he had problems swallowing. Based on the information obtained, the Body Mass Index (BMI) and Malnutrition Universal Screening Tool for Adults (MUST) score were calculated. In this study, a malnutrition risk was defined as a MUST score ≥ 1.

The German version of the Care Dependency Scale (CDS) was used to measure the patients' care dependency degrees. The CDS consists of fifteen items. The results of this assessment are categorized in the "almost care independent" (70-75 points), "limited extent care independent" (60-69 points), "partially care dependent" (45-59 points), "a great extent care dependent" (25-44 points) and "completely care dependent" (≤ 24 points) categories. A higher CDS score is related

to lower degree of care dependency (Dijkstra, Buist, & Dassen, 1996; Lohrmann, Dijkstra, & Dassen, 2003).

Validity and reliability

The original Dutch version of the questionnaire was based on comprehensive literature review, and the face validity was ensured by carrying out consultations with national and international panel expert (Van Nie-Visser et al., 2013). Furthermore, knowledge from clinical practice guidelines was incorporated in the questionnaire, including internationally validated tools (MUST, CDS). The questionnaire has been updated at regular intervals by an international research team (Van Nie-Visser et al., 2013).

The MUST is a validated tool for malnutrition risk screening which is used to assess the weight loss that has occurred over the previous 3-6 months, a lack of nutritional intake for more than five days, or the presence of an acute illness, and is also based on the BMI evaluation. The MUST tool has a "fair–good" to "excellent" concurrent validity between pairs of tools applied to the same patient group ($_K$ from 0.431 to 0.893) (Stratton et al., 2004).

The Care Dependency Scale (CDS) is a tool that is commonly used to assess care dependency and has both good validity and reliability. The content validity of this tool was established by 44 experts in a Delphi survey. The interrater-reliability of the tool was $_K$ 0.40–0.64; the test–retest reliability, $_K$ 0.55–0.80; and the Cronbach's alpha, 0.97 (Dijkstra, Buist, & Dassen, 1996; Lohrmann, Dijkstra, & Dassen, 2003).

Ethical considerations

Ethical approval was obtained from the responsible local ethics committee. All participants gave their written informed consent before data collection. The research was conducted in compliance with recognized international standards, including the principles of the Declaration of Helsinki.

Data analysis

The statistical software SPSS version 25 was used to conduct the data analysis (IBM Corp., 2017). All data were verified, and outliers were removed. Patients that lacked important data and

patients with outlier Body Mass Index values (BMI <10 and>60 kg/m^2) or who were younger than eighteen years of age were excluded from the research sample.

The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for normality testing. To test for statistical differences, the chi-square (X^2) test and Mann-Whitney U test were used. Cohen's d test was used to calculate the effect sizes for numerical data, and the Contingency Coefficient or Phi Coefficient was used for nominal data. Values of Cohens' d were characterised as: <0.2 = developmental effects, 0.2 = small effect, 0.5 = medium effect and 0.8 = large effect. The strengths of association, as measured using the Contingency Coefficient or Phi Coefficient, were characterised as <0.3 low, 0.3-0.5 moderate, >0.5 high (Field, 2016).

Regression analyses

For the purpose of identifying variables that were associated with the risk of malnutrition and dysphagia, two regression analyses were carried out. Factors included as potential predictors were: dysphagia, cancer diseases, blood diseases, dementia, digestive system diseases, respiratory diseases, sex, psychological diseases, age, number of diagnosis, mean CDS score, cardiovascular diseases, diabetes mellitus, musculoskeletal system diseases, CVA/stroke and type of department. Two regression analyses were carried out:

1. For the MUST score, as an outcome variable with the entire research sample (*n* = 17,580).
2. For dysphagia, as an outcome variable in the subgroup of malnutrition risk patients (*n* = 3,321).

At first, a selection of explanatory variables was performed based on the content and bivariate analysis results using the chi-squared test (X^2) and Mann-Whitney U test. Variables with low levels of statistical significance or a low content association with malnutrition risk or dysphagia were excluded. In a second step, each variable was tested for its multicollinearity, and multicollinearity was not detected between variables in both analyses. In a third step, a univariate logistic regression for the outcome and one explanatory (every variable separately) variable was carried out. Variables with low statistical significance (*p*-value > 0.02) were excluded for the multivariable regression analysis, and variables that had odds ratios higher than 1.1 or lower than 0.9 were discussed for content validity. The variables CVA/stroke and type of department were excluded in the first regression analysis on the basis of the above-mentioned criteria. The last step

of the regression analysis was performed using a multivariable linear logistic regression model with the enter method. The effects of the regressions were presented as odds ratios (OR), and confidence intervals (CI), with levels of significance.

RESULTS

Sample characteristics

The prevalence of dysphagia among patients in our sample was 6.6% (1155), and the prevalence of malnutrition risk was 18.9% (3321). From 2012 to 2016, 237 departments took part in our data collection process. In hospitals, most were medical departments, but some were surgical or ICU departments. In nursing homes, no distinction was made between the departments. The distribution of patients who were and were not at risk of malnutrition differed in hospitals regarding the type of the departments ($p < 0.001$) with an effect size of 0.085 (Table 1). There were more females (61.9%) in the group of patients with positive MUST scores. The mean age of patients at risk of malnutrition was slightly higher (i.e. 1.4 years). Both diseases of the digestive system and forms of cancer had higher prevalence levels among patients at risk of malnutrition, 9.0 and 8.7%, respectively. In contrast, patients who were not at risk of malnutrition had a higher prevalence of diseases of the musculoskeletal system (6.7%). Patients at risk of malnutrition were significantly more care dependent, mean CDS score of 60.7 (18.8), than patients who were not at risk of malnutrition, mean CDS score of 65.9 (14.8).

Table 1: Characteristic of the research sample in two groups according to MUST score (N = 17,580).

	MUST ≥ 1	**MUST = 0**	***p*-value**	**Effect size**
Number of patients % (*n*)	18.9 (3321)	81.1 (14259)	-	-
Type of the hospital ward % (*n*)			<0.001**	0.085‡
Medical ward	39.3 (1306)	35.3 (5031)		
Surgical ward	25.6 (849)	34.8 (4969)		
Psychiatric ward	6.7 (223)	5.2 (742)		
ICU ward	2.2 (74)	1.8 (261)		
Other wards	7.6 (253)	8.5 (1205)		
Nursing home % (*n*)				
Long-term care	18.5 (616)	14.4 (2051)		
Female % (*n*)	61.9 (2057)	56.3 (8034)	<0.001**	0.044†
Mean age in years (SD)	68.46 (18.76)	67.06 (17.52)	<0.001*	-0.079§
Mean BMI kg/m^2 (SD)	21.90 (5.04)	27.31 (4.91)	<0.001*	1.096§
Dysphagia % (*n*)	13.6 (453)	4.9 (702)	<0.001**	0.138†

Mean number of medical diagnoses (SD)	2.64 (1.77)	2.45 (1.71)	<0.001*	-0.110§
Medical diagnoses related to nutrition % (*n*)				
Cancer diseases	18.2 (606)	9.5 (1359)	<0.001**	0.108†
Blood diseases	9.8 (325)	5.6 (792)	<0.001**	0.068†
Dementia	15.4 (511)	9.8 (1395)	<0.001**	0.071†
Digestive system diseases	28.3 (941)	19.3 (2746)	<0.001**	0.087†
Respiratory diseases	19.8 (656)	14.8 (2108)	<0.001**	0.053†
Psychological diseases	14.7 (489)	13.2 (1887)	0.024**	0.017†
Cardiovascular diseases	39.4 (1307)	44.6 (6356)	<0.001**	-0.041†
Diabetes mellitus	12.2 (405)	14.8 (2114)	<0.001**	-0.290†
Musculoskeletal system diseases	25.7 (855)	32.4 (4624)	<0.001**	-0.056†
CVA/stroke	6.6 (218)	6.7 (949)	0.849**	-0.001†
Mean CDS sum score (SD)	60.70 (18.78)	65.89 (14.83)	<0.001*	0.332§
CDS categories % (n)				
Completely care dependent	9.2 (306)	3.8 (541)	<0.001**	0.127‡
To a great extent care dependent	10.7 (354)	7.0 (1003)		
Partially care dependent	12.2 (405)	10.0 (1428)		
To a great extent care independent	16.5 (548)	15.6 (2219)		
Completely care independent	51.4 (1708)	63.6 (9068)		

*= Mann-Whitney U test; ** = X^2Test; † = Phi Coefficient; ‡ = Contingency Coefficient; § = Cohen's d; SD = Standard deviation; CVA = cerebrovascular accident; MUST = Malnutrition Universal Screening Tool for Adults; BMI = Body Mass Index; ICU = intensive care unit; CDS = Care Dependency Scale

In the group at risk of malnutrition, 13.6% of patients had dysphagia as opposed to 4.9% of the patients who were not at risk of malnutrition. Patients who suffered from dysphagia and were at risk of malnutrition made up 2.6% of the study sample, whereas in those patients with dysphagia, 39.2% were at risk for malnutrition.

First aim: associations between dysphagia and malnutrition risk

The MUST score was chosen as an outcome variable to assess the association between malnutrition risk and dysphagia. The results of the univariate regression for each variable separately and for the multivariable regression analysis appear in Table 2. A strong association

was found between malnutrition risk and dysphagia. The results of the univariate analysis showed that dysphagia had the highest OR (3.05), however, the highest OR measured in the multivariable analysis was for the diagnosis of cancer diseases (OR = 2.24), and dysphagia was associated with an OR of 2.16. The variables age, psychological diseases and diabetes mellitus were not statistically significantly associated with malnutrition risk.

Table 2: Bivariate analysis, univariate and multivariable linear logistic regression analysis with MUST score as outcome variable (N = 17,580).

Explanatory variables	Bivariate analysis *p*-value	Univariate regression analysis		Multivariable regression analysis	
		p-value	OR (CI lower - CI upper)	*p*-value	OR (CI lower - CI upper)
Dysphagia	<0.001**	<0.001	3.050 (2.692 - 3.456)	<0.001	2.157 (1.879 - 2.477)
Cancer diseases	<0.001**	<0.001	2.119 (1.909 - 2.352)	<0.001	2.243 (1.993 - 2.524)
Blood diseases	<0.001**	<0.001	1.845 (1.612 - 2.111)	<0.001	1.989 (1.710 - 2.313)
Dementia	<0.001**	<0.001	1.677 (1.503 - 1.871)	0.010	1.221 (1.049 - 1.422)
Digestive system diseases	<0.001**	<0.001	1.658 (1.521 - 1.807)	<0.001	1.784 (1.613 - 1.973)
Respiratory diseases	<0.001**	<0.001	1.419 (1.288 - 1.564)	<0.001	1.604 (1.433 - 1.794)
Sex	<0.001**	<0.001	1.261 (1.167 - 1.363)	<0.001	1.289 (1.187 - 1.400)
Psychological diseases	0.024**	0.024	1.132 (1.017 - 1.261)	0.061	1.127 (0.995 - 1.276)
Age	<0.001*	<0.001	1.068 (1.036 - 1.101)	0.784	1.000 (0.997 - 1.002)
Number of diagnosis	<0.001*	<0.001	1.066 (1.043 - 1.088)	<0.001	0.901 (0.861 - 0.942)
Mean CDS score	<0.001*	<0.001	0.982 (0.980 - 0.984)	<0.001	0.983 (0.980 - 0.986)

Cardiovascular diseases	<0.001**	<0.001	0.807 (0.747 - 0.872)	0.002	0.847 (0.764 - 0.940)
Diabetes mellitus	<0.001**	<0.001	0.798 (0.712 - 0.894)	0.060	0.883 (0.775 - 1.005)
Musculoskeletal system diseases	<0.001**	<0.001	0.722 (0.663 - 0.787)	<0.001	0.796 (0.717 - 0.883)

*= Mann-Whitney U test; **= X^2 Test; CDS = Care Dependency Scale; OR = Odds ratio; CI = Confidence Interval

Second aim: predictors for dysphagia in the group of patients at risk of malnutrition

To identify predictors for dysphagia among patients at risk of malnutrition, univariate and multivariable logistic regression analyses were carried out with dysphagia as the outcome variable. A significant association was found between dysphagia and between cancer (OR = 2.04), CVA/stroke (OR = 1.78) and respiratory disease (OR = 1.45) in multivariable analysis. The male gender was also significantly associated with dysphagia with an OR of 1.67. Other explanatory variables were not significant or had only slight effects (Table 3).

Table 3: *Bivariate analysis,* univariate and multivariable linear logistic regression analyses of patients at risk of malnutrition with dysphagia as outcome variable (n = 3,321).

Explanatory variables	Bivariate analysis *p*-value	Univariate regression analysis		Multivariable regression analysis	
		p-value	OR (CI lower - CI upper)	*p*-value	OR (CI lower - CI upper)
Cancer	<0.001**	<0.001	1.556 (1.230 – 1.968)	<0.001	2.038 (1.561 -2.662)
Dementia	<0.001**	<0.001	2.187 (1.727 – 2.768)	0.057	0.721 (0.515 – 1.010)
CVA/stroke	<0.001**	<0.001	3.123 (2.298 – 4.245)	0.002	1.782 (1.246 – 2.550)
Respiratory diseases	0.001**	0.001	1.484 (1.178 – 1.869)	0.007	1.448 (1.105 – 1.899)
Age	<0.001*	<0.001	1.011 (1.005 – 1.017)	0.002	0.989 (0.982 – 0.996)

Male gender	0.001**	0.001	1.383 (1.132 – 1.689)	<0.001	1.671 (1.330– 2.099)
Mean BMI	0.010*	0.020	0.976 (0.955 – 0.996)	0.822	0.997 (0.976 – 1.020)
Mean number of medical diagnoses	<0.001*	<0.001	1.200 (1.140 – 1.262)	0.786	0.990 (0.923 – 1.062)
Mean CDS score	<0.001*	<0.001	0.962 (0.957 – 0.966)	<0.001	0.951 (0.945 – 0.957)

*=Mann-Whitney U test; ** = X^2Test; CDS = Care Dependency Scale; OR = odds ratio; CI = confidence interval; CVA = cerebrovascular accident

Table 4: Differences between patients at risk of malnutrition with and without dysphagia (n = 3,321).

	Dysphagia	**No dysphagia**	***p*-value**	**Effect size**
Number of patients % (*n*)	13.6 (453)	86.4 (2868)	-	-
Female % (*n*)	55.2 (250)	63.0 (1807)	0.001**	-0.055†
Mean age in years (SD)	71.53 (17.42)	67.98 (18.92)	<0.001*	-0.019‡
Mean BMI kg/m² (SD)	21.39 (5.01)	21.98 (5.05)	0.010*	0.117‡
Mean number of medical diagnoses (SD)	3.20 (2.03)	2.56 (1.71)	<0.001*	-0.364‡
Medical diagnoses related to nutrition % (*n*)				
Cancer diseases	24.5 (111)	17.3 (495)	<0.001**	0.064†
Blood diseases	7.9 (36)	10.1 (289)	0.156**	-0.025†
Dementia	25.8 (117)	13.7 (394)	<0.001**	0.115†
Digestive system diseases	28.7 (130)	28.3 (811)	0.854**	0.003†
Respiratory diseases	25.6 (116)	18.8 (540)	0.001**	0.058†
Psychological diseases	17.0 (77)	14.4 (412)	0.142**	0.025†
Cardiovascular diseases	41.5 (188)	39.0 (1119)	0.315**	0.017†
Diabetes mellitus	13.7 (62)	12.0 (343)	0.297**	0.018†
Musculoskeletal system diseases	25.4 (115)	25.8 (740)	0.851**	-0.003†
CVA/stroke	14.8 (67)	5.3 (151)	<0.001**	0.132†
Mean CDS sum score (SD)	46.25 (24.66)	62.99 (16.56)	<0.001*	0.936‡

* = Mann-Whitney U test; ** = X^2 Test; † = Phi Coefficient; ‡ = Cohen's d; CVA = cerebrovascular accident; SD = standard deviation; BMI = Body Mass Index; CDS = Care Dependency Scale

To compare patients at risk of malnutrition with and without dysphagia, we also performed univariate analyses using statistical tests (Table 4). A significant difference was found with respect to gender in the groups of patients with and without dysphagia ($p = 0.001$) (Table 4). Patients at risk of malnutrition and with dysphagia had significantly more medical diagnoses, 3.20 (2.03) versus 2.56 (1.71), $p < 0.001$, than patients at risk of malnutrition without dysphagia. Significant differences regarding the presence of medical diagnoses were found for cancer, dementia, CVA (cerebrovascular accident)/stroke and respiratory diseases. Patients at risk of malnutrition with dysphagia had significantly lower CDS scores, 46.25 (24.66), than patients at risk of malnutrition without dysphagia, 62.99 (16.56), $p < 0.001$.

There were 53.6% ($n = 243$) of patients with dysphagia, who had at least one of the diseases which were identified as significant in the multivariable regression analysis: cancer, CVA/stroke, or respiratory disease. Moreover, 69.3% ($n = 314$) of patients had at least one of the diseases which were identified as statistically significant in the bivariate analysis regarding dysphagia (cancer, CVA/stroke, dementia and/or respiratory disease); compared to patients without the dysphagia, both results were significant ($p < 0.001$).

DISCUSSION

Based on our results, the prevalence of malnutrition risk in the research sample was 18.9%, which is in line with that which has been reported in the recent literature, where the prevalence of malnutrition risk ranges from 20 to 60% (Allard et al., 2016; Mosselman, Kruitwagen, Schuurmans, & Hafsteinsdóttir, 2013; Slavíková, Procházka, Dlouhý, Anděl, & Rambousková, 2018; Tannen & Lohrmann, 2013), depending on setting and assessment tool used.

We found that 6.6% of patients in our sample had dysphagia. In another recent study conducted in an Austrian hospital setting which had a similar research design, the prevalence was 7.6% in a cohort in which patients were older than 65 years (Eglseer, Halfens, Schols, & Lohrmann, 2018). Our patient sample, however, included patients who were 18 years or older with a mean age of 67.32 (17.77). Two cross-sectional studies conducted in Dutch nursing home settings with residents older than 65 years have been carried out recently (Huppertz et al., 2018; Van der Maarel-Wierink et al., 2014). In the first study, 6349 residents were included, and oropharyngeal dysphagia was reported in 12.1% of these, but their mean age was 83.8 (7.8) years (Huppertz et al., 2018). In the second study, 8119 nursing home residents were included, and 9% of these had dysphagia. Their mean age was 84.0 (7.0) years (Van der Maarel-Wierink et al., 2014). Thus, the higher prevalence in the samples with older patients is evident.

The co-occurrence of a risk of malnutrition and dysphagia is a serious health condition and should not be underestimated. The co-occurrence of malnutrition and dysphagia generally varies from 3 to 29% (Namasivayam-MacDonald, Morrison, Steele, & Keller, 2017; Namasivayam, 2017). Our results show that the malnutrition risk and dysphagia occurred simultaneously in 2.6% of the whole research sample and that about 40% of patients with dysphagia were at risk of malnutrition. These findings show that the problem is quite common and deserves more attention in the nursing practice.

Factors associated with malnutrition risk

The results of the univariate regression analysis show that suffering from dysphagia increases the risk for malnutrition by more than three times (OR = 3.05 (95% CI, 2.69–3.46)). The results of the multivariable linear regression analysis showed that the odds ratio for becoming

malnourished when patients suffer from dysphagia is still 2.16 (95% CI, 1.88–2.48), and the variable with highest OR was cancer diagnosis 2.24 (95% CI, 1.99–2.52). These results show that there is a strong association between the risk of malnutrition and dysphagia. Dementia was also a significant factor with an OR of 1.22 (95% CI, 1.05–1.42) in our regression analysis regarding malnutrition risk. Cerebrovascular disease (CVA/stroke) was not significantly associated with malnutrition risk. Nevertheless, the prevalence of dementia and CVA/stroke were significantly higher among malnutrition risk patients with dysphagia as compared to the prevalence in the group without dysphagia. A strong association between dementia and malnutrition or dysphagia has been presented in several studies (Carrión et al., 2015; Humbert et al., 2010; Suttrup & Warnecke, 2016).

An additional result of the multivariable regression analysis was the identification of an association between malnutrition risk and blood diseases with an OR of 1.99 (95% CI, 1.71–2.31). One of the explanations for this could be that some of the patients with blood disease have blood cancer or that the treatment of neoplasms could affect the blood cell count (anaemia, thrombocytopenia, leukopenia). Another explanation could be that blood cell count worsens in patients with malnutrition. Zhang et al. (Zhang, Pereira, Luo, & Matheson, 2017) reported significant decreases in several blood biomarkers in malnourished patients, such as a haemoglobin, haematocrit, or the iron level, and an increased level of white blood cells (Zhang et al., 2017).

We found that the two most highly influential factors for malnutrition risk were forms of cancer and dysphagia. The risk of malnutrition were more than two times higher for patients with one of these problems/diseases. The risk could potentially be even higher if they were combined. For example, patients that had had laryngeal cancer and undergone a laryngectomy experienced dysphagia and breathing problems. These influenced the patients' oral food intake while eating, and 90% of them experienced trouble at the beginning (Slouka et al., 2018). It is known that the prevalence of malnutrition in cancer patients depends on the tumour localisation (Norshariza et al., 2017; Wie et al., 2010). Of the total number of cancer cases reported in 2015, 4.8% Age-Standardized Rates World (ASR-W) were reported for locations that are directly associated with swallowing (e.g. cancer of the lip and oral cavity, nasopharynx, pharynx, larynx) (Ferlay et al., 2015). But even if the cancer is not localized in these regions, patients with cancer suffer from

several problems that are association with a risk of malnutrition, such as xerostomia, mucositis, nausea and vomiting, loss of appetite, constipation and diarrhoea (Dimunová, Dankulincová Veselská, Raková, & Bednarek, 2018). In this case, nutritional interventions should be tailored to meet the needs of cancer patients (Arends et al., 2017).

Factors associated with dysphagia

A notable result from the second multivariable regression was the connection between the male gender and dysphagia as an outcome variable. Male patients had an OR of 1.67 (95% CI, 1.33–2.10). A higher prevalence of dysphagia among male patients has been reported in several studies (Wakabayashi & Matsushima, 2016; Yang, Kim, Lim, & Paik, 2013); nevertheless, an association between dysphagia and gender was not supported by the findings of other studies (Carrión et al., 2015; Rofes et al., 2018; Sarabia-Cobo et al., 2016). Even though the male patients in our sample had a higher risk of dysphagia than the females, the correlation between dysphagia and gender has not yet received sufficient support, and this could be an area of important future research.

More than fifty percent of patients at risk of malnutrition who had dysphagia had at least one of the following diseases: cancer, CVA/stroke, or respiratory disease. Moreover, the results of the second multivariable logistic regression proved that these diseases were associated with dysphagia, which is in line with the results of other recent studies (Carrión et al., 2015; Govender, Smith, Taylor, Barratt, & Gardner, 2017; Huppertz et al., 2018; Madhavan, Lagorio, Crary, Dahl, & Carnaby, 2016; Rofes et al., 2018). The results indicate that patients with the diseases mentioned above are high-risk groups for the co-occurrence of dysphagia and risk of malnutrition.

What do these findings mean for clinical practice?

The importance of the association between risk of malnutrition and dysphagia was shown by the results of the multivariable logistic regression analysis when the risk of malnutrition was treated as an outcome variable as mentioned above. We recommend carrying out assessments for dysphagia in all patients at risk of malnutrition. The assessment should be carried out because patients at risk of malnutrition and dysphagia often have different diets or meal consistency

requirements (Baugreet, Hamill, Kerry, & McCarthy, 2017; Brown, Ross, Jones, Hughes, & Banks, 2014; Laguna et al., 2016). This recommendation is supported by the findings of Popman et al. (Popman, Richter, Allen, & Wham, 2018), who described an association between a high risk of malnutrition and a higher prevalence of dysphagia. Screening for dysphagia may provide valuable information that allows health care staff to prepare appropriate nutritional interventions (Popman et al., 2018). Wakabayashi et al. (Wakabayashi & Matsushima, 2016) also recommended assessing the nutritional status of every patient with dysphagia. However, malnutrition risk screening should be an integral part of patient admission to every health care facility (Eglseer, Halfens, Schols, & Lohrmann, 2018; Doris Eglseer, Halfens, & Lohrmann, 2017; Guerra et al., 2016; Khalatbari-Soltani & Marques-Vidal, 2016).

Screening for malnutrition risk and screening for dysphagia in patients at risk of malnutrition can be completed during their admission to the health care institution or ideally within 24 hours of their admission (Middleton et al., 2015). Even in the cases where screening is not feasible for all patients, it should be carried out at least for patients at risk of malnutrition and at higher risk of dysphagia. The information provided on the associations between malnutrition risk and dysphagia and cancer, CVA/stroke, or respiratory disease could be used as a warning sign, indicating that dysphagia assessments should be carried out for patients with these diseases, particularly if they are at risk of malnutrition.

Limitations

The limitations of this study are that dysphagia was assessed by a nurse who asked the patients questions or observed problems during swallowing. The use of another method for dysphagia assessment (dysphagia screening tool, video fluoroscopy, or fibreoptic endoscopic evaluation of swallowing) would potentially yield different results. There were more than six thousand patients with missing data about MUST score items or dysphagia, and these patients had to be excluded from the study. This number is higher primarily because bedridden patients could not be weighed. The cross-sectional study design did not allow us to identify causality between the factors mentioned and malnutrition. Furthermore, we performed a secondary data analysis; the initial data were initially collected to answer another research question. Therefore, we needed to use the available data set and were not able to adapt the questions or add new questions. Nevertheless, the study provides important results for a large sample of patients.

CONCLUSION

Based on our results, dysphagia among patients in the research sample was associated with more than two times higher prevalence of the malnutrition risk. The findings of this study should raise the awareness of the co-occurrence of malnutrition and dysphagia. The results of the study indicate, that in people with the risk of malnutrition should be screening of dysphagia carried out as integral part, and especially with the higher risk group of patients with cancer, a CVA/stroke, or a respiratory disease. Early screening for dysphagia among patients at risk of malnutrition could lead to better malnutrition prevention and better nursing care. More studies need to be carried out to clarify the association between dysphagia and gender as well as the impact of early malnutrition and dysphagia screening.

Conflict of Interest statement

No conflict of interest has been declared by the authors.

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