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Research Article

Risk Factors of Oropharyngeal Dysphagia and Malnutrition in Neurological Patients

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Background

Oropharyngeal dysphagia (OD) and malnutrition are prevalent among neurological patients, particularly those with cerebrovascular disease and neurodegenerative conditions. Both conditions can significantly impact the health and recovery of these individuals. The study was aimed at identifying risk factors associated with OD and malnutrition, using the biopsychosocial model to explore the relationships between these outcomes and various risk factors, including body structures, body functions, level of activity and participation, and contextual factors.

Methods

This cross-sectional study included 144 neurological patients, aged 19–93 years. Data were collected on a range of factors, including oral and pharyngeal structures, appetite, cognitive function, and social participation. The prevalence of OD and malnutrition was assessed using the Standardized Swallowing Assessment and Global Leadership Initiative on Malnutrition (GLIM) criteria. Risk factors were evaluated using logistic regression models based on the biopsychosocial model.

Results

The prevalence of OD and malnutrition in the study sample was 27.1% and 35.4%, respectively. Significant risk factors for OD included impaired oral structures (tongue, lips, and soft palate), cognitive dysfunction, and appetite loss. Malnutrition was associated with soft palate impairment, reduced calf circumference, weight loss, and social isolation. Higher scores in the WHO Disability Assessment Schedule (WHODAS 2.0) getting along domain (indicating poor social functioning) and living alone were linked to increased malnutrition risk. No significant relationship was found between environmental factors or health conditions and OD or malnutrition. While most dysphagia patients retained some ability to eat orally, dietary adaptations were frequently required.

Conclusion

This study highlights the high prevalence of OD and malnutrition among neurological patients and identifies key risk factors, including both physical impairments and psychosocial elements. Early screening and targeted interventions, such as dietary modifications and cognitive support, are essential for improving patient outcomes. A biopsychosocial approach is effective in understanding the multifactorial nature of these conditions and informs clinical practice. Future longitudinal studies are necessary to better understand causal relationships and enhance the generalizability of these findings.

1. Introduction

Oropharyngeal dysphagia (OD) is a condition defined by the World Health Organization (WHO) as difficulty or inability to move bolus safely and effectively from the oral cavity to the esophagus [1]. Neurogenic OD occurs due to diseases of the central and peripheral nervous system, neuromuscular transmission, or muscles [2]. Prevalence of OD reported in the geriatric population ranges from 11% to 91%, in patients with neurodegenerative disorders from 35% to 86%, and in stroke patients from 25% to 81% [3]. A 2021 systematic review reported that stroke patients frequently exhibited symptoms such as early leakage of the food bolus, delayed initiation of swallowing, and abnormalities in pharyngolaryngeal motion. In individuals with Parkinson's disease, vallecular residue was the most common finding, whereas those with atypical Parkinsonian syndromes also showed pharyngolaryngeal motor dysfunction. Residue accumulation in the pyriform sinus was predominantly seen in patients with myositis, motor neuron disease, and brain stem strokes. Cases of myasthenia gravis were marked by fatigable weakness of the swallowing muscles, and amyotrophic lateral sclerosis presented with varied patterns of dysphagia [4]. Sequelae of OD include aspiration pneumonia, malnutrition, and dehydration, which lead to an increased risk of associated morbidity and mortality [1, 2].

Malnutrition is one of the most common OD sequelae, defined by WHO as deficiency, excess, or imbalance in the process of energy and/or nutrient intake [5]. OD directly affects food intake, but malnutrition may exacerbate the manifestations of dysphagia due to progressive neuromuscular dysfunction [6]. The prevalence of malnutrition in rehabilitation worldwide ranges from 14% to 65%, and the highest rates have been observed in Europe and Australia [7]. Studies show that for patients who are diagnosed with OD and malnutrition at the same time, the 1-year mortality rate reaches 65.8% [8].

OD and its complications lead to social isolation and a decrease in quality of life [9]. Malnutrition and the risk of malnutrition are associated with increased mortality, which emphasizes the need for early screening and identification of risk factors to identify patients who may require additional support [10].

Additionally, both OD and malnutrition contribute to increased length of hospital stay and are associated with significant economic burden on healthcare systems. A study found that patients with dysphagia incurred total inpatient costs that were, on average, 6243 higher in US dollars compared to patients without dysphagia [11]. Another study found that average total costs associated with malnutrition per capita over 60 days were $3770 if nutrition therapy was delayed, versus $2419 if nutrition therapy was started early [12].

Several risk factors for neurogenic OD and malnutrition have been reported in the literature. Longitudinal studies have also identified older age, functional dependence, and severity of condition (dementia) as risk factors for OD. Additionally, the presence of OD is associated with a greater risk of malnutrition [13, 14]. A 2022 study with multiple sclerosis patients similarly identified the severity of condition as a risk factor. Cerebellar impairment and motor dysfunction were also found to be risk factors for dysphagia [15]. A 2019 meta-analysis on malnutrition risk factors for poststroke patients found that the following factors correlated with an increased risk of malnutrition: malnutrition on admission, presence of OD, comorbidities (stroke or diabetes mellitus), tube feeding, and reduced level of consciousness. Inconclusive results were found for alcohol consumption, hypertension, depression, pneumonia, infection, and male sex. Smoking was not associated with an increased risk of malnutrition [16].

However, to the authors' knowledge, none of the studies have classified risk factors according to the International Classification of Functioning, Disability, and Health (ICF) biopsychosocial model, which would help with the rapid identification of OD or malnutrition risk presence in a rehabilitation setting and description of functional status [17].

This study was aimed at investigating the risk factors of neurogenic OD and malnutrition according to the ICF model.

2. Materials and Methods

2.1. Study Design and Participants. A cross-sectional study was conducted at Riga East University Hospital (REUH) in Riga, Latvia, and National Rehabilitation Centre (NRC) "Vaivari" in Jurmala, Latvia, from May 31st, 2021, to January 3rd, 2023. All patients admitted to REUH Neurology and Neurosurgery Clinic and NRC "Vaivari" Neurorehabilitation program were screened for eligibility. In the study sample, REUH represented inpatients with acute neurological diseases and NRC "Vaivari" rehabilitation inpatients with subacute and chronic neurologic conditions.

The inclusion criteria were defined as follows: age ≥ 18 years, hemodynamic stability, and confirmed neurological diagnosis. Patients were excluded if they were intubated or had disturbed consciousness (Glasgow Coma Scale (GCS) score ≤ 8 points) [18].

2.2. Variables. Characteristics of study population were provided in terms of demographic data, primary neurological diagnoses, and functional measures. Demographic data included gender, clinical setting, native language of patient, marital status, and employment status, which also includes having a disability status that is officially granted as part of social support from the government of Latvia.

To analyze data regarding risk factors, dependent, independent, and intermediate variables were defined, as well as confounding factors.

Several possible risk factors (dependent variables) across all the ICF components were tested:

a. Body structure model in total included seven variables —tongue, teeth, lips, jaw, hard and soft palate, and calf circumference.

b. Body functions had 10 variables—consciousness, loss of appetite, attention, cognition, language, pain, type of breathing, aspiration, body mass index, and weight loss.

c. Activities and participation covered aspects of participation, mobility, self-care, and various life activities with seven variables.

d. Personal factor model tested the effect of 10 variables—education, gender, native language, smoking and use of alcohol, physical activity, oral hygiene, time since onset of illness, marital status, and age.

e. Environmental factor model included three variables—polypharmacy, place of residence, and caretakers.

f. Effect of health condition was also tested with the following variables: localization of impairment and presence of multimorbidity.

Independent variables (outcomes) were defined as the presence of OD and/or malnutrition, and intermediate variables were unhealthy lifestyle habits.

Confounding factors were determined to be age, health condition, and duration of illness.

2.3. Outcome Measures. To determine the presence of OD and malnutrition, a clinical assessment of patients was done. OD was determined by using the Standardized Swallowing Assessment [19]. Malnutrition was diagnosed according to the Global Leadership Initiative on Malnutrition (GLIM) framework [20]. Screening and nutrition assessment were performed with the Mini Nutritional Assessment–Short Form (MNA-SF) [21], and then, the GLIM diagnostic indicators were applied. Additionally, anthropometric indicators were assessed, and laboratory screening tests were done, assessing albumin, cholesterol, and triglycerides. The study sample was described by the Functional Oral Intake Scale (FOIS) [22].

To explore risk factors, outcome measures covering all the ICF components were chosen. For oral motor structures, clinical examination was used. Body functions were assessed with the GCS [18], the Montreal Cognitive Assessment (MoCA) (permission for use of MoCA in the study has been obtained) [23], and the Visual Analogue Scale [24]. Component activities and participation were covered by the WHO Disability Assessment Schedule (WHODAS 2.0). Contextual factors were reported according to Section 2 Demographic and Background Information of the WHODAS 2.0 questionnaire [25], as well as medical history data and a questionnaire created by the authors. Researchers involved in the assessment of patients had previously familiarized themselves with outcome measure manuals or undergone training and certification where applicable to ensure correct use and interpretation of results.

2.4. Statistical Analysis

1. Descriptive statistics were used for outcomes and characteristics of study population. Proportions were reported for categorical data and frequencies (means or medians) for continuous variables. Prevalence of malnutrition and dysphagia was calculated for the study sample. Descriptives of WHODAS 2.0 were analyzed for each domain and total scores using box plots. Additionally, shifts in proportions of FOIS levels were reported for dysphagia and malnutrition using bar graphs, and a chi-square test was used to compare proportions between those with and without malnutrition or dysphagia.

2. Logistic regression analysis to predict OD and malnutrition was performed for each group of risk factors according to the ICF.

   a. Univariate regression analyses were done to evaluate the association between each individual predictor variable and both outcomes. Predictor variables with p value < 0.25 were included in the next step of analysis.

   b. Stepwise regression analysis was performed to find a model of predictor variables that best explained each outcome.

   c. Models were compared using Hosmer–Lemeshow goodness-of-fit test. If models were significantly different ($p < 0.05$), the model with higher χ^2 values was chosen. If the models were not significantly different, the model with the least number of variables was chosen.

2.5. Ethics Approval. This study adheres to the Declaration of Helsinki. The study protocol was approved by the following ethics committees: Ethics Committee of NRC "Vaivari" on May 18, 2021; REUH Ethics Committee for Medical and Biomedical Research on October 8, 2020 (15-A/20); and Riga Stradins University Research Ethics Committee on October 26, 2020 (6-1/10/31). Written informed consent was obtained from all patients or their next of kin before their enrollment in the study. If informed consent could not be obtained, patients were excluded from the study.

3. Results

3.1. Study Sample. During the study, 308 patients were screened for eligibility. We enrolled 144 neurological patients. Reasons for exclusion from the study were patients' refusal to participate in the study or informed consent could not be obtained, GCS score ≤ 8 points, no neurological diagnosis confirmed, and/or hemodynamic instability.

The age range in the study sample was 19–93 years (median 63.00). Other descriptive statistics of the study sample are summarized in Table 1. Of those included, 109 patients had been diagnosed with cerebrovascular disease, 7 with neoplasms, 5 had suffered injuries to the head, and 23 had other neurological conditions. Most patients also had secondary neurological diagnoses (Table 2).

Prevalence of OD and malnutrition risk or malnutrition in the study sample was 27.1% and 35.4%, respectively.

Median (IQR) for FOIS was 7 (IQR = 6 – 7), for MNA-SF it was 10 (IQR = 8.5 – 12), and for MoCA 22 (IQR = 18 – 25) points. WHODAS 2.0 results according to domains are summarized in Figure 1. The highest median scores, indicating more severe disability, were observed in the domains mobility, self-care, life activities, and participation.

TABLE 1: Descriptive statistics of the study sample ($n = 144$).

Demographic variables	Frequency	Percentage
Gender		
Male	74	51.4
Female	70	48.6
Clinical setting		
Hospital	78	54.2
Rehabilitation center	66	45.8
Native language		
Latvian	96	66.7
Russian	48	33.3
Marital status		
Married	65	45.1
Unmarried	12	8.3
Divorced	20	13.9
Widowed	22	15.3
Separated	4	2.8
Cohabiting	21	14.6
Employment		
Paid work	55	38.2
Self-employed	1	0.7
Homemaker	1	0.7
Retired	59	41
Disability status	17	11.8
Unemployed due to health status	3	2.1
Unemployed due to other reasons	8	5.6

3.2. Risk Factor Models. Table 3 represents the comparison of all models explaining both dysphagia and malnutrition. The body structure model that best explained dysphagia contained six variables (tongue, teeth, lips, jaw, soft palate, and calf circumference). The body function model included appetite and cognitive functions. The activities and participation model included WHODAS 2.0 getting along domain and employment status. The personal factor model included education, low physical activity, oral hygiene, time since the onset of illness, and age.

For malnutrition, a body structure model with the best fit consisted of three variables—teeth, soft palate, and calf circumference. Body function model included appetite and weight loss. Activities and participation model included WHODAS 2.0 getting along domain score. Personal factor model included marital status.

Models of environmental factors and health conditions showed no significance in predicting dysphagia or malnutrition.

Table 4 summarizes odds ratios (ORs) and 95% confidence intervals (CIs) for developing dysphagia or malnutrition from the logistic regression analysis. ORs for all risk factors increasing the likelihood of developing dysphagia or malnutrition are reported in Figure 2.

According to the risk factor models, the analysis suggests positive associations between impaired lips, impaired soft palate, loss of appetite, cognitive function impairment, higher WHODAS getting along score, and increased risk of dysphagia. Findings also suggest positive associations between reduced calf circumference, loss of appetite, weight loss, higher WHODAS getting along score, living alone, and increased risk of malnutrition.

3.3. Oral Intake Levels. Chi-square test results showed no statistically significant difference between type of oral intake in groups of patients with and without malnutrition ($p > 0.166$). However, there was a statistically significant difference between types of oral intake among patients with and without dysphagia ($p < 0.001$). Most dysphagia patients in the study sample were not tube dependent but instead received a FOIS score of 6 (Figure 3).

4. Discussion

This study investigated risk factors of OD and malnutrition among neurological patients, according to the biopsychosocial model. Relationships between both outcomes and risk factors representing the ICF components were explored. The findings suggest that significant predictors of the risk of dysphagia and malnutrition among individuals with neurological conditions are specific body structures, appetite, and activity levels.

4.1. Prevalence of OD and Malnutrition. The prevalence of OD and malnutrition in the study sample was notable, and it aligns with findings from previous studies, which have shown that both conditions are prevalent in neurological patient populations, particularly those with cerebrovascular diseases and neurodegenerative conditions [14, 26, 27]. OD is a common issue in these patients, contributing to poor nutritional intake, aspiration, and increased mortality risk. Malnutrition, in turn, is often caused by difficulties in swallowing, chewing, and overall impaired ability to consume adequate nutrition orally.

4.2. OD Risk Factors. The predictors of OD in this study were identified through the application of the biopsychosocial model. The body structure model that best explained the presence of OD mostly included variables related to the oral and pharyngeal structures (tongue, teeth, lips, jaw, soft palate, and calf circumference) which are directly involved in the food intake process. This finding is consistent with research showing that structural impairments, such as inadequate oral health and poor dentition, can significantly contribute to dysphagia, which in turn can increase the risk of malnutrition [28, 29]. It has also previously been highlighted by other studies how impaired oral structure functioning (reduced strength, range of motion, and sensitivity) can hinder the process of swallowing, leading to an increased risk of aspiration and nutritional deficiencies [30].

In the body function model, appetite and cognition were key predictors. Appetite loss is often experienced by people with neurogenic dysphagia, as it takes extra effort to chew and swallow, which causes an avoidance of eating and drinking activities. All of this can contribute to a decline in food intake and nutritional status, also highlighted in other studies [4]. Cognitive impairments, which are common in

TABLE 2: Distribution of patients according to primary neurological diagnoses.

Condition	Number of patients
Cerebrovascular diseases (I60–I69)	
Ischemic stroke	70
Sequelae of ischemic stroke	23
Sequelae of hemorrhagic stroke	6
Rupture of cerebral aneurysm	2
Sequelae of cerebral aneurysm rupture	1
Hemorrhagic stroke	4
Transient cerebral ischemic attacks and related syndromes (G45)	
Transient ischemic attack	3
Intracranial injury (S06)	
Traumatic brain injury	2
Sequelae of injuries of the head (T90)	
Sequelae of traumatic brain injury	3
Malignant neoplasm of the brain (C71)	
Neoplasm	4
Neoplasm of uncertain or unknown behavior of the brain and central nervous system (D43)	
Sequelae of neoplasm	3
Other disorders of the brain (G93)	
Encephalopathy	2
Encephalitis, myelitis, and encephalomyelitis (G04)	
Meningoencephalitis	1
Encephalitis	3
Meningitis in other infectious and parasitic diseases classified elsewhere (G02)	
Meningitis	2
Sequelae of inflammatory diseases of the central nervous system (G09) (G02)	
Sequelae of encephalitis	1
Myasthenia gravis and other myoneural disorders (G70)	
Myasthenia gravis	3
Epilepsy (G40)	
Epilepsy	1
Nerve, nerve root, and plexus disorders (G50–G59)	
Neuropathy	1
Polyneuropathies and other disorders of the peripheral nervous system (G60–G64)	
Polyneuropathy	2
Extrapyramidal and movement disorders (G20–G26)	
Parkinson's disease	2
Demyelinating diseases of the central nervous system (G35–G37)	
Multiple sclerosis	2
Systemic atrophies primarily affecting the central nervous system (G10–G14)	
Cerebellar ataxia	1
Disorders of vestibular function (H81)	
Vestibular neuronitis	1
Cerebral palsy and other paralytic syndromes (G80–G83)	
Paralytic syndromes	1

neurological disorders, may lead to difficulties in self-regulating feeding behaviors and impaired swallowing coordination, resulting in penetration and aspiration. These findings reinforce the importance of addressing both cognitive and appetite-related issues when managing OD in this population, which is in line with other studies [4].

The activities and participation model indicated that higher scores on the WHODAS 2.0 getting along domain

TABLE 3: Hosmer and Lemeshow goodness-of-fit tests for model comparisons.

Models	Log-likelihood	Chi-squared (χ^2)	Degrees of freedom (df)	*p* value
Dysphagia				
Body Structures 1	83.57	14.712	6	0.065
Body Structures 2	144.608	3.157	4	0.789
Body Functions 1	55.522	3.249	8	0.918
Body Functions 2	114.494	5.550	2	0.698
Activities and Participation 1	156.745	5.030	5	0.754
Activities and Participation 2	158.206	8.346	2	0.400
Personal Factors 1	18.117	0.153	6	1.000
Personal Factors 2	161.539	5.359	1	0.011
Malnutrition				
Body Structures 1	96.46	13.152	3	0.107
Body Structures 2	96.656	11.149	2	0.193
Body Functions 1	35.148	10.547	7	0.160
Body Functions 2	92.895	5.510	4	0.239
Activities and Participation 1	179.529	7.298	5	0.505
Activities and Participation 2	181.591	6.101	1	0.636
Personal factors	182.823	7.420	1	0.115

(which measures social functioning) and employment status were predictive of OD. This suggests that social aspects, such as the patient's inability or unwillingness to engage in social eating and drinking or participate in other meaningful activities, may be indicative of their swallowing abilities. It also aligns with the increasing awareness that dysphagia is not only a physical issue but also relates to psychosocial functioning and overall quality of life [31–33].

4.3. Pathophysiological Mechanisms of OD. It is important to consider that the pathophysiological presentation of dysphagia varies across neurological subtypes, which may help explain the diversity of risk factors observed in our study. For example, poststroke dysphagia is frequently characterized by acute pharyngeal impairments and risk of aspiration [34], whereas in Parkinson's disease, progressive bradykinesia and rigidity lead to reduced oral and pharyngeal clearance [35]. In dementia, dysphagia often arises from cognitive decline and impaired feeding behaviors [36], while in motor neuron disease, bulbar muscle weakness results in profound oral and pharyngeal deficits [37]. These differences highlight that, while structural, functional, and psychosocial risk factors are shared, their relative contribution may differ depending on the underlying neurological condition. Moreover, dysphagia and malnutrition are multifactorial and multidimensional conditions that profoundly compromise health and may ultimately lead to mortality. Although the underlying causes and clinical manifestations may vary across populations, routine screening and assessment should be regarded as a fundamental component of standard care, ensuring timely identification and management of disease-specific dysphagia mechanisms.

4.4. Malnutrition Risk Factors. Body structure model demonstrated that variables like teeth, soft palate, and calf circumference were significant predictors for malnutrition. Dental health is of great importance in relation to malnutrition, as poor oral hygiene and partial or complete edentulism can make it more difficult for patients to chew and swallow adequately. This can lead to a lack of variety in the diet and eventually reduced food intake and insufficiency of critical nutrients. The soft palate is also a critical structure in the pharyngeal phase of swallowing, where its main task is closing the nasopharynx to avoid food from entering. Therefore, soft palate impairment can contribute to dysphagia (bolus regurgitation into the nasal cavity) and, over time, inadequate nutrition. Additionally, calf circumference, often used as an indicator of muscle mass, suggests that malnutrition in the study cohort might also be associated with muscle wasting and sarcopenia, which are common in neurological diseases, further complicating the rehabilitation process.

For the body function model, appetite and weight loss emerged as significant risk factors for malnutrition. This is in line with the well-established link between appetite dysregulation and malnutrition due to pathological functioning, which is often seen in patients with neurological disorders [38]. Weight loss, often exacerbated by dysphagia and impaired nutrient absorption, is a critical indicator of malnutrition, which is linked to a negative functional prognosis and recovery [39].

The activities and participation model indicated that poorer performance in the WHODAS 2.0 getting along domain was also a predictor of malnutrition. Social isolation, which often results from disability due to neurological impairment, often limits access to food and caregiving support, making it more difficult for individuals to maintain adequate nutrition. In turn, malnutrition can worsen social isolation by increasing health care costs, further impairing the ability to engage in both work and leisure activities, which negatively impacts financial stability and thus creates a vicious cycle.

TABLE 4: Logistic regression models best predicting the likelihood of dysphagia and malnutrition.

		OR	95% CI lower	95% CI upper
Dysphagia				
Body structure model				
Tongue	s203 Tongue	0.870	0.242	3.122
Teeth	s3200 Teeth	0.453	0.129	1.594
Lips	s3204 Structure of the lips	9.861	2.224	43.712
Jaw	s3208 Other specified structure of the mouth	2.839	0.778	10.363
Soft palate	s32021 Soft palate	7.285	1.384	38.346
Calf circumference	s750 Structure of the lower extremity	0.959	0.845	1.089
Body function model				
Loss of appetite	b1302 Appetite	3.307	1.319	8.294
Cognitive functions	b164 Higher-level cognitive functions	0.899	0.831	0.973
Activities and participation model				
WHODAS getting along	d710 Basic interpersonal interactions d720 Complex interpersonal interactions d730 Relating with strangers d770 Intimate relationships	1.022	1.007	1.038
Employment	d840 Apprenticeship (work preparation) d845 Acquiring, keeping, and terminating a job	1.093	0.951	1.257
Personal factor model				
Education		0.656	0.390	1.103
Low physical activity		0.860	0.017	44.120
Oral hygiene		0.000	0.000	—
Age		0.892	0.763	1.043
Malnutrition				
Body structure model				
Teeth	s3200 Teeth	1.902	0.659	5.491
Soft palate	s32021 Soft palate	1.344	0.363	4.973
Calf circumference	s750 Structure of the lower extremity	0.828	0.727	0.942
Body function model				
Loss of appetite	b1302 Appetite	10.947	3.257	36.800
Weight loss	b530 Weight maintenance functions	15.521	5.591	43.092
Activities and participation model				
WHODAS getting along	d710 Basic interpersonal interactions d720 Complex interpersonal interactions d730 Relating with strangers d770 Intimate relationships	1.017	1.003	1.032
Personal factor model				
Marital status		1.265	1.014	1.579

Abbreviations: CI, confidence interval; OR, odds ratio.

Personal factor model showed that marital status (living alone) also increases the likelihood of malnutrition since it might indicate less or no support from caregivers. This leads to a lack of social support for meal preparation and less encouragement to eat, limited access to healthy foods, difficulty maintaining consistent meal patterns, and increased social isolation. This is also in line with existing research where psychosocial contributors have been identified as significant risk factors [14].

4.5. Role of Environmental and Health Condition Factors. Interestingly, models of environmental factors and health conditions showed no significant predictive value for either OD or malnutrition. However, there was a slightly increased likelihood of malnutrition for patients whose personal factors showed no spouse, significant other, or presence of direct relatives, which also denotes social environment and highlights the importance it plays in the occurrence of malnutrition. For OD, there was an increased risk if the person was unemployed, as shown by the activities and participation model, which also represents both economic and social environment. Nevertheless, these findings overall contrast with the well-established understanding that social, economic, and physical environment factors (determinants of

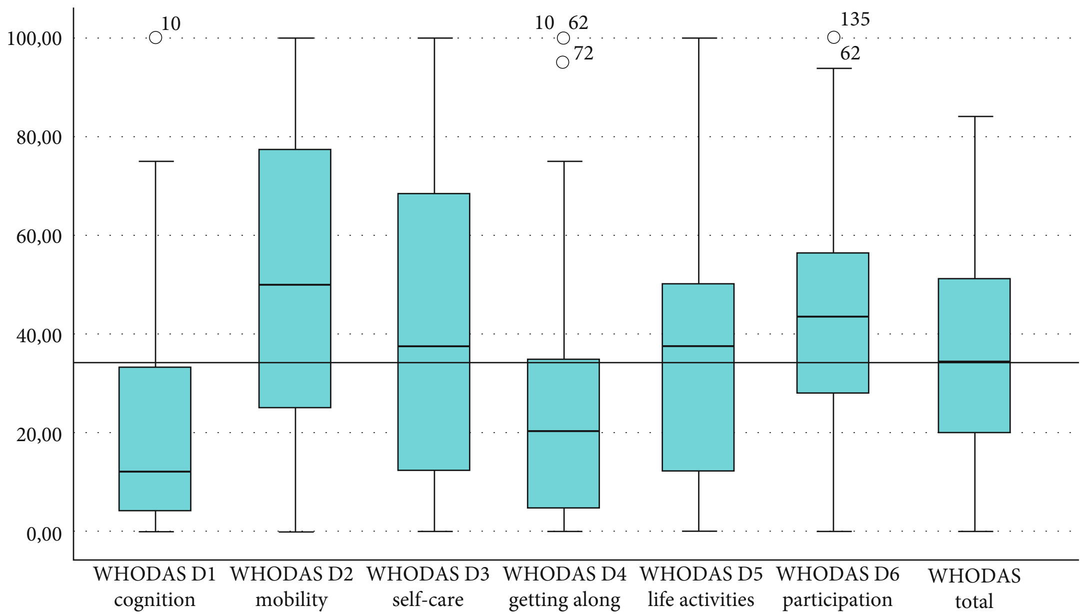

Figure 1: WHODAS results according to domains.

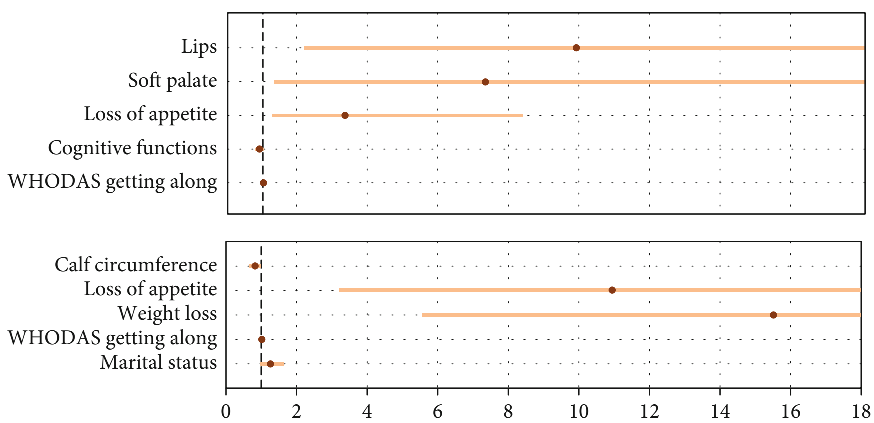

Figure 2: Forest plots for odds of developing dysphagia and malnutrition.

health) are more prominent in influencing health outcomes [40, 41]. A possible explanation for the lack of significance in this study could be the relatively homogenous settings in which the data were collected, where environmental factors and health conditions might not have varied sufficiently to show a clear impact.

4.6. Oral Intake and Dysphagia. FOIS levels indicate that, while dysphagia is common in this population, retained abilities to consume food orally suggest that the majority of participants in the study sample had manifestations corresponding to milder dysphagia and less severe impairment. Patients with neurogenic OD in this study sample were most often prescribed an oral diet with some limitations and adaptations. This finding supports the idea that many patients with neurogenic OD can manage oral feeding with appropriate interventions, such as dietary modifications or compensatory techniques, also observed in Wolf et al.'s study [14]. Encouraging oral feeding for patients with OD when feasible offers such benefits as promoting patient autonomy, variety in nutrition, and reducing the risk of malnutrition, which in turn contributes to patients' physical, psychological, and social well-being.

4.7. Implications for Clinical Practice. Findings from this study have several important clinical implications. First, the high prevalence of OD and malnutrition in neurological patients highlights the need for routine screening and early intervention to identify and manage these conditions. Early identification of at-risk patients—especially those with impaired cognition, loss of appetite, and structural or functional impairments in the oral cavity—can lead to better outcomes by facilitating timely interventions, including dietary modifications, nutritional support, and further speech and nutritional therapy, also underlined by other authors [4].

Second, the biopsychosocial framework can be effective for understanding and addressing the multifactorial nature of OD and malnutrition but also the contextual

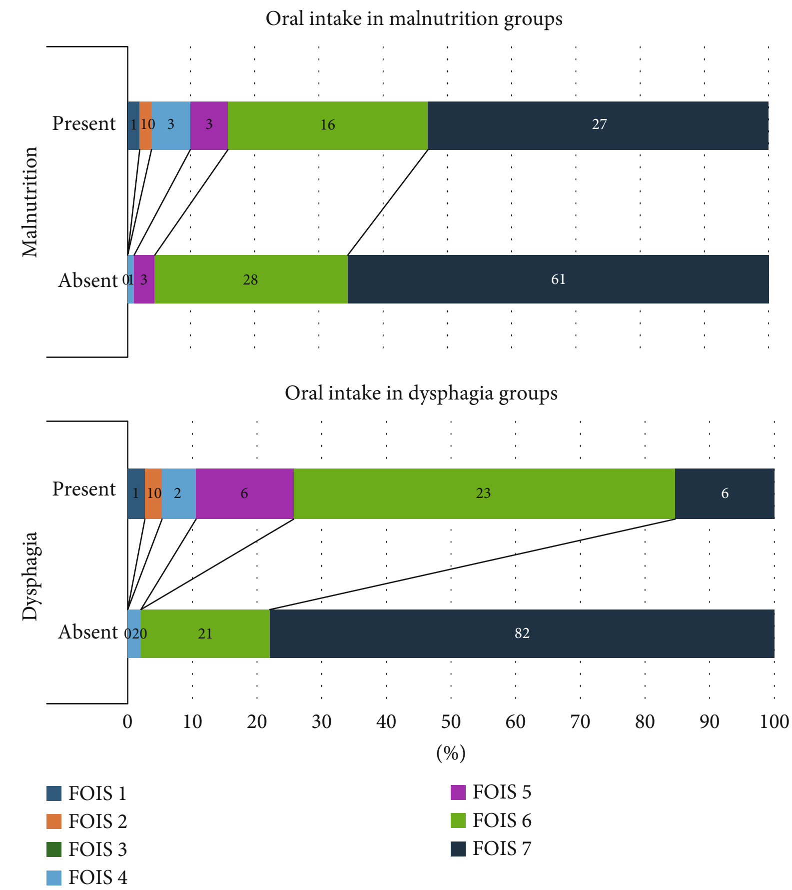

Figure 3: Oral intake according to FOIS in malnutrition and dysphagia groups.

(psychological, social, etc.) factors that may contribute to these conditions. Use of a holistic approach can inform rehabilitation strategies that are already being applied; for example, patients can also benefit from improving oral care, optimizing cognitive functioning, and addressing social isolation. Finally, the findings suggest that the severity of OD and its impact on nutrition may sometimes be milder in neurological patients than assumed. This underscores the importance of individualized care plans that consider the individual's functional capacity and needs, as well as autonomy, allowing for the use of oral intake where feasible and appropriate.

4.8. Limitations and Further Research. This study has several limitations that need to be considered. The cross-sectional design limits authors' ability to draw conclusions about causality. Longitudinal studies are needed to track changes in OD and malnutrition over time and identify any causal relationships between different factors and both outcomes. Although the study was conducted in two centers that provide different levels of care, the sample was merged for the statistical analysis to ensure maximal variability of the data. Since the focus of the study was risk factors of neurogenic OD and malnutrition and the sample size was relatively small, it was decided to exclude confounding factors. The data collected still do not allow for generalizability of the findings but give insight into the problem. Expanding the study to multiple centers, with larger sample sizes, more diverse patient groups, and more varied manifestations and severity of OD and malnutrition, could provide a more comprehensive understanding of these issues.

5. Conclusions

OD and malnutrition are prevalent and significant concerns among neurological patients in both acute care and rehabilitation facilities. Oral and pharyngeal structures (ICF body structures), appetite and cognition (body functions), and social functioning and employment status (activities and participation) were the most important predictive factors for OD. Teeth, soft palate, and calf circumference (body structures of the ICF), appetite and weight loss (as body functions), and social functioning (component of activities and participation of the ICF), as well as living alone (personal factors) were significant predictors for malnutrition.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Author 1 (Līga Savicka): methodology, investigation, formal analysis, writing—original draft, visualization. Author 2 (Baiba Kubile): investigation, writing—review and editing. Author 3 (Guna Bērziņa): conceptualization, methodology, data curation, writing—review and editing, supervision.

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