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Prevalence of Oropharyngeal Dysphagia in Patients with Stroke: A Systematic Review and Meta-Analysis

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Oropharyngeal dysphagia (OD) is a prevalent and clinically significant challenge among patients with stroke, affecting their quality of life and overall prognosis. This systematic review aims to comprehensively assess and synthesize existing evidence on the prevalence of OD in a patient's stroke. A comprehensive literature search was performed in major medical databases, including PubMed, Scopus, and Web of Science, from inception to March 2023. Studies revealed the prevalence of OD in adult stroke patients. Two reviewers independently assessed the titles, abstracts, and full texts of potentially eligible studies. The studies were evaluated for bias using the Joanna Briggs Institute's critical appraisal checklist. Data from the studies were extracted, and a meta-analysis was performed to estimate the pooled prevalence of OD in stroke patients. The initial search yielded 1,272 relevant studies, of which eight met the inclusion criteria for the systematic review. The combined sample size of the studies included was 1,830 patients. The pooled prevalence of OD in stroke patients was estimated to be 31.0% (95% confidence interval [CI]: 11.0-55.0%). Subgroup analysis based on stroke type (ischemic vs. hemorrhagic), stroke location (left hemisphere vs. right hemisphere vs. brainstem), and time since stroke onset was conducted to explore potential sources of heterogeneity. In conclusion, the study highlights the significant burden of OD in patients with stroke, emphasizing the need for early detection, comprehensive assessment, and tailored interventions to improve patient outcomes and identify risk factors.

Keywords: Prevalence, Dysphagia, Characteristics, Oropharyngeal, Stroke patients, Swallowing disorders

INTRODUCTION

Difficulty swallowing, i.e., dysphagia, can cause serious health problems, including malnutrition, dehydration, and aspiration pneumonia [1]. Regular monitoring of dysphagia plays a key role in identifying patients at risk of respiratory and nutritional complications [2]. Severe dysphagia, measured by the Fiberoptic Endoscopic Dysphagia Severity Scale (FEDSS) with a score of six, has been shown to predict increased health insurance costs, highlighting its impact on both physical and economic well-being [3].

The World Health Organization (WHO) classifies oropharyngeal dysphagia (OD) under ICD-9: 787.2 and ICD-10: R13. OD is prevalent across various underlying conditions, with its incidence varying by disease severity. Studies show that OD affects up to 27% of older adults living in the community, over 50% of elderly patients who are hospitalized or institutionalized, 50% of stroke patients, and 24% to 86% of individuals with

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neurodegenerative diseases. Additionally, OD affects 17% to 86% of patients with structural head and neck disorders. OD significantly impacts respiratory health, often leading to respiratory infections like aspiration pneumonia, which have a mortality rate of up to 50% [4].

In stroke patients, neurological damage often results in OD due to impaired control and coordination of the swallowing mechanism. This can result in difficulties in swallowing, muscle weakness or paralysis, sensory deficits, and cognitive impairments affecting the planning and organization of swallowing tasks [5]. The symptoms and severity of OD can vary based on overall health, stroke recovery, and therapy adherence. Some patients may regain the ability to swallow safely, while others may develop new symptoms as their condition worsens. These fluctuations make long-term treatment challenging, requiring regular assessments, treatment adjustments, and care plan modifications [2,6].

A cross-sectional study found that 47% of stroke patients exhibited signs of OD. Understanding the prevalence and consequences of dysphagia in stroke patients is crucial for providing appropriate care and improving outcomes. Regular assessments and comprehensive management strategies are necessary to address the challenges faced by stroke survivors with OD [7]. Characteristics of OD in stroke patients include difficulty closing the lips, controlling the tongue, and initiating a pharyngeal swallow, anterior hyoid motion, tongue base retraction, pharyngeal residue, and pharyngoesophageal contraction. Another study observed that post-stroke patients with OD had tongue weakness and delayed laryngeal vestibule closure (LVC), leading to reduced bolus propulsion force [8]. These impairments can result in respiratory and nutritional complications such as aspiration pneumonia and malnutrition. Identifying these characteristics and potential complications is essential for implementing effective management strategies.

The prevalence and characteristics of OD after a stroke may vary across studies due to differences in definitions, clinical settings, study populations, measurement tools, and timing of assessments. Research on OD prevalence helps understand its burden on the population. Regular monitoring of OD is vital for identifying patients at risk, developing effective interventions, and improving patient outcomes. A recent systematic review focused on OD prevalence in adults across various healthcare settings; however, a comprehensive overview of OD prevalence and characteristics specifically among stroke patients is still lacking [1].

To address this gap, this comprehensive review aims to identify and map the available evidence on the prevalence and characteristics of OD among stroke patients. Systematic reviews are particularly useful in clarifying key concepts and definitions in the literature and identifying critical characteristics or factors. The result of this comprehensive review will inform the development of clinical guidelines and interventions to enhance the management of OD among stroke patients.

METHODS

The review followed the (PRISMA-ScR) guidelines for Reporting Items of Systematic Reviews and Meta-Analyses Extension for Scoping Reviews [9]. Although protocol registration and critical evaluation of individual studies were not conducted, the study design of each report was assessed.

Search strategy

A comprehensive search was conducted in PubMed, Scopus, and Web of Science databases to retrieve relevant articles on the prevalence and characteristics of OD patients with stroke. The search encompassed publications from the inception of these databases until March 2023. These databases were chosen due to their comprehensive coverage of sources related to OD in stroke patients.

The search formula utilized was as follows: (“prevalence” OR “incidence” OR “frequency”) AND (“characteristics” OR “symptoms” OR “sign”) AND (“OD” OR “oral-pharyngeal dysphagia” OR “swallowing disorder” OR “dysphagia”) AND (“stroke” OR “ischemic stroke” OR “cerebrovascular accident”). Articles that fulfilled the inclusion criteria were written in English, published up to March 2023, assessed the prevalence and/or characteristics of OD in stroke patients, accessible in full text, and were randomized controlled trials (RCTs), cohort studies, prospective or retrospective studies, case reports with at least 18 patients per group.

On the other hand, articles that fell under the exclusion criteria were abstracts, editorials, letters, and duplicate publications reporting on the same study without additional outcomes, unpublished studies, studies involving paediatric patients, animal studies, systematic reviews, and studies focusing on other types of dysphagia. After removing duplicate articles, individual screening of titles and abstracts used Mendeley (version 1.19.8, Mendeley, London, United Kingdom). Articles not meeting the inclusion criteria were excluded. The

number of searches conducted within every database and the number of duplicates were recorded and managed using Mendeley software's built-in "check for duplicates" function. Abstracts that satisfied the inclusion criteria were retrieved for further screening, and subsequently, full-text articles were reviewed based on the inclusion and exclusion criteria. Articles that did not address information on the prevalence or characteristics of OD in stroke patients were excluded. To assess the risk of bias in the chosen studies, the Joanna Briggs Institute (JBI) evaluation checklist was used for prevalence studies [10], and two independent reviewers were involved in this assessment. In particular, nine questions on this checklist must be answered (with the choices "Yes", "No", "Unclear", and "Not Applicable"), and the reviewers must also provide their overall assessment (by selecting "Include", "Exclude", or "Seek Further Info"). The cut-off for methodological quality was set at 50%, i.e., any study that received a score of less than 50% would be excluded [11].

Subsequently, the included articles were summarized, providing information such as author, publication year, country, sample size, age, study type, diagnostic tools used, prevalence of OD in stroke patients (%), population, and the main characteristics and findings of OD in stroke patients from the studies. Figure 1 illustrates the article selection process.

Statistical analysis

Using appropriate statistical methods, a meta-analysis was performed to determine the pooled prevalence of OD in stroke patients. Each study's dysphagia prevalence has been calculated along with its corresponding 95% confidence interval (CI). The heterogeneity of the included studies was evaluated using the I^2 statistic, and a random-effects model was utilized in cases of significant heterogeneity [12].

Ethical standard

This review was conducted in accordance with the ethical guidelines and principles outlined by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

RESULTS

Search results

Initially, 1,272 articles were found in the database (PubMed: 1,119, Scopus: 103, Web of Sciences: 50). After removing duplicates, 1,243 unique articles remained, and upon screening their titles, 1,201 articles were excluded. The remaining 42 articles underwent abstract screening, and from these, 27 articles were evaluated in full text for eligibility. Ultimately, 19 articles were excluded, with six of them lacking specificity on the type of dysphagia and thirteen not providing information on the prevalence and characteristics of OD in patients with stroke.

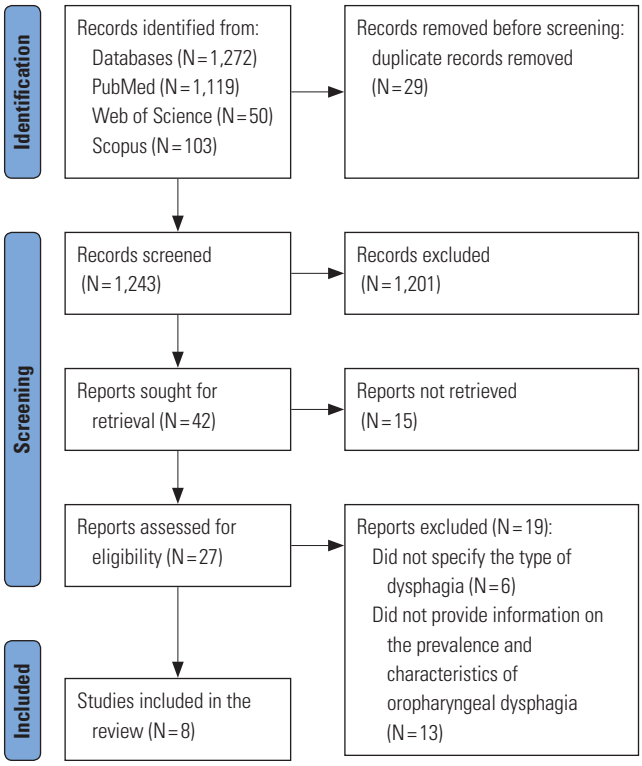

Figure 1. The flow chart illustrating the systematic search and selection process of included studies.

In this systematic review, eight suitable articles were shortlisted (Figure 1). All of them had scores of more than 50% (on JBI's checklist), indicating low risk of bias and sufficient quality. These articles focused on the prevalence and characteristics of OD among patients with stroke and were authored by [2,13-17] as well as two additional articles that discussed the characteristics by [18,19].

Among the selected studies, five were prospective, one was a RCT, one was cross-sectional, and one was longitudinal cohorts. These articles were thoroughly reviewed and analysed as part of the systematic review process (Table 1).

Table 1 presents the prevalence of OD from seven studies encompassing different populations, including stroke patients. The reported prevalence ranged widely, from 5.8% to 68.8% among stroke patients [15]. Notably, the highest prevalence of OD in stroke patients was observed in studies that

Table 1. The prevalence and characteristics of included studies

First author, year (References)	Country	Sample size	Age	Type of study	Diagnostic tool	Prevalence of oropharyngeal dysphagia in stroke patients (%)	Population
[13]	United Kingdom	800 patients	Mean=78.9±11.5 years, range=90.4- 67.4 years	longitudinal cohort study	Subjective tools of assessment (questionnaire: Sydney Swallow Questionnaire)	The prevalence of oropharyngeal dysphagia in stroke patients is 8%	Elderly community-dwelling individuals
[18]	Netherlands	42 patients	Mean=69.1±8.7 years, range=60.4-77.8 years	Cross-sectional study	Fiberoptic endoscopic evaluation of swallowing (FEES)	Not provided	Chronic post-stroke oropharyngeal dysphagia
[2]	Spain	247 patients	Mean=72.3±11.9 years, range=84.2-60.4 years	The observational, prospective, and longitudinal study	Volume Viscosity Swallow Test (V-VST)	The prevalence of oropharyngeal dysphagia in post-stroke patients on admission is 39.7% The prevalence of oropharyngeal dysphagia in post-stroke patients three months after stroke is 41.4%	Post-stroke oropharyngeal dysphagia
[14]	Spain	128 patients (31 post-stroke patients)	Age >18 years	Prospective study	V-VST Video-fluoroscopy (VFSS)	The prevalence of oropharyngeal dysphagia in female stroke patients is 35.48%	Ageing, head and neck cancer, stroke and Parkinson's disease
[19]	USA	332 patients (107 stroke patients)	Age ≥21 years	Prospective study	Dysphagia Detection System (DDS) VFSS	Not provided	Adults with stroke or another brain injury
[15]	Korea	415 patients	Age ≥65 years	Prospective cohort study	Standardized Swallowing Assessment (SSA) The K-ADL and K-IADL questionnaires	The prevalence of oropharyngeal dysphagia in patients without stroke is 33.7% The prevalence of oropharyngeal dysphagia in patients who have a history of stroke is 5.8%	Older community-dwelling Koreans
[16]	Spain	120 patient's groups (66 stroke patients) 14 healthy volunteers	Age >18 years	Prospective study	V-VST VFSS	The prevalence of oropharyngeal dysphagia in patients with a previous stroke is up to 55%	Health voluntary (HV) Patient (NDD, Stroke, Elderly)
[17]	Spain	120 patients	Age ≥18 years	Randomized controlled trial (RCT) reference-controlled, multiple-dose, fixed-order, single-blind, and single-centre study	V-VST VFSS	The prevalence of oropharyngeal dysphagia in stroke patients is 68.8%	Stroke patients with oropharyngeal dysphagia (OD)

utilized VFSS (68.8%) and VVST (55%) as diagnostic tools for dysphagia [16,17].

On the other hand, studies that employed subjective assessment tools such as questionnaires, like the K-ADL questionnaires (5.8%) and the Sydney Swallow Questionnaire (8%) reported the lowest prevalence of OD [13,15]. It's worth mentioning that these two studies focused on elderly community-dwelling individuals, while the studies with the highest prevalence mentioned earlier specifically targeted a population of stroke patients with OD [17].

Table 2 contains several insightful studies on the main characteristics of OD in stroke patients. 16% of participants experienced pneumonia caused by coughing and choking, leading to fatalities [13]. Regarding malnutrition, A low risk was observed in 57.1% of the patients, 7.1% of the participants exhibited a moderate risk, while 33.3% showed a high risk [18].

Table 2. The main characteristics and findings of oropharyngeal dysphagia in stroke patients

First author, year (References)	Patient age	Gender	Characteristics of dysphagia based on diagnostic methods	Malnutrition in dysphagic patients	Dysphagia severity	Stroke type	Other characteristics or findings
[18]	The mean age for all patients is 69.1 (±8.7) years The mean age for no/mild dysphagia patients is 69.5 (±7.7) years The mean age for moderate-to-severe dysphagia patients is 68.8 (±9.1) years	Male patient is 32 (76.2%) Female patient is 10 (23.8%) Dysphagia severity is categorized as male (no/mild) 9 patients Male (severe) 21 patients Female (no/mild) 3 patients Female (severe) 7 patients	Fiberoptic Endoscopic Evaluation of Swallowing (FEES): Penetration was observed in 29 (69.0%) of patients Penetration during swallows of thin liquids was seen in 14 (35.7%) patients Aspiration occurred in 18 (42.9%) patients Aspiration during swallows of thin liquids occurred in 14 (33.3%) patients Pharyngeal residue was detected in 21 (50.0%) patients Other signs of oropharyngeal dysphagia were present in 34 (81.0%) patients	Low risk of malnutrition in 24 (57.1%) patients Moderate risk of malnutrition in 3 (7.1%) patients High risk of malnutrition in 14 (33.3%) patients Patients using oral nutritional supplements (ONS) or tube feeding 14 (33.3%) patients	Patients with mild OD 3 is (7.1%) Patients with moderate OD is 15 (35.7%) Patients with severe OD is 13 (31.0%)	Not provided	Received speech and language therapy in 27 (64.3%) patients
[2]	The mean age for all patients is 72.3±11.9 years	Male patient is 59.5%	Volume viscosity swallow test (V-VST): Impaired safety of swallowing (on admission): 34.0% Impaired efficacy (on admission): 30.8% Impaired safety of swallowing (after 3 months): 19.1% Impaired efficacy (after 3 months): 39.0%	Not provided	Patients with mild ischemic stroke are 109 (44.1%)	Ischemic stroke 95.5% (236 patients) Hemorrhagic Cerebral 4.1% (10 patients) Cerebral venous thrombosis 0.4% (1 patient) Stroke location: The left hemisphere (Ischemic stroke) 44.1% (109 patients) Supratentorial location 89.6% (163 patients) Partial anterior circulation (PACI) lesion type 41.3% (102 patients)	Not provided
[14]	The mean age for male patients is 79.42±1.36 years	Not provided	Video-fluoroscopic Swallow Study (VFSS): Stroke patients with impaired safety: 77.4% Stroke patients with impaired efficacy: 96.67% Stroke patients with penetrations: 67.74% Stroke patients with aspirations: 35.48% Stroke patients with silent aspirations: 9.67%	Two patients had malnutrition	Not provided	Not provided	Stroke patients with oral residue 61.29% Stroke patients with pharyngeal residue 74.19% When volume bolus increases, it significantly increases oropharyngeal residue Severely impaired Oropharyngeal Swallow Response (OSR) in 5 mL liquid bolus Penetration aspiration scales (PAS) are high in stroke patients 4.55±0.41 Impaired oropharyngeal Swallow Response (OSR) with a delayed time to laryngeal vestibule closure (LVC)

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Table 2. Continued

First author, year (References)	Patient age	Gender	Characteristics of dysphagia based on diagnostic methods	Malnutrition in dysphagic patients	Dysphagia severity	Stroke type	Other characteristics or findings
[19]	The mean age for all stroke patients is 70±14 years The mean age for men is 77.3±8.7 years The mean age for female is 75.7±8.4 years	Male patient is 39.5% Female patient is 28.4%	VFSS: Impaired safety on thin liquids was observed in 60% of participants at the participant level	Not provided	Not provided	Not provided	Swallowing inefficiency and residue is a common finding Poor voluntary cough 0.5% Reduced or absent lip closure by 2.2% Reduced or absent tongue movement by 1.7% Poor voice quality 20.5% Impaired ability to drink water 18.1%
[16]	The mean age for stroke patients with dysphagia is 73.5±11.4 years	Male patient is (37) 56.1%	Not provided	Patients with malnourishment (17) 25.8%	The severity of dysphagia according to dysphagia severity (SSQ): 495.2±55.1 in stroke patients	Not provided	Increasing bolus viscosity reduces cough and voice changes strong effect on the safety of the swallow Dysphagic patients have delayed airway protection, and LV closure time is prolonged in patients with impaired safety Patients in the study show prolonged swallow response and UES opening During the 5-mL liquid swallow
[17]	The mean age of all patients is 76.7±8.9 years	Male patient is 54.4%	VFSS: Prevalence of penetrations in thin liquid: 41.2% Prevalence of penetrations in thickened viscosities ranged from 2.6% to 13.2% Prevalence of aspirations in thin liquid (17.5%) Efficacy of swallow: Pharyngeal residue in thin liquid 41.2% Oral residue in thin liquid 38.6%	Patients with malnutrition or at risk 54.4%	National Institute of Health Stroke Scale (NIHSS) on admission (mean±SD) 7.5±6.8 NIHSS on discharge (mean±SD) 5.3±5.9	Ischemic stroke in 78.1% of patients	Safety of swallow: Penetration and aspiration decreased with viscosity Severely delayed LVC at liquid viscosity Impaired swallowing safety associated with severe delay in LVC
[13]	Not provided	Not provided	Not provided	Not provided	Not provided	Not provided	Common Symptoms Food stuck in the throat is the most common symptom Difficulty swallowing hard foods Choking or coughing when swallowing 16% died from pneumonia

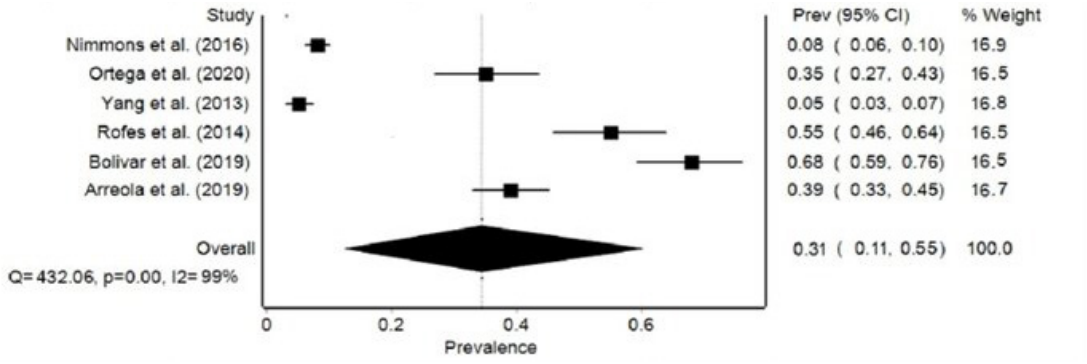

Figure 2. Forest plot for the prevalence of oropharyngeal dysphagia in stroke populations.

Moreover, 33.3% of patients required oral nutritional supplements or tube feeding. Additionally, highlighted the vulnerability of stroke patients to malnutrition, with prevalence rates ranging from 25.8% to 54.4% [14,16,17].

Furthermore, employed FEES measurements to identify various issues related to OD. They found that 69.0% of patients exhibited penetration, 42.9% had aspiration, 50.0% showed pharyngeal residue, and 81.0% displayed further signs of OD. Penetration and aspiration were more prevalent through the consumption of thin liquids, affecting 35.7% and 33.3% of patients, respectively [18]. Highlighted high Penetration Aspiration Scale (PAS) scores in stroke patients (4.55±0.41) [14].

Conducted an examination of swallowing safety and efficacy. Initially, 34.0% of patients exhibited impaired safety upon admission, but this proportion decreased to 19.1% after three months post-stroke. In contrast, 30.8% of patients had impaired efficacy initially, and this percentage increased to 39.0% after three months [2].

Reported that the prevalence level of participants was 60% for impaired swallowing safety on thin liquids, often accompanied by swallowing inefficiency and residue [19]. Observed delayed airway protection, specifically laryngeal vestibule (LV) closure time, in dysphagic patients, particularly those with impaired safety. These patients also demonstrated delayed swallow response, delayed airway closure, and delayed opening of the upper oesophagal sphincter when consuming 5 mL liquids. Patients who had impaired safety during swallowing exhibited a delay in the closure of LV across all viscosity in comparison to those with normal swallowing [16].

Furthermore, investigated the safety and efficacy of swallowing in patients with post-stroke OD. They found that the prevalence of penetration and aspiration decreased with increasing viscosity, with thin liquids showing a prevalence of 41.2% for penetration and 17.5% for aspiration. Pharyngeal residue was present in 41.2% of patients consuming thin liquids and did not significantly increase with other viscosities. Patients with post-stroke OD exhibited a severe delay in time to LVC during liquid consumption, indicating impaired swallowing safety [17].

Various studies have evaluated the severity of dysphagia in their respective patient samples. utilized the Dysphagia Severity Scale (DSS) and observed that among their patients, 7.1% had mild OD, 35.7% had moderate OD, and 31.0% were severely dysphagic [18]. In the study, most post-stroke patients presented with mild ischemic stroke, with the left hemisphere being affected in 44.1% of cases [2]. used the dysphagia severity (SSQ) scale and found a score of 495.2±55.1 in stroke patients, indicating the severity of dysphagia in their cohort [16]. Similarly, using the National Institutes of Health Stroke Scale (NIHSS), stroke severity reported a mean score of 7.5±6.8 on admission and 5.3±5.9 on discharge [17].

Furthermore, different studies have provided insights into the type and location of strokes within their patient populations. Reported that 95.5% of their patients had an ischemic stroke, 4.1% had a hemorrhagic cerebral stroke, and 0.4% had cerebral venous thrombosis. Regarding the location of strokes, the majority of patients had a supratentorial stroke, accounting for 89.6% of cases [2]. Similarly, found that 78.1% of their patients had an ischemic stroke [17].

Meta-analysis of the prevalence of OD in stroke patients

Figure 2 presents a forest plot illustrating the findings of a meta-analysis on the prevalence of OD in patients with stroke (n=1,830). The random-effects model estimated a pooled prevalence rate of 31.0% (95% CI: 11.0-55.0%) for OD in this population. The meta-analysis included studies with signifi-

cant heterogeneity (I^2 = 99%). The I^2 statistic, which measures the proportion of variation between studies, revealed significant heterogeneity rather than being due to random chance.

DISCUSSION

This systematic review and meta-analysis encompassed eight articles to unveil two crucial findings related to the prevalence and characteristics of OD among stroke patients. It stands as the first review to offer a comprehensive overview of published studies that specifically focused on the prevalence and characteristics of OD in patients with stroke, highlighting their interconnectedness in a single study. The review underscores the significant public health and clinical concern surrounding the prevalence of OD, particularly among stroke patients, with potentially severe consequences if left unaddressed.

OD, characterized by difficulties in swallowing, may lead to malnutrition, dehydration and aspiration pneumonia, further emphasizing its clinical significance. Moreover, the review identified various risk factors associated with OD in patients with stroke, including older age, male gender, stroke severity, and the presence of comorbidities. These findings provide valuable insights for healthcare professionals in understanding and effectively managing OD among stroke patients.

Prevalence of OD in patients with stroke

The meta-analysis revealed an overall prevalence of OD among stroke patients to be 31.0% (95% CI: 11.0-55.0%). However, prevalence varied significantly across studies, with rates ranging from 5.8% to 68.8%. This wide range of prevalence rates highlights the heterogeneity in the stroke population and is consistent with findings from a systematic review performed in India, which found a dysphagia prevalence of 47.71% among stroke patients [20]. Multiple studies have reported varying prevalence rates of OD among stroke patients. Instrumental assessments, such as fiberoptic endoscopic evaluation of swallowing (FEES) and video fluoroscopy with the volume-viscosity swallow test (VFSS-VVST), resulted in higher prevalence rates than subjective assessments like questionnaires. This suggests objective assessments provide more accurate estimations of OD prevalence in patients with stroke [21,22].

Gender-related differences in OD among stroke patients were examined in four of the seven studies reviewed. The findings showed that males are more likely to experience OD, with prevalence rates ranging from 39.5% to 59.5%. However, variations in gender distribution across these studies suggest that more research is necessary to better understand the underlying mechanisms driving these gender-specific differences in OD among stroke patients. These studies emphasize the importance of considering gender as a significant factor in both understanding and addressing OD in stroke patients. The observed variation in prevalence rates may be attributed to differences in sample size, study design, and the diagnostic tools used to assess dysphagia, underscoring the need for standardized methodologies in future research [2,15-17].

Characteristics of OD in patients with stroke

The review revealed common characteristics of OD in patients post-stroke, including issues such as penetration, aspiration, pharyngeal residue, and high PAS scores. Studies showed that the prevalence of penetration and aspiration decreased with increasing viscosity, with thin liquids having a prevalence of 41.2% for penetration and 17.5% for aspiration. The pharyngeal residue was observed in 41.2% of patients consuming thin liquids but did not significantly increase with other viscosities [14,17,18]. These findings align with earlier research, including a 2015 study reporting that 84.8% of dysphagic patients experienced penetration or aspiration with at least one food consistency [23], and in a study in 2017, which showed 15.2% of patients had oropharyngeal food residue in solid food [24]. Additionally, a 2016 study highlighted that 16% of participants experienced pneumonia symptoms [13]. This is consistent with other findings, which reported pneumonia prevalence rates between 29.1% and 50% among dysphagic patients [25], Moreover, reports indicate that pneumonia impacts approximately one-third of individuals who experience acute stroke [24]. During the post-acute rehabilitation phase, malnutrition was also commonly reported among stroke patients, with prevalence rates reaching up to 45% [26].

Significant impairments were noted in swallowing efficacy and safety. According to the Volume-Viscosity Swallow Test (V-VST) and video fluoroscopy, 96.67% of stroke patients reported impaired efficacy, and 77.4% had impaired safety [14]. Furthermore, 60% of the participants experienced impaired safety while swallowing thin liquids, often accompanied by swallowing inefficiency and residue [19]. Patients who experience weakened safety exhibited a delay in the laryngeal vestibule (LV closure) closure compared to those with safe swallowing across all viscosities [16]. A study also assessed swallowing safety in patients with neurological disorders and found that 54.5% of stroke patients had dysphagia, with 80.2%

showing impaired safety according to video fluoroscopic study, and 82.2% and 74.3% showing impaired efficiency and safety of swallowing, respectively, according to V-VST [25].

Previous studies collectively suggest that dysphagia is a common complication among post-stroke patients, with varying degrees of severity. Most studies indicate that the majority of post-stroke patients experience dysphagia to some extent, with moderate to severe cases being particularly prevalent. More research is needed to understand better the prevalence and causes of dysphagia in this population and explore potential treatments. The distribution of stroke types and locations found in the studies aligns with the prevalence in the general stroke population, as observed in the 2015 study, which included 200 acute stroke patients, with 102 having left hemispheric strokes and 85.5% having supratentorial strokes [23].

Clinical implications and future directions

This systematic review and meta-analysis provide valuable insights into the prevalence and characteristics of OD in stroke patients, which has significant implications for clinical practice. OD is a common swallowing impairment post-stroke managed by speech-language pathologists (SLPs) [27]. The pooled prevalence of 31.0% (95% CI: 11.0-55.0%) highlights this population's substantial burden of OD, aligning with the significant prevalence noted in previous studies [28]. This information can help healthcare providers, particularly SLPs, to anticipate and prepare for the high likelihood of dysphagia in stroke patients. Identifying common characteristics such as penetration, aspiration, and pharyngeal residue can guide clinicians' assessments and interventions. For instance, the finding that thin liquids pose a higher risk for penetration and aspiration (41.2% and 17.5%, respectively) can inform clinical decision-making regarding dietary modifications and compensatory strategies, such as the use of thickened liquids, which is a common practice among SLPs [29].

This study contributes to the field of speech therapy in several essential ways. By synthesizing current evidence on OD prevalence and characteristics in stroke patients, this review provides SLPs with a robust foundation for evidence-based practice. This can inform clinical reasoning, assessment protocols, and treatment planning. The identified risk factors (e.g., older age, male gender, stroke severity) can help speech therapists develop more targeted screening and assessment protocols for high-risk patients. Furthermore, the detailed characteristics of OD in stroke patients (e.g., impaired safety with thin liquids and delayed LVC) can guide SLPs in developing more tailored and effective intervention strategies. The findings on associated complications like pneumonia and malnutrition underscore the importance of interdisciplinary collaboration, allowing SLPs to advocate for comprehensive care and early intervention in stroke patients [30].

Looking towards the future, this study lays the groundwork for further research and clinical practice advancements. The observed variability in prevalence rates highlights the need for standardized assessment protocols. Future research could focus on developing and validating uniform diagnostic criteria for OD in stroke patients. Given the dynamic nature of post-stroke recovery, longitudinal studies could investigate the trajectory of OD over time, informing long-term management strategies. The detailed characterization of OD in this review can inform the development of targeted interventions, and future research could evaluate the efficacy of specific treatment approaches based on the identified characteristics.

Additionally, the findings could guide the development of technology-assisted assessment and treatment tools, such as apps for monitoring swallowing function or telehealth platforms for remote dysphagia management. The results of this study can also be incorporated into educational programs for speech therapy students and continuing education for practising clinicians, enhancing their understanding of OD in stroke patients. Further research on the practices and clinical decision-making of SLPs in managing dysphagia in stroke patients can provide valuable insights into optimizing patient outcomes [31].

While this review focused on stroke patients, it is worth noting that OD is prevalent in various neurological conditions. For instance, a meta-analysis has investigated the prevalence of OD in Parkinson's disease [32], this study underscores the importance of SLPs in assessing and managing OD across various neurological conditions.

In conclusion, this systematic review and meta-analysis not only provide a comprehensive overview of the prevalence and characteristics of OD in stroke patients but also offer a foundation for improving clinical practice, guiding future research, and enhancing education in speech therapy. The role of SLPs in assessing and managing OD in stroke patients is crucial for improving swallowing function and overall quality of life post-stroke [31]. By bridging the gap between research and practice, this study contributes to advancing the care and outcomes for stroke patients with OD.

Strengths and limitations of the study

Strength

The review employed a comprehensive search strategy across multiple databases to collect relevant articles on the prevalence and characteristics of OD in stroke patients. This extensive approach broadened the scope and depth of the analysis. By including various study designs, such as prospective studies, cross-sectional analyses, and RCTs, the review offered a well-rounded examination of the topic. A meta-analysis was conducted to determine the pooled prevalence of OD among stroke patients, thereby enhancing the robustness and generalizability of the results. Due to the high heterogeneity among the studies, a random-effects model was used in the meta-analysis to account for variability, which improved the validity and reliability of the findings. This method ensures that the conclusions accurately reflect the true variation and complexities involved in studying OD in stroke populations.

Limitations

The high heterogeneity observed among the included studies could limit the comparability of the findings and may affect the overall accuracy of the meta-analysis. The variation in study designs, sample sizes, and diagnostic tools used could contribute to this heterogeneity. The review only included articles in English, probably leading to language bias and excluding studies published in other languages. This limitation could result in an incomplete representation of the prevalence and characteristics of OD in s patients with stroke. In addition, in this review, the studies were performed in various populations and healthcare settings, potentially limiting the ability to generalize the findings. Differences in patient demographics, stroke severity, and healthcare practices may influence the prevalence and characteristics of OD in patients with stroke. The review also highlighted the lack of standardized definitions and diagnostic criteria for OD among the included studies. This lack of consistency may affect the accuracy and comparability of the reported prevalence rates and characteristics.

CONCLUSIONS

In conclusion, this systematic review and meta-analysis offered offer significant insights into the prevalence and characteristics of OD among stroke patients. The findings of this review highlight the significance of early detection and effective treatment of OD in patients with stroke prevention is crucial for reducing complications and enhancing patient outcomes. Further research is warranted to address the identified limitations and to enhance our understanding of this common complication in stroke patients. Improved standardization in defining and diagnosing OD will be crucial for future research in this area.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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