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Review Article

Validity and reliability of swallowing screening tools used by nurses for dysphagia: A systematic review

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ABSTRACT

Dysphagia following neurological impairment increases the risk of dehydration, malnutrition, aspiration pneumonia, and even death. Screening for dysphagia has been reported to change negative outcomes. This review evaluated the validity and reliability of measurement tools for screening dysphagia in patients with neurological disorders to identify a feasible tool that can be used by nurses. Electronic databases were searched for studies from 1992 to 2015 related to dysphagia screening measurements. The search was applied to the Pubmed, CINAHL, Cochrane, Medline, EBSCO host, and CEPS + CETD databases. A checklist was used to evaluate the psychometric quality. The tools were evaluated for their feasibility for incorporation into routine care by nurses in hospitals. A total of 104 papers were retrieved, and eight articles finally met the inclusion criteria. The sensitivity and specificity of the screening tools ranged from 29% to 100% and from 65% to 100%, respectively. The interrater reliability ranged from good to excellent agreement. On the basis of quality evaluations, all the included studies had a risk of bias because of inadequate methodological characteristics. The Standardized Swallowing Assessment is the most suitable tool for detecting dysphagia because its psychometric properties and feasibility are higher than those of other screening tools that can be administered by nurses.

1. Introduction

Dysphagia, or difficulty in swallowing, is a serious, life-threatening medical condition that affects a substantial number of patients with neurological impairment or neurodegenerative diseases [1,2]. The reported incidence of dysphagia in studies enrolling patients with acute stroke, regardless of the lesion location, has ranged from 30% to 78% [3]. Dysphagia is a frequent consequence of progressive neurological disease and dementia and is a common disability observed in patients with Parkinson's disease in rehabilitation programs and nursing homes [4–6]. The detrimental consequences of dysphagia encompass various conditions including significant decline in social and physical functioning, malnutrition, aspiration pneumonia, and death [7]. Therefore, routine screening and reevaluation of swallowing functions are necessary in patients with neurodegenerative diseases.

Screening of swallowing functions is a procedure designed to detect any clinical indication of potential risk of neurological deglutition dysfunction or aspiration. The swallowing assessment generally involves observation through various dietary textures and consistencies as well as providing a detailed description of the clinical function of component swallowing phases with some judgment of the degree of dysfunction [8]. Clinical and instrumental assessment methods are administered to identify underlying anatomical and physiological abnormalities leading to swallowing problems, and finally to design an appropriate treatment plan. According to the American Speech–Language–Hearing Association (ASHA), swallowing screening methods are pass–fail procedures used to identify patients who may require a comprehensive assessment of swallowing functions [9]. The major benefit of this pass–fail method is that patients who pass would no longer have delayed feeding and those who fail can be referred to speech–language pathologists (SLPs) for further evaluation. A

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study reported that the risk of pneumonia is higher in unscreened patients than in those who pass a simple swallowing screening [10]. Potential benefits can be observed regarding pneumonia morbidity, hospital stay duration, and mortality.

Screening and assessment of swallowing are different procedures and are generally conducted at different times by different people seeking nonidentical information. The ASHA (Division 13, 2006) defines a swallowing screening as a minimally invasive evaluation that rapidly examines the following: (1) the likelihood of dysphagia, (2) the requirement for further swallowing assessment, (3) the safety of patient oral intake, and (4) the requirement for alternative nutritional support [11]. The swallowing assessment generally includes an examination of the patient's history related to swallowing problems: a detailed evaluation of oral, pharyngeal, and laryngeal anatomy; sensory and motor function; behavioral, cognitive, and language abilities; and a feeding trial [12]. Screening for swallowing abnormalities, the first step in an appropriate management plan [13], has reduced the risk of pneumonia [14]. However, the purpose of a swallowing assessment is to enable clinicians to understand the patients' swallowing physiology and select appropriate treatment strategies [12].

Dysphagia screening measurements have been developed and used by various health professionals. A videofluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES) are administered by SLPs. These invasive methods provide dynamic imaging of swallowing functions. However, these methods are not feasible and cannot be repeatedly administered because they require special equipment and skilled personnel [15]. Although SLPs have taken a leadership role in dysphagia management in most Western countries, speech-pathology services in hospital settings in Asian countries such as Taiwan are lacking. Furthermore, nurses provide 24-hour care and are most often present at the bedside, particularly during meal times and while administering medications. They play a crucial role in the identification, management, and prevention of dysphagia-related complications. Nurses should be trained to detect signs and symptoms of dysphagia and be aware of signs indicating a risk of dysphagia or aspiration in patients [16]. However, a universal and reliable swallowing screening tool that can be applied to patients by nurses is not available. To successfully integrate swallowing screening into daily care routines, a swallowing screening tool should be simple to use and interpret without requiring invasive techniques or equipment. Moreover, its reliable administration should be achieved through minimal training so that the entire process of training and implementing is not cumbersome [17]. A reliable and accessible screening tool can enable the nursing staff to make proper decisions regarding future evaluation and advanced care plans for dysphagia when required.

Various noninvasive bedside screening measurements such as trial swallow, oximetry, and simple questionnaires for self-reporting dysphagia are available [15]. Cochrane and Holland [18] suggested that screening tools should be able to do the following: (1) provide a true measure of the patient's degree of "risk"; (2) sensitively detect "risk" when it is present; (3) accurately provide negative results when the patient is not "at risk"; (4) provide consistent results if used by different people; (5) be easy to use and intelligible to those conducting the screening; (6) be acceptable to patients; and (7) be acceptable regarding resource usage, such as time and equipment. Thus, a systematic review was performed to identify swallowing screening tools used for patients with neurological disorders. Moreover, we evaluated the measurement properties of the tools, including validity, reliability, sensitivity, and specificity, for identifying dysphagia and aspiration risks. The following question was formulated: "What are the psychometric properties of the available screening tools used by nurses to detect swallowing difficulties following a neurological disorder?"

1.1. Aim

This review examined the validity and reliability of screening tools used for assessing dysphagia in patients with neurological disorders to identify a feasible tool that can be used by nurses.

2. Materials and methods

2.1. Search methods

An expert panel was established to guide the systematic review process. The search for eligible studies was comprehensive and involved multiple strategies. Data were sought from published and unpublished literature in English and Chinese journals. Searches were limited to human-based studies. An initial limited literature search of PubMed was conducted to identify relevant key words contained in the title, abstract, and subject description. We used Medical Subjects Heading (MeSH) to select search terms. Similar strategies were used in searching other bibliographic databases for relevant research articles published between January 1992 and November 2015. The search was applied to the Pubmed, CINAHL, Cochrane, Medline, EBSCO host, and CEPS + CETD databases. We used the following terms as keywords: "dysphagia," "difficulty in swallowing," "assessment," "screen," "tool," "scale," "validity," "sensitivity," "reliability," "nurse." The key words used to search for publications that met the design criteria were "randomized controlled trial/s," "clinical trial/s," "exploratory study," and "investigation study." Fig. 1 shows the flow of information through the different phases.

The reference lists of all relevant articles were checked. In order to locate and retrieve unpublished studies, we studied research reports, proceedings from international conferences, and web sites of key agencies. Where data were incomplete, or where there was a lack of clarity about the relevance of a trial, the first author was contacted and requested to provide additional information. The literature search was carried out on November 26, 2015, and papers were included in the review.

2.2. Selection criteria

2.2.1. Types of studies

The selection criteria were studies restricted to randomized controlled trials or clinical trials on the validity and reliability of swallowing screening tools used by nurses. If filtering could not identify randomized controlled trials, clinical trials were also included. Retrieved abstracts were further scrutinized to include only those studies with screening tools used by nurses. In addition, articles that added a clinical assessment, SLP judgments about swallowing function, or patients' clinical features and outcomes as a gold standard or a reference test were also included. Excluded from the review were screening tools compared with a VFSS or FESS and fully investigated by SLPs or physicians for dysphagia screening. Moreover, reviews, editorials, or letters, and those articles that were unrelated to our mentioned purpose were not reviewed. Only articles meeting the inclusion criteria were retained for critical appraisal. Also, only publications with full text in English and Chinese were reviewed.

2.2.2. Type of participants

Studies of human volunteers with neurological disorders were included, and animal and laboratory studies were excluded.

2.2.3. Type of outcome

The outcomes of interest were validity, reliability, sensitivity, and specificity of swallowing screening tools for identifying dysphagia.

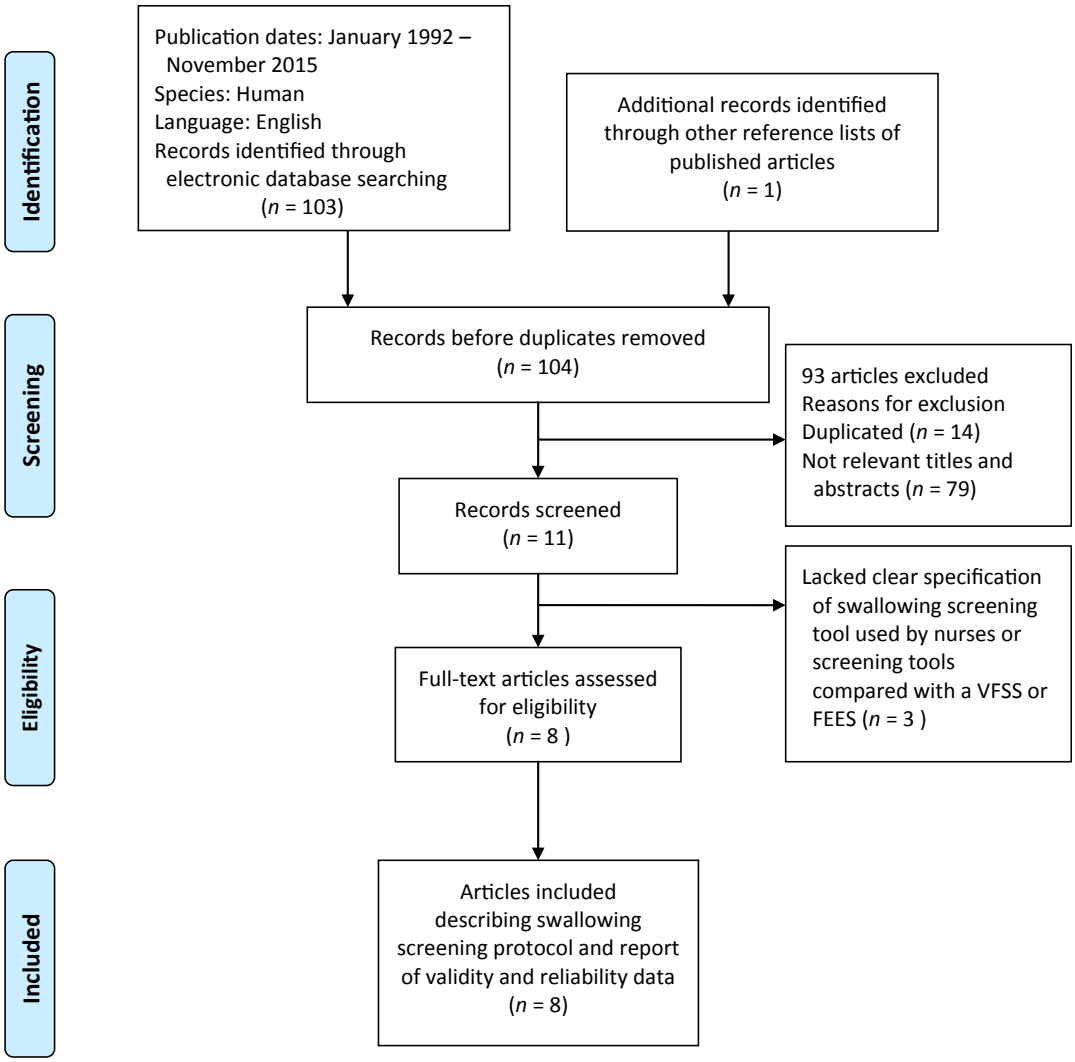

Fig. 1. Literature search flow diagram. VFSS = Videofluoroscopic swallowing study; FEES = Fiberoptic endoscopic evaluation of swallowing.

2.3. Data extraction procedures

Data from included studies were independently extracted by two members (JLJ and YCM) of the team using a data extraction form. Differences of opinion were resolved by discussion. The methodological quality of the studies and the measurement properties of the dysphagia screening instruments were assessed.

2.3.1. Methodological quality

The study quality of every included article was independently assessed by the two members (JLJ and YCM) using the 12-step criteria adapted from Jaeschke et al [19] and Terwee et al [20]. This form considered the following three broad issues for appraising a diagnostic test:

1. Are the results of the study valid?
2. What are the results?
3. Will the results help me and my patient/population?

Table 1 shows a description of these criteria in brief with a little modification in some questions' grammar [9]. Most questions were answered with "Yes," "No," or "Can't tell" except questions 7, 8, and 12, which required description. The first two questions were "screening questions" and could be answered quickly. If the answer to one of them was "No" or "Can't tell," it was not worth continuing to the remaining questions. It seemed we could not be sure about an article's results (Question 8) if the reference test and the index test were not carried out blindly (Question 4), and/or all patients did not get the index and the reference test regardless of the results of the index test (Question 3), and/or there was a kind of spectrum bias in selection of neurological patients leading to choosing only a subgroup of patients with neurological disorders (Question 5), and/or there were other confidence limits in the methodology. In addition, a diagnostic test could not be useful for patients and could not help to identify swallowing disorders following neurological disorders (Questions 11 and 12), unless we could be at least approximately sure about its results (Question 8), and its psychometric features (e.g., sensitivity and specificity) were acceptable. Based on these criteria, the evidence level of every article was categorized as level I or II:

I. Blinded comparison (Question 4) with no verification and spectrum biases (Questions 3 and 5 answered "Yes" or at least "Can't tell"), with reported calculable results (Question 7) [9].

Table 1
The 12-step criteria in brief, adapted from Jaeschke et al.

Items	12-Step criteria
Issue (a)	
1	Was there a clear question for the study to address?
2	Was there a comparison with an appropriate reference standard?
3	Did all patients get the diagnostic test and the reference standard? (verification bias)
4	Could the results of the test of interest have been influenced by the results of the reference standard? (review bias)
5	Is the disease status of the tested population clearly described? (spectrum bias)
6	Were the methods for performing the test described in sufficient detail?
Issue (b)	
7	What are the results?
8	Are we sure about these results?
Issue (c)	
9	Can the results be applied to your patients/the population of interest?
10	Can the test be applied to your patient or population of interest? (availability of resources, expertise, and opportunity costs)
11	Were all outcomes important to the individual or population considered?
12	What would be the impact of using this test on your patients/population?

Note. From "Users' guides to the medical literature: III. How to use an article about a diagnostic test. A. Are the results of the study valid?," by R. Jaeschke, G. Guyatt, and Sackett DL, 1994, *JAMA*, *271*, p. 389–91. Copyright 1994, *American Medical Association*. Adapted with permission.

II. Studies that did not have at least one of the four above conditions of Questions 3, 4, 5, and 7.

2.3.2. Assessment of the measurement properties of swallowing screening tools

The quality of the measurement properties was assessed by evaluating the results from the studies. Hence, the measurement properties of the screening tools included in this study were assessed using an assessment template developed with reference to the work of Terwee [20]. The psychometric data investigated were as follows: validity, reliability, sensitivity, and specificity.

Criterion validity is the extent to which each measure relates to a preexisting valid measure or gold standard [21]. Criterion validity is often divided into concurrent and predictive validity. The use of criterion-related validity is supported in most of the reviewed articles [8,17,22–25]. The reviewers give a positive rating for criterion validity if the correlation with valid measures was at least 0.70 [21]. Interrater reliability is the equivalent of a measuring tool determining whether the same results are produced by different raters when the rating is performed independently for the same individual. Test–retest reliability is an evaluation of whether a consistent result is produced on different occasions for the same individual, which can tell the stability of the measure [26]. A positive rating was given for interrater or test–retest reliability when the weighted kappa was at least 0.70 [21].

Sensitivity refers to the accuracy of the screening tools in correctly identifying a problem [26], that is, the proportion of patients with dysphagia who have a positive result or true positive. A positive rating was given for sensitivity when the percentage exceeded 70% [15]. Specificity also indicates the accuracy of the screening tests by measuring the ability of measurements to identify noncases correctly [26], that is, not to falsely identify a condition without swallowing difficulty as dysphagia. A positive rating was given for specificity when the percentage was at least 60% [15].

3. Results

3.1. Selection of studies

The database search for reviewed references from included articles yielded 103 articles published between January 1, 1992 and November 26, 2015. One additional article was examined and identified from the reference list of selected articles. In total, 93 articles were excluded on the basis of information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment. Three papers lacking clear specification of the screening tool used by nurses and those using VFSS or FEES as a reference standard were excluded. Finally, eight articles met our inclusion criteria for review. The search process is presented as a flow diagram in Figure 1. All eight papers included different numbers of participants, ranging from 25 [22] to 395 [23], with a combined total of 1254.

3.2. Characteristics of instruments

Table 2 lists the characteristics of included studies and instruments. The studies originated from four countries, the United Kingdom, India, South Korea, and the United States. The target population of the studies was mainly patients with stroke and neurological disorders in hospitals. One study targeted elderly residents with neurological disorders in nursing homes. Nurses and SLPs, or speech–language therapists, performed the screening in most studies; however, eight measurements were administered by nurses. Except for Edmiaston et al [14], the researchers [8,10,22–25,27,28] administered the index test and reference test within 24 hours of each other.

The measurements were structured using various components. The first step ensured the physical ability of patients to participate in the screening. In the first step, patients' alertness and ability to be positioned upright with some degree of head control were evaluated. If any of these conditions were not met, the patients were considered inappropriate for screening. Signs and symptoms prior to, during, and after trial swallows, including wet voice, laryngeal elevation, and coughing and choking, were assessed to identify swallowing problems. The trial swallows that used various volumes and viscosities of water and semisolid materials were the major components. The trial swallows generally started with a small amount of water from one teaspoon to 5 mL per swallow. If the initial swallow was successful, the amount was gradually increased, as much as 3 oz or up to half a glass of water. Other semisolid or solid foods with different viscosities were used in the trial swallows. The sequences of these subsets for trial swallowing differed among the tests. The results were reported dichotomously as pass–fail, yes–no, or positive–negative for all the tools.

3.3. Psychometric property of the measures

Table 2 lists the published psychometric data of the identified instruments. Criterion validity was the most commonly reported type of validity. Some tools compared the results with those of

Table 2
Characteristic of the studies and measurements included in the systematic review.

Authors (country)	Target population	Setting	Sample Size	Assessor	Assessment time	Instrument	Reference standard	Psychometric properties
Perry [8,24] (UK)	Stroke	Hospital	200	Nurses SLTs	Within 24 h of admission	Standardized Swallowing Assessment (SSA)	Clinical judgment of swallow function	Sensitivity of 97% and specificity of 90% for detection of dysphagia, with positive and negative predictive values of 92% and 96% Good agreement with summative clinical judgment of swallow function (kappa = 0.88)
Massey and Jedlicka [22] (USA)	Stroke	Hospital	25	Content validity: 3 nurses, 1 neurologist, 2 SLPs Interrater reliability: 2 research assistants Predictive validity: research assistant, physician or SLPs	2 research assistants within 2 h	Massey Bedside Swallowing Screen (MBSS)	Modified Barium Swallow	Content validity: strongly agree Interrater reliability: relatively high Predictive validity: sensitivity and specificity as 100%
Weinhardt et al [25] (USA)	Stroke	Hospital	83	Nurses SLPs	SLPs performed the screening within 1 h of nurses	Dysphagia Screening Tool	NR	94% agreement between the nurses and SLPs
Bravata et al [26] (USA)	Stroke	Hospital	101	Nurses SLPs	Retrospective cohort study	Nursing Dysphagia Screening Tool	National Institutes of Health Stroke Scale (NIHSS)	The nursing dysphagia screening tool had a positive predictive value of 50% and a negative predictive value of 68%, with a sensitivity of 29% and specificity of 84%. The use of the NIHSS to identify dysphagia risk had a positive predictive value of 60% and a negative predictive value of 84%. The NIHSS had better test characteristics in predicting dysphagia than the nursing dysphagia screening tool.
Edmiaston et al [14] (USA)	Stroke	Hospital	300	Nurses SLPs	Between nurse and SLPs evaluation was 32 h	Acute Stroke Dysphagia Screen (ASDS) (new tool)	Mann Assessment of Swallowing Ability (MASA)	For the new tool, interrater reliability was 93.6% and test–retest reliability was 92.5%. The new tool had a sensitivity of 91% and a specificity of 74% for detecting dysphagia and a sensitivity of 95% and a specificity of 68% for detecting aspiration risk.
Park et al [23] (South Korea)	Residents (65 y and older, including neurological patients)	Nursing home	395	Research assistants	Each individual was assessed by one assistant with one tool, then assessed 1 h later by another assistant with the other tool	Korean version of Standardized Swallowing Assessment (K-SSA)	Gugging Swallowing Screen (GUSS)	Compared to results from the GUSS, with 9-point and 14-point cutoffs, the K-SSA had a sensitivity of 94% and specificity of 65% for screening dysphagia and 86% sensitivity and 71% specificity for screening aspiration risks.

(*continued on next page*)

Table 2 (*continued*)

Authors (country)	Target population	Setting	Sample Size	Assessor	Assessment time	Instrument	Reference standard	Psychometric properties
Cummings et al [28] (USA)	Neurological disorders	Hospital	101	Nurses SLPs	Nurses performed the screening within 1 h	Yale Swallow Protocol	NR	Intra- and interrater protocol agreements for the two speech–language pathologists were 100%. Interrater protocol agreement between registered nurses and speech–language pathologists was 98.01%.
Donovan et al [10] (USA)	Stroke	Hospital	49	Nurses SLPs	Within 2 h of each other during the first 48 h after admission	Nurse Dysphagia Screen Tool	NR	Sensitivity and specificity of the Nurse Dysphagia Screen were 89% and 90%, respectively.

NR = not reported; SLPs = speech–language pathologists; SLTs = speech–language therapists.

other screening tools such as the Mann Assessment of Swallowing Ability, with the clinical judgment of swallowing function provided by speech–language therapists to validate the tool. The sensitivity and specificity of the screening tests ranged from 29% to 100% and from 65% to 100%, respectively. Four studies reported interrater reliability ranging from good to excellent agreement [17,22,24,28]. The test proposed by Massey and Jedlicka [22] had the highest sensitivity and specificity (100%); however, the methodological quality of the study was questionable because of the small sample size. No reference standard with acceptable psychometric quality was reported in three studies [10,27,28]. The Standardized Swallowing Assessment (SSA) exhibited high psychometric quality, with high sensitivity and specificity of 97% and 90%, respectively. Moreover, this assessment was performed by nurses to detect dysphagia in an adequate number of patients.

3.4. Methodological quality of the research

The results of the evaluation of the methodological quality of the included studies are illustrated in Table 3. All studies that were included in this systematic review did not exhibit adequate methodological quality. The evidence level of the eight articles [8,10,17,22–25,27,28] has been categorized as level II. All the included studies exhibited a bias associated with at least one of the three items (items 3–5) of the 12-step criteria adapted from Jaeschke et al. Therefore, all the studies had a risk of bias. For these selected studies, the importance of methodological limitations should be emphasized, and the results of the screening tools should be carefully considered.

4. Discussion

In this review, we evaluated the quality and feasibility of swallowing screening tools that can be used by nurses in patients with neurological disorders. The selection of the type of healthcare worker who is most suitable for conducting screenings (nurses, physicians, or SLPs) and the protocol to be followed remains controversial. However, in clinical practice, the number of SLPs is limited. Moreover, if screenings are conducted only by SLPs, then newly admitted patients may be required to wait for a long time to undergo screening. Therefore, an optimal dysphagia screening tool that can be administered by nurses is required in neurological care units. Moreover, screening by nurses, in addition to physicians and SLPs, is recommended in international guidelines [24,29].

High-quality studies on the development and evaluation of screening tools are required to standardize the optimal tool. We prepared a table that provides an overview of the measurement properties of swallowing screening tools used by nurses. This can facilitate the combined assessment of screening tools when the most suitable tool for nurses is being selected.

An ideal screening tool should be rapid and minimally invasive, and should be able to determine the following factors: (1) the likelihood of dysphagia and aspiration, (2) requirement of further swallowing assessment, and (3) safety of patient oral intake [10]. Moreover, the ideal screening tool should have high sensitivity and specificity, and should accurately identify patients who have a risk of dysphagia and aspiration [30]. In this review, most tools exhibited acceptable sensitivity and specificity, except for the nursing dysphagia screening tool used in Bravata et al's [26] study, which had a sensitivity and specificity of 29% and 84%, respectively. These low sensitivity and specificity rates may have been because of the retrospective design of the study. However, the tool used in Massey's study exhibited 100% sensitivity and 100% specificity. This could have been because of the biased sampling of patients in the study; those who already had symptoms of dysphagia were evaluated. In

Table 3
Results of articles' quality assessment.

Reference	Items												Evidence level
	Issue (a)						Issue (b)		Issue (c)				
	1	2	3	4	5	6	7	8	9	10	11	12	
Perry [8,24]	Yes	Yes	Yes	CNT	Yes	Yes	R	Yes	Yes	Yes	Yes	ID	II
Massey and Jedlicka [22]	Yes	No	Yes	No	Yes	Yes	R	Yes	Yes	Yes	Yes	ID	II
Weinhardt et al [25]	Yes	No	No	CNT	Yes	CNT	R	CNT	Yes	Yes	Yes	ID	II
Bravata et al [26]	Yes	CNT	No	CNT	Yes	CNT	R	CNT	Yes	Yes	Yes	ID	II
Edmiaston et al [14]	Yes	Yes	Yes	CNT	Yes	Yes	R	No	Yes	Yes	Yes	ID	II
Park et al [23]	Yes	Yes	Yes	CNT	No	Yes	R	Yes	CNT	CNT	CNT	CNT	II
Warner et al [27]	Yes	Yes	Yes	CNT	Yes	Yes	R	Yes	Yes	Yes	Yes	ID	II
Cummings et al [28]	Yes	Yes	Yes	CNT	Yes	Yes	R	Yes	Yes	Yes	Yes	ID	II

CNT = cannot tell; ID = identification of disorder accurately; R = reported.

addition, the number of patients in the single study was not adequate to draw a decisive conclusion. The sensitivity and specificity of a test often vary with disease prevalence; therefore, health professionals should consider prevalence as a guide when selecting a study that most closely resembles their situation [31]. However, we evaluated sensitivity and specificity because tools with high sensitivity are desirable when screening for dysphagia; this lowers the possibility of overlooking a patient with dysphagia, which can result in serious adverse events [17].

On the basis of psychometric properties regarding validity, reliability, sensitivity, and specificity, the following seven tools met the psychometric quality requirement and could be administered by nurses: the SSA, Massey Bedside Swallowing Screen, Dysphagia Screen Tool, Acute Stroke Dysphagia Screen, Yale Swallow Protocol, Korean version of the SSA, and nursing dysphagia screening tool. The psychometric properties and feasibility of the SSA were higher than those of other screening tools that can be administered by nurses for detecting dysphagia. Moreover, the SSA is simple and involves a general screening and water test. Clinical signs such as voice quality and coughing are recorded while water from a spoon is sipped and water from a glass is consumed. In addition, simple instructions are provided in the SSA that can guide nurses in performing the test, referring patients to SLPs, and modifying patients' diet accordingly.

The current study had several limitations. We may have overlooked some studies because our literature search was restricted to some databases. Criteria for including studies in a systematic review may have been influenced by the knowledge of the results of potential studies, leading to inclusion bias.

Systematic reviews are prone to selection bias; therefore, we may not have included all published studies on swallowing function screening. On the basis of our quality evaluations, all included studies exhibited a risk of bias because of ineffective sampling methods, insufficient methodological rigor, and inadequate reporting. In particular, these studies involved a high risk of selection bias because of a lack of randomized sampling [32].

We were able to compare the selected tests only in a descriptive manner rather than by statistical pooling because these tests differed substantially in the methods used for bedside screening; for instance, the manner in which water and other test materials were administered differed. In addition, the protocol used for the reference test varied widely. This hampered comparison among the bedside tests used in various studies and precluded data pooling.

All the included studies in this systematic review did not show adequate methodological quality. The evidence level of the eight articles was categorized as level II. Therefore, for these selected studies, the importance of methodological limitations should be emphasized, and the results of the screening tools should be carefully considered.

Because the severity of dysphagia rapidly changes during the acute phase of a neurological disorder, a 24-hour interval between the administration of index and reference tests may not be adequate to ensure that a patient's condition will not significantly change between the two tests [15]. The average time between the two tests was more than 24 hours only in the study of Edmiaston et al [14]. Moreover, the effect of swallowing recovery or change should be considered.

Finally, this systematic review focused on bedside screening tests to detect dysphagia in patients with neurological disorders; however, most bedside tests reported in the literature have primarily been performed in patients with stroke. Caution should be exercised in generalizing the results of our review to other neurological conditions.

5. Conclusion

This systematic review demonstrated that all the included studies did not show adequate methodological quality. Few studies have been published on the relevant topic ($n = 8$), and they involve nonexperimental study designs. Nevertheless, we suggest that the SSA with favorable psychometric properties is a suitable screening tool for detecting dysphagia and can be administered by nurses in hospitals. The number of SLPs is limited in some hospitals. Therefore, screening tests that can be conducted by nurses may accelerate the process of screening admitted patients with neurological disorders. Further validation of the reliability of screening tools is necessary in patients with neurological disorders who are admitted to hospitals in Taiwan. Moreover, to incorporate swallowing screening into routine care, additional studies should be conducted to investigate the effects of administering screening tools on patient outcomes.

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