REVIEW ARTICLE

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Dysphagia Screening Measures for Use in Nursing Homes: A Systematic Review

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Purpose: The purpose of this study was to evaluate the psychometric quality and feasibility of measurements for screening dysphagia in older adults to identify the 'right tool' for nurses to use in nursing homes. **Methods:** A systematic review was done. Electronic databases were searched for studies related to dysphagia screening measurements. A checklist was used to evaluate the psychometric quality and applicability. Tools were evaluated for feasible incorporation into routine care by nurses. **Results:** 29 tools from 31 studies were identified. Dysphagia screening tools with an acceptable validity and reliability had sensitivity between 68% and 100% and specificity between 52% and 100%. The Gugging Swallowing Screen (GUSS) and the Standardized Swallowing Assessment (SSA) were the tools with high psychometric quality, especially with high sensitivity, that nurses could perform feasibly to identify the risk and to grade the severity of dysphagia and aspiration of nursing home residents. **Conclusion:** Results show that GUSS and SSA are reliable and sensitive tools for screening dysphagia which nurses can use in nursing homes. Further research is needed to examine feasibility of screening with identified tools, and also, to establish effective and standardized protocols for these tools so they can be effectively incorporated into routine care.

Key words: Deglutition disorders, Nursing, Nursing homes, Screening, Systematic review

INTRODUCTION

Dysphagia can be life threatening, particularly in frail, older adults. It is one of the major health care problems leading to aspiration pneumonia which is the second most common infection found in nursing home (NH) residents[1,2]. Swallowing difficulty increases with age. Such impairment is a major health problem in NHs. Dysphagia is found in 52.7% of NH residents in Korea[3] and in 40% to 60% of institutionalized older adults in the United States[4].

In NHs, many professionals are involved in dysphagia assessment and management. Although speech-language specialists have taken a leadership role in dysphagia management in most western countries[5], there is little speech-pathology service for NHs in Asian countries like Korea. In addition, the omission of nurses has been central to malpractice issues related to dysphagia in NHs[2]. Awareness of dysphagia in older people, diagnostic procedures, and treatment options available should be increased among health care professionals, including nurses[1]. Nurses are the primary and often sole professional provider employed by NHs and are responsible for directing and evaluating the work of licensed and unlicensed assistance staffs[6]. Nurses play an important role in the identification, assessment, management, and prevention of complications related to dysphagia[7]. They are the professionals most often present at the

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bedside, particularly during mealtimes and while administering medications, and are the first members of the health care team to notice any signs and symptoms of dysphagia[8,9]. Most patients with dysphagia can be identified with various tools, through systematic interviews, observation of signs & symptoms and trial swallows[8]. Dysphagia screening measurements have been developed and used by various health professionals. Videofluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES) are administered by speech-language pathologists (SLPs). Although these invasive methods provide dynamic imaging of the swallowing function, it is inappropriate to be feasibly and repeatedly administered because these require special equipment and skilled personnel[8]. There are various non-invasive bedside screening measurements such as trial swallows, oximetry, and even simple questionnaires for self-report of dysphagia[8]. The trial swallows use diverse amount and viscosities of swallowing materials resulting in varying degree of psychometric properties[8]. However, there is no universal agreement on which of these are reliable tools that can be applied to NH residents easily by nurses. Therefore, we performed a systematic review to identify the instruments screening and/or assessing dysphagia in older adults, to evaluate their measurement properties, and to assess the feasibility of their use in order to identify the 'right tool' for nurses to use in NHs.

METHODS

1. Search strategy

We performed a computerized search for assessment or screening tools cited in the literature from January 1992 to July 2011 in the CINAHL, PubMed, ScienceDirect, Embase, and Research Information Sharing Service in Korea (RISS) databases. The following terms were used to identify eligible studies: 'dysphagia', 'swallowing', 'eating', 'difficulty', 'problem', 'assessment', 'screening', 'tool', 'scale', 'evaluation', 'measurement', 'long-term care', and 'nursing home', either alone or in combination. References in the retrieved papers and citations of relevant reviews were checked and hand searched for further references and to minimize the chance of missing substantial studies.

2. Selection criteria

Articles were included if they described the original development of dysphagia screening measures and if they evaluated the measurement properties of a dysphagia screening instrument. Studies were also included if they used instruments to assess dysphagia in older adults (age 65 years and older) and if they were in English or Korean. Any studies unavailable through electronic journals or at the local library and abstract-only literature were excluded due to insufficient information.

Two independent reviewers (HKC and HLB) screened the identified titles, abstracts and key words for relevance, and the reference lists of the studies retrieved. The full text articles were reviewed by two reviewers (HKC and HLB) independently according to our inclusion criteria. Consensus between the reviewers was reached through meetings if there was any disagreement whether the article met the eligible criteria. A third party reviewer (YHP) resolved any remaining disagreement.

3. Data extraction procedures

Data from included studies were extracted by the two members (HKC and HLB) of the team independently using the data extraction form. The extracted data included the following: characteristics of the studies (target population and setting) and the instruments (assessor, components, materials, reporting type, severity grading, cutoff point, and time to administer). The methodological quality of the studies and the measurement properties of the dysphagia screening instruments were assessed. In addition, the applicability of the dysphagia screening tools in NHs was assessed.

1) Assessment of the methodological quality of the studies

The methodological quality of the included studies was assessed using the method of Hawker et al.[10] which has been used before to rate studies. The studies were rated as good, fair, poor or very poor for each of the following items: abstract and title, introduction and aims, method and data, sampling, data analysis, ethics and bias, results, transferability or generalizability, and implications and usefulness[10] (Table 1).

2) Assessment of the measurement properties of the dysphagia screening tools

The quality of the measurement properties were assessed by evaluating the results from the studies[11]. 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 et al. [11]. The psychometric data investigated were as follows: validity, reliabil-

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Table 1. Methodological Quality of the Studies (*N*=31)

Studies	Abstract and title	Introduction and aims	Method and data	Sampling	Data analysis	Ethics and bias	Results	Transferability and generalizability	Implications and usefulness
1. DePippo et al. (1992)	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Fair	Poor
2. DePippo et al. (1994)	Fair	Good	Good	Fair	Poor	Very poor	Fair	Fair	Poor
3. Smithard et al. (1997)	Fair	Good	Good	Fair	Fair	Very poor	Good	Good	Fair
4. Smithard et al. (2007)	Good	Good	Good	Fair	Fair	Very poor	Good	Good	Fair
5. Collins & Bakheit (1997)	Good	Fair	Fair	Fair	Fair	Very poor	Fair	Fair	Poor
6. O'Loughlin & Shanley (1998)	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Poor	Poor
7. Hinds & Wiles (1998)	Fair	Fair	Fair	Fair	Fair	Very poor	Fair	Fair	Poor
8. Westergren et al. (1999)	Fair	Good	Good	Fair	Good	Poor	Poor	Fair	Poor
9. Teramoto et al. (1999)	Very poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Very poor
10. Sitoh et al. (2000)	Good	Fair	Good	Fair	Good	Very poor	Fair	Fair	Fair
11. Smith et al. (2000)	Good	Good	Good	Fair	Good	Very poor	Good	Fair	Fair
12. Mann et al. (2000)	Fair	Good	Good	Fair	Good	Very poor	Fair	Fair	Fair
13. Perry (2001a)	Fair	Good	Good	Fair	Good	Good	Good	Good	Good
14. Perry (2001b)	Fair	Good	Good	Fair	Good	Good	Good	Good	Good
15. Han et al. (2001)	Good	Fair	Poor	Poor	Fair	Very poor	Fair	Poor	Poor
16. Massey & Jedlicka (2002)	Fair	Good	Poor	Poor	Poor	Very poor	Poor	Poor	Poor
17. Tohara et al. (2003)	Fair	Fair	Good	Poor	Good	Fair	Fair	Fair	Poor
18. Lambert et al. (2003)	Fair	Good	Fair	Poor	Fair	Very poor	Fair	Poor	Poor
19. Kawashima et al. (2004)	Fair	Fair	Fair	Fair	Fair	Very poor	Fair	Poor	Poor
20. Boczko (2006)	Good	Poor	Fair	Poor	Poor	Very poor	Fair	Poor	Poor
21. Trapl et al. (2007)	Good	Good	Good	Good	Good	Fair	Good	Good	Good
22. Paek et al. (2007)	Very poor	Fair	Fair	Poor	Fair	Poor	Fair	Poor	Fair
23. Miura et al. (2007)	Fair	Fair	Fair	Poor	Good	Very poor	Fair	Poor	Poor
24. Marques et al. (2008)	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair
25. Wakasugi et al. (2008)	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Poor
26. Courtney & Filer (2009)	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Very poor	Very poor
27. Bravata et al. (2009)	Fair	Fair	Good	Poor	Good	Fair	Fair	Poor	Poor
28. Martino et al. (2009)	Good	Fair	Fair	Good	Good	Good	Good	Fair	Fair
29. Westergren et al. (2009)	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair
30. Edmiaston et al. (2010)	Good	Good	Fair	Poor	Poor	Very poor	Fair	Poor	Fair
31. Antonios et al. (2010)	Good	Good	Fair	Fair	Good	Good	Fair	Fair	Fair

ity, sensitivity and specificity.

Criterion validity is the extent to which each measure relates to a pre-existing valid measure or gold standard[11]. Video-fluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES) are considered the 'gold standard' for the screening test[12]. A positive rating was given if a screening tool was validated by comparing the results with either of the gold standards[11], that is the VFSS or FEES.

Internal consistency is a measure of the degree to which items are correlated in a measurement; thus, the same concept is measured[11]. A positive rating was given for internal consistency when Cronbach's alpha was between 0.70 and 0.95[11].

Inter-rater reliability is the equivalent of a measuring tool determining whether the same results are produced by different raters when the rating was performed independently for the same individual[13].

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[13]. A positive rating was given for inter-rater or test-retest reliability when the weighted Kappa was at least 0.70[11].

Sensitivity refers to the accuracy of the screening tools to correctly identify a problem[13], 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 was over 70%[8].

Specificity also indicates the accuracy of the screening tests by measuring the ability of measurements to identify noncases correctly[13], 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%[8]. The sensitivity and specificity were also rated positive when the AUC (area under the ROC) was over 0.70[11].

The rating options for each of the properties of the measurement are as follows[11]: (+) as a positive rating, (?) as an intermediate rating, (-) as a negative rating, and (0) as no data available.

3) Assessment of the applicability of dysphagia screening tools in NHs

The applicability of the measurement was evaluated with several criteria. The feasibility was evaluated in terms of the time needed to administer the measurement and the complexity of the test procedure[8]. The administration time was rated positive if it took less than 10 minutes to complete the screening[14]. A positive rating was given when the test procedure required only trial swallows with water and food while a negative rating was given when other procedures and instruments were needed other than trial swallows. We evaluated whether the screening could be administered by nurses and whether the measurement identifies the aspiration risk. We also evaluated whether the test could provide information on the severity of the dysphagia because this information could guide further decisions in the nursing management of dysphagia in NHs with limited professional resources[15].

The summary of the characteristics of the studies and the descriptive data of the tools are presented in Table 2. Table 3 shows the psychometric data of the instruments. The quality ratings of the studies and the evaluation of the applicability in NH settings are presented in Table 4.

RESULTS

Of the 348 articles identified, after eliminating duplicates, 265 abstracts were reviewed by two independent reviewers (HKC, HLB) to determine whether the study was eligible for inclusion. 89 full-text articles were reviewed. Most of the studies excluded had an irrelevant study population with different study purposes or did not have validated instruments that were available in English or Korean. Finally, 31 articles met the inclusion criteria yielding 29 dysphagia screening tools for review. The search process is presented as a flow diagram in Figure 1. Results of the methodological quality for the included studies are presented in Table 1. Most of the studies were rated 'good' or 'fair' on methods and data analysis, except for 4 studies in which the method was not clearly explained and for 9 studies in which the description of the data analysis was not sufficiently rigorous.

1. Characteristics of the studies and the instruments

Table 2 presents the characteristics of the included studies and the instruments. The target population of the studies was mainly stroke patients in hospitals or rehabilitation units. 7 studies targeted elderly people in long-term care facilities or in communities, but these studies did not provide any psychometric information on the measurement tools. The mean age of the elders ranged from sixties to mid-eighties.

Speech language pathologists (SLPs) and speech language therapists (SLTs) or doctors performed the screening in most of the studies; however, there were 12 measurements which could be administered by nurses.

The measurements were structured with various components. Trial swallows using a range of volumes and viscosities of water and other liquids and solid materials were the major components of 20 tests. Signs and symptoms during and after the trial swallows such as wet voice, laryngeal elevation, and coughing & choking were assessed to identify swallowing problems. Monitoring oxygen saturation and reviewing medical records were components added to the trial swallows. Diverse amounts of water and methods were used for the trial swallows. The trial swallows usually started with a small amount of water from 1 teaspoon or 5 mL to 10 mL per swallow. If the initial swallow was successful, the amount was increased gradually to, as much as 3 oz or up to 150 mL. Other semi-solid or solid foods with different viscosities were used also in the trial swallows. The sequences of these subtests for the trial swallows were different among the tests.

Some tools used components other than that of the trial swallows, such as filling out questionnaires, checking dysphagia signs and symptoms during mealtime instead of administering trial swallows, observing O_2 saturation using an oximetry alone, inducing cough and provocating swallowing reflex, and timing the swallow. These components were used alone or combined differently and modified for the population targeted. Additional instruments such as nebulizer, oximetry and x-ray were needed in some tests, equipment which is not generally available in NHs.

The reporting was made in a dichotomous manner as pass/fail or yes/no or normal/abnormal for most of the tools. 4 tests had cutoff scores for judging dysphagia and aspiration risk. Graded assessment of the dys-

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Table 2. Characteristics of the Studies and Measurements Included in Systematic Review (*N*=29)

Studies	Target population	Setting	Instrument		Assessor	Components	Material	Reporting	Cut-off point	Risk identification	Severity grading	Time to administer
			Full name	Abbreviated								
1. DePippo et al. (1992)	Stroke	Rehabilitation unit	3-oz Water Swallow Test	3-oz WST	DR	Trial swallow: s/s observation	3oz water	Normal / Abnormal	-	+	-	NR
2. DePippo et al. (1994)	Stroke	Rehabilitation unit	Burke Dysphagia Screening Test	BDST	SLP	Trial swallow: s/s observation: medical Hx	3oz water, 1/2 of meal	Pass / Fail	-	+	-	15 min
3. Smithard et al. (1997, 2007)	Stroke	Hospital, Community	Bedside Swallowing Assessment	BSA	DR, RN, SLT	Trial swallow: s/s observation	5 mL, 60 mL water	Safe / Unsafe	-	+	-	NR
4. Collins & Bakheit (1997)	Stroke	Hospital	Oximetry	Oximetry	DR, RN	Oximetry	Oximetry	%	Desaturated by 2%	+	-	NR
5. O'Loughlin & Shanley (1998)	Elderly	Long-term care facility	PAC (prefeeding assessment checklist)-SAC (swallowing assessment checklist)	PAC-SAC	RN	Trial swallow: s/s observation	Food and fluid of different viscosity	NR	-	-	-	NR
6. Hinds & Wiles (1998)	Stroke	Hospital	Timed Water Swallowing Test	TWST	RN, SLP	Trial swallow: s/s observation: questionnaire	5~10 mL, 100~150 mL water	Normal / Abnormal	Outside the 95% prediction	+	-	NR
7. Westergren et al. (1999)	Stroke	Rehabilitation unit	Westergen's Screening for Dysphagia	WSD	RN	Trial swallow: s/s observation	Processed soured milk 30 mL / water 30 mL	Yes / No	-	+	-	NR
8. Teramoto et al. (1999)	Stroke elderly with aspiration pneumonia	Hospital	Simple Two-Step Swallowing Provocation Test	STS-SPT	DR	Swallowing provocation (D/W injection at supra-pharynx)	0.4 mL, 2.0 mL D/W, nasal catheter	Normal / Abnormal	Swallowing reflex within 3 seconds	+	-	NR
9. Sitoh et al. (2000)	Acutely ill elderly	Hospital	Simple Bedside Swallowing Test	SBST	DR, SLP	Trial swallow: s/s observation	30 mL water	Normal / Abnormal	Transit time exceeding 2 seconds	+	+	NR
10. Smith et al. (2000)	Stroke	Hospital	Combination of BSA and Oxygen Saturation Monitoring	BSA+O_2 saturation	SLT	Trial swallow: s/s observation: oximetry	10 mL water, oximetry	%	Desaturated by 2%	+	-	NR
11. Mann et al. (2000)	Stroke	Hospital	Mann Assessment of Swallowing Ability	MASA	SLP	Trial swallow: s/s observation	5 mL, 20 mL water	Normal / Impaired	-	+	+	NR
12. Perry (2001a, 2001b)	Stroke	Hospital	Standardized Swallowing Assessment	SSA	RN	Trial swallow: s/s observation	1tsp, half-glass water	Pass / Fail	-	+	-	NR
13. Han et al. (2001)	Stroke	Hospital	Clinical Functional Scale for Dysphagia	CFS-D	DR	Trial swallow: s/s observation: Hx	5cc water	Score	40 out of 100	+	+	NR
14. Massey & Jedlicka (2002)	Stroke	Hospital	The Massey Bedside Swallowing Screen	Massey BSS	RN	Trial swallow: s/s observation	1 teaspoon water / 60 cc water	Yes / No	-	+	-	NR
15. Tohara et al. (2003)	Patients with dysphagia	Hospital	Three non-VFG Test (water + food test + x-ray)	3 non-VFG	DR, Dentist	Trial swallow: x-ray	3 mL water, 4 g pudding, X-ray	Score	12 out of 15	+	+	NR

Asp. Pneu.=Aspiration pneumonia; DR=Doctor; D/W=Distilled water; GCS=Glasgow Coma Scale; Hx=History; NR=Not reported; RN=Registered nurse; SLP=Speech language pathologist; SLT=Speech language therapist; s/s=Sign and symptom; VFG=Videofluorography.

Table 2. Characteristics of the Studies and Measurements Included in Systematic Review (Continued) (*N*=29)

Studies	Target population	Setting	Instrument		Assessor	Components	Material	Reporting	Cut-off point	Risk identification	Severity grading	Time to administer
			Full name	Abbreviated								
16. Lambert et al. (2003)	Elderly	Long-term care facility	McGill Ingestive Skills Assessment	MISA	OT	Observing mealtime behaviors (50 items, 4 point scale)	Meal	Score	-	-	+	NR
17. Kawashima et al. (2004)	Elderly	Community	Dysphagia Screening Questionnaire	DSQ	Self	Self-report (15 items)	Questionnaire	Severe / None	At least one severe symptom	-	-	NR
18. Boczko (2006)	Elderly	Long-term care facility	9-Clinical Indicators of Dysphagia	9-indicators	Self	Self-report (9 items)	Questionnaire	Yes / No	-	-	-	NR
19. Trapl et al. (2007)	Stroke	Hospital	Gugging Swallowing Screen	GUSS	SLT, RN	Trial swallow: s/s observation	Water, food thickener, bread	Score	14 out of 20	+	+	NR
20. Paek et al. (2007)	Stroke	Hospital	Dysphagia Assessment Tool	DAT	RN	Medical Hx: s/s observation	Meal	Normal / Abnormal	-	+	-	8 min
21. Miura et al. (2007)	Frail elderly	Community	Dysphagia Risk Assessment for the Community Dwelling Elderly	DRACE	Self	Self-report (12 items)	Questionnaire	Score	-	+	+	NR
22. Marques et al. (2008)	Stroke	Hospital	Standardized Swallowing Assessment with water/ pudding	SSA with water/ pudding	SLP	Trial swallow: s/s observation	Water, pudding	Pass / Fail	-	+	+	NR
23. Wakasugi et al. (2008)	Suspected dysphagia	Hospital	Modified Water Swallowing Test+Cough Test	MWST+cough test	DR	Trial swallow: s/s observation: cough reflex elicitation	Citric acid, nebulizer, 3mL water	Positive / Negative	5 coughs	+	-	NR
24. Courtney & Filer (2009)	Stroke	Hospital	Bedside Swallow Assessment-EATS (Examine Ability To Swallow)	BSA-EATS	RN	Trial swallow: s/s observation	Apple sauce, cranberry juice, graham cracker	Pass / Fail	-	+	-	NR
25. Bravata et al. (2009)	Stroke	Hospital	Nursing Dysphagia Screening Tool	NDST	RN	Questionnaire (11 items)	Checklist	Positive / Negative	-	-	-	NR
26. Martino et al. (2009)	Stroke	Rehabilitation acute unit	Toronto Bedside Swallowing Screening Test	TOR-BSST	RN	Trial swallow: s/s observation	10 teaspoon, 1 cup of water, tongue pressor, swab	Pass / Fail	-	+	-	10 min
27. Westergren et al. (2009)	Stroke	Hospital	Minimal Eating Observation Form II	MEOF-II	RN	Observing mealtime behaviors (9 items)	Meal	Normal / Difficulty	-	-	-	NR
28. Edmiaston et al. (2010)	Stroke	Hospital	Acute-Stroke Dysphagia Screen	ASDS	RN	Trial swallow: s/s observation: GCS	3oz water, meal	Yes / No	-	+	-	2 min
29. Antonios et al. (2010)	Stroke	Hospital	Modified Mann Assessment of Swallowing Ability	MMASA	DR, SLP	Trial swallow: s/s observation: Hx	5 mL, 20 mL water	Score	94 out of 100	+	+	NR

Asp. Pneu.=Aspiration pneumonia; DR=Doctor; D/W=Distilled water; GCS=Glasgow Coma Scale; Hx=History; NR=Not reported; RN=Registered nurse; SLP=Speech language pathologist; SLT=Speech language therapist; s/s=Sign and symptom; VFG=Videofluorography.

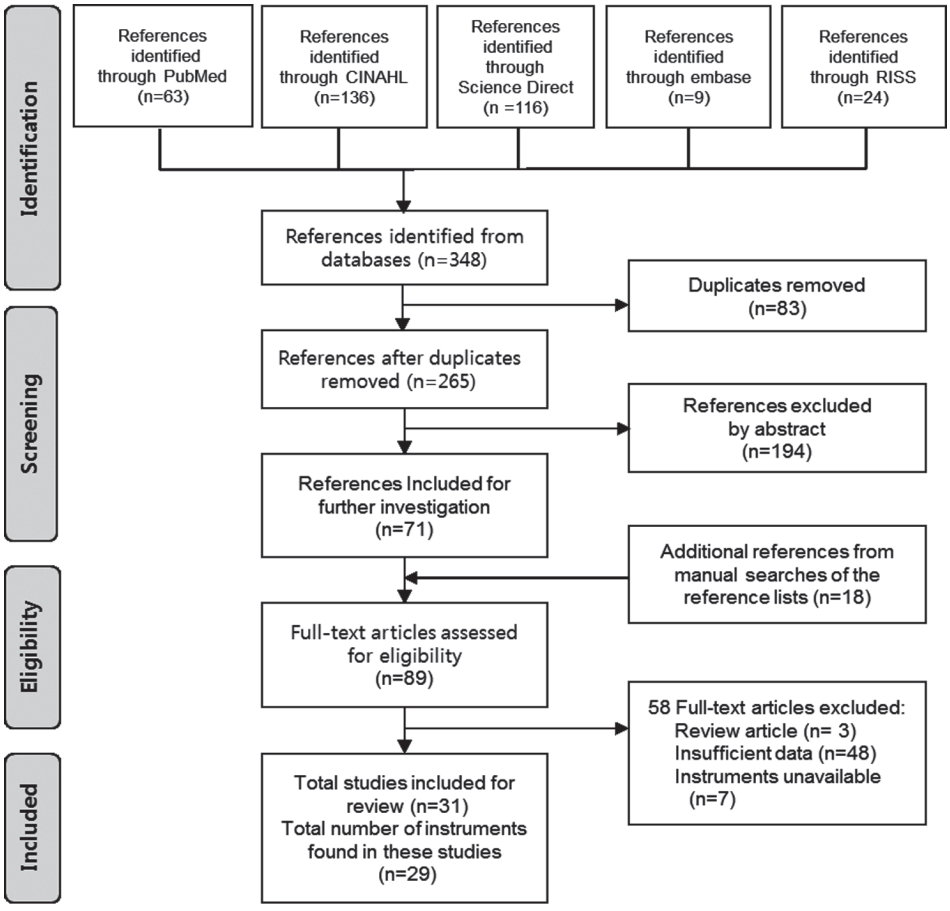

Figure 1. Flowchart of document identification and selection process.

phagia severity was available among these tests with cutoff scores. The time needed for administering the measurement was not reported in most of the measurements.

2. Psychometric property of the measures

Table 3 presents the published psychometric data concerning the identified instruments. Concurrent validity was the most commonly reported validity. 8 tests compared the results with VFSS and 2 tests compared with FEES, which are considered the 'gold standards'. But none of these tools reported the correlation coefficient kappa results except for Gugging Swallowing Screen (GUSS). Some tools compared the results with other screening tools such as Mann Assessment of Swallowing Ability (MASA), with clinical judgments of dysphagia by SLPs, and with clinical evidence of chest infection such as white blood cell counts and chest X-rays to validate the tool. However, none of these were the gold standard of dysphagia measurement. Construct and face validity were also confirmed for 2 tools by a panel of experts.

Internal consistency was reported in 6 studies using questionnaires and checklists observing mealtime behaviors. Cronbach's alpha ranged from 0.76 to 0.88 indicating that the items in these questionnaires were sufficiently correlated. A low kappa coefficient of 0.2 was calculated between the water test and pudding test, concluding that water and semi-solid both should be used in trial swallows[16]. 12 studies reported the inter-rater reliability with the percent of agreement ranging from 68% to 93.6% or with Cohen's kappa ranging from 0.70 to 0.92.

Sensitivity and specificity were reported in most of the tools. A high sensitivity above 90% was reported in 10 tools. GUSS had 100% sensitivity for aspiration with a cutoff of 14 points. An ideal screening tool is both highly sensitive and highly specific and can identify patients at risk of dysphagia and aspiration accurately[17], however, the tools with high sensitivity showed a relatively low specificity. GUSS had 50% specificity in a sample of 20 patients and 69% in 30 patients. Clinical Functional Scale for Dysphagia (CFS-D) had 100% specificity and 100% sensitivity in detecting overt aspiration with a cutoff of 40 out of 100 points. The reason for the 100% sensitivity and 100% specificity could be the biased sampling of

Table 3. Psychometric Data of the Screening Instruments

Instrument	Validity	Reliability	Sensitivity	Specificity
3-oz WST	Reference standard: VFSS	NR	76%	59%
BDST	NR	NR	92%	NR
BSA	Reference standard: VFSS	NR	47~68%	67~86%
Oximetry	Reference standard: VFSS	NR	73%	86%
PAC-SAC	NR	NR	NR	NR
TWST	NR	NR	100%	52%
WSD	Reference standard: medical record	κ=.57~1.0	74%	NR
STS-SPT	Reference standard: chest X-ray and wbc count	NR	100% (1st step), 66.7% (2nd step)	83.3% (1st step), 100% (2nd step)
SBST	NR	κ=.87	31%	95.7%
BSA+O_2 saturation	Reference standard: VFSS	NR	65%	96%
MASA	Reference standard: VFSS	κ=.75~.82	AUC=.80~.83	
SSA	Reference standard: summative clinical judgment	κ=.88	97%	90%
CFS-D	Reference standard: VFSS	NR	100%	100%
Massey BSS	Content: judgment of expert panel Predictive: medical record review	Relatively high	100%	100%
3 non-VFG	Reference standard: VFSS	NR	90%	71%
MISA	Face: judgment of expert panel	Cronbach's α≥.86 Inter-rater: 68%	NR	NR
DSQ	Content: factor analysis	Cronbach's α=.83	NR	NR
9-indicators	NR	Cronbach's α=.85 κ=.09~.57	25%	88%
GUSS	Reference standard: FEES (κ=.58~.67)	κ=.84	100%	63%
DAT	Content: experts agreement ≥ 75%	Cronbach's α=.76~.78 ICC=.73~.76	NR	NR
DRACE	Reference standard: 3-oz water test	Cronbach's α=.88	NR	NR
SSA with water / pudding	Reference standard: summative clinical judgment	NR	NR	NR
MWST+cough test	Reference standard: VFSS & FEES	NR	Cough test (87%), MWST (NR)	Cough test (89%), MWST (NR)
BSA-EATS	NR	NR	NR	NR
NDST	Reference standard: SLP consultation report	NR	29%	84%
TOR-BSST	Reference standard: VFSS	ICC=.92	91.3%	66.7%
MEOF-II	Content: factor analysis	Cronbach's α=.76 Inter-rater: 89%	NR	NR
ASDS	Reference standard: MASA	Inter-rater: 93.6% Test-retest:92.5%	Dysphagia 91%, Aspiration 95%	Dysphagia 74%, Aspiration 68%
MMASA	Reference standard: MASA	κ=.76	92.6%	86.3%

3-oz WST=3-oz Water Swallow Test; 3 non-VFG=Three non-Videofluorography Test (water + food test + x-ray); 9-indicators=9-Clinical Indicators of Dysphagia; ASDS=Acute-Stroke Dysphagia Screen; AUC=Area under the ROC curve; BDST=Burke Dysphagia Screening Test; BSA=Bedside Swallowing Assessment; BSA + O_2 saturation=Combination of Bedside Swallowing Assessment and Oxygen Saturation Monitoring; BSA-EATS=Bedside Swallow Assessment-EATS (Examine Ability To Swallow); CFS-D=Clinical Functional Scale for Dysphagia; DAT=Dysphagia Assessment Tool; DRACE=Dysphagia Risk Assessment for the Community Dwelling Elderly; DSQ=Dysphagia Screening Questionnaire; FEES=Fiberoptic Endoscopic Evaluation of Swallowing; GUSS=Gugging Swallowing Screen; MASA=Mann Assessment of Swallowing Ability; Massey BSS=The Massey Bedside Swallowing Screen; MEOF-II=Minimal Eating Observation Form II; MISA=McGill Ingestive Skills Assessment; MMASA=Modified Mann Assessment of Swallowing Ability; MWST + cough test=Modified Water Swallowing Test + Cough Test; NDST=Nursing Dysphagia Screening Tool; NR=Not reported; PAC-SAC=PAC (prefeeding assessment checklist)- SAC (swallowing assessment checklist); SBST=Simple Bedside Swallowing Test; SLP=Speech Language Pathologist; SSA=Standardized Swallowing Assessment; SSA with water/pudding=Standardized Swallowing Assessment with water/pudding; STS-SPT=Simple Two-Step Swallowing Provocation Test; TOR-BSST=Toronto Bedside Swallowing Screening Test; TWST=Timed Water Swallowing Test; VFSS=Videofluoroscopic Swallowing Study; wbc=White blood cell; WSD=Westergen's Screening for Dysphagia.

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Table 4. Quality Rating and Evaluation of the Applicability of the Screening Instruments

Instrument	Quality rating of measurement property*				Feasibility		Nurse administered	Risk identification	Severity grading
	Validity	Reliability	Sensitivity	Specificity	Time to administer†	Test procedure‡			
GUSS	+	+	+	+	?	+	Yes	Yes	Yes
SSA	+	+	+	+	?	+	Yes	Yes	No
TOR-BSST	+	+	+	+	+	-	Yes	Yes	No
ASDS	-	+	+	+	+	-	Yes	Yes	No
BSA	+	0	-	+	?	+	Yes	Yes	No
MEOF-II	-	+	0	0	?	+	Yes	No	No
BSA-EATS	0	0	0	0	?	+	Yes	Yes	No
NDST	-	0	-	+	?	+	Yes	No	No
DAT	?	?	0	0	+	-	Yes	Yes	No
Massey BSS	?	-	?	?	?	+	Yes	Yes	No
WSD	?	-	+	0	?	+	Yes	Yes	No
PAC-SAC	0	0	0	0	?	-	Yes	No	No
MASA	+	+	+	+	?	+	No	Yes	Yes
CFS-D	+	0	+	+	?	+	No	Yes	Yes
Oximetry	+	0	+	+	?	-	No	Yes	No
MMASA	-	+	+	+	?	+	No	Yes	Yes
3 non-VFG	+	0	+	+	?	-	No	Yes	Yes
BSA + O_2 saturation	+	0	-	+	?	-	No	Yes	No
BDST	0	0	+	0	-	-	No	Yes	No
TWST	0	0	+	-	?	+	No	Yes	No
MWST + cough test	+	0	?	?	?	-	No	Yes	No
3-oz WST	?	0	?	?	?	+	No	Yes	No
STS-SPT	?	0	?	?	?	-	No	Yes	No
SBST	0	+	-	+	?	+	No	Yes	Yes
9-indicators	0	-	-	+	?	+	No	No	No
DRACE	?	+	0	0	?	+	No	Yes	Yes
MISA	?	?	0	0	?	-	No	No	Yes
DSQ	-	?	0	0	?	+	No	No	No
SSA with water / pudding	?	0	0	0	?	+	No	Yes	Yes

*Quality rating of measurement property (+=Positive; ?=Indeterminate; -=Negative; 0=No information available); †Time to administer (+=Less than 10 minutes; -=More than 10 minutes; ?=Time to administer unknown); ‡Test procedure (+=Trial swallow only; -=Procedures and instruments needed other than trial swallows); 3-oz WST=3-oz Water Swallow Test; 3 non-VFG=Three non-Videofluorography Test (water + food test + x-ray); 9-indicators=9-Clinical Indicators of Dysphagia; ASDS=Acute-Stroke Dysphagia Screen; BDST=Burke Dysphagia Screening Test; BSA=Bedside Swallowing Assessment; BSA + O_2 saturation=Combination of Bedside Swallowing Assessment and Oxygen Saturation Monitoring; BSA-EATS=Bedside Swallow Assessment-EATS (Examine Ability To Swallow); CFS-D=Clinical Functional Scale for Dysphagia; DAT=Dysphagia Assessment Tool; DRACE=Dysphagia Risk Assessment for the Community Dwelling Elderly; DSQ=Dysphagia Screening Questionnaire; GUSS=Gugging Swallowing Screen; MASA=Mann Assessment of Swallowing Ability; Massey BSS=The Massey Bedside Swallowing Screen; MEOF-II=Minimal Eating Observation Form II; MISA=McGill Ingestive Skills Assessment; MMASA=Modified Mann Assessment of Swallowing Ability; MWST + cough test=Modified Water Swallowing Test + Cough Test; NDST=Nursing Dysphagia Screening Tool; PAC-SAC=PAC (prefeeding assessment checklist)- SAC (swallowing assessment checklist); SBST=Simple Bedside Swallowing Test; SSA=Standardized Swallowing Assessment; SSA with water/pudding=Standardized Swallowing Assessment with water/pudding; STS-SPT=Simple Two-Step Swallowing Provocation Test; TOR-BSST=Toronto Bedside Swallowing Screening Test; TWST=Timed Water Swallowing Test; WSD=Westergen's Screening for Dysphagia.

the patients who had already manifested symptoms of dysphagia.

3. Applicability of the measurements in nursing home settings

Table 4 presents the quality rating of the measurements and the evaluation of the tools for applicability in NHs. Based on the ratings given to each of the psychometric properties in terms of validity, reliability, sensitivity and specificity, 4 tools were of psychometric quality and could be administered by nurses; GUSS, Standardized Swallowing Assessment (SSA), Toronto Bedside Swallowing Screening Test (TOR-BSST), Acute-Stroke Dysphagia Screen (ASDS). Preparing water and food for swallowing trials in these tests was acceptable for feasible incorporation into NH routines. The feasibility was also evaluated by the time required to perform the tests, however, this information was not provided in a majority

of the studies. Although TOR-BSST has acceptable psychometric properties with a performance time of less than 10 minutes, it was not applicable in NHs because the test procedure required instruments other than water and mandated a 4-hour didactic training from SLPs for nurses to perform the test. ASDS was not applicable in NHs also, because the main focus of the tool is assessing stroke patients in acute stages.

Among these tests, GUSS and SSA showed high sensitivity and specificity with feasible test procedures which nurses in NHs could administer to identify the risk for dysphagia and aspiration. Severity grading was reviewed because it makes an individualized nursing approach possible according to dysphagia with different severities. Only GUSS classified dysphagia into 4 severity codes, assessing the extent of the aspiration risk and the dysphagia severity as well.

DISCUSSION

In this review, we evaluated the quality and the feasibility of dysphagia screening tools that could be used by nurses in NHs. Although a multidisciplinary approach is needed in managing dysphagia, nurses have a crucial role in detecting and managing swallowing difficulty because they are available in NHs 24 hours a day[8]. VFSS is known as the gold standard for dysphagia diagnosis, and FEES is as valuable in that these tests are considered comparably important for the detection of swallowing difficulty[18]. However, VFSS is expensive and requires radiological support and entails radiation exposure[19], and FEES requires experts such as SLPs to perform the test[18]. In addition to the availability of VFSS and FEES, there are limitations imposed by patient cooperation[20]. Because NH residents usually do not have access to these tests and lack the personnel or equipment to perform these tests, it is important to develop tools for detecting swallowing difficulties in the absence of VFSS and FEES[8]. Thus, alternative screening methods have been reviewed to determine which ones could be performed easily at bedside in NHs. Screening by nurses and staff other than physicians and SLPs are also recommended in international guidelines[21,22]. Our search process resulted in profuse studies using a variety of screening methods with different populations, various materials and procedures, and diverse levels of psychometric properties.

GUSS and SSA were identified as feasible tools with acceptable psychometric quality for dysphagia screening among NH residents that could be routinely used by nurses, according to our evaluation criteria. GUSS and SSA had high sensitivity. When evaluating the psychometric properties of diagnostic measurements, using the diagnostic odds ratio is recommended as it measures the discriminatory performance of a test, rather than sensitivity and specificity values[8]. However, we decided to evaluate sensitivity / specificity because when screening for dysphagia, it is desirable that tools have high sensitivity so that the chance for missing a patient with dysphagia resulting in serious adverse events is low[8,11]. If a diagnostic test has high sensitivity, there is a trade-off with specificity, such that the number of false-positives could increase[12]. Such is the case with GUSS having a sensitivity of 100% with a specificity of 63%. However, it is preferable to have high sensitivity to identify as many cases as possible and to prevent adverse events like aspiration[12]. CFS-D and The Massey Bedside Swallowing Screen (Massey BSS) had 100% sensitivity and 100% specificity, but the methodological quality of the study was questionable because of the biased and small sample size.

Various choices of materials and volumes were used during the trial swallows. While many screening tools used water for swallowing trials, significant differences were observed in how much liquid was given and how it was given. Some tests such as 3-oz Water Swallow Test (3-oz WST) require a large amount of water which is not easy to swallow continuously for patients with swallowing difficulty[23]. Water was used at the first phase of most of the dysphagia screenings. SSA used water only. Testing with water showed a higher sensitivity in detecting problems in laryngeal protection, and testing with semisolids was more sensitive for functionally analyzing dysphagia itself[16]. However, swallowing liquids had more problems than semisolid textures among patients in clinical observations[24]. GUSS starts with swallowing semisolid food and proceeds to water and solid food in a stepwise manner in order to minimize the risk of aspiration during the test. Although GUSS is criticized as being less feasible than tests using water only[8], the risk of aspiration during the test has been reduced to a minimum by starting with semisolid textures[24]. Both water and semisolid materials should be used routinely in swallowing screening because the risk of aspiration can be evaluated with water, whereas testing with semisolid food can safely guide the patient to the reintroduction of food[16].

For feasible use by nurses in NHs, the tools need to be simple with less items that do not require lengthy training[25]. Identifying simpler methods will enhance better implementation of dysphagia screening and improve dysphagia management effectively in NH practices. SSA is simple and involves general assessment and trial swallows. Clinical signs such as voice quality and coughing are recorded during trial swallows by sipping water from a spoon and drinking from a glass[25]. GUSS consists

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of 2 subsets: indirect assessment without swallowing and direct assessment with trial swallows. Voice change, drooling, coughing and delayed swallowing are noted. Simple instructions are provided in SSA and GUSS that can guide nurses to perform the test and to make referrals to SLPs or to modify diet appropriately. Simply comparing the changes in GUSS scores to previous scores makes it easy to understand the changes in swallowing difficulty and aspiration risk. In addition, GUSS classifies the severity of dysphagia into 4 codes that enable the assessment of the extent of risk for aspiration and allow nurses to determine the appropriate nursing intervention according to the severity level.

Screening and assessment were used interchangeably in the studies while Perry & Love[19] and Logemann et al.[26] distinguished screening and assessment as two different procedures. Generally, screening tests are administered noninvasively, and the patient is exposed to minimum risk while identifying dysphagia symptoms which entail profound diagnostic assessment[26]. Although the tools reviewed in this study used the term assessment and screening interchangeably, the tools mainly screened for the risk of dysphagia and aspiration. In terms of screening for dysphagia in NHs, GUSS and SSA were chosen based on our criteria with high psychometric quality, especially with a high sensitivity. They are easy to use and intelligible to the nurses who will be carrying out the screening and acceptable in terms of resource use, such as time and equipment in NHs.

We believe that this is the first systematic review on the properties of dysphagia screening tests that can be used in NHs by nurses. Other reviews were not systematic[27], or were limited to studies on patients with neurological disorders or stroke[8,12,15,20]. Conforming to our findings, other reviewers also reported the difficulty in making a comparative analysis because of the variety of tests. Bours et al.[8] concluded in their review that as a screening tool, a water test combined with pulse oximetry produces the most satisfactory results. However, using oximetry scored a minus point in our review because oximetry is not commonly available in Korean NH settings, making it less feasible as a screening tool.

Our results have implications in the implementation of dysphagia screening in NHs by identifying the right screening tool for use by nurses. GUSS and SSA can be feasibly used in NHs with a high prevalence of swallowing difficulty; however, the resources and staffing to screen and manage the problem are limited. Further research is needed to standardize the implementation of screening tools in routine NH care, and to take into account the special circumstances of NH where cognitive problems abound.

This study has a few limitations. We used the method by Hawker et al.[10] for the critical appraisal of studies because our review was not limited only to the primary diagnostic accuracy studies. If the review was to focus on evaluating diagnostic accuracy, it would be desirable to use QUADAS-2[28], a tool for the quality assessment of diagnostic accuracy studies, and to include only the studies that compared the results with VFSS or FEES, the gold standards of dysphagia measurement. Although we focused on searching for tests to detect swallowing difficulty in NH residents, the majority of the tests found were used with stroke patients in an acute setting without presenting measurement properties in different target populations, such as NH residents. As dysphagia recovers within 2 to 4 weeks of stroke onset in more than 80% of patients[29], and dysphagia of NH residents could be caused by reasons other than stroke[3], the results of our review should be generalized with caution. Further research on NH residents applying the recommended instruments is necessary according to the study purpose, and also to validate the use of the screening tools. Despite many studies being identified by our review, we cannot be certain that we did not omit any. We used search terms to retrieve as many relevant studies as possible and performed a hand search after reading the studies thoroughly. The restriction to English and Korean journals could be another limitation. Also, the recommended instruments should be tested in certain languages because measurement properties are not mechanically constant throughout diverse languages or cultures.

CONCLUSION

The review showed that GUSS and SSA are the right tools for detecting dysphagia with high psychometric properties and feasibility that can be administered by nurses in NHs. More research is needed to identify efficient ways to incorporate the implementation of screening procedures especially in NHs with limited staffing and resources. In addition, we recommend developing a standardized protocol for referring NH residents with risk of aspiration to a doctor or SLPs for further evaluation.

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Appendix 1. List of Reviewed Papers

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