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ISSN 1913-2020

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DROIT D'AUTEUR

TABLE OF CONTENTS

TABLE DES MATIÈRES

Aging Effects on Eating Assessment Tool-10 (EAT-10) Total Scores in Healthy, Community-Dwelling Adults

L'effet du vieillissement sur les scores totaux obtenus à l'*Eating Assessment Tool-10* (EAT-10) par des adultes en santé vivant à domicile

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Abstract

The purpose of this study was to examine how aging and sex impacted scores on the Eating Assessment Tool-10 in a large sample of healthy, non-dysphagic adults. Differences in Eating Assessment Tool-10 total normal (< 3) and abnormal (≥ 3) scores were examined across four age categories (21–39 years, 40–59 years, 60–79 years, 80 years and older) and between sexes. The mean (± *SD*) Eating Assessment Tool-10 total score for this healthy cohort of 167 individuals was 0.6 (± 1.6), with the majority of participants (75%) earning a score of zero. No significant differences were found in Eating Assessment Tool-10 total scores across age categories (*p* = .53) or between sexes (*p* = .79). Post-hoc analyses further explored relationships between Eating Assessment Tool-10 total scores and swallow performance measures as observed during videofluoroscopy. All participants (*n* = 15) scoring 3 and greater on the Eating Assessment Tool-10 passed an aspiration screen (i.e., 3-ounce water swallow challenge). Nine participants scoring less than 3 and failing the aspiration screen were not observed to have airway invasion as measured by the Penetration-Aspiration Scale during videofluoroscopy. A significant relationship was not observed between Eating Assessment Tool-10 total scores and highest Penetration-Aspiration Scale score. Eating Assessment Tool-10 total scores reported in the current study for patients with gastroesophageal reflux disease were significantly lower (*p* < .001) than total scores reported in the Eating Assessment Tool-10 validation study by Belafsky et al. (2008). In summary, aging or sex effects did not appear to impact self-report of dysphagia-related symptoms as measured by the Eating Assessment Tool-10. The Eating Assessment Tool-10, therefore, may not demonstrate the sensitivity needed to capture sub-clinical changes of the aging swallowing mechanism.

Abrégé

L'objectif de cette étude était d'examiner l'impact du vieillissement et du sexe sur les scores du *Eating Assessment Tool-10*, et ce, auprès d'un grand échantillon d'adultes en santé qui n'ont pas de dysphagie. Les scores totaux normaux (< 3) et anormaux (≥ 3) obtenus à l'*Eating Assessment Tool-10* ont été examinés au sein de quatre catégories d'âge (21–39 ans, 40–59 ans, 60–79 ans, 80 ans et plus), ainsi qu'en fonction du sexe. La moyenne (± *ÉT*) des scores totaux était de 0,6 (± 1,6) pour cette cohorte de 167 individus en santé et une majorité d'entre eux (75%) ont obtenu un score de zéro. Aucune différence significative n'a été trouvée entre les catégories d'âge (p = 0,53) ou en fonction du sexe (p = 0,79). Des analyses *post-hoc* ont exploré plus en détail la relation entre les scores totaux du *Eating Assessment Tool-10* et des mesures de performance de la déglutition recueillies lors d'une vidéofluoroscopie. Aucune aspiration n'a été dépistée (à l'aide d'une épreuve demandant d'avaler 3 onces d'eau) chez les 15 participants ayant obtenu un score égal ou plus grand que 3 à l'*Eating Assessment Tool-10*. Des aspirations ont été dépistées (à l'aide d'une épreuve demandant d'avaler 3 onces d'eau) chez neuf des participants ayant obtenu un score inférieur à 3 à l'*Eating Assessment Tool-10*. Néanmoins, aucun matériel n'est entré dans leurs voies respiratoires, si l'on se fie aux résultats obtenus avec la *Penetration-Aspiration Scale* lors de la vidéofluoroscopie. Aucune relation significative n'a été observée entre les scores totaux obtenus à l'*Eating Assessment Tool-10* et les scores plus élevés obtenus à la *Penetration-Aspiration Scale*. Les scores totaux obtenus à l'*Eating Assessment Tool-10* par les patients de la présente étude ayant du reflux gastro-oesophagien étaient significativement inférieurs (p < 0,001) à ceux obtenus dans l'étude de validation de Belafsky et al. (2008). En résumé, l'âge et le sexe ne semblent pas influencer les symptômes de dysphagie rapportés par les patients et mesurés par l'*Eating Assessment Tool-10*. Par conséquent, l'*Eating Assessment Tool-10* ne semble pas avoir la sensibilité nécessaire pour identifier les changements subcliniques se produisant en cours de vieillissement au niveau du mécanisme de la déglutition.

The Eating Assessment Tool (EAT-10) was motivated by a need for a clinically practical dysphagia assessment of dysphagia symptom severity, quality of life, and treatment efficacy that can be rapidly administered and easily scored in a clinical setting (Belafsky et al., 2008). Items include symptom-related information such as unintentional weight loss, effort or pain during swallowing, and coughing during eating. Each item on the 10-item instrument is arranged in a 5-point Likert scale (0 = *No problem*, 4 = *Severe problem*).

During the validation study by Belafsky et al. in 2008, the EAT-10 was administered to 235 individuals (patient cohort) with known voice and swallowing disorders and 100 healthy, non-dysphagic individuals (normal cohort). Male participants comprised 53% of the normal cohort, and the mean (± *SD*) age was 48 ± 16 years. The normal cohort included persons without history of voice, swallowing, reflux, or other medical disorders known to influence swallowing function (Belafsky et al., 2008). The mean EAT-10 score for the normal cohort was 0.40 ± 1.01, which produced the upper normal limit score of 2.41 (mean + 2 *SD*). These normative data suggest that an EAT-10 score of ≥ 3 is *abnormal*. The EAT-10 scores of patients across a variety of medical diagnostic categories (e.g., head and neck cancer, reflux disease) had significantly higher EAT-10 scores compared with the healthy group (*p* < .001). The validation study, however, did not explore if aging affects EAT-10 total scores in healthy, community-dwelling adults.

Previous evidence estimates the prevalence of dysphagia in older, community-dwelling individuals at a rate of 11% (Holland et al., 2011). Increasing rates of swallowing impairments are expected as the aging population in the United States rapidly grows. Physiologic changes to the swallowing mechanism resulting from natural aging have been well documented, including loss of dentition, altered salivary flow, muscular atrophy and infiltration of fatty tissue, and reduced mobility and strength of upper aerodigestive tract structures relevant to swallowing (Baum & Bodner, 1983; Ekberg & Feinberg, 1991; Mulheren et al., 2018; Robbins, Hamilton, Lof, & Kempster, 1992; Yoshikawa et al., 2005). These age-related changes in swallowing function known as *presbyphagia* may impact health status and quality of life as an individual continues to age. Although the EAT-10 was validated using a healthy cohort, potential aging effects on total scores were not considered. Understanding how aging can impact swallowing function can help differentiate typical from atypical changes.

The primary purpose of this study was to describe performance on the EAT-10 in a large sample of healthy, non-dysphagic and non-reflux community-dwelling adults. To achieve this aim, we explored differences in EAT-10 total scores across four age categories (21–39 years, 40–59 years, 60–79 years, and 80 years and older) and between sexes. We then compared our healthy cohort results to findings reported in the original validation study by Belafsky et al. (2008). We did not anticipate any sex differences but expected higher EAT-10 total scores in older adults relative to their younger counterparts, although anticipated the average EAT-10 total score would be consistent with the previous report by Belafsky et al. During post-hoc analysis, we further explored associations between EAT-10 total scores and additional swallowing measures, including pass/fail outcomes on an aspiration screening measure and observation of bolus airway invasion during videofluoroscopy. We hypothesized that higher EAT-10 scores (3 and greater) would have higher rates of fails and occurrences of bolus airway invasion.

Method

Participants

Participants for the current study were derived from a normative database consisting of 195 healthy participants. All participants were required to provide informed consent prior to participation in study procedures. This study received approval by the Institutional Review Board affiliated with the university (Pro00011566).

Our current sample included community-dwelling adult volunteers without a current or previous diagnosis of dysphagia, gastroesophageal reflux disease, neurological insult/disease (e.g., stroke, Parkinson's disease), pulmonary disease (e.g., chronic obstructive pulmonary disease), head and neck cancer, anterior neck surgery (e.g., thyroid surgery, anterior spinal surgery), or other medical conditions known to influence swallowing function per self-report during completion of a demographic and clinical questionnaire as part of determining study eligibility. All study participants reported eating a full regular diet with all liquids without restrictions (Functional Oral Intake Scale Level 7; Crary, Carnaby Mann, & Groher, 2005). Further, participants were judged by study personnel to have adequate cognition to participate in study procedures and/or pass a cognitive screen (Montreal Cognitive Assessment; Nasreddine et al., 2005). Participants were recruited using study flyers, word-of-mouth, and community outreach opportunities (e.g., booth at local event).

Procedures

Participants completed the EAT-10 as part of a study protocol investigating the effects of typical aging on oropharyngeal swallowing function. Study procedures in addition to completion of the EAT-10 included completion of a 3-ounce water swallowing challenge (DePippo, Holas, & Reding, 1992; Suiter & Leder, 2008) and videofluoroscopic examination in accordance to the Modified Barium Swallow Impairment Profile protocol (Martin-Harris et al., 2008). Modified Barium Swallow Impairment Profile scores and Penetration-Aspiration Scale (PAS) scores were collected from videofluoroscopic studies obtained under continuous fluoroscopy and recorded at 30 frames per second. All study procedures were completed in an adult radiology suite during a one-time study visit. Participants were compensated for time and travel.

Analysis

EAT-10 scores were tabulated by sex and age category. In addition, scores were categorized in a binary manner as normal (0–2) or abnormal ($\geq$ 3). Fisher's exact test was used to test for associations between the binary score and sex and age categories. Logistic regression was used to test for interaction effects between age and sex using the binary score as the outcome variable. Due to the small sample size for the 80+ year age category, it was combined with the 60–79 age category in the logistic regression model. An alpha level of .05 was used for this analysis to evaluate the significance for all comparisons.

Results

A total of 167 (93 women) participants were included in the analysis from the normative database. Mean age ($\pm$ SD) in the current participant sample was 46 ($\pm$ 17) years. Further demographic information is provided in **Table 1**. The mean ($\pm$ SD) EAT-10 total score was 0.6 $\pm$ 1.6, with a range from 0 to 11. The majority of participants in the current study scored a 0 on the EAT-10 (n = 126, 75.4%; **Table 2**). Fifteen participants (9.0%) earned an w score (i.e., EAT-10 total score of 3 or more). The rate of abnormal scores ($\geq$ 3) was 2% higher in women vs. men (90% vs. 92%), while the rate between age categories differed by no more than 11% observed in the youngest age category (21–39 years) compared to the oldest (80 years and older; 6% vs. 17%). However, there was not a significant difference in binary EAT-10 total scores (< 3, $\geq$ 3) across age categories (p = .53) or between sexes (p = .79). No interaction was found between the age category and sex variables in the logistic regression model (p = .65).

Post-Hoc Analysis

To further investigate study findings, additional data were extracted from the normative database to determine associations between EAT-10 total scores and performance on additional swallowing measures, including the 3-ounce water swallow challenge (Suiter & Leder, 2008), bolus airway invasion as measured by the PAS (Rosenbek, Robbins, Roecker, Coyle, & Wood, 1996), and participants who self-reported a diagnosis of gastroesophageal reflux disease.

Table 1	
Participant Demographics	
Variable	Total (N = 167)
Age (years)	
Mean $\pm$ SD	45.7 $\pm$ 17.2
Range	21–89
Sex	
Female	93 (55.7)
Male	74 (44.3)
Race	
White/Caucasian	121 (72.5)
Black/African American	41 (24.6)
Asian	1 (0.6)
More than 1 race	3 (1.8)
Unknown/not reported	1 (0.6)
Ethnicity	
Non-Hispanic/Non-Latino	163 (97.6)
Hispanic/Latino	4 (2.4)
Age category	
21–39 years (n = 66)	66 (39.5)
40–59 years (n = 57)	57 (34.1)
60–79 years (n = 38)	38 (22.8)
80 years and older (n = 6)	6 (3.6)

Note. Data presented in frequencies (percentages) unless otherwise reported.

Table 2

EAT-10 Total Scores Between Sexes and Across Age Categories

EAT-10 Total Score	Overall	Male	Female	21–39 years	40–59 years	60–79 years	80 years and older
0	126 (75)	58 (78)	68 (73)	56 (79)	42 (74)	28 (74)	4 (67)
1	15 (9)	8 (11)	7 (8)	6 (9)	6 (11)	3 (8)	0 (0)
2	11 (7)	2 (3)	9 (10)	4 (6)	3 (5)	3 (8)	1 (17)
3	7 (4)	3 (4)	4 (4)	3 (5)	3 (5)	1 (3)	0 (0)
4	5 (3)	2 (3)	3 (3)	1 (2)	2 (4)	1 (3)	1 (17)
5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
7	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
8	1 (< 1)	1 (1)	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)
9	1 (< 1)	0 (0)	1 (1)	0 (0)	0 (0)	1 (3)	0 (0)
10	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
11	1 (< 1)	0 (0)	1 (1)	0 (0)	1 (2)	0 (0)	0 (0)
Grouped							
0–2	152 (91)	68 (92)	84 (90)	66 (94)	51 (89)	34 (89)	5 (83)
3–11	15 (9)	6 (8)	9 (10)	4 (6)	6 (11)	4 (11)	1 (17)

Note. Data presented in frequencies (percentages) unless otherwise reported. EAT-10 = Eating Assessment Tool-10.

For the 15 participants with an abnormal EAT-10 total score of 3 or greater, each participant passed a 3-ounce water swallow challenge. Nine participants demonstrating EAT-10 total scores < 3 failed the 3-ounce water swallow challenge, including two participants with change in vocal quality and seven with throat clear/cough after administration. Despite the failed performance on the 3-ounce water swallow challenge, each of the nine participants received PAS scores of 1 across swallowing tasks observed under videofluoroscopy.

Three participants were observed during videofluoroscopy to penetrate (PAS scores of 3, 3, and 4, respectively) during self-administered sequential swallowing thin and nectar-thickened liquid tasks (**Figure 1a**). The remaining 12 participants with scores of 3 or greater

were observed to have PAS scores < 3. Twelve penetration and three aspiration events were observed in participants earning an EAT-10 total score of < 3 (**Figure 1b**). Spearman's rank correlation failed, however, to reveal a significant relationship between EAT-10 total scores and worst (highest) PAS score (r_s = -.04, p = .61).

To investigate potential of reflux on EAT-10 scores, participants who self-reported a diagnosis of gastroesophageal reflux disease (n = 28, 16 women) were also extracted from the normative database. The mean age ($\pm$ *SD*) in the current participant sample who self-reported reflux was 55 ($\pm$ 16) years. These scores were compared with findings from the reflux sample (n = 66) reported by Belafsky et al. (2008), although further demographic information was unavailable. Participants in the current

Figure 1
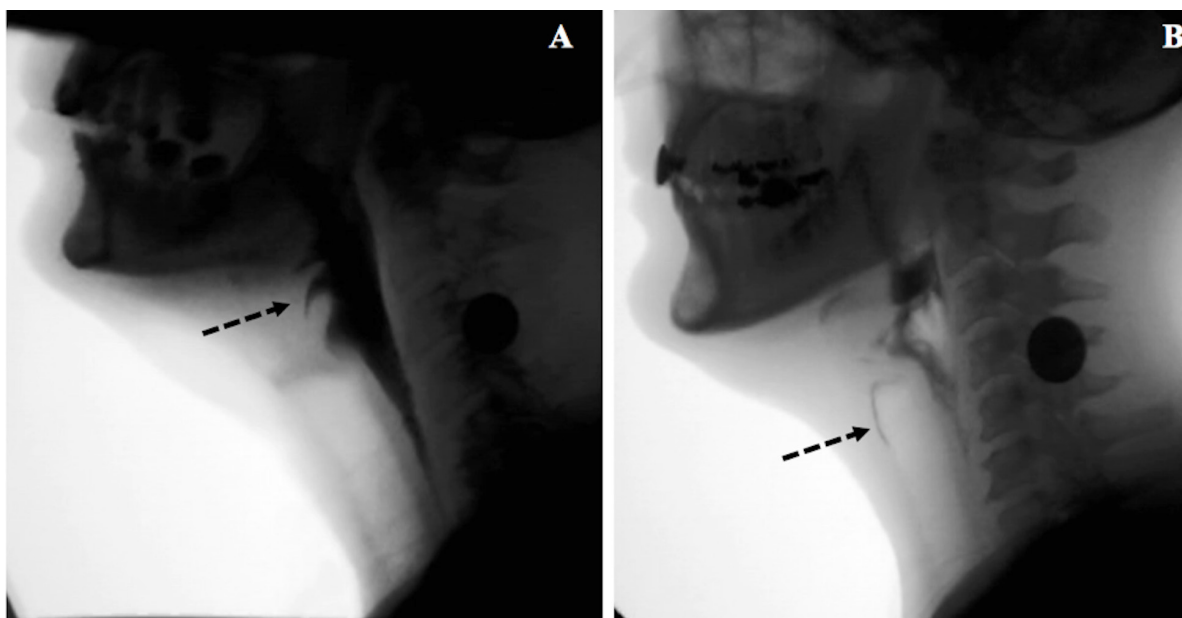
Figure 1A-B. A) 66-year-old male participant with an Eating Assessment Tool-10 (EAT-10) total score of 8 demonstrating penetration (Penetration-Aspiration Scale [PAS] score of 3) during thin liquid sequential swallowing task. B) 48-year-old female participant with an EAT-10 total score of 0 and aspiration (PAS score of 7) during teaspoon thin liquid swallowing task. All remaining swallowing tasks received a PAS score of 1.

cohort who self-reported a history of reflux had a higher average score than participants who did not report reflux (1.9 ± 3.9 vs. 0.6 ± 1.6). However, EAT-10 total scores for participants who reported reflux in the current study had significantly lower scores than reported in the Belafsky et al. study (1.9 ± 3.9 vs. 11.7 ± 3.9; $p < .001$).

Discussion

The purpose of this study was to describe performance on the EAT-10 in a large sample of healthy, non-dysphagic and non-reflux community-dwelling adults and explore the potential influence of age and sex on total scores. The majority of individuals earned a score of 0 (75%), although variability was observed (range 0–11). However, study results failed to find age- or sex-related effects on EAT-10 total scores.

Two items from the EAT-10 that contributed to the highest percentage of participants reporting a score greater than 0 included "swallowing pills takes extra effort" (Question 5) and "when I swallow, food sticks in my throat" (Question 8). When examining previous literature, a population survey reported 40% of adults reported difficulty with swallowing pills (Harris Interactive Survey, n.d.,

as cited in Fields, Go, & Schulze, 2015), with similar findings reported in a study by Fields et al. (2015). Larger pills and pills without a coating were among chief complaints of adults (Harris Interactive Survey, n.d., as cited in Fields et al., 2015), although a small subset of their study population also complained of difficulty with swallowing solids. Our findings support previous studies demonstrating community-dwelling adults experience difficulty with taking pills. However, whether the reported difficulty in swallowing pills is due to fear/anxiety or true pathologic impairment has not been elucidated in previous studies. Further, the potential relationship between difficulty taking pills and solid food dysphagia is interesting and worth exploring.

Another possibility for higher scores reported for Questions 5 and 8 may relate to the presence of dry mouth or hyposalivation contributing to perceived increased effort for pills and globus sensation for solids. Polypharmacy is common among older adults, with the majority consuming at least one medication causing salivary hypofunction (Turner & Ship, 2007). Further contributing factors include systemic diseases and their treatments and other medical conditions, including dehydration. While our stringent criteria excluded medical diseases that are often associated

with dysphagia, it may not have been an exhaustive listing to include conditions that may contribute to a salivary disorder. When comparing rates of scores greater than zero across the age groups for these two EAT-10 questions, however, no discernable differences emerged for either question, suggesting that such self-reported difficulties were represented across the adult lifespan and may not exclusively result from aging.

A critical outcome of swallowing dysfunction is entry of a bolus into the airway. Airway invasion in healthy individuals has been previously documented, particularly in healthy older individuals (Butler, Stuart, Markley, Feng, & Kritchevsky, 2018; Butler, Stuart, Markley, & Rees, 2009; Garand et al., 2019; Robbins, Coyle, Rosenbek, Roecker, & Wood, 1999). This study failed to find a significant relationship, however, between worst (highest) PAS scores and EAT-10 total scores. Further, participants without airway invasion observed during videofluoroscopy in the current study earned a median score of 3 (range 1–11), which would be considered an "abnormal" score according to the validation study by Belafsky et al. (2008). Thus, these findings suggest that airway invasion events may not impact a healthy individual's perception of swallowing difficulty and that a perceived impaired perception of swallowing function may not translate to actual airway invasion.

When examining the influence of reflux on perceived swallowing difficulty as measured by EAT-10, the current study sample reported less perceived difficulty than patients with reflux as reported by Belafsky et al. (2008). One possible explanation for the differences in EAT-10 total scores reflux findings between participants with reflux in the validation study (Belafsky et al., 2008) and our non-dysphagic cohort who self-reported reflux is the participants in the validation study were undergoing treatment for voice and swallowing disorders. Therefore, these participants may have been experiencing reflux that manifested itself in primary voice or swallowing symptoms. Further, reflux was self-reported in this study, so it remains unknown who provided the diagnosis of reflux and what assessment (if any) was completed to confirm the diagnosis.

When Belafsky et al. (2008) applied mean plus 2 SD to yield the upper limit of normal in their study, their data supported the use of ≥ 3 score as abnormal. The mean (± SD) age of the normal cohort (n = 100) reported by Belafsky et al. was similar to that in the current cohort (48 ± 16 years vs. 46 ± 17 years, respectively). Sex distribution was also similar, with men comprising 53% and 44% of the sample in Belfasky et al. and the current study, respectively. The mean

(± SD) EAT-10 total score for the current study was 0.6 (± 1.6). Thus, when using the mean plus 2 SD formula as applied in the Belafsky et al. study, the current data supports the use of a score of 4 or higher (i.e., 0.6 + 3.2 = 3.8) to be considered abnormal. This one-point difference is likely attributed to how we sampled participants since in the current study, we stratified by age category while Belafsky et al. did not. The validation study by Belafsky et al. also did not consider the implications of age on scores. Further, Rofes, Arreola, Mukherjee, and Clavé (2014) found increased sensitivity of identification of oropharyngeal dysphagia observed during videofluoroscopy when reducing the cutoff score to 2 to reduce rates of false negatives (i.e., patients with dysphagia misclassified as healthy). The sample size in the Rofes et al. study only included 14 healthy participants (8 men, 6 women), with all participants earning a total score of 0 on the EAT-10. Participants in the healthy cohort in the Rofes et al. study were younger compared to the current cohort (30.5 ± 6.1 compared to 48 ± 16 in the current study). Unfortunately, age was not a variable of interest in the Rofes et al. study.

Limitations

A primary limitation of our study includes the low number of participants in the oldest age category. When these participants were collapsed in the next youngest age category (60–79 years), differences across age categories remained non-significant. Further, a study by Cordier et al. (2017) using Rasch analysis revealed item redundancy, lack of easy/difficult items, and floor effect in the EAT-10; however, this tool is commonly reported in the literature and translated into other languages. Lastly, our healthy cohort may have occult impairments that had yet to be diagnosed, and thus, may have influenced severity of symptoms reported. Despite these limitations, this study further contributes to understanding typical swallowing in aging adults in helping to delineate typical or "normal" from true pathologic impairment. Although, overall EAT-10 scores were low in our study sample, there was a variability in scores (range 0–11). However, we failed to find any aging effects on EAT-10 scores, as well as failed to find sex effects or a significant relationship between EAT-10 total scores and PAS scores. For individuals who report perceived difficulty on EAT-10 scores, other considerations should be evaluated (e.g., influence of medications) especially in light of instrumentation revealing functional swallowing physiology.

Future Research

Future studies that include concurrent imaging (i.e., videofluoroscopy or fiberoptic endoscopic evaluation of swallowing function) with the EAT-10 tool will provide

increased information regarding the sensitivity and specificity of the EAT-10 with instrumental findings of swallowing function, as well as investigate potential aging influence on EAT-10 total scores in older adults (80 years and older).

Conclusions

This study described EAT-10 total scores in a large sample of healthy, non-dysphagic and non-reflux community-dwelling adults. In summary, the majority of participants earned a score of 0, although variability in scores was observed. Investigation of sex and age-related effects did not reveal significant differences in EAT-10 total scores. Post-hoc analyses also failed to find a significant relationship between EAT-10 total scores and PAS score. Findings suggest that the subacute changes in the upper aerodigestive tract occurring during healthy aging do not necessarily contribute to changes in perceived difficulty of swallowing functions. Further, perceived impairment of swallowing function as captured by the EAT-10 may not translate to occurrence of bolus airway invasion observed on videofluoroscopy.

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Disclosures

No conflicts of interest, financial or otherwise, are declared by the authors.

Trends in Neonatal Dysphagia Research: Insights From a Text Mining Approach

Les tendances de recherche au sujet de la dysphagie chez le nouveau-né : un aperçu résultant d'une exploration de texte

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Abstract

Meta-research is an emerging field that can provide valuable insights into research trends. This preliminary meta-research study aimed to trace and describe the research patterns in the area of neonatal dysphagia from 1970 to present using the technique of text mining. It also aimed to compare the amount of published research in the last 5 decades, identify journals that published the most research papers on neonatal dysphagia, and provide insights into the most common research topics. We utilized a combination of text mining and bibliometric–scientometrics techniques. The titles and abstracts of various scientific articles were analyzed for word frequency and relationship between them using hierarchical cluster analysis and co-occurrence network techniques. A total of 1819 research articles were published across various journals under the Scopus database. Research themes centred around feeding problems in neonates, clinical evaluation, and management, and a few studies focused on treatment outcomes. Findings of this study emphasize the need for unification of terminologies, wider adaptation of the International Classification of Functioning, Disability, and Health framework (World Health Organization, 2001), interprofessional education, and more evidence to support the practice of neonatal dysphagia.

Abrégé

La métarecherche est un domaine de recherche en émergence et pouvant fournir de précieux renseignements sur les tendances de recherche. La présente métarecherche préliminaire avait pour objectif de retracer et de décrire les tendances de recherche au sujet de la dysphagie chez le nouveau-né (depuis 1970), en utilisant une technique intitulée « exploration de texte » (*text mining*). Cette métarecherche avait également pour objectif d'examiner la quantité d'études ayant été publiées dans les cinq dernières décennies, d'identifier les revues qui ont publié le plus d'articles de recherche au sujet de la dysphagie chez le nouveau-né et de fournir un aperçu des sujets de recherche les plus fréquents. Une combinaison de techniques d'exploration de texte et de bibliométrie-scientométrie a été utilisée. La fréquence des mots, ainsi les relations entre ceux-ci, des titres et résumés d'une variété d'articles scientifiques ont été analysées à l'aide de techniques de classifications hiérarchiques et de réseaux de cooccurrence de termes. Un total de 1819 articles de recherche ont été publiés dans les diverses revues indexées dans la base de données Scopus. Les thèmes de recherche de ceux-ci étaient axés sur les problèmes d'alimentation des nouveau-nés, ainsi que sur l'évaluation clinique et la prise en charge de la dysphagie. Le thème de recherche de quelques études portait également sur les effets des interventions. Les résultats de la présente étude soulignent la nécessité d'unifier les terminologies utilisées, d'adopter de façon plus généralisée le cadre proposé dans la *Classification internationale du fonctionnement, du handicap et de la santé* (World Health Organization, 2001), d'offrir des activités de formation interprofessionnelle et de disposer de davantage de données probantes pour soutenir la pratique auprès de nouveau-nés dysphagiques.

The prevalence of dysphagia is estimated to range from 25% to 45% in children who are typically developing (Bryant-Waugh, Markham, Kreipe, & Walsh, 2010), 33% to 80% in children with developmental disorders (Burklow, McGrath, Valerius, & Rudolph, 2002; Field, Garland, & Williams, 2003; Linscheid, 2006; Schwarz, Corredor, Fisher-Medina, Cohen, & Rabinowitz, 2001), and about 27% among preterm infants (Zimmerman & Rosner, 2018). This rise in the prevalence of dysphagia may be because of considerable technological advances in perinatal care during the last 5 decades. These advancements have resulted in an increased survival rate among neonates with histories of low birth weight, prematurity, and a wide array of medical conditions (Hamilton et al., 2007; Martin et al., 2003; Newman, Keckley, Petersen, & Hamner, 2001; Rommel, De Meyer, Feenstra, & Veereman-Wauters, 2003). Medical and surgical advances have shifted the lower limits of viability to shorter gestational periods. This shift in viability has been associated with accelerated neonatal morbidity rates and prolonged need for mechanical ventilator support, thereby increasing the overall duration of hospitalization (Lefton-Greif & Arvedson, 2016). The most critical factor that prolongs hospitalization in neonates is dysphagia (Bakewell-Sachs, Medoff-Cooper, Escobar, Silber, & Lorch, 2009).

Speech-language pathologists (S-LPs) have played a central role in the assessment and management of infants and children with feeding and swallowing disorders for more than 5 decades (Lefton-Greif & Arvedson, 2016). For S-LPs involved in feeding and swallowing rehabilitation, this change in focus from infants and children to neonates poses a new challenge. Lefton-Greif and Arvedson (2016) have highlighted that S-LPs are underprepared to handle the high-risk practice in the area of neonatal dysphagia as there are no opportunities for formal education or uniform protocols. National governing bodies, such as the American Speech-Language-Hearing Association, have taken several steps towards addressing the issue of lack of trained workforce. The American Speech-Language-Hearing Association's (2007) technical report, "Graduate Curriculum on Swallowing and Swallowing Disorders," highlighted the need for education and training of students with knowledge and skills to evaluate and treat dysphagia across a variety of populations and settings. Even with these necessary steps, most S-LPs who did not complete a course on pediatric dysphagia reported feeling unprepared to handle this population (Zimmerman, 2016). These reports further highlight the need for formal training, focused research, and dissemination in this area.

Lefton-Greif and Arvedson (2016) have highlighted the population demographics, advances in evaluation and

management over the past decade, and future directives that might influence the practice of pediatric dysphagia. Although the gaps Lefton-Greif and Arvedson identified are appropriate, infants and neonates present with unique considerations. The present study was carried out to trace the evolution of research in neonatal dysphagia.

We believe that there exists much-hidden information in the scientific literature that cannot be studied from a purely statistical viewpoint. The technique of data mining attempts to bridge this gap by uncovering and analyzing information inaccessible to statistical treatment, especially when the magnitude of data is vast (Gaber, 2012; Gonzalez, Tahsin, Goodale, Greene, & Greene, 2015). Witten, Frank, Hall, and Pal (2017) defined the term *data mining* to be a computational process of extracting new information from existing large amounts of data. Data mining is often used as an umbrella term to refer to classification algorithms (e.g., decision trees and other classifiers), frequent pattern algorithms (e.g., association rule mining, sequential patterns mining and others), clustering algorithms, graphs, and networks (Che, Safran, & Peng, 2013; Herland, Khoshgoftaar, & Wald, 2014). Data mining also includes text mining, image mining, web mining, predictive analytics, and big data techniques (Piatetsky-Shapiro, 2012).

Text mining is a subfield of data mining that aims to extract valuable new information from existing sources of data (Feldman & Sanger, 2007). Text mining, as an interdisciplinary approach, analyzes data in natural language text through the use of specific algorithms (Cohen & Hunter, 2008; Nie & Sun, 2017). Thus, when a set of documents are given the text mining technique extrapolates unique patterns, relationships, and trends contained within the documents.

Existing databases, such as Scopus, PUBMED, and Web of Science, consist of scientific literature that is massive but also fragmented and often nontransparent. These databases consist of several important works of research and equally irrelevant attempts at replication and reduplication. An understanding of patterns among existing research is necessary to avoid wasted effort, optimize resources, and provide the right directions to prioritize research. A relatively new discipline called meta-research aims to provide a bird's eye view of current research by studying research itself. It is interdisciplinary and can benefit from better tools and methods in statistics and informatics. The present meta-research study is a combination of text mining and bibliometric techniques that will allow us to investigate the journal-wise distribution of neonatal dysphagia research over the last 5 decades to trace the evolution of research trends during this period. We believed

that these efforts would shed light on the identification of major academic branches and trends in the area of neonatal dysphagia.

Method

The present study can be described as an attempt towards "research on research" in the area of neonatal dysphagia. It utilized techniques of text mining in the background of scientometric and bibliometric analyses. Given the limited space and scope of the article, the techniques of text mining are not discussed here in detail and could be found elsewhere (see Herland et al., 2014; Krishnamurthy & Balasubramanium, 2019).

Source Selection and Search Strategy

The authors searched the Scopus database using the keywords *neonatal, dysphagia, swallowing problems, swallowing difficulties, feeding problems, feeding difficulties,* and *feeding issues.* The Boolean operations of AND, OR, and AND NOT were used in combination with the keywords mentioned. Further, search filter settings (see Appendix) were limited to subject areas of medicine, nursing, and health professions. Other disciplines, including engineering, chemistry, and social sciences were intentionally removed to maintain the relevance of the search. A complete list of omitted disciplines is mentioned in the Appendix. The document type was restricted to articles, reviews, and articles in press. Source type was limited to journals, and only those articles in the English language were considered.

The present study aimed to investigate changes in the research trends over the past 5 decades. An initial pilot study was carried out to determine the appropriate period to analyze the trends. When a time frame of 10 years was considered, and search queries were made, the results of this pilot study revealed very few articles. Hence, a minimum time frame of 3 decades was fixed to provide better insights and to get a broader perspective of research trends. Based on this, the time frames between 1970 to the present were divided into two. The first time period was considered to be between 1970 and 2000, whereas the second time period was considered to be between 2001 and 2018.

Information Extraction

Search results from the Scopus database were handled in two ways. First, the information on indexation data was imported into an excel sheet (.CSV format) and the text was transformed into columns. Only information pertaining to the title, journal, year of publication, and abstract was retained. Second, data with respect to title and abstract

from the last 5 decades (1970 to 2018) were imported into a text (.txt) file.

Handling of Data

The first aim of the study was to investigate the journal-wise distribution of research over the last 5 decades. Frequency tables were generated for journal data and published research in the area of neonatal dysphagia using SPSS, version 23.

The second aim of the study was to investigate the evolution of research trends in neonatal dysphagia. For this purpose, the text mining approach was utilized to identify and compare the predominant research themes in the last 5 decades. Data mining was carried out using K H Coder version 3, which is an open source software for computer-assisted qualitative data analysis, mainly quantitative content analysis and text mining. Based on the search operations described in the earlier section, the title and abstract data retrieved from the Scopus database as text (.txt) files were fed into K H Coder for further analyses, which are described below.

A co-occurrence network for words was generated for the title and abstract data. This method of analysis provides a graphical representation of the association between the words through connected lines. Closely associated themes are colour-coded with the size of each node representing the frequency of occurrence. Sentences were considered to be the unit of analyses, and the filter edge was set to 30 words. We also used hierarchical cluster analysis. This method of text analysis examines word combinations with similar appearance and groups them into patterns, which are represented in the form of a dendrogram. Both these methods allow for the transformation of text data into a visual representation based on the nature of words.

Results

Results are presented under the following headings to provide better insights into the publication and research trends across the first and the second time periods.

Amount of Published Research

From 1970 to 2018, 1819 research articles were published across various journals in the Scopus database.

For the first period (1970 to 2000), 395 published research articles were found in the Scopus database under the search term *neonatal dysphagia* and accounted for 21.7% of the total publications. A graphical representation of publication distribution over the first time period is depicted in **Figure 1**. For the second period (2001 to 2018),

1424 published research articles were found in the Scopus database and accounted for 78.3% of the total publications. A graphical representation of publication distribution over the second time period is depicted in **Figure 1**.

Journals That Published the Most Papers

From 1970 to 2000, more than 30 journals published research studies on neonatal dysphagia. A ranking based on number of research articles published was created, and the top five research journals publishing on neonatal dysphagia are presented in **Table 1**.

From 2001 to 2018, more than 50 journals published research articles on neonatal dysphagia. A ranking based on number of research articles published was created, and the top five research journals publishing on neonatal dysphagia are presented in **Table 2**.

Figure 1

Distribution of published research on neonatal dysphagia over the first and second time period. Number of publications per publication decade.
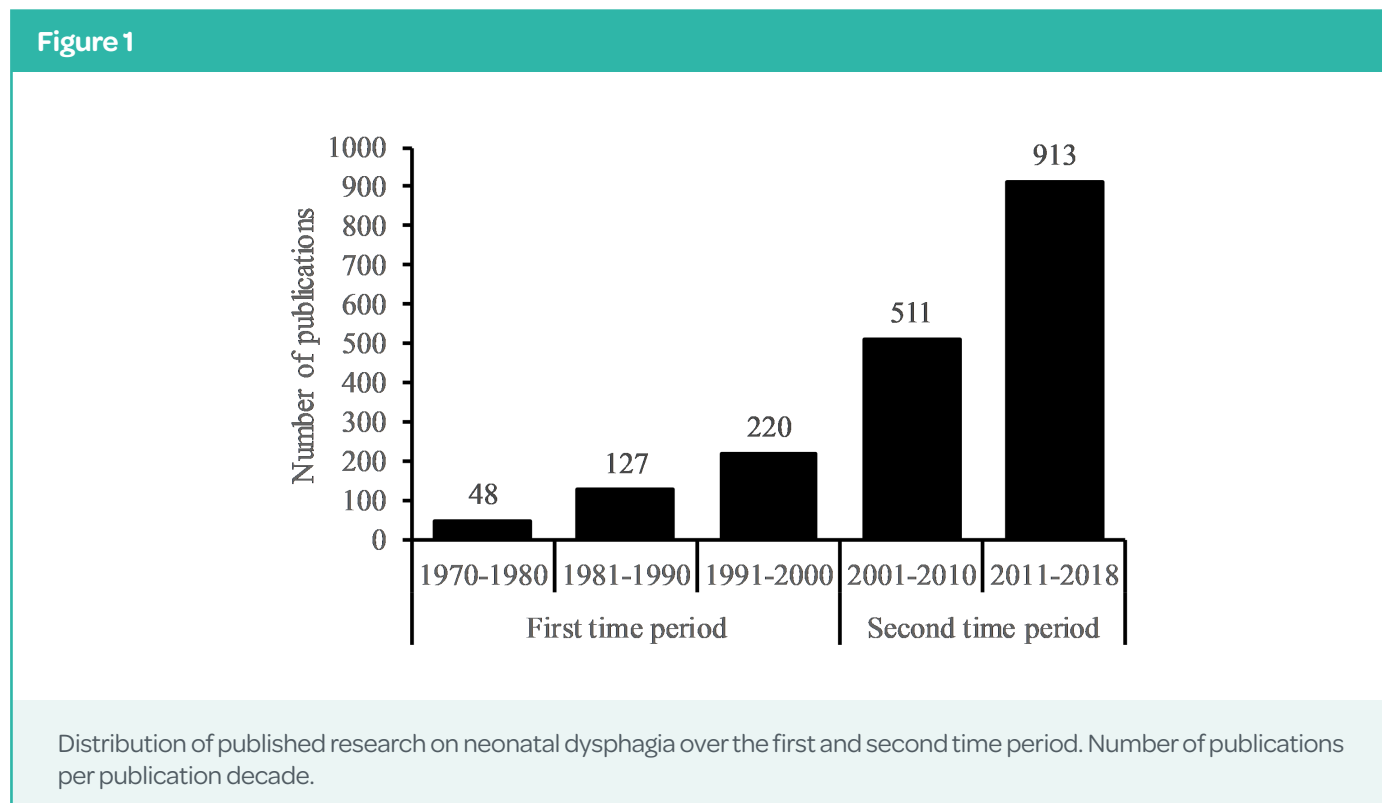
Table 1

Top Five Journals Publishing Research Articles on Neonatal Dysphagia During the First Time Period (1970–2000)

Rank	Journal	Number of publications	%
1.	Pediatrics	16	4.7
2.	American Journal of Medical Genetics	12	3.5
3.	Journal of Pediatric Surgery	11	3.2
4.	American Journal of Diseases of Children	8	2.3
5.	Journal of Obstetric, Gynecologic & Neonatal Nursing	7	2.1

Note. A total of 395 articles were published during the first time period.

Table 2

Top Five Journals Publishing Research Articles on Neonatal Dysphagia During the Second Time Period (2001–2018)

Rank	Journal	Number of publications	%
1.	Journal of Perinatology	29	2.8
2.	Advances in Neonatal Care	23	2.2
3.	American Journal of Medical Genetics Part A	23	2.2
4.	International Journal of Pediatric Otorhinolaryngology	20	1.9
5.	Pediatrics	20	1.9

Note. A total of 1424 articles were published during the second time period.

To know the specific contribution of the speech and hearing field to the study of neonatal dysphagia, we limited the search results to the *health professions* category, as speech and hearing is a subcategory within health professions in the Scopus database. A Scopus search within the subcategory of health professions for the terms mentioned earlier revealed just 24 research articles from 1984 to 2018. A ranked list of the top five journals publishing on neonatal dysphagia within the health professions category is presented in **Table 3**.

Most Frequently Researched Themes

To identify the most frequently researched themes, hierarchical cluster analysis and co-occurrence network analysis were used. These techniques examine the word combinations in the abstract and group them into patterns based on their association with each other while providing a graphical representation through connected lines. The hierarchical cluster analysis is a dendogram, whereas a co-occurrence network is a concentric representation of word association.

The hierarchical cluster analyses generated for the research data from 1970 until 2018 revealed six different groups, and the bars on the left-hand side of the dendrogram represent the term frequency of each word (see **Figure 2**). When these six groups were visually inspected, the highest frequency was observed for the term *infant*; hence this was considered to be the first group along with the associated words that are grouped under the same colour code. The term infant was frequently associated

Table 3

Top Five Journals Under the Health Profession Category That Published Research Articles on Neonatal Dysphagia During 1984 to 2018

Rank	Journal	Number of publications	%
1.	Dysphagia	9	37.5
2.	Seminars in Speech and Language	5	20.8
3.	International Journal of Speech-Language Pathology	2	8.3
4.	Physical & Occupational Therapy in Pediatrics	2	8.3
5.	Acta Radiologica	1	4.2

Note. A total of 24 articles were published under the health professions category between 1984 and 2018.

with *feeding* and *problems*. Moreover, these two words are in close association with the term infant. Thus, feeding problems in infants was the first theme.

The second group was identified by the next highest frequency of word occurrence. It was found that the term *neonatal* was the second frequently occurring word and was in close association with the terms *period, unit,* and *care*. Therefore, dysphagia among neonates in the neonatal intensive care unit was considered the second theme. The third cluster showed the most frequent word *patient*, which is in close proximity with terms like *treatment, management, diagnosis, clinical,* and *outcomes*. Hence, the third major theme was identified to be evaluation and management outcomes in neonatal dysphagia. The fourth cluster was comprised of *child* and *weight*, which are in close association with the terms *intervention* and *development*. This association of word combinations gives an impression that intervention among low birth weight neonates may be the fourth theme. The terms *risk, factor, mortality,* and *rate* constituted the fifth and the sixth cluster. Therefore, the fifth and sixth themes together can be considered risk factors associated with neonate mortality.

Our co-occurrence network (**Figure 3**) showed 35 of the most frequent words in published research data from 1970 until 2018. These words were grouped into colour-coded clusters with the connecting line representing the association among them. The first cluster (represented in light green) was identified as the most prominent node, representing the highest frequency words *infant* and *feeding*. Other terms including *problems, difficulty, neonate,* and *oral* revealed a strong association with the main terms *neonate/infant feeding problems*. The yellow community was considered the second node as it had a dual connection to the first community. The terms *diagnosis, management, clinical,* and *outcome* were very close to each other. The purple community was identified as the third node and included the terms *mortality*, *rate*, and *breastfeeding*, and was in single direct connection with the term *neonate*. This combination of words gave the impression that the central theme of this cluster may be feeding and swallowing factors associated with a high rate of mortality among neonates. The red community was considered the fourth node with terms like *unit, care,* and *health* indicating that the common theme may be dysphagia among neonates in intensive care units. The fifth community (blue) showed common appearing terms to be *disease* and *congenital*, which were connected to terms *respiration* and *feeding* through the term *severe*. This combination of words gave us the impression that the dominant theme of this community could be feeding

Figure 2

Hierarchical cluster analysis for title and abstracts from the published research data from 1970 to 2018.
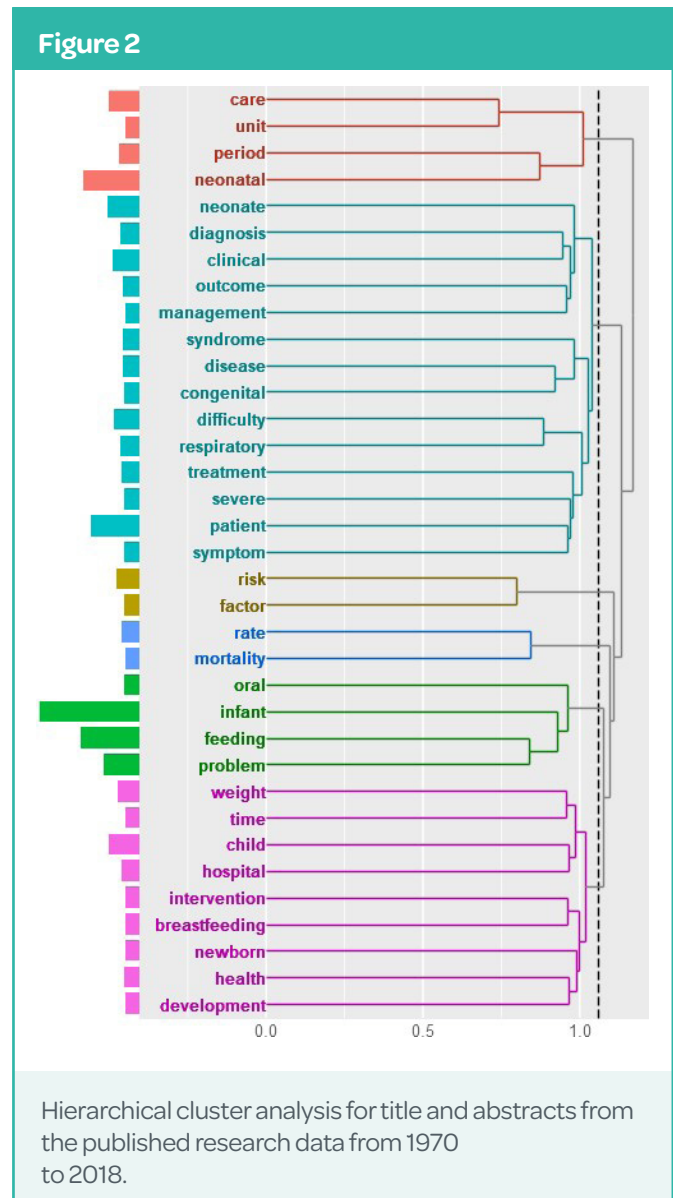
and respiratory problems among neonates with severe congenital anomalies.

Discussion

An inspection of the number of publications in the area of neonatal dysphagia revealed a definite increasing trend from 1970 to 2018. This shows the increased attention that the area of neonatal dysphagia has received over the last 5 decades. Even though the present study did not aim to compare the research outputs of adult and pediatric dysphagia, an earlier study by Krishnamurthy and Balasubramanium (2019) reported a higher number of research articles in the area of adult dysphagia. While there is increased attention in the area of neonatal dysphagia, the amount of articles is significantly lower than the adult dysphagia population.

Figure 3
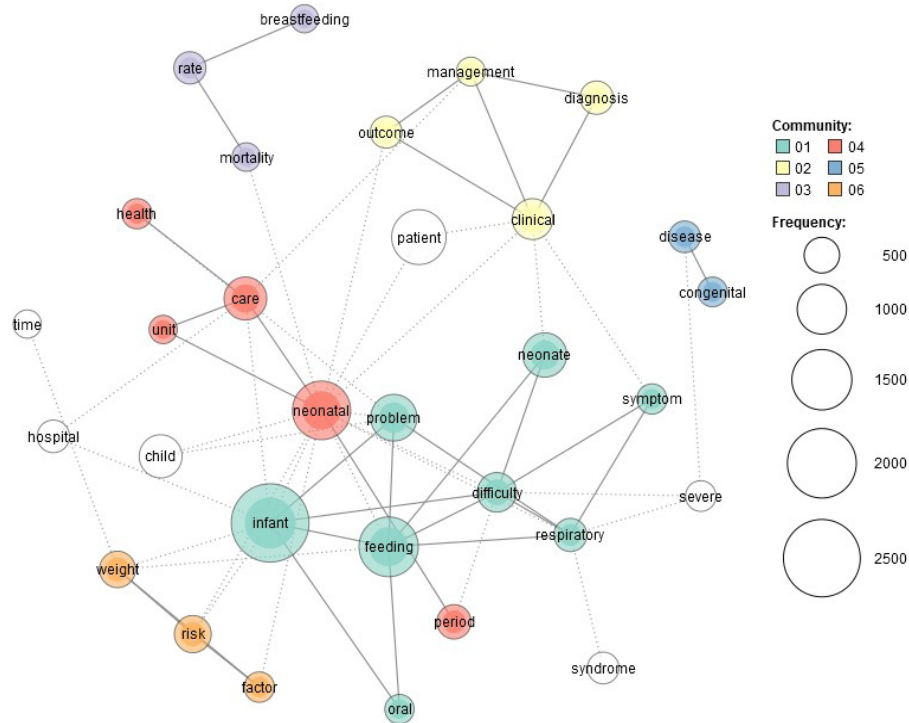
Co-occurrence network analysis for title and abstracts from the published research data from 1970 to 2018.

During the first time period examined in this study (i.e., 1970 to 2000), the journal *Pediatrics* published the most research articles, which accounted for 4.69% of total publications. For the second time period (i.e., 2001 to 2018), *Journal of Perinatology* published the most research articles, accounting for 2.78%. It can be observed from **Table 1** that most of the journals that published articles about neonatal dysphagia had a medical background, especially pediatric medicine and surgery. For the second time period, even though journals from pediatric medicine and surgery remained prominent, we observed other specialties, such as neonatology, nursing, and otorhinolaryngology, contributing a significant share. This trend can be interpreted as a paradigm shift in medical care from the first to the second time period. During the first period, pediatric medicine and surgery was the predominant profession to be involved in neonatal dysphagia; whereas for the second time period, a wide variety of professionals ranging from nurses to S-LPs to gastroenterologists could be seen involved in neonatal dysphagia research. Also, it is possible that the nature of the approach used towards patient care has evolved to be multi-disciplinary with various professionals serving patients' needs.

Hierarchical cluster analysis and co-occurrence network analysis examine word combinations with similar appearance and group them into patterns while providing a graphical representation of the association among the words through connected lines. The results of the present study revealed five important research themes in the area of neonatal dysphagia since 1970. These themes centred around feeding problems in neonates, clinical evaluation, and management, and a few studies focused on treatment outcomes. We believe this limited output may be due to two reasons that are described in-depth below.

First, there are naming differences within the S-LP field and terminologies used during dissemination. Often, *feeding* is used rather than *pediatric dysphagia* to indicate the array of swallowing difficulties exhibited by infants and children. Even though we have included the terms like *feeding*, the results from the present study signify a strong need for unification of terminologies to enhance dissemination. Despite the apparent increase in the number of research articles, due to the lack of unified terminology there exists fragmentation of research output for the scientific literature on neonatal/pediatric dysphagia. These factors may be responsible for clinicians

and researchers not looking in correct journals for these articles, and therefore, not obtaining this critical scientific literature. A possible solution to this issue could be the uniform implementation of the International Classification of Functioning, Disability, and Health (ICF) framework, developed by the World Health Organization (2001). Lefton-Greif and Arvedson (2007) suggested that the ICF framework may provide a common context for establishing a standardized language for describing and studying health and health-related domains. In relation to the trends revealed in the present study, there is a need for better sensitization and broader adoption of the ICF framework by clinicians and researchers. Uniform implementation of the ICF framework may help in developing and evaluating outcomes for interventions, predict health care delivery needs, and influence policies and allocation of essential resources towards the area of neonatal dysphagia.

Second, as shown in **Table 3**, there were only 24 research articles under the *speech and hearing* subcategory of the Scopus database. This low number may be because most S-LPs involved in neonatal intensive care units are predominantly practicing clinicians—not researchers—and time constraints hinder these S-LPs from playing an active role of clinician–researchers. In addition, it might be the case that speech and hearing journals are not prioritizing pediatric dysphagia articles resulting in fewer accepted manuscripts within this subcategory.

The cluster analysis and co-occurrence network consist of terms like *respiratory, congenital, syndrome, preterm, low birth weight,* and all these terms are in close association with the term *feeding*. This combination of terms suggests that existing studies have focused on feeding/swallowing problems commonly occurring in settings of medical, health, and developmental conditions. However, terms like *randomized control trials*, which indicate high-quality research studies, did not appear among our co-occurrence network analysis or hierarchical cluster analysis. This finding suggests that there may be fewer or no randomized control trial studies in the area of neonatal dysphagia. Evidence-based practices in pediatric/neonatal dysphagia have not kept pace with the recognition of these problems. High-quality investigations are needed to identify the best clinical practices for optimal outcomes in this population.

The findings of the present study also revealed that several disciplines, such as nursing, neonatology, pediatrics, and speech language pathology, are emerging to be involved in the practice of neonatal dysphagia; this calls for an emphasis on interprofessional education among practicing S-LPs. Introducing interprofessional education as part of the graduate curriculum would prepare future S-LPs to function

as full members of interprofessional collaborative practice and demonstrate the added value contributed by S-LPs. Current practices in the evaluation and management of pediatric/neonatal dysphagia may immensely benefit from the interprofessional collaborative practice.

Limitations and Future Directions

The present study is a preliminary report that summarizes the research in pediatric dysphagia from 1970 to 2018. The authors limited their search only to the Scopus database; further studies could include databases such as PubMed and Web of Science. Even though the present authors have rigorously and carefully examined the articles before their inclusion in the study, a selection bias may persist. The discipline of dentistry was omitted and can be considered a drawback. Some of the reported topics can appear out of its original context and may induce interpretation errors. Further research should consider stringent selection criteria using the same methodology. A similar methodology could be used to investigate the funding trends for pediatric/neonatal dysphagia using the National Institutes of Health reporter. It would be interesting to investigate if these trends carry over for research funding support.

Conclusions

The present study summarizes the research that has been carried out from 1970 to 2018 in the area of neonatal dysphagia using the text-mining technique. Findings emphasize the need for unification of terminologies, wider adaptation of the ICF framework, and interprofessional education. There is a pressing need for evidence-based practice in the area of neonatal dysphagia. It is essential that we become proactive in both clinical practice and research domains as we lay a foundation for S-LPs' involvement with neonates and infants who have a wide range of feeding and swallowing difficulties.

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Disclosures

No conflicts of interest, financial or otherwise, are declared by the authors.

Development and Preliminary Application of a Caregiver Directed Questionnaire to Identify Feeding–Swallowing Difficulties in Young Children

Développement et application préliminaire d'un questionnaire parental pour identifier les difficultés d'alimentation-déglutition de jeunes enfants

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Abstract

The present clinical focus article was designed to explain the development and preliminary application of a questionnaire to query parents/caregivers about the feeding–swallowing difficulties of their children. The overall goal of this questionnaire is to provide a tool for the identification of feeding–swallowing difficulties we found retrospectively to be associated with developmental language disorders (Malas, Trudeau, Chagnon, & McFarland, 2015; Malas et al., 2017), which might eventually aid in early diagnosis and intervention for these disorders. Our working hypotheses were that the questionnaire would provide a useful/feasible method to query for feeding–swallowing difficulties and that specific indicators of feeding–swallowing difficulties would occur more frequently in our all comers and developmental language-disordered samples. The questionnaire contains 30 Likert-type questions querying for indicators of feeding–swallowing difficulties from the four general categories of difficulties in sucking, food transition difficulties, food selectivity, and salivary control issues. We sent it to parents from an all comers population and to parents from a smaller sample of children with developmental language disorders; 97 and 9 questionnaires were analysed from these two samples, respectively. Preliminary results suggest that the questionnaire might be a useful tool in identifying feeding–swallowing difficulties via parent-directed questions in young children and that indicators of the general categories of difficulties in sucking and food selectivity were the most frequently observed in both samples. Ongoing work in our lab is directed at the refinement and further validation of the tool to increase its utility in identifying feeding–swallowing difficulties in children with later occurring developmental language disorders.

Abrégé

Le présent article clinique a été conçu pour rapporter/décrire le développement et l'application préliminaire d'un questionnaire parental recueillant des informations sur les difficultés d'alimentation-déglutition de jeunes enfants. L'objectif général de ce questionnaire est de fournir un outil permettant l'identification de difficultés d'alimentation-déglutition ayant été montrées comme étant rétrospectivement associées au trouble développemental du langage (Malas, Trudeau, Chagnon et McFarland, 2015; Malas et al., 2017), ce qui pourrait éventuellement aider à l'identification et l'intervention précoce auprès des enfants atteints de ce trouble. Nos hypothèses étaient que le questionnaire serait une méthode utile/faisable pour recueillir des informations sur les difficultés d'alimentation-déglutition et que des indicateurs spécifiques de difficultés d'alimentation-déglutition apparaîtraient comme plus fréquents dans nos échantillons d'enfants tout-venant et ayant un trouble développemental du langage. Le questionnaire contient 30 questions recueillant des informations à propos d'indicateurs de difficultés d'alimentation-déglutition provenant de quatre catégories générales : difficultés de succion, difficultés de transition vers les solides, sélectivité alimentaire et difficultés de contrôle salivaire. Nous l'avons envoyé à des parents d'une population d'enfants tout-venant et d'un petit échantillon d'enfants ayant un trouble développemental du langage. Les réponses de 97 et 9 questionnaires, provenant respectivement de ces deux échantillons, ont été analysées. Les résultats préliminaires suggèrent que le questionnaire pourrait s'avérer un outil utile pour identifier les difficultés d'alimentation-déglutition de jeunes enfants, et ce, directement auprès de leurs parents. Les résultats suggèrent également que des indicateurs de difficultés de succion et de sélectivité alimentaire étaient les plus fréquents dans les deux échantillons. Les projets de recherche actuels de notre laboratoire sont dirigés vers le raffinement et la poursuite des travaux de validation de cet outil afin d'augmenter son utilité dans le processus d'identification des difficultés d'alimentation-déglutition des enfants ayant un trouble développemental du langage.

A long-standing research interest in our laboratory has been to examine potential relationships between feeding–swallowing and speech-language behaviours in both children and adults (i.e., Lapointe & McFarland, 2004; Malas, Trudeau, Chagnon, & McFarland, 2015; Malas et al., 2017; McFarland & Tremblay, 2006). This work is intended to expand our theoretical understanding of interactions between these seemingly diverse behaviours but also, and of potential relevance to the current study, to eventually improve the clinical services offered to patients with underlying pathologies or neurological injuries impacting feeding–swallowing and speech-language (e.g., Flowers, Silver, Fang, Rochon, & Martino, 2013; Martin & Corlew, 1990; Stipancic, Borders, Brates, & Thibeault, 2019).

We recently focused our experimental attention on how feeding–swallowing difficulties might characterize children with developmental language disorders (i.e., Malas et al., 2015, 2017). We carried out two retrospective case-file analyses to quantify and characterize prior history of feeding–swallowing difficulties in children with language disorders without other co-occurring neurodevelopmental deficits or history of prematurity. Specific indicators of feeding–swallowing difficulties from the four general categories of difficulties in sucking, food transition difficulties, food selectivity, and salivary control issues were selected based on clinical experience and previous literature (e.g., Adams-Chapman, Bann, Vaucher, & Stoll, 2013; Delaney & Arvedson, 2008; Lindberg, Bohlin, & Hagekull, 1991; Motion, Northstone, Emond, Stucke, & Golding, 2002). Results revealed that children with developmental language disorders had significantly higher percentages of history of feeding–swallowing difficulties when compared to the general population estimate of Lindberg et al. (1991). Indicators of food transition difficulties (e.g., late or difficult introduction of solids, increased mealtime duration, poor or reduced appetite, choking, difficulty in oral or pharyngeal phase of swallowing) and food selectivity (e.g., food rigidity, food refusal) were the most frequently occurring in the samples of children with developmental language disorders in these previous studies.

These retrospective data indicated a potential developmental relationship between feeding–swallowing and language competence. It is clear that feeding–swallowing and speech-language production share a common anatomy (McFarland, 2016; McFarland & Tremblay, 2006), and we have previously hypothesized that co-occurrence of difficulties in these seemingly diverse behaviours may result from underlying deficits and distributed effects across feeding–swallowing and

speech-language systems (Hill, 2001; McFarland & Tremblay, 2006; Nip, Green, & Marx, 2011). We also hypothesized that mealtimes are important learning contexts for speech and language (Zimmerman, Connaghan, Hoover, Alu, & Peters, 2019) and that the presence of feeding–swallowing difficulties—and/or parental frustration related to these difficulties (Faith, Storey, Kral, & Pietrobelli, 2008)—may disrupt caregiver–infant interactions and language stimulation during feeding (Harding, Wade, & Harrison, 2013).

During the course of these previous studies, it became apparent that we needed a method to directly query caregivers about the feeding–swallowing abilities of their children to supplement case-files and/or to prospectively assess feeding–swallowing progression. We set about, therefore, to develop a parent-directed questionnaire using the rigorous procedures detailed in Streiner and Norman (2008).

A parent-directed questionnaire was selected for several reasons. First, parents are reliable sources of information about their children's feeding–swallowing (Bortolus et al., 2002) and they are sensitive to feeding–swallowing difficulties (Barkmeier-Kraemer et al., 2017). Further, home-based, as contrasted to laboratory-based, judgments have been shown to provide ecologically valid indicators of feeding–swallowing difficulties (Sanchez, Spittle, Allinson, & Morgan, 2015). Lastly, a parent-directed questionnaire may eventually provide an efficient and economical tool for identification and referral of children for further assessments of both feeding–swallowing difficulties and speech-language difficulties (Bricker & Squires, 1989; Centre Hospitalier Universitaire Sainte-Justine, 2017; Sanchez et al., 2015; Thoyre et al., 2014), one of our ultimate goals in this line of research.

Although there are several standardized and non-standardized parental questionnaires to document feeding–swallowing abilities in children (e.g., Arts-Rodas & Benoit, 1998; Barkmeier-Kraemer et al., 2017; da Costa, van den Engel-Hoek, & Bos, 2008; de Lauzon-Guillain et al., 2012; Howe, Lin, Fu, Su, & Hsieh, 2008; Jaafar, Othman, Majid, Harith, & Zabidi-Hussin, 2019; Ramsay, Martel, Porporino, & Zygmuntowicz, 2011; Sanchez et al., 2015; Seiverling, Hendy, & Williams, 2011; Thoyre et al., 2014), none met our experimental/clinical needs of highlighting *feeding–swallowing difficulties* occurring between birth and 2 years of age by sampling all indicators we found retrospectively to be associated with developmental language disorders (Malas et al., 2015, 2017). For example, several of the existing questionnaires primarily aimed at distinguishing children with and without *feeding–swallowing disorders* (e.g., the

Behavioral Pediatrics Feeding Assessment Scale by Crist & Napier-Phillips, 2001; the Montreal Children's Hospital Feeding Scale by Ramsay et al., 2011; and the Pediatric Eating Assessment Tool by Thoyre et al., 2014) and would not have been useful to characterize early feeding–swallowing difficulties that would be less clinically apparent. Other questionnaires query parents only about difficulties with breast- or bottle-feeding (e.g., the Baby Eating Behavior Questionnaire by Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2011; the Infant Breastfeeding Assessment Tool by Matthews, 1988) and thus would not have provided the more complete profile of feeding–swallowing difficulties we needed.

We therefore embarked on the development of a new parent-directed questionnaire to identify the presence of feeding–swallowing difficulties in children between birth and 2 years of age. It should be emphasized that the goal of this questionnaire *is not the clinical identification of feeding–swallowing disorders,* but rather the presence of more subtly represented *feeding–swallowing difficulties* that have been shown previously to be associated with developmental language disorders (Malas et al., 2015, 2017). Based on the consensus statement provided in Goday et al. (2019), pediatric feeding disorders can be defined as age inappropriate impairments in oral intake that have significant medical, nutritional, and/or psychosocial consequences to an infant's health and well-being. This is in contrast with difficulties, that are usually clinically subthreshold, often signalled by parents, and typically without serious medical or nutritional consequences.

The goals of the present clinical focus article, therefore, were (a) to explain the development of the questionnaire and (b) to provide preliminary retrospective data on its application with children from an all comers sample and children with developmental language disorders. In terms of the second objective, we were specifically interested in determining the feasibility of the questionnaire to sample early feeding–swallowing difficulties and to highlight the characteristics of those feeding–swallowing difficulties in our all comers and developmental language-disordered samples.

These objectives led to the following working hypotheses: (a) the parent-directed questionnaire will be a feasible method, as measured by rate of return of parental responses and rate of missing responses, and (b) specific indicators of feeding–swallowing difficulties will emerge as more frequently occurring in our all comers and developmental language-disordered samples. In terms of this last experimental objective, we are eventually interested in not only providing a more complete profile of feeding–swallowing difficulties as provided by the questionnaire, but also in determining the "quickest" clinical route for identifying feeding–swallowing difficulties that may eventually provide clinical indicators of later developmental language disorders.

Method

All experimental procedures were approved by the research ethics board of the Centre Hospitalier Universitaire Sainte-Justine (file number: 3786).

Feeding–Swallowing Questionnaire

As explained above, no previously published questionnaires met our research needs. We therefore developed and content-validated a series of parent-directed questions in French to sample indicators of the four categories of feeding–swallowing difficulties used in our previous studies (i.e., Malas et al., 2015, 2017) and by applying the guidelines for creation of health measurement scales outlined in Streiner and Norman (2008). As illustrated in **Figure 1**, this process involved (1) the determination of experimental/clinical needs, (2) a thorough appraisal of existing feeding–swallowing questionnaires, (3) rigorous question development, (4) content validation by the research team, (5) content validation by a clinician/professor expert not familiar with research objectives and method, and (6) content validation by three elementary school teachers and three parents of young children not familiar with the research study to ensure that the questions selected and the language used were appropriate to our research objectives, free from jargon, and at a level that was comprehensible to French-speaking parents with at least a Grade 6 reading level.

The questionnaire in its current form consists of 30 Likert-type questions querying indicators of feeding–swallowing difficulties occurring between birth and 2 years of age that can be grouped into general categories of difficulties in sucking, food transition, food selectivity, and salivary control difficulties (Malas et al., 2015, 2017) and 3 Likert-type questions assessing food appreciation, general mealtime behaviours, and parental concerns. A 5-point Likert scale from 1 (*very rarely, not at all*) to 5 (*very often, absolutely*) was used to provide a range of responses (Streiner & Norman, 2008), and as suggested by Streiner and Norman (2008), we used an inverted response scale for 11 of the questions distributed randomly to discourage "yea-saying" biases. We also included two open-ended questions asking parents whether they observed other feeding–swallowing difficulties in their child, and/or whether they had additional comments to share about their child's feeding between birth and 2 years of age. The entire

Figure 1

Phase 1: Experimental/Clinical Needs Assessment of a Parent-based Questionnaire to Identify Feeding-Swallowing Difficulties in Young Children
To meet the demands of an upcoming prospective research project on the relationship of feeding-swallowing difficulties to developmental language disorders.

Phase 2: Review of the Existing Feeding-Swallowing Questionnaires
Identification and appraisal of the parental questionnaires published in French or English at the time of the development of the questionnaire.

Phase 3: Question Development
Development of a preliminary list of questions to cover evidence-based indicators of feeding-swallowing difficulties shown previously to be associated with developmental language disorders in our previous retrospective work (Malas, Trudeau, Chagnon, & McFarland, 2015; Malas et al., 2017) and others.

Phase 4: Content Validation by the Research Team (i.e., two Clinicians/Professors, two Graduate Students and a Speech-Language Pathologist)
Group discussion to assess the clarity and relevance of the questions for our research objectives.

Phase 5: Content Validation by a Clinician/Professor Expert not Familiar With the Research Study
Individual interview to assess the relevance of the questions for our research objectives.

Phase 6: Assessment by 3 Elementary School Teachers and 3 Parents of Young Children
Individual interviews to assess the clarity and ease of comprehension of the questions for a target level of education of 6th grade.

Phase 7: Final Preliminary Version
Production of the final preliminary version of the questionnaire with 33 Likert-type questions (30 were analyzed in the current report) and two open-ended questions. The estimated time of completion is under 15 minutes.

Flowchart of the process used to develop the feeding–swallowing questionnaire based on the guidelines for creation of health measurement scales outlined in Streiner and Norman (2008).

questionnaire takes parents approximately 15 minutes to complete. For the purposes of the present report, we focus only on the responses to the 30 questions of specific indicators presented in **Table 1**. It is important to note that the questionnaire was developed and tested in French as it is the language used in the authors' research and clinical environment, and the English translation is provided as a convenience for the non-French-speaking readership.

Participants

Parents of children from the all comers sample. We advertised the study in preschools identified through the childcare establishment locator website of the Gouvernement du Québec (https://www.mfa.gouv.qc.ca/fr/services-de-garde/parents/localisateur/Pages/

index_en.aspx) and other places frequented by parents with young children and among the family and the social network of the research team. We targeted children from 2 to 7 years of age to be consistent with the age range used in our previous publications (i.e., Malas et al., 2015, 2017). Based on this outreach, 125 questionnaires and self-addressed stamped return envelopes were sent to parents that expressed interest. Given that one of the eventual goals of our research is to "detect" feeding–swallowing difficulties that may signal later language disorders in the general population, no attempt was made to screen for birth status (e.g., premature), neurodevelopmental or language development of the children, nor their socioeconomic nor health status. It should be emphasized, therefore, that it is highly likely that this questionnaire was directed to parents

Table 1		
Feeding–Swallowing Questions		
	Original French Question	**English Translation**
Questions querying for indicators of difficulties in sucking		
Introductory statement:	*En général, lors de l'allaitement ou du boire au biberon...*	[In general, during breast- or bottle-feeding...]
Question 1:	*Mon enfant prenait le sein ou la tétine du biberon correctement.*	[My child correctly latched on to the breast or nipple.]
Question 2:	*La succion (tétée) de mon enfant était forte.*	[My child had a strong suck.]
Question 3:	*Pendant un boire, la succion (tétée) de mon enfant était constante.*	[My child's sucking was constant during a feed.]
Question 4:	*Mon enfant vomissait ou régurgitait (par la bouche ou par le nez).*	[My child vomited or regurgitated (through the mouth or nose).]
Question 5:	*Mon enfant s'étouffait.*	[My child choked.]
Question 6:	*Mon enfant avalait facilement.*	[My child swallowed easily.]
Question 7:	*Mon enfant terminait un boire dans un temps raisonnable.*	[My child finished a feed within a reasonable time.]
Question 8:	*Mon enfant avait de la facilité à compléter un boire.*	[My child finished a feed easily.]
Question 9:	*Mon enfant avait un bon appétit.*	[My child had a good appetite.]
Question 10:	*Le poids de mon enfant était trop faible pour son âge, ou son poids diminuait.*	[My child was low weight for his/her age or his/her weight was diminishing.]
Questions querying for indicators of food transition difficulties		
Introductory statement	*En général, lors d'un repas (purées ou aliments solides)...*	[In general, during mealtime (purees or solid foods)...]
Question 11:	*L'introduction des purées a été difficile.*	[Introduction of purees was difficult.]
Question 12:	*L'introduction des aliments en morceaux a été difficile.*	[Introduction of pieces of food was difficult.]
Question 13:	*Mon enfant vomissait ou régurgitait (par la bouche ou par le nez).*	[My child vomited or regurgitated (through the mouth or nose).]
Question 14:	*Mon enfant avait des nausées (« haut-le-cœur »).*	[My child gagged.]
Question 15:	*Mon enfant s'étouffait.*	[My child choked.]
Question 16:	*Mon enfant avait de la difficulté à mastiquer (mâcher) les aliments.*	[My child had difficulties masticating (chewing).]
Question 17:	*Mon enfant avalait tout rond, sans bien mastiquer (mâcher).*	[My child swallowed food whole without chewing well.]
Question 18:	*Mon enfant gardait de la nourriture ou des liquides dans sa bouche sans avaler (pendant plus de 5 secondes).*	[My child held food or liquids in his/her mouth prior to swallowing (more than 5 seconds).]

Question 19:	*Mon enfant mangeait trop lentement.*	[My child was eating too slowly.]
Question 20:	*Mon enfant avait un bon appétit.*	[My child had a good appetite.]
Question 21:	*Mon enfant mangeait comme les autres enfants de son âge.*	[My child was eating like other child his/her age.]
Question 22:	*Le poids de mon enfant était trop faible pour son âge, ou son poids diminuait.*	[My child was low weight for his/her age or his/her weight was diminishing.]

Questions querying for indicators of food selectivity

Introductory statement:	*En général, lors d'un repas...*	[In general, during mealtime...]
Question 23:	*Mon enfant était difficile (concernant ses goûts alimentaires).*	[My child was a picky eater.]
Question 24:	*Mon enfant était sensible à la température ou à la texture des aliments.*	[My child was sensitive to food temperature or texture.]
Question 25:	*Mon enfant mangeait seulement des aliments en purée ou hachés.*	[My child only ate pureed or ground food.]
Question 26:	*Mon enfant refusait de goûter à des nouveaux aliments.*	[My child refused to taste new food.]
Question 27:	*Mon enfant recrachait de la nourriture.*	[My child spit up food.]

Questions querying for indicators of salivary control issues

Introductory statement:	*En général...*	[In general...]
Question 28:	*De la salive s'écoulait à l'extérieur de la bouche de mon enfant.*	[My child drooled.]
Question 29:	*Mon enfant avait beaucoup de salive dans sa bouche.*	[My child had a lot of saliva in his/her mouth.]
Question 30:	*Mon enfant avait de la difficulté à contrôler sa salive.*	[My child had difficulty controlling his/her saliva.]

Note. Parental responses to questions 1 to 9, 13 to 20, and 26 to 30 were collected using a Likert response scale ranging from 1 (*très rarement* [very rarely]) to 5 (*très souvent* [very often]), and parental responses to questions 10 to 12 and 21 to 25 were collected using a Likert response scale ranging from 1 (*pas du tout* [not at all]) to 5 (*tout à fait* [absolutely]). An inverted response scale was used for questions 1 to 3, 6 to 9, 20, and 21.

of children that had feeding–swallowing difficulties and/or current or future speech-language difficulties given current population estimates (Lindberg et al., 1991; Tomblin et al., 1997). Of these 125 questionnaires, 106 were completed and returned. From this base, we excluded nine questionnaires because parents reported their child's age as outside of the target range. The demographics of the 97 remaining children are provided in **Table 2**. These children ranged from 2 years 0 months to 6 years 11 months (M_{age} = 3;11, *SD* = 1;4) at the time the caregivers completed the questionnaires.

Parents of children with developmental language disorders. These participants were recruited from the

medical files of the 131 children seen between April 2011 and March 2012 for a suspicion of a language disorder in the outpatient speech-language pathology clinic of the Centre Hospitalier Universitaire Sainte-Justine, a large Montréal-based pediatric hospital. These 131 medical files went through an initial screening to eliminate children with cognitive, sensory, visual, hearing, or motor impairments or global developmental delay (*n* = 8); epilepsy, neurological, or genetic problems (*n* = 4); autistic spectrum disorders or other pervasive developmental deficit (*n* = 7); oral or craniofacial abnormalities (*n* = 2); childhood apraxia of speech (*n* = 35); and prematurity (*n* = 11). Questionnaires and self-addressed stamped return envelopes were sent

to the parents of the remaining 64 children and 23 were returned.

A second round of screening removed from further consideration questionnaires from children with acquired

cerebral lesion (*n* = 1) or stuttering (*n* = 1) and normal (*n* = 7) or delayed language (*n* = 5). This resulted in a small sample of nine questionnaires from parents of children that received a clinical diagnosis of receptive and/or expressive developmental language disorders (see Malas et al., 2017, for

Table 2

Demographics of Participants

	AC sample (*n* = 97) *n* (%)	DLD sample (*n* = 9) *n* (%)
Person(s) that completed the questionnaire		
Mother	89 (92)	8 (89)
Father	4 (4)	1 (11)
Both parents	3 (3)	0 (0)
Mother and sister	1 (1)	0 (0)
Child's gender		
Male	47 (48)	6 (67)
Female	50 (52)	3 (33)
Premature birth (< 37 weeks)		
Yes	10 (10)	0 (0)
Adoption		
Adopted child	2 (2)	1 (11)
Family size		
1 child	12 (12)	0 (0)
2 or more children	85 (88)	9 (100)
Birth order		
First	57 (59)	6 (67)
Other(s)	40 (41)	3 (33)
Children speaking		
One language	86 (89)	6 (67)
Two or more languages	11 (11)	3 (33)
Children understanding		
One language	81 (84)	4 (44)
Two or more languages	16 (16)	5 (56)
Best spoken and understood language(s)		
French	95 (98)	7 (78)
English	2 (2)	0 (0)
French and English	0 (0)	2 (22)

Note. AC = all comers; DLD = developmental language disorder.

a detailed explanation of language assessment procedures used at the Centre Hospitalier Universitaire Sainte-Justine in 2011–2012) and who ranged in age from 6 years 10 months to 9 years 1 month at the time of the completion of the questionnaires (M_{age} = 7;11, SD = 0;10). Note that although the average age of the children in this sample is higher than the all comers sample, no comparisons are made between these two groups. The demographic and language characteristics of these children are presented in **Tables 2 and 3**, respectively.

Analyses

As stated previously, parental responses to the 30 questions querying feeding–swallowing difficulties were collected using a Likert scale ranging from 1 (*very rarely, not at all*) to 5 (*very often, absolutely*). These responses were gathered in an Excel file and the scores from the inverted scale questions converted back to the non-inverted scale.

Feasibility.

Percentage of returned questionnaires. As a first indicator of feasibility of the questionnaire, we calculated individually for both samples the percentage of completed questionnaires that were returned. Based on published guidelines (i.e., Streiner & Norman, 2008) and results from previous studies that have used the percentage of returned questionnaires as an indicator of feasibility (e.g., Seid, Sobo, Gelhard, & Varni, 2004; Troude, Squires, Foix L'Hélias, Bouyer, & de La Rochebrochard, 2011), we operationally defined a high response rate as 80% or more.

Percentage of missing responses. As a second indicator of feasibility of the questionnaire, we calculated for both samples the number of responses that were left blank, and this was converted to a percentage of the total number of possible responses. Based on published guidelines (i.e., Streiner & Norman, 2008) and previous studies that have used percentages of missing responses as an indicator of feasibility (e.g., Bouwmans et al., 2013; Seid et al., 2004), we operationally defined a low rate of missing responses as 5% or less.

Characterizing parental responses to the questionnaire. In order to address our second experimental objective and to determine whether specific indicators of

Table 3				
Language Characteristics and Diagnosis of DLD				
	Age of diagnosis of DLD (Years;Months)	Expressive (E) and/or receptive (R) language difficulties	Presence of standardized testing contributing to the DLD diagnosis (Percentile)*	
1	3;7	E & R	Yes:	ÉVIP (6)
2	4;10	E & R	Yes:	ÉVIP (32), EOWPVT-R (1)
3	4;3	E & R	Yes:	ÉVIP (47), CELF-BC (16)
4	5;2	E & R	Yes:	ÉVIP (4)
5	4;8	E & R	Yes:	ÉVIP (45)
6	3;11	E	No	
7	4;7	E & R	Yes:	ÉVIP (8), CELF-CFD (9), CELF-NR (9)
8	5;9	E & R	Yes:	CELF-CFD (1), CELF-SS (2), EOWPVT-R (6)
9	5;2	E	No	

Note. *Cut-offs used when standardized testing contributed to the DLD diagnosis: ÉVIP = 50th percentile (Elin Thordardottir et al., 2011); Clinical Evaluation of Language Fundamentals [CELF]–Canadian French version (all subtests) = 16th percentile (Elin Thordardottir et al., 2011); EOWPVT-R = 16th percentile (Groupe coopératif en orthophonie–Région Laval, Laurentides, Lanaudière, 1995). CELF-BC = basic concepts; CELF-CFD = concepts and following directions; CELF-NR = number repetition; CELF-SS = sentence structure; DLD = developmental language disorder; EOWPTV-R = Expressive One-Word Picture Vocabulary Test-Revised; ÉVIP = Échelle de vocabulaire en image Peabody [French version of Peabody Picture Vocabulary Test].

feeding–swallowing difficulties emerged as more frequently occurring in our two samples, we compared the individual responses to questions in our two samples. Recall that each question queried for a specific indicator of feeding–swallowing difficulty (see Method above). A question was judged to be indicative of a feeding–swallowing difficulty if the parental response on the 5-point Likert scale was 4 or above. A similar cut-off has been used in the past for identifying and characterizing questionnaire-based feeding–swallowing difficulties in samples of children from the general population and with neurodevelopmental disorders (e.g., Hubbard, Anderson, Curtin, Must, & Bandini, 2014; Schmitt, Heiss, & Campbell, 2008; Toyama & Agras, 2016).

In order to determine which indicators of feeding–swallowing difficulties emerged as most frequently occurring in our all comers and developmental language-disordered samples, we identified those questions with the highest percentage of parental responses exceeding the Likert-scale cut-off. No attempt was made to statistically compare the data between our two samples given (a) the large differences in age of the children, (b) the large differences in sample size, (c) the fact that the samples were collected under very different experimental conditions, and (d) it was not an experimental goal of the current work.

Results

Percentages of Returned Questionnaires and Missing Responses

All comers sample. As mentioned, 106 of the 125

questionnaires sent to parents of children from the all comers sample before additional exclusion criteria were applied were returned. This gave rise to an overall returned questionnaire rate of 85%. Of the 2910 possible responses on the questionnaire (97 questionnaires multiplied by 30 questions per questionnaire), only six were left blank which gave rise to a missing response rate of less than 1%. There was also one questionnaire in which the parent indicated two responses for three single questions. These responses were eliminated from further consideration.

Sample of children with developmental language disorders. As mentioned, 23 of the 64 questionnaires sent to the parents of children before additional screening was applied were returned. This gave rise to an overall returned questionnaire rate of 36%. Of the 270 possible responses on the questionnaire (9 questionnaires multiplied by 30 questions per questionnaire), none were left blank. This gave rise to a missing response rate of 0%.

Characterizing Parental Response to the Questionnaire

Presented in **Figures 2 and 3** are the percentages of above cut-off responses per question for the all comers and developmental language-disordered samples, respectively. Data are colour coded to represent the general categories of the feeding–swallowing difficulties that are queried by the specific questions/indicators.

As illustrated in **Figure 2**, for the all comers sample the three questions with the highest percentages of above cut-off responses were Questions 8 (29%), 4 (26%), and 24 (20%). Questions 4 and 8 queried for sucking difficulties,
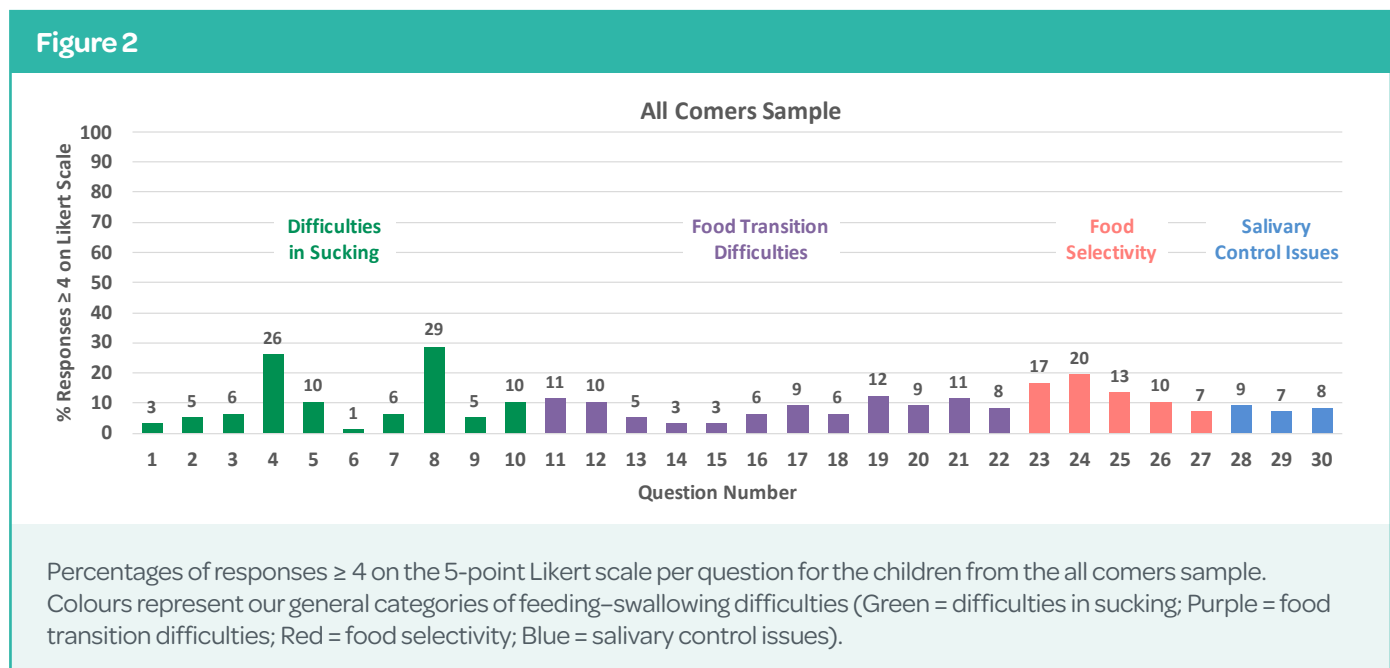

Figure 2

All Comers Sample

Percentages of responses ≥ 4 on the 5-point Likert scale per question for the children from the all comers sample. Colours represent our general categories of feeding–swallowing difficulties (Green = difficulties in sucking; Purple = food transition difficulties; Red = food selectivity; Blue = salivary control issues).

Figure 3

Percentages of responses ≥ 4 on the 5-point Likert scale per question for the sample of children with developmental language disorders. Colours represent our general categories of feeding–swallowing difficulties (Green = difficulties in sucking; Purple = food transition difficulties; Red = food selectivity; Blue = salivary control issues).
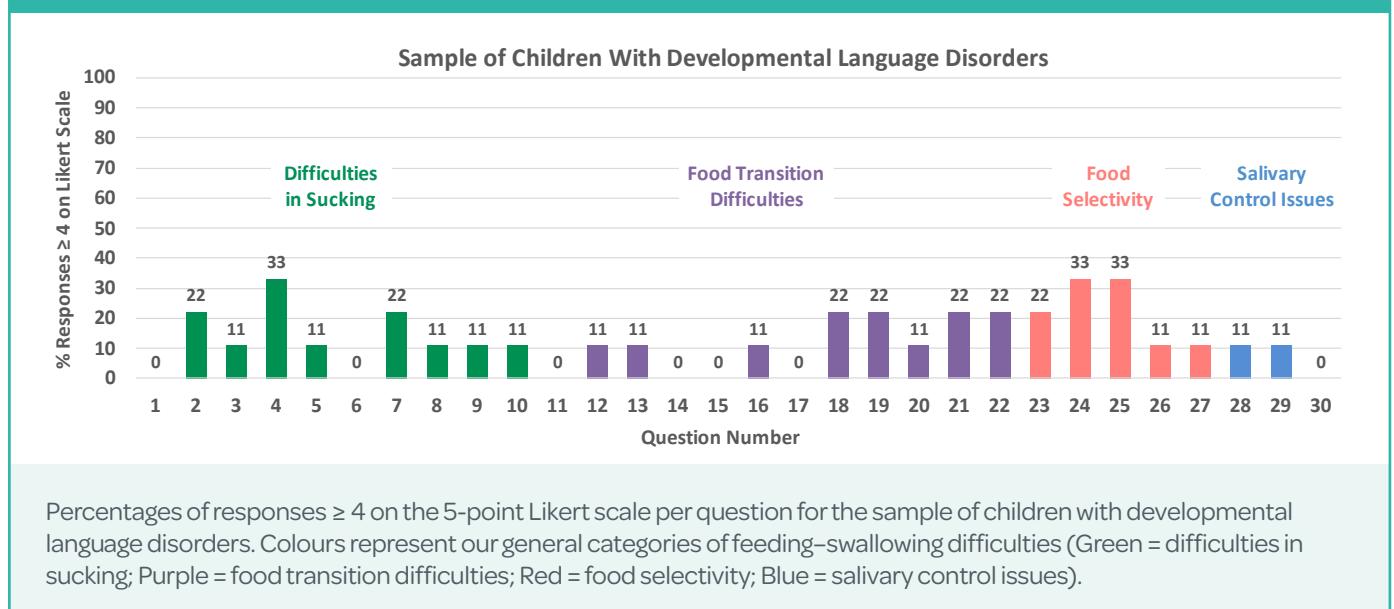
while Question 24 queried for food selectivity difficulties. As illustrated in **Figure 3**, for the sample of children with developmental language disorders the three questions with the highest percentages of responses above cut-off were Questions 4 (33%), 24 (33%), and 25 (33%). Question 4 queried sucking difficulties, and Questions 24 and 25, food selectivity.

Discussion

The present work was designed to explore the potential utility of a parent-directed questionnaire to sample feeding–swallowing difficulties in young children and to complement our previous retrospective findings looking at the relationship between feeding–swallowing difficulties and later language disorder (Malas et al., 2015, 2017). The questionnaire passed through rigorous content development and validation and was at a point where preliminary data were needed prior to explore its clinical/research application.

We had two related hypotheses/predictions, one that the questionnaire would be a feasible method of sampling feeding–swallowing difficulties in young children, and two, that specific indicators of feeding–swallowing difficulties might emerge as most frequently occurring in the developmental language-disordered and all comers samples. The potential feasibility of our questionnaire was confirmed with the high rate of return of the questionnaire for the all comers sample (Seid et al., 2004; Streiner & Norman, 2008; Troude et al., 2011) and the low rate of missing responses for both samples (Bouwmans et al., 2013; Seid et al., 2004; Streiner & Norman, 2008). This, combined

with the relatively short time of completion, suggests the tool might be a feasible tool for future research applications. The rate of return from the all comers sample is particularly encouraging as our overall research and clinical goal is to be able to sample feeding–swallowing difficulties in the general population of French speaking parents/children and begin to identify early indicators of later language disorders based on feeding–swallowing difficulties.

The fact that the rate of response from the developmental language-disordered sample is much lower than that from the all comers sample is perhaps not surprising given that the parents of children with developmental language disorders did not indicate a desire to participate in the study prior to receiving the questionnaire. Further, there was a relatively large time lapse from the target age of the questionnaire to the time of the completion of the questionnaire. Recall that the average age of the children from the language-disordered sample at the time of the completion of the questionnaire was 7 years 11 months. Given this, the 36% return rate for this sample appears acceptable and is comparable with the response rate for previous unsolicited questionnaires sent to parents of children with neurodevelopmental disorders (e.g., Allison et al., 2008; Hastings, Allen, McDermott, & Still, 2002). Given that at least a subset of parents of the children in the developmental language-disordered sample were willing to recall previous history of feeding–swallowing difficulties and return the questionnaire despite being asked to recall events several years earlier may be due to the fact that feeding–swallowing difficulties (Barkmeier-Kraemer et al., 2017; Sanchez et al., 2015) and/or the frustration of parents

related to those difficulties are highly salient to caregivers. These data are encouraging for our current prospective work in which we are sampling parental responses during the development of their children and during times when feeding–swallowing difficulties would be present in their children.

Regarding our second experimental hypothesis that certain feeding–swallowing difficulties would be more common in our two samples, we found that difficulties in sucking and food selectivity were most frequently indicated in the questionnaires from both the all comers and developmental language-disordered samples. Although statistical comparisons among the response categories between these two samples were neither planned nor possible, the fact that similar indicators were present in both experimental samples is perhaps not surprising. Our all comers sample included children born prematurely and most probably included infants that would later have language and potentially other neurodevelopmental difficulties/disorders considering a 12%–16% prevalence of neurodevelopmental disorders in the general population of children within the target age range of the current study (Boyle et al., 2011; McGuire, Tian, Yeargin-Allsopp, Dowling, & Christensen, 2019). Our more frequently occurring categories of sucking and selectivity difficulties were also more frequently observed in the retrospective, questionnaire-based study of Lindberg et al. (1991). And, previous investigations have demonstrated that problems in sucking and/or food selectivity are common in children born prematurely or in young children with neurodevelopmental difficulties (e.g., Cerro, Zeunert, Simmer, & Daniels, 2002; Emond, Emmett, Steer, & Golding, 2010; Field, Garland, & Williams, 2003; Hawdon, Beauregard, Slattery, & Kennedy, 2000; Malas et al., 2015; Mizuno & Ueda, 2005; Motion et al., 2002; van den Engel-Hoek, Harding, van Gerven, & Cockerill, 2017; Zimmerman & Rosner, 2018).

Although the present work suggests the potential utility of the parent-directed questionnaire, there are some obvious limitations in this preliminary work that include the small sample size of children with developmental language disorders and the potential limitation of parents' abilities to recall events several years prior. Historical developmental data are, however, regularly collected by clinicians to have a more thorough developmental profile and parents can recall prior feeding–swallowing difficulties of their children years later (Wenar & Coulter, 1962). Results from the current study combined with our previous retrospective work (i.e., Malas et al., 2015, 2017) provide insights on the potential utility of collecting prior history of feeding–swallowing difficulties in the identification process of developmental language disorders.

The use of parent-directed questionnaires to look at developmentally based feeding–swallowing difficulties, as mentioned previously, is crucial as "parents have more experience with their children, over a longer time, and in many more situations than do professional examiners" (Diamond & Squires, 1993, p. 109). They are therefore more likely to be able to provide ecologically-valid information about their child's feeding–swallowing behaviours than what would be captured during mealtime observations in laboratory or clinical settings (Sanchez et al., 2015). Pediatric healthcare establishments are moving towards professional–patient partnerships in care, which include greater participation of caregivers in the identification of early developmental difficulties (e.g., Barkmeier-Kraemer et al., 2017; Centre Hospitalier Universitaire Sainte-Justine, 2017; Guevara et al., 2013; Schonwald, Huntington, Chan, Risko, & Bridgemohan, 2009). Parent-directed questionnaires have also been shown to be time- and cost-effective (Bricker & Squire, 1989; Centre Hospitalier Universitaire Sainte-Justine, 2017).

Future directions include the application of the questionnaire in an ongoing large-scale, prospective investigation using parents as primary informants, combined with a language questionnaire and clinical measures of language and feeding–swallowing. The goal of this work is to further validate the questionnaire beyond content validation and the present initial step and to provide a more in-depth assessment of potential interactions between feeding–swallowing and speech-language development in young children. With this study, we intend to (a) investigate whether and when in the developmental trajectory feeding–swallowing difficulties might be used as predictors of concurrent and/or later language difficulties and (b) confirm whether individual questions and/or response categories, such as those querying for sucking and/or food selectivity issues, might be used by speech-language pathologists to identify children at risk for developmental language disorders. In this regard, it will be interesting to determine whether certain questions/ indicators emerge or whether the persistence of difficulty over developmental stages might be a differentiating factor in identifying feeding–swallowing difficulties signalling later language disorders (Motion, Northstone, Emond, & ALSPAC Study Team, 2001).

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31

Development and Preliminary Application of a Caregiver Directed Questionnaire to Identify Feeding–Swallowing Difficulties in Young Children

Volume 44, No. 1, 2020

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Acknowledgments

Disclosures

No conflict of interest, financial or otherwise, are declared by the authors.