

BMJ Open Swallowing behaviours and feeding environment in relation to communication development from early infancy to 6 years of age: a scoping review protocol

Heather Flowers,^{1,2} Daniel Bérubé,¹ Mona Ebrahimipour,^{1,3} Marie-France Perrier,^{1,4} Sarah Moloci,⁵ Stacey Skoretz^{6,7}

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For numbered affiliations see end of article.

Correspondence to

Dr Heather Flowers;
heather.flowers@uottawa.ca

ABSTRACT

Introduction Understanding the influences of early swallowing function and feeding environment on the development of communication will enhance prevention and intervention initiatives for young children. This scoping review will help elucidate key elements affecting the developmental trajectory of communicative systems, typically robust and well-developed by formal school entry. We aim to (1) map the current state of the literature in a growing field of interest that has the potential to advance knowledge translation, (2) identify existing gaps and (3) provide research direction for future investigations surrounding feeding-swallowing functions and environment that support or forestall communication development in young children.

Methods and analysis We are proposing a scoping review to identify the breadth and depth of the existing literature regarding swallowing-feeding functions and environment relative to the onset and progression of communicative behaviours from infancy to 6 (<6;0) years of age. Our protocol delineates rigorous methods according to Arskey and O'Malley's framework and includes elaborations by Levac and colleagues. We will search the literature based on 10 databases, 17 peer-reviewed journals, 4 conference proceedings and 6 grey literature sources. Two authors will independently screen abstracts and review full articles, remaining blind to each other's results. A third author will contribute to resolving any discrepant results from both the abstract and article review. Subsequently, we will extract data and chart information from accepted articles using a pre-established data collection form. We will stratify results according to healthy versus impaired swallowing-feeding functions and communication development.

Ethics and dissemination Our scoping review does not require ethical approval. We will disseminate our final study results through international and national conference presentations, publication in a peer-reviewed journal and knowledge translation activities with stakeholders.

BACKGROUND

There has been growing interest in the effects of swallowing and feeding functions on the

Strengths and limitations of this study

- A key strength includes a first and comprehensive literature mapping for research on the influence of early swallowing-feeding behaviours and environment on communication development.
- A second strength includes a rigorous search design involving multiple sources, such as databases, journals, conference proceedings and the grey literature.
- An inherent limitation of our scoping review is that we will not conduct quality appraisal for individual articles given anticipated breadth of results and research designs.
- A second limitation is that we did not include nutritional factors alongside feeding as potential mediators of optimal development of communicative behaviours. The breadth of the review protocol is extensive and cannot feasibly accommodate infant or maternal nutritional inquiry.

development of communicative systems in young children. Research is necessary to understand the complexity of influences that may foster optimal development and conversely forestall delays, especially in the wake of increasingly prevalent communication disorders. Whether or not children incur communication disorders via elusive causes or predisposing conditions, a high proportion of newborn babies will develop a communication disorder. They often remain vulnerable from birth through to school entry (generally before the age of 6 years), especially if diagnosis is delayed or early interventions are lacking.¹ Various prenatal, perinatal or post-natal congenital abnormalities or conditions, including syndromes, cerebral palsy and premature birth, may predispose children to impaired communication development. Currently, congenital syndromes affect about

Table 1 Medline search strategy

| Item | Term set | Area |
|------|--|------------|
| 1 | exp Deglutition/ | Swallowing |
| 2 | exp Gastroesophageal reflux/ | Swallowing |
| 3 | Deglutition disorders/ | Swallowing |
| 4 | 'Feeding and eating disorders of childhood'/ | Swallowing |
| 5 | Breast feeding/ | Swallowing |
| 6 | Bottle feeding/ | Swallowing |
| 7 | Feeding methods/ | Swallowing |
| 8 | Enteral nutrition/ | Swallowing |
| 9 | Parenteral nutrition/ | Swallowing |
| 10 | Kangaroo-mother care method/ | Swallowing |
| 11 | Pacifiers/ | Swallowing |
| 12 | sucking behaviors/ | Swallowing |
| 13 | ((enteral or tube or gastric) adj (feed\$)).ti,ab,kw. | Swallowing |
| 14 | ((deglut\$ or feed\$ or swallow\$ or feed\$-swallow\$) adj3 (difficult\$ or disorder\$ or abnormal\$ or delay\$ or dysfunction\$ or impair\$ or problem\$ or disabl\$ or disabl\$ or deficit\$)) .ti,ab,kw. | Swallowing |
| 15 | ((deglut\$ or feed\$ or swallow\$ or feed\$-swallow\$) adj3 (behavior or develop\$ or neurodevelop\$ or matur\$ or function\$)) .ti,ab,kw. | Swallowing |
| 16 | (dysphag\$).ti,ab,kw. | Swallowing |
| 17 | ((bottle fe\$) or (bottlefe\$) or (breast fe\$) or (breastfe\$) or (feeding mode) or (feeding methods)).ti,ab,kw. | Swallowing |
| 18 | ((gastroesophageal or gastro-esophageal or infantile or gastric) adj3 (reflux or regurgitat\$)).ti,ab,kw. | Swallowing |
| 19 | exp Speech/ | Comm |
| 20 | exp Speech disorders/ | Comm |
| 21 | exp Language development disorders/ | Comm |
| 22 | exp Child language/ | Comm |
| 23 | Speech sound disorder/ | Comm |
| 24 | Verbal behavior/ | Comm |
| 25 | Manual communication/ | Comm |
| 26 | Communication disorders/ | Comm |
| 27 | Social communication disorder/ | Comm |
| 28 | Autism spectrum disorder/ | Comm |
| 29 | Language disorders/ | Comm |
| 30 | Language development/ | Comm |
| 31 | ((speech or oromotor or "oral motor" or verbal\$ or oro-motor or orofacial or oro-facial or "oral facial") adj3 (aprax\$ or dysprax\$ or prax\$)).ti,ab,kw. | Comm |
| 32 | ((speech or speak\$ or oral or language or verbal\$ or communication or voice or vocal\$ or babbl\$ or coo\$ or "oral motor" or oromotor or oro-motor or orofacial or oro-facial or "oral facial" or oralfacial or articulata\$ or phonetic\$ or phonologic\$ or phonemic\$ or pre-linguistic or prelinguistic) adj3 (difficult\$ or disorder\$ or abnormal\$ or delay\$ or dysfunction\$ or impair\$ or problem\$ or disabl\$ or disabl\$ or deficit\$)) .ti,ab,kw. | Comm |
| 33 | ((speech or speak\$ or oral or language or verbal\$ or communication or voice or vocal\$ or babbl\$ or coo\$ or "oral motor" or oromotor or oro-motor or orofacial or oro-facial or "oral facial" or oralfacial or articulata\$ or phonetic\$ or phonologic\$ or phonemic\$ or pre-linguistic or prelinguistic) adj3 (behavior or develop\$ or neurodevelop\$ or matur\$ or acqui\$)) .ti,ab,kw. | Comm |
| 34 | exp child/ | Population |
| 35 | exp infant/ | Population |
| 36 | adolescent/ | Population |
| 37 | (pediatric* or paediatric* or child* or newborn* or infan* or baby or babies or neonat* or pre-term or preterm* or premature birth* or NICU or preschool* or pre-school* or kindergarten* or kindergarden* or elementary school* or nursery school* or schoolchild* or toddler* or boy or boys or girl* or middle school* or pubescen* or juvenile* or teen* or youth* or high school* or adolesc* or pre-pubesc* or prepubesc*).mp. | Population |

4% of Canadian babies.² In particular, the birth prevalence of Down syndrome is 0.16%³ and orofacial clefts are evidenced in 0.13% of live births.⁴ Even more prevalent, cerebral palsy ranges from 0.31% to 0.36% of 8-year-old children in the USA.⁵ Far exceeding the prevalence of other conditions, prematurity is currently estimated at 8% of all births,⁶ and ensuing difficulties may persist throughout childhood.

In fact, 8% of American children aged 3–17 years has a speech, language, voice or swallowing disorder.⁷ More specifically, a recent population study demonstrated a frequency of language disorders by entry to mainstream schooling in 10% of children.⁸ Close to one-third of the sample had a language disorder of unknown cause,⁸ which is often attributable to specific language impairment.⁹ Similarly, the prevalence of language impairment in Canadian kindergarteners is about 8%.¹⁰ Concerning speech acquisition, ~15% of 3-year-old and 4% of 6-year-old children have a speech sound disorder.¹¹ Speech and/or language impairments often co-occur, affecting over 10% of kindergarten children.¹⁰ They may be also present in children with social communication impairments, such as autism spectrum disorder, which affects one and a half percent of Canadian children currently.¹²

Despite good epidemiological information and a long history of research on speech and language development in the preschool years,^{13–17} a significant gap exists concerning knowledge of the earliest precursors to communication.¹³ There is, however, emerging evidence for synchrony and congruence between maternal vocalisations and fetal behaviours.¹⁸ In particular, the fetus is preferentially sensitive to particular types of maternal linguistic input and may even mirror associated gestural oral behaviours (such as mouth opening).¹⁹ Early after birth, synchronous mother–infant vocal behaviours continue to manifest.²⁰ Vocalisations of the newborn infant include cries, vegetative sounds and comfort sounds such as cooing, as described in Stark and her colleague's²¹ seminal study, all occurring well before the onset of reduplicated babbling.¹³ Of note, a recent study underscored differences in maternal response to early speech-like vocalisations (protophones) compared with infant cries.²⁰ That is, mothers more frequently engaged in verbal turn-taking when infants produced protophones compared with cries.²⁰ Cooing is an early speech-like behaviour, occurring as early as 1 month of age,²¹ and it may well be a hallmark indicator to the healthy progression of higher order speech and communicative systems because of its association with positive affect and relational interactions.²²

A body of evidence suggests that early positive attachment and interactive experiences between mothers and babies facilitate affective, cognitive and communication development.²³ Over the long term, children demonstrate improved social-emotional^{24 25} and cognitive²⁶ development when their mothers are emotionally available,^{24 26} provide skin-to-skin contact²⁵ and/or provide verbal stimulation²⁶ in early infancy. Likewise, intact early infant

neuroregulation, particularly attention (a precursor to interactive engagement), predicts good social communication outcomes by school entry.²⁷

Notwithstanding, the nature and potential range of early facilitators and associated trajectory of infant responses that converge for the healthy or optimal development of communication, particularly the onset of joint attention,²⁸ remain elusive. Given the highly responsive and largely reflexive behaviours in the neonatal period, young infants are difficult to evaluate and monitor in a natural setting. Hence, there remains a paucity of literature on very early onset of vocalisations and progression towards the development of symbolic communication despite evidence for early maternal verbal contingencies following infant vocalisations^{20 29} and interactive cues such as eye-gaze patterns.²⁹ An ideal naturalistic early context for understanding communication development includes physiologically driven periods when infants are alert, most notably prior to and during feeding sequences. For example, early vocalisations of contentment may be inextricably linked to the feeding context.³⁰ Interestingly, infants remain by and large dependent for feeding, until just about the time when symbolic communication and joint attention emerge (8–12 months).³¹ Consequently, the feeding environment can promote optimal linguistic exposure and interactions, facilitating development of the auditory system and various basic motor functions of the vocal tract.³²

Various theoretical premises exist regarding the development of communication: (1) one revolving around the tightly coordinated and integrative physiological development of the respiratory and vocal/articulatory systems,^{33 34} (2) another particularly centred on intrinsic innate developmental stages for speech and language acquisition^{35 36} and (3) a third pertaining to a connectionist framework for speech production and/or processing alongside learning demands,³⁷ dependent on capacity for resource allocation.³⁸ By extension, a connectionist model could intuitively include physiological integrity as necessary for higher-level resource allocation, whereby excessive demands or dysfunction would preclude optimal activation of complex behaviours and cognitive processing. Conversely, physiological integrity coupled with environmental facilitators would permit the necessary resource allocation for the optimal development of integrated networks for communicative systems, ensuring appropriate stage to stage developmental progression.

To illustrate, from a physiological standpoint, both respiration and swallowing are primordial life-sustaining functions, and they are inextricably linked and tightly coordinated behaviours.^{39–41} Consequently, integrity of swallowing depends on adequate respiratory functions and together they provide the physiological and neurological basis for developing voice and speech functions.^{33 34} Physiological integrity of swallowing coupled with a facilitative feeding environment³² may well optimise connections and prime the development of neural networks for communication. Conversely, detriment to swallowing

Table 2 Complete list of search sources including databases, journals, conference proceedings and grey literature

| Literature type | Sources |
|------------------------|--|
| Databases | <ul style="list-style-type: none"> ▶ AMED ▶ CINHAL ▶ Education Source ▶ Embase ▶ ERIC ▶ Linguistics and Language Behaviour Abstracts ▶ Medline ▶ PsycInfo ▶ Scopus ▶ Web of Science |
| Journals | <ul style="list-style-type: none"> ▶ American Journal of Speech-Language Pathology ▶ Canadian Journal of Speech-Language Pathology ▶ Child Development ▶ Clinical Linguistics and Phonetics ▶ Developmental Medicine and Child Neurology ▶ Dysphagia ▶ Gastroenterology ▶ Infancy ▶ International Journal of Behavioral Development ▶ International Journal of Speech-Language Pathology ▶ Journal of Child Language ▶ Journal of Communication Disorders ▶ Journal of Pediatric Gastroenterology and Nutrition ▶ Journal of Pediatrics ▶ Journal of Speech, Language, and Hearing Research ▶ Nature ▶ The American Journal of Gastroenterology |
| Conference Proceedings | <ul style="list-style-type: none"> ▶ ASHA Conference ▶ Dysphagia Research Society ▶ International Conference on Speech and Language Development ▶ World Pediatrics |
| Grey Literature | <ul style="list-style-type: none"> ▶ Networked Digital Library of Theses and Dissertations ▶ Open Access Theses and Dissertations ▶ Open Grey ▶ Proquest Dissertations and Theses Global ▶ Ontario Public Health Libraries Association ▶ Grey Matters |

functions can incur disease and grossly compromise physiological integrity of the respiratory and auditory systems. Examples include increased risk of secondary respiratory infections⁴² and otitis media.^{43 44} There is a need to

collect additional knowledge about swallowing/feeding and speech/language relationships, including mediation by the auditory system⁴⁵ to help us improve our current understanding of healthy versus disordered development of communication. Specifically, we want to improve the processes of early detection, evaluation and intervention for swallowing/feeding and associated communicative functions in an integrated manner.

Rationale

Identifying relationships between early physiological functions (such as feeding and swallowing) and communication (from speech-like behaviours such as cooing to phonological development for meaningful word production and language use in discourse) will help us improve our understanding of the development of communication. We need to consider these relationships starting in early infancy because the feeding context has great potential as a facilitative environment for social interactions. Nevertheless, problems with swallowing function and/or suboptimal feeding environment may have a grossly prohibitive effect on optimal and healthy development of communicative systems. We still need a comprehensive understanding of precursors and determinants longitudinally from birth to the age of 6 years, when most children begin formal schooling.

Objectives

The primary objective of our scoping review is to provide an overview of the literature considering the association between swallowing physiology and feeding environment and the development of communicative functions, whether healthy or disordered. The specific objectives include (1) identifying the number and design of articles over time, (2) mapping sample characteristics and study themes in the existing literature and (3) identifying gaps in knowledge pertaining to the contribution of swallowing function and feeding environment to the development of communicative systems in infants and young children.

METHODS AND ANALYSIS

Operational definitions

We have defined swallowing to include oropharyngeal and/or oesophageal stages⁴⁶ involving anatomical, neurological (eg, coordinated respiratory/swallowing behaviours) and/or physiological functions. Paediatric feeding includes (1) interest in feeding⁴⁷ and consequent environmental engagement, (2) behavioural manifestations of dietary preferences and/or (3) progression through developmentally appropriate food and/or liquid consistencies and type.⁴⁸ As such, feeding does not include nutritional aspects of intake and/or diet, such as adequacy of macro or micronutrients. Hereafter, the term 'environment' will refer to contingent internal and external stimuli within the feeding process and related context. Consequently, elements could include feeding mode, accompanying auditory or visual stimuli, location

Table 3 Proposed coding categories for abstract and full article review

| Step 1: exclude if abstract | Step 2: exclude if full article |
|--|---|
| (1) Is clearly a review, commentary or opinion | (1) Is clearly a review, commentary or opinion |
| (2) Clearly has only an adult sample (≥ 18 years of age) | (2) Has a sample exclusively outside desired age range (≥ 6 years of age) |
| (3) Swallowing/feeding context outside operational definition (ie, relates exclusively to nutritional intake) | (3) Swallowing/feeding context outside operational definition (ie, relates exclusively to nutritional intake) |
| (4) Outcomes relating to communication or other aspects of child development (motor, cognitive) clearly absent | (4) Outcomes relating to communication clearly absent |
| (5) n/a | (5) Outcomes relating to swallowing/feeding and communication development clearly absent |
| (6) Clearly involves same data as another abstract | (6) Clearly involves same data as another article |
| Otherwise accept for full article retrieval | Otherwise accept for scoping review |

(eg, intensive care unit, home, an incubator) and social interactions (eg, verbal and tactile).

Communication refers to the exchange of information, ideas, needs and desires between at least two persons.³¹ It involves both linguistic and paralinguistic codes,³¹ whereby methods of transmission include speech, intonation, gestures and body language.³¹ Examples of earliest behavioural manifestations may include first words or manual signs, presenting in children as young as 8 months,³¹ rapidly increasing in complexity.⁴⁹ For the purpose of this scoping review, the definition of communication encapsulates the entire developmental progression from earliest precursors in the newborn infant to the use of near adult-like constructs by school entry.³¹

Therefore, we need to appreciate factors involving swallowing physiology and feeding relative to the onset of prelinguistic vocalisations and progression towards a highly complex communicative system. Such an understanding will help identify early facilitators or prognostic indicators of delay in the development of communication, whether speech, language or social communication (or a combination therein). A recent shift in culture in healthcare settings has already manifested, whereby early infant behaviours (such as vocalisations) are understood to be cues that communicate a need and warrant a social interactive response.^{50 51} Hence, recommended feeding practices follow from observing infant cues for readiness,^{52 53} rather than from assessing oral motor abilities (such as non-nutritive sucking) or from documenting quantity of ingested feeds.⁵³ Accordingly, there has been a recent increase in attention to paediatric feeding-swallowing disorders and their relationship to communication development.⁵⁴⁻⁵⁹ Research investigations involving swallowing behaviours and feeding are badly needed to guide preventative and clinical treatment initiatives to promote the healthy development of communication from infancy to school entry.

Framework

Given the breath of our topic, we chose to conduct a scoping review of the literature that will guide knowledge translation, identify gaps in the literature and inform

future research investigations from an emerging evidence base.⁶⁰ Our scoping review follows Arskey and O'Malley's framework involving six stages,⁶¹ including elaborations, such a clearly articulated reason and scope of inquiry as well as a transparent and replicable approach to study selection.⁶² We have applied the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols reporting checklist^{63 64} as a guide for the process of literature appraisal and for reporting results (online supplementary table 1).

Patient and public involvement

Neither patients nor the public was involved in the development of the current scoping review protocol.

Stage 1: identifying the research questions

We have developed a single broad research question to inform our search strategy and to derive key domains for our results. We seek to understand the foundational underpinnings of the early development of communication in relation to its inherent physiological and environmental precursors surrounding early swallowing and feeding behaviours. The overarching broad question that our review addresses is:

What early feeding/swallowing factors are associated with communication development from birth to six (<6;0) years of age?

Our line of inquiry includes early child development in both health and congenital or acquired diseases/disorders. The resulting review will facilitate an appreciation of swallowing-feeding factors that relate to the development of communication within an epidemiological framework. Underlying secondary questions relate to swallowing physiology and the feeding environment more specifically. The development of our secondary questions results from an iterative process, whereby reformulations of the questions posed a priori (ie, those identified herein) may result and/or new questions may arise. Our secondary questions currently include:

1. What underlying congenital problems (eg, cerebral palsy, cardiac/respiratory/gastrointestinal anatomical

Table 4 Basic study characteristics for extraction from each accepted article

| Categories | Characteristics |
|----------------------------------|--|
| (1) Article details | <ul style="list-style-type: none"> ▶ Year of publication. ▶ Document type (peer-reviewed journal article, thesis, government document, conference proceeding or published abstract). ▶ Location of study (country). |
| (2) Study details | <ul style="list-style-type: none"> ▶ Design (cohort, case-series, RCT, case study, case series, qualitative). ▶ Time frame (cross-sectional, longitudinal). ▶ Setting (hospital, home). ▶ Population (children with typical communication development, children with disordered/atypical communication development). |
| (3) Sample characteristics | <ul style="list-style-type: none"> ▶ Sample size. ▶ Groups. ▶ Age range. ▶ Sex/gender. ▶ Ethnicity. ▶ Language(s) used. ▶ Aetiology (if applicable). ▶ Comorbidities (if applicable). ▶ Hearing status. |
| (4) Feeding/swallowing variables | <ul style="list-style-type: none"> ▶ Physiology and behaviours. ▶ Environment. ▶ Modes. |
| (5) Communication outcomes | <ul style="list-style-type: none"> ▶ Speech (early vocalisations, babbling, protowords, single word production, multiword production). ▶ Language (content, form, use). ▶ Gestural behaviours. |
| (5) Main findings of study | Trends Effects |
| (6) Data analyses | Type Rigour |
| (7) Themes/domains of study | Barriers to communication development Facilitators to communication development |
| (8) Study limitations | Design Outcomes Generalisations |
| (9) Pertinence ⁴³ | Clinical practice Policy Research |

- defects, neurological syndromes, prematurity, transient birth-related distress) impact swallowing-feeding integrity and the development of communicative functions?
2. What swallowing-related impairments (eg, poor respiratory function, reflux, weak neonatal latch/sucking behaviours, otitis media) compromise or delay the onset of communicative functions?
 3. How do feeding environments alter the onset and course of development of communicative functions?
 - a. Feeding mode (breast, bottle, combination feeding, enteral feeding).
 - b. Setting (neonatal intensive care unit stay, hospital stay, interventions such as incubation for phototherapy).

- c. Interactive constructs (quality and quantity of feeding-related caregiver verbal and/or tactile interactions).

Stage 2: identifying relevant studies

The search strategy for Medline was developed in three steps by the first (HF) and third authors (ME) with input by the final author (SS) through ongoing consultation with a research librarian. First, we undertook a consultative process, whereby we analysed and reviewed all Medical Subject Heading (MeSH) terms associated with communicative functions and feeding/swallowing behaviours multiple times to maximise specificity while retaining the necessary scope of inquiry. Subsequently, the first and third authors chose MeSH terms for exploration if all subordinate terms were truly relevant to the content area and research questions. Second, review of other relevant systematic or scoping reviews revealed additional possibilities for MeSH terms and context-dependent terms (eg, title, abstract and keywords) in the areas of swallowing-feeding^{65–68} and communication.^{69–72} The two authors (HF and ME) developing the search strategy selected terms for a paediatric population from a published filter,⁷³ identified by the research librarian, rather than limit the search within Medline. Finally, we developed additional context-dependent terms that we felt were not captured from the previous two steps based on our expert knowledge of the fields of swallowing and communicative sciences. The research librarian then confirmed the integrity of the terms and search strategy (table 1) and provided consultation for additional databases to search.

We selected nine additional databases to search based on adaptations of the Medline search terms (table 2). We did not include PubMed as part of the search, given the possibility of its referencing predatory journals.⁷⁴ We consider our set of selected databases sufficient to capture potentially relevant PubMed citations. We will not apply date or language limits on the searches to the extent possible. That is, we will accommodate languages that we can read (including at least English, French, German, Italian, Persian and Spanish) and seek translations for other languages (if possible) from colleagues and contacts within our scientific communities. All study designs are of interest, including case reports, case series, qualitative, cohort, case-control and quasi-experimental studies, as well as randomised controlled trials.

Further, we identified additional sources most relevant to the content of the scoping review and based on feasibility of search conduct. We will apply the same article inclusion criteria and determine search terms accordingly. Selections include 17 journals, 4 conference proceedings and 6 grey literature sources (table 2). The research librarian assisted with determining grey literature sources. We will search all sources electronically from the first date of their online availability. Finally, we will review the reference lists and citations of selected articles through Google Scholar using a process of forward

and backward chaining.⁷⁵ Our intent is to complete all searches within 6 months of the publication of the current scoping review protocol.

Stage 3: selecting studies

We will compile and store all citations using Covidence⁷⁶ and Microsoft Excel. Following elimination of duplicates and citations without abstracts, we will review the remaining abstracts and articles in a two-step process. Two independent reviewers will code the abstracts for potential inclusion or exclusion (table 3). Coding criteria are purposefully open-ended for abstract review to permit selection of all those potentially relevant for full article retrieval. Additionally, codes are hierarchical, such that if code 1 is relevant, and the abstract therefore deemed ineligible, the remaining codes are not applicable. Subsequently, the two abstract reviewers will discuss and resolve discrepancies by consensus, requesting input from a third reviewer for consensus deliberations. All abstracts not assigned an exclusion code will be accepted for full review.

The same process will apply to full article review to determine final articles for inclusion. That is, two reviewers, blind to each other's evaluations, will independently assess all full articles, determining eligibility for inclusion according to more stringent and hierarchically coded criteria (table 3). Any articles written in languages outside of those understood by the two reviewers will undergo translation (if possible) for key methodological content to enable coding. Coding criteria for the full article review will be more stringent than for the abstract review, since all pertinent information will be available and reviewers will make a final decision about article selection. Where discrepancies exist, the two reviewers will engage in discussion to achieve consensus regarding inclusion or exclusion. In the event of difficult resolution, a third reviewer will assist in consensus deliberations. That is, all three reviewers will revisit the article in a process of reiterative evaluation to determine final inclusion or exclusion of the article. All codes and final decisions for inclusion or exclusion from both abstract and full article reviews will be entered into the excel datasheet.

Articles without exclusion codes will be accepted for the scoping review. Accepted articles that initially required translation will undergo a second review (if possible) by the same translator and/or a different translator to ensure that the appropriate content is available for data extraction and charting.

Stage 4: charting the data

Multiple reviewers will be responsible for collecting data, each from a proportion of the articles, followed by independent verification of all data by research personnel. Data collection will involve documenting key characteristics and variables of interest for each article (table 4) and recording them in a database for storage and analysis. All reviewers collecting and charting data will be responsible for ongoing communication about emerging themes or

domains of inquiry that could alter and enhance data collection procedures.

Stage 5: collating, summarising and reporting the results

Data from stage four will be summarised to map the emergence and breadth of literature over time for the primary objective. Subsequently, we will stratify the findings according to healthy vs impaired development. Various forms of data presentation will include tables, line graphs (for chronological information), histograms and/or pie charts. To illustrate, we will tabulate study characteristics according to design, population, setting and pertinence for policy, clinical practice or research. Similarly, we will visually represent information pertaining to swallowing-feeding functions and domains of communication development in charts. Where available, we will describe themes that arise from our review, including barriers and facilitators to the development of communicative functions in young children. We will not include quality or rigour of specific analyses in the scoping review, because the intent is to obtain a sense of the extent of the literature in the area rather than appraise individual articles.

Our scoping review will therefore provide a first overview of trends and breadth for an emerging body of literature. Most important, we will identify gaps in the current knowledge base and provide guidance for the prevention and treatment of potential communication impairments beginning in early infancy.

Stage 6: optional consultation exercise

We intend to seek input and consultation from caregivers and practitioners once we have compiled and mapped the results of our full scoping review. We hope that such consultation may elucidate gaps that were otherwise not salient to us and subsequently render our knowledge translation endeavours more feasible and accessible to stakeholders.

ETHICS AND DISSEMINATION

Following completion of all stages of scoping review, findings will be disseminated via local and international conference presentations and submission to a peer-reviewed journal. Knowledge translation activities will then include development of accessible materials for end-users, such as parents, infant caregivers and clinicians from various fields of professional practice, so that they may understand and advocate best practice for communicative development in children. In addition, we will share our findings with policy-making organisations and other stakeholders, such as the Canadian Child and Youth Health Coalition and the Paediatric International Patient Safety and Quality Collaborative.

Author affiliations

¹School of Rehabilitation Sciences, Faculty of Health Sciences, University of Ottawa, Ottawa, Ontario, Canada

²Institut du savoir - A Knowledge Institute, Montfort Hospital, Ottawa, Ontario, Canada

³In-patient Rehabilitation, Elisabeth-Bruyere Hospital, Ottawa, Ontario, Canada

⁴In-patient Rehabilitation, Children's Hospital of Eastern Ontario, Ottawa, Ontario, Canada

⁵In-patient Medical Units, Hopital Montfort, Ottawa, Ontario, Canada

⁶School of Audiology and Speech Sciences, The University of British Columbia, Vancouver, Ontario, Canada

⁷Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Ontario, Canada

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Contributors All coauthors provided meaningful and unique contributions to the development, preparation and/or writing of the current scoping review protocol. HF formulated the topic and conceptualised the questions and theoretical framework. She also guided the research team at all stages of the review development and wrote the bulk of the protocol. DB contributed critical and novel insight for the research questions, theoretical framework and review components relative to communicative functions. SS contributed critical and novel insight for the research questions and for operational definitions relative to swallowing functions. She also provided advice for scoping review methods and proposed analyses. ME provided conceptual input in the development of the search terms relating to communicative functions in collaboration with HF and in consultation from a research librarian. M-FP contributed to writing the introduction, especially with respect to epidemiology of communication impairments. SM contributed by drafting ideas related to the clinical relevance of the scoping review. All authors reviewed multiple renditions of the manuscript, providing suggestions and editing until all approved the appropriateness for submission.

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