

EFFECTS OF LATE PRETERM BIRTH ON COMMUNICATION AND FEEDING  
IN INFANTS AND TODDLERS BIRTH TO 24 MONTHS: A SYSTEMATIC  
REVIEW

By

ABIGAIL GRACE HARRIS

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Approved by:

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Dr. Mary Alt  
Department of Speech, Language, and Hearing Sciences

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## ABSTRACT

**Background** Every year in the United States, approximately 267,000 infants are born late preterm, meaning between 34 0/7 weeks to 36 6/7 weeks gestation (March of Dimes Peristats). Not much is readily known on developmental outcomes of this cohort of infants, and not all US based graduate programs in Communication Sciences and Disorders (CSD) may be preparing future Speech-Language Pathologists (SLPs) to practice in this area of the field (Farrugia, 2022). The objective of this systematic review is to assess available developmental information on late preterm infants from birth to 24 months of age, with a focus on communication and feeding development.

**Methods** A literature search was conducted through the University of Arizona library registry and the MEDLINE (EBSCO Host) database. Included articles assessed the impact of late preterm birth on development of communication and feeding skills from birth to 24 months.

**Results** Six articles are reported in this review with varied results on communication and feeding outcomes. Late preterm birth is associated with increased risk for communication delays and feeding difficulties, but confounding variables and other factors impact these associations.

**Discussion** Findings from this review suggest that there is still much to be investigated in the population of infants born preterm. SLPs must be gathering this information and staying abreast of factors that impact development.

## INTRODUCTION

In 2005, the term ‘late preterm’ arose from the ‘US National Institute of Child Health and Human Development workshop’ to define the group of infants born between 34 and 36 and 6/7 weeks of gestation. The term was changed from ‘near term’ to ‘late preterm’ in order to acknowledge the increased risks associated with late preterm birth. The 267,000 infants born late preterm every year accounts for 70% of all preterm births, and early birth places these infants at risk for health and developmental risks, including communication and feeding delays (Stewart et al., 2019).

There are many risk factors affecting women that can lead to the late preterm delivery of their infants. The etiology is multifactorial. Late preterm delivery could be the result of infection, multiple pregnancy, maternal obesity, intrauterine growth restriction, or changes in the hypothalamic-pituitary-adrenal (HPA) axis. There are many other maternal health conditions, such as severe hypertension, that could lead to late preterm delivery (Morgan & Boyle, 2017).

Due to a more developed appearance and larger size, increased morbidity and mortality among late preterm infants has been generally underestimated. Although these risks have been acknowledged, the health outcomes of infants born late preterm are a growing area of interest among medical professionals. Some of the main concerns involve respiratory morbidity as well as hypothermia, hypoglycemia, hyperbilirubinemia, growth impacts, and neurodevelopmental outcomes. Some of the less researched concerns are impacts on the development of communication and pediatric feeding disorder (Goday et al., 2019). In the field of speech-language pathology, there are questions regarding the impact of late preterm birth on communication and feeding. Within the speech-language pathologist’s scope of practice is the evaluation of and intervention in communication and feeding (Loeb et al., 2019).

Communication and feeding outcomes are less researched and understood for the cohort of late preterm infants. Speech-language pathologists (SLPs) play a pivotal role in early intervention by providing services for children from birth to 3 years. They provide treatment to improve communication and swallowing ability and support families through this process. However, not all US-based graduate programs in Communication Sciences and Disorders (CSD) may be preparing future SLPs for this area of practice (Farrugia, 2022).

The purpose of this review is to assess the current research available on the impacts of late preterm birth on communication and feeding from birth to 24 months of age. This information may inform CSD training programs on future directions.

## **METHODS**

### **Search strategy**

The systematic review was completed according to the guidelines of the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) protocols. The literature search was conducted through the University of Arizona Library registry online search engine and the MEDLINE (EBSCO Host) Database from February 20-February 28, 2023. To complete the search, seven search terms were used, which are listed and defined below. All article reference results were noted, and duplicates were removed.

### **Search terms**

Six combinations of seven search terms were used: “late preterm” AND “communication delay” OR “pediatric feeding disorder” OR “developmental delay” OR “feeding difficulty” OR “speech delay” OR “language delay.”

### **Inclusion and Exclusion Criteria**

Articles were included if they included the following criteria:

1. The population included infants with a gestational age of 34 to 36 6/7 weeks in the study design and included results of assessment for this specific population.
2. Assessed communication outcomes, as it relates to speech and language development, or feeding outcomes, as it relates to feeding skills at stages of development.
3. Included infant outcomes from birth to 24 months of age.
4. Outcomes in the English language.

Articles were excluded if:

1. The population was premature infants that did not include or isolate a gestational age of 34 to 36 6/7 weeks in the methods and results.
2. Only included outcomes outside of communication, as it relates to speech and language development, or feeding, as it relates to feeding skills and behaviors. Example of excluded outcomes: neurological development or infant nutrition.
3. Did not include outcomes from birth to 24 months.
4. Assessed outcomes in a language other than English.

Articles of any publication date were considered. A filter for “scholarly resources” was selected for the University of Arizona library search engine.

From the initial search, articles were excluded based on title and abstract. Articles that appeared to meet the inclusion criteria based on title and abstract were reviewed for further eligibility by consideration of the full text. Articles that did not meet inclusion criteria were excluded and reasons for exclusion were noted. All included studies were grouped for syntheses based on study type (follow-up).

## **Data Extraction**

The author of the review independently and manually collected data from each report by using a spreadsheet to organize the study characteristics and outcomes. All six of the studies were cohort style and involved analysis of assessment of parental perceptions. Therefore, no numerical data synthesis was conducted. No automation tools were used. A narrative-style synthesis was used to synthesize the information from each study, along with a grouping based on study characteristics.

Data outcomes related to “communication” and “feeding skills” were sought. For assessments in the included studies, only statistics regarding communication or feeding outcomes were sought. However, other factors and confounding variables were considered for impact on results regarding communication. Only developmental outcomes from 0-24 months were sought, even though all results from included studies were not compatible with this outcome domain. Results outside of this age range were still considered if grouped with an age from 0-24 months. Outcomes regarding “late preterm” infants were sought, but comparison populations were considered for their impact on understanding the outcomes of late preterm assessment.

Strengths and limitations of the studies were assessed by looking at the reported strengths and limitations in each article and by assessing risk of bias for each study.

### **Risk of Bias Assessment**

The review author independently assessed the risk of bias of each included study against key criteria. Bias was rated using these terms: low risk of bias, moderate risk of bias, serious risk of bias, or critical risk of bias, in accordance with methods recommended by The Cochrane Collaboration. The “Tool to Assess Risk of Bias in Cohort Studies” was used in this review because the included studies were categorically follow-up (cohort) studies. Signaling questions

were used that addressed cohort population exposure, assessment of exposure, outcome of interest, prognostic variable adjustment, assessment of prognostic factors, assessment of outcome, and follow-up of cohorts. The “Risk of Bias In Non-randomized Studies – of Interventions” (ROBINS-I) tool was used to organize and graph the assessment to create a summary plot and a traffic light plot.

## **RESULTS**

113 articles total were identified using the search strategy, of which six articles met the inclusion criteria for review. Of the six included articles, 66% were prospective studies and 33% were retrospective studies.

The initial search between the registry and database produced 149 articles, of which 36 were duplicates. After the preliminary search, 113 articles were screened by the author based on title and abstract, and 85 of the articles were excluded based on the exclusion criteria. 28 articles were selected for further review, based on the inclusion criteria. These 28 articles were further assessed for eligibility, and six articles were selected from these for use in the systematic review.



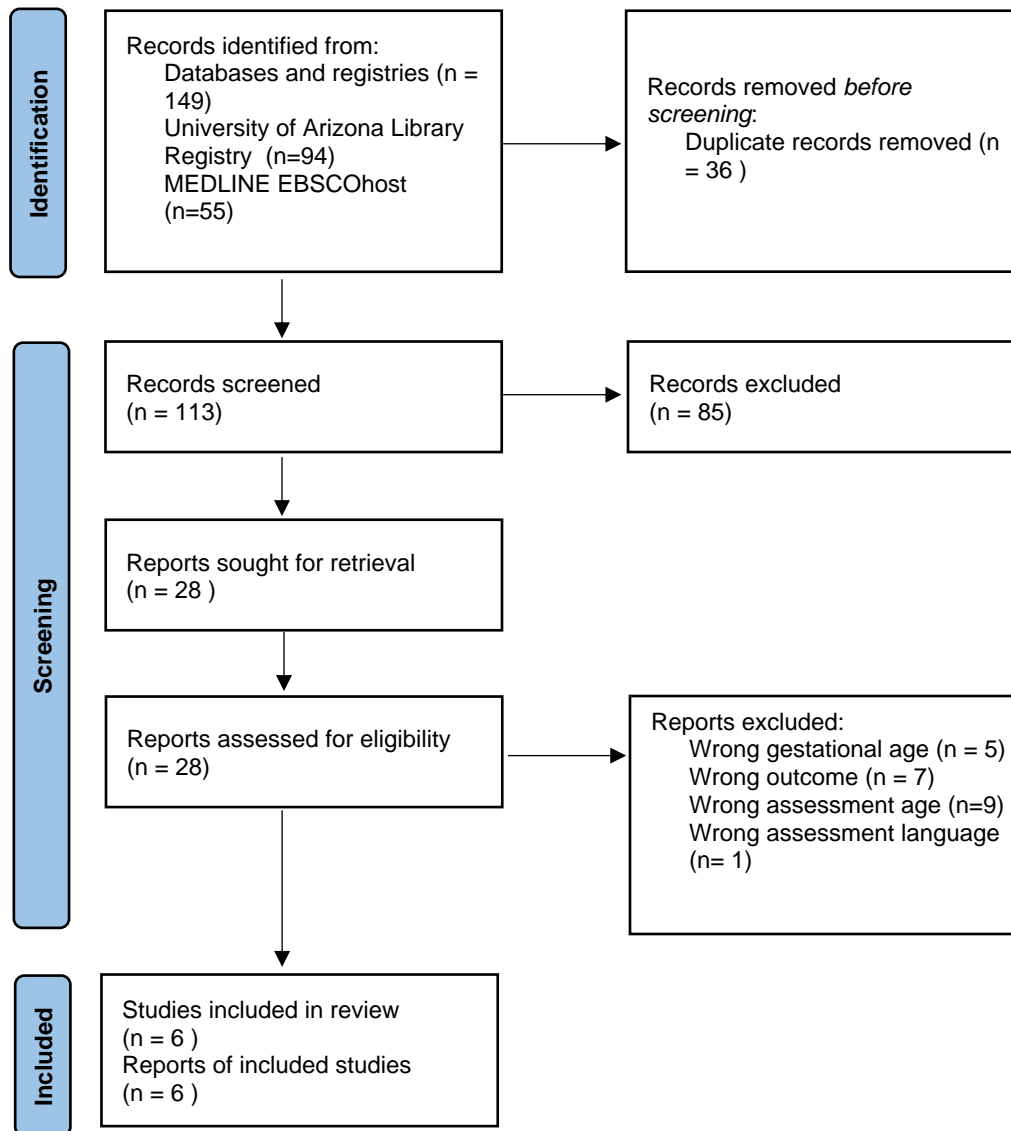


Figure 1: PRISMA Flow Diagram

### Studies assessed for eligibility but excluded:

The 28 studies that were sought for retrieval appeared to meet the inclusion criteria; however, they were excluded from use in the review for multiple reasons. The first reason was that the study looked at the population with the incorrect gestational age. For the purposes of this review, the study needed to include the population of infants born late preterm (34 to 36 6/7

weeks) and isolate this population in both the methods and results. Multiple excluded studies grouped together infants born late preterm with infants born “premature,” “moderate preterm,” or “early term” in their assessment. In assessing communication development and feeding skills, these studies also grouped these populations together in assessment of the results. Therefore, five studies were excluded according to this criterion (Park et al., 2019; Spittle et al., 2017; Putnick et al., 2017; McMahon et al., 2022; Shapiro-Mendoza, 2013).

The second reason for exclusion was wrong outcome. Seven of the studies assessed for eligibility were at first considered for including terms like “neurodevelopmental,” “developmental delay,” and “feeding.” However, upon further review these studies did not assess specific areas of communication, such as speech or language, and feeding skills (Cheong et al., 2019; Woythaler et al., 2011; Petrini et al. 2009; Jois, 2018; Kalia et al., 2009; Chatziioannidis et al., 2018; Hellmeyer et al., 2012).

The third reason for exclusion was wrong assessment age. Nine of the studies that were assessed for eligibility assess communication and feeding outcomes; however, the included age range was outside the scope of the objective of this review (birth to 24 months) or was generalized. These studies were used to assess outcomes outside of or beyond 24 months (Williams & Pugh, 2018; Laptok, 2013; Darcy, 2009; Rabie et al., 2015; Horgan, 2015; Asadi et al., 2019, Ramachandrappa & Jain, 2009; van Dokkum et al., 2021; Cleaveland, 2010).

The final reason for exclusion was completed assessments in a non-English version. For the purposes of this review, results were to look at English-version assessments. Upon initial eligibility assessment, this study appeared to fit the criteria, but upon further review of the abstract a language difference was discovered (Martinez-Nadal et al., 2017).

**Included article summaries:**

The overview summaries of the included studies are presented below.

In their 2016 article, Ballantyne et al. present their prospective cohort study, which reviewed Ages and Stages Questionnaire-3 (ASQ) scores of 52 late preterm infants at 12 months. Before controlling for covariates, late preterm infants were at significantly greater risk of developmental delay in communication (13.5 versus 4.5%). When controlling for covariates, the authors did not find a significant association between late preterm gestational age and poor communication skills. However, there was significance in whether the infant had spent any time in the NICU, resulting in a greater risk for communication delay.

Brown et al., in their study from 2014, conducted a retrospective analysis that looked at 12,302 children born late preterm and term at ages 2-3 years and 4-5 years of age. They gathered information via maternal self-report. This article extended past the age range but provided interesting information. When controlling for confounders, the authors did not find that gestational age provided greater risk for receptive vocabulary delay when comparing late preterm and term (13.1% versus 12.7%). However, they surmised that social determinants and parenting played a greater role in influencing receptive vocabulary development.

DeMauro et al. (2011) did a prospective study in which they surveyed parents of 571 late preterm parents on feeding behaviors seen at home. These parents reported difficulty with infant appetite, oromotor dysfunction, avoidant behavior, and maternal feeding anxiety at similar levels compared to parents of early preterm infants. Also, avoidant behavior in late preterm infants at 3 and 6 months of age correlated with requiring medical attention for feeding at 12 months of age.

In their retrospective analysis from 2016, Dueker et al. reviewed data of ASQ scores on thousands of children in Michigan and found that for each week of gestation past 35 weeks,

scores in the communication domain improved. Odds of having anormal communication scores increased by 21%, 24% and 27% at 8-, 20-, and 24-months assessment age.

Mirzakahani et al. (2020), in their prospective cohort analysis looked at the stability of skills in 42 late preterm children at 24 and 36 months of age on parent-reported scores on the ASQ-3. The second age point was out of the range, but infants born late preterm had a 30% higher risk of delay in communication skills at 36 months. The research did provide information on possible association of late preterm birth and communication delay at 24 months with stability of delay at 36 months.

In their 2014 prospective cohort study, Stene-Larsen et al. gathered mother-reported information from the Ages and Stages Questionnaire (ASQ) on 1673 18-month-old toddlers born late preterm. They found that the odds of communication impairment were 74% higher at 18 months compared to children born term, suggesting that this group may be at risk for communication delays. However, there was no significant increase in odds at 36 months.

**Study Characteristic Syntheses (relevant to inclusion criteria):**

**Publication Date** – 2011 to 2020

**Study type** – two retrospective cohort studies and four retrospective cohort studies

**Population** – between 42 and 12, 302 infants born late preterm across all studies

**Location** – United States, Canada, and Norway

**Measures** – communication, developmental delay, receptive vocabulary delay, infant feeding skills in appetite, oromotor dysfunction, avoidant feeding behavior, hospitalizations or subspecialty visits, and parental discomfort

**Measurement Tools** - parental self-report across all studies

**Factors controlled or adjusted for** – maternal education, method of delivery, NICU admission/non-admission/readmission, perinatal variables, family

structure/resources/functioning, infant sex, breastfeeding, prenatal and postnatal risk factors

**Assessment age** – 3 months to 24 months

**Communication outcomes** – late preterm birth may increase risk of communication delay than in term-born infants; when controlling for confounders, social factors, NICU admission, and birth weight may have greater impact on communication development; gestational age affects development

**Feeding outcomes** - late preterm infants have similar feeding difficulties to early term infants; avoidant feeding behavior can lead to need for medical attention later on

**Study Characteristics for individual studies:**

For each of the six studies, study characteristics were noted and are present below in a table. The studies met all inclusion criteria.

Author, year	Study Design	Location	Study population	Measures	Assessment age
Ballantyne et. al, 2016	descriptive comparative study	Alberta, Canada	52 late preterm infants and 156 term (37 weeks or >) infants	communication, gross motor, fine motor, problem-solving, and personal-social	12 months
Brown et. al, 2014	secondary analysis	Canada	12 302 late preterm, early, and full term infants	developmental delay and receptive vocabulary delay	2 to 3 years and 4-5 years
DeMauro et. al, 2011	prospective study	Philadelphia, Pennsylvania	571 late preterm infants and 319 early preterm	infants' feeding skills in appetite, oromotor dysfunction, avoidant feeding behavior, hospitalizations or subspecialty visits, and parental discomfort	3, 6, and 12 months corrected age
Dueker et. al, 2016	retrospective analysis	Michigan, United States	thousands of infants born between 35 and 41 weeks gestational age	communication, gross motor, fine motor, problem-solving, and personal-social	8, 12, 20, or 24 months
Mirzakhani et. al, 2020	prospective cohort analysis	across the United States	42 late preterm infants and 593 term infants	stability of communication, gross motor, fine motor, problem-solving, and personal-social skills	24 and 36 months
Stene-Larsen et. al, 2016	prospective cohort study	Norway	7109 early term and 1673 late preterm	communication, gross motor, fine motor, problem-solving, and personal-social	18 and 36 months

Figure 2 – study characteristics

<b>Assessment Tools</b>	<b>Factors Controlled (or adjusted) for</b>	<b>Communication OR Feeding Outcomes</b>	<b>Study Limitations</b>
Ages and Stages Questionnaire-3 ASQ-3	maternal education, method of delivery, NICU admission or non-admission, breast-feeding status, and infant sex	LPT infants were at significantly greater risk of developmental delay in communication at 13.5 versus 4.5%. NICU admission was the most significant factor associated with risk of communicating delay	risk measured using parent-reported screening tool, no neurodevelopmental follow-up at two years of age, maternal participants income greater than average, population included NICU and non-NICU
Motor and Social Developmental Scale	perinatal variables, gestational age, family structure, family resources, family functioning, proximal social, processes	after controlling for confounders, children born late preterm were not at greater risk for receptive vocabulary delay (13.1% vs 12.7%) than those born full term at 4 to 5 years old. Social factors may provide a greater risk.	maternal self-report, bias in falsley considered variables, issues of generalizability because of loss to follow-up
telephone interview or mailed questionnaires surveying feeding	hospitalization or specialty clinic visits	parents of early and late preterm infants reported similar rates and patterns of feeding dysfunction. In late-preterm infants, avoidant feeding behavior at 3 and 6 months was correlated with medical attention for feeding at 12 months	bias in families that agreed to participate, parental report, no information on type of feeding or parental mental health, full-term infants not included in comparison
Ages and Stages Questionnaire (ASQ)	family income, mother's level of education, and child sex	from 35 weeks on, each additional week of gestation increased the odds of having a normal communication score by 21%, 24%, and 27% borth each assessment age	parent reported GA, ASQ is only a screening tool, not information for infants at 34 weeks to include them, self-selection of sample could have affected results
Ages and Stages Questionnaire-3 (ASQ-3)	maternal variables and offspring variables, including breastfeeding	late-preterm children at higher risk of delay in commuicaion skills (30% at 36 months), late preterm birth was the main risk factor in suboptimal scores, developmental delays were stable between 24 and 36 months for preterm children	higher number of pregnant women with asthma because of the VDAART cohort study, small sample size, nonprofessional assessment, and short follow-up
Ages and Stages Questionnaire	prenatal risk, acute cesarean delivery, postnatal risk factors	early and late preterm scored poor than term-born for communication, late preterm born children had 74% greater odds of communication impairment at 18 months, which remained stable at 36 months	mothers had higher education attainment than average, bias in maternal self-report, possibility of insignificant adjustment of risk factors

Figure 3 – study characteristics cont.

## Risk of bias in included studies

Risk of bias was assessed for each individual study and compiled into two summary plots found below.

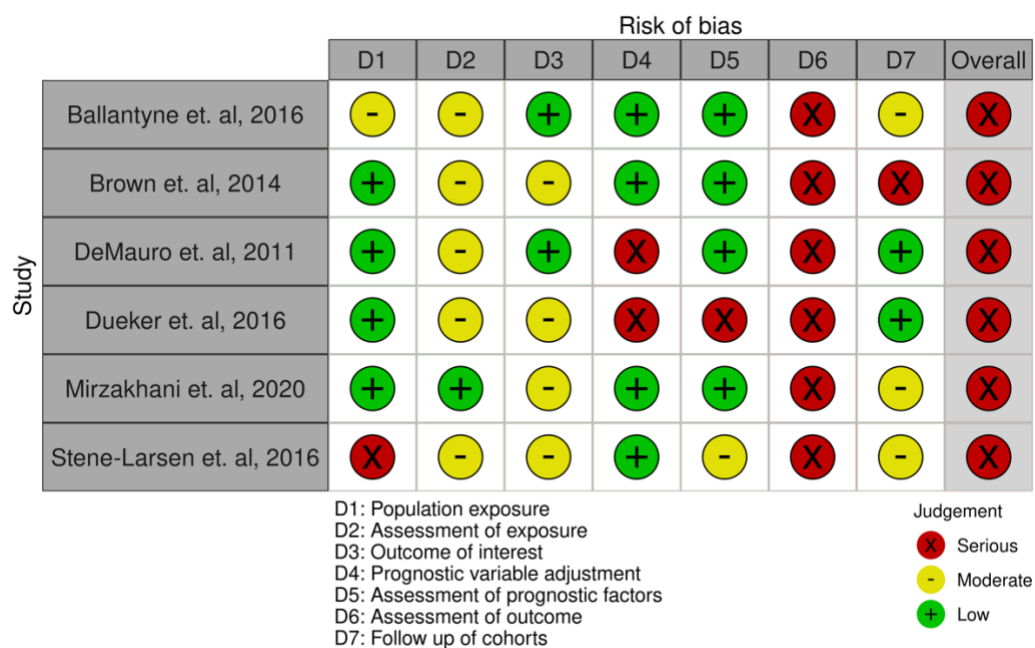


Figure 2 – Robvis traffic light plot

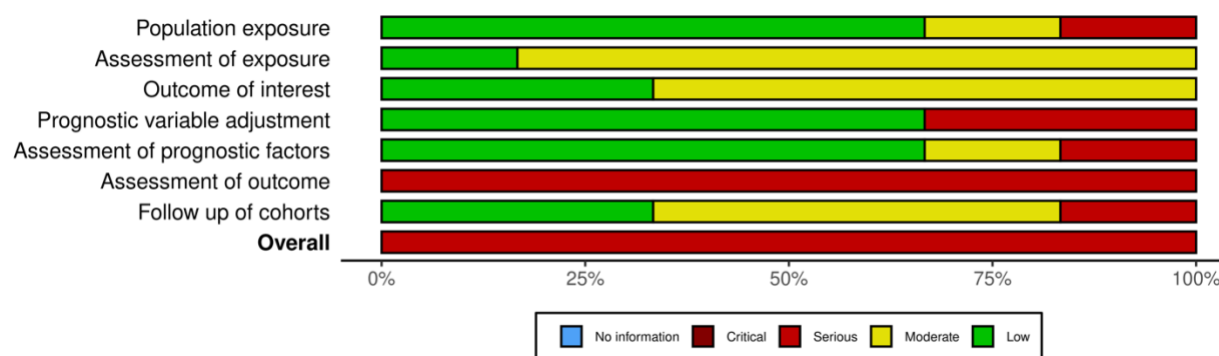


Figure 3 – Robvis summary plot

Across the six studies, the greatest risk of bias was found in the assessment of outcomes.

Following that, assessment of exposures, outcome of interest, and follow up of cohorts were the



areas of higher risk of bias. All six studies were considered to have a serious risk of bias for having at least “serious bias” in one domain. Bias in assessment of outcome was consistent across all studies because each study used self-report, either using the ASQ or a different questionnaire, to assess outcome, which creates a serious risk of bias. Brown et al. (2014) presented a serious risk of bias for domain seven because missing outcome data was likely related to the fact that nonrespondents were more likely to have social risk factors, lower income, and lower education. DeMauro et al. (2011) presented a serious risk of bias in domain four because their study did not match for many prognostic variables. Dueker et al. (2016) presented a serious risk of bias in domains four and five because the study did not present unique characteristics for each cohort and assess presence or absence of other factors. Stene-Larsen et al. (2014) presented a serious risk of bias in domain one because the population of infants in the study was drawn from data across an eight-year span, which introduces risk of bias for presenting to different points of care over a different time frame. The remainder of domains were either low to moderate risk of bias, based on the confidence in lack of bias for that domain.

## DISCUSSION

From the limited quantity of studies pertaining to the objective of this review, it can be concluded that more research needs to be conducted on this cohort of infants. There is still so much to be learned and investigated in this population of infants, toddlers, and young children who are born late preterm. The medical community understands that this is a population at risk, emphasizing with practitioners that infants born late preterm are at risk for growth and developmental delays.

Many of the studies reviewed here found an association between late preterm birth and communication delays at first glance (Ballantyne et al., 2016; Mirzakhani et al., 2020; Stene-Larsen et al., 2016). However, once adjusting for confounding variables, many of those findings were no longer significant (Brown et al., 2014). The researchers questioned whether social factors play a bigger role. This leaves questions for speech-language pathologists on whether they are staying abreast of the social factors and social determinants of health that so highly influence children and their families.

Some of the results shared here questioned whether other factors had a greater association with communication delays, including low birth weight for gestational age and the infant's need for longer hospitalization at birth (Ballantyne et al., 2016). This begs the question of whether SLPs are gathering this information to improve an understanding of the infant and their family.

Based on the study assessing feeding difficulties, late preterm infants and their caregivers may experience feeding difficulties and maternal anxiety at similar levels compared to infants born more preterm (DeMauro et al., 2011). Avoidant behaviors may play a longer lasting role than originally thought. The question becomes: how are speech-language pathologists ensuring

that all families with infants at any stage of preterm birth have access to supportive services early?

The conclusions from this study leave more questions for practice in the field of speech-language pathology and areas of future research relating to the cohort of infants born late preterm. This review directs to multiple avenues of study, including postnatal, maternal health, and social factors that may impact communication development, as well as assessment of outcomes using methods other than parental self-report.

### **Strengths of evidence:**

Each study reported in this review has unique strengths that accompany its limitations, and all of the studies maintained these same strengths in design and methodology: standardized developmental screening measure and comparison of late preterm infants to another cohorts of infants. Other strengths found in some studies include prospective data collection (Ballantyne et al., 2016; DeMauro et al., 2011; Mirzakhani et al., 2020; Stene-Larsen et al., 2014), controlling for maternal and infant factors (Ballantyne et al., 2016; Brown et al., 2014; Mirzakhani et al., 2020; Stene-Larsen et al., 2016), and large sample size (Brown et al., 2014; Dueker et al., 2016; Stene-Larsen et al., 2016).

### **Limitations:**

Among studies include in this review, there are a variety of limitations for the evidence included in the studies. One of the major limitations is that every study reported on in this review used a parental report screening-tool to assess infant development over a period. This can create a risk of bias because it is not a direct measure of assessment and can involve parental biases.

Screening-tools are only meant to screen and do not diagnose, so is difficult to make direct claims regarding communication delays or feeding difficulties. Furthermore, some of the studies conducted a prospective analysis on a cohort of infants whose mothers had factors that impact generalizability, for example: higher education or income levels than average or a higher number of asthma diagnosis (Stene-Larsen et al., 2016; Ballantyne et al., 2016; Mirzakhani et al., 2020). Small sample size, insignificant adjustment of risk factors, and lack of information on feeding or parent mental health are a few of the other potential limitations (Dueker et al, 2016; Brown et al., 2014; DeMauro et al., 2011).

Limitations for this systematic review include potential bias associated with the methods of literature search and review. The review process was done manually, and no automation tools were used to sort or deduplicate references. This could lead to potential error in missing duplicates or missing a citation applicable to the review. Furthermore, another limitation of this review is the analysis of results and lack of generalizability. Many of the individual studies reported in this review had limitations to generalizability because of loss to follow-up. Because the author used a narrative synthesis style, and there was a lack of statistical syntheses of results, it is more difficult to find either consistency or heterogeneity among studies based on statistical evidence. There is also potential bias in the interpretation of evidence because the author manually extracted data from the included articles. There is a risk of bias in missing or misinterpreting data in individual extraction and in the narrative synthesis.

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