

Oral feeding skills in premature infants: A concept analysis

Dyah Dwi Astuti^{1,3} , Yeni Rustina² , and Dessie Wanda^{2*} 

¹ Postgraduate Program, Faculty of Nursing, Universitas Indonesia, Depok 16424, Indonesia

² Department of Pediatric Nursing, Faculty of Nursing, Universitas Indonesia, Depok 16424, Indonesia

³ Department of Pediatric Nursing, Poltekkes Kemenkes Surakarta, Letjend Sutoyo, Mojosongo, Surakarta 57127, Indonesia



Abstract

Background: The delay in developing oral feeding skills becomes a problem experienced by premature infants. One of the reasons for the delay may be related to inconsistent definitions of oral feeding skills, which can cause discrepancies in the provision of nursing care.

Objective: This study aimed to clarify the concept of oral feeding skills in premature infants.

Methods: The Walker and Avant concept analysis method was used. A literature search was also conducted from five databases: CINAHL, PubMed, ProQuest, EMBASE, and Google Scholar, to find articles between January 2020 and December 2022.

Results: The literature search obtained 20 articles on oral feeding skills from various disciplines. Five attributes were developed from the concept analysis, including (1) coordination ability to suck, swallow, and breathe, (2) the ability to regulate oral-motor functions, (3) the ability to regulate sensory functions, (4) the ability to maintain the stability of physiology function, and (5) the ability to regulate feeding behavior. Antecedents to oral feeding skills include immaturity of the nervous system, gestational age, feeding intolerance, increased length of stay and cost of care, increased rehospitalization, stress on parents, and increased morbidity and mortality. Consequences include optimization of growth and development, reduction of length of stay and cost of hospitalization, increased bonding attachment, increased self-efficacy of parents in caring for premature infants, and improvement of the quality of life of premature infants.

Conclusion: The concept analysis provides five comprehensive attributes and their antecedents and consequences. However, this concept can be used to provide nursing care to premature infants, assess the criteria for discharge, and optimize nutrition for the growth and development of premature infants.

Keywords

concept analysis; nursing; oral feeding skills; premature infants

*Corresponding author:

Dessie Wanda, S.Kp., M.N., Ph.D

Faculty of Nursing, Universitas Indonesia
 Jl. Prof. Dr. Bahder Djohan, Kampus UI
 Depok Jawa Barat 16424, Indonesia
 Email: dessie@ui.ac.id

Article info:

Received: 27 March 2022

Revised: 28 April 2022

Accepted: 7 July 2022

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E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Background

Premature infants are a vulnerable group with delayed development of oral feeding skills (da Rosa Pereira et al., 2020; Pados et al., 2021). The development of oral feeding skills in premature infants is a challenge for nurses and parents, and oral feeding skills are essential indicators for premature infants' discharge. Approximately 40% of premature infants have difficulty transitioning from enteral to oral feeding (da Rosa Pereira et al., 2020). A systematic study showed that premature infants still had problems with oral feeding for the first four years of life, with a prevalence of 42% (Pados et al., 2021).

Internal and external factors cause oral feeding skills problems in premature infants. Internal factors include immaturity that causes various complications such as respiratory distress syndrome, intracranial hemorrhage, and bronchopulmonary dysplasia (Chen et al., 2021). These complications disrupt the nervous system that regulates the development of oral feeding skills (Chen et al., 2021). On the

other hand, external factors come from environmental exposure during treatment in intensive care. Procedures that cause pain in the oral area, such as intubation, suctioning, removing the plaster from the oral area, and inserting a tube into the stomach, provide an unpleasant negative experience in giving oral feedings to premature infants (Kamity et al., 2021).

Problems with oral feeding skills in premature infants cause the attainment of full feed feeding to be unfulfilled. It impacts growth and development delays, such as increasing stunting risk (Kamran et al., 2021). Another impact that appears includes the increased length of stay and problems in financing treatment (Chen et al., 2021). Issues with oral feeding skills can continue until post-treatment in the intensive care unit, which causes high rehospitalization rates and stress due to insufficient breast milk intake, such as hyperbilirubinemia (Azuma & Maron, 2020).

The term oral feeding skills are often used in multidisciplinary clinical practice. The terms used include oral feeding success, feeding intolerance, infant feeding

responsiveness, oral feeding readiness, oral feeding performance, feeding behavior, and oral feeding competence (Azuma & Maron, 2020). However, the definition of oral feeding skills is debatable, and some experts define oral feeding skills based on visual, sensory, and behavioral observations. In addition, several experts use a developmental approach to describe oral feeding skills, and they represent oral feeding skills as regulation and stabilization of physiological status and behavioral expression (Kamran et al., 2021).

The use of oral feeding skills in research is still not comprehensive. Some researchers use research instruments that focus on the ability of premature infants to suck, swallow, and breathe, emphasizing safety assessment when oral feeding. Practically, the research instrument still does not figure out the stages of development of oral feeding skills, such as the stages of sensory and behavioral development. As a result, it causes the research instrument to be unable to figure out valid and reliable results (Azuma & Maron, 2020).

The use of inconsistent terms impacts the inaccuracy of assessment, risk identification, implementation, and evaluation of nursing. The examples of inappropriate assessment cases of oral feeding skills at the time of discharge of premature infants may cause discrepancies in nursing interventions. Furthermore, using inappropriate terms in research will cause errors in measuring the infant's oral feeding skills variable (Girgin et al., 2021). In light of this, the concept analysis of oral feeding skills is essential to appropriately provide a clear definition in clinical practice and research. This paper will describe the conceptual analysis of premature infants' oral feeding skills using Walker and Avant (2014)'s approach.

Concept and the Aim of the Analysis

The concept of interest is the oral feeding skills of premature infants in the intensive care unit. Researchers identify, analyze, and clarify the concept more comprehensively to obtain a definition that can be applied in a more practical and holistic manner in the provision of nursing care for premature infants in intensive care rooms, such as in nursing assessments, establishing nursing diagnoses, and making nursing care plans (Walker & Avant, 2014).

All Uses of the Concept

The method in identifying the use of this concept was a literature review. The literature review aimed to analyze the use of the concept from various literature to obtain new views on premature infants feeding skills. Therefore, a literature review is essential to provide figures on the use of multidisciplinary concepts to analyze the diversity of applications using concepts from various disciplines (Walker & Avant, 2014).

The database sources used were CINAHL, PubMed, ProQuest, EMBASE, and Google Scholar. The author considered database sources to be able to explore the use of databases from various disciplines such as nursing, medical, psychology, behavioral, and social sciences. The author used the keywords "oral feeding skills" and "definition" and developed the major heading (MH) and subject heading (SH)

in every search in the database. The inclusion criteria were publications in the form of journal articles from January 2020 to December 2022, in English-language journals, and full-text articles. Researchers used Walker and Avant (2014)'s approach to analyze the concept of oral feeding skills.

The selection of articles was carried out by reading the titles and abstracts. Then, articles appropriate for the concept analysis were selected based on full text. The results of the literature study obtained 20 research articles. The articles included four articles in the field of nursing, eight in the field of medical science (pediatric and neonatology), four in the field of rehabilitation and neurology, and one in the field of nutrition, psychology, physiology, and tropical disease. Table 1 describes the definition of the concept of oral feeding skills.

Defining Attributes

At this stage, the researchers identified the characteristics of the concept repeatedly. Next, the researchers classify keywords with the same meaning into keyword clusters. Finally, the researchers gave names or labels to keyword clusters so that attributes were obtained to clarify the definition of the oral feeding skills concept (Walker & Avant, 2014). At this stage, the researchers developed five attributes of oral feeding skills, including (1) the ability to coordinate sucking, swallowing, and breathing, (2) the ability to regulate oral-motor functions, (3) the ability to regulate sensory function, (4) the ability to maintain the stability of psychology, (5) and the ability to regulate the feeding behavior of premature infants. The operational definition of oral feeding skills is the infant's ability to coordinate sucking, swallowing, and breathing; regulation of oral-motor function; regulation of sensory function, maintain psychological stability; and regulation of feeding behavior to caregivers or the environment to fulfill nutrition needs. Table 2 describes the steps for defining attributes.

The first attribute of coordinated sucking, swallowing, and breathing is described as regulating the contraction and relaxation of the esophagus, as well as the complex interactions of the gastrointestinal, cardiorespiratory, and nervous systems. The ability to swallow in infants develops from 12 to 14 weeks of gestation, while the ability to suck develops at 14 weeks of pregnancy. The ability to coordinate sucking-swallowing-breathing is achieved at 34 weeks of gestation. Sucking-swallowing-breathing coordination ability will impact a safe oral feeding process, and no aspiration occurs (Chen et al., 2021).

The second attribute is the ability to regulate oral-motor function. This attribute is a complex process of the musculoskeletal system through the synchronous movement of the oral area. The ability of this oral-motor function is shown by the infants opening the mouth, positioning the tongue, and maintaining the neck and head posture. This attribute is the result of the interaction between the central nervous system and the musculoskeletal system. The maturation of both systems affects the success of oral feeding (Brantes et al., 2021).

The third attribute is the ability to regulate sensory functions. This ability responds to olfactory, auditory, vestibular, and kinesthetic sensations. For example, the ability of this attribute is the positive response of premature infants to the olfactory stimuli of the smell of breast milk and the mother's

voice, as well as the infant's response to the kinesthetic stimuli of the mother's touch. The ability to regulate sensory function results from neurodevelopmental development (Sasmal & Shetty, 2021).

The fourth attribute of the ability to regulate the stability of physiological status is the ability to prevent airway disorders such as aspiration and minimize energy expenditure. The ability on this attribute is related to the attribute of sucking-swallowing-breathing coordination ability. Success in this ability is indicated by the stability of oxygenation, minimal

energy expenditure, and the absence of fatigue (Sasmal & Shetty, 2021).

The fifth attribute is the ability to regulate feeding behavior, namely providing feeding cues to caregivers or the environment. The process of oral feeding is the infant's interaction with caregivers or the environment. Infants give feed cues, while caregivers or the environment recognize these cues. Infants with oral feeding readiness show active cues are awake, focus attention on the environment and make eye contact with caregivers (Azuma & Maron, 2020).

Table 1 Concept definitions of oral feeding skills based on literature review ($n = 20$ articles)

No	Authors	Field	Definition
1.	Brantes et al. (2021)	Nursing	The skills to regulate and coordinate complex processes, including the role of physiologists, behavioral regulation, oral-motor regulation, and sucking, swallowing, and breathing coordination to meet nutritional needs.
2.	Samane et al. (2022)	Nursing	The skills to give cues to the infants feeding behavior to the environment or caregivers so that self-regulation is formed to maintain the stability of the physiological coordination of breathing, sucking, and breathing.
3.	Girgin et al. (2021)	Nursing	The complex interactions between the gastrointestinal, cardiorespiratory, and nervous systems result in oral-motor coordination.
4.	Sasmal and Shetty (2021)	Nursing	The skills to coordinate sucking-swallowing-breathing, prevent desaturation episodes, and minimize energy expenditure.
5.	Viswanathan and Jadcherla (2020)	Neonatology	Propelling milk from the mouth to the stomach involves a complex coordination of sucking-swallowing-breathing, regulating a relaxation and contraction rhythm between the upper and lower esophageal sphincter (UES, LES).
6.	Putnick et al. (2022)	Pediatric	Complex activities that require coordination of oral-motor, neurological (gives hunger cues), gastrointestinal, cognitive (sensory perception responses), and social cues.
7.	Zinoni et al. (2021)	Neonatology	The skills to suck feeding volume and prevent apnea and desaturation from occurring.
8.	Azuma and Maron (2020)	Neonatology	Complex developmental stages that require integrating sensory inputs such as sound, smell, and touch involve maturation of motor coordination and stabilization of the respiratory system.
9.	Patton et al. (2022)	Pediatric	The skills to fulfill nutrition needs for growth and development include meeting the needs of energy, protein, fat, and carbohydrates and reducing the occurrence of intolerance to feedings, such as desaturation and bradycardia during feeding, preventing food penetration into the lungs.
10.	Li et al. (2021)	Neonatology	The complex processes of the sensory and motor systems that are influenced by many factors.
11.	Majoli et al. (2021)	Neonatology	Oral feeding skills are the ability to coordinate sucking-swallowing- breathing.
12.	Kamity et al. (2021)	Neonatology	The skills to swallow begin with swallowing a bolus of food and end in the stomach, as a result of coordinating the functions of sucking, swallowing, respiration, and maintaining the airway and neurological control.
13.	Chen et al. (2021)	Medical Rehabilitation	Complex skills become the integration of sucking, swallowing, and breathing.
14.	Widman-Valencia et al. (2021)	Neurologist	The complex process is coordinated bilateral contraction and relaxation of muscles in the mouth, tongue, larynx, pharynx, and esophagus.
15.	Pineda et al. (2020)	Occupational Therapy	Behavioral response with coordination between sucking patterns, protecting the airway during swallowing.
16.	Ostadi et al. (2021)	Speech Therapy	Skills resulted from developing oral-motor skills, maintaining posture, and coordinating sucking, swallowing, and breathing.
17.	Philippe et al. (2022)	Nutrition	Oral feeding skills provide optimal nutrition by creating an environment that supports the skills to stimulate behaviors that support feeding behaviors and practices by involving the role of parents.
18.	Elsewadi et al. (2022)	Physiology	The skills to coordinate between swallowing, sucking, and breathing.
19.	Segala et al. (2022)	Psychology	Oral feeding skills regulate oral, auditory, vestibular, and kinesthetic sensations associated with stimuli to achieve a safe feeding experience.
20.	Gu et al. (2022)	Tropical Disease	The regulation of feeding behavior and physiology are influenced by the olfactory system, namely odorant receptors (ORs), odorant-binding proteins (OBPs), and odorant-degrading enzymes (ODEs).

Model Case

Nurse M, who works in the intensive care unit, gave oral breast milk through a bottle to Baby A. Baby A was 34 weeks gestation, six days old, and had a birth weight of 1,460 grams.

Nurse M observed awake status before giving oral fluids. Baby A appeared to be active, opened his eyes, and made eye contact. Nurse M then stimulated placing the tip of the bottle in the corner of the baby's left lip. Baby A seemed to turn to the left and look for the food sources. Baby A then opened the

mouth, pressed the lips and tongue against the jaw, maintained the stability of the head and neck muscles, and positioned the baby inflexion. Baby A seems to maintain a regular rhythm of sucking and feeding breast milk, there was a swallowing milk sound, and there was no hiccup sound. During feeding, Baby A did not appear tired; there was no cyanosis or apnea. The monitor showed a respiratory rate of 48 beats per minute, a heart rate of 148 beats per minute, and an oxygen saturation of 98%. Baby A fell asleep after being given breast milk.

The model case illustrates all the attributes of the concept of oral feeding skills as Walker and Avant (2014) claimed that the model case contains all attributes analyzed. The first attribute, the ability to coordinate sucking-swallowing-breathing, was shown in the case of maintaining sucking rhythm, no hiccup sounds, and no cyanosis and apnea. The

second attribute was the ability to regulate oral-motor functions; namely, the baby opened the mouth, pressed the lips, the tongue was in the opposite direction of the jaw, maintained the stability of the head and neck muscles, and flexed posture. The third attribute was the ability to regulate sensory functions. For example, the baby responds to the stimulus when the nurse performs tactile stimulation and the smell of milk at the corner of the baby's lips. The fourth attribute, the ability to maintain the stability of the function of physiologists, was characterized by respiratory rate, heart rate, and oxygen saturation within normal limits. The fifth attribute was the regulation of feeding behavior when the nurse conducts an awake status assessment which shows the baby was active, opened his eyes, made eye contact with the caregiver, and the baby fell asleep after the feeding needs were fulfilled.

Table 2 Keywords cluster in defining attributes

Keywords Cluster	Sources	Attribute
<ul style="list-style-type: none"> o Coordination of sucking, swallowing, and breathing o The complex interaction of the gastrointestinal, cardiorespiratory, and nervous systems. o Regulating the rhythm of relaxation between the upper and lower esophageal sphincters, contraction of the esophagus 	Brantes et al. (2021); Chen et al. (2021); Elsewadi et al. (2022); Girgin et al. (2021); Kamily et al. (2021); Majoli et al. (2021); Ostadi et al. (2021); Pineda et al. (2020); Samane et al. (2022); Sasmal and Shetty (2021); Viswanathan and Jadcherla (2020); Zinoni et al. (2021)	The ability to coordinate sucking-swallowing-breathing
<ul style="list-style-type: none"> o Oral-motor regulation o Maintaining posture o Oral-motor skills o Complex processes of the musculoskeletal system o Bilateral coordination of muscle contraction and relaxation o Maturation of motor coordination 	Azuma and Maron (2020); Brantes et al. (2021); Girgin et al. (2021); Li et al. (2021); Ostadi et al. (2021); Putnick et al. (2022); Segala et al. (2022); Widman-Valencia et al. (2021)	The ability to organize oral-motor functioning
<ul style="list-style-type: none"> o Olfactory system regulation o Response receptors (odorant receptors/ORs), Odorant-binding proteins (OBPs), Odorant-degrading enzymes (ODEs) o Sensory perception response o Integration of sensory input of sound, smell, and touch o Regulation of auditory, vestibular, and kinesthetic sensation 	Azuma and Maron (2020); Gu et al. (2022); Li et al. (2021); Putnick et al. (2022); Segala et al. (2022)	The ability to organize sensory functioning
<ul style="list-style-type: none"> o Physiological stability o Preventing desaturation and bradycardia o Preventing food penetration into the lungs o Preventing aspiration o Minimizing energy expenditure 	Azuma and Maron (2020); Brantes et al. (2021); Gu et al. (2022); Patton et al. (2022); Samane et al. (2022); Sasmal and Shetty (2021); Zinoni et al. (2021)	The ability to maintain physiologic stability
<ul style="list-style-type: none"> o Infants feeding behavior cues o Regulation of feeding behavior o Supporting feeding behavior o Social cues o Self-regulation 	Brantes et al. (2021); Gu et al. (2022); Philippe et al. (2022); Pineda et al. (2020); Putnick et al. (2022); Samane et al. (2022)	The ability to organize behavioral cue

Additional Cases

Borderline Case

Baby A has a gestational age of 34 weeks, chronological age of 6 days, and a birth weight of 1,460 grams, was currently being given oral feedings. Nurse M gave the Mother of Baby A an educational program from the beginning of care. Mother of Baby A was given education about the introduction of baby feeding cues, such as recognizing the baby's awake status, how to breastfeed, and recognizing signs of aspiration when feeding. Every day Mother of Baby A performed maternal therapeutic touch and maternal voice stimulus before starting

breastfeeding exercises. Mother of Baby A routinely cares for the Kangaroo Mother Care (KMC). Baby A's care room was subject to environmental settings such as noise and lighting. At the time of the assessment before discharge, the mother was able to breastfeed, the baby's sucking reflex was strong, the weight had increased, and the baby had reached full feed.

Contrary Case

Baby A has a gestational age of 34 weeks, a chronological age of 6 days, and a birth weight of 1,460 grams. There was no structured educational program during caring, and educational programs were provided shortly before discharge. Mother of

Baby A rarely visited and interacted with Baby A. Mother of Baby A had not performed KMC regularly. Baby A was cared for in an uncovered incubator and did not use nesting. At the time of the assessment before discharge, the mother had not been able to breastfeed and felt unable to care for the baby at home, the baby's suction reflex was weak, and the target for weight gain had not been reached.

A borderline case is illustrated as the concept analysis by loading the time and intensity of an event (Walker & Avant, 2014). In the borderline case, the health education intervention contained attributes the ability to coordinate sucking-swallowing-breathing, regulate feeding cues, and regulate physiological functions. The attributes of the ability to regulate sensory functions are figured Stimulation of Maternal therapeutic Touch, Maternal Voice Stimulus, KMC, and environmental regulation. On the contrary case, the figure did not show the attributes of the formulated concept. The impact of the absence of these attributes, among others, the mothers had not been able to breastfeed and felt unable to care for the baby at home, the baby's sucking reflex was weak, and the target of weight gain had not been achieved.

Antecedents

The antecedent is the event that occurs before the concept happens. An example of the antecedents of oral feeding skills is immaturity in premature infants (Walker & Avant, 2014). The antecedent concept of oral feeding skills of premature infants is influenced by gestational age and maturity of the nervous

system, such as reflex development (Kamran et al., 2021). The delay in oral feeding skills in premature infants may cause malnutrition, aspiration pneumonia, and feeding intolerance that can increase the morbidity and mortality of premature infants (Chen et al., 2021). In addition, the delay in developing oral feeding skills increases the length of hospitalization, problems in financing treatment, high rates of rehospitalization, and stress on parents (Azuma & Maron, 2020) (Figure 1).

Consequences

Consequences are the events resulting from the concept (Walker & Avant, 2014). The literature review results stated that the oral feeding skill intervention impacted the development and growth of premature infants (da Rosa Pereira et al., 2020; Soleimani et al., 2020). Samane et al. (2022) conducted a study on the attributes of the regulation of feeding behavior, namely the cue-based feeding educational intervention. The results showed that the intervention improved the attainment of full feed and reduced the length of hospitalization and cost of care. Fontana et al. (2018) conducted a study on the attributes of sensory function regulation with the KMC intervention, visual stimulation with the mother's facial recognition, and tactile stimulation with the massage. This study proved an increase in maternal self-efficacy in caring for premature infants and the formation of mother-infant bonding attachments (Figure 1).

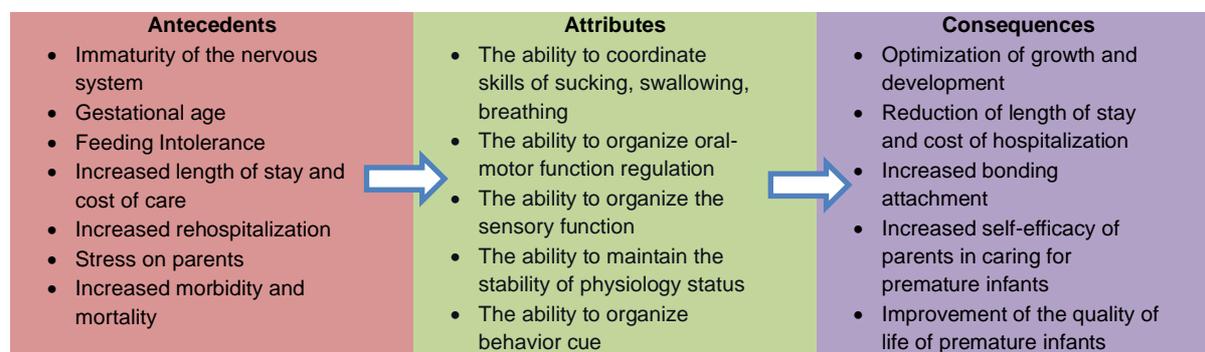


Figure 1 Antecedents, attributes, and consequences of oral feeding skills

Defining Empirical Referents

Empirical referents classify classes, categories, or actual phenomena by demonstrating the other concepts (Walker & Avant, 2014). The use of attributes for regulating sucking-swallowing-breathing coordination, the ability to regulate oral-motor functions, and the ability to control the stability function of physiology are found on the instruments of The Early Feeding Skills Assessment (EFS) (Kamity et al., 2021), Oral Feeding Quality scale (OFQS) (Kamran et al., 2021), and Neonatal Oral Motor Assessment Scale (NOMAS) (Kamran et al., 2021). EFS is an instrument to measure oral readiness to feed. NOMAS and OFQS are instruments that assess oral feeding skills that focus on evaluating the suction reflex. Attributes of the ability to regulate feeding behavior and sensory control functions are found on the instrument, the Oral Feeding Readiness scale (OFRS) (Kamran et al., 2021). The

use of instruments can assess the safety and development function appropriately. However, it is recommended for all existing instruments to include all five attributes developed in this study for assessing premature infants' oral feeding skills.

Implications for Nursing Practice

The concept analysis of oral feeding skills in premature infants resulted in five extended attributes. The five attributes describe the assessment of the concept of oral feeding skills both visually, sensory, physiologically, and feeding behavior. Attributes of the ability to regulate oral-motor function and suck-swallow-breath coordination are visually assessed. The attribute of the ability to control sensory functions describes the sensory assessment of concepts, while the attribute of the ability to regulate feeding cues behavior describes an evaluation of the behavioral development of premature infants.

The five attributes also illustrate the regulation of physiological functions, feeding safety, and behavioral expression. However, the results of this concept analysis answer the gap in oral feeding skills that is still a debate between visual, sensory, and behavioral assessments (Kamran et al., 2021).

The implications of the oral feeding skills analysis in premature infants have implications for clinical nursing practice, especially neonatology nursing, that the concept of oral feeding skills is comprehensive in terms of visual, sensory, and behavioral assessments. This concept is necessary for providing nursing care to premature infants, for nursing practice in assessing the criteria for returning premature infants, and for optimizing nutrition that has a long-term impact on the growth and development of premature infants (Azuma & Maron, 2020).

Conclusion

The concept analysis resulted in five attributes of oral feeding skills in premature infants: the ability to coordinate sucking, swallowing, and breathing; the ability to regulate oral-motor functions; the ability to control sensory functions; the ability to maintain the stability of physiological functions; and the ability to regulate feeding behavior. This comprehensive and holistic concept analysis can be used in the clinical practice of providing nursing care, for instance, applying the five attributes in assessing oral feeding skills as criteria for the discharge of premature infants. The study results can also be used to evaluate the existing instruments to better assess the development of premature infant oral feeding skills.

Declaration of Conflicting Interest

There are no conflicts of interest in this study.

Funding

None.

Acknowledgment

Acknowledgment to the Faculty of Nursing, Universitas Indonesia, especially the Doctoral Study Program in Nursing that has facilitated and supported the completion of this concept analysis.

Authors' Contributions

DDA conceptualized, designed, analyzed, and drafted the manuscript. YR and DW contributed to conceptualizing, analyzing, reviewing, and supporting concepts with intellectual content. All authors provided final approval of the version to be published.

Authors' Biographies

Dyah Dwi Astuti, M.Kep., Ns.Sp.Kep.An is a Pediatric Nursing Specialist and a Doctoral Student at the Faculty of Nursing, Universitas Indonesia. Her research interests are nursing care for low birth weight/premature infants and stunting in children.

Prof. Yeni Rustina, S.Kp., M.App.Sc., Ph.D is a Professor at the Department of Pediatric Nursing, Faculty of Nursing, Universitas Indonesia. Her research interests are Kangaroo Mother Care (KMC), nursing care for low birth weight/premature infants, developmental care for low birth weight/premature infants, and family-centered care for high-risk newborns.

Dessie Wanda, S.Kp., M.N., Ph.D is an Associate Professor at the Department of Pediatric Nursing, Faculty of Nursing, Universitas Indonesia. Her research interests are infectious disease, clinical education, reflective practice, and qualitative research.

Data Availability

Not Applicable.

Ethical Consideration

Not applicable.

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Cite this article as: Astuti, D. D., Rustina, Y., & Wanda, D. (2022). Oral feeding skills in premature infants: A concept analysis. *Belitung Nursing Journal*. <https://doi.org/10.33546/bnj.2107>