




# Swallowing difficulties in the different forms of food supply in congenital heart disease infants: a systematic review

Dificuldades de deglutição nas diferentes formas de oferta de alimentação em lactentes cardiopatas congênitos: uma revisão sistemática

Dificultades para tragar em las diferentes formas de su ministro de alimentos em lactantes com cardiopatias congénitas: una revisión sistemática

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## Abstract

**Introduction:** The safest way of feeding babies with heart disease can be a challenge for the multidisciplinary team to choose. **Objective:** To identify the main swallowing difficulties in the different forms of feeding in infants with congenital heart disease. **Methods:** The guiding question was: “What are the main swallowing difficulties in the different forms of feeding in infants with congenital heart disease?”. The population was defined as infants with heart disease, considering breastfeeding as exposure of interest and bottle feeding considered a comparison group. Swallowing difficulties were considered the outcome. Articles without language restriction were selected, regardless of the year of publication until April 2019, which presented in the title, abstract or body of the article a relationship with the objective

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### Author's contributions:

NBMS: Data collection; article writing.

VSGM: Data collection; article writing; article review.

LDRB: Article review.

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of the research and the eligibility criteria, with an observational design. After data extraction, the measurements were transformed into percentages and described in a qualitative synthesis. **Results:** A total of 828 articles were found, and after analysis, 11 articles were included in total. The main difficulties presented by infants with heart disease at the mother's breast were coughing, choking, cyanosis, drop in peripheral oxygen saturation and incoordination between sucking, breathing and swallowing. The swallowing difficulties most found in the offer of the mother's breast were: cough, choking, cyanosis, drop in saturation, incoordination between sucking-breathing-swallowing, fatigue, oral leakage, prolonged feeding time, inadequate lip sealing, inadequate nipple grip, and altered cervical auscultation. **Conclusion:** Infants with heart disease have swallowing difficulties both in the mother's breast and in the bottle, with a higher frequency of presentations of difficulties being observed with the bottle.

**Keywords:** Infant; Heart Diseases; Deglutition; Breast Feeding; Nursing Bottles.

## Resumo

**Introdução:** A forma de alimentação mais segura nos bebês cardiopatas pode ser um desafio para escolha da equipe multiprofissional. **Objetivo:** Identificar as principais dificuldades de deglutição nas diferentes formas de oferta de alimentação em lactentes cardiopatas congênicos. **Métodos:** A questão norteadora foi: "Quais as principais dificuldades de deglutição nas diferentes formas de oferta de alimentação em lactentes cardiopatas congênicos?". A população foi delimitada como lactentes cardiopatas, considerando amamentação como exposição de interesse e alimentação em mamadeira considerado grupo comparação. Dificuldades de deglutição foram consideradas desfecho. Foram selecionados artigos sem restrição de idioma, independentemente do ano de publicação até abril de 2019, que apresentassem no título, resumo ou corpo do artigo relação com o objetivo da pesquisa e os critérios de elegibilidade, com delineamento observacional. Após a extração dos dados, as medidas foram transformadas em porcentagem, e descritas em uma síntese qualitativa. **Resultados:** Foram encontrados 828 artigos ao total, sendo que após análises, foram incluídos 11 artigos ao total. As principais dificuldades apresentadas pelos lactentes cardiopatas em seio materno foram: tosse, engasgo, cianose, queda da saturação periférica de oxigênio e incoordenação entre sucção, respiração e deglutição. As dificuldades de deglutição mais encontradas na oferta de seio materno foram: tosse, engasgo, cianose, queda de saturação, incoordenação entre sucção-respiração-deglutição, fadiga, escape oral, tempo prolongado de alimentação, vedamento-labial inadequado, prensão inadequada do bico, e ausculta cervical alterada. **Conclusão:** Os lactentes cardiopatas apresentam dificuldades de deglutição tanto em seio materno quanto em mamadeira, sendo observada maior frequência de apresentações das dificuldades, com mamadeira.

**Palavras-chave:** Lactente; Cardiopatas; Deglutição; Aleitamento Materno; Mamadeiras.

## Resumén

**Introducción:** La forma más segura de alimentación en bebés con enfermedades del corazón puede ser un desafío para el equipo multidisciplinario para elegir. **Objetivo:** Identificar las principales dificultades deglutorias en las diferentes formas de alimentación en lactantes con cardiopatías congénitas. **Métodos:** La pregunta orientadora fue: "¿Cuáles son las principales dificultades deglutorias en las diferentes formas de alimentación en lactantes con cardiopatías congénitas?" La población se definió como lactantes con cardiopatías, considerando la lactancia materna como exposición de interés y la alimentación con biberón considerada una grupo de comparación. Las dificultades para tragar se consideraron el desenlace. Se seleccionaron artículos sin restricción de idioma, independentemente del año de publicación hasta abril de 2019, que presentaran en el título, resumen o cuerpo del artículo relación con el objetivo de la investigación y los criterios de elegibilidad, con un diseño observacional. Después de la extracción de datos, las medidas se transformaron en porcentajes y se describieron en una síntesis cualitativa. **Resultados:** Se encontraron un total de 828 artículos, y después del análisis, se incluyeron 11 artículos en total. Las principales dificultades que presentaron los lactantes con cardiopatía en el pecho materno fueron: tos, ahogo, cianosis, caída de la saturación periférica de oxígeno y falta de coordinación entre la succión, la respiración y la deglución. Las dificultades de deglución más encontradas en la oferta

del pecho de la madre fueron: tos, ahogo, cianosis, descenso de la saturación, descoordinación entre succión-respiración-deglución, fatiga, escape oral, tiempo de alimentación prolongado, sellado labial inadecuado, agarre inadecuado del pezón y auscultación cervical alterada. **Conclusión:** Los lactantes com cardiopatía presentan dificultades para la deglución tanto em el pecho materno como em el biberón, observándose una mayor frecuencia de presentaciones de dificultades con el biberón.

**Palabras clave:** Lactante; Cardiopatías; Deglución; Lactancia Materna; Biberones.

## Introduction

Congenital heart disease (CHD) can be defined as a structural alteration of the heart and/or great vessels, which are important for the performance of cardiac function<sup>1</sup>. This type of abnormality may or may not appear accompanied by cyanosis, which is an important physiological characteristic<sup>2</sup>. The incidence of CHD has been increasing in recent years, being present in approximately 12 -14 per 1,000 live births<sup>3</sup>.

Among the symptoms of CHD, signs such as tiredness when breastfeeding, color change, drop in peripheral oxygen saturation (SpO<sub>2</sub>) and increased heart rate are characteristic<sup>4</sup>. presence of dyspnea<sup>5</sup>. The symptoms of CHD can directly interfere with the feeding process, which can lead to nutritional, hydration and pulmonary function losses<sup>6</sup>. Cardiac alterations can lead to greater incoordination between suction, breathing and swallowing (SxRxD), thus increasing the risk of oropharyngeal dysphagia in this population<sup>7</sup>.

Dietary aspects end up being more difficult for infants with heart disease, especially with regard to acceptance of textures and the way food is offered, which may require adaptations for better acceptance by the child<sup>4</sup>. It is known that the biodynamics of swallowing have different characteristics depending on the way in which food is offered, either by breast (SM) or bottle, since they have functional and anatomical differences, such as shape, texture, odor, taste, temperature, elasticity, expressed milk flow and extraction medium<sup>8</sup>.

In order to verify these swallowing difficulties in patients with heart disease, a speech-language evaluation is recommended. The most commonly performed evaluations are the clinical evaluation of swallowing, which is performed by a speech therapist, and includes postural, positioning, structure and oral function aspects<sup>9</sup>. The gold standard assessment to assess swallowing is swal-

lowing videofluoroscopy, which allows the speech therapist and/or physician to assess other structures involved in swallowing, in addition to aspects that cannot be directly assessed through clinical assessment, such as velopharyngeal function, pharyngeal coordination, aspiration and penetration of food in the airways<sup>10</sup>

Considering the characteristics of infants with CHD and the differences in swallowing biomechanics brought about by the different forms of oral feeding<sup>6,7,8</sup>, it is important to identify and analyze the evidence already reported on this topic. It is also important to identify the most frequent feeding difficulties in this population and thus verify the most suitable form of feeding for these infants. With that, the objective of this research is to identify the main swallowing difficulties in the different forms of feeding in infants.

## Material and methods

This systematic review was conducted in accordance with the instructions of the Cochrane Collaboration<sup>9</sup> and was reported according to the PRISMA Guideline (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)<sup>10</sup>. The study protocol was registered in PROSPERO - (<http://www.crd.york.ac.uk/PROSPERO/>), under approval number CRD42019118011.

In this study, the guiding question was: “What are the main swallowing difficulties in the different forms of oral feeding in infants with congenital heart disease?”. For this purpose, a search was carried out in electronic databases, complemented by a manual search of other bibliographic resources in the health area related to swallowing in patients with heart disease, in order to minimize selection bias. Therefore, studies published up to April 2019 were included, with no deadline for starting searches as provided for in the PRISMA Guideline<sup>10</sup>. To search the databases, keywords were

identified in MeSH (Medical SubjectHeadings), DeCS (Descriptors in Health Sciences) and EM-TREE (Embase SubjectHeadings). The complete search strategy, with terms and descriptors used for PubMed, can be seen in Table 1. To increase the sensitivity of the search, terms and synonyms were incorporated into the search mode and the search was adapted to the requirements of each database. The search was carried out in the following bibliographic databases: Medline, The Cochrane Central

Register of Controlled Trials and EMBASE, Latin American and Caribbean Literature in Health Sciences, CidSaude, PAHO, REPIDISCA, BDENF, Med Carib, WHOLIS, IBECS, Scielo and Google Scholar.

Only studies with an observational design were included (cohort, case-control, cross-sectional, case study and case series), with no restriction on language or publication date, with children of both sexes, aged 0 to 2 years, with CC, who presented

**Table 1.** Search strategy used in the PubMed database

<b>(#1) Patient</b>	"Infant[Mesh]" OR "Infants" OR "Infant, Newborn[Mesh]" OR "Infants, Newborn" OR "Newborn Infant" OR "Newborn Infants" OR "Newborns" OR "Newborn" OR "Neonate" OR "Neonates"
<b>(#2) Exposure</b>	"Heart Diseases[Mesh]" OR "Disease, Heart" OR "Diseases, Heart" OR "Heart Disease" OR "Cardiac Diseases" OR "Cardiac Disease" OR "Disease, Cardiac" OR "Diseases, Cardiac" OR "Heart Defects, Congenital[Mesh]" OR "Congenital Heart Defect" OR "Defect, Congenital Heart" OR "Heart, Malformation Of" OR "Defects, Congenital Heart" OR "Heart Abnormalities" OR "Heart Defect, Congenital" OR "Abnormality, Heart" OR "Abnormalities, Heart" OR "Heart Abnormality" OR "Congenital Heart Defects" OR "Cardiovascular Abnormalities[Mesh]" OR "Abnormalities, Cardiovascular" OR "Abnormality, Cardiovascular" OR "Cardiovascular Abnormality"
<b>(#3) Outcome</b>	"Breast Feeding[Mesh]" OR "Feeding, Breast" OR "Breastfeeding" OR "Breast Feeding, Exclusive" OR "Exclusive Breast Feeding" OR "Breastfeeding, Exclusive" OR "Exclusive Breastfeeding" OR "Bottle Feeding[Mesh]" OR "Bottle Feedings" OR "Feeding, Bottle" OR "Feedings, Bottle" OR "Bottlefeeding" OR "Bottlefeedings"
<b>Search</b>	<b>#1 AND #2 AND #3</b>

data related to swallowing. In this study, exposures were considered instead of interventions, with breastfeeding considered as exposure of interest and bottle feeding considered non-exposure. Swallowing difficulties were considered the main outcome of this review, including studies that present self-reports, data from medical records, clinical and complementary assessments of swallowing. Studies that did not present the outcomes studied were excluded.

Studies were initially analyzed by title and abstract by two independent evaluators, including studies that met the eligibility criteria, listing the study as "included", "excluded" or "unclear". Discrepancies were discussed between reviewers (N.B.M.; VSGM) and full texts of the studies included in this step were obtained and evaluated independently by the two reviewers. The reasons for exclusion of the evaluated full texts were re-

corded and a third reviewer (L.D.R.B.) participated in the research to carry out possible ties between the articles that would be included or not. After the consensus or deliberation of the third reviewer, the included articles were transferred to data extraction, following a standard form in Excel© (Microsoft Corporation, USA), in which the following variables were extracted: methodological design, number and characteristics of subjects, form of feeding, exposure (breastfeeding) and comparison group (bottle-feeding) characteristics, and outcome outcomes. Disagreement situations were decided by the third reviewer.

For each outcome of interest, the number of participants in each group, baseline, and mean (or median) change, standard deviations (SD) and interquartile and baseline intervals (or standard errors, or confidence intervals) were extracted. when present. After extracting the data, it was possible to

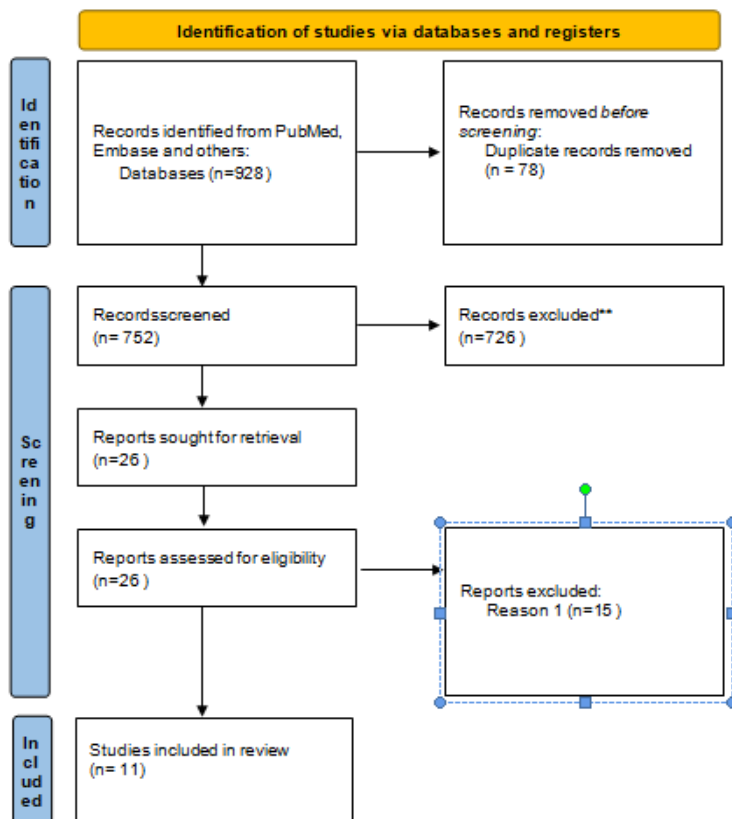
transform the measurements into percentages, but those that could not be transformed were described in a qualitative synthesis. Due to the heterogeneity of the studies, it was not possible to carry out a meta-analysis of the data.

The risk of bias was recorded for each study using the “Quality Assessment Tools”<sup>13</sup>, specific for observational studies. For this purpose, it was applied by two independent evaluators (N.B.M.; V.S.G.M.) and the strength of evidence was classified by reference to the total of positive results for the 14 criteria recommended in the tool. In the present investigation, studies with a “yes” answer to questions 7, 8, 9, 10, 11 and 14, or those with adequacy for at least 50% of the 14 items, were considered to have a lower risk of bias. In the end, a third evaluator (L.D.R.B) applied the instrument as

a tiebreaker, when there was no agreement between the other evaluators.

## Results

As identified in Figure 1, 828 records were found in PubMed, Cochrane, EMBASE and other sources. After excluding 78 duplicate records, titles and abstracts of 752 records were analyzed. Of these, twenty-six articles were selected by the two evaluators for complete reading, of which fifteen pre-selected articles were excluded for not presenting the outcome of the present study. At the end of the search, eleven articles were included in the present research, and in these selected articles, there are 430 patients in total.



**Figure 1.** presents the characteristics of the included studies.

Table 2 presents the characteristics of the included studies, highlighting the designs, sample number, patient age, total number of patients with surgical correction performed, type of instrument

used to verify eating difficulties, the total number of patients who had swallowing and feeding difficulties and the percentage of these difficulties.

**Table 2.** Characteristics of the studies

Study, Year	Kind of study	(n)*	Average Age (days)	Surgical Correction	Type of Assessment	Eating and swallowing difficulties (n)*	Eating and swallowing difficulties (%)
Marino et al., 1995 <sup>19</sup>	Transversal	7	15,14	6	Clinical evaluation of swallowing	4	57,14
Clemente et al., 2000 <sup>15</sup>	case-control	64	411	59	Quiz	11	17,18
Jadcherlaet al., 2009 <sup>16</sup>	Transversal	69	NI	64	Medical record analysis	NI	NI
Monteiro et al., 2012 <sup>5</sup>	Transversal	132	282,9	21	Quiz	30	22,72
Pereira, 2012 <sup>17</sup>	Case series	10	105	8	Clinical evaluation of swallowing	8	80
Pereira et al., 2015 <sup>21</sup>	Transversal	19	96	19	Clinical evaluation of swallowing	16	84,21
Tregayet al., 2016 <sup>14</sup>	Transversal	20	38,57	20	Quiz	11	55
Souza et al., 2017 <sup>8</sup>	Transversal	31	21	31	Clinical evaluation of swallowing	23	74,19
Rickman 2017 <sup>22</sup>	Transversal	46	NI	1	Quiz	NI	NI
Almeida et al., 2018 <sup>18</sup>	Case report	1	15	1	Clinical evaluation of swallowing	1	100
Miranda et al., 2019 <sup>20</sup>	Transversal	31	21	31	Clinical evaluation of swallowing	23	74,19

According to the data in Table 3, among the eleven articles selected for the study<sup>6,8,14-22</sup>, eight of them<sup>6,8,16,17,19-22</sup> brought information about patients who had already been breastfed, which was associated with other complementary feeding methods

or not. Nine studies<sup>6,8,14,15,17,19-22</sup> presented data on bottle feeding and six articles<sup>6,8,14,18-21</sup> presented data on BH and bottle feeding, associated. Among the eleven studies included in the review, three<sup>14,16,20</sup> also brought data on the use of alternative feeding.

**Table 3.** Ways of feeding and swallowing difficulties

Study, Year	MS (n)	Difficulties (n)	Difficulties (%)	Bottle (n)	Difficulties (n)	Difficulties (%)	MS+Bottle (n)	Difficulties (n)	Difficulties (%)	VA (n)	Difficulties (n)	Difficulties (%)
Marino et al., 1995 <sup>19</sup>	7	7	100%	7	4	57,14%	7	4	57,14%	0	NA	NA
Clemente et al., 2000 <sup>15</sup>	0	0	0	25	11	44%	0	0	0	0	0	0
Jadcherla et al., 2009 <sup>16</sup>	64	NE	NE	0	NE	NE	0	0	0	5	NE	NE
Monteiro et al., 2012 <sup>8</sup>	21	NE	NE	13	NE	NE	10	NE	NE	0	0	0
Pereira, Levy, 2012 <sup>17</sup>	2	1	50%	8	7	87,5%	0	0	0	0	0	0
Pereira et al., 2015 <sup>21</sup>	5	3	60%	12	12	100%	1	1	100%	0	0	0
Tregay et al., 2016 <sup>14</sup>	0	0	0	9	7	77,77%	1	1	100%	9	3	33,33%
Souza et al., 2017 <sup>8</sup>	11	NE	NE	15	NE	NE	5	NE	NE	0	0	0
Rickman, 2017 <sup>22</sup>	33	NE	NE	9	NE	NE	0	0	0	9	NE	NE
Almeida et al., 2018 <sup>18</sup>	0	0	0	0	0	0	1	1	100%	0	0	0
Miranda et al., 2019 <sup>20</sup>	16	NE	NE	19	NE	NE	4	NE	NE	8	NE	NE

Subtittle: NE – not specified; incoordination SxRxD – sucking, breathing, swallowing; VA – alternative route; SM – maternal breast; AC – cervical auscultation; RR – respiratory rate; HR – heart rate; O2 – oxygen/saturation.

The evaluations identified in the eleven articles included<sup>6, 8, 14-22</sup>, were obtained through three different ways: four articles<sup>6,14,15,22</sup> obtained data through questionnaires applied with parents, another six studies<sup>6, 17-21</sup> brought data obtained through the clinical evaluation of swallowing, and one study<sup>14</sup> obtained data through the analysis of medical records.

Table 3 presents data found in the articles according to the variables of interest: bottle, SM and alternative route. In this same table, data were extracted when specified in the article, according to the proposed subdivision by way of feeding CC infants.

According to Table 4, the most frequent swallowing alterations found in the offer in MS were coughing, choking, cyanosis, drop in SpO<sub>2</sub>, incoordination between SxRxD<sup>6, 19, 21</sup>. In the offer in bottle, the most frequent alterations were incoordination between SxRxD, cough, fatigue, drop in peripheral oxygen saturation (SPO<sub>2</sub>), oral leak,

prolonged feeding time, inadequate lip seal, inadequate nipple grip, altered cervical auscultation, choking and cyanosis<sup>6, 15, 17, 21</sup>.

Some studies did not differentiate the feeding difficulties found with the way in which it was offered either in SM or bottle. The most prominent alterations were increased respiratory rate, drop in SpO<sub>2</sub>, increased heart rate, weak and arrhythmic sucking, cyanosis, reflux, dyspnea and malnutrition<sup>6,19,20,22</sup>. Of the selected articles, four<sup>8,17,19,21</sup> brought quantitative data on swallowing disorders, in the different forms of food supply. It was possible to observe divergences in the findings presented in these four studies regarding signs suggestive of aspiration. It should be noted that all the included studies that brought data on difficulties both with MS and with a bottle, obtained similar results, in which infants with CHD evaluated had a lower number of signs suggestive of penetration and/or laryngotracheal aspiration when offered MS.

**Table 4.** Types of Difficulties in the Different Oral Offers

study, year	MS	Feeding bottle	MS+ Feeding bottle
Marino et al., 1995 <sup>19</sup>	saturation drop	saturation drop	saturation drop
Clemente et al., 2000 <sup>15</sup>	NI	Tiredness, prolonged eating time.	NI
Jadcherla, et al, 2009 <sup>16</sup>	NI	NI	NI
Monteiro et al., 2012 <sup>6</sup>	Cyanosis, reflux, dyspnoea, malnutrition	Cyanosis, reflux, dyspnoea, malnutrition	Cyanosis, reflux, dyspnoea, malnutrition
Pereira, Levy, 2012 <sup>17</sup>	Desaturation, fatigue, cough	Incoordination between SxRxD, cough, fatigue, desaturation, oral leakage	NI
Pereira et al., 2015 <sup>21</sup>	Incoordination between SxRxD, desaturation.	Incoordination between SxRxD, oral escape, desaturation, stasis in the oral cavity, cyanosis, cough	Cough, SxRxD incoordination, oral leak
Tregay et al., 2016 <sup>14</sup>	NI	NI	NI
Souza et al., 2017 <sup>8</sup>	Inadequate sealing and gripping, pauses, incoordination between SxRxD, AA, coughing, choking, respiratory distress, cyanosis, pallor	Inadequate sealing, nipple grip, pauses, Incoordination between SxRxD, AA, cough, choking, respiratory distress, cyanosis, pallor.	NI
Rickman, 2017 <sup>22</sup>	Weak and arrhythmic sucks	Weak and arrhythmic sucks	NI
Almeida et al., 2018 <sup>18</sup>	NI	NI	NI
Miranda et al., 2019 <sup>20</sup>	Increased RR, decreased O2, increased HR	Increased RR, decreased O2, increased HR	Increased RR, decreased O2, increased HR

Subtitle: RR – respiratory rate, HR – heart rate, SxRxD – suckingXbreathingXswallowing, AA – altered auscultation, NI – not informed.

The evaluation of all studies was carried out using the “Quality Assesment Tools”, and is illustrated in Table 5. Considering the item “does not apply” in which the articles were classified when the question did not apply to the study methodology. Of the articles selected, eight of the eleven

articles had a low risk of bias, with two articles<sup>8,20</sup> having a low risk of bias, with a better methodological description exposed in the articles. Three other articles<sup>6, 14, 15</sup> showed a high risk of bias for the analyzed criteria.

**Table 5.** Risk of Bias Assessment (QualityAssessment Tools)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Marino et al., 1995 <sup>19</sup>	S	S	NA	S	N	N	NA	S	S	NA	S	N	NA	N
Clemente et al., 2000 <sup>15</sup>	S	NA	NA	S	N	N	NA	S	N	NA	S	NA	NA	N
Jadcherla, et al, 2009 <sup>16</sup>	S	S	NA	S	N	N	NA	S	S	NA	S	N	NA	N
Monteiro et al., 2012 <sup>6</sup>	S	S	NA	N	N	N	NA	S	N	NA	N	N	NA	N
Pereira et al, 2012 <sup>17</sup>	S	S	NA	S	N	N	NA	S	S	NA	S	N	NA	N
Pereira et al., 2015 <sup>21</sup>	S	S	NA	S	N	N	NA	S	S	NA	S	N	NA	N
Tregay et al., 2016 <sup>14</sup>	S	NA	NA	S	N	N	NA	S	N	NA	S	NA	NA	NA
Souza et al., 2017 <sup>8</sup>	S	S	S	S	N	S	NA	S	S	NA	S	NA	NA	S
Rickman, 2017 <sup>22</sup>	S	S	NA	S	N	N	NA	S	N	NA	S	NA	NA	N
Almeida et al., 2018 <sup>18</sup>	S	S	NA	NA	N	N	NA	S	S	S	S	N	NA	N
Miranda et al., 2019 <sup>20</sup>	S	S	NA	S	N	S	NA	S	S	NA	S	N	NA	S

Caption: S - Yes; N - No; NA- Not applicable. The questions evaluated are: 1- Was the research question or objective of this article clearly stated?; 2- Was the study population clearly specified and defined? Is the cohort population free of the outcomes of interest at the time they were recruited?; 3- Was the participation rate of eligible persons at least 50%? 4- Were all subjects selected or recruited from the same or similar populations (including the same time period)? Were the inclusion and exclusion criteria for the study pre-specified and uniformly applied to all participants?; 5- Was a justification of the sample size, power description or variance and effect estimates provided?; 6- For the analyzes in this article, was interest exposure measured before the result was measured?; 7- Was the schedule sufficient to reasonably expect an association between exposure and outcome, if any?; 8- For exposure that can vary in amount or level, did the study examine different levels of exposure in relation to outcome? 9- Were the exposure measures clearly defined, valid, reliable and implemented consistently in all study participants?; 10- Was the exposure evaluated more than once over time?; 11- Were the outcome measures clearly defined, valid, reliable and consistently implemented in all study participants?; 12- Were the outcome assessors blinded to the participants' exposure status?; 13- Was the loss to follow-up after baseline 20% or less?; 14- The main potential confounding variables were measured and statistically adjusted for their impact on the relationship between exposure(s) and outcome(s).



## Discussion

Few studies were found in the literature that presented data on the difficulties in the different forms of food supply. Most of the studies in this systematic review are cross-sectional studies that are carried out in a short period of time and characterized by the analysis of the relationship between the frequency of the disease or other condition of interest and other characteristics of the population at a given time and place<sup>23</sup>. It should be noted that these are studies with cross-sectional designs, these infants were evaluated in a single moment, not being able to monitor the appearance of any sign or symptom of feeding difficulty that could arise after this evaluation.

The gender and age variables did not correlate with eating difficulties in the studies. This fact corroborates the findings of a study that brings similar data with the pediatric population with other comorbidities, in which age could not be correlated with any of the findings<sup>25</sup>.

Swallowing alterations in children with CHD found in the studies were identified in heterogeneous groups, which present with other associated comorbidities, such as Down Syndrome and other syndromes<sup>17,24</sup>, possibly dysphagia, which is identified as difficulty in swallowing with nutritional impairment, being considered a symptom and not a pathology<sup>26</sup>, is not exclusively associated with CHD. However, one of the studies<sup>8</sup> identified the presence of dysphagia in isolation, in which infants diagnosed with CHD, excluding other comorbidities, presented difficulties in the oral and pharyngeal phase<sup>8</sup>.

Different swallowing alterations were reported, the most frequent being: incoordination between SxRxD, tiredness, cyanosis, coughing and choking, in the different forms of supply. Drawing a parallel with the population of infants with acute viral bronchiolitis, the swallowing characteristics found are similar to the incoordination between SxRxD, fatigue and cough when ingesting oral food, which can be identified in these patients<sup>27</sup>. Thus, we identified that infants with CHD have similar changes in coordination and breathing pattern during feeding than patients with respiratory diseases.

As well as the drop in SPO<sub>2</sub> in which it was possible to verify variation in the population of infants with CHD<sup>20</sup>, as identified by a study in the population with acute viral bronchiolitis<sup>27</sup>. This is

another sign suggestive of dysphagia present in both populations, which can be explained by the variation in respiratory rate and fatigue that are characteristics of breastfed infants on SM and/or bottle in these populations<sup>17, 19-21, 27</sup>.

A study carried out with preterm newborns, evaluated different signs presented by babies with SM and bottle feeding, and found that SM-fed babies were able to have greater coordination between SxRxD, when compared to bottle-fed babies<sup>28</sup>. In an analysis of this systematic review, we also found studies that showed that infants had better performance and coordination when they were fed in MS<sup>8,17,21</sup>.

The clinical evaluation of swallowing is also brought in several studies included in this review, and this evaluation is important for defining or not a dysphagia condition. It is chosen by professionals because it is a non-invasive method, has a low cost and evaluates possible swallowing disorders<sup>29</sup>. Other studies that used the complementary evaluation through videofluoroscopy of swallowing, being effective to observe characteristics of tongue positioning, propulsion of the food bolus, managing to observe both oral and pharyngeal phase alterations<sup>30</sup>.

With regard to the correct grip, comparing SM and the bottle, a recent study<sup>30</sup>, with a sample of 25 infants with different comorbidities, through the evaluation of swallowing by videofluoroscopy, observed better grip, mandibular excursion, tongue movement, when food was offered through SM. In the bottle, it was possible to observe greater oral escape, inadequate handling, and episodes of penetration and aspiration of food in the airways. These findings corroborate the results found in our review, in which there were signs of this alteration in the biodynamics of swallowing according to the way of feeding<sup>30</sup>.

The reduced number of studies with this population indicates that further studies are still needed with these infants with heart disease. It is also necessary to provide more information so that professionals can, at the time of the evaluation, know what to expect from the results based on the characteristics presented and the most frequent alterations, thus being able to define the most appropriate form of feeding for the infant. that moment.

## Conclusion

The most frequent swallowing alterations found in the MS offer were coughing, choking, cyanosis, drop in SpO<sub>2</sub> and incoordination between SxRx.D. When offered in a bottle, the most frequent alterations were the same as those identified in MS, plus fatigue, oral leakage, prolonged feeding time, inadequate lip sealing, inadequate nipple grip, altered cervical auscultation. Swallowing difficulties presented by infants with CHD were more frequent when food was offered in a bottle.

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