



**Complementary feeding approaches and risk of choking:
a systematic review**

V Curso de Mestrado em Promoção da Saúde

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a systematic review**

Dissertação apresentada para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Promoção da Saúde, realizada sob a orientação científica de:

Prof.^a Doutora Ana Rita Pedro

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Abstract

Introduction: There are two main complementary feeding (CF) approaches: traditional spoon-feeding (TSF) and baby-led weaning (BLW). Many parents and healthcare professionals have concerns about the risk of choking associated with BLW. Since asphyxia is one of infants' main causes of death, this dissertation aims to understand the influence of the CF approach adopted by caregivers on infants' risk of choking.

Methods: A systematic review was performed. The search was conducted through PubMed, Scopus, and Web of Science databases. We included randomized controlled trials or observational studies published between January 2010 and November 2023, with a clear definition of the intervention and directly assessing the risk of choking.

Results: After the selection procedure, seven of the 165 studies initially identified were included. No study reported statistically significant differences in the risk of choking between babies following BLW, Baby-Led Introduction to Solids (BLISS), and TSF. Yet, in five studies, although not statistically significant, infants in the TSF group had more choking episodes than those in the BLW or BLISS groups.

Conclusion: The risk of choking does not seem to be associated with the CF approach. Instead, it may be related to the familiarity of the baby with each texture and the parent's understanding of the information about how to minimize the risk of choking. Yet, recall bias may be present in all included studies. Advice on how to modify foods to make them safer needs to be clearer and reinforced to all parents.

Keywords: complementary feeding, risk of choking, choke, baby-led weaning, spoon-feeding

Resumo

Introdução: Existem dois principais métodos de introdução alimentar: o tradicional e o “baby-led weaning” (BLW). Muitos pais e profissionais de saúde têm preocupações sobre o risco de engasgo no método BLW. Sendo a asfixia uma das principais causas de morte na infância, esta dissertação pretende compreender a influência do método de introdução alimentar adotado no risco de engasgo dos bebês.

Métodos: Foi realizada uma revisão sistemática. A pesquisa foi realizada nas bases de dados PubMed, Scopus e Web of Science. Foram incluídos ensaios clínicos randomizados ou estudos observacionais publicados entre janeiro de 2010 e novembro de 2023 e com uma definição clara da intervenção e avaliando diretamente o risco de engasgo.

Resultados: Após o processo de seleção, sete dos 165 estudos inicialmente identificados foram incluídos. Nenhum estudo encontrou diferenças estatisticamente significativas no risco de engasgo entre bebês que seguiram um método tradicional, BLW original e modificado. Contudo, em cinco estudos, embora a diferença não fosse estatisticamente significativa, os bebês que seguiram o método tradicional tiveram mais episódios de engasgo que os do grupo BLW.

Conclusão: O risco de engasgo não parece estar associado ao método adotado. Em vez disso, pode estar relacionado com a familiaridade do bebê com cada textura e com a compreensão, por parte dos pais, da informação sobre como minimizar o risco de engasgo. Contudo, o viés de recordação pode estar presente nos estudos incluídos. É necessário clarificar e reforçar junto de todos os pais a informação sobre como modificar os alimentos para torná-los mais seguros.

Palavras-chave: introdução alimentar, risco de engasgo, engasgo, baby-led weaning, método tradicional

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List of abbreviations and acronyms

CF	Complementary feeding
BLW	Baby-Led Weaning
TSF	Traditional Spoon-Feeding
ESPGHAN	European Society for Paediatric Gastroenterology Hepatology and Nutrition
WHO	World Health Organization
BLISS	Baby-Led Introduction to Solids
SR	Systematic review
PICOS	Population, Intervention, Comparison, Outcomes, and Study
RCT	Randomized controlled trial
CT	Controlled trial
RR	Risk ratio
CIs	Confidence intervals
MD	Mean difference

Introduction

The second semester of a baby's life is characterized by the sensory and motor development of the different organs and systems, making this period an excellent window of opportunity for the training of taste and texture of different foods (1–4). Therefore, in the "complementary feeding" (CF) period, foods are progressively introduced to the infant's diet.

There are two main approaches to CF: Baby-Led Weaning (BLW) and Traditional Spoon-Feeding (TSF). Since these CF approaches do not have precise definitions and are applied differently according to countries' traditions and food habits, it's important to understand how they are defined and applied in Portugal.

Portuguese health authorities seem to broadly recommend a TSF approach to CF where, whether for safety reasons (e.g., risk of choking) or for learning, the first complementary food must be offered by spoon and have a creamy texture, progressively transitioning to less homogeneous and more granular textures as the infant demonstrates good control of grinding/chewing/swallowing, until the introduction of solid food. In the transition phase, mixed feeding (i.e., part spoon-fed and part self-fed) can be carried out to guarantee maximum nutritional security (5).

When it comes to BLW, Portugal entities seem to adopt a reserved position, stating that: "The literature demonstrates the importance of maintaining prudence in advising on this CF approach, based on the weak robustness of published studies. Apparently, the option for BLW leads to a greater supply of milk and a smaller offer of other foods, with no advantages relative to a greater acceptance of new foods" (5).

Many factors contribute to parents' decision of which CF approach to implement, but the main one seems to be the perceived risk of choking associated with BLW (6–11). In one study, because of this perceived threat, most mothers delayed the transition from spoon-feeding to self-feeding and the progression of their infant's diet textures, sometimes until the emergence of infant teeth (6). However, another study shows how individual this experience can be, since for some parents BLW felt like a natural progression with low parental effort, and for others, it was perceived as a source of stress, anxiety, mess, and choking risk (7).

Despite sometimes being more concerned about the potentially increased risk of choking in BLW approaches than caregivers, healthcare professionals recognized multiple

potential benefits, namely healthier eating behaviors, fewer mealtime battles, greater convenience, possible developmental advantages, the introduction to the concept of family mealtime and an opportunity to practice tongue movements, swallowing, and jaw strength (10–14).

These perceptions of both healthcare professionals and caregivers about the choking risk associated with CF approaches cannot be overlooked. We need stronger scientific evidence to support or refute these concerns and beliefs. Accordingly, the effect of the CF approach on the choking risk was one of the suggested areas for research for high-income settings by the European Society for Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) in 2017, considering its potentially dangerous consequences (2).

Choking and asphyxia in the first year of life is a very real and important threat that endangers infants' lives. In Portugal, asphyxia was the first cause of death in the first year of life (15). In the United States and Brazil, choking is a leading cause of morbidity and mortality among children (16,17). In the United Kingdom, around one infant a month dies from choking on food or other items (18).

Understanding why and how infants choke and preventing it is, therefore, an important public health intervention that contributes to achieving Sustainable Development Goal number three – ensure healthy lives and promote well-being for all at all ages.

Therefore, we performed a systematic review of the literature published in the last 13 years, to understand if the risk of choking changes according to the CF approach implemented by caregivers. Specifically, we aimed to compare the risk of choking of infants aged 6-12 months following a BLW, a Baby-Led Introduction to Solids (BLISS), and a TSF approach.

The manuscript submitted to the Journal of Pediatric Gastroenterology and Nutrition is presented next, followed by the references used in this introduction.

Manuscript

Complementary feeding approaches and risk of choking: a systematic review

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Introduction

European entities recommend that to prevent choking, complementary foods should be offered in an appropriate texture and consistency for the infant's developmental stage (1,2). The earliest gross motor skills needed to spoon-feed pureed foods (i.e., controlling the head when sited and diminishing the extrusion reflex of the tongue) can be observed between 3-4 months of age, while the gross motor skill needed for self-feeding finger foods (e.g., sitting without support, having eyes-hands-mouth coordination) can be more commonly observed between 5-7 months (1-4). Maybe for this reason, spoon-feeding only purees during complementary feeding (CF), using the commonly known traditional spoon-feeding (TSF) approach, was the norm until recently.

However, failure to introduce lumpy solid foods by 9-10 months is associated with an increased risk of feeding difficulties and reduced consumption of fruits and vegetables later in life (1). In 2017 the European Society for Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) discouraged prolonged use of pureed foods and recommended a progressive evolution of textures to lumpy foods by 8-10 months, advocating that from nine months infants drink from a cup and self-feed family foods with adaptations like cutting into bite-sized pieces or as finger foods (1). The World Health Organization (WHO) also strongly recommends that from six months infants are responsively fed through a CF approach that encourages them to self-feed in response to their physiological and developmental needs (5).

The Baby-led weaning (BLW) philosophy seems to be in line with this encouragement to self-feed. In this approach, the infant controls the CF process and mostly feeds himself hand-held foods (ground, chopped, or pieced) instead of being spoon-fed by an adult (1,6). Since Gill Rapley brought the BLW approach to light scientifically in the early 2000s, one of the main concerns raised by parents and health professionals was the risk of choking (7-13).

To address this concern, in 2015, the "Baby-Led Introduction to Solids" (BLISS) emerged – a modified version of BLW that specifically highlighted the importance of avoiding foods likely to constitute a choking risk (12,14). Research has shown that, although in the BLISS group parents were statistically significantly less likely to offer high-choking-risk foods, the incidence of choking was not statistically significantly different from the BLW group (14).

Health professionals need stronger scientific evidence to recommend a BLW or BLISS approach to CF, reassuring caregivers that it doesn't imply a higher choking risk. Indeed, ESPGHAN considered the effect of the CF approach on choking risk a research gap (1).

Objective

To address this gap, the aim of this systematic review (SR) is to better understand the influence of the CF approach adopted by caregivers on infants' risk of choking.

Methods

1. Search strategy

This SR followed the Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) criteria and the PRISMA Guidelines (15). The protocol for this SR was registered on PROSPERO, CRD42023473614 (Available online: https://www.crd.york.ac.uk/prospERO/display_record.php?ID=CRD42023473614, accessed on 13 December 2023)

Search was conducted from 27 October to 27 November 2023, through PubMed, Scopus, and Web of Science databases, using the following search syntax: ("BLW" OR "BLISS" OR "Baby led weaning" OR "Baby led introduction to solids") AND ("choke" OR "choking"). A publication date filter was applied to include studies published between January 2010 and November 2023.

2. Inclusion and exclusion criteria

Inclusion criteria were defined as follows: randomized controlled trials (RCTs), controlled trials (CTs), or observational studies (cohort studies, case-control studies, and cross-sectional studies) published after 2010, comprising healthy term-born babies, aged 6-12 months, and eating solid foods at the outcome evaluation, having a clear definition of "TSF" and "BLW" or "BLISS" and directly addressing the risk of choking as an outcome. Book chapters, protocols, editorials, comments, reports, guidelines, or reviews were excluded.

3. Main Outcomes

The main outcome of this SR was the "risk of choking", defined as the blockage of the upper airway by food, associated with the risk of asphyxia and death.

Offering "high-choking-risk foods" was not considered part of our outcome since it doesn't imply the child will choke. Indeed, babies can choke with liquids, purees, and other foods not considered as "high-choking-risk". Also, gagging, being a natural, involuntary, and evolutionary reflex developed to prevent choking, was not assessed as an outcome.

4. Measures of Effect

The effects were reported as risk ratio (RR) with 95% confidence intervals (CIs) and mean difference (MD) or % difference of events (95% CIs).

5. Study Selection and Data Extraction

The selection process was performed by three reviewers (LC, AS, AP). Two of them (LC, AS) independently screened the references retrieved from the three databases. Firstly, the references were imported into the Rayyan[®] platform for an initial duplicate removal. Then, LC and AS reviewed the titles and abstracts of the selected articles and applied the inclusion criteria. Afterward, inclusion criteria were also independently applied by the two reviewers to the selected full texts. In both steps, the reviewers compared their selection and in case of incongruences, the third reviewer (AP) mediated the discussion.

The following data was independently extracted by LC and AS from the included studies: authors, year of publication, country, title, study design, sample size, aims, definition of intervention, control, and outcome, measures of effect, and outcomes.

6. Quality Assessment

The quality assessment of each study was independently assessed by LC and AS, using the Quality Assessment Tool for Quantitative Studies.

7. Strategy for Data Synthesis

A qualitative data synthesis was carried out based on inductive thematic analysis of the extracted data, grouping studies by intervention group, and allowing themes to emerge from the data itself.

Results

1. Study selection

Of the 165 studies initially identified, seven were included (Figure 1).

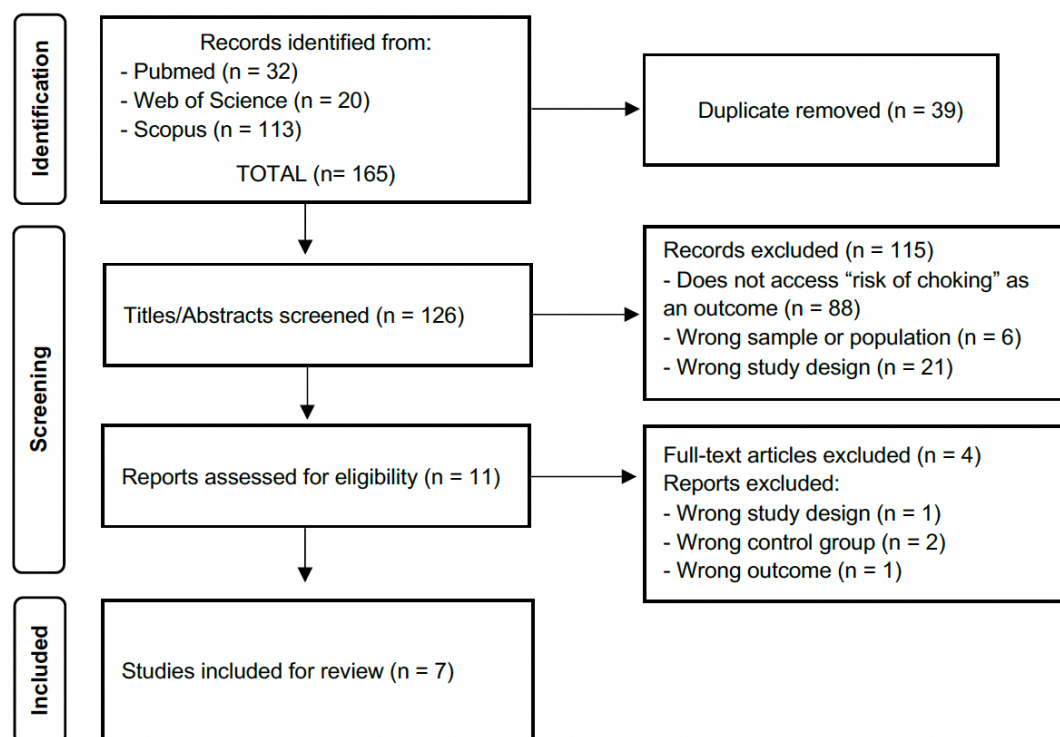


Figure 1. PRISMA Flow Diagram of the literature search and selection.

2. Characteristics of the included studies

Four RCTs and three cross-sectional studies published between 2016 and 2023 were included (Table 1). Studies were conducted in Turkey, New Zealand, Brazil, Poland, and England. The quality assessment of each study is summarized in Supplementary Table 1.

3. Exposure Evaluated

The choking risk was assessed in babies following a BLISS approach in three RCTs and an unmodified BLW approach in three cross-sectional studies and one RCT. Due to a lack of consensus, the definitions of the CF approaches considered in each study are presented in Table 1.

Nevertheless, the underlying characteristic of BLW is babies mostly self-feeding whole pieces of food, which contrasts with TSF, where purees are spoon-fed by caregivers (10,16,17). In BLISS, from six months, babies mostly self-feed three types of firm foods at each meal at their speed, and information on how to minimize the choking risk (e.g., safe cuts, family recipes, food lists) and how to recognize and manage choking events is given to parents (18–20).

4. Outcomes

The included studies evaluated the “risk of choking” outcome heterogeneously and the definition of choking events was also described by most (but not all) authors (Table 1). When this outcome wasn’t described, the research team contacted the corresponding author by email for additional clarifications, without a response until the publication date. All results regarding the risk of choking can be found in Table 2.

When comparing the choking risk between babies following a TSF versus a BLW or a BLISS approach, no study reported statistically significant differences (16–20). However, infants in the TSF group had more choking episodes and serious choking incidents that required medical involvement than those in the BLW or BLISS groups, although not statistically significant (10,18-21). In Białek-Dratwa’s (2022) study, despite results indicating a strong association between the CF approach and the prevalence of choking (with a difference of 1.52 percentage points in prevalence of choking events between groups), the authors concluded that choking occurred comparably often in both groups (21).

Discussion

Choking and asphyxia in the first year of life is a very real and important threat that endangers infants' lives. Health professionals can only educate caregivers on factors that increase or decrease this risk if they have access to robust evidence on the matter, which is not currently available.

Despite not finding a statistically significant association between CF approaches and the risk of choking, some studies included in our SR reported more choking episodes in babies following a TSF approach, which contradicts parents' beliefs that there is a higher risk of choking in BLW or BLISS approaches (7–12).

To better understand the results of this SR, other related factors need to be considered. This includes the specific foods and textures responsible for choking events, safety information given to parents and its understanding, the familiarity of the baby with each texture, maternal characteristics, supervision at mealtimes, parents' ability to differentiate gagging from choking, the adherence to each CF approach, and the recall bias.

The foods most appointed as responsible for choking events are raw fruit (e.g., apples, grapes) and raw vegetables (e.g., carrots) (13,14,17,18,20,22). Despite not being typically considered as high-choking-risk, slippery foods (e.g., melon, banana, avocado), food with skin (e.g., blackberries, sweet potato), and sticky foods (e.g., granola, porridge), were also appointed as responsible for choking events (17,19,20). Other foods responsible for choking events in the studies included in our SR can be found in Supplementary Table 2. Interestingly and contrarily to what WHO believed, parents in these studies did not report pulses, nuts, or seeds as foods responsible for choking events (5).

One commonly appointed limitation in current scientific literature is that RCTs with BLISS intervention groups may not be representative of all parents applying BLW because information specifically designed to reduce food-related choking (e.g., a list of high-choking-risk foods) and how to handle it is normally given to parents (18–20).

These kinds of lists do seem to be useful since, in one RCT, only one infant in the BLISS group was offered raw apple at seven months, compared with 11 infants in the TSF group (19). However, in two RCTs the authors had specifically advised against the offer of the foods responsible for the parent-defined most serious choking events, which raises questions about the clarity of these lists or information (18,19).

Hence, regardless of the CF approach, it's important to give parents clearer information on ways in which all foods can be modified to make them safer (e.g., grating or cooking raw apple and carrot until it is possible to transform them in puree at once when smashed with the fingers, cutting foods into strips or sticks instead of rounded shapes, removing the high-risk parts of foods like skins, seeds or strong fibers) (22–24).

The comprehension of the information on how to handle a choking episode is also questionable since, in 46.7% of choking events reported in an RCT, parents withdrew the food with the index finger, which is a very dangerous practice that can increase the risk of asphyxia (20). Accordingly, despite acknowledging the differences between

gagging and choking, mothers suggest that being educated about the management of both situations would or have helped them (7,9,11,13).

It's also important to assess, despite the CF approach, which textures are normally responsible for choking events. Despite not having found an association between the texture involved in choking events and the CF approach, semi-solid or solid consistency was responsible for most choking episodes in two RCTs (19,20). Only in a cross-sectional study, a greater frequency of choking episodes was associated with the TSF approach (for lumpy purees and finger foods) and with the proportion of puree and spoon use (for smooth and lumpy purees). Babies who ate purees less frequently had significantly more choking episodes on lumpy purees, and the greater the proportion of puree use, the higher the choking episodes for finger foods. For babies following a BLW approach, but receiving small amounts of lumpy foods, the choking risk was higher (although not significantly) for lumpy foods (17).

This data leads us to question whether a lower exposure to a specific texture increases the choking risk because they were less skilled at manipulating them and whether practice and familiarity, on the contrary, can decrease not only the risk of choking but also the concern of mothers. In two different studies, mothers were mostly worried about choking before actually starting BLW, and it became less of a concern once they witnessed how skilled their infant was at expelling food out of their mouth if needed and once they were able to clearly distinguish between gagging and actual choking (11,13).

Regarding the influence of maternal characteristics, Brown's (2018) study found that mothers following the BLW approach were on average older and had a higher level of education than those following a TSF approach, as also seen in other studies (17,25–29). It also showed that maternal years in education were significantly negatively associated with episodes of choking (17). However, maternal age and level of education did not differ between intervention and control groups in the other included studies.

To prevent choking events, close supervision at mealtimes is also of paramount importance, regardless of the CF approach (7,9,23). One RCT found that at 11 months, babies in the BLISS group were twice as likely to have an adult sitting with them at mealtimes, which could have ultimately increased the choking risk for babies in the TSF group (19). Also, to decrease the choking risk, babies need to have sufficient head and trunk control to sit straight while eating (2,23). Though it was not assessed in the studies included in our SR, the reported choking events might have been related to postural errors at mealtime, regardless of the CF approach.

Moreover, since many parents can't accurately differentiate choking from gagging, when studies ask about any choking episodes, instead of only serious choking events, their data can be misleading (7,10,13,17). For example, serious choking events were so rare in two studies that they couldn't determine whether there was a statistically significant difference according to the CF approach (10,19). Also, most choking events seemed to be dealt with at home and did not require medical intervention (13,18,19). This makes us wonder if all choking episodes reported by parents were indeed of clinical importance or just a natural and protective gag reflex. However, some efforts were made to decrease this risk of misclassification: one cross-sectional study only evaluated choking episodes that required immediate medical help (which excludes gagging), and a clear distinction between gagging and choking was made in two RCTs and two cross-sectional studies (10,17,19–21). Also, in an RCT, 92% of choking episodes directly observed by a parent included at least one indication of airway compromise (19).

The difference in the choking risk according to the degree of adherence to each CF approach was only measured in one study, which verified that the degree of adherence to a BLW approach did not influence the choking risk at any age (19).

There is also a possible influence of recall bias because of the retrospective nature of the questionnaires and interviews applied in all included studies. However, one RCT also collected data from daily calendars, and the authors considered that its comparability indicated that recall was accurate (19).

One of the main limitations of this SR is the weak quality of most included studies, which was mainly due to the lack of assessment and/or description of the influence of possible confounders in four of them, and the difficulty in assessing if the data collection tools have shown to be valid or reliable in six of them. Also, due to methodological differences in these studies, it was not possible to perform meta-analyses. Having different comparison groups, and different definitions for choking risk, BLW, BLISS, and TSF approaches, it's difficult to accurately compare their results and reach a conclusion on what to recommend to health professionals and caregivers. Also, the evidence regarding other factors that may influence the choking risk in babies is very scarce.

The main strength of this SR is that independent of the CF approach, we found that factors like the familiarity of the baby with each texture, and the clarity and understanding of the information provided to parents on how to minimize choking events may play a bigger role in the risk of choking than thought. Further research is needed to better understand the influence of other important factors such as mealtime environment

(namely pressure to eat or the use of screens or toys to distract the baby while eating), how caregivers offer the food (e.g., facing or sideways), and baby's posture while eating (e.g., column verticality).

Conclusions

Contrary to the perceptions of health professionals and caregivers, BLW or BLISS approaches do not seem to be associated with a higher risk of choking. Possibly more relevant factors include how familiar the baby is with each texture, and if parents understand the information provided on how to minimize the risk of choking. Hence, advice on how to modify foods to make them safer needs to be clearer and reinforced, independently of the CF approach, especially where nutritious foods are involved.

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Tables

Table 1. Main characteristics of the studies included in the review.

Reference	Country	Study Design	N	Intervention / Exposure (BLW / BLISS)	Control (TSF)	Outcome
Arslan N (2023)	Turkey	RCT	72	Had a training module with information regarding feeding with the BLW method.	Access to information regarding feeding with the BLW method was not provided.	Risk of choking
Dogan E (2018)	Turkey	RCT	280	Received 4 additional group contacts and 6 home visits for supporting and education about BLISS.	Were not given any feeding protocol to follow and received standard well-childcare from the providers of their choice.	Incidence of choking and foods that had caused the incident.
Fangupo LJ (2016)	New Zealand	RCT	206	Received 8 additional group or individual parent contacts for education and support about BLISS.	Received 8 visits before 12 months of age that endorses conventional complementary feeding methods.	Frequency of choking (i.e.: a piece of food partially or completely blocking the airway in the past month), food responsible for the event, and what form it was fed in.
de Paiva CSS (2023)	Brazil	RCT	139	Parents were instructed to encourage the infant to feed by themselves firm, strips or sticks of food.	Greater influence of parents in the feeding process. Initially, the consistency of the food should be pasty.	Occurrence of choking (i.e.: partial or total obstruction of airflow that can cause cyanosis and/or asphyxia), consistency of the food that caused the event, and type of food involved.
Bialek-Dratwa A (2022)	Poland	Cross-sectional	646	Mothers using BLW.	Mothers using the spoon-feeding method or not familiar with BLW.	Prevalence of choking (i.e.: the airway becomes blocked, and the child may not be able to cry, cough, or breathe).
Brown A (2018)	England	Cross-sectional	1151	Strictly or Loose BLW: allowed the baby to self-feed foods usually in their whole form.	The baby was spoon-fed pureed foods.	Occurrence of choking (i.e.: complete blockage of the airway), consistency of the food that caused the event, and actual food involved.
Fu X (2018)	New Zealand	Cross-sectional	628	Full vs Partial BLW: "mostly baby feeding themselves, some adult spoon-feeding" or "baby feeding themselves" vs "about half spoon-feeding by an adult and half baby feeding themselves".	Parents who chose "spoon-fed by an adult" or "mostly spoon-fed by an adult, some baby feeding themselves".	Serious choking incidence (i.e.: requiring immediate medical help)

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Table 2. Summarized results of the “risk of choking” outcome.

Reference	Groups	Risk of choking					
		6 months			12 months		
Arslan N (2023)	BLW (n=31)	Mean ± SD	n (%)	Intergroup p-value	Mean ± SD	n (%)	Intergroup p-value
	TSF (n=31)	1.04 ±0.2	1 (3.8)		0,16	1.0 ±0.0	
Dogan E (2018)	BLISS (n=142)	Incidence					
	TSF (n=138)	2					
Fangupo LJ (2016)	By calendar	6 months			8 months		
	BLISS (n=105)	14/86 (16.3) ^a	RR [95% CI]	p-value	14/78 (17.9) ^a	RR [95% CI]	p-value
Fangupo LJ (2016)	TSF (n=101)	20/79 (25.3) ^a	0.67 (0.37-1.23)	0.20	14/74 (18.9) ^a	0.94 (0.48-1.87)	0.87
	By questionnaire	6 months		7 months	8 months	11 months	
Fangupo LJ (2016)	BLISS (n=105)	17/94 (18.1) ^a		11/91 (12.1) ^a	14/95 (14.7) ^a		18/93 (19.4) ^a
	TSF (n=101)	19/88 (21.6) ^a		7/83 (8.4) ^a	16/88 (18.2) ^a		13/81 (16.0) ^a
Fangupo LJ (2016)	RR [95% CI]	0.86 (0.48-1.54)		1.31 (0.53-3.21)	0.78 (0.40-1.52)		1.21 (0.63-2.31)
	p-value	0.61		0.56	0.46		0.57
de Paiva CSS (2023)	BLISS (n=48)	n (%)		CI (95%) - %		p-value	
	Mixed (n=46)	10 (22.2)		11.7-37.5		0.694	
de Paiva CSS (2023)	TSF (n=45)	11 (26.2)		14.4-42.3			
		13 (30.2)		17.7-42.3			
Bialek-Dratwa A (2022)	BLW (n=413)	n (%)		p-value		V Cramer	
	TSF (n=222)	31 (6.94)		0.0000		0.7125987	
Brown A (2018)	Strict BLW (n=412)	Ever choked on any food		$\chi^2 = 8.006$	Number of choking episodes		$F_{2,153}=7.901$
	Loose BLW (n=377)	11.9%		p-value	Mean ± SD (n)		p-value
TSF (n=362)	15.5%		1.94±1.16 (49)		0.001		
Fu X (2018)	Full BLW (n=155)	11.6%		1.73±1.41 (66)			
	Partial BLW (n=93)			1.83±0.96 (42)			
Fu X (2018)	TSF (n=628)	One episode		More than one episode			
		n (%)		n (%)		n (%)	
Fu X (2018)	Full BLW (n=155)	1 (1)		0		0	
	Partial BLW (n=93)	0		0		0	
Fu X (2018)	TSF (n=628)	11 (2)		6 (1)		6 (1)	

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^a Data expressed as number of participants who choked/number of participants with data (%).

Supplementary Table 1. Assessment of quality for the quantitative studies using Quality Assessment Tool for Quantitative Studies.

Reference	Selection Bias	Study Design	Confounders	Blinding	Data Collection Method	Withdrawals and dropouts	Overall Quality Score
(Arslan N, 2023)	Moderate	Strong	Strong	Moderate	Weak	Strong	Moderate
(Dogan E, 2018)	Moderate	Strong	Strong	Moderate	Weak	Strong	Moderate
(Fangupo LJ, 2016)	Weak	Strong	Weak	Moderate	Weak	Weak	Weak
(de Paiva CSS, 2023)	Moderate	Strong	Weak	Weak	Weak	Moderate	Weak
(Bialek-Dratwa A, 2022)	Weak	Weak	Weak	Weak	Strong	Not Applicable	Weak
(Brown A, 2018)	Weak	Weak	Strong	Weak	Weak	Not Applicable	Weak
(Fu X, 2018)	Weak	Weak	Weak	Weak	Weak	Not Applicable	Weak

Supplementary Table 2. Summarized results of main outcomes about food responsible for choking events.

Reference	Food responsible for choking event						
Dogan E (2018)	Raw apple (n=2) Raw carrot (n=3)						
Fangupo LJ (2016)	7 months Teething rusks (14% to 19% both groups) Hard crackers (13% BLISS) Raw vegetables (13% TSF)			12 months Hard crackers (47% to 48%)			
	Consistency	Total n (%)	BLISS n (%)	Mixed n (%)	TSF n (%)	p value	
	Liquid	5 (15.2)	3 (33.3)	-	2 (15.4)	0.206	
	Pasty	1 (3)	-	-	1 (7.7)		
	Semi-solid/solid	27 (81.8)	6 (66.7)	11 (100)	10 (76.9)		
de Paiva CSS (2023)	Food group					0.405	
	Meat	7 (21.2)	2 (22.2)	2 (20)	3 (21.4)		
	Tubercles	1 (3.0)	1 (11.1)	-	-		
	Vegetables	4 (12.1)	-	1 (10)	3 (21.4)		
	Fruits	11 (33.3)	3 (33.3)	5 (50)	3 (21.4)		
	Eggs	3 (9.1)	-	1 (10)	2 (14.3)		
	Leguminous	1 (3.0)	-	-	1 (7.1)		
	Cereals	1 (3.0)	-	1 (10)	-		
Brown A (2018)	Number of choking episodes and % that ever choked on:	Strict BLW	Loose BLW	TSF	Number of choking episodes (Mean ± SD)	Ever choked (% yes)	Foods (n)
		Mean ± SD (% yes)	Mean ± SD (% yes)	Mean ± SD (% yes)	p-value	p-value	Hard/snappable (19)
	Finger food	1.57±1.03 (11.05)	1.21±0.826 (15.46)	1.76±0.971 (11.21)	0.014*	0.087	Slippery (17)
	Lumpy puree	0.32±0.57 (12.9)	0.54±0.8 (10.4)	1.18±1.16 (10.3)	0.002*	0.178	Dry bread with spread (15)
	Smooth puree	0.71±0.75 (3.44)	0.58±0.94 (1.35)	1.14±1.21 (2.10)	0.493	0.301	Food with skin (12)
							Sticky food (10)

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* Statistically significant

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