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REVIEW ARTICLE

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Developing a core outcome set for childhood obesity prevention: A systematic review

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Abstract

Synthesis of effects of infant feeding interventions to prevent childhood obesity is limited by outcome measurement and reporting heterogeneity. Core outcome sets (COSs) represent standardised approaches to outcome selection and reporting. The aim of this review is to identify feeding outcomes used in infant feeding studies to inform an infant feeding COS for obesity prevention interventions. The databases EMBASE, Medline, CINAHL, CENTRAL, and PsycINFO searched from inception to February 2017. Studies eligible for inclusion must examine any infant feeding outcome in children ≤1 year. Feeding outcomes include those measured using self-report and/or observational methods and include dietary intake, parent–child interaction, and parental beliefs, among others. Data were extracted using a standardised data extraction form. Outcomes were assigned to outcome domains using an inductive, iterative process with a multidisciplinary team. We identified 82 unique outcomes, representing nine outcome domains. Outcome domains were "breast and formula feeding," "introduction of solids," "parent feeding practices and styles," "parent knowledge and beliefs," "practical feeding," "food environment," "dietary intake," "perceptions of infant behaviour and preferences," and "child weight outcomes." Heterogeneity in definition and frequency of outcomes was noted in reviewed studies. "Introduction of solids" (59.5%) and "breastfeeding duration" (55.5%) were the most frequently reported outcomes. Infant feeding studies focus predominantly on consumption of milks and solids and infant weight. Less focus is given to modifiable parental and environmental factors. An infant feeding COS can minimise heterogeneity in selection and reporting of infant feeding outcomes for childhood obesity prevention interventions.

KEYWORDS

"childhood obesity", "complementary feeding", "core outcome set", "food and nutrient Intake", "infant feeding", nutrition

1 | INTRODUCTION

Childhood obesity is a significant risk factor for diabetes (Bacha & Gidding, 2016), respiratory problems (Mohanan, Tapp, McWilliams, & Dulin, 2014), cardiovascular dysfunction (Cote, Harris, Panagiotopoulos, Sandor, & Devlin, 2013), and poor psychological health (Beck, 2016). Childhood obesity also tracks to adulthood, leading to an increased risk of later morbidity and mortality (Maffeis & Tato, 2001). Recent evidence suggests that despite some stabilisation of childhood obesity, rates remain high (Ogden et al., 2016). A recent examination of eight European countries identified that rates of obesity among children under 10 years were 7% (Ahrens et al., 2014). American data indicate that 9.4% of

children aged 2–6 years, and 19.6% of children aged 6–11 years, were obese in 2013–2014 (Ogden et al., 2016).

Early infant feeding practices are associated with increased risk of childhood obesity. For instance, earlier introduction of solids (Pearce & Langley-Evans, 2013), shorter duration of breastfeeding (Modrek et al., 2017), poor dietary intake (Pearce & Langley-Evans, 2013), and nonresponsive parent–infant feeding interactions (DiSantis, Hodges, Johnson, & Fisher, 2011) are implicated in the development and maintenance of childhood obesity. The first 2 years of life represent a critical window for establishing healthy feeding behaviours and infant dietary habits (Woo Baidal et al., 2016). During the first 12 months specifically, infants undergo rapid developmental changes and concurrently changing feeding needs (Brown & Lee, 2011; Taylor et al., 2017). Although feeding of breast and formula milk has been widely studied and consistently associated with later child weight outcomes, including risk of later child obesity (Modrek et al., 2017), there is also increasing empirical focus on complementary feeding in the aetiology of obesity (DiSantis et al., 2011; Pearce & Langley-Evans, 2013;Woo Baidal et al., 2016). This is because the transition to complementary foods that occurs during the weaning period in the first year demonstrates important associations with later weight and dietary patterns (Brown & Lee, 2011; Taylor et al., 2017). Thus, complementary feeding can be seen as a distinct and important behavioural domain for obesity prevention.

As a result, there is increased research interest in developing and evaluating complementary infant feeding interventions in the first year to prevent childhood obesity (Redsell et al., 2016). Recent reviews of infant complementary feeding interventions highlight inconsistent or minimal effects on feeding practices, dietary intakes, or weight outcomes (Blake-Lamb et al., 2016; Matvienko-Sikar et al., 2017; Redsell et al., 2016; Reilly, Martin, & Hughes, 2017). One potential reason for inconsistencies across trials may relate to heterogeneity in outcome reporting, definition, and measurement (Matvienko-Sikar et al., 2017). Lack of standardisation of infant complementary feeding outcomes limits synthesis and comparison of infant feeding intervention effects and impairs evaluation and examination of the mechanisms of change underpinning childhood obesity prevention interventions (Matvienko-Sikar et al., 2017).

Core outcomes sets (COSs) are standardised sets of outcomes, developed to improve outcome selection and measurement for specific health topics (Williamson et al., 2012). COSs are defined as the "minimum that should be measured and reported in all clinical trials of a specific condition and could also be suitable for use in other types of research and clinical audit" (Clarke, 2007). Development of a COS does not therefore restrict studies to only examining these outcomes but represents the minimum outcome set to collect and report (Williamson et al., 2017). Development of COS is supported by the Core Outcome Measures in Effectiveness Trials (COMET) initiative, with guidance recently published in the COMET handbook version 1 (Williamson et al., 2017). COS development typically follows three interrelated consecutive stages: a systematic review to identify all existing outcomes; a Delphi survey to identify and prioritise important outcomes for inclusion in the COS; and an in-person consensus meeting of relevant stakeholders to achieve consensus on the most essential outcomes for inclusion in a COS for a specific health topic. This process focuses on *what* to measure rather than *how* outcomes should be measured and involves multiple stakeholder perspectives to achieve consensus on the COS.

Key messages

- There is considerable heterogeneity in infant feeding outcomes in the extant literature.
- The most commonly examined infant feeding outcomes are "introduction of solids" and "breastfeeding duration."
- Greater attention needs to be given to modifiable parental behavioural and environmental outcomes.
- Development of a standardised core outcome set of infant feeding outcomes for childhood obesity prevention interventions is essential to effectively synthesise and interpret effects of childhood obesity prevention interventions.

Development of a COS for trials of infant feeding interventions for prevention of childhood obesity is timely and crucial (Matvienko-Sikar et al., 2017). This is particularly evident in light of the importance of initiation and maintenance of healthy early feeding practices in the first year of life and the increased empirical focus on intervention delivery during this period. Given the increasing focus on complementary feeding particularly, which moves beyond a focus on breastfeeding only, development of a COS in the area of complementary feeding is warranted. Inclusion of standardised outcomes across trials will facilitate improved synthesis and comparison of intervention effects to better determine the most effective approaches to improving infant feeding practices and/or preventing childhood obesity. The first stage in development of such a COS is identifying potentially relevant outcomes from the extant literature (Matvienko-Sikar et al., 2017; Williamson et al., 2017). This paper reports a systematic review of the extant feeding literature of infants up to 1 year to identify all potential infant feeding outcomes for inclusion in a COS of interventions to prevent childhood obesity. A secondary aim is to examine heterogeneity of outcome reporting across studies.

2 | METHODS

This review was performed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for systematic reviews (Moher, Liberati, Tetzlaff, Altman, & Grp, 2009). The protocol for this systematic review is registered on PROSPERO, registration number: CRD42017055608. This COS project is registered on the COMET database, and further details are available at www.comet-initiative.org. The protocol for development of this COS is published (Matvienko-Sikar et al., 2017).

2.1 | Eligibility of studies

2.1.1 | Inclusion criteria

Studies examining at least one infant feeding outcome in children up to 1 year of age were eligible for inclusion. Feeding outcomes were

defined as any feeding-related outcome measured up to 1 year of age. Outcomes measured using self-report and observational methods were eligible, including outcomes such as dietary intake, parent–child interaction, milk and solids consumption, and parental beliefs, among others. Types of studies included in the current review were not limited to obesity-focused examinations. This is because the authors acknowledge that suitable outcomes for trials of obesity prevention interventions may arise from existing research that is not obesity focused. Studies were not therefore required to be trials of infant feeding interventions and could include observational, quasi-experimental, and randomised control trial designs.

2.1.2 | Exclusion criteria

The following types of studies were not eligible for exclusion: Studies only examining outcomes in children over 1 year of age; studies involving children with malnutrition or ongoing medical conditions related to feeding; studies focusing on dental caries. Studies focusing on breastfeeding only were also excluded as the authors acknowledge such studies may require a dedicated breastfeeding-specific COS. There were no restrictions on child sex or ethnicity, but the search was limited to literature published in English, and grey literature was not examined.

2.2 | Search strategy

The following databases were searched from inception to February 2017: EMBASE, MEDLINE, CINAHL, the Cochrane Library, and PsychINFO. Search terms were required to be reported in the title, abstract, and/or study keyword and were modified for databases as needed: ("Infant" OR infancy OR "child" OR "children" OR "paediatric" OR "pediatric" OR "baby" OR "parent*" OR "parent*") AND ("diet*" OR "feeding" OR "early feeding" OR "complementary feeding" OR "complementary food" OR "weaning" OR "feeding interaction*" OR "nutrition" OR "solid food" OR "first food" OR "responsive feed*" OR "anticipatory guid*" OR "baby led" OR "feed* practice*" OR "eating behav*" OR "food preference") AND ("Randomised controlled trial*" OR "randomized controlled trial" OR "RCT*" OR "control* group" OR "controlled trial") OR ("cohort" OR "observational" OR "pilot study" OR "case-control study" OR "quasi-experiment*"). Reference lists of identified articles were also examined.

2.3 | Study selection and data extraction

All study titles, abstracts, and full texts were independently screened by two researchers (K. M. S. and N. McG.) against eligibility criteria. Any disagreements were discussed until resolved by consensus. Relevant study characteristics were independently extracted using a standardised data extraction form (see Data S1) by two researchers (N. McG. and C. G.). The data extraction file was developed for the purposes of this review and required data on paper characteristics, study characteristics, participant details, and outcomes examined. Data extraction for half of all studies was checked by a third researcher (K. M. S.). Data extracted included author, year of publication, study design, sample size, study setting, participant characteristics, study outcomes, and outcome measurement tool. Outcomes reported in the methods and/or results were included. As one aim of this review is to examine heterogeneity of outcome reporting, each article was treated as a unique study.

2.4 | Quality assessment

Quality assessment of all included studies was conducted by one reviewer (C. G.), with a randomly selected 33% of these independently assessed by a second reviewer (K. M. S.). This was done to determine if study quality influenced frequency or heterogeneity of outcome reporting between or within studies. Quality was assessed using six items previously outlined in a COS for neonatal abstinence syndrome (Kelly et al., 2016). Items included assessing if primary and secondary outcomes are clearly stated and defined, if authors explain outcome selection, and whether methods were used to enhance quality of outcome measurement (Kelly et al., 2016).

2.5 | Assessment of outcome reporting

All outcomes identified from data extraction were compiled into a long list of infant feeding outcomes. Based on previous evidence (Kapadia et al., 2015), it was expected that outcome terminology and assessment would vary. Outcomes determined to have similar definitions or themes were therefore merged. This was done via a consensus process with a group of researchers with experience and expertise in conducting infant feeding and childhood obesity research. The group comprised two health psychologists with experience in childhood obesity and of developing COSs (K. M. S. and M. B.), a developmental psychologist (C. H.), and a nutritionist (C. K.). A midwife with expertise in COS development and trials (D. D.) was also consulted during this process. Outcomes were initially grouped into outcome domains representing the overarching outcome area based on conceptual similarities of outcomes by K. M. S., with all outcome domains subsequently reviewed and discussed with M. B., C. K., and C. H.

Outcome matrices based on the Outcome Reporting Bias in Trials project outcome matrix (Kirkham et al., 2010), and as recommended by the COMET initiative (Williamson et al., 2017), were constructed to visually represent the frequency, consistency, and disparity of outcome reporting across studies. Individual matrices were created for each outcome domain. Each matrix included the outcome or outcome domain on the *X* axis and the reviewed studies reporting these on the *Y* axis. The frequency of reporting of individual outcomes was calculated for all studies in this review. The frequency with which overarching outcome domains were included in reporting across studies was also calculated; this was done by calculating the number of studies that reported outcomes that are grouped under each of the nine outcome domains.

3 | RESULTS

The literature search identified 13,838 unique citations. Titles and abstracts of all articles were screened against inclusion criteria. Following this, full texts of 575 articles were evaluated against inclusion criteria; 126 articles were deemed eligible for inclusion in this review (see Figure 1).

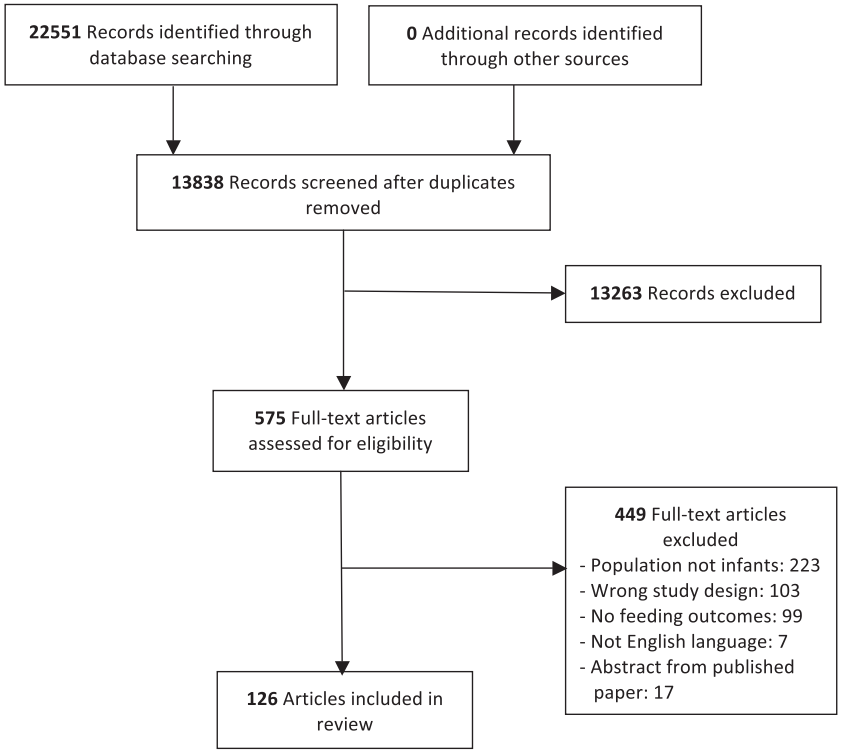

FIGURE 1 Systematic review flow chart

3.1 | Study characteristics

Study characteristics are presented in Table 1. The majority of articles reported were longitudinal/cohort studies (n = 81); 27 were randomised controlled trials; 13 were cross-sectional; 2 were repeated measure interventions; 1 was a case–control comparative study; 1 was a nonrandomised controlled trial; and 1 was a study protocol. Studies were conducted in the United States (25%), the United Kingdom (19%), and Australia (14%). The majority of studies (97.62%) were rated as being of high quality (see Table 1); thus, further sensitivity analyses related to study quality were not conducted.

3.2 | Study outcomes

Two hundred and thirty-six outcomes were initially identified (see Data S2). Following review of outcomes and merging of outcomes with similar definitions, 82 unique outcome terms were identified across 126 studies. Outcomes were merged based on similarities in definitions/themes. The 82 outcomes were then grouped into nine outcome domains. These are "breastfeeding and formula feeding," "introduction of solids," "parent feeding practices and styles," "parent knowledge and beliefs," "practical feeding," "food environment," "dietary intake," "perceptions of infant behaviour and preferences," and "child weight outcomes." Individual outcomes are presented in their respective outcome domains in Table 2.

3.2.1 | Frequency of outcome domains

The most frequently reported outcome domain was "breastfeeding and formula feeding," which was reported in 82.5% (n = 104) of reviewed studies. "Introduction of solids" outcomes were reported in 64.3% (n = 81) of studies, and "dietary intake" outcomes were reported in 52.4% (n = 66) of studies. "Child weight-related outcomes" were reported in 50.8% (n = 64) of studies. "Practical feeding" and "food environment" were the least commonly reported outcome domains, reported in only 5.5% (n = 7) and 6.3% (n = 8) of studies, respectively. See Figure 2 for frequency of all outcome domains; see Data S3 for matrix representing frequency of outcome domain reporting within and across studies.

3.2.2 | Frequency of outcomes

Frequencies of outcomes within each outcome domain, and across all reviewed studies, are presented in Data S4. Across all outcome domains, the most frequently reported outcome was timing of introduction of solids, which was reported in 59.5% (n = 75) of reviewed studies. This was followed by breastfeeding duration (55.5%, n = 70), infant weight (38.1%), and types of food consumed (34.9%, n = 44). Of the two most frequently reported outcomes, 39.7% of studies reported both outcomes in the same paper. Only 4.8% of studies reported the four most common infant feeding outcomes together. A number of outcomes were reported in one study only: infant desire for drinks; infant emotional eating; portion size; supplement intake; feeding intentions; perceived behavioural control of introduction to solids; weight concern; concern about eating; emotional feeding; feeding to soothe; modelling; authoritative feeding; and authoritarian feeding.

4 | DISCUSSION

This review examined reporting of infant feeding outcomes from 126 papers related to feeding of infants up to 1 year of age. The findings indicate a considerable degree of heterogeneity in reporting of core outcome domains and of individual infant feeding-related outcomes. Study outcomes predominantly focus on the areas of breastfeeding and formula feeding, child weight-related outcomes, introduction of solids, and dietary intake. Less attention is given to parents' feeding practices

TABLE 1 Characteristics of included studies (*n* = 126)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
Abdul Raheem et al., 2013	Longitudinal	Maldives	458	1, 3, and 6 months	Maternal depression, infant feeding, and growth	High
Abraham et al., 2012	Longitudinal	Scotland	4,493	9–12 months; 19–24 months	Infant feeding, eating patterns, and weight status	High
Andersen et al., 2015a	Longitudinal	Denmark	513	Birth and 9 months	Maternal obesity and offspring dietary patterns	High
Andersen et al., 2015b	Longitudinal	Denmark	374	9 months	Infant dietary patterns	High
Ashman et al., 2016	Longitudinal	Australia	67	3, 6, 9, and 12 months	Dietary intake and anthropometric status of mothers and infants	High
Baird et al., 2008	Longitudinal	UK	1,740	6 and 12 months	Feeding, dietary patterns, and infant weight	High
Betoko et al., 2013	Longitudinal	France	1,004	Birth, 4, 8, and 12 months	Infant feeding patterns	High
Binns et al., 2007	Longitudinal	Australia	453	12 months	Cow's milk consumption	High
Black et al., 2001	RCT	USA	181	3 months	Early complementary feeding	High
Bonuck et al., 2014	RCT	USA	464	12 months	Bottle use	High
Bonuck et. al, 2010	Repeated measures intervention	USA	299	12 and 24* months	Bottle weaning intervention and toddler overweight	High
Boudet-Berquier et al., 2016	Longitudinal	France	2,732	12 months	Introduction of complementary foods	High
Braid et al., 2014	Longitudinal	USA	7,650	9 months	Early introduction of complementary foods in preterm infants	High
Brekke et al., 2007	Longitudinal	Sweden	10,762	Birth and follow-up at median 12 (*SD* 1.1) months	Consumption of high sugar, low nutrient foods	High
Brodribb et al., 2013	Longitudinal	Queensland, Australia	6,470	17 weeks/4 months	Introduction of solids and water	High
Bronte-Tinkew et al., 2007	Longitudinal	USA	8,693	9 months	Food insecurity, toddlers' overweight (weight for length), physical health, and length for age	High
Brown et al., 2015	Longitudinal	UK	298	6–12 (*M* = 8.34 months), 18–24* months	Child satiety responsiveness	High
Bruun et al., 2016	Longitudinal	Denmark	499	3 days to 16 weeks	Breastfeeding and introduction of complementary foods	High
Bryanton et al., 2007	Longitudinal	Canada	175	12 and 24 hr post-partum and 1 month	Birth experience and post-partum parenting including feeding	High
Cameron et al., 2014	RCT	Australia	389	4 months and 20* months	Effectiveness of INFANT trial on dietary intake	High
Cameron et al., 2015	RCT	New Zealand	802	4 months	Intervention effects on introduction of complementary foods	Moderate
Campbell et al., 2013	RCT	Melbourne, Australia	239	4, 9, and 20* months	Intervention effects on obesity risk behaviours and infant BMI	High

(Continues)

TABLE 1 (Continued)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
Carletti et al., 2017	Longitudinal	Italy	148	3, 6, 9, 12, 18*, 24*, and 36* months	Introduction of complementary foods	Low
Cartagena et al., 2016	Cross-sectional	USA	62	4 and 12 months	Modifiable feeding practice by overweight status	High
Cassells et al., 2014	RCT	Australia	244	4 months	Maternal infant feeding practices and beliefs, and infant neophobia	High
Castro et al., 2015	Cross-sectional	Ireland	11,134	17 weeks	Complementary feeding determinants	High
Chivers et al., 2010	Longitudinal	Australia	1,403	12 months (24* months and 36 months)	Body mass index, adiposity rebound, and infant feeding	High
Chu et al., 2012	Longitudinal	Canada	246	12 months	Maternal physical activity, infant feeding practices, and infant weight gain	High
Dancel et al., 2015	Cross-sectional	USA	398	12 months	Acculturation and feeding styles	High
de Campora et al., 2016	Longitudinal	Italy	53	7 and 12 months	Emotional dysregulation and obesity risk	High
de Hoog et al., 2011	Longitudinal	The Netherlands	2,998	6 months	Infant feeding and ethnic differences in infant growth (including weight, length and weight-for-length during the first 6 months of life)	High
de Oliviera et al., 2012	RCT	Brazil	163	6 months	Prevention of early introduction to solids and nonbreast milk	High
Emmett et al., 2000	Longitudinal	UK	1,178	4 and 8 months	Drink consumption	High
Emmett et al., 2016	Longitudinal	UK	*n* > 11,000	6 and 15* months	Dietary patterns during complementary feeding	High
Fairley et al., 2015	Longitudinal	UK	987	6, 12, and 24* months	Modifiable risk factors for obesity and BMI	High
Faith et al., 2006	Cross-sectional	USA	971	7 and 12 months	Fruit juice consumption and adiposity gain	High
Farrow et al., 2006	Cross-sectional	UK	69	6 months	Maternal feeding control and infant weight gain	High
Fildes et al., 2015a	Longitudinal	UK	1,920	8 months	Parental control of infant feeding. Influence of infant weight, appetite, and feeding method	High
Fildes et al., 2015b	Cross-sectional	UK, Greece, and Portugal	139	1 month after introduction of solids	Increasing vegetable acceptance in infancy	High
Gatica et al., 2012	Longitudinal	Brazil	4,231	3, 12, 24*, 48* months	Food intake variations by SES and behavioural characteristics	High
Gondolf et al., 2012	Cross-sectional	Denmark	312	9 months	Dietary habits of partly breastfed and completely weaned infants	High
Gooze et al., 2011	Longitudinal	USA	9,850	9 and 24* months	Prolonged bottle use and obesity risk	High
Griffiths et al., 2007	Longitudinal	UK	18,150	9 months	Ethnic variations in infant feeding practices	High
Griffiths et al., 2009	Longitudinal	UK	10,533	9 months	Infant feeding practices and weight gain	High
Grimm et al., 2014	Longitudinal	USA	1,078	10.5 months	Fruit and vegetable intake	High
Groner et al., 2009	Protocol	USA	34	12 months	Obesity prevention	High
Gross et al., 2016	RCT	USA	456	3 months		High

(Continues)

TABLE 1 (Continued)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
					Obesity prevention intervention on infant feeding practices	
Hamilton et al., 2011	Longitudinal	Australia	375	3 and 7 months	Decisions to introduce complementary feeding	High
Hampson et al., 2011	Longitudinal	Norway	37,919	6 months	Prenatal negative affectivity and food choices for infants	High
Hohman et al., 2017	RCT	USA	279	Ages 3, 16, 28, and 40 weeks	Intervention effects on infant dietary patterns	High
Hoppe et al., 2004	Longitudinal	The Netherlands	142	9 months	Protein intake, body size, and body fat	High
Horodynski et al., 2015	RCT	USA	100	3 and 6 months	Intervention for obesity reduction	High
Howe et al., 2015	Longitudinal	New Zealand	687	3 months	Ethnic differences in obesity risk factors	High
Huh et al., 2011	Longitudinal	USA	847	6 months	Introduction of solids and obesity risk	High
Jacknowitz et al., 2007	Longitudinal	USA	5,276	9 months	WIC effects on infant feeding	High
Jiang et al., 2016	Repeated measures intervention	China	582	12 months	Intervention effects on BMI	High
Johnson et al., 1993	RCT	Ireland	262	12 months	Effects of child development programme	High
Kim & Peterson, 2008	Cross-sectional	USA	8,150	9 months	Childcare effects on feeding practices and weight gain	High
Klingberg et al., 2016	Longitudinal	Sweden	9,727	After birth, throughout first year, 12 months	Introduction of complementary foods	High
Koh et al., 2014	Cross-sectional	Australia	277	*M* = 27 weeks (*SD* = 3.2)	Maternal self-efficacy and fruit and vegetable intake	High
Kronberg et al., 2014	Cross-sectional	Denmark	4,503	6 months	Early introduction to solids	High
Kupers et al., 2015	Longitudinal	The Netherlands	2,475	1, 6, 12*, and 24* months	Infant weight gain	High
Lande et al., 2005	Longitudinal	Norway	1,825	6 and 12 months old	Birth size, feeding practices, and BMI	High
Launer et al., 1992	Longitudinal	Israel	318	6, 12, and 18* months	Maternal recall of feeding events	High
Layte et al., 2014	Longitudinal	Ireland	11,134	Birth, 9 months old, and 3 years* old	SES and rapid infant growth	High
Lim et al., 2016	Longitudinal	Singapore	486	6, 9, and 12 months	Dietary pattern trajectory	High
Lin et al., 2013	Longitudinal	Hong Kong	3,390	<3, 3–4, 5–6, 7–8, and >8 months	Timing of solid food introduction and obesity	High
Lindberg et al., 1996	Case–control comparative study	Sweden	48	5.3 +/− 1.99 months in nurse-identified cases and 6 +/− 2.32 months in parent-identified cases	Maternal infant interactions during food refusal	High
Llewellyn et. al., 2010	Longitudinal	UK	2,402 pairs (twins)	*M* = 8.2 (*SD* = 2.18) months	Appetitive traits that have been shown to be heritable later in childhood	High
Llewellyn et. al., 2012	Longitudinal	UK	2,402 pairs (twins)	*M* = 8.2 (*SD* = 2.18) months	Inheritable susceptibility to adiposity	High

(Continues)

TABLE 1 (Continued)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
Mihrshahi et al., 2011	RCT	Australia	612	4.3 ± 1.0 (months)	Intervention effects on rapid weight gain	High
Moschonis et al., 2013	RCT	Greece, UK, and Portugal	283	2 tests between 5 and 12 months	Intervention to increase vegetable liking and consumption	Low
Newby et al., 2014	Longitudinal	Australia	462	4 and 6 months	Introduction of complementary foods	High
O′ Donovan et al., 2015	Longitudinal	Ireland	823	2 days and 2, 6, and 12 months	Adherence with early infant feeding and complementary feeding guidelines	High
Okubo et al., 2015	Longitudinal	UK	1,018	*Ages 6 and 12 months, and 3 and 6 years	Diet quality and adiposity	High
Oliveira et al., 2015	Longitudinal	Portugal, UK, and France	1,280	4*, 12, and 48 months	Birth weight and eating behaviours	High
Park et al., 2014	Longitudinal	USA	1,333	~3 weeks and 2, 3, 4, 5, 6, 7, 9, 10, and 12 months of age, and 6 years*	Influence of sugar-sweetened beverage intake during infancy	High
Parkinson et al., 2009	Longitudinal	UK	583	6* weeks, 4, 8, 12, and 30 months, at 5–6 years	Infant appetite correlating with child eating behaviour	High
Paul et al., 2011	RCT	USA	160	2–3 weeks, 4–6 months, 1 year	Intervention to prevent obesity	High
Pimpin et al., 2016	Longitudinal	UK	2,154	Infant feeding data at *M* = 8 (*SD* = 2.2) Dietary data at 21 months Weight and height every 3 months, from birth to 5 years*	Dietary protein intake, association with body mass index and in children up to 5 years of age	High
Pontin et al., 2007	Longitudinal	UK	11,490	4 weeks, 6 months, and 15* months	Breastfeeding pattern	High
Quah et al., 2015	Longitudinal	Singapore	210	Ages 3, 6, 9, 12, 15*, 18*, and 24* months	Appetitive traits, body mass index, and weight gain	High
Quah et al., 2016	Longitudinal	Singapore	1,237	At birth, data from 0 to 6 months, and 15 months*	Maternal feeding beliefs and practices	High
Qiu et al., 2008	Longitudinal	China	1,520	1, 3, and 6 months	Infant feeding practices	High
Reat et al., 2015	Cross-sectional	USA	196	*M* = 11.4 (*SD* = 5.6) months	Dietary intake and feeding practices	High
Rebhan et al., 2009	Longitudinal	Germany	3,103	6 days and 2, 4, 6, and 9 months	Infant feeding practices	High
Rifas-Shiman et al., 2011	Longitudinal	USA	837	6 months, 1 year, and 3* years	Maternal feeding restriction, and childhood obesity	High
Robinson et al., 2009	Longitudinal	UK	536	6 and 12 months	Infant feeding practice, body composition in childhood	High
Schack Nielsen et al., 2010	Longitudinal	Denmark	5,068	1 year	Complementary feeding protect against adult overweight	High
Schroeder et al., 2015	RCT	USA	278	1–24* months (monthly), 3, 4, and 5 years old*	Intervention on early obesity prevention	High
Scott et al., 2009	Longitudinal	Australia	519	4, 10, 16, 22, 32, 40, and 52 weeks post-partum	Early introduction of solid foods in infants	High
Scott et al., 2015	Longitudinal	Australia	303	Birth, 6, 12, 18, and 26 weeks post-partum	Introduction of complementary foods	High
Spence et al., 2013	RCT	Australia	528	4–19* months approximately		High

(Continues)

TABLE 1 (Continued)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
					Intervention's impact on diet quality in early childhood	
Spence et al., 2014	RCT	Australia	528	4–19* months approximately	Intervention (InFANT) to improve child diet quality	High
Tang et al., 2015	Longitudinal	China	695	1, 3, and 6 months post-partum	Early introduction of complementary feeding	High
Tarrant et al., 2010	Longitudinal	Ireland	401	6 weeks and 6 months	Weaning practices	High
Taveras et al., 2010	Longitudinal	USA	1,826	First and second trimester, few days after birth, 6 months, and 1, 2*, 3*, and 4* years	Racial/ethnic differences in early-life risk factors for childhood obesity	High
Taveras et al., 2011	Nonrandomised controlled trial	USA	80	6 months	Feasibility of intervention to improve nutrition and physical activity behaviours of mothers and infants	High
Thompson et al., 2013a	Longitudinal	USA	217	3, 6, 9, 12, and 18* months of age	Pressuring and restrictive feeding styles, infant feeding and size (African American)	High
Thompson et al., 2013b	Longitudinal	USA	217	3, 6, 9, 12, and 18* months of age	Period of infant feeding for the development of disparities in obesity	High
Thorisdottir et al., 2011	Longitudinal	Iceland	141	6, 9, and 12 months	Nutrition and iron status following a revision in infant dietary recommendations, and its association with diet and growth	High
Timby et al., 2014	RCT	Sweden	213	<2, 4, 6, and 12 months	Parental feeding control in relation to feeding mode and growth pattern during infancy	High
Toh et al., 2016	Longitudinal	Singapore	842	9 and 12 months	Infant feeding practices (Asian longitudinal)	High
Vail et al., 2015	Longitudinal	UK	571	At birth, 3 and 12 months	Age at weaning and infant growth	High
Van Der Merwe et al., 2015	Cross-sectional	South Africa	435	Ranged from 1 day to 5 months	Infant feeding practices	High
Van Jaarsveld et al., 2011	Longitudinal	UK	2402 pairs of twins	3, 9, and 15* months	Appetitive traits and weight gain in infancy	High
van Jaarsveld et al., 2014	Longitudinal	UK	800	Mean (*SD*) age was 8.2 (2.2) months	Appetite and growth among siblings	High
van Rossem et al., 2013	Longitudinal	The Netherlands	3,184	Infant feeding outcomes at 12 months Anthropometric outcomes at 1, 2, 3, 4, 6, 11, 14*, 18*, 24*, 30*, 36*, and 45*	Weight change before and after the introduction of solids	High
Vitolo et al., 2012	RCT	Brazil	363	6 and 16* months	Intervention: maternal dietary counselling, consumption of energy-dense foods among infants	High
Vitolo et al., 2014	RCT	Brazil	619	6–9 months	Intervention: child feeding training programme for primary health care professionals	High
Wasser et al., 2011	Longitudinal	USA	217	3, 6, 9, 12, and 18 months*	"Fussy" infants and complementary foods before 4 months of age	High
Wasser et al., 2013	Longitudinal	USA	217	3, 6, 9, 12, and 18 months*	Nonmaternal involvement in feeding and dietary intakes among infants and toddlers	High

(Continues)

TABLE 1 (Continued)

Study (Author, year)	Design	Study setting	Participants (*n*)	Child age at outcome assessment	Study focus	Quality of outcome reporting
Watt et al., 2009	RCT	UK	212	Approximately 10 weeks, and subsequently 12 and 18* months old	Social support intervention on infant feeding practices	High
Wen et al., 2009	RCT	Australia	56	1, 3, 5, 9, and 12 months	Feasibility of addressing risk factors for childhood obesity through an intervention	High
Wen et al., 2011	RCT	Australia	258	6 and 12 months	Intervention on infant feeding practices and "tummy time"	High
Wen et al., 2012	RCT	Australia	497	6, 12, and 24* months	Intervention on children's BMI at Age 2	High
Woo et al., 2013	Longitudinal	China, Mexico, and USA	324	Weekly between 2 and 52 weeks	Infant feeding practices and anthropometry at age 1 year	High
Woo et al., 2015	Longitudinal	China, Mexico, and USA	324	Weekly between 2 and 52 weeks	Infant complementary diet diversity	High
Wright et al., 2004	Longitudinal	UK	707	6 weeks and 4, 8, and 12 months	Early weaning	High
Yin et al., 2013	RCT	USA	844	*M* = 2.1 (*SD* 0.4) months	Parent health literacy and "obesogenic" infant care behaviours	High
Yuan et al., 2016a	Longitudinal	France	268	1–12 months of age, monthly 7-day food record	Infant dietary exposures to sweetness and fattiness during the first year of life and feeding practices	High
Yuan et al., 2016b	Longitudinal	France	1,142	4, 8, and 12 months	Early determinants of food liking among 5-year-old children	High
Zhang et al., 2009	RCT	China	599	2–4, 6, 9, 12, 15*, and 18* months of age	Intervention to improve child feeding practices and growth in rural China	High
Zhang et al., 2013	RCT	China	599	2–4 and 10–11 months	Intervention on infant feeding	High
Zheng et al., 2015	Longitudinal	China	40,510	1, 3, and 6 months and 4–5 years*	Complementary feeding and childhood adiposity in preschool-aged children	High
Ziol-Guest et al., 2010	Cross-sectional	USA	4,450	9 months	First- and second-trimester WIC participation and breastfeeding rates and cow's milk introduction during infancy	High

Note. BMI: body mass index; InFANT: infant feeding activity and nutrition trial; SES: socio-economic status; WIC: women, infants, and children programme; RCT: randomised controlled trial.

TABLE 2 Outcome domains and outcomes

Outcome	Outcome definition
Domain 1. Breastfeeding and formula feeding (*n* = 15)	
Breastfeeding duration	The length of time mothers breastfeed their infants. This can include the length of time mothers exclusively breastfed their infants or the length of time before mothers ceased all breastfeeding
Breastfeeding intentions	Parental intentions to initiate breastfeeding and/or intentions relating to duration of breastfeeding
Breastfeeding initiation	Whether mothers began breastfeeding their infant, regardless of duration of breastfeeding
Breastfeeding frequency	How often infants are breastfed
Breastfeeding intensity	How often and for how long the infant is breastfed
Exclusive breastfeeding	Feeding the infant only breast milk, without introducing solids or formula
Duration of exclusive breastfeeding	The length of time mothers only breastfeed their infants
Feeding method (breast milk, formula, solids, and combination)	The method by which the infant is fed. This can include single feeding approaches or a combination of feeding approaches
Timing of introduction to formula	The infants age when formula was introduced. This can include combination feeding of breast and formula milk
Formula feeding	Whether the infant ever consumed formula milk, rather than routine consumption of formula milk
Bottle/formula feeding frequency	How often infants are fed formula milk by bottle
Amount/volume formula consumed	The quantity of formula milk consumed
Duration of infant formula feeding	The length of time infants consumed formula milk
Type of formula fed	The type of formula provided to infants (e.g., early baby and hungry baby)
Number of feeds per day of either breastfeeding or formula	The frequency of any milk feeds per day
Domain 2. Introduction of solids (*n* = 6)	
Timing of introduction of solids	The infant's age when solids were introduced to the diet. Solids are considered any food or liquid substance, other than breast milk or formula milk
Intended age of solids introduction	Parental intentions to introduce solid foods at a certain age. This can be in line with feeding recommendations or not
Timing of introduction of certain foods	The infant's age when individual foods and/or liquids were introduced to the diet. These can include overarching food groups (e.g., vegetables) or specific foods within those groups (e.g., carrot, potato, and broccoli)
Timing cow's milk introduced	The age at which infants began consuming cow's milk
Timing nonmilk drink introduced	The age at which infants began consuming nonmilk drinks
Adding solids to bottle	Including solids, such as cereals, to the infant's bottle
Domain 3. Parents feeding practices and styles (*n* = 16)	
Instrumental feeding	Using incentives or rewards, such as other preferred foods, to encourage consumption of foods
Emotional feeding	Using food to regulate a child's emotions, for instance, giving the child food in response to distress
Feeding to soothe	Use of food to prevent or stop infant from crying
Restriction	Limiting the child's access to foods. Caregivers can restrict for health or weight control purposes. For instance, restricting "unhealthy" foods or restricting the amount a child eats

(Continues)

TABLE 2 (Continued)

Outcome	Outcome definition
Pressure	Pressuring or cajoling the child to eat more at mealtimes. For instance, insisting the child finishes everything on their plate
Modelling	Caregivers acting as models of eating that children learn to emulate. Caregivers who engage in healthy appropriate eating behaviours serve as positive models; caregivers who engage in unhealthy eating behaviours serve as negative models
Parent control	Guiding children's eating by exerting control, such as restricting how much their child eats or putting pressure on the child to eat more
Feeding to schedule	Caregivers allowing the infant to eat whenever they want or only providing food for the infant at set times
Parent–infant interaction during feeding	How parents and infants interact during feeding, can include responsiveness of both, including feeding behaviours and responses to reactions
Satiety and hunger responsiveness	Caregiver's awareness and attention to infant cues for hunger or fullness, and the initiation and termination of feeding in response to those cues
Laissez faire feeding style	Not setting limits on quality or quantity of foods infants consume, while showing little interaction with the infant during feeding
Indulgent feeding	Not setting limits on quality or quantity of foods infants consume, while also being highly involved with feeding
Authoritative feeding	Feeding style that is characterised by high parental demandingness and high responsiveness
Authoritarian feeding	Feeding style that is characterised by high parental demandingness and low responsiveness
Responsive infant feeding	Infant feeding in which the parent is aware of and responds in a timely and appropriate manner to infant cues and needs
Bottle to bed	Allowing the infant to take the bottle while laying down in their bed or cot and bottle-feed themselves to relaxation/rest
Domain 4. Parent knowledge and beliefs (*n* = 9)	
Parent's feeding intentions	Parents intentions to feed the infant in a certain way, this can be in line with infant feeding recommendations or not
Maternal feeding self-efficacy	The degree to which the caregiver perceives themselves capable of the necessary tasks involved in infant feeding
Knowing what foods should be offered/avoided	Caregiver knowledge of what foods should be offered to infants and what foods should be avoided during early feeding
Knowledge about how to offer complimentary foods	Caregiver knowledge of the appropriate ways to feed infants complimentary foods
Perceived behavioural control about introducing solids	Caregiver's perceived ease of introducing solid foods to the infant's diet
Perceptions of child weight	Parents perceptions of the child's weight
Weight concern	Caregiver's concerns about the child's risk of being overweight or underweight
Concern about eating	Caregiver's concern that the infant is not getting enough to eat or is eating too much
Perceived responsibility	Caregivers' perceptions of their responsibility for child feeding, including responsibility for feeding in general, portion size, and the types of foods consumed
Domain 5. Practical feeding (*n* = 2)	
Self or assisted feeding	Whether the child self-feeds (finger foods or spoon use) or is assisted in feeding by the caregiver (spoon fed). This relates to all feeding occasions rather than just introduction of solids
Beverage container use	Whether the child drinks from a bottle, “sippy-cup,” or cup, which is developmentally appropriate for their age
Domain 6. Food environment (*n* = 3)	

(Continues)

TABLE 2 (Continued)

Outcome	Outcome definition
Feeding environment	The environment in which feeding takes place. This includes, but is not limited to, communication with the infant, sitting down to eat with the infant, and turning off the television during feeding
Offering healthy foods	Availability and provision of healthy foods to infant
Infant consuming family foods	Whether the infant is fed common family foods that are consumed by all members of the family, or if the food is prepared specially for the infant and differs from the family meal/foods
Domain 7. Dietary intake (*n* = 16)	
Types of food consumed	Relates to the different types of foodstuffs infants consume. This can include ever feeding, and/or the quantity of foods consumed, ranging from fruits and vegetables to sweet and savoury snacks
Energy/nutrient intakes	Intake of different nutrients, protein, energy, fat, and so forth
Portion size	The size or amount of food provided to infants
Consumption of new foods	Infant consumption of new foods
Type of first food	The type of solid infants were first introduced to
Offering age appropriate foods and beverages	Whether the foods and beverages provided to infants are developmentally appropriate
Ready-made food consumption	Infant consumption of commercial baby food; this includes pre-packaged, ready-made, or shop-bought foods. These foods can include cereals, fruit, vegetables, fish, meat, sweets, and desserts
Food variety	Infant consumption of a varied diet
Frequency of solid food consumption	How often infants consume solid foods, including main meals and snacks
Home-made food consumption	Infant consumption of food prepared by caregiver. This can include the type of food prepared by caregiver for infant
Texture of foods consumed	Texture of foods provided to infants (pureed and lumpy), can include whether the texture is developmentally appropriate for infant age
Type of milk consumed	Infant consumption of different types of milk, including full-fat cow's milk, low-fat cow's milk, soya milk, and goat's milk. This does not include formula milk
Type of "other drinks" consumed	Infant consumption of a range of nonmilk drinks. These include water, sugar-sweetened beverages, herbal drinks, tea/coffee, and warm drinks (other than tea or coffee)
Frequency of sugar-sweetened beverage consumption	How often infants consume sugar-sweetened beverages
Food/feeding preparation method	The methods by which infant foods are prepared
Supplement intake (e.g., vitamins/minerals/probiotics)	Infant consumption of vitamins and minerals
Domain 8. Perceptions of infant behaviours and preferences (*n* = 12)	
Infant appetite	Infant's perceived appetite
Food preferences	Perceptions of the infant's liking of established or newly introduced foods
Infant food responsiveness	The infant's desire to eat in response to food stimuli, regardless of how hungry they are
Infant enjoyment of food	Perceptions of how much the child enjoys eating and is interested in food
Infant satiety responsiveness	The infant's ability to regulate their intake based on their own fullness
Infant slowness in eating	The speed at which the child eats
Infant food fussiness	Whether the infant is seen as being a "picky eater" and highly selective about the foods that are consumed

(Continues)

TABLE 2 (Continued)

Outcome	Outcome definition
Child willingness to try new foods	Perceptions of child's aversion to novel foods
Food refusal	Perceptions of infants refusal of any foods offered, not limited to new foods
Ease of feeding	How easy the infant is perceived to be to feed
Desire for drinks	How often the child is perceived to want a drink such as water, breast milk, formula milk, or other
Emotional eating	The infant eating more (overeating) or less (under-eating) in response to emotional states
Domain 9. Child weight-related outcomes (n = 3)	
Weight	Including infant's weight, and weight for age and length
Body fat	Includes BMI and skinfold thicknesses
Length	Includes infant length and length for age

Note. BMI: body mass index.

and styles and parents' knowledge and beliefs. Outcomes relating to the food environment, practical feeding, and perceptions of infant behaviour and preferences are further under-represented. Differences in terminology and reporting of individual outcomes highlight that the same or similar outcomes are often reported differently across studies. Inconsistency in outcome selection and reporting limits synthesis and comparison across studies (Williamson et al., 2017) and hinders the development and evaluation of childhood obesity prevention efforts.

The four most common outcome domains identified in the current review ("breastfeeding and formula feeding," "introduction of solids," "dietary intake," and "child weight-related outcomes") were unsurprising in the context of childhood obesity prevention. Over two fifths of all reviewed studies included outcomes assigned to the "breastfeeding and formula feeding" outcome domain, suggesting that this is a core aspect of infant feeding in the first year of life. This is interesting given that this review excluded studies with a breastfeeding only focus, further indicating the importance of this domain in any examination of early child feeding. This is unsurprising in light of consistent evidence linking factors such as breastfeeding (Modrek et al., 2017) and type of formula consumption (Koletzko et al., 2009; Weber et al., 2014) to later child weight status. Outcomes within the "child weight-related outcomes" domain, child weight (Institute of Medicine (U.S.), Committee on Obesity Prevention Policies for Young Children, Birch, Burns, Parker, & Institute of Medicine (U.S.), 2011), and weight trajectories (Baird et al., 2005; Institute of Medicine (U.S.), Committee on Obesity Prevention Policies for Young Children, et al., 2011; Woo Baidal et al., 2016) are also consistently associated with risk of later childhood obesity. Outcomes within the "introduction of solids" domain, such as the timing of introduction of foods and beverages other than breast or formula milk, are also associated with risk of later childhood obesity (Weng, Redsell, Swift, Yang, & Glazebrook, 2012). Similarly, outcomes within the "dietary intake" domain, including types and amounts of foods consumed, demonstrate associations with childhood obesity, although a recent review has identified inconsistencies across findings. (Matvienko-Sikar et al., 2018).

The domains of "parent feeding knowledge and beliefs" and "parent feeding practices and styles" were reported less frequently. This suggests that less consideration is given to parent-related factors when examining infant feeding overall. "Feeding practices and styles" include responsive and nonresponsive feeding behaviours, such as parent awareness and attention to satiety and hunger responsiveness and pressure to eat. Such outcomes are particularly important for examinations of infant feeding interventions because they reflect modifiable behaviours that are consistently associated with infant feeding and weight outcomes (DiSantis et al., 2011; Hurley, Cross, & Hughes, 2011; O'Malley et al., 2015). Recent reviews have shown that interventions incorporating responsive feeding components demonstrate greater benefits for some feeding and weight outcomes than interventions without this focus (Matvienko-Sikar; Redsell et al., 2016). What parents know and believe about how, what, and when to feed is also important in terms of improving infant feeding. Parents' perceived self-efficacy around infant feeding (Campbell, Hesketh, Silverii, & Abbott, 2010) will also influence when and how different feeding behaviours occur. These outcome domains are therefore important to consider in feeding and obesity prevention research because many

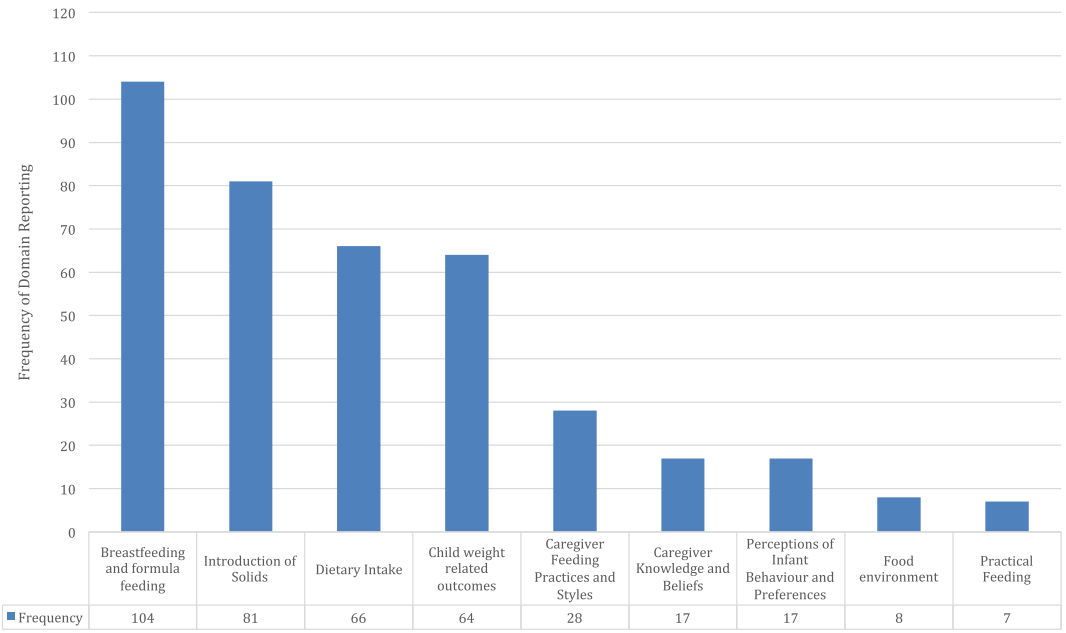

FIGURE 2 Reporting of outcome domains in reviewed studies

behavioural infant feeding interventions operate on an assumption that modifying such outcomes leads to effects for child weight outcomes. By not assessing these outcomes, important information on the mechanisms of change of infant feeding interventions may be missed, further limiting development of efficacious obesity prevention interventions.

Outcomes categorised under the perceptions of infant behaviour and preferences domain are under-represented across trials. These outcomes are important because of the bidirectional nature of the parent–infant feeding relationship, whereby parents engage in feeding behaviours based on infant reactions and/or perceived temperament (Jansen et al., 2017). As noted in a recent examination of parents' feeding responses to fussy eating, this bidirectional relationship can result in poorer child feeding outcomes (Jansen et al., 2017). For instance, pressuring a child to eat may lead to problematic food avoidant behaviours (Jansen et al., 2017). It is important to note that a number of outcomes within this domain come from the Child Eating Behaviour Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001). Thus, under-representation of this outcome domain in the current review may reflect less frequent use of this questionnaire in infant feeding examinations, rather than reduced importance of this domain.

Under-representation of the "food environment" and "practical feeding" outcome domains may reflect a greater focus in the literature on individual-level factors related to infants and/or parents than on environmental factors. More recently, there has been greater attention paid to broader environmental factors, and this recent focus is not reflected in all studies included in this review. The food environment relates to the environment in which feeding takes place and the types of food provided/available within this environment. Exposure to obesogenic environments is associated with poorer dietary intake and weight outcomes in older children (Schrempft, van Jaarsveld, Fisher, & Wardle, 2015), and such outcomes warrant further examination in infancy. "Practical feeding" relates to beverage container use and the child's self-feeding behaviours. In the first year of life, these factors may be of less importance to weight outcomes than, for instance, between 1 and 2 years of age (Woo Baidal et al., 2016), thus explaining infrequent reporting here.

The observed inconsistencies in outcome definitions and reporting have important implications for childhood obesity prevention, particularly trials of infant feeding interventions conducted with infants under 1 year. Lack of standardisation of outcomes facilitates a continuation of heterogeneity in the literature on infant feeding approaches to obesity prevention. This limits synthesis of trial outcomes and robust evaluation of the effects and mechanisms of change underpinning childhood obesity prevention interventions (Matvienko-Sikar). Without standardisation of outcomes, an effective and efficient approach to developing, implementing, and evaluating infant feeding interventions for childhood obesity prevention cannot be conducted. This heterogeneity therefore provides a robust rationale for the development of a COS for trials of infant feeding interventions for infants up to 1 year, of which this review forms the first part (Matvienko-Sikar et al., 2017).

4.1 | Strengths and limitations

This review had a number of strengths, including use of the established Preferred Reporting Items for Systematic Reviews and Meta-Analyses systematic review methodology (Moher et al., 2009) and the COMET initiative guidelines (Williamson et al., 2017). As such, the authors are confident that all relevant papers were identified for the current review; this was further strengthened by the lack of restriction on date of publication. Inclusion of infant feeding studies that are not explicitly weight focused in the current review is also a strength as it facilitated evaluation and examination of all reported infant feeding outcomes. It is possible that important outcomes may be overlooked in trials of obesity prevention interventions and this may contribute to inconsistencies observed in intervention effects (Matvienko-Sikar et al., 2017; Redsell et al., 2016).

Inductive generation of outcome domains could be considered a limitation of this review. Previous reviews (Kapadia et al., 2015) have

utilised standardised approaches to categorising outcomes, such as the Outcome Measures in Rheumatology (OMERACT) filter (Boers et al., 2014) to assign individual outcomes to a number of prespecified key domains. The inclusion of a multidisciplinary team in this outcome synthesis process provides confidence in the outcomes and outcome domains presented in this review however. This review does not address outcome measurement instruments used to examine individual outcomes or outcome domains, as has been done in other reviews of children with neurodisabilities (Kapadia et al., 2015). Examination of outcome measurement instruments provides further insight into heterogeneity of outcome evaluation and also facilitates identification of potentially useful outcome tools. However, it is advised by the COMET initiative (Williamson et al., 2017) and the consensus-based standards for the selection of health measurement instruments (Prinsen et al., 2016) initiative to first establish *what* to measure; only when this is done should measurements, or the *how* to measure, be examined.

4.2 | Future research

The findings of the current review highlight a significant need for standardisation of infant feeding outcomes for trials of obesity prevention interventions in children up to 1 year. Doing so will facilitate improved evaluation of existing interventions and development of more robust and effective interventions to prevent childhood obesity in the future. Given the current high rates of childhood obesity (Ogden et al., 2016), development, implementation, and evaluation of effective obesity prevention interventions is crucial.

This review represents the first stage in development of an infant feeding COS for childhood obesity prevention interventions (Matvienko-Sikar et al., 2017). The 82 outcomes identified in this review will form the basis for the development of the COS. As outlined in the COMET handbook version 1.0, the next stage is to engage in a consensus process with expert stakeholders to elicit views about important outcomes for COS inclusion (Williamson et al., 2017). This will be conducted as an online Delphi survey with stakeholder groups including parents, health care professionals, and researchers. The identified outcomes and outcome domains will be used in this process to prioritise outcomes for the COS. This will be followed by a nominal group consensus meeting to achieve consensus on outcomes for inclusion in the COS (Matvienko-Sikar et al., 2017). The final COS will present a standardised list of outcomes to guide research and practice in infant feeding childhood obesity prevention.

5 | CONCLUSIONS

This review identified nine domains of 82 infant feeding outcomes from 126 studies. There was considerable heterogeneity and inconsistencies in outcome selection and reporting. Current outcome reporting focuses predominantly on early consumption of milks and solids and infant weight. Less focus is given to important modifiable parental feeding practices and styles. Similarly, there is proportionally little attention given to environmental factors relating to infant feeding. These results provide a robust foundation for the development of an infant feeding COS for childhood obesity prevention interventions for children up to 1 year.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest relevant to this article to disclose.

CONTRIBUTIONS

KM-S conceptualised the review, developed the review protocol, synthesised outcomes, conducted analyses, and drafted the manuscript. CG conducted searches and quality assessment, conducted analyses, and made significant contributions to reviewing and revising the manuscript. NM conducted searches and made significant contributions to reviewing and revising the manuscript. ET contributed to drafting the review protocol and substantially contributed to reviewing and revising the manuscript. MB, CK, CH, and DD contributed to analyses and substantially contributed to drafting, reviewing, and revising the manuscript. PMK advised on all aspects of the review and made significant contributions to reviewing and revising the manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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