Article

A Review of Registered Randomized Controlled Trials for the Prevention of Obesity in Infancy

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Abstract: Childhood overweight and obesity is a worldwide public health issue. Our objective was to describe planned, ongoing and completed randomized controlled trials (RCTs) designed for the prevention of obesity in early childhood. Two databases (World Health Organization International Clinical Trials Registry Platform, ClinicalTrials.gov) were searched to identify RCTs with the primary aim of preventing childhood obesity and at least one outcome related to child weight. Interventions needed to start in the first two years of childhood or earlier, continue for at least 6 months postnatally, include a component related to lifestyle or behaviors, and have a follow up time of at least 2 years. We identified 29 unique RCTs, implemented since 2008, with most being undertaken in high income countries. Interventions ranged from advice on diet, activity, sleep, emotion regulation and parenting education through individual home visits, clinic-based consultations or group education sessions. Eleven trials have published data on child weight related outcomes to date, though most were not sufficiently powered to detect significant effects. Many trials detected improvements in practices such as breastfeeding, screen time and physical activity in the intervention groups compared to the control groups. Further follow-up of ongoing trials is needed to assess longer-term effects.

Keywords: Behaviours; Childhood; Infant feeding; Interventions; Obesity; Prevention; Physical activity.

1. Introduction

Childhood obesity is a worldwide public health issue with an estimated 38.3 million children under five years affected by overweight or obesity in 2019 (1). Between 1980 and 2015, the global prevalence of obesity in children in the 2-4 year age group rose almost twofold, from 3.9 to 7.2% in boys and from 3.7 to 6.4% in girls (2). Children who are overweight in early childhood are more likely to still be affected by overweight or obesity in later childhood, adolescence and adulthood (3) and obesity in childhood can affect a child’s immediate health as well as their educational attainment and quality of life (4). Obesity has been associated with an increased risk of non-communicable diseases...
such as type 2 diabetes, cardiovascular disease and many cancers (5). This in turn has implications for health systems as well as economies.

With recognition of the rise in prevalence of obesity in early life and its resulting consequences, there has been an increasing focus on the first 1000 days, from conception to 2 years, as a critical life stage to prevent obesity (4, 6). Obesity-related behaviours such as poor diet quality, decreased physical activity, increased sedentary behaviours and decreased sleep duration are established in, and track from, early life (7). Evidence has accumulated about the best ways to support parents to establish protective behaviours and influence their child’s trajectory toward healthy growth, and several early intervention trials have been conducted. In Australasia, for example, four RCTs of early obesity prevention interventions including over 2000 mother-child dyads have been undertaken since 2008 (8-11) and the results have been combined in an individual participant data prospective meta-analysis (12) undertaken by the Early Prevention of Obesity in Childhood (EPOCH) Collaboration (13). The interventions that were tested included a combination of promoting and extending the duration of breastfeeding, introducing appropriate healthy solid foods after 6 months, limiting discretionary foods, promoting parental responsiveness to feeding cues, ensuring adequate sleep and activity patterns and limiting screen time. The prospective meta-analysis showed that children in the intervention group had lower body mass index (BMI) z-scores at 18 to 24 months than children in the control group (−0.12 adjusted mean; 95% confidence interval, −0.22 to −0.02, P = 0.017), which is equivalent to a 2% absolute reduction in the prevalence of overweight and obesity. Improvements were also detected in behaviours which may protect against obesity, such as reduced television viewing time, improved feeding practices, and increased breastfeeding duration. Although the effect size of the interventions on BMI z-score was modest, it is important on a population-level scale, and the observed improvements in behaviours in early life may have consequences in later childhood.

Several trials evaluating interventions for obesity prevention in early life started in the last decade. However, intervention content and delivery features within these trials are often not clearly defined, and therefore interventions are difficult to replicate. In addition, because of the complexity of most interventions it is not clear which components of the intervention have contributed to the positive effects, if any, of the interventions. It also remains unknown at which age to commence interventions, the optimal duration and intensity of the interventions, and the best delivery methods and agents for effective implementation. Important contextual factors that underlie interventions such as level of background health care and features of the target population may influence the level of effectiveness (14). Qualitative analyses including process analysis of behavioural interventions showing how they work and in which population groups are lacking (15).

Clinical trial registries offer a valuable resource to understand the landscape of planned and ongoing clinical trials in a particular area (16). Since the International Committee of Medical Journal Editors (ICMJE) declared clinical trial registration an ‘ethical obligation’ in 2005, registration rates of trials have increased substantially, providing a more complete database of clinical trials that are planned, ongoing or recently completed (17, 18). The Australian NHMRC Centre of Research Excellence in the Early Prevention of Obesity in Childhood (EPOCH CRE) has established a repository of registered trials to identify and describe the features of early obesity prevention intervention trials and identify evidence gaps in this critical area (19). Trial registries are regularly searched to identify RCTs evaluating preventive behavioural interventions designed to reduce childhood obesity according to predefined criteria. The ultimate aims of this repository are to improve data quality by sharing information about tools and measurements and to promote collaboration among trialists.

In this review we aim to conduct descriptive analyses to understand features of registered RCTs which aim to reduce the risk of overweight and obesity in children in the first two years. We review the intervention components, the features of delivery and implementation including mechanisms and agents, the theoretical models that they are based on, the target populations, and examine funding sources. Our purpose is to summarise the accumulating evidence for the primary prevention of
obesity in children and identify promising intervention features, in order to inform future health promotion programmes and policies.

2. Methods

2.1. Search strategy

As part of our ongoing research work in the EPOCH CRE, the World Health Organisation (WHO) International Clinical Trials Registry Platform and ClinicalTrials.gov have been searched every three to five months since April 2016 by K.H. in order to identify eligible trials to add to the EPOCH CRE Trial Repository (19). Search terms included variations of ‘infant’, ‘child’ ‘overweight’, ‘obesity’ and ‘prevention’.

Registration records were screened and studies were included if (1) they were RCTs, (2) the main aim was to prevent childhood obesity, (3) the intervention commenced within the first two years or antenatally, (4) continued for at least 6 months postnatally, (5) included a component related to lifestyle, and (6) the trial had a follow-up period of at least two years from baseline. Pilot studies were excluded. Published papers for each of the eligible trials were identified using the registration number and/or study title via the PubMed database. For trials with multiple publications, all relevant publications were used to extract pertinent information. For studies which had published results, information was extracted from the final published papers, while studies with only a protocol or clinical trial registration record were coded as per the latest protocol or record. The latter studies were included as our purpose was to describe not only completed interventions and their results, but also the type of interventions that are currently being planned or undertaken.

2.2. Data extraction

For each eligible trial the following information was extracted: registration number, study title, principal investigator, protocol/results publication year, recruitment country/ies, study design, number of participants, timing of intervention commencement, timing of baseline data collection, primary outcome(s), secondary outcome(s), delivery agent, main intervention components and the type of control group.

Detailed data on intervention characteristics were extracted using an adapted version of the Template for Intervention Description and Replication (TIDieR) reporting guidelines (20). Intervention commencement was coded as antenatal or post-natal and intervention setting was coded as clinic/community-based, home-based or both. Delivery agent was coded according to who provided the intervention to participants (e.g. nurses, dietitians, psychologists, etc.) and intervention mode was coded as individual, group, individual and group, telephone or mobile application, or a combination of these. Intervention delivery referred to the implementation materials (such as educational handouts, educational videos) as well as procedures (such as home visits or through mobile applications). Target populations were coded by ethnicity, socio-economic position, literacy level and parental weight status. Funding sources were categorised as government, non-government organisation, university, industry, or mixed. Where available, theoretical model, cost data and biomarkers were also extracted. Where data for some variables were missing, trialists were contacted to provide further information.

Data were extracted by two investigators (D.J. and L.R.) then cross-checked for accuracy by a third investigator (S.M.). Inconsistencies were settled through discussion.

2.3. Quality assessment

All trials with published weight related data were included in the quality assessment using the Cochrane Risk of Bias tool version 2 (RoB2) for randomised trials (21). Risk of bias assessment was undertaken on all publications including follow up publications. Each trial was assessed independently by two reviewers (S.M. and D.J.) as “low risk” or “high risk” of bias or having “some
concerns”. Disagreements were resolved through discussion. No trials were excluded from the review based on the results of the risk of bias assessment.

2.4. Data synthesis

Findings are presented in data tables and summarised in the text. Only descriptive comparisons were performed as described in section 2.2 above.

3. Results

Electronic searches identified 2292 records. After removing duplicates and applying the inclusion and exclusion criteria, 29 unique trials met our eligibility criteria and are summarised in Table 1. To date 38% (n=11) have published outcomes (22-32). Of the trials that haven’t yet published outcomes, 12 are ongoing, one has not progressed because of funding issues, and the remaining 5 trials have a status which is unclear in terms of their level of progression/completion. Most trials have been conducted/planned in high income countries, with the majority being undertaken in the USA (n=12, 41%), with the remainder being in Australia (n=5, 17%), the Netherlands (n=3, 10%), Sweden (n=2, 7%), New Zealand (n=2, 7%), Italy (n=1, 3%) and Spain (n=1, 3%). Three trials (10%) have been planned in low- and middle-income countries (Mexico, Guatemala, and China) although one has not progressed due to lack of funding (33).

The majority of trials are parallel group RCTs (n=20, 69%). There are three trials with factorial RCT designs, which have more than one intervention arm, and there are six cluster RCTs for which participants were randomised at the group level.

It is worth noting that three trials - INFANT Extend (34), CHAT (35) and Greenlight Plus (36) - build on the earlier foundation trials of INFANT (9), Healthy Beginnings (8) and Greenlight (37), respectively. There are similarities to the foundation trials in the intervention components but the duration of interventions are lengthened (34) or new methods of delivery are being trialled (35, 36).

3.1. Intervention Characteristics

In approximately a third of the 29 trials (n=9, 31%) the interventions have commenced or plan to commence antenatally, and in a further eight trials (28%) intervention commencement occurs when the child is one month old or younger. In the remaining 12 trials (41%) the interventions commence when the child is between 1 and 12 months of age. The duration of interventions ranges from nine months to six years, with an average duration of 23.3 months (SD 14.8). In three trials, the duration of the intervention is unclear (and there was no response from trial authors who were contacted). A total of 83% (n=24) of trials targeted ‘parents’ or ‘mothers and caregivers’ while 17% (n=5) specifically targeted mothers.

Most interventions (55% n=16) were delivered or plan to be delivered in community settings such as clinics, a further six (21%) were based within the home and seven interventions (24%) use a combination of home and community settings.

In terms of intervention delivery mode, the majority of interventions (n=10, 34%) were delivered face-to-face individually, four (14%) are delivered in a group setting, such as a parent support group, and a further four (14%) use a combination of individual and group delivery. In two trials (7%) the interventions were completely delivered via telephone or mobile application, and the remaining trials used a combination of delivery modes for the interventions (n=9, 31%).

Most trials involve multiple forms of delivery methods (Table 2). In terms of materials, the majority use some form of educational handouts (n=24, 83%) and are either delivered at the home visit, clinic or group session or mailed out. Two trials (7%) involve educational videos and five trials (17%) include an educational website or application. Three trials use an “educational tool kit” which was tailored to low literacy populations. In terms of the procedures, six trials (21%) involved consultations with health professionals over the phone and in four trials (14%) the intervention was
delivered through text messages. For more information about each individual trial, please refer to Appendix Table 1.

Interventions were delivered by a range of health professionals and researchers (Table 2), with nurses being the most common (n=9, 31%). Five interventions were nurse-led in clinics and four were delivered through nurse home visits. Dietitians delivered the intervention in five trials (17%), community health workers also in five trials (17%), trained research assistants in four (14%), and Paediatric residents/Paediatricians also in four (14%). Other delivery agents included lactation consultants, general practitioners, midwives, physiotherapists and trained sleep specialists. In six trials (21%) a combination of delivery agents was used. For more information about delivery agents for each individual trial, please refer to Appendix Table 2.

3.2. Intervention components/content

Most trials include between three and eight intervention components and target multiple behaviours as part of the interventions (Table 3). The most common component was providing general advice about healthy dietary behaviours in children (n=24, 83%), followed by encouraging play and activity (n=20, 69%), breast/bottle feeding advice (n=16, 55%), and targeted parenting practices, especially education around hunger and satiety cues (n=13, 45%). Several trials targeted sleep promotion (n=13, 34%), parental modelling of behaviour (n=13, 45%) or limiting small-screen and TV time (n=9, 31%). Other intervention components included how and when to introduce solids (n=10, 34%), limiting junk foods (n=6, 21%), and how to deal with fussy eating (n=5, 17%). Only one trial included information about growth monitoring and growth charts as part of the intervention. For more information about intervention components and key messages for each individual trial, please refer to Appendix Table 3.

In terms of the specific techniques of delivery, ‘anticipatory guidance’ was referred to in six (20%) (23, 24, 29, 34, 37, 38) of the 29 trials and ‘motivational interviewing’ was explicitly used in eight (28%) (27, 37, 39-44) of the 29 trials.

3.3. Target Populations

Fifty-two percent of trials (n=15) target a locally representative population while the remainder target either those of low socio-economic position (n=7, 24%), ethnic minorities (n=5, 17%), a low literacy population (n=1), or a population of parents affected by overweight/obesity (n=1, 3%). It should be noted that the five studies that targeted ethnic minorities could also be grouped as low socio-economic status populations, but they were coded to the ethnic minority group as this was the main focus of the study (40, 45-48).

3.4. Theoretic basis of trials

Of all trials, the use of a theoretic model or theory was stated in 12 (41%) and many of these (n=7, 24%) used multiple theories (Appendix Table 4). The most commonly used theories were Social Cognitive Theory (n=9, 31%) and Social Learning Theory (n=5, 17%). Three trials (10%) used the Health Belief Model.

3.5. Funding Sources

A total of six trials (21%) report solely government funding. Of the remaining trials, the majority (n=14, 48%) reported some form of governmental funding in addition to other funding sources. Most of these were jointly funded by non-governmental organisations, universities and industry. The majority of US studies (n=9, 75%) were funded by the National Institutes of Health and The National Institute of Diabetes and Digestive and Kidney Disease, while the Australian and NZ studies were
funded by the Australian National Health and Medical Research Council and the Health Research Council NZ, respectively (Appendix Table 5). Universities co-funded (n=10) 34% of studies.

While no studies were solely funded by industry, 6 (21%) had some industry funding, with Meat and Livestock Australia, Heinz, Danone Nutricia and Karitane Products Society contributing to three studies (10%). Two Latin American studies, the SPOON studies in Mexico (33) and Guatemala (49), were to be partially funded by the PepsiCo Foundation but in recent communications one trial has been cancelled (48). In addition to providing funding, Danone Nutricia provided jars of baby food and printed information materials for participants in the Baby’s First Bites trial (41).

3.6. Cost effectiveness data

Only five (17%) of the trials stated in the protocols or other publications that they planned to collect (or have already collected) data on costs of the intervention or conduct cost effectiveness analyses. The Healthy Beginnings trial completed a retrospective economic evaluation, where intervention resources were determined from local health district records (50). Healthcare utilisation was determined using patient level data linkage and it was estimated that the program could be delivered for just over AUD$700 per child with a cost-effectiveness ratio of AUD$376 per 0.1 reduction in BMI z-score, which is regarded as a moderately priced intervention.

Three trials (10%) indicated that they will conduct detailed cost effectiveness analyses (35, 44, 51). In addition, the PRIMROSE trial plans to conduct a cost utility analysis (44). The INFANT Extend trial (34) plans to conduct an economic analysis and monitor use of health services in both control and intervention groups to assess whether the program reduces parent’s health seeking behaviours elsewhere.

3.7. Biomarkers

Of the 29 trials, only two have planned to collect biomarkers and of these; neither has published results. The INSIGHT trial (52) has conducted genetic testing for appetite, growth, and temperament on the child, mother and father. The SCHeLTI (53) trial will collect blood from the infant as well as other samples (saliva, stool), and blood and other samples will also be collected from the mother and father. It is unclear which tests will be conducted but the samples will form part of a Biobank and be kept for at least 20 years.

3.8. Weight related outcomes

To date 11 trials have reported weight related outcomes (22-32) while nine [(9, 34, 35, 37, 39-41, 47, 48, 54)] have published protocol papers only, and eight [(33, 36, 42, 43, 46, 49, 53, 55)] are in the planning stages and information is only available from the clinical trial registration record.

A comparison of the reported weight related outcomes showed heterogeneity in reported measures, with BMI, BMI z-scores, weight-for-length percentiles, waist circumference and prevalence of overweight and obesity being reported. In addition, the outcomes were reported at different time points (Table 4).

Of the 11 trials with published outcomes, five [19,39,41,43,44] have follow-up weight outcomes at later time points, up to age 5 years from baseline [20,40,42,57,45], providing further insight into the duration of intervention effects. Retention rates at the first follow up where outcomes were reported ranged from 73% to 92%.

Of the 11 trials, three - POI.nz, Healthy Beginnings and INSIGHT [19, 39,67] - have demonstrated statistically significant differences in weight outcomes between the intervention and control groups at the first follow up. Healthy Beginnings demonstrated a significantly lower BMI at 2 years in its intervention group when compared with the control [Mean difference -0.29 (95% CI 0.02 to 0.55), p=0.04], however there was no statistically significant reduction in BMI observed in follow up at 3.5 or 5 years of age. INSIGHT reported different outcomes at 1 and 3 years and demonstrated a reduced weight for length percentile at 1 year of age and a reduced BMI z-score at 3 years of age [Mean
difference -0.28 (95% CI -0.53 to 0.01), p=0.04) in the intervention group compared to the control group. An overall group effect for the prevalence of obesity at 2 years was observed in the POL.nz study (p=0.027). Participants receiving the “sleep intervention” (including the sleep and combination group) demonstrated a lower prevalence of obesity when compared to the “food, physical activity and breastfeeding” (FAB) and control groups (OR= 0.54, 95% CI 0.35–0.82). Children who received the sleep intervention (sleep and combination groups) had significantly lower BMI z-scores at age 3.5 years (−0.24; 95% CI: −0.38, −0.10) and at age 5 years (−0.23; 95% CI: −0.38, −0.07) than children who did not (control and FAB groups).

It is important to note that many of the studies were not adequately powered to achieve statistical significance for weight-related outcomes. The effect sizes were generally small and BMI ranged from mean differences of 0.06 to 0.3 kg/m², and for BMI z-scores differences ranged from 0.01 to 0.3.

3.9. Secondary outcomes

Secondary outcomes are shown in Table 5. They were related to behaviour change and included duration of breastfeeding, child diet and eating habits, physical activity, screen time, sleep and health-related parenting practices. Of the 11 trials with published outcomes we identified a total of 105 unique secondary outcomes collected across the trials, with 75% (n=81) related to diet and infant feeding.

3.10. Risk of bias assessment

Risk of bias assessment was undertaken on the fifteen publications (of 11 trials) [13,15,19,15,26,27,28,31,35,39,41,43,44,54,56-58] with weight related outcomes. Ten of the fifteen were judged as low risk in all risk of bias domains (67%), a further 4 were judged as high risk, and one study was judged as having “some concerns”. Almost all (14/15) had a low risk of bias arising from the randomisation process, and one study was deemed as high risk. Two of fifteen studies had some concerns or a high risk of bias arising from “the effect of assignments to interventions” and “measurements of outcomes”, while the remaining thirteen in both domains were low risk. Most studies were judged as low risk in regard to missing outcome data (13/15; 87%), however the remaining two studies were deemed as high risk of bias in this domain. For selection of reported results, all 15 studies had low risk of bias in this domain. Assessments by trial are shown in Appendix table 6 and Figure 1 shows the summary of risk of bias assessments.

4. Discussion

This review examined RCTs with a behavioural/lifestyle intervention focused on obesity prevention in infancy and shows the range of trials and intervention components being implemented in different contexts at varying stages of completion. We summarised the key characteristics and features of interventions including the behavioural targets, delivery mechanisms and agents, duration of interventions and target populations. We also examined the theoretical basis for interventions and whether economic evaluations were carried out and assessed the funding sources of these interventions. Interventions were designed to influence a range of important behavioural targets including early feeding and diet, physical activity, sleep, sedentary time and parenting.

Of the 11 trials that were completed and reported weight related outcomes, two (22) (56) have shown a small but significant beneficial effect of interventions on child BMI z-score at 2 years of age and one found significant improvements in the prevalence of obesity, but not BMI (59). It is possible that some trials may not have been powered to detect intervention effects for weight-related outcomes, so it remains uncertain whether these interventions are effective in reducing BMI z-score. The EPOCH Collaboration demonstrated how combining trial data in a meta-analysis can substantially increase the statistical power to detect an intervention effect for weight-related outcomes. The four included trials had minimal power on their own (all less than 0.35) to detect the
observed intervention effect of 0.12 on BMI z-score at p<0.05. However, their combined power was 0.83 (60).

Encouragingly, many trials showed impacts on weight-related behaviours such as improving the duration of breastfeeding, improving healthy food intake and reducing discretionary foods. These behaviours may be important for long term obesity risk and other health outcomes. This also demonstrates the need to understand the intervention components that are responsible for the changes in behaviours, how they work and for whom, so that they can be implemented in the most efficient manner in the most appropriate populations (61).

It is also important to note that to date only one trial (56) has shown a sustained effect on BMI lasting until 3 years. This phenomenon, described as the ‘fade out effect’ (62), is common in interventions that begin in early childhood and are delivered for short time frames, resulting in the effects not being sustained. This may imply that early interventions need to be of a longer duration and may need complementary interventions as children grow, in order for impacts to remain and make substantial changes to a child’s growth trajectory. Trials which have begun recently with duration of implementation of the interventions over 3 and up to 6 years will be able to contribute more definitive answers on whether early interventions can contribute to preventing obesity in the longer term (39, 53).

Our review has shown a high degree of heterogeneity in the way primary and secondary outcomes are collected and reported. For example, there was a wide range of weight related outcomes such as BMI, BMI Z-score, weight for length percentile, waist circumference and prevalence of overweight and obesity that were assessed at differing ages and time points. Likewise, for dietary outcomes there was a wide range of different measures for similar outcomes. For example, intake of fruit and vegetables was reported as grams/day, times/day and serving size/day which varies with age and between countries. These variations precluded our ability to pool data and conduct a meta-analysis. This highlights the need for standardisation of outcomes related to infant weight and behaviours to facilitate outcome harmonisation and synthesis (63), and the need for a core outcome set for early childhood obesity interventions (64).

Our review included interventions focused on individual behaviours rather than targeting the wider environmental determinants such as the food and built environments, despite many of the interventions being delivered in a community setting. These interventions are important, given the age group – most infants spend a large proportion of their time at home with their parents. Although we are not able to draw specific conclusions given the small sample sizes and lack of power to show effects in most trials, the home setting was used in some studies and may be more advantageous in terms of dose, tailoring, delivery and participant convenience. Individual or face-to-face interventions may have some advantages over group or indirect methods, such as online interventions (65). In general, with face-to-face interactions the intervention delivery agents are more tuned to the individual’s needs and capabilities and can tailor the intervention to suit (66). During the first year, parents are likely to seek extra advice and therefore they may be more receptive to skill development and parental advice promoting healthy family eating and physical activity (9). As children learn from, and model parental physical and health-related activity levels, targeting parental engagement in infancy also features heavily in recent studies.

The rise in interventions that use online modes of delivery and delivery through telephone or text messages is encouraging as it means that interventions can be delivered cheaply, quickly and conveniently at scale. The question remains whether these interventions are effective and as acceptable as those delivered face-to-face individually or in group settings. Process and impact evaluation of these modes of delivery are currently lacking (15) however, with situations such as the coronavirus disease (COVID-19) crisis these modes may be a pragmatic way for interventions to be delivered (67), and future studies should focus on the effectiveness of alternative modes of delivery.

The studies were coded to seventeen domains of intervention content which targeted multiple areas, demonstrating the complexity in the evaluation of trials. In most studies there is a lack of detail about the specific content used within interventions, and this limits the transferability of the study
approach. This highlights the importance of deconstructing interventions to their smallest common elements (61) to determine which components are actually driving the effects. In addition, it was difficult to ascertain dose of intervention delivered with few studies providing statistics and information on the average number of clinics/groups/home visits attended and adherence to the protocol, which again may influence the effectiveness of study results. Although some interventions were based on theory, and some on multiple theoretical models, most did not state the theoretic basis for the intervention.

It is logical to conclude that by improving health-related behaviours the flow-on effect will be to improve weight related outcomes, but as highlighted, many trials did not achieve statistical significance and this may have been because of a lack of power to show effects. An alternative explanation may be that most of the interventions were delivered for a relatively short duration over one or two years. Longer durations may be important to create sustained change and prevent intervention ‘fade out’. Interventions in this age group were focused at the individual level of diet and activity and as children get older it would be important to look at the wider social and environmental factors which may play an additional role in the development of obesity.

There is a critical knowledge gap with respect to the ideal duration of interventions and when to intervene. Accumulating evidence has highlighted the influence of the preconception and perinatal periods for preventing childhood obesity and non-communicable disease later in life (68-71). It is possible that many trials have not targeted women early enough, with only three trials with published outcomes starting antenatally. Only one trial (which is currently in progress) has randomised women preconception (53). Interventions starting in preconception could prove more effective and at least one study has found a dose response association between preconception BMI and offspring’s childhood BMI, so future research in this area is warranted (69).

5. Limitations

This review was limited by the fact that we only searched trial registries to identify eligible trials. This may mean that some unregistered trials were not identified, however, registration has been a requirement for all trials since 2005 (18), and a recent study found high rates of registration since this requirement came into effect (17). Another limitation was that for some of the trials the intervention characteristics were coded from clinical trial registry information and in some cases these were very brief and not up-to-date. This may have led to some missing information. We attempted to contact trialists for missing information and where possible published protocol papers were used to code and categorise the intervention components.

Effectiveness in all of the trials was defined as a statically significant difference in weight related outcomes in favour of the intervention compared to controls as described by the trial authors. Because some trials had small sample sizes this would have resulted in inadequate power to detect a significant effect. This problem has been overcome in the four Australasian trials, which have collaborated to conduct an IPD prospective meta-analysis, resulting in improved power to detect effects (72).

In many of the trials there were high loss to follow up rates. This suggests that the intensity of interventions and participant burden should be considered when designing interventions and health promotion programs. It also shows that some form of early process analysis signifying participant satisfaction with trials should be considered (15).

There were a relatively small number of trials with published data that met the review criteria and many of the studies included multi-component interventions which made comparisons between trials difficult. However, the number of studies that will progress to reporting outcomes in the future holds promise for more definitive evidence for effective intervention strategies.

6. Conclusion
This review shows the breadth of work that is occurring globally across trials for the prevention of obesity in early childhood. We have described the key characteristics and features of trials including the behavioural targets, delivery mechanisms and agents, duration of interventions and key target populations. In the coming years, more trials are likely to publish their results and it will be possible to ascertain which intervention strategies are most effective for prevention of childhood obesity. The complexity of multicomponent interventions means that evaluating these interventions is difficult and complex methods will need to be employed to show which intervention components at which doses and via which delivery methods are most effective. This may be achieved by bringing together researchers from all relevant trials to share data and learnings to transform the thinking and practices around early childhood obesity prevention- the TOPCHILD collaboration aims to achieve this (73).
| Registration No | Trial Name/Acronym | Author, Year (if published) | Country | Study design | Number randomized | Intervention commencement | Duration of follow up | Primary outcome(s) | Secondary outcome(s) | Delivery mode | Intervention components | Controls |
|-----------------|--------------------|----------------------------|---------|--------------|-------------------|--------------------------|-----------------------|-------------------|---------------------|--------------|-------------------------|----------|
| AC TR N12 607 000 168 459 | Healthy Beginnings | Wen 2012 (74) Wen 2015 (57) | Australia | RCT | N=667 mother-child dyads | Antenatally | Birth until 5 years | Child BMI z score at child age 2 and 5 years | Infant feeding practices, TV viewing time, active play time, mothers dietary behaviours | Nurse home visits | The nurse visited eight times at home, once at 30-36 weeks' gestation and seven times after the birth (at 1, 3, 5, 9, 12, 18 and 24 months). Four key areas included infant feeding practices, child nutrition and active play, family physical activity and nutrition, and social support. | Usual care: 1x Community Health nurse home visit plus home safety promotion materials at 6 and 12 months. |
| ISR CT N81 847 050 | InFANT | Campbell 2013 (23) | Australia | Cluster RCT | N= 542 parent-child dyads | Mean 3.8 months | Child age 4 months until 20 months | Child diet (3x 24 hour diet recalls), child physical activity (accelerometry) and child TV viewing (parent report) | BMI z scores | Sessions with dietitian in pre-existing mothers groups, supportive materials (DVD, written materials and newsletter) | Six 2 hour sessions of education delivered by dietitian targeting nutrition, physical activity and sedentary behaviours occurred within pre-existing mothers groups, commencing at 3 months at 3 monthly intervals (3, 6, 9, 12, 15 | Usual care with Maternal and Child Health nurse plus 6 newsletters regarding unrelated aspects of child health or development |
| AC TR | NOURISH | Study Name | Daniels | Year | N= | Child Age | BMI z score | Maternal Feeding Practices | Notes |
|-------|---------|------------|---------|------|-----|-----------|--------------|-----------------------------|-------|
| N12   | 608     | 000        | 056     | 392  |     |           |              |                             |       |
|       |         |            |         |      |     |           |              |                             |       |
|       |         |            |         |      |     |           |              |                             |       |
|       |         |            |         |      |     |           |              | Educational group sessions in supported by detailed written information regarding repeat food exposure to variety of foods, responsive feeding and cues, health child food intake, reduce TV viewing, promotion of authoritative parenting style, managing food fussiness |       |
|       |         |            |         |      |     |           |              |                             |       |
|       | 0754    | 626        |         |      |     |           |              | Normalized BMI, child age |       |
|       |         |            |         |      |     |           |              | Maternal feeding practices |       |
|       |         |            |         |      |     |           |              |                             |       |
|       |         |            |         |      |     |           |              |                             |       |
|       | 0756    | 756        | 626     | 075  |     |           |              | Conducted at WIC; Educational counselling about bottle feeding via a flip-chart was given to parents (with messages about healthy weight, dental caries and iron deficiency anaemia), an |       |
|       |         |            |         |      |     |           |              |                             |       |
|       |         |            |         |      |     |           |              |                             |       |
| 5. | NC T00 892 983 | POI.nz | Fangupo 2015 (38) | Taylor 2016 (ref) New Zealand | 2x2 factorial RCT | N=802 parent-child dyads | Antenatally to 2 years of age (follow up study has data at 3.5 and 5 years of age) | Weight velocity (0-6, 6-12, 12-24 months) and BMI z scores at 24 months | Sleep and physical activity (parent report, accelerometry), duration of breastfeeding, timing of solid introduction, diet quality, measures of family function and well being | Home visits and group sessions | 3 intervention groups. FAB (Feeding, Activity and Breastfeeding): 8 additional visits for education and support around breastfeeding, food and activity (breastfeeding focus at antenatal and 1 week of age, food related at 4, 7, 13 and 18 months and physical activity at 3.9 and 18 months age) provided by lactation consultants and trained research nurses. Reinforced with written and visual information. SLEEP: 2 additional reviews providing | Usual care: Routine Well Child checks (6 core visits in the first 18 months) | nutrient density | education pamphlet to share with family members and a sippy cup was provided. Baseline anthropometric measurements (height and weight), sociodemographic survey and dietary intake assessment were all completed at baseline (12 months), 15 months, 18 months, 21 months and 24 months |
| Study | Country | Description | Intervention Details |
|-------|---------|-------------|----------------------|
| The BeeBOFT Study | Netherlands | | Guidance and resources for home sleep (group antenatal session and home visit at 3 weeks). Combination: both (i.e. 9 intervention visits/sessions) |
| | | | Health-related behaviour (breakfast daily, activity and outside play, sweetened beverage consumption, television viewing and computer time), BMI and prevalence of overweight and obesity at 36 months of age |
| | | | E-health4Uth Healthy Toddler: Parents completed an online module which provided personalised education regarding their child's nutritional habits and physical activity at 18 months and 24 months. This was followed by face-to-face counselling by the YHC professional to parents during routine well child visits. Parents completed questionnaires regarding family characteristics and health-related behaviours when child 1 month, 6 months, 14 months and 36 months of age |
| | | | Usual care: Routine well baby visits at 18 and 24 months with general information on child health-related behaviours provided to parents |
| | | | Web-based eHealth module and discussion of personalised advice during regular well child visit |

| Study | Country | Description | Intervention Details |
|-------|---------|-------------|----------------------|
| | | | |usual care: Routine well baby visits at 18 and 24 months with general information on child health-related behaviours provided to parents |
| | | | None listed |
| GREENLI | USA | | Tool kit with written information, routine |
| Sanders | | | Low-literacy toolkit for parents, a health-education program |
| | | | Usual care: plus, injury prevention program |
### Addressing Health Literacy and Numeracy to Prevent Childhood Obesity

**Cruzatt** (42)  
**USA**  
**RCT**  

| N= 450 parent-child dyads (estimate) | Child age 2 months | Proportion of children at 24 months who are not overnight (BMI) | Weight status of children at 5 years of age (BMI z score) | 'Tool kit' with written information, routine reviews with trained Paediatric resident in primary care clinics | Interaction with Paediatric resident physicians who are trained in improved health communication skills. Also provided with low literacy handouts and study-related 'gifts' to assess nutrition and physical activity behaviours and reinforce evidence based recommendations about early childhood nutrition and physical activity | Usual care: plus injury prevention program (attention placebo) |
|---|---|---|---|---|---|---|

**Usual care:** Routine care plus trained research intervention materials were mailed at 2 weeks postpartum, intervention materials were mailed

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### Insight

**Savage**  
**USA**  
**RCT**  

| N= 279 mother-infant dyads (estimate) | Child age 1-2 weeks | BMI at 3 years | Patterns of infant weight gain, infant | Mailed educational visits, trained | At 2 weeks post-partum, intervention materials were mailed | Usual care: Routine care plus trained research |
|---|---|---|---|---|---|---|

**Usual care:** Routine care plus trained research

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**Note:** Estimates provided for the proportion of children at 24 months who are not overnight.
| Study | ID | Country | Design | Participants | Intervention | Control Intervention | Description |
|-------|----|---------|--------|--------------|--------------|---------------------|-------------|
| 10.   | NC | Sweden  | RCT    | N= 200 families | Child age 1 year | BMI at 6 years | Physical activity, sedentariness, motor function/development, sleeping habits, food intake, eating patterns and quality of life. Trained coach (dietitian, physiotherapist or a nurse), phone calls, mailed information, home visits, clinic visits, booklets | Usual care: Routine Child Health Care Clinic plus general health newsletter at baseline |
|       |     |         |        |              | Child age 1 year to 6 years |          | | |
|       |     |         |        |              | BMI at 6 years |          |          | |
| 11.   | AC | Australia | Cluster RCT | N= 540 mother-child dyads | Child age 3 months | BMI z score and waist circumference | Dietary quality, physical | Melbourne InFANT Program content will be delivered via six online educational content, | Usual care: Routine care in Maternal and child health care |
| 611 | child dyads | to 36 months | e at 36 months | activity, screen time | emailed newsletters, nutrition expert | emailed newsletters (3 monthly from child age 18 months to 3 years. Educational content will be made available online. First-time parent group will be mediated by a nutrition expert, for up to one hour per week. | Child Health Centres plus general health newsletters every three months for three years |
| 000 | 386 | 932 |

| 12. | Starting Early Obesity Prevention Program | Gross (78) | US A RCT | N= 533 women-child dyads | Antenatally to 3 years (published data exists at 3 months) | Reduction in prevalence and degree of obesity at 3 years (BMI percentiles), diet composition, infant lifestyle behaviours (better sleep habits, reduced screen time, increase physical activity), improvement in parent feeding knowledge attitudes, styles and practices. | Individual nutrition/breastfeeding counselling, 15 nutrition and parenting support groups (NPSG) coordinated with well child visits, supported with plain language handouts and nutrition education DVDs. (Visits: prenatal consultation on breastfeeding, lactation support on postnatal ward, then 15 group sessions at 1, 2, 4, 6, 9, 12, 15, 18, 21, 24, 27, 30 and 33 months) | Usual care: Standard prenatal visits then standard Paediatric primary care (at 5 days, 1 month, 2 months and 4 months) then |
| Study ID | Design | Country/Region | Sample Size | Study Population | Intervention | Outcome Measures |
|----------|--------|----------------|-------------|------------------|--------------|------------------|
| 13       | RCT    | US             | N=150       | Parent-child dyads | Antenatal Baby's gender-specific WFL z-score at 4 to 6 months of age | BMI at child age 2 and 5 years, Mothers Knowledge, Two face to face meetings with registered dietitian and once on phone, nutritional education handout |
| 14       | RCT    | New Zealand    | N=206       | Antenatal       | Baby led introduction to solids (BLISS) | Body Mass Index at 12 months (and follow-up at 24 months), Energy self regulation, Eating behaviours, Energy intake, Home visits, face to face meetings and phone calls with lactation consultant and trained researcher, 8 additional contacts from pregnancy to 9 months of age. 5 meetings with lactation consultant antenatally, at 1 week, 3-4 weeks, 3-4 months and 5 months (3x face to face and 2x via telephone, 10-60mins duration) to support prolonged milk feeding and delay of complementary feeding until 6 months. Followed by face to face meetings (30-60min) with trained researcher at 5.5, 7 and 9 months with individualised advice to support mothers with above plus further education on appropriate foods and feeding cues. Questionnaires on baby |
| Study | Registration Number | Title | Country | Study Design | Participants | Intervention | Usual Care | Secondary Outcomes | Notes |
|-------|---------------------|-------|---------|--------------|--------------|-------------|------------|-------------------|-------|
| 15.   | NC T01 905 072      | Preventing Childhood Obesity through Early Guidance | USA | RCT | N=140 pregnant women | Antenatally | Child age 1 week to 3 years BMI at 3 years | Monthly phone calls regarding breastfeeding status. Home visits at 36 weeks of pregnancy; at 3 days after birth; at 2 weeks of age; and at 2, 4, 6, 9, 12, 18, and 24 months. Printed materials with key concepts; growth monitoring, feeding, parenting, activity, and sleep. | Led approach adherence at 6, 7, 8, 9, 12, and 24 months. BMI calculated at 12 and 24 months. Secondary outcomes assessed via questionnaires at 12 and 24 months. | |
| 16.   | ISR CT N16 991 919  | PRIMROS E | Sweden | Cluster RCT | N=1369 infants (1355 families) | Child age 9-10 months to 4 years BMI at 3 years | Child health care worker home visits, phone calls, Women Infant and Children’s (WIC) clinic | Usual care: Routine WIC clinic care plus home visits to monitor measurements and monthly breastfeeding survey calls | Nurses assist parents to change their own health behaviours and to promote healthy dietary and physical activity behaviours in their children. Parents are offered individual session when child is 9-10 months old, then group and phone sessions at 1.5, 2, 3, and 4 years old. | |
| 17. | PM C44 424 09 | Early Obesity Prevention | Schröder, 2015 (31) | US A | Cluster RCT | N= 232 infants | Paediatric visit at 1 month of age | All paediatric visits at 1, 2, 4, 6, 9, 12, 15, 18, and 24 months of age, and at annual visits up to age 5 years | BMI, BMI Z score, triceps skinfolds, weight | Parental dietary practices, breastfeeding duration, SNAP participation | Face to face, during all paediatric visits up till 24 months. Supportive phone call once a month and reminder post cards with short educational messages | Families receive ‘growing leaps and bounds’ program which includes: nutrition, physical activity, feeding practices, eating patterns, enhancing parents self-efficiency to care for infants, helping parents make healthy food choices for their infants and themselves. The 12 sets of educational brochures are discussed at 1, 2, 4, 6, 9, 12, 15, 18, and 24 months paediatric visits | Usual care: standard paediatric visits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18. | AC TR N12 616 001 470 482 | CHAT | Wen 2017 (35) | Australia | RCT (3 arm) | N=1056 mother-child dyads | Antenatally | BMI z-score at 12 and 24 months, breastfeeding rate at 12 months, and timing of introduction of the solids at 6 months | Child TV viewing time at 12 and 24 months; dietary quality at 24 months | Mailed educational material, telephone or SMS support | Intervention arm 1 (SMS): Text messages providing information about healthy infant and child feeding and lifestyle twice a week for 4 weeks. Intervention arm 2 (telephone support): 6 staged intervention packages by mail followed by a phone call from the research nurse within 1-2 weeks nurse and discuss the | Usual care: Routine childhood nursing services from Community Health Services plus home safety promotion material and newsletter on Kids Safety 4 times over the study period |
| Trial ID | CHALO | Karasz, 2018 (47) | US | RCT |
|----------|-------|------------------|----|-----|
| 19       |       | NC T03 077 425   |    |     |
|          |       | N=360 mothers of children 4-6 months old | | |
|          |       | Home visits at 6 months of age | | |
|          |       | Children aged 6 months to 18 months | | |
|          |       | Quantity of sippy cups/bottles, number of sippy cups/bottles a day (My smile buddy) | | |
|          |       | Weight for length, BMI for age Z score, weight velocity Z score, added sweeteners/solids, fruit and vegetables/day, sweetened beverages, use of bottles/sippy cup at bed time, sweet and salty snacks, physical activity, screen time, tooth brushing, dental visits, caries | | |
|          |       | Home visits by community health workers, follow up telephone support, patient navigation to keep timely dental visits, pamphlets | | |
|          |       | n=6 home visits by health workers: four of the home visits include only mother-child dyads which focus on building rapport, intimacy, identifying risks or family concerns, education, discussing goals, enhance mother skills to identify infant hunger/satiety cues, and oral hygiene practices. Two of the home visits at 8 and 14 months included either the father or mother in law | | |
|          |       | Enhanced usual care, pamphlet containing ECC and obesity prevention messages, and dental referrals, | | |

| Trial ID | CHALO | Moran, 2019 (32) | Italy | RCT |
|----------|-------|------------------|-------|-----|
| 20       |       | NC T03 131 284   |       |     |
|          |       | N=529 parent-newborn dyads | | |
|          |       | First 2 weeks of life | | |
|          |       | Newborn to 2 years of age | | |
|          |       | BMI at 12 months, lifestyle and feeding practices in the first 2 years of life | | |
|          |       | Educational program by Paediatricians during routine visits | | |
|          |       | Paediatricians were trained to provide parents with standardized lifestyle counselling supported by educational written material about the first two years of life during routine visits at 1, 3, 6, 12 and 24 months. | | |
|          |       | Usual care: Routine visits with regular Paediatrician at 1, 3, 6, 12 and 24 months | | |
| No. | Study Title | Authors | Country | Design | Sample Size | Intervention Duration | Child BMI Measurement | Parental Intervention | Mobile Application |
|-----|-------------|---------|---------|--------|-------------|-----------------------|----------------------|----------------------|---------------------|
| 21  | "Samen Happie!" An mHealth intervention to prevent obesity through parenting | Karsse, n L 2017 (55) | Netherlands | RCT | N= 300 parent-child dyads (estimate) | 7-11 months | Child BMI at 6 months, 12 months to 4 years. | Parental parenting weight-related behaviours (eating, drinking, sleeping, physical activity/screen time) | Weight-related behaviours of the child (healthy eating, drinking, sleeping, and exercise) | Mobile application that teaches parents about health parenting practices and styles, but also allows parents to practice through various challenges. The information is grouped into four important determinants: eating, drinking, sleeping and exercise | Waitlist control condition (receive the app after the 12 month intervention period) |
| Study | Title | Authors | Country | Study Design | Sample Size (N) | Intervention Details | Outcome Measures |
|-------|-------|---------|---------|--------------|-----------------|---------------------|------------------|
| 22.   | Preventing Early Childhood Obesity, Part 2: Family Spirit Nurture, Prenatal - 18 Months | Ingalls 2019 | US A | RCT | 338 expectant mothers (estimate) | Antenatal (36 weeks) until child age 24 months | BMI z scores, Breast and complementary feeding rates, Implementation of infant and toddler responsive feeding behaviours, Consumption of fruits and vegetables, Calorie intake from sugar sweetened beverages (SSB), snacks, and desserts, Physical activity levels, Screen time and other sedentary activities | Maternal stress, Maternal depression, Maternal alcohol and drug use, Infant and maternal metabolic health, Home visits by trained Family Health Liaison |
| 23.   | Baby's First Bites: Promoting Vegetable Intake in Early Childhood | van der Veek 2019 | Netherlands | RCT factorial | 240 mother-child dyads | Child age 4 months until 36 months | Vegetable consumption, Vegetable liking and self-regulation of child eating behaviours, child anthropometries (BMI) and maternal | Phone calls, home visits, video feedback, 3x intervention arms, Repeated vegetables exposure (RVE) - exposure to either green beans or cauliflower as target | Standard Optimised Standard of Care (OSC) transportation assistance to prenatal appointments and well-baby clinic appointments PLUS 8 home visits with educational lessons on injury prevention topics (attention placebo) |
| Study ID | Intervention | Countries | Sample Size | Age | Measurements | Outcomes | Notes |
|---------|--------------|------------|-------------|-----|--------------|----------|-------|
| 24      | SPOON: Guatemala | N= 1500 care giver-child dyads (estimate) | 0-6 months | Infant and young child feeding practices | Adherence to Nutritional Supplement Regime, Exclusive Breastfeeding | Home visits, group sessions and community mobilisation activities, dietary supplement | 2x intervention groups: SPOON behavioural change strategy+SQ-LNS: Participants will receive Small Quantity Lipid-based Supplements (SQ-LNS) from 6-24 months and a behavioural change to promote adequate infant and young child feeding practices and the use of SQ-LNS will be delivered to mothers or caregivers. SPOON behavioural change strategy+MNPs: Usual care: Participants receive standard health care services provided by the Ministry of Health, including micronutrient powders (MNPs) |
Participants will receive micronutrient powders (MNPs) from 6-24 months and a behavioural change to promote adequate infant and young child feeding practices and the use of MNPs will be delivered to mothers or caregivers. Behaviour change strategy uses ethnographic and marketing methods to promote adequate infant and young child feeding practices and the use of SQ-LNS.

### Study Details

| Study ID | Title                      | Country | Design | N | Parent-Child Dyads | Child Age | Child Dietary Intake | Child Anthropometrics | Parental Feeding Styles | Education Program | Usual Care |
|----------|----------------------------|---------|--------|---|-------------------|-----------|---------------------|-----------------------|----------------------|------------------|------------|
| 25.      | Strong Futures Beck2018    | US      | RCT    | 240 | 2 weeks to 2 years | 2 weeks   | Dietary intake      | Anthropometrics at 6, 12, 15, and 24 months | Parental feeding styles | Education program | Usual care: financial coaching; education on financial topics (budgeting, savings, managing debt) provided by lay health educators trained in financial coaching, reinforced by text messages. |
| 26.      | PROGESPI Perez-Lopez Spain  | Spain   | Cluster RCT | 414 | Antenatally until 24 months | BMI at 24 months | Weight growth rate, Food intake | Motivational Interviewing in groups | 6x 90 minute group workshops (2x during pregnancy, 4x within) | General information |
| Study | Design | Country | Principal Investigator | Sample Size | Intervention | Control | Measurements | Outcome | Description |
|-------|--------|---------|------------------------|-------------|--------------|---------|--------------|---------|-------------|
| 27.   | SCHeLTI (Sino-Canadian Healthy Life Trajectory Initiative) | China | Wu 2018 (53) | Cluster RCT | N=4000 mother-child dyads (estimate) | 6 weeks | 6 weeks until 5 years | BMI at 5 years | Fat mass index (child) at 5 years, skinfold thickness at 5 years, birthweight for gestational age prior to hospital discharge after delivery, weight-for-length z-score at <2 years of age | Face to face education sessions, group educational activities, text messaging, motivational web-based tools and apps, community based activities | Multifaceted intervention aiming to positively change behaviour with patient centred face to face sessions, group educational activities and social supports, text messaging to encourage personal goals and barriers to behaviour changes, motivational web-based tools and apps for self monitoring and | Usual care: plus access to web-based tools and Apps that provide information on child health and safety. |
| Study Number | Study Design | Country | Study Population | Study Details | Outcomes Measured |
|--------------|--------------|---------|------------------|---------------|-------------------|
| 28. T03 752 762 | SPOON-Mexico | Martinez 2018 (33) | N=1200 care giver-child dyads (estimate) 0-6month s until 24months | Infant and young child feeding practices Height Weight gain rate Haemoglobin Prevalence of obesity Prevalence of stunting Prevalence of anaemia Adherence to Nutritional Supplement Regimen, Exclusive Breastfeeding | Home visits, group sessions, dietary supplement |
| 29. T04 042 467 | Greenlight plus study (55) | Rothman 2019 (36) | N=900 parent-infant dyads | First newborn clinic visit All child Dr visits from 0-24 months Child weight for length trajectory | Weight for length Z score, BMI Z score trajectory, child overweight or obese During all child clinic visits from 0-24 months | Community based activities SQ-LNS supplement from 6-24 months and an innovative behavioural change strategy designed using ethnographic and marketing methods to promote adequate infant and young child feeding practices and the use of SQ-LNS via home visits and group sessions. Data recorded at child age 6, 9, 12, 15, 18, 21 & 24 months Usual care: Standard health care services as specified by the Health Secretary |

**Usual care:**
- Standard health care services as specified by the Health Secretary

**Families will receive the Greenlight intervention plus a health information technology (HIT) intervention aimed at supporting family goal-setting and behavior change. They will receive instructions on how to access the Greenlight technology platform (iOTA text messaging and website).**
- Families will consistently receive text messages and goals set

**During child’s clinic visits from 0-24 months,** parents will the receive the basic Greenlight material (low literacy, age specific education booklet) to promote healthy lifestyle and obesity prevention.
for children in the first two years of life

FAB: Feeding Activity Breastfeeding, NPSG: Nutrition Parenting Support Groups, LNSP-SQ: Lipid Nutrient Supplement Paste Small Quantity, MNP: Micronutrient Powders, POI: Prevention of Obesity in Infancy, SNAP: Supplemental Nutrition Assistance Program, WIC: Women, Infants, and Children Special Supplemental Nutrition Program, YHC: Youth Health Care
Table 2: Intervention delivery materials, procedures and agents used in early intervention studies for the prevention of obesity in infancy (N=29).
(Refer to Appendix Tables 1 and 2 for more detail on individual trials)

| Intervention delivery | N   | % of total |
|-----------------------|-----|------------|
| **Materials**         |     |            |
| Educational handout   | 15  | 52         |
| Educational handout (image-based) | 4  | 14         |
| Educational video     | 2   | 7          |
| Low literacy educational tool kit | 3  | 10         |
| Educational website/app | 5  | 17         |
| Educational material mailed out | 5  | 17         |
| Feeding supplement    | 2   | 7          |
| **Procedures**        |     |            |
| Nutrition and parenting support groups | 7  | 24         |
| Phone call consultation | 6  | 21         |
| Home Visits           | 12  | 41         |
| Educational text messages | 4  | 14         |
| **Agents**            |     |            |
| Nurse (via home visits) | 5  | 17         |
| Nurse (via clinic visits) | 5  | 17         |
| Registered Dietitian  | 5   | 17         |
| Lactation Consultants | 3   | 10         |
| Trained Research Assistants | 4  | 13         |
| Community Health Worker | 1  | 3          |
| Role                                      | Count | Subtotal |
|-------------------------------------------|-------|----------|
| Community Health Worker (via home visits) | 4     | 13       |
| Nutrition expert                          | 2     | 7        |
| Paediatric residents/Paediatrician        | 4     | 13       |
| Psychologist                              | 1     | 3        |
| General Practitioners                     | 1     | 3        |
| Midwives                                  | 1     | 3        |
| Physiotherapist                           | 1     | 3        |
| Trained Sleep Specialists                 | 1     | 3        |
| Multidisciplinary team                    | 2     | 7        |
Table 3: Intervention components/key messages and advice used in early intervention studies for the prevention of obesity in infancy (N=29). (Refer to Appendix Table 3 for more detail on individual trials)

| Advice/ Key message/ Component                  | N  | %  |
|-----------------------------------------------|----|----|
| Breastfeeding/Bottle feeding advice           | 16 | 55 |
| Introduction of solids                        | 10 | 34 |
| Limit junk foods (eg sweets)                  | 6  | 21 |
| Repeat food exposure                          | 3  | 10 |
| Healthy dietary behaviours in children        | 24 | 83 |
| Food serving size                             | 5  | 17 |
| Parenting/hunger satiety cues                 | 13 | 45 |
| Parent modelling                              | 13 | 45 |
| Fussy eating                                  | 5  | 17 |
| Soothe/ Sleep                                 | 3  | 10 |
| Sleep promotion                               | 10 | 34 |
| Play/ activity                                | 20 | 69 |
| Tummy time                                    | 3  | 10 |
| TV/ screen time                                | 9  | 31 |
| Oral hygiene practices                        | 1  | 3  |
| Growth chart education                        | 1  | 3  |
| Health information technology access education| 1  | 3  |
| Health-communication curriculum               | 2  | 7  |
Table 4. Effect of trial interventions on weight outcomes in early intervention studies for the prevention of obesity in infancy.

| Study, Author, Year | Sample Size | Primary Outcome                  | Reported Outcome at End of Follow up | Effect size |
|---------------------|-------------|----------------------------------|--------------------------------------|-------------|
| Healthy Beginnings, Wen 2012 | N= 667 *N=497 | BMI 2 years                      | 16.82 | 16.53 | Mean difference -0.29 (95% CI 0.02 to 0.55), p=0.04 |
| Wen 2015 | *N=415 | BMI at 3.5 years                  | 16.8 | 16.74 | Mean difference -0.06 (95% CI -0.41 to 0.28) p=0.33 |
| | | BMI z score at 3.5 years           | 0.97 | 0.89 | Mean difference -0.08 (95% CI -0.30 to 0.16) p=0.44 |
| | *N= 369 | BMI 5 years                       | 16.28 | 16.31 | Mean difference 0.3 (95% CI -0.30 to 0.37) p=0.06 |
| | | BMI z score at 5 years             | 0.63 | 0.65 | Mean difference 0.02 (95% CI -0.19 to 0.22) p=0.06 |
| INFANT, Campbell, 2013 | N=542 *N=457 | BMI (z score) at age 20 months    | 0.8 | 0.8 | Mean difference -0.01 (95% CI -0.16 to 0.13) p=0.86 |
| INFANT, Hesketh, 2020 | *N=361 | BMI (z score) at age 3.6 years    | - | - | Mean difference 0.05 (95% CI -0.1 to 0.19) |
| | | Waist circumference at 3.6 years  | - | - | Mean difference -0.01 (95% CI -0.12 to 0.19) |
| | *N=337 | BMI (z score) at age 5 years       | - | - | Mean difference -0.02 (95% CI -0.2 to 0.16) |
| | | Waist circumference at 5 years    | - | - | Mean difference 0.01 (95% CI -0.17 to 0.20) |
| Study                                      | N= | BMI z score age 2 years | Mean difference | p     |
|--------------------------------------------|-----|------------------------|-----------------|-------|
| NOURISH, Daniels, 2013                     | 698 | 0.75                   | -0.14           | 0.10  |
| *N=530                                     |     | 0.61                   |                 |       |
| Daniels, 2015                              | 424 | 0.41                   | 0.07            | 0.06  |
| *N=424                                     |     | 0.34                   |                 |       |
| Feeding Young Children Study, Bonuck, 2013 | 300 | Reduction in weight    | OR 1.01 (95% CI 0.9 to 1.1), p=0.8 |
| *N=135                                     |     | >85th percentile       |                 |       |

| Study                                      |       | BMI at 2 years         | FAB | Sleep | Both | P     |
|--------------------------------------------|-------|------------------------|-----|-------|------|-------|
| POL.nz, Taylor 2017                        |       |                        | 16.9| 17.1  | 16.8 | 0.086 |

| Study                                      |       | BMI z score age 2 years | FAB | Sleep | Both | P     |
|--------------------------------------------|-------|------------------------|-----|-------|------|-------|
|                                            |       |                        | 0.77| 0.92  | 0.68 | 0.104 |

| Study                                      |       | Waist circumference at 2 years | FAB | Sleep | Both | P     |
|--------------------------------------------|-------|-------------------------------|-----|-------|------|-------|
|                                            |       |                                | 46.7| 47.0  | 46.6 | 0.610 |

| Study                                      |       | Prevalence of overweight and obesity at 2 years | FAB | Sleep | Both | P     |
|--------------------------------------------|-------|------------------------------------------------|-----|-------|------|-------|
|                                            |       |                                                | 68  | 73    | 61   | 0.770 |

| Study                                      |       | Prevalence of obesity at 2 years | FAB | Sleep | Both | P     |
|--------------------------------------------|-------|---------------------------------|-----|-------|------|-------|
|                                            |       |                                 | 33  | 40    | 19   | 0.027 |

FAB v Sleep group (odds ratio [OR], 0.46 [95% confidence interval (CI), 0.25–0.83]; p = .011
| Study                                                                 | N     | Effect Measure (95% CI)         | p-value |
|----------------------------------------------------------------------|-------|---------------------------------|---------|
| FAB v combination group (OR, 0.51 [0.28–0.90]; P = .022)            |       |                                 |         |
| Sleep and combination v FAB and control (OR, 0.54 [0.35–0.82]; P = .004) |       |                                 |         |
| BMI z score at age 3.5 years                                        | N=808 | FAB: 0.81, Sleep: 0.54, Both: 0.56 | p=0.004 |
|                                                                   |       | FAB v Control difference 0.15   |         |
|                                                                   |       | (95% CI -0.04 to 0.34)          |         |
|                                                                   |       | Sleep v Control difference -0.16|         |
|                                                                   |       | (95% CI -0.36 to 0.04)          |         |
|                                                                   |       | Both v Control difference -0.18  |         |
|                                                                   |       | (95% CI -0.37 to 0.02)          |         |
| BMI z score at age 5 years                                           | N=557 | FAB: 0.39, Sleep: 0.66, Both: 0.44| p=0.004 |
|                                                                   |       | FAB v Control difference 0.25   |         |
|                                                                   |       | (95% CI 0.04 to 0.47)           |         |
|                                                                   |       | Sleep v Control difference -0.14 |         |
|                                                                   |       | (95% CI -0.36 to 0.09)          |         |
|                                                                   |       | Both v Control difference 0.06   |         |
|                                                                   |       | (95% CI -0.29 to 0.16)          |         |
| BMI (mean) at 36 months                                              | N=2102| FAB: 15.66, Sleep: 15.78        | p=0.12  |
| Prevalence of overweight/obesity (%) at 36 months                   |       | 3.99%                           |         |
|                                                                   |       | 4.77%                           |         |
| Weight-for-length percentile at 1 year of age                       | N=291 | FAB: 64.4%, Sleep: 57.5%        | p=0.4   |
| Study                                      | Sample Size | BMI z-score at 3 years of age | Mean difference | p-value  |
|-------------------------------------------|-------------|-------------------------------|-----------------|----------|
| INSIGHT Paul, 2018                        | N=232       | 0.15                          | -0.13           | Mean difference -0.28 (95% CI -0.53 to 0.01), p=0.04 |
|                                           |             | Mean BMI percentiles          | 54th            | 47th     |
|                                           |             | Difference 6.9 percentile     | points (95% CI -14.5 to 0.6) | p=0.7 |
| BLISS, Taylor, 2017                       | N=206       | BMI z score age 12 months     | 0.20            | 0.44     |
|                                           | *N=178      | Adjusted difference 0.21,    | (95% CI -0.7 to 0.48) | p=0.7 |
|                                           |             | BMI z score age 24 months     | 0.24            | 0.39     |
|                                           | *N=166      | Adjusted difference 0.16,    | (95% CI -0.13 to 0.45) | p=0.7 |
| PRIMROSE, Doring, 2016                    | N=1369      | BMI at 4 years of age         | 16.1            | 16.0     |
|                                           | *N=1148     | Mean change -0.11 (95% CI -0.31 to 0.08), p=0.26 |
|                                           |             | Waist Circumference (cm) at 4 years of age | 53           | 52.5     |
|                                           |             | Mean change -0.48 (CI -0.99 to 0.04), p= 0.07 |
|                                           |             | Prevalence of overweight and obesity at 4 years of age | 15.5% | 14.8% |
|                                           |             | RR 0.95 (95% CI 0.69 to 1.32) p=0.78 |
| Early Obesity Prevention: Schroeder 2015 (31) | N=292       | BMI at baseline               | 15.03           | 15.29    |
|                                           | *N=278      | Mean difference 0.26          |                 |          |
|                                           |             | BMI Z score at baseline       | -0.152          | -0.283   |
|                                           |             | Mean difference -0.435        |                 |          |
|                                           |             | Weight at baseline            | 4.56            | 4.91     |
|                                           |             | Mean difference 0.35, p<0.006 |                 |          |
|                                           | *N= 218     | BMI at 12 months              | 17.29           | 17.23    |
|                                           |             | Mean difference -0.06         |                 |          |
|                      | BMI Z score at 12 months | Weight at 12 months | BMI at 24 months | BMI Z score at 24 months | Weight at 24 months |
|----------------------|--------------------------|---------------------|-----------------|--------------------------|---------------------|
|                      | 0.539                    | 9.81                | 16.20           | 0.218                    | 12.61               |
| Mean difference      | -0.047                   | 0.04, P>0.05        | 0.14            | 0.121                    | 0.15, P>0.05        |

*N=232

PREBIT, Morandi, 2019

**Prevalence of overweight/obesity (%) at 2 years of age**

|                      | Prevalence of overweight/obesity (%) at 2 years of age | 26.3% | 23.8% | 3% difference in prevalence, p=0.49 |
|----------------------|--------------------------------------------------------|-------|-------|-------------------------------------|

*N=569
*N= 529

*Number that completed the study.
Table 5. Effectiveness of trial intervention on secondary outcomes.

| Study, Author, Year | Sample size | Outcome | Reported Outcome at End of Follow up | Effect size |
|---------------------|-------------|---------|--------------------------------------|-------------|
| Healthy Beginnings, Wen 2012, Wen 2015 | N=667       | Infant feeding practices | Control Group | Intervention Group | Difference: 7, CI (1 to 13) p=0.03 |
|                     |             | Vegetable ≥1 serving/day | 83%           | 89%           |                                      |
|                     |             | Fruit ≥1 serving/day      | 93%           | 90%           | Difference: -2, CI (-7 to 3), P=0.43 |
|                     |             | Food for reward           | 72%           | 62%           | Difference: -9, CI (-17 to -1), P=0.03 |
|                     |             | Water >3 cups/day         | 19%           | 24%           | Difference 6, CI (-1 to 13), P=0.12 |
| INFANT, Campbell, 2013 | N=457      | Hot chips/French fries    | 88%           | 86%           | Difference -1, CI (-7 to 5), P=0.65 |
|                     |             | Salty snack               | 70%           | 65%           | Difference -5, CI (-13 to 4), P=0.29 |
|                     |             | Sweet snack every day     | 77%           | 73%           | Difference -4, CI (-12 to 4), P=0.31 |
|                     |             | Soft drink                | 26%           | 24%           | Difference -3, CI (-10 to 5), P=0.48 |
|                     |             | Outdoor play ≥120 minutes/day | 61%        | 62%           | Difference 1, CI (-8 to 9), P=0.9 |
|                     |             | TV on during meal         | 76%           | 66%           | Difference -10, CI (-18 to -2), P=0.02 |
|                     |             | Eat dinner in front of TV | 68%           | 56%           | Difference -12, CI (-21 to -3), P=0.01 |
|                     |             | Viewing TV >60 minutes/day | 22%         | 14%           | Difference -8, CI (-15 to -1), P=0.02 |
|                     |             | Child diet at 20 months   |               |               | Mean difference 13.33 (95% CI -2.59 to 29.25), p=0.1 |
|                     |             | Fruit intake (g/d)        | 152.9         | 161.2         | Mean difference 6.62 (95% CI -2.51 to 15.76), p=0.16 |
|                     |             | Vegetable intake (g/d)    | 80.8          | 85.3          |                                      |
|                          | Mean (g/d) | Mean (g/d) | Mean difference | 95% CI          | p-value |
|--------------------------|------------|------------|-----------------|-----------------|---------|
| Water intake (g/d)       | 338.7      | 362.9      | 30.28           | -3.30 to 63.87  | 0.08    |
| Noncore drink intake (g/d)| 25.4       | 23.7       | -5.56           | -17.48 to 6.36  | 0.36    |
| Sweet snack intake (g/d) | 14.7       | 11.0       | -3.60           | -6.34 to -0.86  | 0.01    |
| Savoury snack intake (g/d)| 5.8        | 4.8        | -1.02           | -2.82 to 0.79   | 0.27    |
| Child physical activity (min/d)| 236.8     | 224.1     | -2.03           | -9.75 to 5.70   | 0.61    |
| Television viewing (min/d)| 60.6       | 45.5       | -17.12          | -26.45 to -7.79 | <0.001  |

N=361

**Child diet at 3.6 years**
- Fruit intake (g/d)  
  - Mean difference: Standardised effect size 0.23 (95% CI 0.01 to 0.45)
- Vegetable intake at 3.6 years  
  - Mean difference: Standardised effect size 0.28 (95% CI 0.05 to 0.51)
- Water intake at 3.6 years  
  - Mean difference: Standardised effect size 0.41 (95% CI 0.14 to 0.67)
- Fruit variety at 3.6 years  
  - Mean difference: Standardised effect size 0.13 (95% CI -0.10 to 0.35)
- Vegetable variety at 3.6 years  
  - Mean difference: Standardised effect size 0.24 (95% CI 0.03 to 0.45)
- Non core drinks at 3.6 years  
  - Mean difference: Standardised effect size 0.08 (95% CI -0.18 to 0.33)
| Variable                                         | Standardised effect size | 95% CI          |
|-------------------------------------------------|--------------------------|-----------------|
| Sweet snacks intake at 3.6 years                | -0.24                    | -0.42 to -0.07  |
| Savory snack intake at 3.6 years                | -0.06                    | -0.23 to 0.12   |
| Television viewing at 3.6 years                  | -0.08                    | -0.25 to 0.09   |
| Sitting time at 3.6 years                        | -0.13                    | -0.49 to 0.23   |
| Child physical activity at 3.6 years             | 0                        | -0.26 to 0.27   |
| Light intensity PA at 3.6 years                  | 0.17                     | 0.11 to 0.44    |
| Moderate to vigorous PA at 3.6 years             | -0.21                    | -0.50 to 0.08   |
| Child diet at 5 years                            | 0.07                     | 0.14 to 0.27    |
| Fruit intake (g/d)                               |                          |                 |
| Vegetable intake at 5 years                      | 0.11                     | 0.10 to 0.32    |
| Water intake at 5 years                          | 0.19                     | 0.03 to 0.40    |
| Fruit variety at 5 years                         | 0.12                     | -0.10 to 0.33   |
| Vegetable variety at 5 years                     | 0.14                     | -0.06 to 0.34   |

N=337
| Behavior                        | Standardised effect size | 95% CI        |
|--------------------------------|--------------------------|---------------|
| Non core drinks at 5 years     | -0.17                    | -0.33 to -0.00 |
| Sweet snacks intake at 5 years | -0.26                    | -0.47 to -0.05 |
| Savory snack intake at 5 years | 0.00                     | -0.22 to 0.23  |
| Television viewing at 5 years  | -0.15                    | -0.33 to 0.03  |
| Sitting time at 5 years        | -0.08                    | -0.26 to 0.10  |
| Child physical activity at 5 years | 0.00                  | -0.26 to 0.25  |
| Light intensity PA at 5 years  | 0.15                     | 0.09 to 0.38   |
| Moderate to vigorous PA at 5 years | -0.16                 | -0.42 to 0.18  |

**Response to refusal of familiar foods**

| Response                      | N=466 | N=464 | P-value     |
|-------------------------------|-------|-------|-------------|
| Insist child eats it at 2 years | 37(90)| 18(39)| 0.001       |
| Offer milk drink instead at 2 years | 22(53)| 14(30)| 0.022       |
| Offer liked food instead at 2 years | 78(189)| 63(140)| 0.001       |
| Encourage to eat: turn mealtime into game at 2 years | 57(139)| 21(47)| 0.001       |
| Offer food reward at 2 years  | 31(75)| 9(19) | 0.001       |
| Feeding Strategy                                                                 | N   | At 2 years          | At 5 years          | P     |
|---------------------------------------------------------------------------------|-----|---------------------|---------------------|-------|
| Encourage to eat: offer nonfood reward                                           | N= 464 | 27 (65)                  | 18 (39)                  | P=0.026 |
| Accept that child may not be hungry; take food away                             | N= 464 | 91 (222)               | 96 (213)               | P=0.033 |
| Response to refusal of unfamiliar foods (neophobia): Assume child dislikes; do not offer again | N= 457 | 13 (32)                  | 5 (11)                  | P=0.033 |
| Disguise food                                                                    | N= 456 | 65 (156)                | 45 (98)                | P<0.001 |
| Offer with liked food                                                            | N= 462 | 94 (229)                 | 94 (206)                | P=0.99  |
| Times offered a food before deciding whether liked ($6$ times)                   | N= 465 | 35 (87)                  | 72 (159)                | P<0.001 |
| Response to refusal of familiar foods: Insist child eats it                       | N= 390 | 65 (126)                 | 48 (94)                 | P=0.001 |
| Offer milk drink instead                                                          | N= 391 | 6 (11)                   | 3 (6)                   | P=0.22  |
| Offer liked food instead                                                          | N= 389 | 41 (78)                  | 37 (72)                 | P=0.47  |
| Encourage to eat                                                                 | N= 391 | 53 (103)                 | 42 (84)                 | P=0.034 |
| Feed child with spoon/fork                                                       | N= 390 | 63 (120)                 | 42 (83)                 | P<0.001 |
| Offer food reward                                                                | N= 390 | 39 (74)                  | 29 (58)                 | P=0.055 |
| Offer nonfood reward                                                             | N= 391 | 39 (74)                  | 29 (58)                 | P=0.055 |
| Responsive feeding strategies                                                     | N= 391 | 39 (74)                  | 29 (58)                 | P=0.055 |

NOURISH Daniels, 2015
| *N* | Intervention                                      | Control + sleep | FAB + Sleep | RR (95% CI)                  | *p* |
|-----|--------------------------------------------------|-----------------|-------------|-----------------------------|-----|
| 389 | Accept that child may not be hungry; take food away at 5 years | 79 (152)        | 88 (173)    | 1.02 (0.98 to 1.06)         | 0.014 |
| 382 | Response to refusal of unfamiliar foods (neophobia)a | 14 (27)         | 13 (25)     | 1.01 (0.95 to 1.07)         | 0.88 |
| 382 | Assume child dislikes; do not offer again at 5 years |                |             |                             |      |
| 382 | Disguise food at 5 years                         | 53 (102)        | 41 (78)     | 1.02 (0.96 to 1.08)         | 0.018 |
| 391 | Offer with liked food at 5 years                 | 92 (178)        | 93 (184)    | 1.01 (0.95 to 1.07)         | 0.85 |
|     | Times offered a food before deciding whether liked (#6 times) at 5 years | 55 (107)        | 39 (77)     | 1.02 (0.96 to 1.08)         | 0.002 |
| 135 | Bottle frequency (any use, %)                    | 44%             | 33%         | 1.11 (1.05 to 1.17)         | 0.025 |
|     | Offered 2 fruits a day (%)                       | Control + sleep | FAB + Sleep | RR 1.02 (95% CI 0.98 to 1.06), p=0.455 |
|     |                                                    | 94%             | 96%         |                             |      |
|     | Offered 2 vegetables a day (%)                   | Control + sleep | FAB + Sleep | RR 1.02 (95% CI 0.99 to 1.05), p=0.282 |
|     |                                                    | 96%             | 98%         |                             |      |
| 495 | Used a cup, not bottle (%)                       | Control + sleep | FAB + Sleep | RR 1.13 (95% CI 0.95 to 1.35), p=0.16 |
|     |                                                    | 47%             | 53%         |                             |      |
|     | Daily breakfast (%)                              | Control + sleep | FAB + Sleep | RR 1.02 (95% CI 0.97 to 1.08), p=0.375 |
|     |                                                    | 91%             | 93%         |                             |      |
| Measure                                                                 | Control + sleep | FAB + Sleep | RR (95% CI)      | p-value |
|------------------------------------------------------------------------|----------------|-------------|------------------|---------|
| Family dinner at the table (%)                                        | 66%            | 59%         | 0.9 (0.79 to 1.04) | 0.146   |
| Did not eat meals in front of the TV (%)                              | 15%            | 17%         | 1.16 (0.78 to 1.74) | 0.464   |
| Household fruit and vegetable availability (mean)                      | 31             | 32          | 0.99 (-0.5 to 2.48) | 0.194   |
| Number of obesogenic foods in household (mean number)                 | 21             | 21          | 0.39 (-0.88 to 1.66) | 0.39    |
| Night sleep, duration (hour)                                          | 11.6           | 11.5        | 11.6             | 11.5    | 0.74  |
| Night awakenings (number per night)                                   | 1.6            | 1.7         | 1.6              | 1.5     | 0.66  |
| Bedtime resistance score (mean occurrence)                            | 0.13           | 0.15        | 0.11             | 0.12    | 0.011 |
| Light to vigorous physical activity (mins per day)                    | 231            | 240         | 232              | 236     | 0.63  |
| Health Related Behaviours-Breakfast daily (%)                         | 96.7%          | 98.3%       | 1.6% difference   | 0.03    |
| Activity and outside play (hours/day, mean SD) | 2.56 | 2.68 | Mean SD difference 0.12, p=1.9 |
| Sweetened sugar beverage consumption (glasses/day, mean) | 2.31 | 2.10 | Mean difference -0.21 glasses per day, p=0.003 |
| Television/computer time (hours/day mean) | 1.22 | 1.05 | Mean difference -0.17 hours/day, p=0.001 |

| Met 2012 AAP screen time guidelines |
|---|
| 44 weeks | 30.2 | 53 | P<0.01 |
| 1.5 years | 15.9 | 23.5 | P=0.15 |
| 2.5 years | 59.8 | 60.9 | P=0.87 |

| Television on during infant meals |
|---|
| 44 weeks | 45.7% | 32.5% | P=0.04 |
| 1.5 years | 68.1% | 48.7% | P<0.01 |
| 2.5 years | 78.4% | 66.4% | P=0.05 |

| Children engagement in daily outdoor play at 2 years |
|---|
| 15.1% | 30.0% | P=0.01 |

| Dietary intake of children at 1 year |
|---|
| salty snacks | 20.3% | 9.8% | P=0.03 |
| vegetables daily | 89.0% | 95.9% | P=0.049 |

| Use of feeding to soothe |
|---|
| Context based |
| -8 weeks | 2.83 | 2.57 | P=0.008 |
| -16 weeks | 2.76 | 2.50 | P=0.009 |
| -32 weeks | 2.43 | 2.00 | P<0.0001 |
| -44 weeks | 2.56 | 2.16 | P<0.0001 |
| Emotion based |
### Starting Early Obesity Prevention Program

**Gross, 2016**

|                      | N=533 | *N=456 |
|----------------------|-------|--------|
| Ever breastfed in the hospital | 95.3% | 95.9%  |
|                      | OR 1.16 (95% CI 0.47 to 2.85), p=0.82 |
| Exclusive BF in the hospital | 31.1% | 37.1%  |
|                      | OR 1.31 (95% CI 0.89 to 1.93), p=0.20 |
| Exclusive BF leaving the Hospital | 37.9% | 45.7%  |
|                      | OR 1.38 (95% CI 0.95 to 2.01), p=0.11 |
| Any BM at 3 months   | 80.4% | 83.3%  |
|                      | OR 1.21 (95% CI 0.75 to 1.95), p=0.47 |
| Exclusive BM at 3 months | 23.4% | 33.0%  |
|                      | OR 1.61 (95% CI 1.07 to 2.44), p=0.03 |

### Additional Data

#### Adding cereal to bottle

|        | 8 weeks | 16 weeks | 32 weeks | 44 weeks |
|--------|---------|----------|----------|----------|
|        | 2.01    | 1.78     | P=0.07   |
|        | 1.90    | 1.57     | P=0.002  |
|        | 1.65    | 1.36     | P=0.0003 |
|        | 1.62    | 1.31     | P=0.0001 |

#### Put child to bed with bottle/sippy cup

|        | 8 weeks | 20 weeks | 32 weeks | 52 weeks |
|--------|---------|----------|----------|----------|
|        | 1.8%    | 20.0%    | 14.0%    | 5.3%     |
|        | P=0.18  | CI [95% 0.6-15.6], P=0.01 |
|        | 20.0%   | 8.4%     | CI [95% 0.2-0.8], P=0.03 |
|        | 14.0%   | 10.2%    | CI [95% 0.3-1.6], P=0.38 |

#### Night time feeds (7pm-7am)

|        | 8 weeks | 20 weeks | 32 weeks |
|--------|---------|----------|----------|
|        | 3.3     | 3.1      | P=0.2    |
|        | 2.2     | 1.8      | P=0.32   |
|        | 1.7     | 1.3      | P=0.01   |
|                                | BM 24 hr | Formula | OR (95% CI) | p-value |
|--------------------------------|----------|---------|-------------|---------|
| 100% BM on 24 hr diet recall   | 33%      | 42.7%   | 1.51 (1.03 to 2.21) | 0.04    |
| Breastfeeding intensity        | 59.7%    | 67.7%   | -8.0 (-15.3 to -0.75) | 0.03    |
| continuous score (Mean)        |          |         |             |         |
| Ever gave BM and formula       | 31.1%    | 22.4%   | 0.64 (0.36 to 1.15) | 0.15    |
| at same feed per day           |          |         |             |         |
| Introduced tea, water, juice   | 16.7%    | 6.3%    | 0.34 (0.18 to 0.64) | 0.001   |
| or cereal in bottle at 3        |          |         |             |         |
| months old                     |          |         |             |         |
| Total maternal infant          | 9.8      | 10.3    | 0.51 (0.19 to 0.83) | 0.002   |
| feeding knowledge              |          |         |             |         |

|                                | BM 24 hr | Formula | OR (95% CI) | p-value |
|--------------------------------|----------|---------|-------------|---------|
| Starting Early Obesity         |          |         |             |         |
| Prevention Program Gross       | N=533    | *N=456  |             |         |
| Tummy time (ever)              | 78.9%    | 86.4%   | 1.71 (1.04 to 2.8) | 0.04    |
| Tummy time (daily)             | 49.6%    | 50.5%   | 1.04 (0.72 to 1.5) | 0.93    |
| Tummy time on the floor (ever) | 24.1%    | 40.7%   | 2.16 (1.44 to 3.23) | 0.001   |
| Tummy time mostly on the floor | 5.2%     | 11.8%   | 2.44 (1.2 to 4.98) | 0.02    |
| Mean tummy time per day        | 1.87     | 1.96    | -0.09 (-0.46 to -0.28) | 0.64    |
| Mean infant age (weeks) for     | 6.90     | 6.62    | 0.28 (-0.75 to 1.31) | 0.60    |
| starting tummy time (SD)       |          |         |             |         |
| Unrestrained floor time (ever) | 28.9%    | 40.6%   | 1.69 (1.14 to 2.49) | 0.01    |
| Restricted time (ever)         | 85.3%    | 85.4%   | 1.00 (0.60 to 1.69) | 1.00    |
| Behavior                                      | BLISS, Taylor, 2017 | N= 160                  |
|-----------------------------------------------|----------------------|-------------------------|
| Restricted time (60 min or more)              | 58.6%                | 54.3%                   |
|                                               | OR 0.84 (95% CI 0.58 to 1.22), p=0.39 |
| Infant bouncy seat (ever)                     | 57.5%                | 61.2%                   |
|                                               | OR 0.86 (95% CI 0.59 to 1.25), p=0.45 |
| Indoor baby swing (ever)                      | 20.7%                | 20.4%                   |
|                                               | OR 0.98 (95% CI 0.62 to 1.55), p=1.00 |
| Car seat when not in a car (ever)             | 16.4%                | 9.5%                    |
|                                               | OR 0.54 (95% CI 0.30 to 0.95), p=0.04 |

| Scale                        | BLISS, Taylor, 2017 | N= 160                  |
|------------------------------|----------------------|-------------------------|
| Energy self-regulation       | 4.03                 | 4.01                    |
| (Mean SD of scale 1-5 based | Mean difference -0.04 (95% CI -0.29 to 0.21) |
| on parental response)       |                      |                         |
| Satiety response             | 3.23                 | 3.01                    |
| (Mean SD of scale 1-5 based | Mean difference -0.24 (95% CI -0.41 to -0.07) |
| on parental response)       |                      |                         |
| Food responsiveness         | 2.41                 | 2.51                    |
| (Mean SD of scale 1-5 based | Mean difference 0.12 (-0.09 to 0.34) |
| on parental response)       |                      |                         |
| Food fussiness              | 2.61                 | 2.43                    |
| (Mean SD of scale 1-5 based | Mean difference -0.18 (95% CI -0.40 to 0.05) |
| on parental response)       |                      |                         |
| Child enjoyment of food      | 3.84                 | 4.07                    |
| (Mean SD of scale 1-5 based | Mean difference 0.24 (95% CI 0.05 to 0.43) |
| on parental response)       |                      |                         |
|                        | Children’s eating habits | Mothers’ eating habits |
|------------------------|--------------------------|------------------------|
|                        | Fruits (t/d)             | Fruits (t/d)           |
|                        | 1.1 (0.03)               | 1.1 (0.04)             |
|                        | 1.01 (–0.09 to 0.11), P=0.78 | 0.07 (–0.04 to 0.18), P=0.22 |
|                        | Vegetables (t/d)         |                        |
|                        | 0.9 (0.03)               | 1.3 (0.04)             |
|                        | 0.13 (0.04 to 0.22), P=0.01 |                      |
|                        | Fish (t/wk)              |                        |
|                        | 1.5 (0.06)               | 1.3 (0.04)             |
|                        | 0.10 (–0.06 to 0.27), P=0.21 |                      |
|                        | French fries (t/mo)      |                        |
|                        | 1.8 (0.07)               | 1.1 (0.04)             |
|                        | –0.37 (–0.58 to –0.17), P<0.001 | 0.07 (–0.02 to 0.21), P=0.10 |
|                        | Sugared drinks (t/wk)    |                        |
|                        | 2.7 (0.15)               | 1.3 (0.06)             |
|                        | –0.49 (–0.97 to –0.15), P=0.04 |                      |
|                        | Discretionary calories (t/wk) |                        |
|                        | 5.9 (0.12)               | 1.3 (0.06)             |
|                        | –0.60 (–1.01 to –0.18), p=0.01 |                      |
|                        | Mean difference 143 (CI 95% to 526) | -241 |

PRIMROSE, Doring, 2016

N=1148
### Mothers' eating habits

| Food                        | Baseline Mean | Follow-Up Mean | Change (95% CI)     | P-value |
|-----------------------------|---------------|----------------|---------------------|---------|
| Vegetables (t/d)            | 1.8 (0.07)    | 2.0 (0.07)     | 0.18 (-0.01 to 0.38) | 0.07    |
| Fish (t/wk)                 | 1.7 (0.10)    | 1.4 (0.08)     | -0.33 (-0.58 to -0.10) | 0.01    |
| French fries (t/mo)         | 1.8 (0.11)    | 1.5 (0.14)     | -0.26 (-0.60 to 0.08) | 0.13    |
| Sugared drinks (t/wk)       | 5.9 (0.12)    | 5.3 (0.17)     | -1.00 (-1.72 to -0.28) | 0.01    |
| Discretionary calories (t/wk) | 5.9 (0.12)    | 5.3 (0.17)     | -1.00 (-1.72 to -0.28) | 0.01    |

### Children's physical activity

| Activity                  | Baseline Mean | Follow-Up Mean | Change (95% CI)     | P-value |
|---------------------------|---------------|----------------|---------------------|---------|
| 51 min/day                |               | 50.6 min/day   | -0.36 (-3.00 to 2.28) | 0.81    |

### Mothers' physical activity

| Activity                  | Baseline Mean | Follow-Up Mean | Change (95% CI)     | P-value |
|---------------------------|---------------|----------------|---------------------|---------|
| 2.6 (0.04)                | 2.6 (0.03)    | 0.07 (-0.02 to 0.16) | 0.13    |

### Early Obesity Prevention, Schroeder, 2015

| Measurement               | Baseline Mean | Follow-Up Mean | Change (95% CI)     | P-value |
|---------------------------|---------------|----------------|---------------------|---------|
| Tricep skinfold at baseline | 7.85          | 7.94           | Mean difference 0.09 |         |
| Tricep skinfold at 12 months | 8.82          | 9.70           | Mean difference 0.88 | P<0.002 |
| Triceps skinfold at 24 months | 8.42          | 8.83           | Mean difference 0.41 |         |
| Triceps + subcapular skinfold at baseline | 14.45         | 14.36          | Mean difference -0.09 |         |
| Triceps + subcapular skinfold at 12 months | 15.36         | 16.46          | Mean difference 1.1 P<0.018 |         |
| Triceps + subcapular skinfold at 24 months | 14.06         | 14.68          | Mean difference 0.62 |         |
| Use infant cereal as first complimentary food | -             | -              | P<0.001 (INT less likely) |         |
| Use stage 1 vegetables as first complimentary food | -             | -              | P<0.05 (INT less likely) |         |
| Offered soda              | 9%            | 1%             | P<0.006             |         |
| Category                                                                 | Value 1  | Value 2  | P-value |
|--------------------------------------------------------------------------|----------|----------|---------|
| Sweetened tea                                                           | 8.2%     | 1%       | P<0.01  |
| Punch                                                                   | 5.8%     | 0%       | P<0.02  |
| Cow’s milk                                                              | 16.2%    | 2.5%     | P<0.001 |
| Delay introduction of drink and food other than breast milk              | -        | -        | P<0.05  |
| N=186                                                                   |          |          |         |
| Perceived feeding responsibility at 24 months                           | 4.45     | 4.50     | 0.05 P=0.930 |
| Perceived parent overweight at 24 months                                | 3.28     | 3.15     | 0.13 P=0.409 |
| Perceived child overweight at 24 months                                 | 2.89     | 2.98     | 0.09 P=0.194 |
| Concerns about child overweight at 24 months                            | 2.06     | 2.29     | 0.23 P=0.329 |
| Dietary restriction at 24 months                                        | 3.44     | 3.77     | 0.33 P=0.010 |
| Pressure to eat at 24 months                                            | 2.68     | 2.72     | 0.04 P=0.939 |
| Monitoring at 24 months                                                 | 4.13     | 4.41     | 0.28 P=0.046 |
| N= 550                                                                  |          |          |         |
| Feeding on demand at 12months (%)                                        | 80%      | 93%      | 13% difference, P=0.001 |

PROBIT, Morandi, 2019
| N  | Activity                                      | Percentage 1 | Percentage 2 | Difference | p-value   |
|----|----------------------------------------------|--------------|--------------|------------|-----------|
| 468| Television viewing at age 2 years (>30mins a day, %) | 67%          | 73%          | 6%         | 0.08      |
| 468| Sweetened Beverage consumption at age 2 years (any, %) | 57%          | 63%          | 6%         | 0.16      |
**Appendix Table 1.** Intervention delivery materials and procedures of early intervention studies for the prevention of obesity in infancy (N=29).

| Trial name                     | Educational handout | Educational handout (image-based) | Educational video | Low literacy educational tool kit | Educational website/app | Educational material mailed out | Feeding supplement | Nutrition and parenting support groups | Phone call consultation | Home Visits | Educational text messages |
|-------------------------------|---------------------|----------------------------------|-------------------|-----------------------------------|-------------------------|-------------------------------|-------------------|----------------------------------------|------------------------|-------------|--------------------------|
| Healthy Beginnings            | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| InFANT                        | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| NOURISH                       | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| FYCS                          | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| POL.nz                        | x                   | x                                |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| BeeBOFT                       |                     |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| GREENLIGHT                    | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| Addressing Health Literacy and Numeracy to Prevent Childhood Obesity | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| INSIGHT                       |                     |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| Early STOPP                   | x                   |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| InFANT EXTEND                 |                     |                                  |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| Starting Early Obesity        | x                   | x                                |                   |                                   |                         |                               |                   |                                        |                        |             |                          |
| Prevention Program | HLPP | BLISS | Preventing obesity through early guidance | PRIMROSE | Early Obesity Prevention: | CHAT | CHALO | PROBIT | Samen Happie | Family Spirit | Nurture | Baby's first bites | SPOON- Guatemala | Strong Futures | PROGESPI | SChelTI | SPOON- Mexico | Greenlight plus |
|---------------------|------|-------|--------------------------------------------|-----------|--------------------------|------|-------|--------|-------------|---------------|---------|----------------|----------------|---------------|-----------|---------|---------------|----------------|
|                     | x    |       |                                            |           |                          | x    |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     | x    | x     |                                            |           |                          | x    | x     | x      |             |               |         |                           |                 |               |           |         |               |                |
|                     | x    |       |                                            |           |                          |      | x     |        |             |               |         |                           |                 |               |           |         |               |            |
|                     |      | x     |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      | x     |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      | x     |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
|                     |      |       |                                            |           |                          |      |       |        |             |               |         |                           |                 |               |           |         |               |                |
## Appendix Table 2. Intervention delivery agent.

| Trial name                          | Nurse home visits | Nurse clinic visits | Registered Dietitian | Lactation consultants | Trained Research assistants | Community Health Worker | Community Health Worker Home visits | Nutrition expert | Paediatric residents/ Paediatrician | Psychologist | General Practitioners | Midwives | Physiotherapist | Trained Sleep Specialists | Multi disciplinary |
|-------------------------------------|-------------------|--------------------|----------------------|-----------------------|---------------------------|-------------------------|-------------------------------|-----------------|-------------------------------------|--------------|----------------------|----------|------------------|-------------------------|------------------|
| Healthy Beginnings                  | 5 (17)            | 5 (17)             | 5 (17)               | 3 (10)                | 4 (13)                    | 1 (3)                   | 4 (13)                        | 2 (7)           | 4 (13)                             | 1 (3)        | 1 (3)                | 1 (3)     | 1 (3)            | 1 (3)                   | 2 (7)            |
| InFANT                              | x                 | x                  | x                    | x                     |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| NOURISH                             |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| FYCS                                |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| POL.nz                              | x                 |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| BeeBOFT                             |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| GREENLIGHT                          |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         | x               |
| Addressing Health Literacy and Numeracy to Prevent Childhood Obesity |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         | x               |
| INSIGHT                             | x                 |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         |                 |
| Early STOPP                         | x                 | x                  | x                    | x                     |                           |                         |                               |                 |                                    |              |                      |           |                 |                         | x               |
| InFANT EXTEND                       |                   |                    |                      |                       |                           |                         |                               |                 |                                    |              |                      |           |                 |                         | x               |

Total N(%): 5 (17)
| Project Name | HLPP | BLISS | Prevention Program |
|--------------|------|-------|--------------------|
| Preventing obesity through early guidance | x | x | x |
| PRIMROSE E | x | | |
| Early Obesity Prevention Program | x | x | |
| CHAT | x | | |
| CHALO | | x | |
| PROBIT | | | x |
| Samen Happie Family Spirit Nurture | | | |
| Baby’s first bites | | | x |
| SPOON-Guatemala | | | x |
| Strong Futures | | | x |
| PROGESPI | x | x | x | x |
| SCHeLTI | | | | x |
| Starting Early Obesity Prevention Program | | | |
Appendix table 3. Intervention components/key messages of early intervention studies for the prevention of obesity in infancy (N=29).

| Trial name/acronym                          | Breastfeeding/Bottlefeeding advice | Intro of solids | Limit junk foods (eg. sweets) | Repeat food exposure | Healthy dietary behaviours in children | Food serving size | Parenting/hunger satiety cues | Parent modelling | Fussy eating | Soothe/Sleep | Sleep promotion | Play/activity | Tummy time | TV/screen time | Oral hygiene practices | Growth chart education | HIT technology access education |
|--------------------------------------------|------------------------------------|----------------|-------------------------------|----------------------|----------------------------------------|------------------|-------------------------------|------------------|--------------|-------------|----------------|---------------|----------|----------------|-------------------------|---------------------------|-----------------------------|
| Healthy Beginnings                         | x                                  |                | x                             | x                    | x                                      | x                 | x                             | x                 |              |             |                |               |          |                |                         |                          |                             |
| InFANT                                     | x                                  |                | x                             | x                    | x                                      | x                 |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| NOURISH                                    | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| FYCS                                       | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| POI.nz                                     | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| BeeBOFT                                    | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| GREENLIGHT                                 | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| Addressing Health Literacy and Numeracy to Prevent Childhood Obesity | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| INSIGHT                                    | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| Early STOPP                                | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| InFANT EXTEND                              | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| Starting Early Obesity Prevention Program   | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| HLPP                                       | x                                  |                | x                             | x                    | x                                      |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| BLISS                                      | x                                  |                |                                |                      |                                        |                   |                  |                   |              |             |                |               |          |                |                         |                          |                             |
| Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 January 2021
## Appendix table 4: Theoretical Models.

| Theoretical models used | Social cognitive theory | Social-ecological theories | Social learning theory | Health beliefs model | Behavioural model | Attachment theory | Transtheoretical model of change | Ecological developmental theory | Theory of planned behaviour | McGuire communication model | Common Risk/Health Factor Approach (CR/HFA) | Not listed |
|-------------------------|-------------------------|----------------------------|------------------------|----------------------|-------------------|------------------|-------------------------------|-------------------------------|---------------------------|-----------------------------|---------------------------------|-----------|
| Healthy Beginnings      | 10(34)                  | 1(3)                       | 5(17)                  | 3(10)                | 1(3)              | 2(7)             | 1(3)                          | 1(3)                          | 1(3)                      | 1(3)                        | 1(3)                            | 16(55)    |
| InFANT                  |                         | x                          |                        |                      |                   |                  |                               |                               |                          |                            |                                 |           |
| NOURISH                 |                         | x                          |                        |                      |                   |                  |                               |                               |                          |                            |                                 |           |
| FYCS                    |                         | x                          |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| POL.nz                  | x                       |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| BeeBOFT                 | x                       | x                          | x                      |                      |                   |                  | x                             | x                             |                          |                            |                                 | x         |
| GREENLIGHT              |                         | x                          |                        |                      |                   |                  |                               |                               |                          |                            |                                 |           |
| Addressing Health Literacy and Numeracy to Prevent Childhood Obesity | x | | | | | | | | | | | |
| INSIGHT                 |                         |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| Early STOPP             | x                       |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| InFANT EXTEND           |                         |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| Starting Early Obesity Prevention Program | x | x | x | | | | | | | | | |
| HLPP                    |                         |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| BLISS                   |                         |                            |                        |                      |                   |                  |                               |                               |                          |                            |                                 | x         |
| Preventing obesity through early guidance | | | | | | | | | | | | |
| Project/Program                | Status |
|-------------------------------|--------|
| PRIMROSE                      | x      |
| Early Obesity Prevention      | x      |
| CHAT                          | x, x   |
| CHALO                         | x      |
| PROBIT                        | x      |
| Samen Happie                  | x      |
| Family Spirit Nurture         | x      |
| Baby’s first bites            | x, x, x|
| SPOON-Guatemala               | x      |
| Strong Futures                | x      |
| PROGESPI                      | x      |
| SCHeLTI                       | x      |
| SPOON-Mexico                  | x      |
| Greenlight plus               | x      |
### Appendix table 5: Funding Sources.

| Study                                | Funding Sources                                                                 |
|--------------------------------------|-------------------------------------------------------------------------------|
| Healthy Beginnings                   | Australian National Health and Medical Research Council                        |
| INFANT                               | Australian National Health and Medical Research Council                        |
|                                      | HJ Heinz                                                                        |
|                                      | Meat and Livestock Australia                                                  |
|                                      | Department of Health South Australia                                         |
|                                      | Food standards Australia New Zealand                                          |
|                                      | Queensland University of technology                                          |
| NOURISH                              | Roberta Holmes Transition to contemporary Parenthood Program (La Trobe University) |
| Feeding Young Children Study         | US department of Agriculture                                                  |
|                                      | National Institute of Food and Agriculture                                    |
| POI.nz                               | Health Research Council New Zealand                                          |
|                                      | Southern District Health Board                                                |
| BeeBOFT                              | ZonMW- Netherlands Organisation of Health Research and Development             |
|                                      | NOW- Netherlands organisation for scientific research                         |
| GREENLIGHT                           | Eunice Kennedy National Institute of Child Health and Human Development        |
|                                      | Centers for Disease Control and Prevention                                    |
|                                      | Office of Behavioural and Social Science Research                             |
|                                      | National Institutes of Health                                                 |
|                                      | Robert Wood Johnson Foundation Physician Faculty Scholars Program              |
|                                      | Health Resources and Services Administration                                  |
|                                      | KiDS of the New York University Langone Foundation                            |
| Addressing Health Literacy and Numeracy to Prevent Childhood Obesity | NYU Langone Health                                                             |
|                                      | National Institutes of Health                                                 |
| INSIGHT                              | National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)       |
|                                      | National Institute of Health                                                  |
|                                      | National Center for Advancing Translational Sciences                          |
|                                      | The Children’s Miracle Network (Penn State Children’s Hospital)               |
|                                      | US Department of Agriculture                                                  |
|                                      | Penn State Clinical and Translational Institute                               |
| FAS                                  | Vinnova                                                                        |
|                                      | Medical Research Council                                                      |
|                                      | The Karolinska Institute                                                       |
| Early STOPP                          | Australian National Health and Medical Research Council                        |
|                                      | National Heart Foundation                                                     |
| INFANT extend                        | World Cancer Research Fund International                                      |
| Starting Early Obesity Prevention Program | National Institute of Food and agriculture                                   |
|                                      | National institute of Health/Child Health and Human development               |
| HLPP                                 | Bronx-Lebanon Hospital Center Health Care System                              |
|                                      | United Healthcare Foundation                                                  |
| BLISS | National Institute of Health  
Preventing Childhood Obesity through early guidance | American Diabetes Association  
University of Otago
Heinz Watties Ltd
Perpetual trustees
NZ federation of Woman’s Institutes |
|---|---|---|
| PRIMROSE | American Diabetes Association  
The Swedish Council for Working Life and Welfare
The Swedish Research Council
The Research and Development Committee
Stockholm, Uppsala and Sormland County Council
Regional Research Council of the Uppsala and Orebre Health Care Region
The Public Health Committee of Stockholm County Council
The Vardal Foundation
AFA insurance
The foundation of the Swedish Diabetes Society
The Karolinska Health Care Sciences Postgraduate School
The Karolinska Institute |
| Early Obesity Prevention: | Dannon Institute (USA) |
| CHAT | NSW Ministry of Health |
| CHALO | Grant from the National Institute on Minority Health and Health Disparities |
| PROBIT | Region Vento  
University of Verona |
| Samen Happie | Behavioural Science Institute, Radbound University |
| Family Spirit Nurture | Eunice Kennedy National Institute of Child Health and Human Development  
Share Our Strength  
Indian Health service  
John Hopkins University Discovery Award |
| Baby’s first bites | NWO - Netherlands organisation for scientific research  
Danone Nutricia research |
| SPOON Guatemala | Inter-American Developmental Bank  
The PepsiCo Foundation  
JPO-JSF Poverty Reduction Program  
Fundazúcar |
| Strong futures | University of California  
Eunice Kennedy National Institute of child health and human development  
International Peace Maternity and Child Health Hospital affiliated to Shanghai Jiao Tong |
| PROGESPI | FFIS (Fundacion para la Formacion e Investigacion Sanitarieas de la Region de Murcia) |
| SChelTI | University of Sherbrooke  
University of Sherbrooke, Health Campus  
National Science Foundation of China(NSFC)  
Canadian Institutes of Health Research (CIHR) |
| SPOON Mexico | Inter-American Development Bank  
Hospital Infantil de Mexico Federico Gomez |
| Greenlight plus                                      | Servicios de Salud de Nayarit
|                                                    | The PepsiCo Foundation

| Vanderbilt University Medical Center               | Patient-Centered Outcomes Research Institute
|                                                    | Duke University
|                                                    | University of North Carolina, Chapel Hill
|                                                    | Stanford University
|                                                    | NYU Langone Health
|                                                    | University of Miami
### Appendix table 6. Risk of Bias (RoB 2.0) assessments.

| Study                                      | Design | Risk of bias      |
|--------------------------------------------|--------|-------------------|
| Healthy Beginnings @ 2 years               | RCT    | High Risk         |
| Healthy Beginnings @ 5 years               | RCT    | High Risk         |
| Feeding Young Children Study               | RCT    | Some Concerns     |
| INFANT                                     | RCT    | Low Risk          |
| INFANT at 3 and 5                          | RCT    | Low Risk          |
| NOURISH at 2 years                         | RCT    | Low Risk          |
| NOURISH at 5 years                         | RCT    | Low Risk          |
| PRIMROSE                                   | RCT    | High Risk         |
| INSIGHT at 1 year                          | RCT    | Low Risk          |
| INSIGHT at 3 years                         | RCT    | Low Risk          |
| BeeBOFT                                    | RCT    | Low Risk          |
| BLISS                                      | RCT    | Low Risk          |
| POL.nz                                     | RCT    | Low Risk          |
| PROBIT                                     | RCT    | Low Risk          |
| Early Obesity Prevention                   | RCT    | High Risk         |

**Figure 1.** Risk of bias graph.
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