



OPRU Briefing Paper - Assessing the effectiveness of obesity interventions in the early years in UK studies: a systematic review

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Key message

For many children in the UK, obesity develops in the early years (age 0-5), with excess weight gain often occurring before starting school. Given how strongly obesity tracks, preventing excess weight gain in young children is a public health and policy priority. However, the evidence for effective obesity interventions among young children in the UK is limited.

We conducted a systematic review to assess the strength of the evidence base and identify effective interventions that have been implemented in the UK. We identified six trials of UK interventions that were delivered in the early years and that reported anthropometric outcomes. Two interventions targeted children with overweight or obesity, the others were for children of any weight status; the focus of three interventions was on disadvantaged or deprived families.

Compared with control, five trials reported reductions in BMI standard deviation scores (zBMI) though most effect sizes were small and only one was reported to be statistically significant. In analyses comparing participants to their own baseline, five trials reported reductions in zBMI, three of which were reported to be significant, including two interventions that targeted children with overweight or obesity. We note that issues of statistical significance are complex given small sample sizes and trial designs.

In summary, we found a limited number of preventative obesity interventions with robust evaluations in the early years in the UK. Data from the UK suggest that interventions in the early years hold promise for obesity reduction but further consideration of international data will be important. There is clear need for the development and implementation of further UK evidence-based interventions for young children.

Executive summary

Background

National Child Measurement Programme (NCMP) data for 2020/21 show 27.7% of reception age (4-5 years) children had overweight or obesity in England. Obesity tracks strongly through childhood, adolescence and into adulthood with associated morbidities. Ensuring children start primary school with a healthy weight is an important priority for policymakers. The first five years of life present a window of opportunity for effective behavioural and lifestyle interventions, including a balanced diet with regular physical activity, to establish healthy behaviours for healthy growth. Owing to the complex determinants and pathways to obesity, it remains key that interventions are robustly evaluated in order that implementation or development of programmes is based on reliable evidence. Understanding the current landscape of interventions and the strength of the supporting evidence base, is crucial to inform the thinking of policy teams.

Aims

We were asked by the Department of Health and Social Care to explore the effectiveness of UK interventions or programmes for obesity prevention and treatment in children aged 0-5 years. A further aim was to identify gaps in the provision of prevention and treatment interventions for obesity in the early years and within the evidence base.

Executive summary

What we did

We searched nine databases and included studies in all languages published during the last 10 years (2011-2021). We were aware that the strength of evidence prior to 2011 was limited and wanted this work to reflect current or recent interventions and programmes. Only intervention studies or randomised controlled trials with a control, or before and after implementation, design were included. We included studies reporting interventions in the early years i.e., for children aged 0 to 5 years of any weight status, but excluded studies relating to developmental origins (i.e., interventions relating to breast/formula feeding). We did not differentiate between prevention and treatment intervention given that the content and components of these interventions in the early years are broadly the same; we differentiated the difference between prevention and treatment as those eligible or targeted for an intervention. Interventions or programmes with both diet and/or physical activity components were included, but included studies were required to report anthropometric outcomes (i.e., weight, waist, BMI or BMI z score) in order to assess effectiveness. Our searches included evidence from all countries, but here we have included only studies undertaken in the UK.

We also conducted two patient and public involvement (PPI) sessions with the Family Research Advisory Group (FRAG) through OPRU's PPI partner the National Children's Bureau (NCB); one at the outset of the work and one upon completing the review of UK evidence. The PPI sessions were useful to discuss concepts and findings, in addition to representing the views and experiences of the general public.

Summary of findings

There is a lack of interventions that have been robustly evaluated in the UK; we found only five studies reporting six trials.

Trials related to five interventions or programmes, three of which focussed on children from disadvantaged families (D) and two targeted children with overweight/obesity (OB):

- ✓ Be active Eat Healthy/Healthy Heroes (D)
- ✓ ToyBox (D)
- ✓ Lifestyles Eating and Activity for Families (OB)
- ✓ Health Exercise Nutrition for the Really Young (D)
- ✓ Planet Munch (OB - 1 of 2 trials)

Programmes were evaluated via: Two randomised controlled trials (RCTs), one cluster randomised trial (CRT), two feasibility CRTs, and one impact assessment of a weight management programme.

Compared to baseline, five interventions were found to be reduce zBMI at follow up (three significantly; two of which targeted children with overweight/obesity). Compared to control, five interventions showed reductions in zBMI (one significantly).

Only two trials reported follow up beyond 12-months, meaning the longer-term effects are unclear. All trials and sample sizes were small in scale. No data on cost-effectiveness were identified. Only one programme adhered to NICE guidance.

Background

NCMP data show that the prevalence of obesity among reception age children increased between 2019/20 and 2020/21, from 9.9% to 14.4%; severe obesity also increased from 2.5% to 4.7%, an 87% change (Figures 1 and 2).¹

Figure 1. Prevalence of overweight and obesity among reception age children in England from 2010/11 to 2020/21

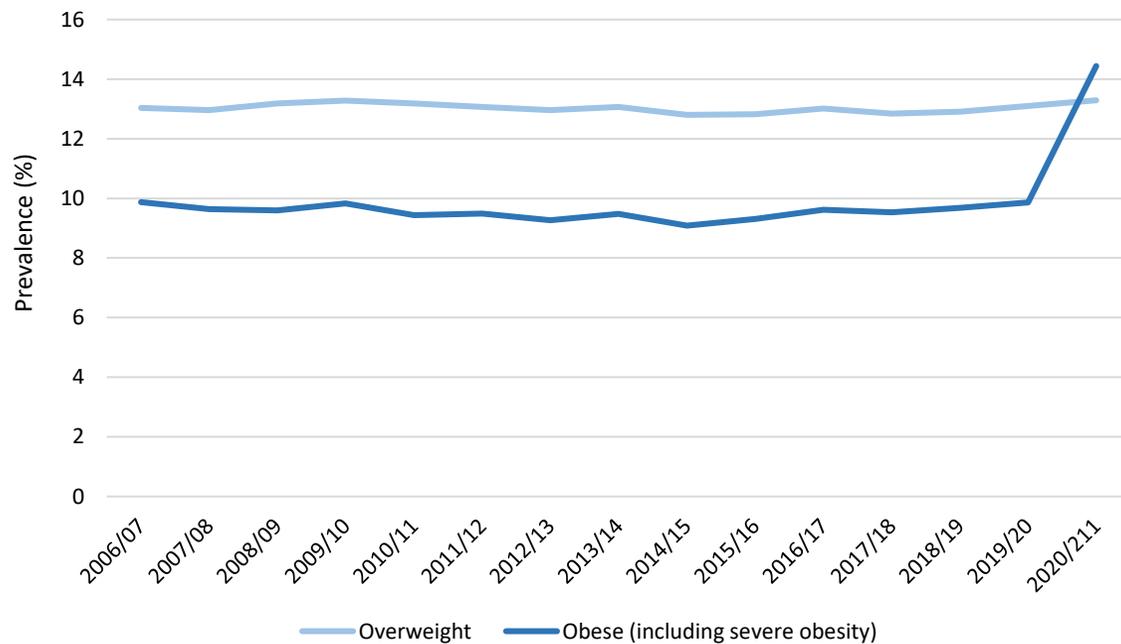
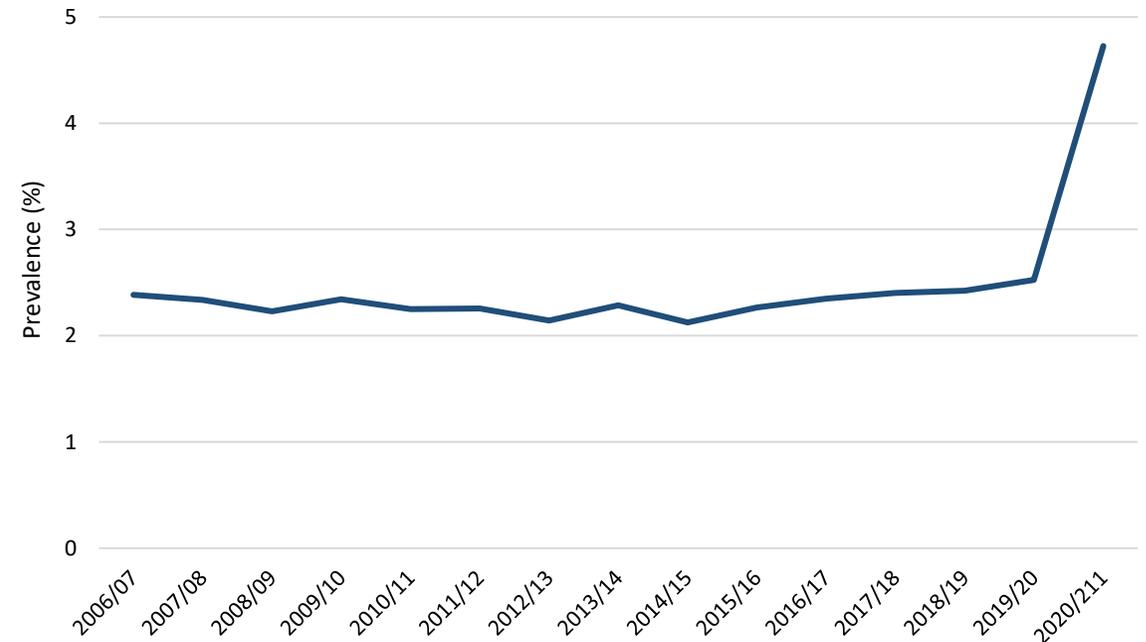


Figure 2. Prevalence of severe obesity among reception age children from 2010/11 to 2020/21

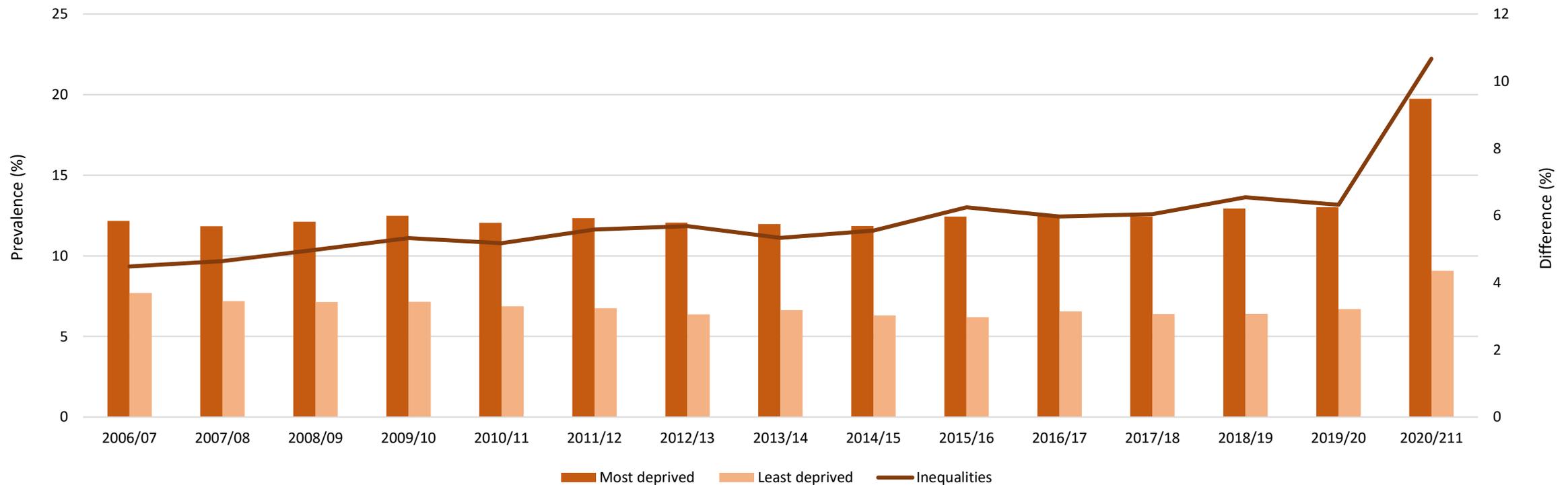


1. National Child Measurement Programme, England 2020/21 School Year. <<https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2020-21-school-year>>.

Background

NCMP data also show that for children aged 4-5 years, inequalities in obesity are dramatically increasing (Figure 3). While the NCMP sample size was smaller for 2020/21, these increases in prevalence and inequalities appear to be a worrying impact of the Covid-19 pandemic.

Figure 3. Prevalence of obesity for reception age children for most and least deprived deciles² and inequalities in obesity i.e., the difference between most/least deprived



2. English indices of deprivation 2019. <<https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019>>.

Background

Obesity often has routes in early life and early childhood represents a period of important physical, mental and emotional developmental. If established, obesity tracks strongly through childhood, adolescence and into adulthood with associated morbidities.³ Of children with obesity, 55% are likely to have obesity as adolescents, while 80% of adolescents with obesity are likely to have obesity in early adulthood.⁴ Prospective evidence also shows that most excessive weight gain among adolescents with obesity occurred between the ages of 2 and 6 years and that high acceleration in children's BMI during the preschool years is associated with a higher risk of obesity in adolescence.⁵ There is established evidence that childhood overweight and obesity are linked with many negative health implications in the short and long term. Children with excess weight have an elevated risk of cardiovascular disease; higher BMI in childhood is associated with hypertension, dyslipidemia, type-2 diabetes and cardiovascular mortality later in life.⁶ Obesity is also associated with adverse mental health outcomes, including depression, emotional disorders and low self-esteem;⁷ children with obesity also often live with associated stigma.⁸

For the purposes of this review, we have not included interventions that relate to breast/formula or complementary feeding, as we considered the targeting of policies in this area to be markedly different; however, we acknowledge the importance of breast feeding and complementary feeding. Established evidence shows that breastfed children have less risk of having obesity later in childhood compared to children that were formula fed, longer duration of breastfeeding and exclusivity are also important in protecting against obesity. Complementary feeding is also important; the age of introduction, quantity and quality of foods to meet nutritional needs play a role in determining later obesity risk.

3. M. Abdelaal et al, Morbidity and mortality associated with obesity. *Ann Transl Med.* 2017;5:161. <<https://doi.org/10.21037/atm.2017.03.107>>.

4. M. Simmonds et al., 'Predicting Adult Obesity from Childhood Obesity: A Systematic Review and Meta-Analysis', *Obesity Reviews*, 17.2 (2016), 95–107 <<https://doi.org/10.1111/obr.12334>>.

5. M. Geserick et al., 'Acceleration of BMI in Early Childhood and Risk of Sustained Obesity', *The New England Journal of Medicine*, 2018 <<https://doi.org/10.1530/ey.16.11.5>>.

6. A. Umer et al., 'Childhood Obesity and Adult Cardiovascular Disease Risk Factors: A Systematic Review with Meta-Analysis', *BMC Public Health*, 17.1 (2017), 1–24 <<https://doi.org/10.1186/s12889-017-4691-z>>.

7. J. Rankin et al., 'Psychological Consequences of Childhood Obesity: Psychiatric Comorbidity and Prevention', *Adolescent Health, Medicine and Therapeutics*, Volume 7 (2016), 125–46 <<https://doi.org/10.2147/ahmt.s101631>>.

8. M. Van Geel et al., 'Are Overweight and Obese Youths More Often Bullied by Their Peers? A Meta-Analysis on the Relation between Weight Status and Bullying', *International Journal of Obesity*, 38.10 (2014), 1263–67.

Background

The National Institute for Health and Care Excellence (NICE) produces quality standards that provide guidance on how interventions can effectively prevent children from developing obesity. These are principally the adoption of a healthy and balanced diet, addressing lifestyle risk factors within the family and social settings, reducing sedentary lifestyle and incorporating strategies for behavioural change.⁹ The environments in which children spend their time, including nurseries and preschools, in addition to their homes, should be consistently structured to promote a healthy lifestyle. Evidence from systematic reviews support this guidance, showing that the most effective interventions are multicomponent, with elements that address both dietary behaviours and physical activity.^{10,11}

Introducing and modelling healthy behaviours at a young age is important not only to establish a healthy weight and growth but in order to establish good habits. Dietary habits are shaped during the early years but track and persist over time, meaning parental feeding habits are likely to be a good intervention target to prevent excess weight gain in young children.¹² Evidence suggests that proactive parenting and behaviour management can be effective in creating a healthy nutritional environment for young children.¹³

Among children in the early years there is a predominant focus on prevention, although components of interventions that seek to prevent or treat obesity for young children are broadly similar. In this report we distinguish treatment from preventive interventions just in terms of whether children with obesity are exclusively targeted. Given current trends, early interventions are key to ensuring a good start and a healthy foundation for later life¹⁴ and, for this reason, the early years are an important target for policy makers.

9. National Institute for Health and Care Excellence, 'Obesity in Children and Young People : Prevention and Lifestyle Weight Management Programmes', July 2015.

10. T. Brown et al., 'Interventions for Preventing Obesity in Children', Cochrane Database of Systematic Reviews, 2019.7 (2019) <<https://doi.org/10.1002/14651858.CD001871.pub4>>.

11. J. Ling and others, 'Lifestyle Interventions in Preschool Children: A Meta-Analysis of Effectiveness', American Journal of Preventive Medicine, 53.1 (2017), 102–112.

12. S. Scaglioni, et al., Factors Influencing Children's Eating Behaviours. *Nutrients*. 10.6 (2018), 706.

13. Z. Montano, et al. Longitudinal relations between observed parenting behaviors and dietary quality of meals from ages 2 to 5. *Appetite*. 87. 1 (2015), 324-329.

14. B. Mikkelsen et al., 'Life Course Approach to Prevention and Control of Non-Communicable Diseases', *BMJ (Online)*, 364 (2019) <<https://doi.org/10.1136/bmj.l257>>.

Background

There are a number of relevant programmes that have been implemented in the UK, e.g., the Sure Start and MEND/mini-MEND but they did not meet our inclusion criteria and have not been included in this report. Sure start was evaluated (prior to 2011) using a quasi-experimental design, where Sure Start populations were compared to non-Sure Start populations at nine months, three and five years. Children from Sure start families were reported to be less likely to be overweight¹⁵ but data were not provided. In England, the MEND programme was evaluated for children aged 7-13 years, while mini-MEND was evaluated in Australia (no significant differences were observed between intervention and control for anthropometric measures).¹⁶

AIMS OF THIS REVIEW

The main aim was to explore the effectiveness of interventions or programmes for obesity prevention and treatment in the early years in the UK.

We also aimed to identify gaps in the provision of obesity interventions in the early years and within the evidence base.

15. E. Melhuish et al., 'Evaluation and Value of Sure Start', *Archives of Disease in Childhood*, 95.3 (2010), 159–61 <<https://doi.org/10.1136/adc.2009.161018>>.

16. H. Skouteris et al., 'A Parent-Based Intervention to Promote Healthy Eating and Active Behaviours in Pre-School Children: Evaluation of the MEND 2-4 Randomized Controlled Trial', *Pediatric Obesity*, 11.1 (2016), 4–10.

Methods

- In November 2021 we searched nine databases for evidence relating to individual, family or community-based obesity interventions for children aged 0-5 years. We excluded studies relating to breast- or formula-feeding interventions as these are linked to the field of developmental origins research, which was not the focus of this review.
 - We searched the international evidence base but included only UK studies for the purposes of this report. We included intervention studies or randomised controlled trials, quasi-experimental studies, and studies that had a before/after implementation design. We included studies that compared an intervention to a control. We included single or multi-component interventions (diet and/or physical activity).
 - We included both preventative and treatment interventions, given that the components of interventions in the early years are similar; we differentiated between prevention and treatment interventions by those eligible or targeted i.e., interventions were considered treatment when targeted at children with overweight and obesity.
 - We excluded publications prior to 2011 (2011-2021) as we wanted to reflect current or recent interventions and programmes; a recent review showed the strength of evidence prior to 2011 to be limited.¹¹ We included studies that reported anthropometric outcomes (waist measurement, weight, zBMI or BMI) either as a primary or as a secondary outcome, as these measures are the most robust way of assessing effectiveness.
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Methods

- There was a total of 18,788 records included for screening (see Appendices 1 and 2 for search terms and flow chart). Two reviewers (SM and MS) independently screened on title and the abstract. Using EPPI-Reviewer software we used an 'active learning approach' where, prioritisation of records was periodically refreshed during screening, in order that the most relevant articles were screened first.
 - A graphical output was used to indicate when to stop screening, i.e., when the number of relevant studies had plateaued. A model was then built using the machine learning algorithm and applied to classify unscreened items with a score that indicates relevance; the classifier model reduces the likelihood that relevant studies would be missed.
 - In total, 6,779 records were manually screened. During title and abstract screening, 6,217 records were excluded manually, and 12,004 records were excluded by the machine. There were 567 records included for full text screening, where 356 records were manually excluded, leaving 211 relevant studies, of which four were conducted in the UK. Data from an unpublished study was provided to us, meaning the total included UK studies was five (reporting on six trials).
 - In November 2021 and in March 2022 we also ran two patient and public involvement (PPI) sessions with the Family Research Advisory Group (FRAG) facilitated by the National Children's Bureau. The first session was held at the outset and aimed to discuss the rationale of our work, in addition to families' experiences of obesity and views of how best to address the problem in the early years; the second session was conducted in March 2022 to discuss the findings of the work.
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What we found

Description of studies

Five studies, including six trials were included in the final analysis;^{17,18,19,20,21} unpublished data for two trials were provided by the author upon request (see Table 1 for a summary of interventions/trials and Appendix 3 for further details). Sample sizes ranged from 42 to 117. Intervention duration ranged from 8 weeks to 12 months, with follow-up ranging from 15-17 weeks to 24 months in length. One study was undertaken in Glasgow, one in Lancashire, one in Hertfordshire, one in Cornwall and the last study took place in two areas in North and Central England. Two of the studies were randomised controlled trials (RCTs),¹⁹ one cluster randomised trial (CRT),¹⁷ two feasibility CRTs^{18,21} and one before/after impact assessment of a weight management programme.²⁰ The studies were assessed for their quality (Appendix 4). The randomised trials were assessed using the Cochrane risk of bias tool; risk of bias was judged to be high in all studies most commonly due to weaknesses in adherence to the intervention. No bias assessment was conducted for the Planet Munch trial as data were unpublished at the time of writing. The before/after impact assessment was assessed using the ROBINS-I tool and was also found to have a high risk of bias. The study was judged as moderate in terms of bias in the selection of participants/adherence to the intervention and high risk in missing data. Data on cost-effectiveness were not identified for any of the interventions.

17. A. Hodgkinson et al., 'An Educational Intervention to Prevent Overweight in Pre-School Years: A Cluster Randomised Trial with a Focus on Disadvantaged Families', *BMC Public Health*, 19.1 (2019), 1–13.

18. S. Malden et al., 'A Feasibility Cluster Randomised Controlled Trial of a Preschool Obesity Prevention Intervention: ToyBox-Scotland', *Pilot and Feasibility Studies*, 5.1 (2019), 1–11 <<https://doi.org/10.1186/s40814-019-0521-7>>.

19. J. Lanigan et al., 'The TrimTots Healthy Lifestyle Programme for prevention of obesity in preschool children: evidence from 2 randomised controlled trials', Unpublished.

20. L. P. Tee et al., 'Successful Outcomes in Childrens Specialist Weight Management: Impact Assessment of a Novel Early Years Weight Management Programme', *Journal of Human Nutrition and Dietetics*, 34.5 (2021), 819–826.

21. M. Bryant et al., 'Cluster Randomised Controlled Feasibility Study of HENRY: A Community-Based Intervention Aimed at Reducing Obesity Rates in Preschool Children', *Pilot and Feasibility Studies*, 7.1 (2021), 59

Table 1. Brief summary of included interventions and trials^a

Intervention, Location, study type	Author, year, study type	Participants eligible / targeted	Participants (intervention, control) ^b	Intervention detail	Intervention duration	Follow up	When evaluated	Reduction in mean zBMI vs baseline (SD / CI 95%)	Reduction in mean zBMI vs control (SD / CI 95%)
Be active, Eat Healthy/ Healthy Heroes, Lancashire	Hodgkinson et al., (2019), Pragmatic CRT	2-4 years, Mean age=NR	81 (47, 34)	'Be Active, Eat Healthy' resources were used to improve Sure Start Early Years' Centres policy on food and drink. The Healthy Heroes curriculum aimed to promote healthy eating and physical activity with healthy cookery courses, activity play sessions, activity cards for families to play at home.	6 months	2 years	NR (Trial published in 2019)	-0.18* (SD 0.99)	-0.74* (-0.38, -1.10)
ToyBox, Glasgow	Malden et al., (2019), Feasibility CRT	3-5 years, Mean age=4.4	42 (26, 16)	The intervention was delivered at the preschool and at home environment. At the preschool environment, physical activity and sedentary behaviour were targeted and at home environment both physical activity and sedentary behaviour and eating and water consumption were targeted.	18 weeks	15-17 weeks	2018	+0.02 (-0.11, 0.15)	-0.04
LEAF, Cornwall	Tee et al., (2021), Impact Assessment	Children aged ≤6 years with severe OB Mean age=4.1	147	Children attended a 20h programme over 12 months that included home and clinical-based assessment by a multidisciplinary team and community-based intervention through 6 workshops about diet and physical activity.	12 months	Intervention end	2012-17	-0.5*	
HENRY, Various	Bryant et al., (2021), Feasibility CRT	Parents & children 6 months - 5 years Mean age=NR	117 (47, 70)	Parents attended a programme that targets parental skills, knowledge on healthy eating, physical activity and well-being. Topics covered: eating habits, healthy meals, portion sizes, emotional well-being, physical activity.	8 weeks	11 months	NR (Trial published in 2021)	-0.9	-1.4
Planet Munch Trial 1 Hertfordshire	Lanigan et al., (Unpublished) RCT	1-5 years, with OW/OB/high risk Mean age=2.4	88 (49, 39)	The intervention consisted of workshops, music, movement, healthy snack time and interactive teaching sessions that aimed to educate families on dietary and physical activity practices and help them adopt a healthier lifestyle.	6 months	6 months 24 months	(Trial not published)	-0.2* (-0.3, -0.03) -0.3* (-0.5, -0.1)	-0.2 (-0.5 to 0.05)
Planet Munch Trial 2 Hertfordshire	Lanigan et al., (Unpublished) RCT	1-5 years Mean age=2.1	85 (38, 47)	The intervention consisted of workshops, music, movement, healthy snack time and interactive teaching sessions that aimed to educate families on dietary and physical activity practices and help them adopt a healthier lifestyle.	6 months	6 months 12 months	(Trial not published)	-0.02 (-0.2, 0.2) -0.3 (-0.7, 0.1)	-0.09 (-0.4, 0.2)

a. Further detail provided in Appendix 3 | b. Numbers at randomisation | * Reduction was statistically significant (if reported)

Narrative synthesis

BE ACTIVE, EAT HEALTHY/ HEALTHY HEROES

Intervention: Be Active, Eat Healthy / Healthy Heroes is an educational intervention to prevent overweight and obesity in preschool children with a focus on disadvantaged families. The intervention was conducted in Lancashire and aimed to promote healthy eating and physical activity in a fun way using activity cards, stickers, songs, puppets and by delivering healthy cookery courses and active play sessions. It was delivered by the staff of Sure Start early years centres, who provided a 2-hour session to run the intervention in clusters and 2-day training to deliver the intervention to parents and children. Participants of interest were 2-year-old children with their mother/caregiver, that were enrolled in Early Year's centres and recruited via letters.

Evaluation: Healthy Heroes was evaluated via a pragmatic cluster randomised trial (i.e., a trial evaluating the effectiveness of the intervention in real-life conditions). The control was normal care within Sure Start early years centres. Recruitment letters were sent to 160 families, 87 of which participated and 81 completed the study. Participants anthropometric measurements were obtained objectively by a researcher. The study had a 2-year follow up. The intervention group reduced their mean (SD) zBMI between 2 and 4 years (-0.18 (0.99)), while the control group increased their zBMI at the same timepoints (0.56 (0.60)). Children in the intervention group had on average higher zBMI at the beginning of the study compared to the control group. Researchers built a multi-level model with final BMI z-score as the outcome with initial zBMI controlled. The intervention effect was found to be significant ($p=0.002$); children in the intervention group had greater mean reduction in zBMI compared to the children in the control group (0.49 (95%CI 0.17,0.80)).

Observations: This was a small trial delivered to disadvantaged families. The intervention had a diet and physical activity component; however, researchers did not assess physical activity at follow up and recognised that it was challenging for mothers to complete the dietary assessments as some had poor levels of literacy and assessments were found to be time consuming. The trial showed encouraging results, but it is not certain that the observed reduction in zBMI was a result of the intervention.

Narrative synthesis

TOYBOX

Intervention: ToyBox was a preschool obesity prevention intervention that took place in Glasgow, Scotland in March-June 2018. Participants were children aged 3-5 years old, recruited in preschools via email by Glasgow City Council, predominantly in deprived areas. Physical activity and sedentary behaviour sessions were targeted in preschool and home settings; eating and water consumption was also targeted in the home environment. Children and parents participated in interactive activities about eating, snacking, water consumption and physical activity. The intervention was delivered by practitioners that were provided with 2.5 hours of training.

Evaluation: Toybox was evaluated via an 18-week feasibility cluster randomised controlled trial among six preschools in Glasgow. The control was the normal curriculum within pre-schools. Initially, 112 preschools were contacted for expressions of interest, 11 expressed interest to participate of which 6 were chosen that were similar in size and sociodemographics. These six preschools were randomised to either the ToyBox intervention (n=3 centres, 26 children) or usual curriculum control group (n=3 centres, 16 children). The study was completed by 22 out of 26 children in the ToyBox group and 14 out of the 16 children in the control group. Participants were measured objectively by the same researcher at baseline and 15-17 weeks after the intervention. The intervention was not found to be effective in reducing zBMI, small increases in zBMI were observed in both groups (intervention: 0.02 (95%CI -0.11, 0.15), control: 0.06 (95%CI -0.04, 1.05).

Observations: The levels of fidelity to the intervention were different in the preschool and home environments. The intervention was implemented with high fidelity at the preschools, but fidelity was lower in the home environments; therefore, the dietary and physical activity components may not have been delivered as originally intended. Due to the small sample size the generalisability of this study is limited.

Narrative synthesis

LIFESTYLES, EATING AND ACTIVITY FOR FAMILIES (LEAF)

Intervention: The LEAF programme is a weight management service for children with severe obesity delivered in Cornwall and the Isles of Scilly. Targeted population were children younger than 6 years with severe obesity or severe obesity with relevant comorbidity. Children were referred to the programme from paediatricians, GPs and the NCMP. A multidisciplinary team comprising a community paediatrician, specialist dietitian and physical activity advisor delivered the intervention, which lasted one year. LEAF had five stages (initial home visit, child assessment and anthropometric measurements, six healthy lifestyle workshops, follow-up clinic appointments, and discharge from the programme once healthier lifestyle achieved).

Evaluation: A before/after impact assessment was used to evaluate LEAF with no control. In total, 147 children participated in the programme; uptake data were not reported. After achieving a healthier lifestyle, children were discharged from the LEAF programme and referred to primary care. Follow up anthropometric measurements were recorded in primary care if required. In total, 65 children completed the assessment with anthropometric measurements at baseline and following programme participation. A statistically significant reduction in zBMI ($z = -5.4$, $p < 0.001$) was observed with an average zBMI decrease of 0.5 between baseline and the post-programme measurement. Measurements were objectively recorded by the multidisciplinary team.

Observations: Parental engagement was reported to be low during the programme and, if deemed necessary, more intensive input was provided by schools and social care. LEAF is a multi-component programme with information relating to diet, portion sizes, food labelling and physical activity with behavioural elements. It is not clear which components of the interventions were potentially effective in achieving zBMI reduction.

Narrative synthesis

HEALTH EXERCISE NUTRITION FOR THE REALLY YOUNG (HENRY)

Intervention: HENRY is a UK community-based preschool obesity prevention programme that aims to provide parents with skills and knowledge on healthy eating behaviour, nutrition, physical activity, and emotional well-being. Children younger than 5 years are eligible to participate in HENRY. The programme is delivered in child centres by trained staff. HENRY is an ongoing programme and around 40 local authorities in the UK currently commission HENRY.

Evaluation: HENRY has been evaluated in a before/after and vs control analysis using data collected from parent-report questionnaires. The control was standard care within children centres. After completing the programme, parents reported that the family followed healthier lifestyles by increasing their consumption of fruit and vegetables and reducing their consumption of foods high in in sugar and salt. HENRY did not routinely measure anthropometric outcomes due to developers' concerns that reference to weight in obesity interventions may discourage participation. However, a recent feasibility study conducted between July 2017 and November 2019 measured children's height and weight with zBMI as a primary outcome. Initially, 388 parents were approached and 287 of them consented to participate. After contact with a researcher, 117 parents from 12 childcare centres in two (unspecified) local authorities in areas of high deprivation in northern and central England participated; 99 completed the study. NatCen researchers were responsible for data collection, which took part at baseline and at 11 month follow up. Children of any weight status were eligible to participate in the study but baseline measurements showed that children in HENRY centres had higher zBMI (mean 1.8 [SD=2.47]) compared to control centres (mean 0.0 [SD=2.05]). At follow up, children in HENRY centres reduced their mean zBMI by 0.9, whilst children in control centres increased their zBMI by 0.5.

Observations: HENRY was designed as a universal intervention but tended to enrol participants with higher overweight and obesity rates; additionally, all participants were recruited from centres located in areas with relatively high deprivation.

Narrative synthesis

PLANET MUNCH

Intervention: Planet Munch (previously called Trim Tots) is a multicomponent 24-week programme that included diet and physical activity components, with behaviour change. Planet Munch has the central aim of educating children and encouraging them to achieve sustainable changes in diet and physical activity through art and play. Planet Munch ran from 2008 to 2011 at children's centres in Hertfordshire. The intervention was delivered by a multidisciplinary team including researchers, community artists and children centre staff. All team members were provided with training prior to programme delivery. The target population was children aged 1-5 years, who were recruited through newsletters, leaflets and posters or from the children centre staff or the researchers.

Evaluation: Planet Munch has been evaluated in two randomised controlled trials: one for the targeted intervention for children with overweight, obesity or at high-risk (children with at least one parent with overweight or who experienced rapid growth in infancy), and one for an intervention for children of any weight status. The controls were a delayed intervention condition for eligible children in each trial. Trial 1 was the targeted intervention: 88 children living with overweight or at high-risk, were randomly assigned to the intervention (n=49) or the waitlist control group (n=39). The programme was completed by 64 children with available data at 24 months follow for 42 children. The anthropometric measurements were objectively measured by the staff that undertook the trial. Children in the intervention arm had significantly lower zBMI compared to baseline at the end of the trial (-0.2, 95%CI: -0.3, -0.03) and 24 month follow up (-0.3, 95%CI: -0.5, -0.1); children also reduced zBMI compared to control (-0.2, 95%CI: -0.5, -0.05) but not significantly. Trial 2 for children of any weight status: 85 children participated (38 in the intervention group and 47 in the control group). The programme was completed by 64 children with available data at 12 months follow up for 39 children. Compared to baseline, small reductions in zBMI were found at the end of the trial (-0.02, 95%CI: -0.2, 0.2) and at 12 month follow up (-0.3, 95%CI: -0.7, 0.1); there were negligible differences compared to control (-0.09, 95%CI -0.4, 0.2).

Observations: Planet Munch was found to be effective when targeted to higher risk children and is the only preschool intervention programme in the UK that uses NICE recommendations i.e., include advice on achieving a healthy diet, addresses lifestyle risk factors within the family and social settings, and incorporates strategies for behavioural change. NICE guidelines also recommend that the first step to reduce obesity are multi-component lifestyle interventions that begin during preschool years, and involve parents and carers.

PPI findings



- Findings are reported from two sessions with the FRAG, comprising mainly parents, one at the outset of the project, the second to present findings from the review. During the first session, parents reported that they were aware of some UK obesity prevention programmes and that they thought they may be effective, but perceived time and financial restrictions to be a potential barrier to engagement.
 - Parents believed that both caregivers and schools have an important role in helping children sustain a healthy weight. During the second session, findings were presented and parents discussed the lack of implementation of evidence-based interventions by local authorities; a lack of funding was discussed as a potential reason.
 - Parents agreed that the implementation of evidence-based interventions, with the involvement of well-trained professionals, was important. It was also highlighted by parents that available interventions need to be advertised, to increase awareness for families.
 - Parents suggested that, for young children, caregivers are primarily responsible for providing a healthy diet; however, it was acknowledged that some families may have financial limitations. Parents suggested that local authorities should try to support families with targeted initiatives or vouchers and that it would be useful to educate the public (including parents of young children) on how to correctly read food labels.
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Discussion

We reviewed the evidence of preventative and treatment interventions for obesity in the early years and found only six trials from five studies relating to five interventions or programmes. All interventions were multi-component; two targeted children with overweight/obesity (LEAF and Planet Munch trial 1) and three has a focus on disadvantaged families/deprived areas (Healthy Heroes, ToyBox, and HENRY). Reductions in zBMI in individuals compared to their own baseline were observed at follow up in five studies; however, some were very small and only three were reported to be significant, one of which was among children with overweight/obesity. Significant reductions in zBMI compared to control were observed in two studies, one of which was among children with overweight/obesity. Overall, we found a lack of interventions with robust evaluation that included anthropometric outcomes. Published studies also had a high risk of bias and findings were difficult to compare owing to heterogeneity in study designs, intervention approaches and outcome reporting. Some of the reported reductions in zBMI should be interpreted with caution. For example, children that received the HENRY intervention, started the programme with higher mean zBMI than those in the control group, which may have affected the effect size; the control groups also gained weight to amplify the effect size further.

The Be active, Eat Healthy/Healthy Heroes intervention was the only trial to show a significant difference between intervention and control in terms of zBMI among children of any weight status; however, weight gain was observed in both groups, most substantially among the control group. Only two trials were followed up beyond 12-months, meaning there is very little evidence for longer-term effects. To assess the strength of these findings it is more important to consider trial design and the plausibility of effect sizes, as opposed to statistical significance, given the limited evidence base and small-scale trials and sample sizes.

These data do however suggest that UK weight management and prevention interventions for the early years have potential promise. Unpublished data were provided for two trials relating to the Planet Munch (formerly Trim Tots) intervention, which showed significant reductions in zBMI for children with overweight, obesity or at high risk. The LEAF Programme was also effective in reducing zBMI but was only delivered to children with severe obesity and was not compared to a control. The Planet Munch trial showed reductions were sustained at 24-month follow up. Planet Munch was the only preschool obesity intervention in the UK that adheres to the NICE recommendations i.e., provides advice on how to achieve a healthy diet, encourages physical activity and includes behaviour change strategies.

Discussion

Parents were invited to consider realistic changes they felt could be made to their current lifestyle to improve their diet and physical activity. Planet Munch and LEAF were delivered by specialists: for Planet Munch, researchers, community artists and children's centres staff facilitated the intervention; and for LEAF, dietitians, pediatricians, physical activity advisors facilitated the intervention. Planet Munch also set up a steering committee consisting of parents, health care professionals, physical activity instructors and play specialists who advised on programme design and delivery, which was an area of good practice. However, when delivered to children without a weight status requirement, the Planet Munch trial found the intervention did not produce significant reductions in zBMI when compared to baseline or control.

Limitations

Our search strategy included the international evidence base and yielded a high number of records. We used EPPI-Reviewer software to apply an active learning approach, which greatly reduced screening time but resulted in 12,004 records being excluded without being screened. It is possible that there are relevant studies that have not been included in this review. We also chose to only include studies that reported anthropometric outcomes, as these would be the most powerful in assessing effectiveness. Objectively recorded BMI is also prone to less bias than other energy balance behaviours such as dietary intake or sedentary time. However, we acknowledge there may be interventions that are effective in changing energy balance behaviours that are not included in this review. We also excluded studies published before 2011; however, previous systematic reviews do not show any significant UK studies prior to this time. Finally, we were unable to conduct meta-analysis given that there were differences between studies in terms of: study design; intervention composition, delivery, and duration; follow-up time; targeting and eligibility; mean age; and control conditions.

Discussion

Research context

We found very few effective preventative interventions in terms of anthropometric outcomes among children in the early years in the UK. We found some evidence of effective interventions for children with obesity, but more research is required. The international evidence base is much larger, particularly from high income countries, including the USA, Canada and Australia. We included the international evidence in our searches and have a database of relevant studies from which data can be synthesised to answer broader research questions about the effectiveness of early years interventions.

Policy relevance

Prevention is at the heart of health agenda in order to proactively tackle the burden of obesity for adults and children but developing effective preventative interventions is complex. There are clear challenges for policy makers and local authorities to overcome when developing interventions. While limited, available evidence suggest that families often cite financial, time and social costs as reasons for low engagement in family programmes. This may be especially true where parents do not recognise developing overweight or obesity in their children or associated risk factors.

There are also likely to be additional costs involved in adopting healthier lifestyles, whether related to buying fresh ingredients or participating in recreational activities. These factors are likely to be felt more acutely by disadvantaged families, meaning interventions would be likely to widen inequalities in obesity. Where interventions are delivered in pre-school or childcare settings, delivery is likely to require specialist skill. Thorough training for staff is key to develop the knowledge and skill required for effective delivery.

NICE recommends the adoption of a healthy and balanced diet, addressing lifestyle risk factors within the family and social settings, reducing sedentary lifestyle and incorporating strategies for behavioural change. Developing interventions that adhere to this guidance, designed with adequate time and funding with a robust accompanying evaluation is critical. Our review shows that only one UK intervention, Planet Munch, has been developed along these lines. If the evidence base is developed further, it will be important to include considerations of cost-effectiveness, in addition to translational research in order to find out whether effectiveness in one area will work in another.

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The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research, the Department of Health and Social Care or its arm's length bodies, and other Government Departments.

Appendix 1 – Search strategy & screening criteria

A1a. Search Strategy

The following databases were searched (Nov 2021):

Pubmed/Medline

Cochrane Library Web

CINAHL

Scopus

PsycINFO

Web of Science

Social Policy and Practice

Health Management Information Consortium (HMIC)

Trials Register of Promoting Health Interventions (TROPHI)

A1b. Screening criteria

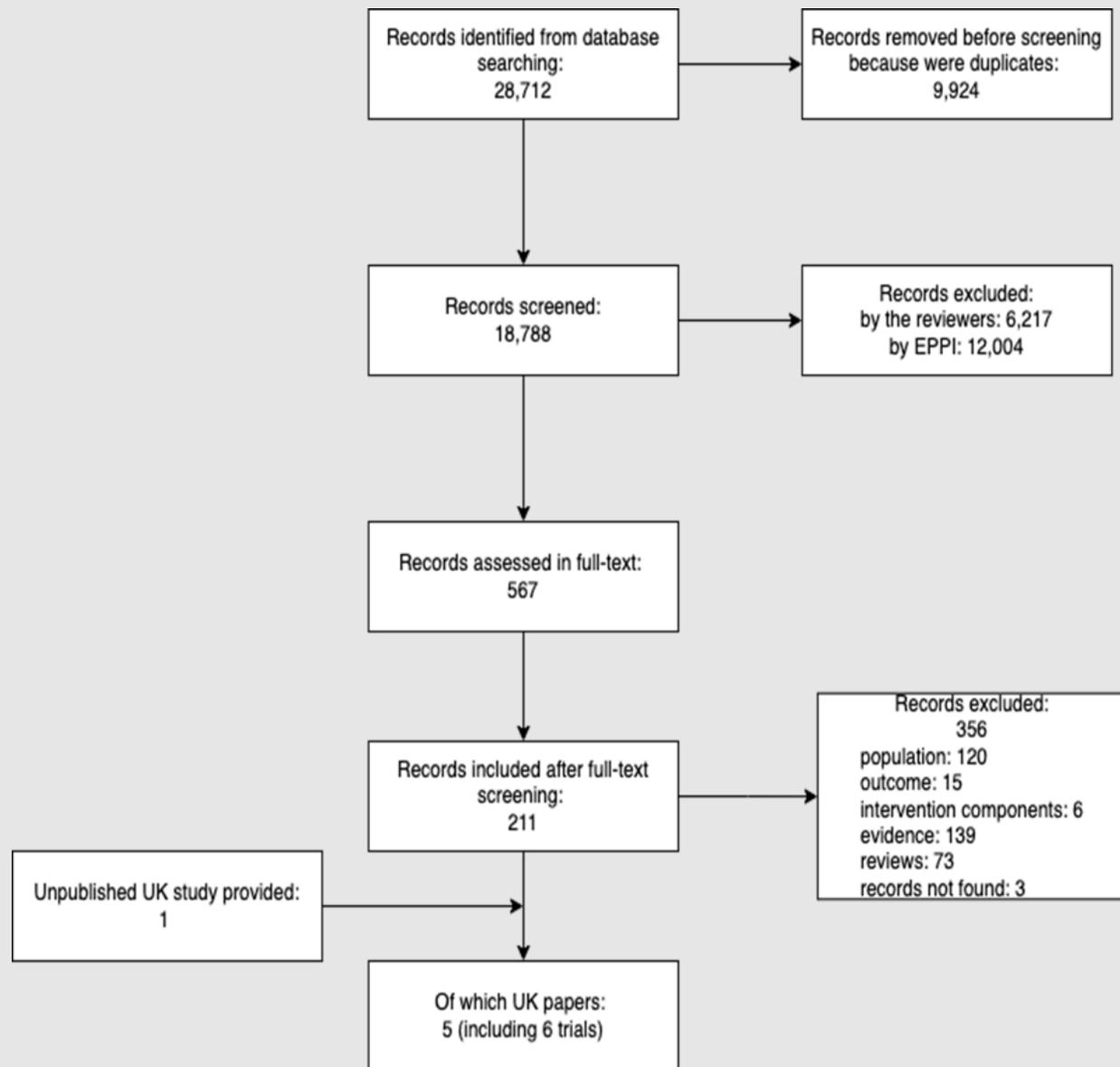
Participants	Children aged 0-5 years
Intervention (exposure)	Obesity prevention or treatment programmes (individual, family- or community based)
Comparison	Pre intervention measures or Control groups
Outcome measure	Anthropometric outcomes like: body weight, growth, BMI, BMI z-score, BMI percentile, adipose tissue, waist circumference
Study designs	Intervention studies, RCTs, studies with before and after implementation, quasi-experimental studies, studies that evaluated uptake and composition of interventions
Other	
Geography	Any country – focus of this briefing: only the UK
Languages	Any language
Time	From 2011 until November 2021

Appendix 1 – Search terms

Table A1. Search terms

Concept 1	Concept 2	Concept 3
Participants	Exposure	Outcomes
Subject headings: “Child, preschool” OR “Schools, nursery” OR “Child day care centers”	(“diet” OR “food” OR “beverages” OR “food quality” OR “food preferences” OR “feeding behavior*”) OR (“exercise” OR “sedentary behavior” OR “physical fitness”) AND (“weight reduction programs” OR “health education” OR “health promotion” OR “primary prevention” OR “pilot projects” OR “feasibility studies” OR “program evaluation”)	(“obesity” OR “body mass index” OR “body weight” OR “body size” OR “body composition” OR “body weight changes” OR
Keywords "child preschool" OR "preschool*" OR "preschool*" OR "pre school*" OR "kindergarten" OR "kindergarden" OR "prekinder*" OR "pre kinder*" OR "pre kinder*" OR "headstart" OR "head start" OR "sure start" OR "surestart" OR "family child care home*" OR "family childcare home*" OR "infant*" OR "toddler*" OR "childcare" OR "child-care" OR "child-care" OR "early learning center*" OR "early learning centre*" OR "early child*" OR "early care and education" OR ("child*" AND ("day-care" OR "day-care" OR "daycare")) OR "playgroup*" OR "play group*" OR "schools nursery" OR ("center" OR "center s" OR "centers" OR "centre" OR "centre s" OR "centres") AND "child, preschool") OR "child day care centers" OR "child day care centers")	(“diet” OR “dietary” OR “food” OR “beverages” OR “snack*” OR “fruit*” OR “vegetable*” OR “food quality” OR “drink*” OR “juice*” OR “nutrition*” OR “food habit*” OR “food choice*” OR “overeat*” OR “over eat*” OR “weight control” OR “weight management” OR “menu planning” OR “menu choice*” OR “meal choice*” OR “meal*” OR “meal planning” OR (“food” AND “consum*”) OR “food preferences” OR “feeding behavior*” OR “feeding behaviour*” OR “energy density” OR “lifestyle behaviour” OR “eating behaviour” OR “healthy eating” OR “health promotion” OR “eating habit*”) OR (“exercise” OR “sedentary behaviour” OR “physical fitness” OR “movement” OR “playtime” OR “play*” OR “sport*”) AND (“intervention*” OR “program*” OR “programme*” OR “project*” OR “therapeutics” OR “scheme” OR “initiative*” OR “strateg*” OR “service*” OR “primary prevention” OR “health education” OR “health promotion” OR “primary prevention” OR “treat*” OR “therapy*” OR “pilot projects” OR “feasibility studies” OR “program evaluation”)	"overweight")("obesity" OR "obes*" OR "body mass index" OR "BMI" OR "bmi z score" OR "bmi z score" OR "body mass index z-score" OR "body mass index z-score" OR "bmi percentile*" OR "bmi centile*" OR "body mass index percentile*" OR "body mass index centile*" OR "adipos*" OR "overweight" OR "healthy weight" OR "weight loss" OR "weight gain")

Appendix 2 – Flow diagram



Appendix 3 – Detailed summary of studies

Author (Year) Study type	Intervention	Sample/Participant's characteristics	Intervention duration	Follow up	Control	Findings
Hodgkinson et al., (2019) Pragmatic, cluster randomized trial with parallel, matched-pair design	Be active, Eat healthy / Healthy Heroes Intervention at Centre level: Staff training on the 'Be active, Eat healthy' resource to help improve Sure Start Early Years' Centres policy on food and drink. Intervention at family level: Healthy Heroes Activity Pack was delivered over 6 months to promote healthy eating and physical activity with healthy cookery courses, activity play sessions, activity cards to families to play at home.	Sample: Total: 81 (I: 47, C: 34) Age: Range 2-4 years, mean=NR Eligible: Children of any weight (23.5% above 91 st centile). Focus on disadvantaged families.	6 months	2 years	Normal care within Sure Start early years Centres	Using multilevel modelling with initial BMI z-score as a covariate, the intervention group were found to reduce their mean BMI z-score between 2 and 4 years (p = 0.002; change difference 0.49; 95% CI 0.17 to 0.80) whereas the control group showed increasing BMI z-score.
Malden et al., (2019) Feasibility cluster randomized controlled trial	ToyBox. An 18-week intervention that targeted physical activity and sedentary behaviour in the preschool and home environment and eating and water consumption was targeted in the home environment.	Sample: Total: 6 preschools I: 3 preschools (N=26), C: 3 preschools (N=16) Age: Range 3-5 years, mean 4.4 (0.46) Eligible: Children of any weight (baseline zBMI: 0.41(SD 1.16) in the intervention group and 0.35 (SD 1.17) in the control group. Focus on disadvantaged families.	18 weeks	15-17 weeks	Pre-school usual curriculum	Both intervention and control groups showed small increases in BMI z-scores at follow-up of 0.02 and 0.06, respectively.
Tee et al., (2021) Impact assessment	LEAF. A 20h programme over 12 months that included home and clinical-based assessment by a multidisciplinary team and community-based intervention through 6 workshops about diet and physical activity.	Sample: Total: 65 Age: Range=NR, mean 4.1 years Eligible: Severe obese (BMI≥3.33 SD or BMI≥99.6 th centile/ 2.66 SD with a relevant co-morbidity).	12 months	12 months	N/A	A highly significant reduction in mean zBMI (0.5; p < 0.001) across the intervention period.
Bryant et al., (2021) Feasibility cluster randomized controlled trial	HENRY. An 8-week programme targeting parental skills, healthy eating, physical activity and well-being. Six centres in two local authorities were randomized to the intervention or control arm. Parents in the HENRY group attended an 8-week programme that provided skills/ knowledge on healthy lifestyle for preschool children/families. Topics included eating habits, healthy meals, portion sizes, emotional wellbeing, parental skills and activity.	Sample: Total: 117 Age: Range 6 months - 4 years Eligible: No weight status criteria. Focus on deprived area.	8 weeks	11 months	Children centre's standard care	At follow-up, BMI z-score in children within HENRY centres children reduced from 1.8 (SD 2.47) to 0.9 (SD 1.75) and increased from 0.0 (SD 2.05) to 0.5 (SD 1.22) in control centres
Lanigan et al., (Unpublished) Trial 1. Randomised controlled trial	Planet Munch/Trim Tots. A 6-month healthy lifestyle programme with workshops, music, movement, healthy snack time and interactive teaching sessions that aimed to educate families on dietary and physical activity practices and help them adopt a healthier lifestyle.	Sample: Total: 88 (I: 49, C: 39) Age: Mean 2.4 (1.0) years (I: 2.5 [1.0] years, C: 2.3 [1.0] years) Eligible: Children with overweight (BMI≥ 91 st centile) or obesity (BMI≥ 98 th centile)	6 months	6 months 24 months	Eligible children delayed intervention	Children in the intervention arm had lower zBMI compared to controls; mean difference (95% CI): -0.9 (-1.4 to -0.4), P = 0.001. Effects reduced after adjustment for age, sex and baseline BMI: -0.3 (-0.6 to 0.03); P = 0.08. Effects were sustained at long-term follow up in trial 1: -0.3 (-0.5 to -0.1) P = 0.005.
Lanigan et al., (Unpublished) Trial 2. Randomised controlled trial	Planet Munch/Trim Tots. A 6-month healthy lifestyle programme with workshops, music, movement, healthy snack time and interactive teaching sessions that aimed to educate families on dietary and physical activity practices and help them adopt a healthier lifestyle.	Sample: Total: 85 (I: 38, C: 47) Age: Mean 2.1 (0.8) years (I: 2.1 [0.8] years, C: 2.1 [0.8] years) Eligible: No weight status criteria	6 months	6 months 12 months	Eligible children delayed intervention	There were negligible differences in weight change for the intervention arm compared to control in trial 2: -0.09 (-0.4 to 0.2).

