Received: 21 December 2022 | Revised: 27 October 2023 | Accepted: 10 November 2023

DOI: 10.1111/apa.17043

ACTA PÆDIATRICA NURTURING THE CHILD WILEY

REVIEW ARTICLE

Scoping review showed that obesity prevention in Nordic countries had limited effects on children from birth to 7 years of age

Josefine Starnberg[1,2] | Lina Renström[1,2]

[1]Centre for Research and Development, Region Gävleborg, Gävle, Sweden

[2]Centre for Clinical Research, Region Gävleborg and Uppsala University, Gävle, Sweden

Correspondence
Josefine Starnberg, Centre for Research and Development, Region Gävleborg, Lasarettvägen 1, 803 24 Gävle, Sweden.
Email: josefine.starnberg@uu.se

Funding information
Centre for Research and Development, Uppsala University and Region Gävleborg

Abstract

Aim: The aim of this scoping review was to map and summarise clinical trials that attempted to prevent obesity in children from birth to 7 years of age in any of the Nordic countries.

Methods: PubMed, CINAHL Plus and clinicaltrials.gov were searched for peer-reviewed papers and registered trials published in English or Swedish. The overall search period was from 1 January 2002 to 13 December 2022. We included randomised and non-randomised trials initiated from birth to 7 years of age that aimed to prevent obesity in Denmark, Finland, Iceland, Norway and Sweden.

Results: The search resulted in 414 papers and 14 were included. Despite having diverse settings and designs, none of them reported consistently favourable results for anthropometric outcomes, apart from beneficial trends in subgroups with a high body mass index at baseline. Most studies reported temporarily improved dietary patterns.

Conclusion: There is a gap in the current research about how to best prevent obesity in children. We suggest that researchers should focus on risk groups and that interventions that last a number of years are needed.

KEYWORDS
anthropometric outcomes, childhood obesity, dietary patterns, overweight, prevention

1 | INTRODUCTION

The prevalence of overweight and obesity in children has markedly increased in the last four decades and is now considered to be one of the most important global health issues.[1,2] It affects one in five children over 5 years of age in Nordic countries.[3,4] In Sweden, the prevalence in 4-year-old children increased from 11% to 13% during the first year of the COVID-19 pandemic.[5] A systematic review and meta-analysis also observed this increasing trend in the general paediatric population, and state that it could be caused by the change of lifestyles during the pandemic.[6]

Childhood obesity is multifactorial and both genetic predisposition and behavioural and environmental factors influence the risk.[7] Other risk factors have been correlated with the increased risk of childhood overweight and obesity, in addition to lifestyle and behaviour. These were having parents with overweight or

Abbreviations: BMI, body mass index; RCT, randomised controlled trial.

obesity, high birth weight, early accelerated growth and low socioeconomic status.[8,9]

Obesity has been associated with cardiovascular conditions and cancer, which account for the majority of European deaths.[10] It has been suggested that, in some regions, the current generation of children will be the first to have a shorter life expectancy than their parents, as a consequence of the morbidity that follows overweight and obesity.[11] Apart from the increased risk of a number of somatic diseases, childhood obesity has also been associated with an increased risk of dropping out of school, anxiety, depression and early death.[12,13]

No country has so far managed to consistently decrease the prevalence of overweight or obesity, but early prevention has been a key factor.[14] A 2019 Cochrane report evaluated the level of evidence presented by 26 randomised controlled trials (RCTs) on interventions for children up to 5 years of age. It concluded that the evidence was moderate or high and that these needed to combine dietary advice and promote physical activity to have even a minor effect on body mass index (BMI).[14] Only nine of these studies were conducted in Europe. In 2018, Volger et al. published a scoping review of 34 papers in order to map obesity prevention in children up to 6 years of age in the United States. They found that just under half of the interventions reported beneficial effects and concluded that parental participation was a key factor.[15]

However, it is possible that addressing the obesogenic environment is even more important. The key drivers for the increasing prevalence of overweight and obesity are consuming energy-dense food and beverages and a sedentary lifestyle.[2,16] Prevention would require comprehensive societal transformation towards healthier diets and a less sedentary lifestyle.

The effects of the obesogenic environment have also been observed in the Nordic countries. According to a number of studies, even young school children ate too much saturated fats, too much sugar and too few unsaturated fatty acids and vegetables in all Nordic countries.[17–22]

This scoping review was conducted to address what research has been carried out to prevent overweight and obesity in children from birth to 7 years of age, before they started their first school grade in the Nordic countries. The aim was to map and summarise the research with regard to the study contexts, study populations, type of interventions and results, with a focus on the anthropometric outcomes. We chose to limit our review to the Nordic countries, because they have comparable healthcare systems and a similar spectrums of health and diseases. For instance, free antenatal care and child health care services are well-established and attended by the vast majority of families. All Nordic countries also offer about 1 year of paid parental leave after a child is born. The majority of children from birth to 7 years of age receive early childhood education and care.[23] Furthermore, the reported prevalence of overweight and obesity in these countries has been similar: 55–59% in adults and 15–30% in children aged 5–19 years.[5,24,25]

Key notes

- Although there is a dire need for prevention of childhood obesity, earlier studies show limited effects of prevention on children's weight status.
- None of the interventions in this scoping review found consistently significant favourable results on anthropometric outcomes, even though some studies did observe a more beneficial trend in subgroups with high body mass index at baseline.
- Future studies should focus on risk groups and interventions lasting over years.

2 | METHOD

We mapped the evidence in this area in a systematic and reproducible manner, by carrying out a scoping review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping reviews guidelines.[26] A scoping review can identify a broad range of study designs and settings and map current research in a field. The framework for scoping reviews by Arksey and O'Malley was applied to the work process.[27] The five stages of this framework are specify the research question, identify relevant studies, select the studies, chart and collate the data, summarise and report the results. No review protocol was published.

2.1 | Criteria

This review covered peer-reviewed papers published in English or Swedish from 1 January 2002 to 13 December 2022, in Denmark, Finland, Iceland, Norway and Sweden. We focused our search on clinical trials, including randomised and non-randomised studies that reported preventive interventions for children from birth to 7 years of age. Treatment interventions for children that already had obesity were excluded. Preventive interventions that were targeted at certain risk groups were included. Study protocols with no available results were also included, as one aim of this review was to map the research within the area. The studies that were included had to present or plan to present anthropometric results such as BMI, fat mass index, fat free mass index or waist circumference. If the included study presented other results than anthropometry, such as dietary patterns, these results were considered and discussed under results and discussion as secondary findings. The study selection criteria are presented in Table 1.

2.2 | Search strategy

We searched for eligible reports in the databases PubMed and CINAHL Plus. The search strategy was prepared by the authors and

TABLE 1 Search strategy and study selection criteria.

Database	Search strategy	Limitations
PubMed	(("Pediatric Obesity"[Mesh]) OR (((pediatric OR child* OR infant* OR toddler OR preschooler) AND (obesity OR overweight)) AND (prevention OR control)) AND (Scandinavia* OR Nordic OR Norway OR Sweden OR Denmark OR Iceland OR Finland) AND (clinicaltrial[Filter] OR randomizedcontrolledtrial[Filter]))	Publication date from 1 January 2002 to 13 December 2022. Article type: randomised controlled trial or clinical trial
CINAHL Plus	((MH "Pediatric Obesity/PC")) AND ((MH "Scandinavia+"))	Publication date from 1 January 2006[a] to 13 December.

Study selection criteria	Inclusion criteria	Exclusion criteria
Study population	Children aged 0–7 years	Studies initiated prenatally, children ≥7 years of age
Study type	Randomised controlled trials, non-randomised controlled trials	Observational studies
Country	Sweden, Denmark, Norway, Finland or Iceland	Non-Nordic countries
Type of intervention	Intervention to prevent overweight or obesity	Treatment of obesity
Language	English, Swedish	Other languages
Outcome	BMI, zBMI or BMI sds, weight, waist circumference, FMI, FFMI, prevalence of overweight or obesity	Not presenting or planning to present anthropometric results

Abbreviations: BMI sds, BMI standard deviation score; FFMI, fat free mass index; FMI, fat mass index; MH, major heading; PC, prevention and control; zBMI, Z-score for BMI.

[a] CINAHL Plus have published reports since 2006.

an experienced librarian, but carried out by the authors. The search strategy and the various start dates are detailed in Table 1 and was performed on 13 December 2022. The search strategy was not peer reviewed. The results from the databases were exported to a text file and processed by both authors separately.

We also searched for registered interventions at clinicaltrials.gov using the topic obesity, with the filters child 0–18 and intervention. The result of registered projects for each relevant country was extracted to a separate text file.

The search results from the databases were screened by title and abstract by both authors separately, to decrease the risk of selection bias and for consistency. No automation tools were used and duplicates were manually removed. Papers that were not relevant for this review, such as non-clinical trials, adult studies and papers that were not in English or Swedish were excluded from the list. Studies on treating children with obesity were excluded, as were studies that were initiated prenatally or after 7 years of age. Finally, studies outside Nordic countries and those that did not report relevant outcomes were excluded. The list of registered projects from clinicaltrials.gov was processed in a similar manner and projects that met inclusion criteria, but had not already been identified, were added to the final result list. There was a general agreement about which papers should be included and presented in this review.

2.3 | Data charting process

The studies that were included were sorted and compiled by both authors using Microsoft Excel, 2016 Office version (Microsoft Corp, Washington, USA) file. Data charting was carried out independently and the tables were compared. When data differed between the authors' files, the papers in question were processed together and the tables were amended. The data that were extracted included the country, study population characteristics, study sample, age during the intervention, type of intervention, primary and secondary outcomes and results.

2.4 | Synthesis of results

A final data items table was created, to provide an overview of the included studies (Table 2). The design and results are presented in a narrative manner. The full names of some of the studies were rather lengthy and these are all included in Table 2 rather than in the main text.

3 | RESULTS

3.1 | Selected papers

The PubMed database yielded 321 papers and the CINAHL Plus database added 93 more papers (Figure 1). One large RCT was identified by clinicaltrials.gov, which followed a feasibility study that had already come up in the searches.[28,29] If more than one published paper presented anthropometry from the same project, the most recent follow-up study was selected as the main paper, but the earlier results are also discussed.

3.2 | Study designs and characteristics

A total of 14 papers were chosen for the review, including five study protocols with no results reported by the date of the search

TABLE 2 Summary of included reports.

Project, Year	Author, Country	Study population, Recruitment	Intervention	Sample size, follow-up and dropout rate	Results
Healthy start 2021	Olsen et al.[36] Denmark	Children aged 2–6 years who were susceptible to obesity. From district with low level of education.	3–7 individual motivational interview (MI) consultations over 15 months plus group cooking classes and activities.	*N* = 543 (plus shadow control group of 420) Follow-up: 15 months after baseline Lost to follow up: 33%	No effect on zBMI, fat mass (%) or fat free mass. Non-significant lower fat mass gain in intervention group. Small negative effect of the intervention on waist-to-hip ratio.
Child-Centred Health Dialogue for primary prevention of obesity – feasibility study 2021	Derwig et al.[29] Sweden	4-year-old children attending CHC (child health care).	Child centred health dialogue model, family guidance to parents of overweight children at 4-year health visit.	*N* = 785 Follow-up: 5 years of age Lost to follow up: <2%	No effect on BMI sds change.
Child-Centred Health Dialogue for primary prevention of obesity, 2021	Derwig et al.[28] Sweden	4-year-old children attending CHC.	Child-centred health dialogue model, family guidance to parents of overweight children at 4-year health visit.	*N* = 6047 Follow-up: 5 years of age Lost to follow up: 18%	No effect on zBMI change, although a trend towards a better intervention effect on those overweight at baseline.
Early food for future health 2019	Helle et al.[42] Norway	6 months of age Recruited by CHC and social media.	Short video clips every month for 6 months, addressing infant feeding topics and recipes.	*N* = 715 Follow-up: 18 months after baseline Lost to follow up: 59%	No effect on weight-for-age z-score, higher BMI-for-age z-score in intervention group.
PRIMROSE 2019	Enoe Person et al.[41] Sweden	9 months of age, attending CHC.	Individual, group and telephone sessions, based on MI, for 39 months.	*N* = 1369 Follow up: 4 and 5 years of age Lost to follow up: 21%	No effect on BMI or prevalence of overweight or obesity.
Healthy School Start II 2019	Norman et al.[38] Sweden	6-year-old children, preschool classes from disadvantaged areas.	Health brochure and MI sessions to parents, classroom activities for 6 months.	*N* = 378 (31 classes) Follow-up: 11 months and 4 years after baseline Lost to follow up: after 4 years was 43%	No effect on BMI sds. Of children with high BMI sds at baseline: beneficial effects after 11 months, unbeneficial effect in boys at the 4-year follow-up.[45]
Mobile-based Intervention Intended to Stop Obesity in Preschoolers (MINISTOP) 2018	Delisle Nystroem et al.[39] Sweden	4.5 year old children Population-based sample.	Information and behavioural support via app for 6 months, with food registration possible. With automated response.	*N* = 315 Follow-up: 12 months after baseline Lost to follow up: 17%	No effect on fat mass index but a larger increase in fat-free mass index in intervention group. Initially better composite scores in intervention group.
Healthy School Start I 2015	Nyberg et al.[40] Sweden	6-year-old children, preschool classes from disadvantaged areas.	Health brochure and MI sessions for parents and classroom activities for 6 months.	*N* = 243 (14 classes) Follow-up: 12 months after baseline Lost to follow up:1%	No effect on BMI sds.

(Continues)

TABLE 2 (Continued)

Project, Year	Author, Country	Study population, Recruitment	Intervention	Sample size, follow-up and dropout rate	Results
Special Turku Coronary Risk Factor Intervention Project for Children (STRIP) 2010	Hakanen et al.[35] Finland	7 months of age, recruited via CHC clinics.	Individual dietary and lifestyle counselling every 1–3 months up to 2 years, then 2 per year until the age of 20.	*N* = 1062 Follow-up: At 15 years of age Lost to follow up: 50%	No effect on BMI, although less cardiometabolic risk factor clustering in intervention group compared to controls.
Study protocols					
IMPROVE (hybrid type 3 evaluation design) 2021	Schaefer Elinder et al.[31] Sweden	6-year-old children in preschool classes.	Health brochure and MI sessions for parents, classroom activities for 6 months, self-test for parents' risk of type 2 diabetes.	*N* = 30 schools, 1400 families approximately Follow-up: 2 years after baseline NA	Not available (NA)
Mobile-based Intervention Intended to Stop Obesity in Preschoolers 2.0 (MINISTOP 2.0) 2020	Henriksson et al.[34] Sweden	2.5-year-old children attending CHC.	6-month access to further developed app.	*N* = 500 Follow-up: NA	NA
Food4Toddlers 2019	Roed et al.[32] Norway	1-year-old children recruited via social media.	Web-based intervention for 6 months with lessons, basic information, recipes and discussion forum.	*N* = 298 Follow-up: 1.5, 2 and 4 years of age	NA
Healthy School Start Plus 2018	Schaefer Elinder et al.[30] Sweden	6-year-old children, preschool classes, disadvantaged areas.	Same as IMPROVE	*N* = 17 schools, 352 children Follow up: 6 and 18 months after baseline	NA
Early Stockholm Obesity Prevention Program 2011	Sobko et al.[33] Sweden	1-year-old children with one obese or two overweight parents attending CHC.	Sessions with educational and individual MI element, 4 sessions at 1–2 years of age, then 2 per year.	*N* = NA Follow-up: yearly between 1 and 5 years	NA

Note: Sample size is at baseline, lost to follow up could be because lack of data, study dropout, etc.

Abbreviations: BMI sds, BMI standard deviation scores; CHC, child health care; IMPROVE, IMplementation and evaluation of the school-based family support PRogram a Healthy School Start to promote child health and prevent OVErweight and obesity; MI, motivational interview; NA, not available; zBMI, Z-scores of BMI.

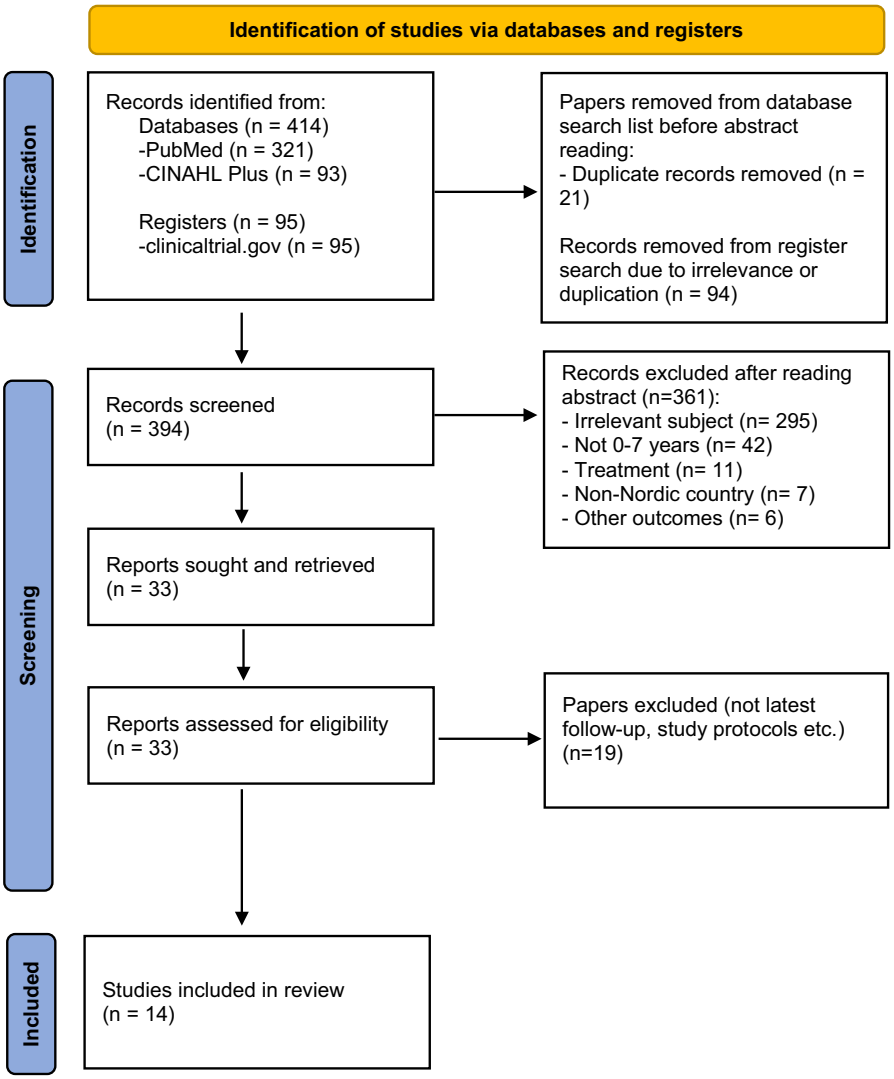

FIGURE 1 Identification and sorting of articles.

(Table 2).[30–34] We found one study from Finland,[35] one from Denmark,[36] two from Norway[32,37] and 10 from Sweden.[28–31,33,34,38–41] There were no studies from Iceland. Three projects were initiated during the child's first year,[35,37,41] three comprised children who were 1–3 years of age[32–34] and the rest were initiated when the children were between 4 and 7 years of age.[28–31,36,38–40] Eight of the trials were cluster interventions.[28–31,33,38,40,41] Two of the projects were directed at risk populations[33,36] or were conducted in disadvantaged areas.[30,38,40]

Four of the interventions were based on innovative electronic health intervention programmes via a website or mobile application,[32,34,39,42] while the others were based on physical counselling sessions with parents, mostly with additional written information.[28–31,33,35,36,38,40,41] The vast majority of the counselling sessions used motivational interviews, which is a person-centred communication strategy that works on behavioural changes in a non-judgmental, constructive and individual manner. Other communication methods that were used were a 10-minute structured child-centred health dialogue involving 4-year-old children and their caregivers[28,29] and a constructive dialogue approach that aimed to engage children and their caregivers, but was not described.[35]

One group of four studies that focused on interventions in preschool classes and lasted 6 months to 1 year were included. These were various stages of a healthy school start intervention and evaluation of a school-based family support programme to promote child health and prevent overweight and obesity.[30,31,38,40]

3.3 | Results of individual studies

None of the studies presented consistent significant favourable results on the anthropometric measures that were studied. The vast majority used BMI metrics as outcomes, but one study group focused more on body composition.[34,39] However, some studies found that the interventions had a larger effect size on children who were overweight or had a higher fat mass index or BMI at baseline, even though the results did not always reach significance or had any lasting effect.[28,38,39,43]

3.3.1 | Physical counselling

Four of the trials were conducted in child health care centres.[28,29,33,41] One of these was a Swedish feasibility study,[29] followed by a large-scale RCT comprising 6000 4-year-old children.[28] This was a low-intensity intervention that comprised 10 minutes of health information for all children, using a child-centred health dialogue. Those who were identified as overweight or obese would also be offered targeted family guidance. This was, however, only performed for one quarter of children fulfilling the criteria. No changes in BMI z-scores were observed after 1 year, although there was a more pronounced, but not significant, beneficial effect on children who were overweight at baseline.[28] Another large Swedish study was initiated when the children were 9 months of age and comprised 1355 first-time parents. Nine sessions, based on motivational interviewing, were arranged over 39 months, and these included individual sessions with caregivers, group sessions and telephone calls. There was no change in the children's BMI, waist circumference or prevalence of overweight during any of the follow-up visits at 5 and 6 years of age.[41] Finally, a Swedish study provided support for the caregivers of approximately 200 1-year-old children whose parents had overweight or obesity. They were offered coaching sessions that comprised one educational element and one motivational interview at least once a year, when the children were 1–6 years of age.[33] The final results had not been published at the time of writing, but a published thesis reported that the project did not manage to prevent overweight or obesity as hoped.[44] However, the intervention group did gain less weight per year and adding power to the study may have strengthened the impact of the intervention.

A Finnish intervention, which focused on 1062 children from 7 months to 20 years of age focused on coronary risk factors. It provided individual counselling sessions that aimed to lower the participants' intake of saturated fat and promote physical activity.[35] These were held twice a year with both the parents and the child, with more frequent visits before the child's seventh birthday. There were no effects on BMI or the prevalence of overweight or obesity from 7 to 15 years of age, but the intervention group had a lower proportion of cardiometabolic risk factor clustering than the control group who did not receive the intervention.

We also assessed a Danish study that targeted a risk population with high maternal BMI, low maternal education or high birth weight.[36] Children who were 2–6 years of age were randomised into three groups, including 315 to an intervention group and 310 to a control group that did not receive the intervention. There was also a shadow control group to enable the authors to control for the possible influence of making parents aware of their child's susceptibility to obesity. All children who were already overweight or obese were excluded. The 15-month intervention consisted of three to seven individual family sessions based on motivational interviewing, cooking classes that were held bimonthly and monthly activities. The authors found no difference in changes in the BMI z-scores, although a non-significant trend towards lower gain in fat mass in the intervention group was observed. In contrast, the intervention group increased their waist-to-hip ratio more than the controls.

3.3.2 | School-based interventions

Four healthy school interventions were conducted in Sweden and lasted 6 months to 1 year. The first intervention consisted of giving a brochure to the parents and a motivational interview sessions with one of their parent and an external counsellor. There were also classroom activities for the children. There was no effect on BMI or the prevalence of overweight or obesity 1 year after baseline.[40] The second project, from the same group, was similar and included twice as many preschool classes in disadvantaged areas. There were no effects on BMI 1 and 4 years after the intervention.[38,45] However, a beneficial effect was found directly after the end of the intervention, as the BMI standard deviation scores for children with obesity at baseline had improved. In contrast, there was an unfavourable 4-year follow-up effect on the BMI standard deviation scores for boys over the 95th percentile in the intervention group, compared with the control group.[38] The third study added another component to the intervention, which was a type 2 diabetes risk test for parents to increase their own motivation for behavioural change.[30] In addition, the motivational interview was held by school nurses. The anthropometric results from this study, published in a doctoral thesis by Malek, showed that as in previous trials there were no differences in BMI between the control and intervention group.[46] The group presented their fourth study in 2021, which extended the first project from 6 months to 1 year. This had a hybrid type-three evaluation design and studied the fidelity to the programme when it was scaled up, as well as outcomes such as diet, physical activity and anthropometry.[31] The results are not yet available.

3.3.3 | Electronic health interventions

A Swedish mobile-based intervention to stop obesity in preschool children was initiated with the parents of 4-year-old children. The researchers offered a mobile application for 6 months, including guidelines for diet and physical activity, food intake registration with feedback and the ability to contact dieticians and psychologists. The researchers noted that the intervention initially produced favourable effects on the composite scores for fat mass index, diet and physical activity, but these were no longer detected 1 year after baseline.[39] Another paper by the same lead author stated that the early effect on the composite scores was most pronounced in those with a high fat mass index at baseline.[43] They also observed a larger growth in fat free mass index in the intervention group, although they suggested that this should be interpreted with caution and could be a chance finding, due to multiple comparisons. The authors developed this method further by conducting an effectiveness implementation study launched via child health care centres. The results of this

study, which was aimed at younger children aged 2.5 years, had not been published at the time of writing.[34]

The other two electronic health interventions were from Norway. The first comprised more than 700 children who were 6 months of age. They were recruited via child health care centres and social media. When the children were 6–12 months of age, the parents received short monthly video clips with information about different infant feeding topics and recipes. No beneficial effect on anthropometric outcomes was detected. In fact, the opposite effect was reported, with higher BMI-for-age z-scores in the intervention than control group at 2 years of age.[37,42] The second study was a RCT. The parents of approximately 400 1-year-old children were recruited via advertisements on social media platforms. The 148 families in the intervention group received access to a website that provided lessons, recipes, a discussion forum and basic information for 6 months. The 150 families in the control group did not. The authors have not yet presented their anthropometric results, which was the secondary outcome described in the study protocol.[32]

4 | DISCUSSION

The best way to prevent childhood obesity remains unknown and no country has so far managed to turn this negative health development around.[1] Many experts in this field have called for prompt high-level preventive measures, such as national policies, tax adjustments and marketing restrictions. However, there is evidence that interventions targeting younger children can be effective.[14] This underlines the need for the best possible research on how we can prevent further increases in the prevalence of childhood obesity.

This scoping review identified, and presents, a broad variety of study designs. Most had quite small sample sizes and lasted less than a year, but a few had larger cohorts and lasted a number of years. Despite the intensity of the interventions and the settings, the beneficial results on anthropometric outcomes were sparse. They were usually detected in conjunction with the intervention, but not noticeable after the studies finished. Most studies found beneficial effects on diet, but these were rarely significant at later follow-up points. This might indicate that if the interventions had lasted longer the effects on diet might have had enough time to influence the anthropometric results more clearly.

The Finnish coronary risk factor project, which lasted nearly 20 years, was the only study that we found that demonstrated long-lasting beneficial effects on weight-related parameters. It did this by providing face-to-face counselling, which discouraged children from eating saturated fat and encouraged physical activity. This was associated with a lower prevalence of cardiometabolic risk factor clustering in the intervention group. The authors concluded that this important outcome demonstrated the beneficial long-term effects of the intervention.[35] This trial had an impressive duration and the fact that it was able to lower the odds of cardiometabolic risk factor clustering is definitely important. The results demonstrated that initially intense lifestyle face-to-face counselling can continue less frequently later on and still have positive effects, as long as it is sustained over several years. However, it should be mentioned that the dropout rate was quite large, as it was almost 50% up to the 15-year follow-up point.

In addition, some of the studies reported that the most favourable results were achieved by children who already had a high BMI at baseline, which indicated that preventive interventions may benefit those with the largest risk.[28,38,39,43,45] This is speculative, but a report by Olsen et al.[47] suggested that preventive interventions that were directed at risk groups were more likely to yield positive results. None of the projects directed at risk populations in our scoping review found beneficial long-lasting results, but they did have quite small sample sizes.[33,38] One of those studies even excluded subjects that were already overweight or obese at baseline, in order to detect a complete primary preventive effect, but this could have affected the interpretation of the results at a population level.[36]

The large Swedish RCT we included in this review offered a low-intensity, targeted intervention to families with children who had been identified with overweight, apart from the general 10-minute child-centred health dialogue. However, more targeted advice was only provided to a quarter of the parents whose children were identified with overweight. The lack of effect that the intervention had on anthropometry may have been due to lack of fidelity to the planned intervention or due to its low-intensity design.[28] We did not find a similar strategy in any of the other identified studies.

Volger et al.[15] carried out a similar scoping review and this American team detected a higher number of studies with beneficial results than our current review. Most of the studies they looked at also had small sample sizes. Those with favourable results did address family behaviours and home routines, in a similar manner to the Nordic studies we identified. However, the majority of the reports reviewed by Volger et al. were targeted at risk populations and we were unable to detect this pattern in the Nordic countries. Once again, this suggests that targeting risk groups, for example including both children with strong heritability and those from socioeconomically exposed areas, would be more effective, at least in this age group.

Interventions aiming at preventing childhood obesity need to provide specific intensity and probably last for a minimum amount of time, but we yet do not know how intensive and how long this needs to be. The 20-year Finnish study had the longest duration, including lifestyle counselling from 7 months to 15 years of age, and was one of the studies that demonstrated beneficial results on cardiometabolic outcomes.[35] More than half of the studies we included in this review only lasted 6 months and found short-lasting, if any, beneficial effects. We believe that a longer duration is required, preferably years, to be able to influence lifestyle behavioural changes.

When it comes to how intensive interventions should be, Messito et al. published the results of a RCT in the United States. They included low-income families and invited the intervention group to 15 individual counselling sessions on nutrition that started prenatally. They found lower weight-for-age z-scores in the intervention group at 18 months and 2 years of age, but not

at 3 years. However, they did notice that the intervention had a dose-dependent effect, with a noticeable effect after at least five sessions and a maximum effect after 10 sessions.[48] This is interesting, as it suggests that more dose-dependent analyses should be included in future studies. We did not find any similar analyses in the studies we reviewed.

Volger et al.[15] were interested in summarising the cost-effectiveness reports in their review, but found no such analyses in the trials they identified. A vast number of reports about the costs of tackling obesity have been published. One Swedish report estimated that a 6-year-old child with obesity had a lifetime cost, in terms of societal costs and production loss, of more than 34 000 Euros for girls and 21 000 Euros for boys, compared to a 6-year-old with normal weight.[49] Only the Swedish child-centred health dialogue study[28,29] and the Swedish study of 1355 first-time parents who received motivational interviews[41] evaluated the cost of the preventive intervention. A subsequent paper on the latter study could not, with certainty, claim the intervention to be cost-effective, due to the lack of consistent results.[50] The same conclusion can be drawn from the other study, but they estimated that the costs for delivering care to the intervention group were lower than in the control group. They also said that they expect the child-centred health dialogue was likely to be cost-effective for children who were overweight.[28] More cost-effectiveness calculations are needed to positively affect policies and laws.

5 | OTHER OUTCOMES

Some of the studies looked into parental self-efficacy, because this has been related to healthy childhood behaviour.[51,52] However, neither of the two projects just discussed, and the first of the four healthy school start projects, reported that their interventions had a positive effect of the intervention on parental self-efficacy. The exceptions were in the subgroup analyses where the interventions had beneficial impact.[40,53,54] Perhaps this could be one of the pathways that needs to be further targeted for future interventions to be successful.

Four of the interventions did not have any effect on physical activity,[39–41,44] but one observed less sedentary time in the intervention group at the last follow-up point[45] and another intervention group spent more time on sports and outdoor activities per week.[55]

When we looked at the effects on diet, we found that there were healthier diets in the intervention groups in seven studies, compared to the controls. The subjects ate more vegetables and had healthier eating routines, with less sugary drinks and less added sugar.[39–42,45,56,57] These are all interesting results, since diet seems to have had a closer correlation with a child's BMI than other factors, such as physical activity.[58] However, there were no lasting effects at any of the long-term follow-up points, apart from in the subgroups analyses. Those interventions that managed to significantly influence dietary habits were diverse and initiated between 6 months and 6 years of age. They were provided at child health care centres, or via websites or schools and offered counselling or actual recipes. Despite the diversity in study designs, they all manage to influence a change to a healthier diet.

6 | LIMITATIONS

The scope of this review was to focus on anthropometric outcomes and the prevalence of overweight or obesity. We chose the most recent follow-up reports from all the projects and did not focus as much on the earlier positive results. This means that some earlier, but important, results may have escaped our attention, even though we tried to include all relevant results in the discussion.

Our search strategy was not peer reviewed, and even though our endeavour was to identify all the studies that met our eligibility criteria, we cannot be certain that we did.

Most studies used BMI metrics as the primary anthropometric outcome, either the actual BMI or the standard deviation scores, with varying reference populations. The study populations were generally rather small and this could have led to type-2 errors. Also, comparing the intervention groups and the control groups using mean values, such as changes in the BMI standard deviation scores between two time points, was only one parameter of a complex issue. It probably did not reflect the whole picture, but it is unclear how this could have been rectified.

7 | CONCLUSION

Most of the interventions covered by this review had short-term effects on diet, despite quite short durations and small sample sizes. In addition, the limited effect on anthropometric outcomes was most pronounced in those with high BMI and/or fat mass index at baseline, which demonstrated the beneficial effect in subgroups that were at risk of developing obesity. We recommend that future studies aim have long durations and focus on risk populations.

AUTHOR CONTRIBUTIONS

Josefine Starnberg: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; validation; writing – original draft; writing – review and editing. **Lina Renström:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; validation.

ACKNOWLEDGEMENTS

The authors thank Mattias Brundell for advice on searching the databases and Colum Walsh and Nick Brown for suggestions, feedback and comments throughout the process.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

ORCID

Josefine Starnberg https://orcid.org/0000-0001-7341-8254

REFERENCES

1. Ng M, Fleming T, Robinson M, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the global burden of disease study 2013. Lancet. 2014;384(9945):766-81. doi:10.1016/S0140-6736(14)60460-8
2. Di Cesare M, Sorić M, Bovet P, et al. The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. BMC Med. 2019;17(1):212. doi:10.1186/s12916-019-1449-8
3. Bygdell M, Célind J, Lilja L, et al. Prevalence of overweight and obesity from 5 to 19 years of age in Gothenburg, Sweden. Acta Paediatr. 2021;110(12):3349-55. doi:10.1111/APA.16089
4. Sarkkola C, Viljakainen J, De Oliveira Figueiredo RA, et al. Prevalence of thinness, overweight, obesity, and central obesity in Finnish school-aged children: a comparison of national and international reference values. Obes Facts. 2022;15(2):240-7. doi:10.1159/000521170
5. Miregård J, Nowicka P, Nylander C. National data showed an increased prevalence of overweight and obesity among four-year-old Swedish children during the first year of COVID-19. Acta Paediatr. 2023;112:1269-74. doi:10.1111/APA.16707
6. Chang TH, Chen YC, Chen WY, et al. Weight gain associated with covid-19 lockdown in children and adolescents: a systematic review and meta-analysis. Nutrients. 2021;13(10):3668. doi:10.3390/nu13103668
7. Loos RJF, Yeo GSH. The genetics of obesity: from discovery to biology. Nat Rev Genet. 2022;23(2):120-33. doi:10.1038/s41576-021-00414-z
8. Woo Baidal JA, Locks LM, Cheng ER, Blake-Lamb TL, Perkins ME, Taveras EM. Risk factors for childhood obesity in the first 1,000 days: a systematic review. Am J Prev Med. 2016;50(6):761-79. doi:10.1016/j.amepre.2015.11.012
9. Hemmingsson E. Early childhood obesity risk factors: socioeconomic adversity, family dysfunction, offspring distress, and junk food self-medication. Curr Obes Rep. 2018;7(2):204-9. doi:10.1007/S13679-018-0310-2
10. OECD/European Union. Health at a Glance: Europe 2020. OECD; 2020.
11. Olshansky SJ, Passaro DJ, Hershow RC, et al. A potential decline in life expectancy in the United States in the 21st century. N Engl J Med. 2005;352(11):1138-45. doi:10.1056/NEJMsr043743
12. Lindberg L, Danielsson P, Persson M, Marcus C, Hagman E. Association of childhood obesity with risk of early all-cause and cause-specific mortality: a Swedish prospective cohort study. PLoS Med. 2020;17(3):e1003078. doi:10.1371/journal.pmed.1003078
13. Lindberg L, Persson M, Danielsson P, Hagman E, Marcus C. Obesity in childhood, socioeconomic status, and completion of 12 or more school years: a prospective cohort study. BMJ Open. 2021;11(3):e040432. doi:10.1136/bmjopen-2020-040432
14. Brown T, Moore TH, Hooper L, et al. Interventions for preventing obesity in children. Cochrane Database Syst Rev. 2019;2019(7):CD001871. doi:10.1002/14651858.CD001871.pub4
15. Volger S, Radler DR, Rothpletz-Puglia P. Early childhood obesity prevention efforts through a life course health development perspective: a scoping review. PLoS One. 2018;13(12):e0209787. doi:10.1371/journal.pone.0209787
16. Osei-Assibey G, Dick S, MacDiarmid J, et al. The influence of the food environment on overweight and obesity in young children: a systematic review. BMJ Open. 2012;2(6):e001538. doi:10.1136/BMJOPEN-2012-001538
17. Enghardt Barbieri H, Pearson M, Becker W. Riksmaten – Barn 2003: Livsmedels-Och Näringsintag Bland Barn i Sverige. Livsmedelsverket; 2006.
18. Kristjansdottir AG, Thorsdottir I. Adherence to food-based dietary guidelines and evaluation of nutrient intake in 7-year-old children. Public Health Nutr. 2009;12(11):1999-2008. doi:10.1017/S136898000999084X
19. Sørensen LMN, Aamodt G, Brantsæter AL, Meltzer HM, Papadopoulou E. Diet quality of Norwegian children at 3 and 7 years: changes, predictors and longitudinal association with weight. Int J Obes (Lond). 2021;46(1):10-20. doi:10.1038/s41366-021-00951-x
20. Damsgaard CT, Dalskov SM, Petersen RA, et al. Design of the OPUS school meal study: a randomised controlled trial assessing the impact of serving school meals based on the new Nordic diet. Scand J Public Health. 2012;40(8):693-703. doi:10.1177/1403494812463173
21. Kyttälä P, Virtanen SM, Kyttälä P, et al. Food consumption and nutrient intake in Finnish 1–6-year-old children. Public Health Nutr. 2010;13(6A):947-56. doi:10.1017/S136898001000114X
22. Warensjö Lemming E, Moraeus L, Petrelius Sipinen J, Lindroos AK. Riksmaten Ungdom 2016–17 – Livsmedelskonsumtion Bland Ungdomar i Sverige. Livsmedelsverket; 2018.
23. Sollerhed AC, Olesen LG, Froberg K, et al. Movement and physical activity in early childhood education and care policies of five nordic countries. Int J Environ Res Public Health. 2021;18(24):13226. doi:10.3390/ijerph182413226
24. WHO European Regional Obesity Report 2022. WHO Regional Office for Europe; 2022.
25. Eriksson M, Lingfors H, Golsäter M. Trends in prevalence of thinness, overweight and obesity among Swedish children and adolescents between 2004 and 2015. Acta Paediatr. 2018;107(10):1818-25. doi:10.1111/APA.14356
26. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73. doi:10.7326/M18-0850
27. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol. 2005;8(1):19-32. doi:10.1080/1364557032000119616
28. Derwig M, Tiberg I, Björk J, Welander Tärneberg A, Hallström IK. A child-centered health dialogue for the prevention of obesity in child health services in Sweden – a randomized controlled trial including an economic evaluation. Obes Sci Pract. 2022;8(1):77-90. doi:10.1002/osp4.547
29. Derwig M, Tiberg I, Björk J, Hallström I. Child-Centred health dialogue for primary prevention of obesity in child health services – a feasibility study. Scand J Public Health. 2021;49(4):384-92. doi:10.1177/1403494819891025
30. Elinder LS, Patterson E, Nyberg G, Norman Å. A healthy school start plus for prevention of childhood overweight and obesity in disadvantaged areas through parental support in the school setting - study protocol for a parallel group cluster randomised trial. BMC Public Health. 2018;18(1):459. doi:10.1186/s12889-018-5354-4
31. Elinder LS, Wiklund CA, Norman Å, et al. IMplementation and evaluation of the school-based family support PRogram a healthy school start to promote child health and prevent OVErweight and obesity (IMPROVE) – study protocol for a cluster-randomized trial. BMC Public Health. 2021;21(1):1630. doi:10.1186/s12889-021-11663-2
32. Røed M, Hillesund ER, Vik FN, van Lippevelde W, Øverby NC. The Food4toddlers study - study protocol for a web-based intervention to promote healthy diets for toddlers: a randomized controlled trial. BMC Public Health. 2019;19(1):563. doi:10.1186/s12889-019-6915-x
33. Sobko T, Svensson V, Ek A, et al. A randomised controlled trial for overweight and obese parents to prevent childhood obesity – early

STOPP (STockholm obesity prevention Program). BMC Public Health. 2011;11:336. doi:10.1186/1471-2458-11-336
34. Henriksson H, Alexandrou C, Henriksson P, et al. MINISTOP 2.0: a smartphone app integrated in primary child health care to promote healthy diet and physical activity behaviours and prevent obesity in preschool-aged children: protocol for a hybrid design effectiveness-implementation study. BMC Public Health. 2020;20(1):1756. doi:10.1186/s12889-020-09808-w
35. Hakanen M, Lagström H, Pahkala K, et al. Dietary and lifestyle counselling reduces the clustering of overweight-related cardiometabolic risk factors in adolescents. Acta Paediatr. 2010;99(6):888-95. doi:10.1111/j.1651-2227.2009.01636.x
36. Olsen NJ, Ängquist L, Frederiksen P, Lykke Mortensen E, Lilienthal HB. Primary prevention of fat and weight gain among obesity susceptible healthy weight preschool children. Main results from the "healthy start" randomized controlled intervention. Pediatr Obes. 2021;16(4):e12736. doi:10.1111/ijpo.12736
37. Helle C, Hillesund ER, Wills AK, Øverby NC. Evaluation of an eHealth intervention aiming to promote healthy food habits from infancy-the Norwegian randomized controlled trial early food for future health. Int J Behav Nutr Phys Act. 2019;16(1):1. doi:10.1186/s12966-018-0763-4
38. Norman Å, Zeebari Z, Nyberg G, Elinder LS. Parental support in promoting children's health behaviours and preventing overweight and obesity – a long-term follow-up of the cluster-randomised healthy school start study II trial. BMC Pediatr. 2019;19(1):104. doi:10.1186/s12887-019-1467-x
39. Delisle Nyström C, Sandin S, Henriksson P, Henriksson H, Maddison R, Löf M. A 12-month follow-up of a mobile-based (mHealth) obesity prevention intervention in pre-school children: the MINISTOP randomized controlled trial. BMC Public Health. 2018;18(1):658. doi:10.1186/s12889-018-5569-4
40. Nyberg G, Sundblom E, Norman Å, Bohman B, Hagberg J, Elinder LS. Effectiveness of a universal parental support programme to promote healthy dietary habits and physical activity and to prevent overweight and obesity in 6-year-old children: the healthy school start study, a cluster-randomised controlled trial. PLoS One. 2015;10(2):e0116876. doi:10.1371/journal.pone.0116876
41. Enö Persson J, Bohman B, Tynelius P, Rasmussen F, Ghaderi A. Prevention of childhood obesity in child health services: follow-up of the PRIMROSE trial. Child Obes. 2018;14(2):99-105. doi:10.1089/chi.2017.0117
42. Helle C, Hillesund ER, Wills AK, Øverby NC. Examining the effects of an eHealth intervention from infant age 6 to 12 months on child eating behaviors and maternal feeding practices one year after cessation: the Norwegian randomized controlled trial early food for future health. PLoS One. 2019;14(8):e0220437. doi:10.1371/journal.pone.0220437
43. Nyström CD, Sandin S, Henriksson P, et al. Mobile-based intervention intended to stop obesity in preschool-aged children: the MINISTOP randomized controlled trial. Am J Clin Nutr. 2017;105(6):1327-35. doi:10.3945/ajcn.116.150995
44. Bergqvist-Norén L. Physical Activity and Obesity Prevention in Early Childhood. Karolinska Institutet; 2022. http://hdl.handle.net/10616/48127
45. Nyberg G, Norman Å, Sundblom E, Zeebari Z, Elinder LS. Effectiveness of a universal parental support programme to promote health behaviours and prevent overweight and obesity in 6-year-old children in disadvantaged areas, the healthy school start study II, a cluster-randomised controlled trial. Int J Behav Nutr Phys Act. 2016;13(1):4. doi:10.1186/s12966-016-0327-4
46. Malek ME. Health promotion and obesity prevention through a school-based parental support Programme. Karolinska Institutet; 2022. http://hdl.handle.net/10616/48056
47. Olsen NJ, Mortensen EL, Heitmann BL. Predisposition to obesity: should we target those Most susceptible? Curr Obes Rep. 2012;1(1):35-41. doi:10.1007/s13679-011-0004-5
48. Messito MJ, Mendelsohn AL, Katzow MW, Scott MA, Vandyousefi S, Gross RS. Prenatal and pediatric primary care-based child obesity prevention Program: a randomized trial. Pediatrics. 2020;146(4):e20200709. doi:10.1542/peds.2020-0709
49. Nilsson K, Fridhammar A, Wahlberg K, Steen Carlsson K. The economic burden of overweight and obesity in Swedish children – a lifetime perspective. IHE Report; 2022.
50. Döring N, Zethraeus N, Tynelius P, de Munter J, Sonntag D, Rasmussen F. Economic evaluation of primrose-a trial-based analysis of an early childhood intervention to prevent obesity. Front Endocrinol. 2018;9:104. doi:10.3389/fendo.2018.00104
51. Parekh N, Henriksson P, Delisle Nyström C, et al. Associations of parental self-efficacy with diet, physical activity, body composition, and cardiorespiratory fitness in Swedish preschoolers: results from the MINISTOP trial. Health Educ Behav. 2017;45(2):238-46. doi:10.1177/1090198117714019
52. Kieslinger K, Wartha O, Pollatos O, Steinacker JM, Kobel S. Parental self-efficacy—a predictor of Children's health behaviors? Its impact on Children's physical activity and screen media use and potential interaction effect within a health promotion Program. Front Psychol. 2021;12:3382. doi:10.3389/fpsyg.2021.712796
53. Derwig M, Tiberg I, Björk J, Kristensson Hallström I. Changes in perceived parental self-efficacy after a child-Centred health dialogue about preventing obesity. Acta Paediatr. 2022;111(10):1956-65. doi:10.1111/APA.16453
54. Döring N, Ghaderi A, Enö Persson J, Tynelius P, Rasmussen F, Bohman B. Effects of the PRIMROSE prevention trial of childhood obesity on parental self-efficacy. BMC Pediatr. 2021;21(1):388. doi:10.1186/S12887-021-02862-2
55. Händel MN, Larsen SC, Rohde JF, Stougaard M, Olsen NJ, Heitmann BL. Effects of the healthy start randomized intervention trial on physical activity among normal weight preschool children predisposed to overweight and obesity. PLoS One. 2017;12(10):e0185266. doi:10.1371/journal.pone.0185266
56. Røed M, Anine M, Medin C, et al. Effect of a parent-focused eHealth intervention on Children's fruit, vegetable, and discretionary food intake (Food4toddlers): randomized controlled trial. J Med Internet Res. 2021;23(2):e18311. doi:10.2196/18311
57. Rohde JF, Larsen SC, Ängquist L, et al. Effects of the healthy start randomized intervention on dietary intake among obesity-prone normal-weight children. Public Health Nutr. 2017;20(16):2988-97. doi:10.1017/S1368980017002026
58. Swinburn B, Sacks G, Ravussin E. Increased food energy supply is more than sufficient to explain the US epidemic of obesity. Am J Clin Nutr. 2009;90(6):1453-6. doi:10.3945/ajcn.2009.28595

How to cite this article: Starnberg J, Renström L. Scoping review showed that obesity prevention in Nordic countries had limited effects on children from birth to 7 years of age. Acta Paediatr. 2024;113:912–922. https://doi.org/10.1111/apa.17043