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ORIGINAL ARTICLE

Universal healthy school start intervention reduced the body mass index of young children with obesity

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Abstract

Aim: To evaluate the effect of a universal, school-based family support programme on body mass index (BMI) of children aged 5–7 years, using pooled data from three trials.

Methods: The programme has three to four components and is delivered during the first school year. It aims to promote healthy dietary and physical activity behaviours, and secondarily prevent unhealthy weight gain. Three cluster-randomised controlled trials were conducted between 2010 and 2018 in low and mixed socioeconomic status areas in Sweden. Weight and height were measured. Multiple mixed linear regression analysis was performed on the pooled data.

Results: In total, 961 children were included (50% girls, mean age 6.3 years). The post-intervention effect on BMI z-score in all children was small, but in those with obesity at baseline, we observed a significant, clinically relevant, decrease in BMI z-score (−0.21). This was most pronounced in children with a non-Nordic born parent (−0.24). Five to six months after the intervention, decreases were no longer statistically significant.

Conclusion: The intervention resulted in changes in BMI comparable to obesity treatment programmes focusing on behaviour change. However, the effect attenuated with time suggesting the programme should be sustained and evaluated for a longer time.

KEYWORDS
family support programme, obesity prevention, parental support, school-based interventions

1 | INTRODUCTION

The prevalence of obesity in Sweden has increased three-fold over the last four decades and today more than 20% of children aged 6–9 years and 52% of adults live with overweight or obesity.[1] The latest national data on four year olds, from routine child healthcare visits, show a concerning increase in overweight or obesity from 11.4% in 2018 to 13.3% in 2020.[2] The increase was larger among boys than girls and levels of obesity rose more than levels of overweight did. Around 55% of children with obesity will become adolescents with obesity, and around 80% of those adolescents will go on to become adults with obesity.[3] Children with obesity risk

Abbreviations: BMI, body mass index; CI, confidence interval; SD, standard deviation.

short-term and long-term physiological[4] and psychosocial[5] consequences. This highlights the importance of addressing obesity early and effectively.

Risk factors for childhood overweight and obesity are many and complex. An unhealthy diet and inadequate physical activity can be seen as the predictable results of living in an obesity-promoting environment,[6] in combination with one or more psychosocial factors.[7] There is also a strong genetic component underlying the large inter-individual variation in body weight that determines the response to this obesogenic environment.[8] Obesity in children shows a strong social gradient to the disadvantage of groups with lower socioeconomic status.[9] Parents play key roles in influencing the food and meal environment of their children, in providing opportunities for physical activity, as well as in transmitting social and cultural norms around food.[10,11] Systematic reviews have confirmed that the school setting is effective for delivering evidence-based interventions for diet and physical activity, especially among children aged 6–12 years.[12] Effectiveness is enhanced by actively involving parents and the home environment.[13] To address the lack of interventions focusing on the home environment in Sweden, our research group began to develop the family support programme A Healthy School Start in 2010. The programme builds on social cognitive theory and has been designed in alignment with the Swedish Education Act, the national primary school curriculum, and the national guidelines for school healthcare.

A Healthy School Start is a universal intervention designed for all children aged 5–7 years who are starting school. Although school-based, the aim is to help parents facilitate healthy behaviours, such as a healthy diet, physical activity and good sleep habits, in the home environment. These behaviours are known to be important risk factors for the development of overweight and obesity. However, there is no obvious focus on bodyweight in the programme. The programme has been evaluated in three cluster-randomised controlled trials involving almost 1000 families from schools in areas with mixed or low socioeconomic status and has repeatedly shown beneficial effects on child diet and physical activity outcomes.[14,15] Although an effect on body mass index (BMI) was not the primary outcome, it was an important secondary one and was objectively measured. This is a universal intervention and weight loss in the whole population would not be desirable, however, for children with obesity it could be beneficial. A relatively consistent favourable effect was seen on BMI in children with obesity in all three trials, reaching statistical significance in the second trial.[15] As the individual studies were powered to detect changes in dietary intake and/or physical activity but not BMI, pooling data from the studies overcomes that issue and makes a secondary analysis of this outcome possible. We also found previously that children with a parent born outside the Nordic region had higher intakes of unhealthy foods, as well as fruit and vegetables, even when adjusted for education, suggesting that parental migration status was a stronger predictor than parental education on dietary behaviours in this group.[16]

The aim of this study was to evaluate the effect of the Healthy School Start intervention on child BMI by analysing pooled data from the previous trials. Based on the results from the individual trials, the hypothesis was that the intervention would have an effect on children with obesity at baseline and that the effect would be more pronounced in children with a parent born outside the Nordic region.

Key notes

- Three cluster-randomised controlled trials of a universal, school-based family support programme A Healthy School Start have been conducted in areas of low to mixed socioeconomic status.
- A significant, clinically relevant, effect on body mass index was seen post-intervention in children with obesity at baseline, particularly if at least one parent was born outside of the Nordic region.
- Efforts are needed to understand how effects can be sustained in practice.

2 | METHODS

2.1 | Setting and recruitment

The trials were conducted starting in 2010, 2012 and 2017, and are summarised in Table 1. Eligible schools (n = 77 in total) were invited to participate from municipalities in either Stockholm or mid-Sweden. All families with children in preschool classes in participating schools (n = 38 in total) were invited, and participation rates ranged from 40% to 72% (Table 1).

2.2 | The A Healthy School Start intervention

The intervention runs during the first academic school year when children are 5–7 years old. It is delivered by school personnel and comprises three to four synergistic core components. The first is a health information brochure for parents, available in different languages, focusing on positive parenting practices in relation to diet, physical activity, screen time, and sleep. The second is a motivational interviewing session with parents focusing on their choice of the above topics, directly after the child's routine scheduled visit with the school nurse. The third component consists of nine classroom activities for the children focusing on health and health-related behaviours, performed by teachers, followed by home assignments to be completed by children together with their parents. In the third trial, a fourth component was added: a validated self-test for type-2 diabetes risk (Finnish Diabetes Risk Score, FINDRISC) completed by parents. This provided automated feedback advising them to visit primary health care if the risk score was high. This and other slight differences in the programme between the trials are summarised

TABLE 1 Summary of the three previous Healthy School Start programmes and evaluations.

	Healthy School Start 1	Healthy School Start 2	Healthy School Start Plus
Intervention components	Three components: brochure; classroom activities; MI-session with parents delivered by MI-trained research staff	Three components (same as in study I)	Four components: brochure; classroom activities; MI-session with parents delivered by MI-trained school nurses; parental diabetes risk self-test
Setting	A municipality in Stockholm County with low to medium socioeconomic status. Schools in areas with mixed socioeconomic status	The municipality in Stockholm County with the highest prevalence of childhood overweight and obesity. Schools from areas with low-socioeconomic status.	Seven municipalities in four counties in mid-Sweden. Schools from areas with low-socioeconomic status
Schools invited to participate	15 eligible of 29 (based on parental education level and healthcare system setup)	13 eligible of 15 (based on parental education level)	49 eligible of 352 (based on parental education level)
Families invited to participate	338 children enrolled in 14 pre-school classes in 8 schools	654 children enrolled in 31 pre-school classes in 13 schools	898 children enrolled in 34 pre-school classes in 17 schools
Participation rate	243 children (72%)	378 children (58%)	353 children (40%)
Data collection	Height and weight were measured objectively by researchers; parental data self-reported	Same as in study I	Same as in study I
Primary outcome	Physical activity* and dietary intake (*power calculation based on)	Height, weight, physical activity*, dietary intake (*power calculation based on)	Dietary intake (power calculation based on)
Measurements (date of baseline)	Baseline (September 2010), post-intervention, follow up at six months	Baseline (September 2012), post-intervention, follow-up at five months	Baseline (September 2017), post-intervention, follow-up at 12 months

Abbreviation: MI, Motivational interviewing.

briefly in Table 1. More detailed descriptions of the first two studies are available in the respective publications.[14,15] Parents in control schools received treatment-as-usual, in this case, a standard nurse visit with no motivational interviewing or particular focus on these health-related behaviours. They also received the health brochure as this alone was not considered sufficient to bring about behaviour change.

2.3 | Data collection

The primary outcome of this study was weight status, expressed as a standard deviation score for BMI. Weight (in kg) and height (in cm) were measured objectively by trained field researchers following a standard protocol. BMI was calculated (kg/m^2) and BMI standard deviation score (BMI z-score) was calculated using Swedish reference values.[17] Data were gathered at baseline and immediately post-intervention. Follow-up data were gathered five months post-intervention in study two, and six months post-intervention in study one. The third study was followed up after 12 months and this data is therefore not included. Potential confounding variables were self-reported by parents. Parents were asked to indicate their region of birth and two groups were created: at least one parent from outside the Nordic region or both/all from the Nordic region. The highest level of education attained by either of the parents was used to dichotomise the parental education level as low (≤12 years of schooling) or high (>12 years of schooling).

2.4 | Statistical analysis

After carefully checking that the coding of the variables was consistent between the three studies, the data were pooled. For the time point immediately after the intervention, data were available from all three studies. For the follow-up analysis, data was available from the first two studies, as they had comparable follow-up periods of five to six months. To determine intervention effects, we performed a mixed linear regression analysis with group (intervention or control) as the predictor and BMI z-score as the outcome. Adjustments for baseline BMI z–score, child gender and parental education were made. We included the child's school class as a random variable to account for any potential clustering effect. All children with baseline data were included in the analysis following the intention to treat principle. In line with the current study objectives, we additionally performed stratified analyses for children with obesity at baseline, defined according to the International Obesity Task Force (IOTF) cut-offs,[18] and according to where parents were born. Data were pseudo-blinded for the statistical consultant as much as practically possible by changing labels identifying study and treatment group to codewords, so they were not immediately obvious when interpreting results. As approximately 10% of the participants did not have

data at follow-up a sensitivity analysis was performed. To check for potentially biased loss-to-follow-up, we conservatively imputed this missing BMI data using last-value-carried-forward method and re-analysed the data.

2.5 | Ethics and consent

For trial one, registration ISRCTN32750699, permission was received from the Regional Ethical Review Board in Stockholm (2010/934–31/1). For trial two, registration ISRCTN39690370, permission was received from the Regional Ethical Review Board in Stockholm (2012/877–31/5). For trial three, registration NCT03390725, permission was received from the Regional Ethical Review Board in Stockholm No. 2017/711–31/1. All parents provided informed written consent; children were informed orally before measurements were taken.

3 | RESULTS

Table 2 describes the samples of the three pooled studies, separately and together. In total, 961 children took part (50% girls, mean age 6.3 years). Despite some differences, the samples are broadly comparable. Differences between trials were designed to capture more variation in parental characteristics and weight status. Between trials, the percentage of families with a high level of education ranged from 32% to 47%, and of families with a parent from outside the Nordic region from 36% to 82%. The percentage of children with overweight or obesity at baseline ranged from 19% to 26%.

3.1 | Effect of intervention on BMI

The effect of the programme on BMI z-score in children in the intervention group, of all weight statuses at baseline, was non-significant (Table 3). Restricting the analysis to children with a parent of non-Nordic background suggested a stronger effect (−0.09), reaching significance (95% confidence interval (CI): −0.16 to −0.01). Among children with obesity at baseline, we observed a larger decrease in BMI z-score (−0.21, 95% CI: −0.36 to −0.05). Again, this effect was most pronounced in those with a parent born outside the Nordic region (−0.24, 95% CI: −0.42 to −0.06). At follow-up, effects had attenuated: while BMI z-scores were still lower, particularly in children with obesity at baseline and more so with a parent born outside the Nordic region, they were no longer statistically significant (Table 3). We observed no change in BMI z-score for children with overweight at baseline (0.05, 95% CI -0.13 to 0.23). For BMI z-scores and weight status prevalences at baseline, post-intervention and at follow-up see Supplemental Tables S1 and S2. The results of the sensitivity analysis did not differ from the main analysis (data not shown).

TABLE 2 Description of the study samples at baseline.

	Trials			Pooled		
	HSS 1	HSS 2	HSS Plus	All	Control	Intervention
N	241	378	342	961	496	465
Girls (%)	49.0	50.5	50.6	50.2	50.4	49.9
Age (years, mean (s.d.))	6.2 (0.3)	6.3 (0.3)	6.3 (0.3)	6.3 (0.3)	6.3 (0.3)	6.3 (0.3)
Controls (N (%))	112 (46.5)	198 (56.1)	193 (51.1)	503 (51.7)	n/a	n/a
Families with low education (%)*	33.6	47.1	32.5	42.4	42.1	34.6
Families with a parent born outside the Nordic region (%)**	36.5	81.5	45.3	62.2	55.4	59.4
Weight (kg, mean (s.d.))	23.4 (4.1)	24.5 (5.0)	24.0 (4.9)	24.0 (4.8)	24.3 (5.0)	23.8 (4.4)
Height (cm, mean (s.d.))	119.5 (5.5)	120.3 (5.4)	119.3 (5.4)	119.7 (5.4)	119.8 (5.7)	119.6 (5.2)
BMI (kg/m^2, mean (s.d.))	16.3 (2.0)	16.8 (2.5)	16.7 (2.4)	16.7 (2.4)	16.8 (2.5)	16.5 (2.2)
BMI z-score	0.41 (1.19)	0.66 (1.37)	0.60 (1.35)	0.57 (1.33)	0.64 (1.38)	0.5 (1.27)
Underweight (%)	3.7	6.1	4.4	4.9	4.6	5.2
Normal weight (%)	77.6	67.5	69.6	70.8	69.0	72.7
Overweight (%)	12.4	15.6	16.4	15.1	15.7	14.4
Obesity (%)	6.2	10.8	9.6	9.3	10.7	7.7

Note: Weight status according to IOTF cut-off values.[18]

Abbreviation: HSS, Healthy School Start; s.d. standard deviation.

*Missing info: 7.1, 8.7, 11.1, 9.2, 9.3 & 9.0%, respectively. **Missing info: 5.4, 6.5, 10.8, 7.8, 8.1 & 7.5%, respectively.

TABLE 3 Effects of the intervention on BMI z-score post-intervention and at follow-up (5–6 months later).

	Post-intervention					Follow-up				
All weight statuses at baseline	n	b	95% CI		p	n	b	95% CI		p
Change in BMI z-score*	893	−0.020	−0.090	0.050	0.583	567	0.014	−0.040	0.070	0.635
Change in BMI z-score**	893	−0.020	−0.080	0.040	0.442	567	0.001	−0.060	0.060	0.924
Change in BMI z-score, in children with parent(s) born outside the Nordic region**	524	−0.090	−0.160	−0.010	0.020	371	−0.002	−0.070	0.070	0.962
With obesity at baseline	n	b	95% CI		p	n	b	95% CI		p
Change in BMI z-score*	82	−0.185	−0.360	−0.005	0.045	51	−0.108	−0.260	0.040	0.154
Change in BMI z-score**	82	−0.205	−0.360	−0.050	0.012	51	−0.142	−0.300	0.010	0.071
Change in BMI z-score, in children with parent(s) born outside the Nordic region**	56	−0.239	−0.420	−0.060	0.010	39	−0.145	−0.320	0.030	0.108

*Unadjusted. **Adjusted for baseline BMI z-score, gender and parental education; school class included as clustering effect.

4 | DISCUSSION

The effect of the programme on BMI z-score in children in the total intervention group compared to the control group was very small and non-significant, except for children with at least one non-Nordic parent. However, we observed a significant decrease in BMI z-score in children who had obesity at baseline. This effect was most pronounced in those children with a parent of non-Nordic background, where the decrease in BMI z-score was −0.24 units. By the follow-up timepoint, five to six months after the end of intervention, effects had attenuated and were no longer statistically significant.

While this was a universal programme which aimed to improve diet and physical activity and thus prevent unhealthy weight gain, it was not intended that weight status should change for all children. The majority had a healthy weight status at baseline so it was desirable that the BMI z-score for the whole group did not decrease significantly. It was however desirable that it decreased in children with a high z-score, which is what we observed. A decrease in BMI z-score of 0.20–0.25 units is deemed clinically important by the US Preventative Services Task.[19] A BMI z-score reduction of 0.25 or greater has been shown to significantly reduce cardiovascular risk factors in overweight children.[20] A review of six Cochrane systematic reviews of overweight and obesity treatment programmes in children and adolescents showed similar effects to our universal programme in children with obesity.[21] The size of the reduction in BMI z-score of these 12-month multi-component behaviour change programmes was between −0.1 and −0.3 units in 4- to 18-year-old children directly post-intervention. Our results are therefore encouraging because A Healthy School Start is a much less demanding intervention for parents and is non-stigmatising for the children, as supported by our qualitative evaluations with parents and children.[22,23]

A similar result was obtained in another universal controlled but non-randomised community-based intervention, the European IDEFICS study.[24] Here, children with overweight or obesity at baseline in intervention communities demonstrated a significantly greater probability of normalised weight status after two years compared to the control communities. The effect was stronger in the six-to-nine-year-old age group (similar to our target group) than in the two-to-five-year-old age group. Similar to our study, the IDEFICS study found a differential effect on children with obesity, even when they were not specifically targeted. Again, this is important because it suggests that children with obesity can benefit from universal interventions without needing to be singled out, resulting in further stigma, which is already common and harmful.[5] A systematic review from 2021[25] of the effectiveness of 21 school-based interventions including children aged five to 12 years of many nationalities at changing obesity-related behaviours and/or a change in BMI/BMI z-score found significant reductions in BMI z-score (−0.05; 95% CI = −0.08 to −0.02) in favour of the intervention. This is similar in magnitude to our (non-significant) result for all children (−0.02; 95% CI = −0.08 to 0.04).

Interventions to prevent obesity are urgently needed from the individual to the societal level beginning in early life as repeatedly stated in the last decade.[26] Obesity is a strong risk factor for chronic diseases such as cardiovascular disease and type-2 diabetes, and several forms of cancer,[4] as well as for poorer mental health, increasing risk for e.g. anxiety and depression.[5] Therefore, effective interventions targeting diet and physical activity among children will not only lead to a lower prevalence of overweight and obesity but will also lower the lifetime risk of other chronic diseases and reduce societal costs.[27] However, the long-term sustainability of interventions must be considered in addition to their short-term or medium-term effectiveness. In our study, the beneficial effects had attenuated during the follow-up period, which is a common finding.[13,21] This should not discourage this type of intervention in the school setting, but rather emphasises the need for more research on age-appropriate interventions throughout the school years and on long-term effectiveness. If this can be demonstrated, then such programmes should become integrated into routine practice as also emphasised by the WHO.[26]

The finding that the intervention seemed most effective in children with at least one parent born outside of the Nordic region is interesting. Higher rates of overweight and obesity in children with immigrant backgrounds have also been observed in Norway, independently of parental education level.[28] In Sweden, we have previously found that children with a parent born outside the Nordic region have higher intakes of unhealthy foods as well as fruit and vegetables even when adjusted for education,[16] and differences in health behaviours and health status are also seen in adults according to migration status.[29] This indicates that there may be greater potential for improvements in diet in families with a parent of non-Nordic background, which might explain the effect seen in this study. More research will however be required to show if this programme can reduce social inequalities in health.

The study had some limitations. The original studies were not powered to detect changes in BMI. Pooling the studies was an attempt to overcome this limitation but as the effects were limited to subgroups this analysis was based on relatively small samples. Although not guaranteed, this is generally accepted as increasing the likelihood of erroneously rejecting a true result (Type II error) more so than accepting a false result (Type I error). When pooling data from studies it is critical that they are compatible and comparable. All three studies were conducted by the same research group and the protocol did not vary with respect to the outcome or potentially confounding variables included. Loss-to-follow-up was non-negligible but we followed an intention-to-treat analysis protocol and also performed a sensitivity analysis with conservatively imputed data.

The reduction in BMI we found in this study is in line with the other changes detected in the individual trials, namely, the findings of a parent-reported increase in intake of healthy foods, a decrease in unhealthy foods and drinks, and an increase in physical activity.[14,15] To our knowledge, this is the first school-based programme in the Nordic countries that have shown beneficial effects on diet, physical activity and BMI. Given that it is widely recognised that childhood overweight and obesity should be prevented as early in life as possible, and data on 4-year-old children in Sweden show a small but alarming increase in obesity after the first year of the COVID-19 pandemic,[2] the need for such a programme is great. One challenge for scaling up the programme nationally is to identify a suitable dissemination organisation, which can provide the support needed for the programme to be continued and updated with new materials. At present there is a lack of such capacity at the national level in Sweden. We are currently conducting an implementation study in 45 schools in three municipalities, with the aim of evaluating the effectiveness of different implementation strategies on programme fidelity and assessing the scalability at the municipal level.[30] Preliminary results suggest that the resources in school health care are a limiting factor and that the leadership of principals and administrators at municipality levels is crucial for successful implementation.

5 | CONCLUSION

A Healthy School Start is a universal, school-based family support programme, and pooled analysis of three randomised controlled trials showed a statistically significant effect on reducing the BMI z-score in children with obesity, with the highest effect on those with a parent born outside the Nordic region. The change in BMI z-score at the end of the intervention was clinically relevant and was comparable to effects achieved in multicomponent behaviour change programmes to treat obesity. This is in line with findings from systematic reviews showing that school-based interventions with parental support can reach all children and have the potential to prevent childhood obesity. However, the effect decreased after the end of the intervention. This is also in line with previous research indicating that family support programmes should be continued for a longer time than one school year. More work is needed to study how such programmes can be extended, implemented and sustained.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

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SUPPORTING INFORMATION

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

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