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An activity stimulation programme during a child's first year reduces some indicators of adiposity at the age of two-and-a-half

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ABSTRACT

Aim: Obesity tracks from childhood into adulthood. We evaluated the effect of early stimulation of physical activity on growth, body composition, motor activity and motor development in toddlers.

Methods: We performed a cluster randomised controlled single-blinded trial in Dutch Well Baby Clinics, with seven nurses and 96 children (40% girls) randomised to the intervention group and six nurses and 65 children (57% girls) to the control group. Intervention nurses advised parents on stimulating motor development and physical activity during regular visits at 2 weeks and two, four, eight and 11 months. Baseline characteristics such as birthweight and mode of feeding were comparable. Outcomes at two-and-a-half years included anthropometry, skinfold thicknesses, bioelectrical impedance analyses, motor development and daily physical activity. We used linear mixed models with nurses as cluster.

Results: We evaluated 143 children (89 intervention, 54 control) as 18 dropped out. Skinfolds were significantly lower in intervention children (29.6 ± 4.7 mm) than controls (32.4 ± 6.0 mm), without differences in motor development or daily physical activity. Female interventions showed lower weight, skinfolds, waist and hip circumference.

Conclusion: An activity stimulating programme during the child's first year improved indicators of adiposity when they were toddlers, especially in girls. Further research should determine whether these effects persist.

INTRODUCTION

Obesity is caused by an imbalance between energy intake and energy expenditure and has become an extensive problem worldwide (1). In addition to changing eating habits over the past decade, habitual physical activity has decreased and this is an important contributor to the obesity epidemic (2). Epidemiologic evidence supports the theory that the relationship between obesity and disease risk begins early in life (3). Parents play an important role in the development of a healthy body weight in children between the ages of two and six (4) and as they get older. Because physical activity patterns track from infancy to childhood and then into adulthood (5), the best strategy for increasing physical activity in young people and adults may be to create an active lifestyle before early childhood (6). Motor development is stimulated by parents through exercises and involves a dynamic interplay between intrinsic maturation of the musculoskeletal and the nervous systems (7). Intrinsic readiness coupled with daily practice enables infants to find the most efficient motor patterns (8,9). Whether or not stimulating physical activity in infants has a positive effect on the development of body composition is unknown (10). Other research in our Groningen Expert Centre for Kids with Obesity (GECKO) Drenthe cohort showed that the amount time an infant is able to move unrestricted at the age of 9 months was inversely related to their *Z*-score waist circumference at 9 months and changes

Abbreviations
BMI, Body mass index; GECKO, Groningen Expert Centre for Kids with Obesity; SD, Standard deviation.

Key notes

- Because obesity tracks from childhood into adulthood, we examined how an activity stimulation programme during a child's first year would influence body composition at the age of two-and-a-half.
- Our comparison of 89 intervention children and 54 controls showed that stimulating activity at an early age resulted in reduced adiposity indicators at the age of two-and-a-half.
- Further research is needed to determine whether these results are sustained and prevent obesity at an older age.

in their *Z*-scores for weight-for-height and weight-for-age between the ages of nine and 24 months (11). Children who never used baby seats showed a decline in their weight-for-height *Z*-score compared with those who did.

The aim of this study was to evaluate the effect of an activity stimulating programme during a child's first year on growth, body composition, motor activity and motor development at the age of two-and-a-half.

METHODS

The design, conduct and reporting of this study followed the Consolidated Standards of Reporting Trials Statement on cluster randomised controlled trials.

Study description

The study was conducted within the wider GECKO study (12). All children born from April 2006 to July 2007 and living in Drenthe, one of the northern provinces of the Netherlands, were eligible for this study. Parents were informed about the current study during the third trimester of pregnancy by the general practitioner, midwife or gynaecologist or at their first visit to the Well Baby Clinic.

In the Netherlands, more than 99% of mothers and children visit the Well Baby Clinics during the first 4 years after birth (13). These visits are free of charge and provide vaccinations. In the Well Baby Clinics, a youth physician and a specialised nurse see the children. The nurse's role includes teaching parents about food habits and daily care of their infant.

Recruitment for the intervention study took place from December 2006 to July 2007 in parallel with recruitment for the GECKO Drenthe birth cohort study (13). Each district in the area was assigned to one nurse. Prior to the study, all nurses in the preselected area were informed about the study and were assigned to either the intervention programme (n = 7) or to the control programme (n = 6). Randomisation was carried out manually by a GECKO researcher, who drew pieces of paper from a bag. Nurses instead of children were randomised to prevent contamination effects. There was no significant difference between the numbers of infants seen by each nurse, although there was variation in caseload. Before each intervention visit (five in total), the intervention nurses received special training from child physiotherapists on how to implement the stimulation programme. In the absence of a nurse, temporary consultation was by a nurse of the same group allocation to prevent contamination. One child already under the care of a child physiotherapist was excluded. The Medical Ethics Committee of the University Medical Centre Groningen approved the study. Parents gave written informed consent for participation.

Study intervention

The aim of the Early Obesity Intervention Programme covered by this study was to stimulate an active lifestyle for babies by stimulating motor development. Recommendations, based on empirical evidence of early developmental intervention programmes in preterm infants (14), were developed by two physiotherapists, who also trained the nurses, and one GECKO researcher after extensive discussions with experienced paediatricians, child psychologists and child physiotherapists. The intervention group received recommendations from a nurse during a home visit 2 weeks after birth and during regular visits at the Well Baby Clinic at two, four, eight and 11 months of age. After every consultation, parents received a printed copy of the recommendations. Table 1 outlines the programme. Parents were advised to spend 1 h daily playing with their infant on a blanket on the floor with the infant in the prone position, as it is known that motor development is maximised in this position (15). Bright and colourful toys were used to stimulate activity. After this stage, expansion of equilibrium and stability, and stimulating the practice of the normal milestones of motor development were promoted. The focus at 2 weeks was to engage symmetric handling and encourage use of coloured toys and sounds. The focus at 2 months was to encourage variation in the infant's position and location of play, and the focus at 4 months was to expand on this. At 8 months, the recommendations were to encourage the infant to crawl and thereby enlarge his playing area. Then at 11 months, parents were instructed to encourage their infant to walk without support. Parents in the control group received standard care without activity recommendations, which consisted of performing anthropometric measurements, immunisations, general health and development information, identifying children in need of extra medical or social support and nutritional advice. In the Netherlands, more than 85% of mothers start breastfeeding after birth, but less than 30% continue breastfeeding after 3 months.

Table 1 Summary of recommendations given to parents in the physical activity stimulation programme

Age of the child	Recommendations
2 weeks	Engage in symmetric handling Encourage the use of brightly coloured toys and sounds
2 months	Stimulate reaching and grabbing by offering toys in the vicinity of the child Stimulate prone position and rolling Provide variations in the places the child is lying down
4 months	Practice sitting Provoke playing with the feet in supine position Provide variation in and out of the playpen
8 months	Stimulate the child to reach, roll and crawl by placing interesting toys at a short distance from the child Offer toys that challenge the child Vary between smooth and rough support surfaces
11 months	Stimulate the child to stand up and play in this position Stimulate walking with and without support

Baseline data collection

The design of the cohort study has been described previously (13). Baseline characteristics of the parents, including parity, body mass index (BMI), education and income, were obtained by questionnaire during the third trimester of pregnancy or shortly after inclusion in this study. Low education was defined as primary or preparatory secondary vocational education, middle education as secondary school, pre-university education or intermediate vocational education and high education as higher vocational education or university. Birthweight was recorded at the first Well Baby Clinic visit. Mode of feeding was recorded during every visit, so a change in feeding practice was noted immediately and discussed.

Follow-up measurements

The follow-up examination in 2009, at the age of two-and-a-half, took place at the Well Baby Clinic or at home. A trained researcher, who was blinded to the group allocation of the child, performed all follow-up measurements.

Anthropometry

Weight was measured barefoot in light underwear using a calibrated digital scale. Height was assessed using a stadiometer. Children were considered overweight or obese if their BMI was above the 85th percentile for their age and gender (16). Waist circumference was measured midway between the lowest rib and the top of the iliac crest at end tidal expiration. Hip circumference was measured across the greater trochanters. Both were measured over bare skin. Skinfold thickness was measured on the right side of the body using a Harpenden skinfold calliper (British Indicators Ltd., West Sussex, United Kingdom). For the assessment, a standard pressure of 10 g/mm^2 was applied and a reading was taken after 3-sec. Triceps and biceps skinfold thickness was measured at the point midway between the acromion and the olecranon. Subscapular skinfold thickness was measured just below the scapula and supra-iliac (abdominal) skinfold thicknesses were measured just above the iliac crest. All of the above measurements were performed twice, and the average was used for the results. Whole body reactance and resistance were measured three times by performing a 50 kHz Bioelectrical Impedance Analyses, using a BIA 101 (Akern®, Florence, Italy). Body fat percentage was calculated as the difference between weight and fat-free mass. Fat-free mass was estimated using the Goran equation (17) as follows: Fat-Free Mass (kg) = (0.16 × [Height (cm)^2/Resistance (Ω)] + [0.67 × Weight (kg)] − [0.11 × Triceps (mm)] − [0.16 × Subscapular (mm)] + [0.43 × Sex (0, girls; 1, boys)] + 2.41.

Physical activity and motor development

Total daily physical activity was measured using the Tracmor, a tri-axial accelerometer (Philips, Eindhoven, the Netherlands). The children wore the accelerometer for 4 days, at least 2 weekdays and 1 weekend day. Parents recorded wearing time and sleep times in a log. On average, the accelerometer was worn for 9.3 h per day (range 6.7–13.5). Valid days were defined by a wearing time of at least 400 min (6.7 h), and valid measurements were defined by at least three valid wearing days. Measurements were excluded if the child had a fever or other illness. Daily physical activity was expressed as total activity counts per day. In total, 76% of the intervention and 66% of the control children had valid measurements.

Motor development was evaluated using the Dutch Second Edition of the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) (18). Only the gross motor subtest was performed divided into different items. This test primarily measures the movement of the limbs and the torso including static positioning, dynamic movement, balance and motor planning. If the individual item was performed well based on strict criteria described by the authors of the Bayley-III, one point was given and the points were added together to provide a total raw score. As prescribed this, raw score was converted to a scaled score with a range of one to 10, with a mean of 10 and standard deviation (SD) of 3. High scores represented better performance.

Statistical analyses

Baseline characteristics are presented as means with standard deviations or number expressed as percentages. Group differences were tested by Student's *t* test or chi-square test. A random intercept model used to test the main differences between the intervention and control groups, using a subject-specific model to adjust for clustering of children within nurses (Table 2), taking nurses as the subject and intervention and gender as fixed factors. Weight and height were adjusted for age. In addition to the main intervention effects, gender effects were studied adding gender and contrast statements for gender with intervention to the linear mixed model (Table 3). Exploratory analyses for differences between the intervention and control groups in the overweight subgroup were performed using Mann–Whitney *U*-test, without adjustments for clusters. Statistical analyses were performed using SPSS 19.0 for Windows (SPSS, Chicago, IL, USA). With the two groups of 89 and 54 children, the study was powered to find a statistically significant difference in BMI of 0.6 kg/m^2 (SD 1.1, α 0.05, 1-β 0.80) and 2.5 mm skinfold thickness (SD 1.1, α 0.05, 1-β 0.80).

RESULTS

Inclusion, dropout and baseline characteristics

Of the 230 interested parents, 161 (70%) agreed to participate. When comparing these children to the children in the GECKO Drenthe birth cohort (13), birthweight, sociodemographic characteristics and weight status of the parents were similar. Also, baseline characteristics of the parents who decided not to participate in this study were comparable with the parents who did participate (data not shown).

Table 2 Results for the intervention and control group at the age of two-and-a-half

	Intervention group n = 89	Control group n = 54	p Value
Overweight	12 (13.5%)	8 (14.8%)	0.50
Weight (kg)*	14.0 ± 1.3	14.0 ± 1.5	0.69
Height (cm)*	92.7 ± 3.2	92.4 ± 3.5	0.61
BMI (kg/m^2)	16.2 ± 1.1	16.4 ± 1.2	0.28
Waist circumference (cm)	48.8 ± 2.3	49.2 ± 2.9	0.35
Hip circumference (cm)	50.2 ± 2.6	50.9 ± 2.9	0.19
Skinfolds (mm)			
Triceps	9.3 ± 1.8	10.0 ± 2.0	0.08
Biceps	6.9 ± 2.1	7.5 ± 2.1	0.40
Subscapular	6.0 ± 1.4	6.4 ± 1.8	0.07
Supra-iliacal	7.3 ± 1.7	8.4 ± 2.2	0.002
Sum of skinfolds	29.6 ± 4.7	32.4 ± 6.0	0.003
Body fat (%)*,†	14.1 ± 3.4	15.2 ± 4.4	0.10
Bayley score‡	10.2 ± 1.7	10.6 ± 2.3	0.20
Daily physical activity (total counts per day × 10^6)	2.26 ± 0.53	2.26 ± 0.58	0.99

Data are presented as mean ± SD or n (%).
In all analyses, clustering for nurse is taken into account.
*Weight, height and fat-free mass were adjusted for age.
†Calculated as the difference between weight and fat-free mass.
‡Scaled score with range 1–19 (higher score represented better performance).

At the age of two-and-a-half, 143 children were included (Fig. 1). The dropout rate could not be attributed to specific nurses (p = 0.12) and did not differ between the intervention and control (n = 7) and control groups (n = 11, p = 0.06). One child was excluded because of Mosaic Down syndrome.

Baseline characteristics for the intervention and control groups are shown in Table 4. At baseline, there were no differences between the groups except for a higher percentage of girls and a slightly older age at follow-up in the control group. When grouping the infants per nurse, no systematic differences were found between nurses. When adjusting for nurses in the analysis, nurses marginally contributed to the model for biceps and triceps skinfolds measurements.

Body composition, physical activity and motor skills at follow-up

The sum of skinfolds was significantly lower in the intervention group than the control group ($p < 0.05$), which was supported by a tendency for lower body fat percentage (14.1 ± 3.4 versus 15.2 ± 4.4, p = 0.10). No differences were found in weight, height, and waist and hip circumferences between groups. In the intervention group, 12 children (13.5%) were overweight or obese, compared to eight children (14.8%) in the control group. The Bayley score for motor development and the daily physical activity, measured over an average of 3.6 days, was comparable between groups. Adjusting the skinfolds for variables that could influence the weight and body composition of the participating children, such as parental BMI, gestational age, birthweight and being first born, did not change the results.

Table 3 Results in the intervention and control group by gender at the age of two-and-a-half

	Boys			Girls		
	Intervention group n = 55	Control group n = 25	p Value	Intervention group n = 34	Control group n = 29	p Value
Overweight	10 (18%)	4 (16%)	0.54	2 (6%)	4 (14%)	0.36
Weight (kg)*	14.4 ± 1.1	14.2 ± 1.7	0.50	13.2 ± 1.2	13.9 ± 1.3	0.03
Height (cm)*	93.3 ± 2.9	92.6 ± 3.9	0.37	91.7 ± 3.3	92.2 ± 3.2	0.52
BMI (kg/m^2)	16.6 ± 1.0	16.6 ± 1.1	0.92	15.6 ± 1.0	16.3 ± 1.2	0.01
WC (cm)	49.4 ± 2.0	48.8 ± 2.7	0.30	47.8 ± 2.3	49.6 ± 3.0	0.005
HC (cm)	50.8 ± 2.5	50.5 ± 2.9	0.65	49.4 ± 2.6	51.2 ± 3.0	0.009
Skinfolds (mm)						
Triceps	9.5 ± 2.0	9.9 ± 1.9	0.26	9.2 ± 1.5	10.1 ± 2.1	0.07
Biceps	7.1 ± 2.3	7.3 ± 2.1	0.92	6.5 ± 1.7	7.7 ± 2.2	0.11
Subscapular	5.8 ± 1.0	6.3 ± 1.4	0.26	6.2 ± 1.8	6.6 ± 2.0	0.26
Supra-iliacal	7.3 ± 1.7	8.3 ± 2.1	0.02	7.4 ± 1.9	8.4 ± 2.3	0.04
Sum of skinfolds	29.8 ± 4.7	31.8 ± 5.3	0.11	29.3 ± 4.7	32.9 ± 6.6	0.008
Body fat (%)*,†	12.9 ± 0.5	12.8 ± 0.7	0.89	16.0 ± 0.6	17.4 ± 0.6	0.11
Bayley score‡	9.9 ± 1.5	10.0 ± 1.5	0.86	10.7 ± 2.0	11.2 ± 2.7	0.27
Daily physical activity (total counts per day × 10^6)	2.31 ± 0.64	2.31 ± 0.60	0.74	2.19 ± 0.30	2.21 ± 0.57	0.33

Data are presented as mean ± SD or n (%).
In all analyses, clustering for nurse is taken into account.
WC = Waist circumference; HC = Hip circumference.
*Weight, height and fat-free mass were adjusted for age.
†Calculated as the difference between weight and fat-free mass.
‡Scaled score with range 1–19 (higher score represented better performance).

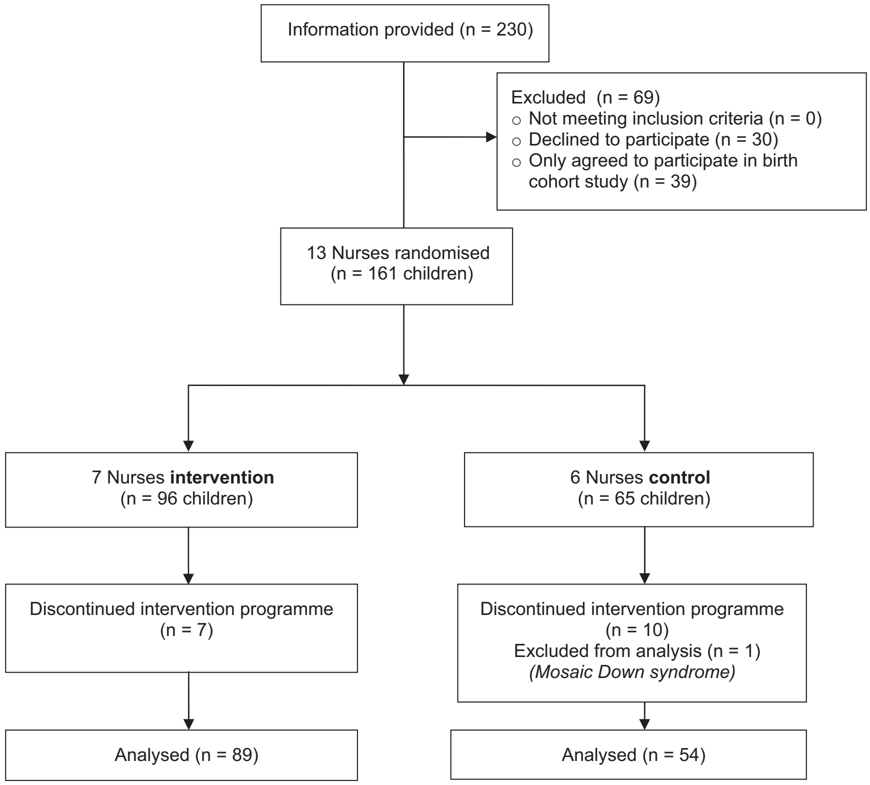

Figure 1 Flow of participants.

With regard to gender effects, the girls benefitted more from the intervention than boys (Table 3). Female in the intervention group had lower weight, BMI, waist circumference and hip circumference compared to the female controls. Differences in skinfolds between interventions and controls were greater for girls and significant for the sum of skinfolds. Supra-iliacal skinfolds were lower in both boys and girls in the intervention group than the controls.

Restricting the analyses to children who were overweight at follow-up produced comparable results. Sum of skinfolds was significantly lower in the interventions than in the controls (34.8 ± 4.6 versus 41.8 ± 4.2 mm, $p < 0.05$). Also biceps (7.4 ± 1.1 versus 9.8 ± 2.2 mm), subscapular (7.2 ± 1.7 versus 8.9 ± 1.9 mm) and supra-iliacal skinfolds (8.7 ± 1.9 versus 10.7 ± 1.8 mm) were significantly lower in overweight interventions ($p < 0.05$) compared with overweight controls.

DISCUSSION

In this study, we found that an activity stimulation programme during the first year of life resulted in lower skinfolds at the age of two-and-a-half.

Our study is relevant because lower skinfolds are an indication of less body fat and a leaner body composition in a toddler may result in a lower cardiovascular risk profile when they get older. Other studies in preschoolers have shown that even at a young age, obesity is related to traditional cardiometabolic risk factors, such as insulin resistance, higher blood pressure, adverse lipid profile and inflammatory effects (19,20). Although waist circumference was not affected, abdominal skinfolds were significant lower in children in the activity stimulation programme. Body fat percentage, based on bioelectrical impedance, was not significantly lower in the intervention group ($p = 0.098$). This could attenuate the strength of our conclusion, although skinfold thickness was a direct measurement, whereas the body fat percentage was based on a prediction equation by Goran et al., which was used but not validated in 2-year-old children, and could therefore give imprecise estimates. By having all measurements carried out by one trained researcher, bias was minimised as much as possible. We did not measure skinfolds of participants at the start of the study, and we have no reason to assume they were different at the beginning of the study as there were no differences between the groups in gestational age, birthweight and parental weight.

Early childhood is a critical period for developing overweight (21) and, therefore, may provide a window of opportunity for effective obesity prevention. The advantage of an intervention programme in a publicly accessible place such as a school, day-care facility or Well Baby Clinic, is that almost all parents and children are reached. Efficacy in preventing obesity and changing behaviour remains poorly understood. Most studies investigating weight and lifestyle in young children are performed in preschool and school settings. Reilly et al. (22) demonstrated the effect of a physical activity programme on 4-year-old children. Despite

Table 4 Baseline characteristics of the intervention and the control group

	Intervention group n = 96	Control group n = 65	p Value
Girls	38 (40%)	37 (57%)	0.03
Mean age at follow-up (months)	29.2 ± 0.7	29.4 ± 0.7	0.03
Gestational age (weeks)	40.0 ± 1.4	39.9 ± 1.6	0.73
Birth weight (g)	3533 ± 521	3561 ± 506	0.75
Feeding at 2 weeks (%)			
Breastfed	64 (73)	30 (65)	0.07
Combination	12 (14)	3 (7)	
Formula fed	12 (14)	13 (28)	
Feeding at 6 months (%)			
Partial breastfeeding	26 (30)	12 (21)	0.26
No breastfeeding	62 (70)	45 (79)	
Firstborn	37 (39)	20 (31)	0.35
Education father (%)			
Low	49 (59)	38 (64)	0.50
Middle	16 (19)	7 (12)	
High	18 (22)	14 (24)	
Education mother (%)			
Low	46 (49)	31 (52)	0.94
Middle	19 (20)	11 (18)	
High	29 (31)	18 (30)	
Income parents (%)			
Low (<1150€)	11 (14)	4 (7)	0.33
Middle (1150–3050€)	45 (57)	37 (69)	
High (>3050€)	23 (29)	13 (24)	
Weight status parents (%)			
Overweight father	38 (44)	24 (41)	0.94
Obese father	5 (6)	4 (7)	
Overweight mother	21 (24)	12 (21)	0.84
Obese mother	10 (11)	5 (9)	

Data are presented as mean ± SD or as n (%).

significant improvements in motor skills, they did not find a reduction in BMI. Furthermore, a Cochrane Review (23) from 2005 stated that studies using school-based and preschool-based interventions, which mostly combined dietary and physical activity approaches, did not improve BMI in children. However, studies that focused either on dietary or physical activity alone showed a small but positive effect on BMI status.

Although we found differences in skinfolds, our programme of early activity stimulation did not affect BMI. It is known that BMI has limited sensitivity as a measurement of excess body fat in nonobese children. BMI is therefore not the best measurement for small differences in body composition (24). This is best illustrated by the differences between boys and girls in our study. Boys were heavier and had a higher BMI than girls, but this did not reflect a higher adiposity, because they also had lower skinfolds. Lazaar et al. (25) also confirmed that by stimulating physical activity in children, body composition could be changed, although BMI remained the same. This supports our idea that the activity stimulation programme resulted in more lean mass and less fat mass. It hoped that this will lead to a lower risk of cardiovascular diseases, or at least to a larger resistance against the obesogenic environment.

In contrast to the hypothesis, we found no differences in activity level or motor development at the age of two-and-a-half. An explanation is that the reduction in skinfold thickness was mediated by changes in motor development and, or, physical activity at an earlier age, during the intervention period, and that effects on body composition lasted into toddler age. Cohort studies investigating motor development in young children have shown that children with obesity were slower in reaching the milestones for crawl, sit and walk (26). Although this slower development does not necessarily seem to lead to lesser achievement of motor skills at later age, it could have had a lasting effect on the development of muscle mass and adipose tissue (25). The intervention described in this paper could be considered as a nudge in the direction of a more favourable growth curve regarding adiposity or in this case skinfold thickness. A lack of difference in physical activity is not likely due to misreporting. Daily physical activity was measured using an objective device, the Tracmor, that is shown to have moderate-to-strong validity in evaluating energy used in three- to 4-year-old children (27). That study also showed that the validity was not decreased when the wearing time was 3 days instead of five. Unfortunately, physical activity could not be reliably assessed in the babies during the intervention period due to confounding movements by the parents, such as lifting or carrying. With regard to motor development, we only used the gross motor scale of the Bayley Scale. We do not think that not measuring the fine motoring scale would have changed our results, since we expected that most of the effects of the intervention would be on gross motor development.

The results might have been influenced by other factors as well, like differences in diet. This is, however, less likely since the children were randomised, based on which nurse they saw, to either the intervention or control group and the number of infants receiving breastfeeding was not different between groups. Although the nurses were instructed not to discuss diet and only discuss the activity programme, we cannot fully exclude the fact that awareness about the importance of physical activity and potential overweight was higher in the parents of the intervention group.

There are few studies regarding programmes aimed at intervention or prevention of obesity in infants, and no study has evaluated whether these programmes have more effect on girls or boys. With regard to our study, the activity programme had more effect on girls, and seemed to be equally effective in overweight children. Intervention girls had significantly lower total skinfolds, but also lower weight, waist and hip circumferences than the boys. Adding an exercise programme to the girls' daily activities may have produced a substantial effect on their energy expenditure, because they are in general less active than boys. Another explanation could be that differences in skinfolds can be proved earlier because of the higher fat percentage found in girls compared to boys.

Finally, we think our intervention programme can have a public health impact once our study can prove similar results in older ages. Our programme is suitable for use in daily practice and could be implemented in a primary care setting. The recommendations can be easily taught to nurses and do not take much time to explain to parents. Because of the high attendance of parents, Well Baby Clinic visits provide a good opportunity for education and to encourage parents to promote an active lifestyle for their child. Since the physical activity programme was provided to parents during regular visits at the Well Baby Clinic, they did not have to make any additional appointments to participate. Unfortunately, we do not have information about the compliance of parents to the intervention programme and whether nurses were consistent in providing the recommendations. However, parents described the programme as interesting and stimulating. In addition, nurses were able to implement the programme as part of their normal consultations and enjoyed providing the recommendations.

CONCLUSIONS

The Early Obesity Intervention Programme showed that an activity stimulation programme in a child's first year resulted in lower skinfolds at the age of two-and-a-half. In girls, the intervention was also associated with a lower weight and smaller waist and hip circumferences in addition to lower skinfolds. Further research with more accurate measurement methods is needed to determine whether these results are sustained and prevent obesity at an older age.

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ETHICAL APPROVAL

The Medical Ethics Committee of the University Medical Centre Groningen (METC2006.110) approved this study. All authors indicate that they have no financial relationships relevant to this article to disclose.

DECLARATION OF COMPETING INTERESTS

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