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Claesson, I., Josefsson, A., Olhager, E., Oldin, C., Sydsjö, G., (2018), Effects of a gestational weight gain restriction program for obese women: Sibling pairs weight development during the first five years of life, *Sexual & Reproductive HealthCare*, 17, 65-74. <https://doi.org/10.1016/j.srhc.2018.07.003>

Original publication available at:

<https://doi.org/10.1016/j.srhc.2018.07.003>

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Effects of a Gestational Weight Gain Restriction Program for Obese Women: Sibling Pairs' Weight Development during the First Five Years of Life

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Acknowledgements: We thank Marie Bladh, statistician, PhD, for statistical advisory

Declarations of interest: none

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Abstract

Objectives: Successful gestational weight gain (GWG) restriction programs for obese (Body Mass Index (BMI) ≥ 30 kg/m²) pregnant women, have not, so far, shown convincing effects on infant's weight development. An intervention starting during the pregnancy might be too late and a pre-conceptional life style change may be preferable. Thus, the aim of this study was to follow children born to mothers who had participated in a weight gain restriction program during pregnancy, and make comparisons with their younger siblings.

Study design and main outcome measures: An extended analysis of 262 children belonging to an intervention group and a control group. The effects of BMI at five years of age and weight-for-length/height development from two months of age until five years of age were assessed.

Results: In the intervention group there was a difference in BMI at five years of age, between index boys and their younger sisters ($p=0.016$). Mean BMI was lower among the boys compared with their younger female siblings. Regarding maternal GWG or the Swedish national reference data there was no difference between the index children and their younger siblings within the intervention or control groups or between younger siblings in the two groups.

Conclusions: Maternal pre-conceptional lifestyle change may have a positive effect on the child's weight development during the five first years of age. However, the effect of participation in an extensive GWG restriction program when it comes to the impact on the offspring's weight development is still unclear and further research is required.

Keywords: obesity; weight development; sibling; follow-up study

List of abbreviations

BMI = Body Mass Index

GWG = Gestational Weight Gain

WL/H = Weight-for-Length/Height

ANC = Antenatal Care Clinic

CWC = Child Welfare Center

ZWL/H = standard score (z-score) of Weight-for-Length/Height

ZBMI = standard score (z-score) of Body Mass Index

Introduction

There is evidence that maternal obesity and excessive gestational weight gain may lead to childhood obesity [1-3], which in Sweden have been estimated to 3-5 % [4]. Intervention studies during pregnancy, aiming to change behavior concerning energy intake and physical activity and thereby restrict the weight gain and decrease adverse outcomes for both mother and child, have been carried out with divergent results [5, 6]. Follow-up studies of the effect of a gestational intervention program on the offspring during childhood have also shown conflicting results [7-13]. In recent years, the question of whether it is too late to begin a life style intervention during pregnancy has arisen and the need for a pre-conceptional change has been suggested [14, 15].

We have previously shown that a gestational weight gain (GWG) restriction program is effective [16, 17] and it seems that the positive effect on the woman's weight development remains up to six years after the intervention [18]. We could not detect any differences in the offspring's weight development during the first five years of life, between children whose mothers belonged to the intervention group or the control group [19]. In an extended analysis we investigated the outcome of a GWG restriction program for obese pregnant women on younger siblings of the index children in order to investigate the potential impact of pre-conceptional behavior change. We compared sibling pairs and estimated the effect of BMI at five years of age and weight-for-length/height (WL/H) development from two months of age until five years of age.

Methods

The study groups comprised index children and their younger siblings whose mothers participated in an intervention study during 2004-2006 at the antenatal care clinic (ANC) in Linköping. A control group of obese pregnant women was recruited from the ANCs in two nearby cities. The siblings were born within five years after the “index child” (i.e. the pregnancy when the mother participated in the intervention study). The original study and the follow-up studies are described elsewhere and are summarized briefly below [16-19]. The intervention program consisted of individual weekly visits with a specially trained midwife during pregnancy and every six months during the first two years after childbirth. The purpose of the visits was to change behaviors regarding nutrition and physical activity. The participants were also invited to join aqua aerobic classes especially designed for obese women. A total of 155 women (67.4%) completed the intervention program. The control group consisted of 193(50.1 %) pregnant obese women who followed the routine program at the ANCs. All the women were recruited and included in the study in early pregnancy, i.e. before gestational week 15. Follow-up studies concerning the weight development of the women were undertaken two and six years after the index pregnancy. The weight development of all children was followed up at five years of age.

In Sweden all families are offered preventive health care for their children throughout childhood and youth. The preventive health care program is free of charge and reaches almost 100 % of all children [20]. At the Child Welfare Center (CWC) children are advised to attend the regular health program (weight and length/height development, physical health, immunizations, cognitive and linguistic development).

Subjects

A description of the population in the original and follow-up studies is displayed in Figure 1. All mothers (n=124) from the original study (the index pregnancy) who within five years

gave birth to additional children were sent a letter with information about the follow-up of their children. Parents of 71 children belonging to the intervention group agreed to participate in the follow-up study, whereas one family refrained. Seventy-one children from the control group were eligible but one child was excluded because of illness (spina bifida and hydrocephalus) and three families refrained from participation. Thus 64 index children and 71 younger siblings (98.6 %) from the intervention group and 60 index children and 67 younger siblings (94.4 %) from the control group took part. The majority of the participants were full-siblings (97.2 % in the intervention group and 98.5 % in the control group). Maternal characteristics with respect to all children who participated in this follow-up study are displayed in Table 1. The information is based on data from the 6-years follow-up study [18].

Data collection

Data were manually extracted from the records at the CWC by the main author (IMC): weight and height data at two, six, 12 and 18 months of age and at four and five years of age. Information about illness, disability, parental smoking habits and breastfeeding was also obtained. Children's background characteristics were obtained from delivery and neonatal records. In Sweden these medical records are standardized for all care within specialty.

Statistics

All analyses were performed using the IBM SPSS program, version 23.0 (IBM Corp., Armonk, NY, USA). Statistical significance was defined as (two-sided) $p \leq 0.05$. Before analyzing the weight changes, the assumption of these variables being normally distributed was validated using the Kolmogorov-Smirnov test. This assumption was not confirmed. A Mann Whitney U-test was therefore used as the method of analysis on all continuous variables. Group differences were estimated by using a Pearson chi-square test and Fischer's

Exact Test on categorical variables. To make a more comprehensive assessment of group differences, linear regressions were performed with BMI at five years of age as a dependent variable, while as independent variable we used birth weight. The size of the child was analyzed using weight and length/height. The value was converted to WL/H (e.g. weight/length or height) and its standard score (z-score) was used ($Z_{WL/H}$). The child's BMI at five years of age was analyzed with respect to BMI reference values, expressed in mean and standard deviations, for Swedish children [21].

Ethics

Ethics approval and consent to participate: The study was performed in accordance with the Declaration of Helsinki of 1975, as revised in 2013 and approved by the Regional Ethical Review Board in Linköping, Sweden. Dnr. 2010/400-31. Ethical principles for studies were followed: All parents obtained written and oral information about the study. Written consent was obtained from all parents. All data have been treated confidentially.

Results

Table 2 show child characteristics. Among the index children there were more children with macrosomia in the control group, compared with the intervention group ($p=0.038$).

The index children's and their younger male or female siblings' BMI and its standard score of BMI (ZBMI) at five years of age and in relation to maternal GWG during the index pregnancy are displayed in Table 3a and Table 3b. Concerning the intervention group and irrespectively the women's GWG during the index pregnancy, there was a significant difference between index boys and their younger sisters ($p=0.013$) (Table 3a). Mean BMI was lower among the male index children compared with their younger female siblings. After adjusting for birth weight the significant difference remained ($p=0.016$). Furthermore, regarding the intervention group and women with GWG <7 kg during the index pregnancy, there was a difference between index girls and their younger sisters ($p=0.047$) (Table 3b).

The female index children had a higher mean BMI compared with their younger female siblings. After adjusting for birth weight the significant difference disappeared ($p=1.000$). A sub-analysis between younger male siblings' BMI and younger female siblings' BMI in the two groups showed no differences (Table 4). The index children and their younger siblings' BMI at five years of age were also analyzed with respect to national reference data (Table 5). There was no significant difference in BMI between the children within the intervention or control groups. We also compared BMI according to reference values for Swedish children between younger male and female siblings in the intervention and control groups at five years of age and found no differences (Table 6). The distributions of standardized scores of WL/H among index children and their younger siblings in the intervention and control groups, from two months of age until five years of age, are displayed in Figure 2 and show no differences.

Discussion

During recent years, the value of a pre-conceptual life style change has been discussed [14, 15]. In this extended analysis we therefore compared weight development and BMI among sibling pairs whose mothers participated in a weight gain restriction program during pregnancy. The results from our previous studies on weight indicate that the women in the intervention group might have undergone a lifestyle change, compared with the women in the control group [16-18]. These changes were not reflected in the index children's weight development or BMI during the first five years of age [19]. In the present study encompassing sibling pairs, born within five years after the mother's participation in the intervention program, there was a difference between the male index children and their younger female siblings in the intervention group. This result should be interpreted with caution. The sample size was small and there is also, according to Swedish reference value, a small difference in mean BMI between the genders, at five years of age boys had slightly higher mean BMI in comparison with girls [21]. In our study the relationship was the reverse. Furthermore, there was no difference concerning the distribution of BMI value among the 15 index boys and the 16 younger sisters (Table 5). However, as shown by Forsum et al. [22], BMI-based cut offs for overweight should be interpreted with caution. BMI is a poor predictor of the body fat content of individual subjects and may not effectively identify children with a high body fat content. BMI only explains a small proportion of the variation in body fat [22]. Despite the absence of significant differences, the majority of all children, irrespective of gender or group, had a BMI above the average range of Swedish reference data.

Terry et al. [23] investigated the relationship between pre- and postnatal factors and the body size at seven years of age. They observed among same-sex siblings that siblings with higher BMI at seven years of age were more likely to have a higher maternal pre-pregnancy BMI

and GWG, a higher birth weight and an increased rate of weight gain during the first four years of age, than their siblings. In our study we found among different sex siblings that index children born after their mothers' participation in the weight gain restriction program, had, irrespectively of the mother's GWG, lower BMI than siblings born within five years after the program.

A number of intervention studies have shown positive effects on maternal GWG, whereas the effect of avoiding adverse pregnancy and/or neonatal outcome is limited [24-26]. So far these intervention programs have started during pregnancy and mainly after the first trimester, i.e. long after the feto-placental components have been exposed to an unfavorable metabolic environment. To reduce adverse obesogenic mediated effects on pregnancy, improvements in the metabolic environment of obese women are required [27]. These improvements should ideally be initiated before the pregnancy and therefore the importance of and the possibility of a pre-pregnancy intervention or counselling may be an essential question. Also a recent Australian article [28] highlights both the need for research concerning an effective pre-conceptional intervention to achieve a healthy pregnancy and a favorable neonatal outcome for obese women, but also the difficulty in recruiting participants to a study. Non-pregnant women do not identify themselves as 'pre-conception' or as a high-risk group. They are predominantly healthy and therefore have little contact with the healthcare system [28]. In a retrospective study the effectiveness of pre-conceptional consults for obese women was investigated [29]. Despite the fact that there was widely documented discussion of potential obesity-related pregnancy complications, the consultations were ineffective in significantly affecting pre-pregnancy weight loss. On the other hand, Weisman et al. [30] showed in a pre-conceptional behavioral intervention that women who participated in the program and gave birth within 12-month follow-up period, had a significantly lower mean GWG compared with

controls. However, when controlling for pre-pregnancy obesity, the intervention effect was no longer significant.

There are strengths as well as weaknesses in this study. To our knowledge, this follow-up study is the first to compare the weight development among sibling pairs whose mother participated in a weight gain restriction program. All data were collected from medical records, i.e. there is no self-reported data. Although there were few individuals in the sub-groups, the total rate of participation in both the intervention and control groups was high. The lack of power is a weakness. However, the original study had a high power to detect difference in maternal GWG [16].

Conclusions

In conclusion, the effect of participation in an extensive gestational weight gain restriction program and its impact on the offspring is still unclear. BMI and WL/H do not differ between offspring born within five years after the mother's participation in the intervention. The challenge to perform an intervention program which provides positive results for both the woman well as for her offspring remain. Continuous studies on family intervention aiming to investigate how the life style of the parents affects offspring's diet, body size and weight development may bring more insights into this topic.

Acknowledgements: We thank Marie Bladh, statistician, PhD, for statistical advisor

Funding: This study was supported by grants from The Health Research Council of the Southeast of Sweden and ALF, County Council of Östergötland

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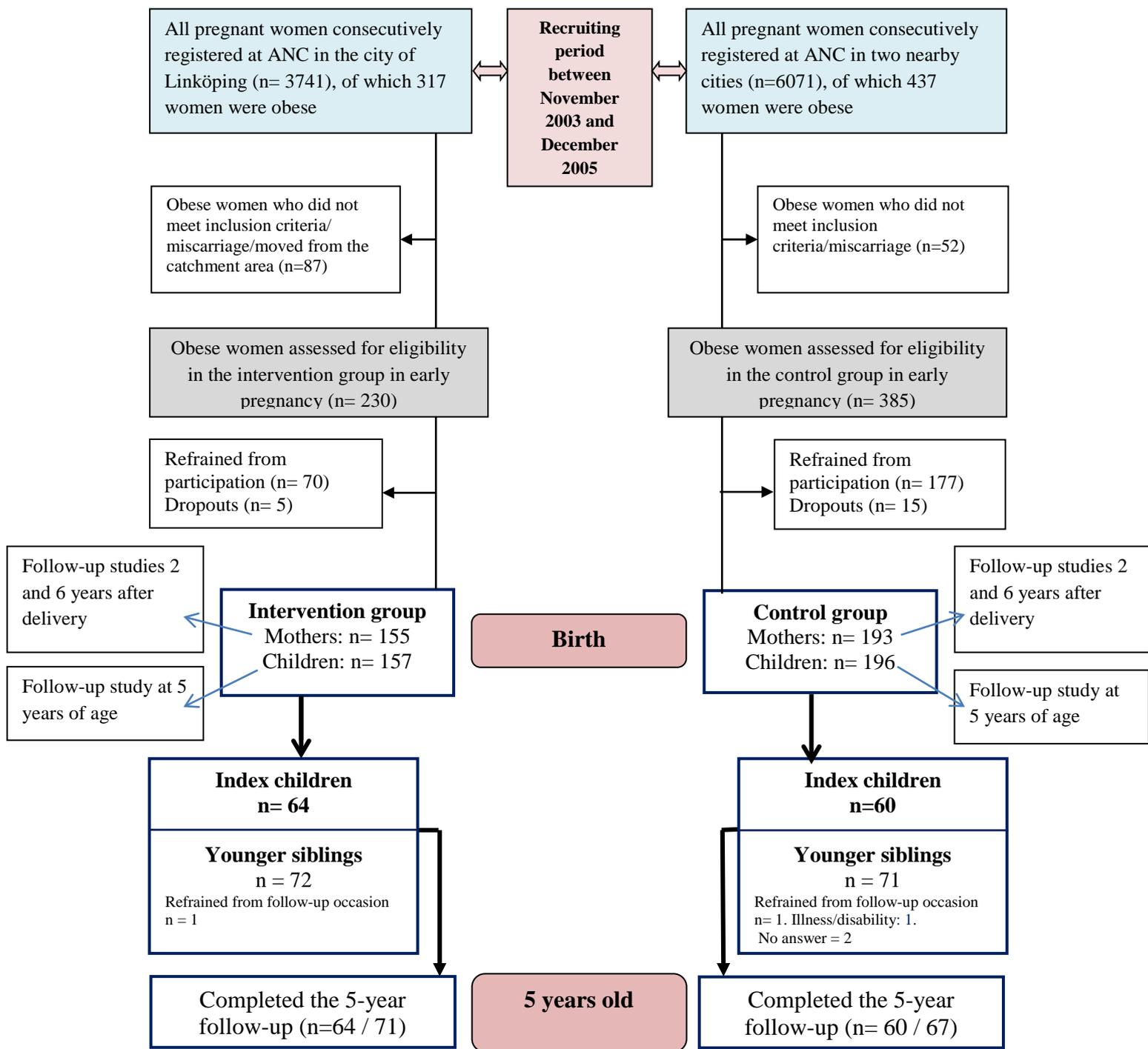


Figure1. Description of the population in the original- and follow-up studies

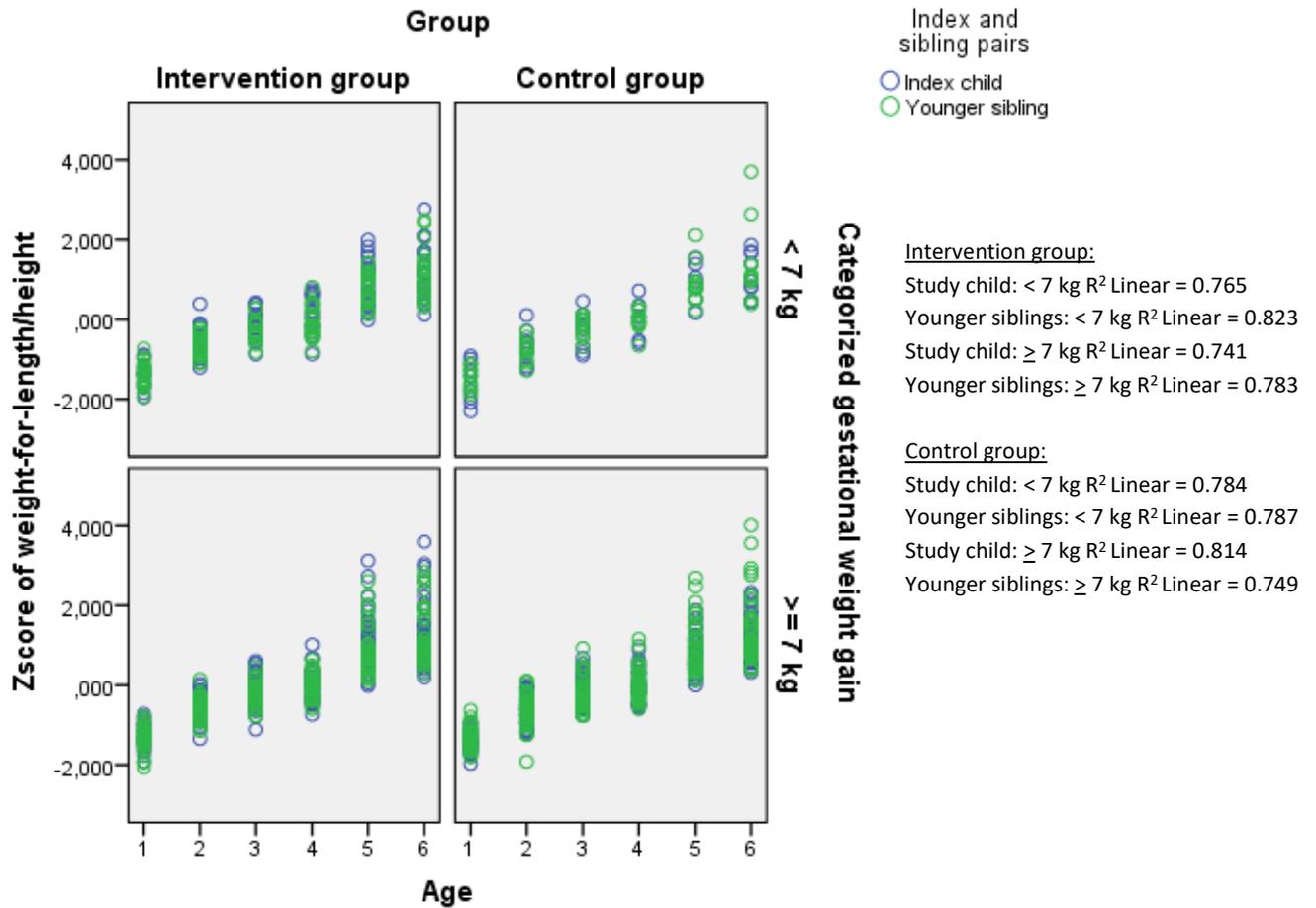


Figure 2. Distribution of standardized scores of weight-for-length/height from 2 months of age until 5 years of age among index children and their younger siblings in the intervention- and control group

Table 1. Maternal characteristics six years after the index pregnancy ^a

	Intervention group		Control group		<i>p</i> ^b
	n	%	n	%	
Age (mean, SD)	64	35.0 (3.83)	60	34.8 (4.36)	0.652 ^c
Parity					0.640 ^d
Two children	39	60.9	39	65.0	
Three children or more	25	39.1	21	35.0	
Marital status					0.624 ^d
Married / cohabiting with the child's father	57	89.1	55	91.7	
Other family situation	7	10.9	5	8.3	
Education level, year					0.334 ^d
≤9	1	1.5	4	6.7	
10 - 12	33	51.6	31	51.7	
>12	30	46.9	25	41.7	
Occupation					0.838 ^d
Gainfully employed / parental leave / student	58	90.6	55	91.7	
Not gainfully employed	6	9.4	5	8.3	
Tobacco user					0.371 ^d
No	55	85.9	49	81.67	
Yes	7	10.9	10	16.67	
No data available	2	3.1	1	1.67	
Weight change (kg) from early index pregnancy to six years after child (irrespective gestational weight gain)	62	-4.7 (11.76)	58	-0.4 (11.15)	0.029 ^c
Weight change (kg) from early index pregnancy to six years after child (gestational weight gain < 7 kg)	20	-10.4 (13.11)	9	-0.9 (5.18)	0.018 ^c

^a All values are given as frequencies unless otherwise stated

^b Missing data are not included in the analyses

^c Mann-Whitney U test

^d Pearson Chi-Square Test

Table 2. Children (index and their younger siblings) characteristics in the intervention- and control group ^a

	<i>Children (index children)</i>					<i>Children (younger siblings)</i>				
	Intervention group		Control group		<i>p</i> ^b	Intervention group		Control group		<i>p</i> ^b
	n	%	n	%		n	%	n	%	
Birth weight in grams (mean, SD)	64	3599(548.161)	60	3751(478.431)	0.104 ^c	71	3801(554.13)	67	3856(499.524)	0.542 ^c
Gender					0.871 ^d					0.180 ^d
Female	34	53.1	31	51.7		29	40.8	35	52.2	
Male	30	46.9	29	48.3		42	59.2	32	47.8	
Gestational weeks (full weeks)					0.629 ^e					0.632 ^e
>37	61	95.3	57	95.0		68	95.8	64	95.5	
33 - 36	3	4.7	3	5.0		3	4.2	3	4.5	
<32	0	0.0	0	0.0		0	0.0	0	0.0	
Children with diagnosis small for gestational age					0.516 ^e					0.514 ^e
No	63	98.4	60	100.0		70	98.6	67	100.0	
Yes	1	1.6	0	0.0		1	1.4	0	0.0	
Children with diagnosis large for gestational age					0.084 ^e					0.193 ^e
No	61	95.3	52	86.7		63	88.7	55	82.1	
Yes	3	4.7	8	13.3		8	11.3	12	17.9	
Macrosomia, birth weight > 4500 g					0.038 ^e					0.300 ^e
No	62	96.9	52	86.7		64	90.1	63	94.0	
Yes	2	3.1	8	13.3		7	9.9	4	6.0	
Smoking habits in the home (during the child's first four years of life)					0.258 ^d					0.402 ^d
No	49	76.6	51	85.0		49	69.0	55	82.1	
Yes	12	18.8	7	11.7		12	16.9	9	13.4	
No data available	3	4.7	2	3.3		10	14.1	3	4.5	
Breastfed child (any time)					0.224 ^c					0.174 ^c
Yes	64	100.0	56	93.3		67	94.4	62	93.5	

No	0	0.0	2	3.3		1	1.4	4	6.0	
No data available	0	0.0	2	3.3		3	4.2	1	2.9	
Duration of total breastfeeding (month)					0.511 ^d					0.323 ^d
> 12	7	10.9	8	13.3		8	11.3	8	11.9	
6-11	29	45.3	24	40.0		29	40.8	34	50.7	
3-5	13	20.3	14	23.3		23	32.4	17	25.4	
< 3	15	23.4	10	16.7		7	9.9	3	4.5	
0	0	0.0	2	3.3		1	1.4	4	6.0	
No data available	0	0.0	2	3.3		3	4.2	1	1.5	
Duration of exclusive breastfeeding (months)					0.986 ^d					0.790 ^d
4-6	35	54.7	31	51.7		37	52.1	34	50.7	
1-3	11	17.2	9	15.0		12	16.9	11	16.4	
< 1	9	14.1	9	15.0		7	9.9	5	7.5	
0	9	14.1	9	15.0		12	16.9	16	23.9	
No data available	0	0.0	2	3.3		3	4.2	1	1.5	

^a All values are given as frequencies unless otherwise stated

^b Missing data are not included in the analyses

^c Mann-Whitney U test

^d Pearson Chi-Square Test

^e Fisher's Exact Test

Table 3a. Body Mass Index (BMI) and standard score of Body Mass Index (ZBMI) for index boys and their younger siblings in the intervention- and control group at 5 years (y) of age and in relation to gestational weight gain (GWG) in the index pregnancy

<u>Intervention group</u>	Boys														
	Index child boy				Younger sibling boy				Index child boy				Younger sibling girl		
	n	mean	SD		n	mean	SD	p*	n	mean	SD	n	mean	SD	p*
<i>All children</i>															
BMI at 5 y of age	15	17.5	2.556		17	16.3	1.560	0.136	15	16.2	1.307	16	17.8	1.946	0.013
ZBMI at 5 y of age	15	0.4778	1.373		17	-0.213	0.838	0.136	15	-0.247	0.702	16	0.614	1.046	0.013
<i>Children of mothers with GWG ≥ 7 kg**</i>															
BMI at 5 y of age	10	17.6	2.706		11	16.0	1.274	0.105	10	16.5	1.440	10	17.9	2.010	0.096
ZBMI at 5 y of age	10	0.511	1.453		11	-0.367	0.684	0.105	10	-0.064	0.774	10	0.675	1.080	0.096
<i>Children of mothers with GWG < 7 kg**</i>															
BMI at 5 y of age	5	17.4	2.522		6	16.8	2.007	0.715	4	15.5	0.770	5	17.0	1.522	0.86
ZBMI at 5 y of age	5	0.412	1.355		6	0.069	1.078	0.715	4	-0.628	0.414	5	0.188	0.817	0.86
<u>Control group</u>															
<i>All children</i>															
BMI at 5 y of age	15	16.4	1.240		14	17.9	2.930	0.239	18	16.8	1.403	17	16.9	1.792	0.792
ZBMI at 5 y of age	15	-0.142	0.666		14	0.659	1.574	0.239	18	0.063	0.754	17	0.1286	0.963	0.792
<i>Children of mothers with GWG ≥ 7 kg**</i>															
BMI at 5 y of age	9	16.7	1.292		9	18.2	3.090	0.270	15	16.6	1.422	15	16.9	1.906	0.852
ZBMI at 5 y of age	9	0.002	0.694		9	0.817	1.660	0.270	15	-0.006	0.764	15	0.116	1.024	0.852
<i>Children of mothers with GWG < 7 kg**</i>															
BMI at 5 y of age	3	16.7	1.050		3	18.195	3.687	0.827	1	18.7		1	17.6		0.317
ZBMI at 5 y of age	3	0.050	0.564		3	0.829	1.980	0.827	1	1.097		1	0.483		0.317

* Mann-Whitney U Test ** Index pregnancy. Only women with simplex pregnancies are included. Weight registered in the same week as the delivery. If this value was missing, the weight was measured 1 or 2 weeks before the delivery

Table 3b. Body Mass Index (BMI) and standard score of Body Mass Index (ZBMI) for index girls and their younger siblings in the intervention- and control group at 5 years (y) of age and in relation to gestational weight gain (GWG) in the index pregnancy

<u>Intervention group</u>	Girls														
	Index child girl				Younger sibling boy				Index child girl				Younger sibling girl		
	n	mean	SD		n	mean	SD	<i>p</i> *	n	mean	SD	n	mean	SD	<i>p</i> *
<i>All children</i>															
BMI at 5 y of age	23	16.3	1.637		23	16.1	1.356	0.341	13	17.1	2.228	13	17.1	2.439	0.682
ZBMI at 5 y of age	23	-0.164	0.879		23	-0.271	0.728	0.341	13	0.247	1.197	13	0.238	1.310	0.682
<i>Children of mothers with GWG ≥7 kg**</i>															
BMI at 5 y of age	14	16.3	1.716		14	16.1	1.204	0.963	6	17.2	3.193	6	17.5	2.501	0.631
ZBMI at 5 y of age	14	-0.185	0.922		14	-0.274	0.647	0.963	6	0.315	1.715	6	0.470	1.343	0.631
<i>Children of mothers with GWG <7 kg**</i>															
BMI at 5 y of age	8	16.7	1.489		8	16.5	1.401	0.600	5	17.2	1.380	5	15.6	1.080	0.047
ZBMI at 5 y of age	8	0.013	0.800		8	-0.088	0.753	0.600	5	0.299	0.7412	5	-0.558	0.585	0.047
<u>Control group</u>															
<i>All children</i>															
BMI at 5 y of age	16	16.0	1.337		16	16.3	1.391	0.451	17	15.9	1.288	17	16.2	1.879	0.642
ZBMI at 5 y of age	16	-0.371	0.718		16	-0.192	0.747	0.451	17	-0.430	0.692	17	-0.251	1.010	0.642
<i>Children of mothers with GWG ≥7 kg**</i>															
BMI at 5 y of age	9	16.4	1.370		9	16.2	0.909	0.825	12	15.6	1.109	12	16.3	2.197	0.564
ZBMI at 5 y of age	9	-0.129	0.736		9	-0.234	0.488	0.825	12	-0.558	0.596	12	-0.193	1.180	0.564
<i>Children of mothers with GWG <7 kg**</i>															
BMI at 5 y of age	4	15.4	1.582		4	17.2	2.272	0.149	3	16.1	1.412	3	15.5	0.758	0.513
ZBMI at 5 y of age	4	-0.657	0.850		4	0.313	1.221	0.149	3	-0.293	0.758	3	-0.638	0.244	0.513

* Mann-Whitney U Test ** Index pregnancy. Only women with simplex pregnancies are included. Weight registered in the same week as the delivery. If this value was missing, the weight was measured 1 or 2 weeks before the delivery

Table 4. Comparison of mean Body Mass Index at 5 years of age between younger siblings in the intervention- and control group

	Intervention group	Control group	p-value*
Index child boy	Younger sibling boy	Younger sibling boy	0.131
	Younger sibling girl	Younger sibling girl	0.150
Index child girl	Younger sibling boy	Younger sibling boy	0.932
	Younger sibling girl	Younger sibling girl	0.490

* Mann-Whitney U test

Table 5. Distributions of Body Mass Index values among index children and their younger siblings in the intervention- and control group at 5 years of age According to Body Mass Index reference values (mean and SD) for Swedish children*

Intervention group																							
Boys										Girls													
Index child boy		Younger sibling boy		<i>p</i> **	Index child boy		Younger sibling girl		<i>p</i> **	Index child girl		Younger sibling boy		<i>p</i> **	Index child girl		Younger sibling girl		<i>p</i> **				
n	%	n	%		n	%	n	%		n	%	n	%		n	%	n	%		n	%		
					0.321						0.098						1.000						0.926
+3 SD	3	20.0	0	0.0		0	0.0	1	6.3		+3 SD	0	0.0	0	0.0	1	7.7	1	7.7				
+2 SD	1	6.7	1	5.9		1	6.7	4	25.0		+2 SD	2	8.7	1	4.3	1	7.7	2	15.4				
+1 SD	3	20.0	3	17.6		2	13.3	5	31.3		+1 SD	5	21.7	4	17.4	3	23.1	3	23.1				
Mean	7	46.7	9	52.9		12	80.0	6	37.5		Mean	14	60.9	15	65.2	8	61.5	7	53.8				
-1 SD	1	6.7	4	23.5		0	0.0	0	0.0		-1 SD	2	8.7	2	8.7	0	0.0	0	0.0				
-2 SD	0	0.0	0	0.0		0	0.0	0	0.0		-2 SD	0	0.0	1	4.3	0	0.0	0	0.0				
-3 SD	0	0.0	0	0.0		0	0.0	0	0.0		-3 SD	0	0.0	0	0.0	0	0.0	0	0.0				
Control group																							
Boys										Girls													
Index child boy		Younger sibling boy		<i>p</i> **	Index child boy		Younger sibling girl		<i>p</i> **	Index child girl		Younger sibling boy		<i>p</i> **	Index child girl		Younger sibling girl		<i>p</i> **				
n	%	n	%		n	%	n	%		n	%	n	%		n	%	n	%		n	%		
					0.172						0.423						0.373						0.755
+3 SD	0	0.0	4	28.6		0	0.0	1	5.9		+3 SD	0	0.0	1	6.3	0	0.0	1	5.9				
+2	1	6.7	0	0.0		2	11.1	2	11.8		+2	0	0.0	0	0.0	0	0.0	0	0.0				

SD									SD								
+1 SD	4	26.7	2	14.3	7	38.9	4	23.5	+1 SD	5	31.3	3	18.8	4	23.5	2	11.8
Mean	9	60.0	7	50.0	7	38.9	10	58.8	Mean	10	62.5	12	75.0	12	70.6	13	76.5
-1 SD	1	6.7	1	7.1	2	11.1	0	0.0	-1 SD	1	6.3	0	0.0	1	5.9	1	5.9
-2 SD	0	0.0	0	0.0	0	0.0	0	0.0	-2 SD	0	0.0	0	0.0	0	0.0	0	0.0
3 SD	0	0.0	0	0.0	0	0.0	0	0.0	-3 SD	0	0.0	0	0.0	0	0.0	0	0.0

*	<u>+3SD</u>	<u>+2SD</u>	<u>+1SD</u>	<u>Mean</u>	<u>-1SD</u>	<u>-2SD</u>	<u>-3SD</u>
Boy	20.341	18.522	17.024	15.766	14.694	13.769	12.961
Girl	21.154	18.720	16.897	15.472	14.320	13.366	12.561

** Fischer's Exact test

Table 6. Comparison of Body Mass Index values (according to reference values for Swedish children) between younger siblings in the intervention- and control group at 5 years of age

	Intervention group	Control group	p-value*
Index child boy	Younger sibling boy	Younger sibling boy	0.151
	Younger sibling girl	Younger sibling girl	0.691
Index child girl	Younger sibling boy	Younger sibling boy	0.772
	Younger sibling girl	Younger sibling girl	0.343

* Fischer's Exact test