

# Four-year Follow-up of School-based Intervention on Overweight Children: The KOPS Study

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## Abstract

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**Objective:** To evaluate the 4-year outcome of a school-based health promotion on weight status as part of the Kiel Obesity Prevention Study (KOPS).

**Research Methods and Procedures:** Within a cluster-sampled quasi-randomized controlled trial, 1764 children at 6 and 10 years of age were assessed between 1996 and 2005 in 32 primary schools in Kiel, North Germany. Six nutrition units followed by 20-minute running games were performed within the first year at school. Prevalence, incidence, and remission of overweight were main outcome measures.

**Results:** The 4-year change in BMI was +11.6%, with increases in prevalence of overweight and obesity from 5.2% to 11.1% and 3.9% to 5.1%, respectively. Cumulative 4-year incidence of overweight and obesity was 9.2% and 3.1%, respectively. Intervention had no effect on mean BMI. The effect on prevalence was significant in children from families with high socioeconomic status [odds ratio (OR), 0.35; 95% confidence interval (CI), 0.14 to 0.91] and marginally significant in children of normal-weight mothers

(OR, 0.57; 95% CI, 0.33 to 1.00). Cumulative 4-year incidence of overweight was lower only in intervention children from families with high socioeconomic status (OR, 0.26; 95% CI, 0.07 to 0.87). Remission of overweight was most pronounced in children of normal-weight mothers (OR, 5.43; 95% CI, 1.28 to 23.01). Prevalence of underweight was unchanged. The intervention had minor but favorable effects on lifestyle.

**Discussion:** A school-based health promotion has sustainable effects on remission and incidence of overweight; it was most pronounced in children of normal-weight mothers and children from families with high socioeconomic status. There was no effect on obesity. The data argue in favor of additional measures of prevention.

**Key words:** childhood obesity, prevention, overweight, intervention, health education

## Introduction

Overweight and obesity are major public health problems, with prevention of childhood overweight providing a mandate of action (1). However, data to support a particular strategy to prevent overweight are currently lacking. School health programs have the potential to influence the health of nearly all children within existing institutional structures. It has been suggested that one third of the health objectives for the nations can be significantly influenced by school health programs (2). This is in line with data of controlled trials conducted in school settings showing feasibility, safety, and effectiveness of cardiovascular health promotion (3). In contrast, most school-based trials came out with only minor or no effects on mean BMI; the effectiveness of obesity prevention programs varies and is currently not well established (4,5). However, some trials were successful and have shown that a reduction in television time, increases in physical activity, reduced consumption of sugar-sweetened bev-

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erages, and increased fruit and vegetable intake may add to the prevention of overweight (6–10).

Most obesity prevention programs considered short observation periods only. This is crucial because the impact of preventive approaches becomes apparent gradually, with small changes in behaviors and health indicators accumulating over longer-term periods. The only study using a 2-year follow-up protocol showed a positive long-term effect of school-based intervention on weight status (7).

The Kiel Obesity Prevention Study (KOPS)<sup>1</sup> was started in 1996 as a cross-sectional and longitudinal 8-year follow-up study investigating determinants and preventive measures of childhood overweight (11). Our preliminary 1-year follow-up data of school-based intervention suggested positive effects on fat mass. The KOPS data also showed that the determinants differ between overweight and obesity and also between boys and girls (12). A low socioeconomic status (SES) and parental overweight affected prevalence of overweight (13). A low SES also served as a barrier against preventive measures (14,15). Thus, evaluating the effectiveness of interventions to prevent overweight needs to take into account overweight and obesity, sex, SES, and parental overweight separately. We hereby report detailed data on the 4-year outcome of KOPS.

## Research Methods and Procedures

### Study Population

Between 1996 and 2001, we enrolled 4997 6-year-old children during the school entry examinations, i.e., 41% of the total population ( $n = 12,254$  born in Kiel between 1990 and 1995). There were no eligibility criteria except willingness to participate. All parents gave their informed written consent. The study was approved by the local ethical committee. The KOPS cohort was representative for all 6-year-old children in Kiel. A total of 1764 of the children (35%) could be restudied at 10 years of age. Compared with the KOPS cohort, this subgroup of children did not differ in mean BMI, triceps skinfold (TSF), fat mass, and waist circumference (WC), but the prevalence of children from families with high SES was lower (35.7% vs. 43.9%).

### Measurements

Anthropometric (height, weight, skinfolds, WC) and bioelectric impedance analysis (fat mass calculated with a population-specific algorithm) measurements were performed (11,12,17). A validated questionnaire (12) (answered by the parents: response rate, 44%) addressed diet, physical activity and inactivity, self-reported weight and height of parents, and parental education and nationality.

### Study Design

The school-based intervention was performed between 1996 and 2001 in two to four “intervention schools” per year. The schools were randomly assigned to the intervention (I) and non-intervention (NI) groups. Because of the varying personnel power of the KOPS team, the number of eligible schools ranged from 17 to 32 schools. Randomization was done every year because 1) many schools should have the possibility to be an “intervention school,” 2) every year other teachers supervise first graders, 3) materials of our intervention were not given to the teachers (thus, they could not repeat the intervention later with another class or give the material to other teachers), and 4) the intervention was mainly performed by a nutritionist and not by teachers. Therefore, 14 of 32 schools in Kiel served as “intervention schools” where 780 first graders were addressed. In the following years, former “intervention schools” served as “non-intervention schools.” Figure 1 shows the number of schools and children per year recruited at baseline (T0) and at the 4-year follow-up (T1). After 4 years, 345 children (I; 44.2%) were restudied. The data of these children were compared with children from NI schools (NI;  $n = 1419$ ). To analyze effectiveness, T1 and T0 changes in variables were considered. Weight status was the primary outcome. Secondary outcome parameters (nutrition, activity, media time) were analyzed in a subgroup of 775 children (NI,  $n = 611$ ; I,  $n = 164$ ). All studies were blinded.

### Intervention

The intervention program was based on the assumption that attitudes of behavior and other factors (e.g., familiar risk, low SES) are predictive for weight changes. Messages (eat fruit and vegetable every day, reduce intake of high-fat foods, keep active at least 1 h/d, and decrease television consumption to <1 h/d) were given to children, parents, and teachers. All first graders of intervention schools were addressed by six nutrition units performed during 2 to 3 weeks within the second term of the first school year. Messages were conveyed as nutrition fairy tales, interactive games, and by preparing a healthy breakfast. After each unit, running games were offered for 20 minutes on the schoolyard. Parents were informed on the occasion of a parental school meeting. Teachers were trained within a half a day structured nutrition education program. Costs of the intervention were calculated to be \$26.20/child.

### Outcome Parameters

Actual German BMI percentiles (18) were used for the classification of underweight ( $\leq 10$ th percentile), overweight ( $\geq 90$ th to <97th percentile), and obesity ( $\geq 97$ th percentile). The follow-up period (T1 – T0) was  $3.8 \pm 0.4$  years. T1 data were corrected to 4 years by linear extrapolation using the following equation:  $BMI_{corrected}(T1) = [(BMI(T1) - BMI(T0)) / (age(T1) - age(T0) \times 4)] + BMI(T0)$ .

<sup>1</sup> Nonstandard abbreviations: KOPS, Kiel Obesity Prevention Study; SES, socioeconomic status; TSF, triceps skinfold; WC, waist circumference; I, intervention; NI, non-intervention; HEI, healthy eating index; SDS, standard deviation score; OR, odds ratio; CI, confidence interval.

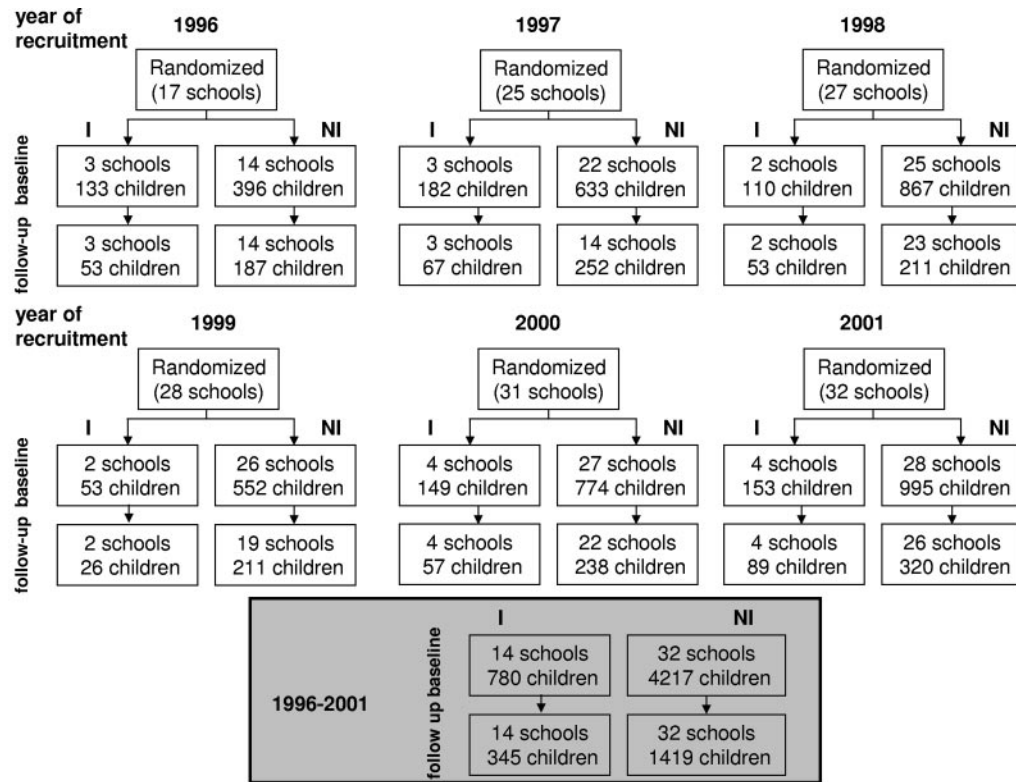


Figure 1: Number of children and schools (cluster) in every year of recruitment at baseline (T0) and at 4-year follow-up (T1).

### Lifestyle Variables

A 26-item food frequency questionnaire was used, and a healthy eating index (HEI) was calculated (12). Regular sport activities (low: not a member in a sports club; medium: 0 to 1 h/wk; high: >1 h/wk) and media time as index of inactivity (watching television or playing computer games, low: <1 hour media time per day; high:  $\geq$ 1 hour media time per day) were assessed (19). A healthy lifestyle was characterized by a good HEI, high activity, and low media time.

### Analysis of Dropouts

The dropout rate was 55.8% in I and 66.4% in NI. There were no sex differences. The prevalence of overweight and percentage of children of low SES were significantly higher in dropouts compared with participants in both I and NI. There was no difference in the prevalence of overweight mothers in dropouts and participants in NI but a higher percentage of normal-weight mothers in I compared with NI (76.5% vs. 67.0%,  $p < 0.05$ ).

Dropout on the school level was seen in NI schools only (the range of dropouts was zero to eight schools; Figure 1). All I schools could be restudied. Reasons for dropout of schools were lack of time and/or limited personnel power.

### Statistics

Statistical analysis was performed with SPSS 13.0 for Windows (SPSS, Inc., Chicago, IL) and STATA 9 (College Station, TX). Results were presented as median and interquartile range. The non-parametric Mann-Whitney  $U$  test was used to determine between-group differences. The  $\chi^2$  test was used to compare prevalence, incidence, and remission of overweight.

**Multivariate Analysis.** Randomization was done at the school level. A multi-level approach was used because of the hierarchical data structure (level 1: pupils, level 2: schools). Multi-level logistic regression analysis was performed with STATA 9 (xtlogit command). Adjustments were done for schools, BMI at baseline, sex, SES, and maternal weight. As dependent variables, we considered prevalence, incidence, and remission of overweight and obesity. Regression analyses were stratified to sex, SES, and weight status of mothers, because these variables were shown as independent determinants of overweight in our cross-sectional analysis in 6-year-old children (17). The dichotomous grouping variable (I yes-no) was the independent variable. Level of significance was set at  $p < 0.05$  (two-sided).

**Statistical Power Analysis.** KOPS was designed to be large enough to detect a mean difference in BMI of 0.4

**Table 1.** Characterization of the study population before (T0) and after the 4-year observation (T1) period [data are given as median (interquartile range)]

	Non-intervention group (n = 1419)			Intervention group (n = 345)		
	T0	T1	$\Delta(T1 - T0)$	T0	T1	$\Delta(T1 - T0)$
Boys/girls (%)	48.8/51.2			50.3/49.7		
SES: low/middle/high (%)	26.6/30.2/43.2			26.7/26.5/46.8		
Overweight and obese mothers (%)	30.2			23.2		
Age (yrs)	6.3 (6.0 to 6.5)	10.2 (10.0 to 10.5)	4.0 (0)	6.3 (5.9 to 6.5)	10.3 (9.9 to 10.5)	4.0 (0)
Height (m)	1.20 (1.17 to 1.24)	1.44 (1.39 to 1.49)	0.24 (0.22 to 0.26)	1.20 (1.16 to 1.23)	1.44 (1.40 to 1.48)	0.24 (0.22 to 0.26)
Weight (kg)	22.0 (20.4 to 24.5)	35.7 (31.7 to 42.0)	13.2 (10.7 to 17.5)	22.5 (20.5 to 24.5)	36.1 (31.7 to 41.2)	13.5 (10.7 to 17.1)
BMI (kg/m <sup>2</sup> )	15.4* (14.6 to 16.4)	17.2 (15.8 to 19.6)	1.8 (0.9 to 3.3)	15.6 (14.8 to 16.7)	17.5 (16.0 to 19.1)	1.7 (0.7 to 3.1)
BMI-SDS	0.03* (-0.59 to 0.55)	0.13 (-0.54 to 0.98)	0.15* (-0.28 to 0.61)	0.11 (-0.43 to 0.70)	0.26 (-0.41 to 0.83)	0.07 (-0.42 to 0.57)
TSF (mm)	10.3 (9.0 to 13.0)	14.3 (10.1 to 19.4)	3.6 (0.0 to 7.3)	10.7 (9.0 to 13.9)	13.7 (10.2 to 18.5)	2.9 (-0.5 to 7.2)
Sum of four skinfolds (mm)	27.7* (22.7 to 35.6)	36.6 (25.9 to 55.8)	8.3 (-0.5 to 22.4)	29.0 (24.0 to 38.2)	38.0 (26.9 to 55.6)	8.7 (-1.7 to 21.1)
FM <sub>BIA</sub> (%)	20.6* (16.1 to 25.3)	20.6 (15.7 to 27.2)	0.54 (-3.9 to 5.4)	21.06 (16.7 to 24.9)	20.8 (16.1 to 27.0)	0.24 (-5.2 to 4.7)
WC (cm)	54.0 (52.0 to 57.6)	62.7 (58.7 to 68.3)	8.1 (5.0 to 12.3)	55.0 (52.0 to 58.0)	63.1 (59.5 to 67.8)	8.3 (4.7 to 12.4)

SES, socioeconomic status; SDS, standard deviation score; TSF, triceps skinfold; FM<sub>BIA</sub>, fat mass as measured by bioelectrical impedance analysis; WC, waist circumference. \* Significant difference between the non-intervention and intervention group; Mann-Whitney test ( $p < 0.05$ ).

## Distribution of BMI

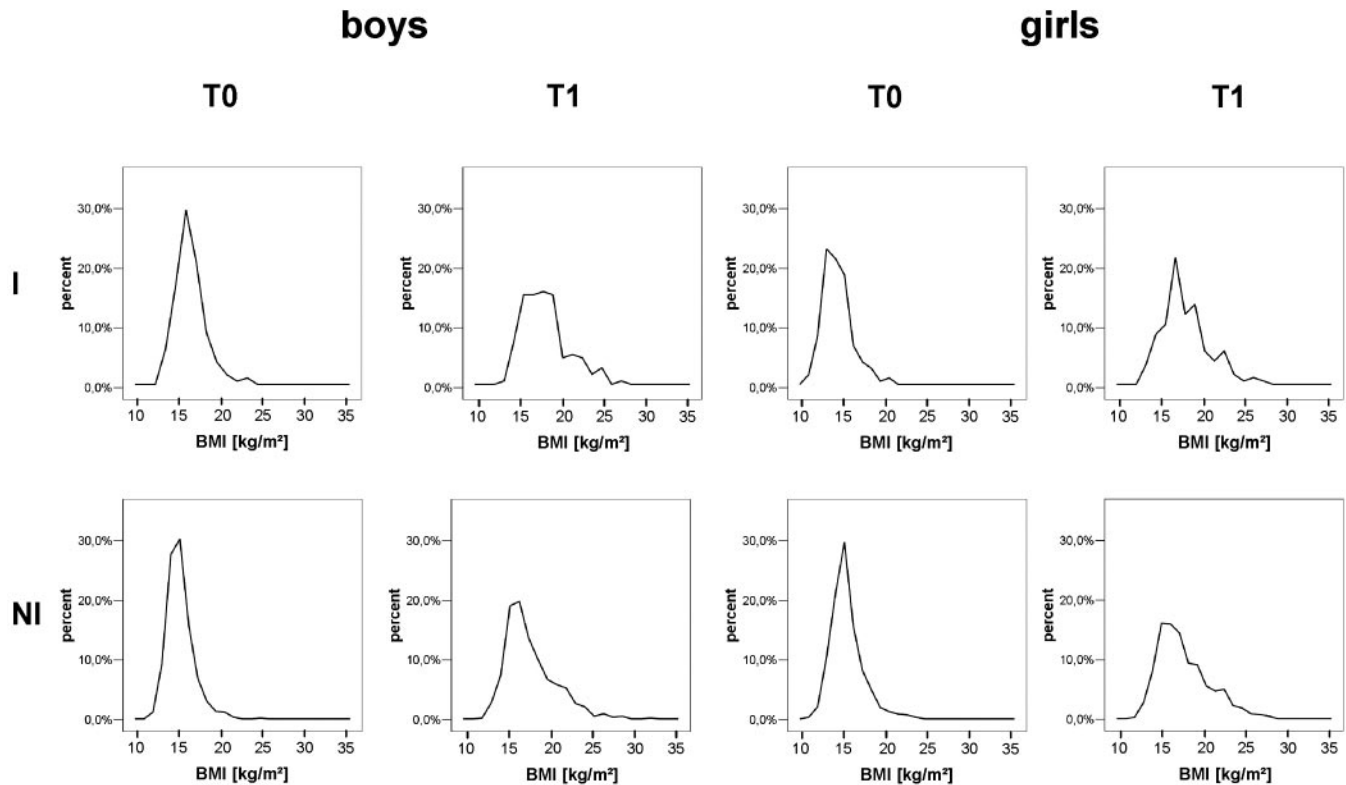


Figure 2: Relative distribution of BMI in the I group and NI group stratified to sex and age group (T0 = 6 years old, T1 = 10 years old). I group—boys:  $n = 173$ , girls:  $n = 172$ ; NI group—boys:  $n = 693$ , girls:  $n = 726$ .

kg/m<sup>2</sup> or a 5% reduction in the prevalence of overweight with 80% power at the two-tailed 5% significance level. To reach this, 340 I and 1420 NI children were needed. We hypothesized that, at T1, the prevalence of overweight plus obesity was 11% in I and 16% in NI, respectively. Sample size calculation was performed with Win Episcope 2.0 ([www.clive.ed.ac.uk](http://www.clive.ed.ac.uk)).

## Results

### Characterization of the Study Population and Clusters

Table 1 shows characteristics of the study population. Distribution of sex and SES did not differ between I and NI, but prevalence of obese and overweight mothers was higher in NI. At T0, BMI, sum of four skinfolds, and fat mass were found to be lower in NI compared with I, but there were no between group differences at T1. Compared with I, the standard deviation score of BMI (BMI-SDS) was lower at T0 in NI. However, the 4-year changes in BMI-SDS were higher in I.

At T1, the distribution of BMI (Figure 2) became skewed to the right in I and NI; compared with 6-year-old children,

the variance in BMI, WC, TSF, and fat mass (data not shown) increased with age. Concomitantly, the left side of the distribution suggested an unchanged prevalence of underweight.

Table 2 shows the characteristics of the schools. Compared with NI schools, I schools were bigger, but the number of children per class was comparable (21 vs. 22). I schools were more often situated in low SES areas; however, the prevalence of overweight and non-German children was the same as in NI schools.

### Prevalence

At T1, there was no significant difference in prevalence of overweight and obesity (Table 3). The effect of intervention increased with SES, resulting in a lower prevalence of overweight in children of high SES [adjusted odds ratio (OR), 0.35; 95% confidence interval (CI), 0.14 to 0.91;  $p = 0.03$ ]. The effect was marginally significant in children of normal-weight mothers (adjusted OR, 0.57; 95% CI, 0.33 to 1.00;  $p = 0.05$ ). No effect was seen in children of overweight mothers.

**Table 2.** Characterization of clusters (=schools)

Median (interquartile range)	Non-intervention schools	Intervention schools
<i>N</i>	32	14
Overweight children (%)	12.3 (9.4 to 14.9)	11.9 (9.7 to 14.8)
SES: low/middle/high (%)	43.8/21.9/34.4*	57.1/14.3/28.6
Number of children ( <i>n</i> )	237* (181 to 312)	330 (205 to 414)
Number of classes ( <i>n</i> )	11* (9 to 15)	15 (9 to 18)
Non-German children (%)	7.3 (5.9 to 18.0)	7.3 (5.8 to 18.9)

SES, socioeconomic status.

\* Significant differences between the non-intervention and intervention schools;  $\chi^2$  test (SES) and Mann-Whitney *U* test ( $p < 0.05$ ).

### Incidence

Similar cumulative 4-year incidence rates of overweight were seen in I and NI (Table 4). Sex and mother's weight had no effect. A significant effect was seen only in children from families of high SES (adjusted OR, 0.26; 95% CI, 0.07 to 0.87;  $p = 0.03$ ).

### Remission

I and NI showed similar cumulative 4-year remission rates of overweight (Table 4). A significant effect was seen in children of normal-weight mothers only (adjusted OR, 5.43; 95% CI, 1.28 to 23.01;  $p = 0.02$ ). A marginally significant effect on remission of overweight was seen in all children (adjusted OR, 2.52; 95% CI, 0.88 to 7.16;  $p = 0.08$ ) and in girls (adjusted OR, 4.52; 95% CI, 0.86 to 23.65;  $p = 0.07$ ), whereas no effect was seen in boys.

### Lifestyle Variables

Compared with NI, 4-year changes in the HEI, physical activity, and media time tended to improve in I (not significant; Table 5).

## Discussion

Evaluating KOPS showed that sustainability in outcome variables could be achieved without structural or environmental changes. There is still need for policy support, but there was a high acceptance, and the costs of the intervention were low. However, our intervention may cause a steeper SES gradient in overweight. There were no potential side effects. Taken together, our data are in favor of a school-based health promotion.

### Weight Status

The majority of studies on school-based health promotions reported effects on health knowledge, attitudes, and behavior (4). In contrast, only modest or no changes in weight were observed. Characteristics of intervention, pu-

berty, and methodologic limitations inherent to study design and the environment may have biased the effect. These data suggested that universal health promotions have long-term effects on overweight, but these effects were selective in children with high SES and children with normal-weight mothers. This may be explained by a healthier lifestyle in these families. However, the inverse social gradient in overweight observed in our children flattened but remained even after adjusting for lifestyle variables (20). In addition, girls tended to profit more than boys. Thus, future programs should take into account SES, parental body weight, and sex as confounders.

There were no effects on obesity, suggesting that health promotion within schools cannot replace treatment. Thus, future frameworks should include the primary care and/or clinical setting (4).

### Study Limitations

Our dropout rate was high. However, these numbers were in line with other long-term studies (21,22). Dropout rates differ between randomized controlled studies and studies performed within a public health setting. Study design may add to dropout rates. Within KOPS, two representative cohorts of children were assessed with post hoc re-identification of I children (23).

Prevalences of overweight and children of low SES families were higher in dropout rate compared with participants. However, despite this selective dropout, the prevalences in I and NI were only marginally different at T0, suggesting internal validity. There might be a bias in external validity; e.g., percent of children who profited from the intervention might be lower in both groups, but the absolute difference between I and NI was the same. The higher prevalence of overweight mothers in NI compared with I may cause selection bias. This might lead to an overestimation of the intervention effect. In addition, stratification reduces study power (i.e., a higher power in NI because of higher number).

**Table 3.** Characterization of weight status at T0 (6-year-old children) and T1 (10-year-old children) and adjusted ORs (95% CI) for prevalence of overweight and obesity after intervention at T1

		SES				Normal-weight mother			
		All	Boys	Girls	High				
Prevalence at T0									
I	Obese (%)	3.8	4.0	3.5	7.6	2.2	2.5	6.3	3.1
	Overweight (%)	7.0	6.4	7.6	10.9	7.7	4.3	12.7	5.0
NI	Normal-weight (%)	83.7	86.1	81.3	79.3	84.6	85.7	79.7	85.1
	Underweight (%)	5.8	3.5	7.6	2.2	5.5	7.5	1.3	6.9
	Obese (%)	3.9	3.3	4.4	7.4	3.3	2.1	8.1	2.1
	Overweight (%)	5.2	4.2	6.2	6.6	5.4	4.2	7.1	4.3
	Normal-weight (%)	83.7	84.7	82.8	76.9	85.1	86.9	79.1	85.7
Prevalence at T1									
I	Obese (%)	5.2	5.8	4.7	7.6	4.4	4.3	11.4	3.4
	Overweight (%)	10.2	10.4	9.9	17.4	14.3	3.7	19.0	7.3
NI	Normal-weight (%)	78.8	78.6	78.9	71.7	72.5	86.3	67.1	82.4
	Underweight (%)	5.8	5.2	6.4	3.3	8.8	5.6	2.5	6.9
	Obese (%)	5.1	4.9	5.4	9.5	4.7	2.8	10.7	2.8
	Overweight (%)	11.1	10.5	11.7	13.3	13.3	8.3	14.7	9.4
	Normal-weight (%)	76.9	77.8	76.1	69.8	76.9	81.2	69.1	80.2
Prevalence (T1) of overweight									
Adjusted OR* (95% CI)	0.87 (0.57 to 1.31)	0.88 (0.48 to 1.64)	0.86 (0.48 to 1.53)	1.31 (0.69 to 2.46)	1.03 (0.51 to 2.07)	0.35* (0.14 to 0.91)	1.31 (0.69 to 2.47)	0.57 (0.33 to 1.00)	
<i>p</i> value	<i>p</i> = 0.497	<i>p</i> = 0.697	<i>p</i> = 0.602	<i>p</i> = 0.406	<i>p</i> = 0.935	<i>p</i> = 0.031	<i>p</i> = 0.411	<i>p</i> = 0.051	
Prevalence (T1) of obesity									
Adjusted OR* (95% CI)	0.83 (0.40 to 1.74)	0.87 (0.32 to 2.32)	0.90 (0.32 to 2.52)	0.52 (0.17 to 1.62)	1.18 (0.27 to 5.22)	1.23 (0.28 to 5.39)	1.02 (0.39 to 2.66)	0.69 (0.22 to 2.17)	
<i>p</i> value	<i>p</i> = 0.628	<i>p</i> = 0.778	<i>p</i> = 0.848	<i>p</i> = 0.258	<i>p</i> = 0.824	<i>p</i> = 0.786	<i>p</i> = 0.972	<i>p</i> = 0.528	

OR, odds ratio; CI, confidence interval; I, intervention; NI, non-intervention; SES, socioeconomic status.

\* Adjusted for baseline BMI of the children, sex, SES, and BMI of the mother, as well as clustering effect among schools (OR of NI was taken as 1).

**Table 4.** Four-year cumulative incidence and remission of overweight and obesity and adjusted ORs (95% CI)

Four-year cumulative incidence	SES								
	All	Boys	Girls	Low	Middle	High	Overweight mother	Normal-weight mother	
Incidence of overweight	I	7.6	8.1	7.2	13.7	11.7	2.2	14.3	5.9
	NI	9.2	9.2	9.1	11.0	11.2	6.8	12.9	7.4
	Adjusted OR* (95% CI)	0.72 (0.43 to 1.19)	0.67 (0.33 to 1.35)	0.76 (0.36 to 1.59)	1.20 (0.54 to 2.67)	0.85 (0.36 to 1.98)	0.26† (0.07 to 0.87)	0.99 (0.43 to 2.26)	0.60 (0.62 to 1.15)
Incidence of obesity	<i>p</i> value	<i>p</i> = 0.198	<i>p</i> = 0.260	<i>p</i> = 0.468	<i>p</i> = 0.655	<i>p</i> = 0.698	<i>p</i> = 0.030	<i>p</i> = 0.974	<i>p</i> = 0.127
	I	2.9	3.2	2.6	3.6	2.4	2.8	8.2	1.3
	NI	3.1	3.1	3.1	5.0	3.3	1.8	5.8	2.0
Remission of overweight	Adjusted OR* (95% CI)	0.58 (0.24 to 1.45)	0.56 (0.16 to 1.97)	0.62 (0.17 to 2.30)	0.29 (0.06 to 1.40)	0.67 (0.12 to 3.87)	1.00 (0.18 to 5.73)	1.04 (0.36 to 3.07)	0.40 (0.09 to 1.79)
	<i>p</i> value	<i>p</i> = 0.244	<i>p</i> = 0.366	<i>p</i> = 0.475	<i>p</i> = 0.123	<i>p</i> = 0.658	<i>p</i> = 0.999	<i>p</i> = 0.939	<i>p</i> = 0.230
	I	41.7	45.5	38.5	40.0	42.9	42.9	20.0	61.5†
Remission of obesity	NI	27.0	37.9	20.0	20.0	21.7	38.5	23.3	26.2†
	Adjusted OR* (95% CI)	2.52 (0.88 to 7.16)	1.79 (0.37 to 8.62)	4.52 (0.86 to 23.65)	9.75 (0.95 to 100.3)	3.55 (0.46 to 27.11)	1.22 (0.17 to 8.50)	0.40 (0.05 to 3.26)	5.43† (1.28 to 23.01)
	<i>p</i> value	<i>p</i> = 0.084	<i>p</i> = 0.468	<i>p</i> = 0.074	<i>p</i> = 0.056	<i>p</i> = 0.223	<i>p</i> = 0.842	<i>p</i> = 0.389	<i>p</i> = 0.022
Remission of overweight	I	30.8	28.6	33.4	42.9	0.0	25.0	40.0	25.0
	NI	38.2	34.8	40.6	28.6	50.0	46.2	29.4	55.0
	Adjusted OR* (95% CI)	1.71 (0.42 to 6.91)	7.74 (0.39 to 152.0)	1.80 (0.26 to 12.50)	0.66 (0.11 to 4.09)	—	7.10 (0.22 to 232.1)	1.01 (0.10 to 9.85)	4.99 (0.48 to 51.61)
Remission of obesity	<i>p</i> value	<i>p</i> = 0.449	<i>p</i> = 0.178	<i>p</i> = 0.552	<i>p</i> = 0.653	<i>p</i> = 0.653	<i>p</i> = 0.271	<i>p</i> = 0.993	<i>p</i> = 0.178

OR, odds ratio; CI, confidence interval; SES, socioeconomic status; I, intervention; NI, non-intervention.

\* Adjusted for baseline BMI of the children, sex, SES, and BMI of the mother, as well as clustering effect among schools (OR of NI was taken as 1).

† Significant difference between I and NI ( $\chi^2$  test,  $p < 0.05$ ).

**Table 5.** Four-year changes in prevalence of lifestyle habits (HEI, physical activity, and media time and lifestyle index) in the NI and I groups

	T0	T1	NI	I
HEI (%)	Good NI: <i>n</i> = 106 (19.3%) I: <i>n</i> = 17 (11.3%)	Good	9.4	47.1
		Medium	54.7	52.9
		Poor	35.8	0
	Medium NI: <i>n</i> = 290 (52.7%) I: <i>n</i> = 90 (59.6%)	Good	11.7	15.6
		Medium	58.3	56.7
		Poor	30.0	27.8
	Poor NI: <i>n</i> = 154 (28.0%) I: <i>n</i> = 44 (29.1%)	Good	0.6	2.3
		Medium	30.5	34.1
		Poor	68.8	63.6
Physical activity (%)	High NI: <i>n</i> = 240 (39.3%) I: <i>n</i> = 69 (42.1%)	High	80.4	81.2
		Medium	8.8	11.6
		Low	10.8	7.2
	Medium NI: <i>n</i> = 160 (26.2%) I: <i>n</i> = 52 (31.7%)	High	70.0	69.2
		Medium	14.4	13.5
		Low	15.6	17.3
	Low NI: <i>n</i> = 211 (34.5%) I: <i>n</i> = 43 (26.2%)	High	51.7	51.2
		Medium	9.3	9.5
		Low	38.9	39.5
Media time (%)	Low NI: <i>n</i> = 455 (74.5%) I: <i>n</i> = 118 (72.0%)	Low	69.2	71.2
		High	30.8	28.8
	High NI: <i>n</i> = 156 (25.5%) I: <i>n</i> = 46 (28.0%)	Low	17.9	30.4
Lifestyle (%)	Healthy NI: <i>n</i> = 44 (8.3%) I: <i>n</i> = 4 (2.8%)	High	82.1	69.6
		Healthy	81.8	0
		Medium	18.2	100
	Medium NI: <i>n</i> = 438 (82.6%) I: <i>n</i> = 124 (86.1%)	Poor	0	0
		Healthy	7.1	7.3
		Medium	86.8	88.7
	Poor NI: <i>n</i> = 48 (9.1%) I: <i>n</i> = 16 (11.1%)	Poor	6.2	4.0
		Healthy	0	0
		Medium	66.7	81.3
		Poor	33.3	18.8

HEI, healthy eating index; NI, non-intervention; I, intervention.

The prevalence of minorities was low in the KOPS study (~7%). Thus, the results cannot be generalized to populations with a higher prevalence of different ethnic groups.

#### ***Do More Intense Interventions Improve Effectiveness?***

It is tempting to speculate that 1) actualizing the school environment in promoting health in addition to classroom interventions or 2) more intense interventions are needed to improve effectiveness of preventive measures (23). However, high intensity may reduce the effectiveness of preven-

tion. A 3-year school-based multi-component intervention for reducing percentage body fat in American Indian elementary schoolchildren (i.e., Pathways) resulted in improved food- and health-related knowledge and behaviors without a reduction in body fat (24). Although the program included a classroom curriculum, food service, physical education, and a family intervention and also received strong support from tribal, educational, and community authorities, the study did not reach its goal, suggesting that more intensive interventions do not have better effectiveness.

### *Are Family-based Interventions More Successful?*

Families represent the most important foci for preventive efforts in children (1,4,5,25). In fact, 10-year follow-up data of the Special Turku Coronary Risk Factor Intervention Project (STRIP) study with biannually individualized dietary and lifestyle counseling during the first 10 years of life showed a reduction in prevalence of overweight in girls but not in boys (21). However, other family-based interventions have limited long-term success rates (26). Within KOPS, counseling and education of 92 families were performed within a 3-month period at home (11,14). The 1-year follow-up data showed some positive effects on food and activity behavior and on mean BMI. Although mean BMI of the whole group improved, mean BMI of overweight children from low SES families increased, suggesting that a low SES served as a barrier against family intervention. The need for social stratification or a societal approach in prevention and treatment of overweight is obvious (27,28).

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