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A three year family-oriented intervention program to curtail obesity had no effect over no intervention in five year old children

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Abbreviations used:

BMI:	Body mass index
Δ BMI:	Delta BMI
SDS:	Standard deviation score
LMS:	Learning and Mastery Service
LQR:	Interquartile range

ABSTRACT

Aim: To examine the effect of a family-oriented multidisciplinary intervention program to curtail weight increase in young children with obesity, and to identify potential success factors within the intervention group.

Methods: Children with obesity at 5-6 years of age in Oppland County, Norway, were identified. Families residing in one part of the county were invited to participate in a group based 3-year intervention program while the rest served as controls (no intervention). Body mass index (BMI) and family characteristics obtained at entry and measurements at birth were explanatory variables and change in BMI standard deviation score (SDS) the outcome measure. For the intervention group, we measured height, weight, skinfold thicknesses and waist-to-height ratio once a year.

Results: The median decline in BMI SDS was 0.19 in both groups (n=32 and n=33, p = 0.731). The decline increased with increasing BMI SDS at entry, but irrespective of being in the intervention program or not. Within the intervention group, only screen time was modestly associated with lack of decline in BMI SDS.

Conclusion: The intervention program had no significant effect on BMI SDS over no intervention, and only screen time was associated with outcome in the intervention group.

(word count 196)

Key words: obesity, child, intervention, body mass index, standard deviation score

Key notes:

- Intervention programs to treat obesity during mid childhood and adolescence have had limited success
- It has been suggested that intervention at an earlier age may be more effective, but few studies have been conducted
- In this multidisciplinary three year family-oriented program the median BMI standard deviation score decreased slightly, but similarly, in the intervention and in a control group with no intervention

Introduction

The prevalence of overweight and obesity among children has increased throughout the world over the last decades, and the WHO estimates that 41 million children under five years of age are overweight or obese [1]. Although the prevalence of overweight and obesity among children in Norway may have stabilized over the last years [2], as in some other European countries [3], 16 % of 8-year-old [2] and 13-17 % of 2-19 year old [4] Norwegian children were overweight or obese in recent studies.

Children with obesity, and in particular adolescents, are at extremely high risk of being affected by obesity as adults, and intervention studies to treat overweight and obesity in childhood have generally had limited or no success [5-7]. Furthermore, studies with some success have usually been evaluated after short follow-up periods and may therefore have limited clinical significance since the risk of relapse may be high [5-7]. The majority of studies have, however, included children in mid or late childhood, and the chance of success may decrease with increasing age [8]. It has therefore been suggested that measures to curtail later obesity should be introduced in early childhood [8, 9].

In a meta-analysis of children less than 11 years old with obesity, the intervention lasted between 3 and 6 months in 18 of 20 studies, and effects were assessed shortly thereafter [5]. Furthermore, the mean age at entry was less than seven years in only three of the studies, and the interventions tended to be limited in terms of approach and involved personnel. Therefore, our aim was to compare the effect of a three year group based multidisciplinary intervention program with no intervention. The program only involved the parents, and the aim was to alter the lifestyle of the family and child. The parents' perceived challenges as the intervention progressed were important in modifying the approach. Our secondary aim was to identify potential success factors within the intervention group.

Methods

Participants (Figure 1)

Through the public health care clinics, we invited parents of all the children who met for the school entry health assessment in 2007 in Oppland County, Norway, to participate in a study on health and growth. Virtually all children attend this examination together with at least one of the parents. Of 1895 children who met for the assessment, the parents of 1119 gave written consent to participate. The parents completed questionnaires on health and habits for the children, and on demographic, socioeconomic, health and lifestyle characteristics of the family [10]. The public health nurses measured the child's weight and height and reported these measures together with the weight and length at birth, which were routinely reported to the clinics from the obstetric departments. For children of families who declined to participate, the public health nurse anonymously reported sex, age, height and weight at the time of recruitment, and we have previously reported that the participants were probably representative of the population [10]. Children with a body mass index (BMI) above the International Obesity Task Force definition of obesity (IOTF 30) [11] were identified as eligible for the present study.

Oppland is one of 20 counties in Norway. It covers 25 192 km^2, has 26 municipalities and had a population of approximately 183,000 in 2007. Two municipalities include cities with 25,000-30,000 inhabitants. The other municipalities are rural with towns of variable sizes. On behalf of the research group, the public health nurses in the six municipalities that were geographically closest to the two hospitals in the county were asked to invite the families of eligible children to participate in the intervention program. These municipalities had approximately 60 % of the population in the county. The families from the other municipalities and

families who were not invited or declined from the intervention municipalities, served as controls.

In the intervention municipalities some families of children with obesity who were not in the originally recruited group, became aware of the project and asked to be allowed to participate. These children were close in age and were included since a larger group would allow for a more accurate estimate of potential effects of the program.

Intervention and control program

The intervention program was organized in cooperation with the Learning and Mastery Service (LMS) at the hospitals. LMSs are by law established as part of the specialist health services in Norway, and their purpose is to promote health, mainly for common health problems, by providing information and encourage discussion among participants in groups. The aim is to strengthen mastering by improving self-efficacy and cognitive symptom management, and to reduce health distress and social role limitations [12].

The LMSs are led by nurses who are trained in providing guidance. Other relevant personnel participate according to specific needs. In this project, only the parents attended the group sessions. Paediatricians, nutritionists, physiotherapists, and a psychologist contributed, partly on a predetermined schedule and partly as needs were identified by the groups. The professionals gave practical advice regarding diet and physical activity, but in particular they encouraged and participated in discussions on experienced challenges in changing lifestyles and on how to deal with them in terms of changing behaviour. Each group consisted of 5-7 pairs of parents, and each session was scheduled to last 2 ½ hours after working hours. The children were occupied in play under the supervision of a preschool teacher while the parents participated in the sessions. The intervention program lasted three

years. At the LMS, the groups were scheduled to meet four times during the first year, twice during the second and one time during the third year. Between each of these sessions the parents and the child were invited once, either individually or in groups, for discussions and assessments by the study nurses.

The children with obesity and their parents from the remaining municipalities and families from the intervention municipalities who were not invited or did not wish to participate in the intervention program, served as controls. They received no information about the intervention program and had no scheduled appointments with health care services during the three years of the study.

Measurements

The weight and length at birth were measured by midwives at the time of birth and reported to the public health care clinics. Comparisons between the intervention and control group were based on routine measurements of height and weight before school entry and in third grade. Public health nurses performed these measurements according to national guidelines. The children were wearing light underclothes. Height was measured to the nearest millimetre and weight to the nearest 100 grams [13].

In the study of effects limited to the intervention group, the measurements were performed by two specifically trained study nurses at the start and after each of the three years. The measurements included height, weight, triceps and subscapular skin fold thicknesses, abdominal circumference and maximum walking distance on a 6 minute walking test [14]. Waist circumference was measured to the nearest millimetre, and waist-to-height ratio was calculated as waist circumference divided by the simultaneously measured height. The skin folds were measured with a Holtain Tanner/Whitehouse Skinfold Caliper and in a way that was identical to how Norwegian references were established [15, 16]. On the 6 minute walking test the

nurses recorded the length in meters the children were able to walk during 6 minutes on a 50 meter lane.

BMI was calculated as weight/height^2 (kg/m^2). Standard deviation score (SDS) for the BMI, waist circumference, waist-to-height ratio and skin folds of the children were based on current Norwegian growth references [16-18]. The parents' heights and weights were self-reported.

Explanatory and outcome measures

BMI SDS at inclusion was the primary explanatory variable and the change in BMI SDS from entry to the end of the program the primary outcome measure. In adjusted analyses we included birth weight, child and family health, lifestyles and other characteristics reported at the study entry as possible confounders. Several of the descriptive ordinal variables were dichotomized in order to do meaningful comparisons [10]. Hospital admissions were admissions for any cause from birth until the preschool assessment. Physical activity per week was reported as frequency of being active enough to experience heavy breathing or sweating [10]. Place of residence was categorized as urban if they lived in municipalities with the two larger cities in the county. Asthma medication included inhaled corticosteroids, medication for asthma attacks or other maintenance medications.

Statistics

Descriptive statistics are presented as per cents (%) for categorical variables and as medians with interquartile range (IQR) for continuous variables. Correlations are reported as the Pearson's correlation coefficient (r). We compared the intervention and control group with the Mann-Whitney U- and chi-square tests, and performed a multiple linear regression analysis across both groups to test whether being in the

intervention or the control group had a significant impact on the change in BMI SDS when adjusting for all the registered exposures.

We considered a difference in mean BMI score of one unit between the intervention and the control group at the end of the study as clinically significant. From available Scandinavian data on children with obesity, we calculated that sixteen children had to be included in each group to detect such a difference with a statistical significance of 5 % and a power of 80 % [19]. Since the study did not have a true randomised design and secondary outcomes were limited to the intervention group, a larger number was desirable, and all eligible children in the county were therefore invited. We used intention to treat in that all who had attended at least one of the sessions were included in the analyses.

Within the intervention group, we used the Related-Samples Wilcoxon Signed Rank Test to compare measures from the start to outcome after three years. In order to assess which factors were associated with success within the intervention group, we performed univariate and multiple linear regression analysis with change in BMI SDS over the three years as the outcome measure. In this model we included skin fold thicknesses as the mean of the sum of the triceps SDS and subscapular SDS measurements, and the waist-to-height ratio SDS with the hypothesis that relatively high values for a given BMI may suggest a higher fat deposit and therefore true obesity while relatively low values may suggest a relatively high lean body mass. We used intention-to-treat analysis and the number of attendances as proxy for motivation in both analyses. The regression analysis was performed in an all-in backward model, and the potential explanatory variables were selected from earlier literature and the strength of association in the post-hoc bivariate analyses. Results are reported as estimated regression coefficients (b), p-values and determination coefficient (R^2).

P-values ≤ 0.05 were considered statistically significant. SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY, USA, 2015) was used for all analyses. The BMI SDS, skinfolds SDS, waist circumference and waist-to-height ratio were calculated in R.2.6.0 (The R Foundation for Statistical Computing, Vienna, Austria) using the Norwegian growth references [16-18].

Ethical considerations

The study was approved by the Regional Committee on Medical Research Ethics (REK 1.2006.3491) and the Norwegian Data Protection Official for Research (02-2006 SI). A signed consent was obtained from one of its parents. The study was registered at ClinicalTrials.gov (NCT00458224) before recruitment.

Results

Comparing the intervention and control group

Figure 1 describes the recruitment of subjects. Of 63 eligible children, 38 lived in the municipalities of recruitment for intervention. The families from the other municipalities (n = 25) and 17 families from the recruitment area who were not invited or declined to participate in the intervention program, served as controls. An additional 23 children of similar age from the intervention municipalities were included at the request of the parents. Since the comparison between the intervention and control group were based on the similarly obtained height and weight measurements both at entry and at the end in public health (Table 1), some children were lost from the comparison, but included in the intervention in order to assess which factors may be associated with outcome. For the children who completed the comparison study, the years of birth were 1999 (n = 3), 2000 (n = 11), 2001 (n = 12), and 2002 (n = 5) for the intervention group and 2000 (n = 1) and 2001 (n=32) for the control group. The measurements at entry of the children who

were lost to follow-up did not differ from those who completed the comparison study (data not shown).

The children in the intervention group had a slightly higher median weight, BMI and BMI SDS at entry and a higher BMI SDS at the end of intervention than the control group, but the median increase in BMI (Δ BMI 2.02 vs. 1.95 kg/m^2) and decline in BMI SDS (Δ BMI SDS 0.19 in both groups) did not differ (p = 0.731, Table 1). By study design, a higher proportion of the families in the intervention group lived in urban municipalities. Compared to the control group, the fathers in the intervention group had a somewhat higher median BMI and a higher proportion of the parents were of the opinion that their child “looked overweight”. There were no other significant differences between the groups (Table 1). The Δ BMI and Δ BMI SDS did not differ between the controls recruited from the intervention municipalities and the no-intervention municipalities (data not shown).

In the multiple linear regression analysis of the whole cohort, we included the BMI SDS at birth and at entry to the study, the BMI of parents, relevant measures of health and lifestyles, the demographic variables in Table 1, and the categories intervention vs. control group as exposures, and Δ BMI SDS as outcome. A higher BMI SDS at entry was associated with a larger decrease in BMI SDS (b = -0.376, p = 0.002, R^2 = 0.154), but independent of being in the intervention or control group. Other variables were of no significance.

Intervention group

Thirty-two children had BMI measurements at the LMSs both at entry and at the conclusion of the three-year intervention (Figure 1). The median number of attendances was 6 (range: 1-16); two attendances at the LMS (range: 0-7), and 5 (range: 1-9) meetings for nurse guidance and measurements. Thirteen of the 32 families attended all the planned sessions (6 at the LMS and 7 at the nurse

guidance meetings). The median BMI SDS and median subscapular skinfold SDS, but not for the median waist-to-height ratio, were significantly lower after three years of intervention than the respective SDS at entry (Table 2). The BMI SDS was closely related to the mean skinfold SDS ($r = 0.864$ at entry and $r = 0.825$ at the end, $p < 0.005$ for both) and to the waist-to-height ratio ($r = 0.833$ and $r = 0.785$, $p < 0.005$ for both), but there was no decline in these parameters similar to the decline in BMI SDS (Table 2). The results for the 13 children of families who attended all the sessions did not differ significantly from those of the rest of the intervention group (data not shown).

In the multiple linear regression analysis, a higher BMI SDS at entry was associated with a larger reduction in BMI SDS, and screen time of more than two hours per day with an increase in BMI SDS (Table 3). No other exposures were significantly associated with a change in BMI SDS.

The parents' weights did not change during the intervention (median 0.00 kg difference for both mothers ($n = 21$) and fathers ($n = 15$).

Discussion

In this study of 5-6 year old children with obesity, a three year multidisciplinary intervention program with the intention to change family and child lifestyles had no effect over no intervention on the development of BMI. Both the intervention and the control group experienced the same slight reduction in BMI SDS, and within the intervention group, only screen time was of significance. In particular, adherence to the program, as a proxy measure of motivation, was of no significance. Skinfold thicknesses and waist-to-height ratio at entry were not associated with change in BMI SDS suggesting that children with an assumed higher fat mass did not obtain a larger decrease in BMI SDS.

We chose to include families on basis of geographical closeness to the hospitals for two reasons: The county is large, and the distance to the other municipalities would make it difficult for families to attend. Furthermore, a true randomization would possibly have introduced a bias from a spill-over effect within the municipalities, i.e. an unrecognized intervention effect, a concern that has been raised in randomized intervention studies where one arm is generally accepted as preferable [20, 21]. Still, we chose to include eligible children in the intervention municipalities who were not invited or declined as controls to account for all eligible children in the county. In these municipalities a spill-over effect was also unlikely since the intervention program was conducted outside the municipalities and no information about the program was publicized during the three year period. This assumption was strengthens by the finding that their development in measurements did not differ from the rest of the controls. On average, the intervention group had a slightly higher median BMI, partly because the families who participated on request tended to have somewhat higher BMIs. On the other hand, the families who participated in the intervention program were probably more motivated for treatment than many control families since most of them, as opposed to the control group, expressed that their children “look overweight”. In particular, the families who participated on request expressed a concern for their children’s health.

The use of BMI SDS as outcome measure may be a weakness since it has been argued that BMI SDS in children with obesity does not accurately correct for age, sex and degree of obesity [22,23]. However, since this was a comparison between groups the use of BMI SDS is nevertheless valid and in line with a recent authoritative systemic review [7]. The information about the children’s physical activity (except for the walking test) and nutrition were self-reported and possibly unreliable.

Recent Cochrane reviews of randomized controlled trials suggest that there were no convincing evidence of significant and persistent weight-reducing effects from published studies involving interventions on diet, physical activity or other behavior in 6-11year old children (mean age 10 years) [6] or adolescents [8] with obesity. In the study of Mead et al, the overall benefit in favor of interventions over usual care was only a BMI SDS score of 0.06 (95% CI: 0.10 to 0.02) units at 6 – 36 months' follow-up, and in 13 of the 27 included studies the SDS score declined as much in the control as in the intervention group [6]. In another Cochrane review, parent-only interventions were as effective as parent-and-child intervention in 5-11 year old children, but minimally more effective than for waiting list controls (BMI SDS score 0.1; 95% CI: 0.19 to 0.01 units lower) [5]. In a meta-analysis of few studies on preschool children, an intervention on diet, physical activity and behavior had a significant, but slight, beneficial effect at 12-18 months' follow-up [24]. However, the quality of evidence was estimated as low or very low, particularly for the two youngest groups. The decline in BMI SDS in our intervention group of 0.19 was similar to the mean decline of 0.20 in the recent systematic review by O'Connor et al. on weight reducing trials among children and adolescents [7], and to the mean decline of 0.22 in a recent Swedish study on 8-12 year-old children with obesity who attended different treatment programs, but without no-intervention controls [25]. However, our non-intervention control group had the same decline suggesting that the intervention had no effect over the general public attention on obesity in children in Norway.

Within our intervention group, the children with the highest BMI SDS score had the largest decline in the SDS score, but this was equally true for the control group and was probably not a specific effect of the intervention program. It is noticeable that presumed risk factors, such as limited attendance to the program (suggestive of lack of motivation), dental caries (suggestive of unhealthy dietary and other behavior),

lower parental education, single parenthood and other presumed unfavorable social and behavioral factors other than long screen time, were not associated with failure of the program. It is likely that screen time is a more accurate measure of a sedentary vs. a physically active lifestyle than parental estimate of physical activity, particularly at this young age when almost all the children were in day care from at least two years of age and when physical activity was probably more related to play than to organized activity.

Conclusion

Our study based on a relatively long-term multidisciplinary approach with a particular aim to address the parents' concerns and challenges, adds to studies that have failed to show a significant effect of specific programs to reduce BMI in children with obesity. The similar reduction in BMI SDS in our intervention and control groups may suggest that a high national focus on overweight and obesity in children, including societal facilitations to encourage protective lifestyles, is the most important approach to curtail the obesity epidemic among children.

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Table 1. Characteristics of the children with obesity and their families who entered a three-year multidisciplinary treatment program or no intervention (control group) in Oppland County, Norway.

Child Characteristics	**Intervention (n = 31)**	**Control (n = 33)**	
Continuous variables	**Median (IQR)**[a]	**Median (IQR)**[a]	**p-value**[b]
Birth weight, kg	3.62 (0.80)	3.72 (0.78)	0.466
BMI SDS at birth[c]	-0.11 (1.43)	0.07 (1.35)	0.287
Age at entry, years	5.83 (0.36)	5.74 (0.66)	0.979
Age at the end, years	7.84 (1.20)	8.42 (1.65)	0.066
Height at entry, cm	119.00 (6.00)	118.00 (8.00)	0.261
Height at the end, cm	133.20 (10.00)	135.00 (16.00)	0.476
Weight at entry, kg	30.00 (7.40)	27.60 (3.00)	**0.012**
Weight at the end, kg	40.30 (14.90)	39.00 (14.90)	0.481
BMI at entry[d], kg/m^{2,}	20.83 (3.21)	19.32 (1.26)	**0.005**
BMI at the end, kg/m^2	22.94 (5.24)	21.89 (4.37)	0.078
Δ BMI[e], kg/m^{2,}	2.02 (3.32)	1.95 (3.76)	0.825
BMI SDS at entry	2.35(1.06)	1.95 (0.49)	**0.012**
BMI SDS at the end	2.25 (0.90)	1.86 (0.64)	**0.018**
Δ BMI SDS	-0.19 (0.73)	-0.19 (0.76)	0.731
Binary variables	**Prevalence (%)**	**Prevalence (%)**	**p-value**[f]
Sex, girls	54.8	57.6	0.978
Hospital admissions	50.0	18.2	**0.007**
Screen time > 2 hours per day	33.3	46.9	0.277
Physical activity > 2 times per week	70.0	93.5	**0.017**
TV in the child's bedroom	36.7	25.0	0.319
Asthma medication after 2 years age	13.3	28.1	0.153
Kindergarten since 2 years of age	92.3	81.3	0.225
Prematurity,	3.3	3.0	0.945
Sleep problems after 2 years of age	10.0	6.1	0.563
Breastfeeding > 4 months	61.1	63.2	0.898
Dental caries	23.3	27.3	0.720
Family Characteristics			
Continuous variables	**Median (IQR)**	**Median (IQR)**	**p-value**[b]
BMI mother, kg/m^2	27.39 (6.64)	26.07 (8.01)	0.317
BMI father, kg/m^2	30.09 (6.30)	27.66 (5.80)	**0.039**
Number of siblings	1.00 (2.00)	1.00 (1.00)	0.513
Binary variables	**Prevalence (%)**	**Prevalence(%)**	**p-value**[f]
Maternal education above high school	37.9	30.3	0.527
Urban living[g]	45.2	18.2	**0.020**
Smoking by family member	56.7	51.5	0.682
Parents think child looks overweight	89.3	33.3	**< 0.0005**
Living with single parent	36.7	24.2	0.283

[a]Inter-quartile range, [b]Mann-Whitney U-test,[c]Body mass index standard deviation score, [d]Body mass index, [e]Body mass index at the end minus at the entry of the study, [f]Chi-square test, [g]Living in one of the two larger cities (>20 000 inhabitants)

Table 2. Development of anthropometric measurements and 6 minute walking test during the three-year intervention program.

Variables (medians and IQR)[a]	Time point Entry (n = 32)	1 year (n = 26)	2 years (n = 20)	3 years (n= 32)	
Age, years	6.48 (1.56)	7.58 (1.42)	8.86 (1.95)	9.57 (1.69)	
Height, cm	125.00 (12.40)	131.80 (12.73)	140.20 (16.77)	141.35 (9.00)	<
Weight, kg	34.60 (8.95)	39.60 (11.05)	48.60 (12.47)	50.65 (16.55)	<
BMI, kg/m^2,[c]	21.65 (3.69)	22.04 (4.31)	23.83 (4.64)	23.90 (6.82)	<
BMI SDS[d]	2.37 (0.81)	2.15 (0.95)	2.27 (0.80)	2.02 (1.04)	
Subscapular skinfold SDS[e]	2.20 (1.21)	1.99 (0.79)	1.95 (0.76)	1.91 (0.67)	
Triceps skinfold SDS[f]	2.14 (1.22)	2.23 (0.56)	2.22 (0.48)	2.20 (0.77)	
Mean skinfold SDS[g]	2.08 (1.07)	2.01 (0.67)	2.11 (0.61)	2.11 (0.73)	
Waist circumference SDS[h]	2.52 (0.88)	2.58 (0.60)	2.47 (0.68)	2.60 (0.56)	
Waist-to-height ratio SDS[i]	2.33 (0.96)	2.48 (0.78)	2.43 (0.80)	2.69 (0.88)	
6 minute walking test, meters[h]	540.00 (108.00)	672.00 (115.00)	660.00 (115.00)	790.00 (135.25)	

[a]Interquartile range, [b]Related-Samples Wilcoxon Signed Rank Test, difference between entry and 3 years, [c]Body mass index, [d]Standard deviation score, [e]21 children at entry, 23 at 3 years and 12 both at start and at 3 years; [f]22 children at entry, 24 at 3 years and 14 at both entry and 3 years, [g]The sum of subscapular and triceps skinfold SDS divided in two; [h]30 children at entry, 23 at 3 years and 23 at both entry and 3 years, [i]30 children at entry, 23 at 3 years and 23 at both entry and 3 years, [h]31 at entry, 17 at 3 years and 16 both at start and at 3 years..

Table 3 Results from linear regression analyses of differences in body mass index standard deviation score (BMI SDS difference) from entry to end of the intervention program after three years in 32 children with obesity aged 5-6 years at entry.

	Unadjusted models		Final model [b] (R^2 = 0.341)	
Explanatory variables	**B[a]**	**p-value**	**B[a]**	**p-value**
Birth weight, kg	0.222	0.140		
Age at entry, years	0.191	0.070		
BMI SDS at entry	-0.446	**0.009**	-0.452	**0.009**
Mean skinfold SDS at entry	-0.302	0.071		
Waist-to-height ratio SDS at entry	-0.172	0.181		
Walking test, min	0.001	0.213		
Number of attendances	0.015	0.517		
Drop out from the intervention	0.068	0.781		
Adherence to the program[c]	0,285	0,182	0.315	0.098
Sex (girls)	0.399	0.067		
Hospital admissions	0.177	0.431		
Screen time > 2 hours per day	0.513	**0.024**	0.435	**0.031**
Physical activity > 2 times per week	-0.243	0.356		
TV in the child's bedroom	0.166	0.496		
Asthma medication after 2 years of age	-0.241	0.463		
Kindergarten since 2 years old	0.034	0.943		
Prematurity	-0.409	0.503		
Sleep problems after 2 years of age	-0.564	0.124		
Breastfeeding > 4 months	-0.007	0.965		
Dental caries	-0.274	0.315		
BMI mother, kg/m^2	0.018	0.453		
BMI father, kg/m^2	0.005	0.875		
Number of siblings	-0.001	0.996		
Maternal education above high school	0.119	0.583		
Urban living	-0.104	0.626		
Smoking by family member	-0.096	0.668		
Parents think child look fat	0.414	0.282		
Living with single parent	-0.127	0.604		

[a]A positive B means an increase in BMI SDS, [b]backward stepwise exclusion of variables with p-value >0.10, [c]At least 10 attendances and continuing the intervention for 3 years

Figure1. Recruitment of families of 5-6 year old children with obesity to intervention and no intervention (controls)

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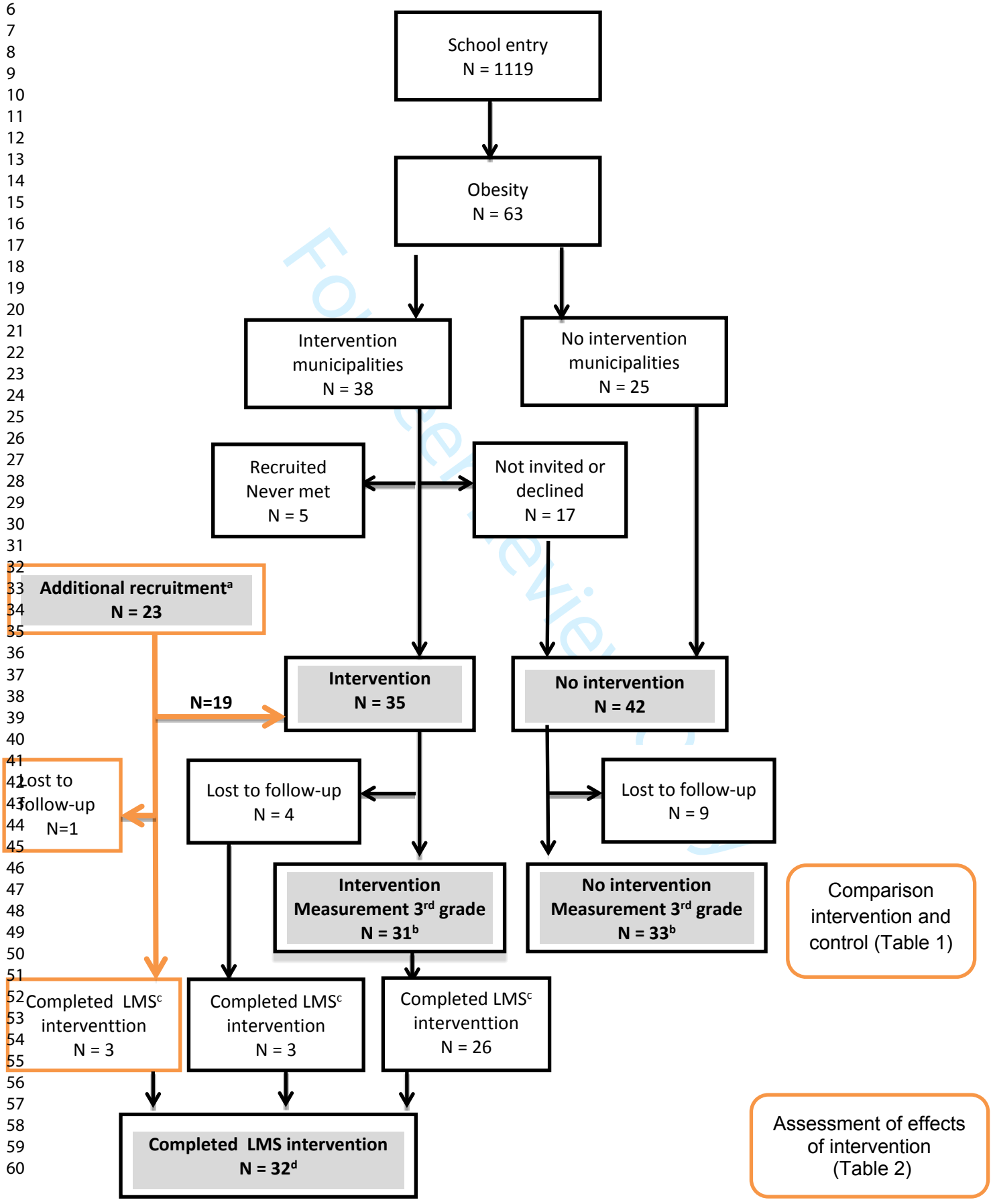

[a]included at the request of parents, [b]comparisons based on measurements at public health care clinics, [c]Learning and Mastery Service, [d]measurements at the start and end at the LMS

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Authors' contributions

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