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Psychological health in preschool children with underweight, overweight or obesity: a regional cohort study

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ABSTRACT

Objective To examine if underweight (UW), overweight (OW) or obesity (OB), or body mass index (BMI) expressed as its SD score (BMI SDS), were associated with psychological difficulties in preschool children.

Design Regional cohort study.

Setting Oppland County, Norway.

Methods At the routine school entry health assessment at 5–6 years of age, parents were invited to participate by local public health nurses. The parents completed questionnaires on sociodemographic, health and lifestyle factors of the child and the family, and on the child's neurocognitive development. They assessed psychological health with the Strengths and Difficulties Questionnaire (SDQ). Public health nurses measured weight and height on all eligible children and reported age, sex, height and weight anonymously for the children who declined to participate.

Participants We obtained information on 1088 of 1895 (57%) eligible children. The proportion of UW, OW and OB was slightly higher among the children who declined.

Main outcome measures SDQ subscale and Total Difficulties Scores.

Results The mean SDQ scores and proportion of scores ≥the 90th percentile had a curvilinear pattern from UW through normal weight (NW), OW and OB with NW as nadir, but the pattern was only significant for the mean Emotional problems, Peer problems and Total SDQ Scales, and for the Total SDQ Score ≥the 90th percentile (TDS90). After adjusting for relevant social, developmental, health and behavioural characteristics, TDS90 was only significantly associated with UW in multiple logistic regression analyses, and only with the lowest quartile of BMI SDS in a linear spline regression analysis.

Conclusions The study suggests that UW and low BMI, but not OW, OB or higher BMI, are independent risk factors for having psychological symptoms in preschool children.

INTRODUCTION

The obesity (OB) epidemic is a major threat to the health of the individual and societies.[1] The high proportion of children with overweight (OW) or OB is particularly worrisome since they are at high risk of OB as adults.[2] We[3] and others[4–7] have shown that a variety of well-intended intervention programmes to curtail OB in children have had minor or

What is known about the subject?

► Underweight, overweight and obesity are associated with psychological symptoms in older children and adolescents.
► The significance of psychological symptoms related to weight has rarely been reported, and with conflicting results, in preschool children.

What this study adds?

► In children aged 5–6 years, obesity and underweight, but not overweight, were significantly associated with psychological symptoms, as assessed with the Strengths and Difficulties Questionnaire.
► After adjusting for social, health and lifestyle factors in the family, only underweight and a low BMI were significantly associated with psychological symptoms.

no significant effect. The programmes have generally been oriented towards improving dietary habits and physical activity. Given the limited success, the significance of psychological aspects during early childhood needs to be explored to increase our understanding of why prevention and treatment are so difficult.

OB is associated with psychological comorbidities, such as depression, low self-esteem and reduced health related quality of life in adults,[8] older children and adolescents.[9–13] However, it is not settled whether, or to what extent, psychological factors may predispose to OW or OB, or simply are a result of having a high body mass index (BMI). Studies are conflicting regarding the significance of attention deficit hyperactivity disorder (ADHD) and other behavioural difficulties as risk factors for OW and OB.[14–16] Studies on psychological symptoms related to unhealthy weights in young children are scarce, but it has been suggested that neither OW or OB,[10 17 18] nor underweight (UW),[18] may be associated with psychological symptoms in

preschool children. In particular we lack knowledge related to UW. However, UW in this age group has been associated with increased parental concern[19] and with food avoidant behaviour and an altered parent–child interaction around meals,[20] which may suggest risks of psychological consequences.

In a regional Norwegian cohort of children aged 5–6 year, we found that OW and OB, but not UW, were associated with unfavourable sociodemographic factors and lifestyles.[21] The aim of the present paper was to examine if the children with UW, OW or OB in this cohort had more psychological symptoms than the children with a normal weight (NW), or whether psychological symptoms were related to certain BMI scores. Our hypothesis was that children at this age may not have been exposed to significant psychological consequences of their BMI, such as bullying, and that any psychological symptoms associated with weight categories other than NW might be considered risk factors for developing unhealthy weights.

MATERIALS AND METHODS
Participants
Parents of all children entering school in Oppland County, Norway, in 2007, were invited to participate at the routine school entry health assessment at 5–6 years of age. Oppland county had a population of approximately 183 000. The county had two cities with 25 000–30 000 inhabitants in each and otherwise rural areas with towns of variable sizes.

Consenting parents completed questionnaires on sociodemographic, health and lifestyle factors of the children and family members, and on neurocognitive development of the children. They assessed their children's psychological health with the Norwegian version of the Strengths and Difficulties Questionnaire (SDQ).[22 23]

The public health nurses measured the height and weight of all eligible children. For the families who declined, the nurses reported age, sex, height and weight anonymously. We have previously concluded that the participating children were fairly representative of all the eligible children, although the prevalence of UW, OW and OB was slightly higher among those who declined.[21]

Patient and public involvement statement
Public healthcare clinics, but not families, were involved concerning content and design.

Anthropometric measurements, health and habits
Height and weight were measured according to national guidelines.[24] BMI was calculated as weight/height^2 (kg/m^2), and BMI SD scores (BMI SDS) were based on Norwegian references.[25] Definitions of the weight groups UW, NW, OW and OB were based on the sex and age specific BMI criteria of the International Obesity Task Force for the children[26 27] and according to the WHO classification for their parents.[28]

Details on sociodemographic factors, health and habits were published in a previous report.[21] We dichotomised parent's education and the following variables from frequency scores on sets of variables in the questionnaire: nutritional standard, physical activity, physical health related problem, dental caries, difficulties in fine motor, language or social skills or sleep, and behavioural difficulties in the family. Details are presented in online supplemental appendix 1.

The Strengths and Difficulties Questionnaire (SDQ)
The SDQ is a screening tool to detect mental health problems in children aged 4–16 years.[22] The questionnaire consists of 25 items addressing five subscales with five items in each: emotional problems scale, hyperactivity scale, conduct problems scale, peer problems scale and prosocial scale. Each item is scored on a three-point scale: not true, somewhat true and certainly true, and each scale is scored with a range of 0–10. For the subscales other than the prosocial scale, higher scores mean more symptoms, and scores at or above the 90th percentile are associated with significant mental health problems.[22] The prosocial scale is scored opposite to the other subscales, and a score below the 10th percentile may indicate a behaviour problem. A Total Difficulty Score (TDS) is created by summing the scores from the first four subscales (range 0–40), and a TDS at or above the 90th percentile (TDS90) is considered a high risk of having a psychiatric disorder.[22] On an impact scale, the parents state whether the child has any difficulties with emotions, concentration, behaviour or in social contact with other people, and if so, which impact it has on everyday life (range 0–10).

The SDQ has been formally translated and validated in Norway.[23] It has been widely used in all the Scandinavian countries, and the distribution of SDQ scores is very similar for comparable age groups within Norway and between the Nordic countries.[29]

Statistics
Descriptive statistics are presented as counts and per cents (%) for categorical variables and as means and SD for continuous variables. We explored the differences in characteristics between the four weight groups UW, NW, OW and OB by using one-way analysis of variance (ANOVA) for continuous and the χ^2 test for categorical variables. When ANOVA or χ^2 tests across all weight groups showed significant differences, we performed post hoc pairwise testing, comparing the other weight groups to NW with the Dunnet's t-test for continuous and the χ^2 test for categorical variables (table 1).

We tested the significance of the weight groups UW, OW and OB as compared with NW, on outcome in terms of TDS90 versus lower TDS scores by logistic regression analyses, both unadjusted and adjusted. We adjusted for variables that differed significantly between groups in the ANOVA or χ^2 test analyses, and for variables that we considered relevant from earlier literature and from

Table 1 Associations between current weight category and the children's personal characteristics, health and habits, and current sociodemographic and health characteristics of parents and siblings (A), and between weight category and scores on the Strengths and Difficulties Questionnaire (SDQ) scales (B). Unselected regional cohort of 5-year-old children in Oppland County, Norway

			Current weight category*				
	Valid n	All (n=1088)	Underweight (n=89)	Normal weight (n=844)	Overweight (n=117)	Obese (n=38)	Overall p value†
(A) Characteristics							
Children's health and habits							
Age in years, mean (SD)	1088	5.72 (0.43)	5.66 (0.44)	5.72 (0.43)	5.66 (0.37)	5.82 (0.57)	0.105
Girls, %	1088	52.5	49.4	51.8	58.1	57.9	0.487
BMI SDS, mean (SD)	1085	0.01 (1.03)	−1.93 (0.56)‡	−0.10 (0.63)	1.42 (0.28)‡	2.36 (0.44)‡	<0.001
Physical activity poorer than peers§, %	1073	5.1	5.6	3.8	7.9‡	24.3‡	<0.001
Any physical health problems¶, %	1016	28.1	27.2	28.2	26.6	31.6	0.943
Any dental caries—parent report, %	1079	20	19.1	18.7	25.4	34.2	0.051
Low nutritional standard**, %	1070	12.8	11.4	13.1	11.4	13.5	0.929
Difficulties with skills or sleep††, %	1062	29.1	28.4	29	28.2	37.1	0.76
Kindergarten from 2 years of age, %	1033	92.1	91.6	92.7	90.7	82.4	0.163
Sociodemographic factors and health characteristics of parents and siblings							
Municipality w/n>20 000, %	1087	32.4	38.2	32.6	30.8	18.4	0.178
Low maternal education, %	1068	44.9	44	41.6	56.9‡	81.1‡	<0.001
Low paternal education, %	1037	60.7	51.8	58.8	72.7‡	85.7‡	<0.001
Both parents low education, %	1077	38.4	36.5	35.3	50.9‡	73.7‡	<0.001
Mother out of work, %	1069	8.2	8.1	7.5	10.4	18.9	0.072
Father out of work, %	1046	4.8	4.7	3.9	7.9	15.2‡	0.009
Parent(s) non-Western, %	1088	2.7	3.4	2.1	3.4	10.5‡	0.015
Living with one caretaker, %	1073	13	9.3	12.1	17.2	29.7‡	0.006
No siblings, %	1065	9.1	4.5	8.9	15.9‡	2.9	0.017
Mother smoking, %	1088	19	14.6	16.6	31.6‡	44.7‡	<0.001
Current BMI mother, mean (SD)	981	24.32 (3.85)	23.03 (3.29)	24.07 (3.64)	26.09 (4.20)‡	27.52 (5.12)‡	<0.001
Current BMI father, mean (SD)	924	26.38 (3.30)	25.09 (2.71)‡	26.26 (3.16)	27.54 (3.71) ‡	28.89 (4.33) ‡	<0.001
BMI SDS average for siblings	630	−0.21 (1.23)	−0.79 (1.24)‡	−0.23 (1.20)	0.25 (1.06)‡	0.55 (1.45)‡	<0.001
Mother currently obese, %	980	9.1	6.2	7.1	17.5‡	34.3‡	<0.001
Father currently obese, %	924	13	3.8‡	11.3	25.5‡	37.5‡	<0.001
Both parents currently obese, %	891	2.7	1.3	2	3.3	19.4‡	<0.001
Behaviour difficulties in family, %	1088	6.2	3.4	5.3	10.3‡	18.4‡	0.001
(B) SDQ item							
Emotional problems scale, mean (SD)	1059	1.16 (1.43)	1.48 (1.82)	1.13 (1.37)	1.02 (1.24)	1.69 (1.93)	**0.011**
Conduct problems scale, mean (SD)	1059	0.91 (1.08)	0.95 (1.04)	0.89 (1.07)	0.97 (1.16)	1.14 (1.18)	0.474
Hyperactivity scale, mean (SD)	1057	2.23 (1.90)	2.29 (2.23)	2.17 (1.87)	2.43 (1.86)	2.89 (1.82)	0.088
Peer problems scale, mean (SD)	1058	0.71 (1.24)	0.93 (1.24)	0.66 (1.18)	0.84 (1.51)	1.11 (1.43)	**0.025**
Prosocial scale, mean (SD)	1057	8.64 (1.41)	8.80 (1.19)	8.63 (1.40)	8.69 (1.47)	8.36 (1.90)	0.44
Total Difficulties Score, mean (SD)	1056	5.02 (3.82)	5.63 (4.43)	4.84 (3.63)	5.26 (4.24)	6.83 (4.55)‡	**0.005**
Impact scale, mean (SD)	1046	0.12 (0.71)	0.07 (0.26)	0.12 (0.71)	0.15 (0.92)	0.14 (0.55)	0.879
Emotional problems scale ≥90-percentile, %	1059	15.7	20.7	15.2	13.9	19.4	0.487
Conduct problems scale ≥90-percentile, %	1059	22.6	27.6	22.3	19.1	27.8	0.453
Hyperactivity scale ≥90-percentile, %	1057	11.8	12.6	11.1	13	22.2	0.226
Peer problem scale ≥90-percentile, %	1058	22.3	27.9	20.8	24.3	36.1	0.078

Table 1 Continued

	Valid n	All (n=1088)	Current weight category*				Overall p value†
			Underweight (n=89)	Normal weight (n=844)	Overweight (n=117)	Obese (n=38)	
Prosocial scale ≤10-percentile, %	1057	19.2	12.8	19.3	21.7	25	0.316
Total Difficulties Score ≥90-percentile, %	1056	10.3	18.6‡	8.7	11.3	25.0‡	**0.001**

*Based on the age and sex specific BMI criteria by the International Obesity Task Force.[24 25]

†P value from comparing all weight groups, that is, from one-way analysis of variance for continuous, and χ^2 for categorical variables.

‡P value ≤0.05 in post hoc pairwise comparison with the normal weight group using Dunnett's t-test (continuous variables) and χ^2 test (categorical). Only performed when overall p≤0.05.

§Computed from the three dimensions on physical activity: frequency, intensity and endurance, each scored from 1 to 3 (better than peers, like peers, poorer than peers), giving a total score of 3–9, where 9 meant poorer than peers in all three dimensions. The figure is the prevalence of children with a score of 6 or higher.

¶Any current or previous chronic illnesses.

**At least three of the following: sweets >1 day/week, soft drink >1 day/week, fast food >1 day/week, breakfast <4 days/week, vegetables <2 days/week, fruit <5 days/week.

††If the child scored lower than their peers on fine motor, language or social skills, had sleep problems after 2 years of age, or if they had received any professional interventions within physiotherapy, speech therapy, psychology or psychiatry, or had received any extra support in kindergarten after 2 years of age.

‡‡Symptom scores range from 0 to 10, Total Difficulties Score is the sum of the first four symptom scores (range 0–40). High score in the symptom scores means more problems, except for the Prosocial scale, which is scored opposite. Impact range 0–10.

BMI, body mass index; SDQ, Strength and Difficulties Questionnaire; SDS, SD score[23].

a theoretical perspective. We adjusted according to two models: In Model 1 we adjusted for the family related covariates, and in Model 2 we added health and lifestyle covariates of the child to the family related covariates (table 2). Associations were described as OR and 95% CI. The explanatory variables were tested for interactions and multicollinearity. We also explored if TDS90 was associated with BMI SDS in linear spline regression analyses.[30]

We used Stata for the spline analysis and SPSS Statistics for Windows V.25.0 for the other analyses. P values ≤0.05 were considered statistically significant. BMI SDS were calculated using R V.2.6.0 (The R foundation for Statistical Computing, Vienna, Austria) using Norwegian growth references.[25]

RESULTS

Of 1895 eligible families, 1119 participated, but analyses were limited to 1088 (57.4%) due to incomplete information for 31 children.

There were significant differences between groups on several health-related and sociodemographic factors (table 1A). In the pairwise analyses, low physical activity and family factors such as low parental education, parents being out of work, single parenthood, non-Western ethnicity, mother smoking and OW or OB in parents and siblings were all significantly associated with OW or OB in the children. UW was only associated with low weight in other family members (table 1A).

There were significant curvilinear associations between mean scores on the SDQ subscales emotional problems and peer problems and weight category with NW as nadir. Scores on the hyperactivity scale and prosocial scale, but not the impact score, showed similar trends (table 1B). There was a similar tendency for the proportion of

children with subscale scores at or above the 90th percentile (table 1B). For the mean TDS and TDS90 the curvilinear association was statistically significant (table 1B).

In the unadjusted logistic regression analyses, TDS90 was significantly associated with weight group (table 2). However, compared with the children with NW, the risk of TDS90 was only significantly higher for children with UW and OB, not OW (table 2). TDS90 was also associated with most of the other family and child related social, health and lifestyle factors, but not with the parents' weight (table 2). When adjusted for family related factors (Model 1), TDS90 was only significantly associated with UW, mother being out of work and behaviour difficulties in the family. When adding child-related variables to the family factors (Model 2), TDS90 was only significantly associated with UW, mother being out of work and skills related to fine motor, language or social function, or sleep behaviour (table 2). Parental weight was not included in the models because missing values reduced the sample size to 806 in Model 1 and 782 in Model 2. However, the results were essentially the same when this variable was included. There were no significant interactions or collinearity between the explanatory variables.

In the multiple linear spline regression with knots dividing the data on BMI SDS into four quartiles, we found a significantly higher, but decreasing risk of TDS90 with increasing BMI SDS within the first quartile (OR=0.48, 95% CI: 0.26 to 0.87), but no changes from the low risk in the second and later quartiles. The results for the other included risk factors did not change substantially.

DISCUSSION

The broad picture from the unadjusted analyses was that children with UW and OB, but not OW, had more

Table 2 Logistic regression analyses of associations between Total Difficulties Score ≥90th percentile (TDS90) on the Strengths and Difficulties Questionnaire (SDQ) and weight category in an unselected regional cohort of 5-year-old children in Oppland County, Norway. Results are presented unadjusted and adjusted for family and child related factors

Explanatory variable	Unadjusted				Adjusted model 1* (n=950)			Adjusted model 2*† (n=911)		
Category	n	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Weight group child (NW reference)	819			0.002			0.017			0.023
UW	86	2.41	1.33 to 4.37		2.69	1.37 to 5.27		2.87	1.41 to 5.85	
OW	115	1.34	0.72 to 2.51		1.04	0.51 to 2.12		1.18	0.57 to 2.45	
OB	36	3.51	1.59 to 7.76		2.19	0.84 to 5.73		2.02	0.73 to 5.62	
Low maternal education	1037	2.23	1.47 to 3.39	<0.001	1.44	0.86 to 2.40	0.167	1.44	0.84 to 2.46	0.187
Low paternal education	1006	2.23	1.37 to 3.62	0.001	1.66	0.94 to 2.93	0.080	1.67	0.93 to 3.01	0.086
Mother out of work	1037	4.15	2.44 to 7.07	<0.001	3.54	1.87 to 6.70	0.001	3.34	1.71 to 6.50	<0.001
Father out of work	1018	2.26	1.06 to 4.81	0.035	1.33	0.56 to 3.18	0.520	1.14	0.44 to 3.00	0.785
Mother smoking	1056	1.70	1.08 to 2.67	0.021	1.09	0.63 to 1.91	0.753	1.06	0.59 to 1.91	0.838
Living with one caretaker	1043	1.36	0.78 to 2.36	0.282	0.85	0.42 to 1.71	0.642	0.88	0.42 to 1.84	0.732
Siblings	1035	0.66	0.36 to 1.21	0.177	0.77	0.38 to 1.59	0.486	0.88	0.42 to 1.87	0.745
Behaviour difficulties in the family	1056	2.59	1.38 to 4.85	0.003	1.55	0.73 to 3.30	0.254	1.23	0.56 to 2.71	0.610
Girl	1056	0.71	0.47 to 1.05	0.086				0.84	0.53 to 1.35	0.477
Physical activity score poorer than for peers	1044	2.99	1.55 to 5.77	0.001				2.15	0.97 to 4.77	0.059
Low nutritional standard	1040	1.48	0.86 to 2.55	0.158				1.22	0.64 to 2.35	0.550
Dental caries	1049	2.07	1.34 to 3.19	0.001				1.47	0.85 to 2.54	0.166
Difficulties in fine motor, language or social skills, or sleep	1033	3.42	2.28 to 5.13	<0.001				3.15	1.96 to 5.07	<0.001

*Family related covariates: low maternal education, low paternal education, mother out of work, father out of work, mother smoking, living with one caretaker, having siblings and ADHD in the family. Weight group of parents is not included because missing values resulted in lower numbers, but the results were essentially the same when included (n=806 in model 1 and n=782 in model 2).
†Lifestyle covariates: sex, combined physical activity score poorer than peers, low nutritional standard, dental caries and difficulties in fine motor, language or social skills, or sleep.
ADHD, attention deficit hyperactivity disorder; NW, normal weight; OB, obesity; [26 27] OW, overweight; UW, underweight.

psychological problems, expressed as emotional symptoms, peer related problems and TDS90, than children with NW. However, after adjusting for numerous unfavourable family and child related factors, only UW and a BMI SDS similar to UW were independently associated with having psychological problems.

The lack of significant psychological consequences of having OW or OB may be unexpected since such associations are well documented in later life.[9–13] It may also be unexpected because preschool children are conscious of and often express dissatisfaction with their body size, including a desire for a thinner or larger body shape.[31–33] However, despite this awareness, most preschool children seem to be satisfied with their appearance.[33 34] The size may not have a psychological impact at this age because acceptance is largely dependent on the attitudes of the parents.[32] Furthermore, although anti-OB attitudes may occur as early as at 3–5 years of age, they do not generally occur in a playmate selection.[35] The vast majority of our children were in kindergarten from 2 years of age, and we suggest that this social setting over years may have

reduced any tendencies to focus on body size. It has also been reported that girls who were followed from 5 to 7 years of age, tended to idealise a larger body size than their own at 5, but a thinner size at 7.[34] However, despite a desire to have a different body size, the girls were satisfied with their appearance, even at 8 years of age.[34] The authors therefore suggested that a desire for a different body size represented a cognitive construct without implying psychological consequences.

Our finding that the occurrence of psychological difficulties did not differ between children with OW and NW in any of the analyses, may not be surprising because we have previously shown that Norwegian children with OW are usually perceived by their parents as having a normal body proportion.[36] Furthermore, BMI may not be a good measure to differentiate between OW and NW in young children because OW may mainly be due to a high lean body mass.[37]

The finding that UW per se was associated with psychological difficulties has, to our knowledge, not been reported previously for this age group. In later

childhood, children with UW, which also implies shorter stature and lower muscle mass, were almost as likely to be teased by peers as children with OB.[38] Dominance, and even bullying and victimisation, are common phenomenon during preschool years,[39] and we suggest that the children with UW may suffer from being the weaker or least robust part in a kindergarten setting. Alternatively, that parents' worry for their lean children[19 20] or restrictive attitude to their children's eating behaviour,[20] may have had a negative influence on the children's mental health. However, we suggest that the latter explanation is less likely since UW, as opposed to OW and OB, was not associated with sociodemographic or family behavioural factors, but with low weight and length at birth and their parents' BMI which may imply genetic predisposition.[21]

There has been an ongoing debate on the significance of ADHD or other behavioural problems as risk factors for OW and OB. Two meta-analyses concluded that ADHD is a risk factor for adolescent and adult OW and OB, but not[15] or possibly a minimal risk factor[14] for childhood OW and OB. Cortese *et al* did not state the age of included children in their meta-analysis, but from the text it is unlikely that young children were included.[14] No preschool children were included in the systematic review by Nigg *et al*.[15] There was no association between behavioural problems and OW or OB in our study, which is in line with the findings in a large Norwegian cohort who was assessed with The Child behaviour Checklist at 18 and 36 months of age.[40] In another Norwegian study of children aged 6–12 years, mothers of children with OW and OB rated their children lower on energy, optimism, compliance, concentration, perseverance and self-confidence, and higher on egocentricity, irritability and anxiety than mothers of children with lower BMIs on the Norwegian Hierarchical Personality Inventory for Children.[41] These children were older, but we cannot exclude that preschool children with OB may have psychological symptoms that was not detected with the SDQ.

The strengths of the study were the unselected regional setting where we could assume that the participants were reasonably representative of all the eligible children and families, and the extensive information on the families and children who participated. We cannot exclude selection bias since we had no information on social or health issues on families who declined to participate. However, the participation rate varied from 20% to 85% in the different municipalities[21] suggesting that varying motivation by public health nurses to recruit families had a greater impact on the participation rate than potential selection bias. The somewhat limited number of participants with weights other than NW and dependencies on reports by parents on questionnaires rather than professional assessments were other weaknesses.

CONCLUSION

Our results suggest that the excess occurrence of psychological difficulties in preschool children with OW and OB was due to stresses related to family factors rather than their body size. UW and a low BMI was associated with having psychological symptoms, also after adjusting for family-related factors. We suggest that the reason may be that children with UW are the weaker part in a group setting like kindergarten although we cannot exclude that parental concern or restrictive attitudes were of significance.

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