

High prevalence of overweight and obesity among 6-year-old children in  
Finnmark County, North- Norway.

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Short title: Childhood obesity in Finnmark, Norway.

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## **Abstract**

**Aim:** The aim was to determine the prevalence of overweight and obesity among 6–year-old children in Finnmark, the northernmost county of Norway.

**Methods:** This is a survey of 1774 children born during 1999 and 2000 from 18 of 19 child health care centres in Finnmark. Body mass index data extracted retrospectively in 2007 from health records at the age of 6 years was compared with international definitions of over- and underweight. The prevalence figures were further compared with socio-demographic figures on municipality level.

**Results:** Overall, 19 % of the children were classified as overweight or obese; 5 % were classified as obese. The prevalence of overweight and obesity was higher among girls (22%) than among boys (16%) ( $p < 0.01$ ). The prevalence of underweight was 8 % among both girls and boys. Despite large variations in the prevalence of overweight and obesity between municipalities (9-35%), no association was found with municipality figures on socio-demographic factors.

**Conclusion:** In the northernmost county Finnmark, the prevalence of overweight including obesity among 6- year-old children was somewhat higher than in previous surveys from Norway, especially among girls.

## **Keywords**

Child health care centre, Child obesity, Overweight, Prevalence.

### Key notes

- In this survey from Finnmark County 2007, the prevalence of overweight including obesity was 19 % among 6-year-old children and overweight was more prevalent among girls.
- These figures are somewhat higher compared with other surveys in Norway carried out in the same period.
- Child health care centres in Norway collect valuable information on child health.

## **Introduction**

Childhood obesity represents a major risk factor for chronic disease and is associated with social and psychological problems in addition to decreased health related quality of life (1). Overweight children and adolescents have a high risk of becoming overweight as adults (2), with a higher premature mortality in the future as a possible consequence on the population level (3).

Childhood overweight and obesity have reached epidemic proportions worldwide, and the obesity problem is on the rise in low and middle-income countries (4). Data from the US showed the combined prevalence of overweight and obesity among school children to be above 35 % using body mass index (BMI) based on International Obesity Task Force (IOTF) recommended definitions (5, 6).

International surveillance data suggests a similar worldwide epidemic following US trends (7, 8). In Europe, 20 percent of children and adolescents are estimated to be overweight and 1/3 of these obese according to IOTF guidelines (9). A variety of cut-off values and definitions have been used, making it difficult to compare prevalence data between studies (10). International cut-off values for overweight as well as underweight as provided by the IOTF (5, 11) and WHO (12) make comparisons of weight deviations easier.

In spite of increased general awareness and actions taken by national governments to counteract the paediatric obesity epidemic, overweight and obesity prevalence continues to increase in Europe (13). Even if recent studies indicate the rates to stabilize in some countries, the authors emphasise that the prevalence figures are still unacceptably high (14).

At the Department of Paediatrics, Hammerfest Hospital Norway we experienced high and increasing numbers of referrals concerning obese children as we entered the new millennium. As a part of the preparation for an intervention study among overweight and obese children, we wanted to learn more about the extent of childhood overweight and obesity in our region. Prevalence studies concerning overweight among children in the urban areas of Oslo, Bergen and Tromsø have been published (15-18), suggesting prevalence rates that are similar to those reported from other Northern and Western European countries (17). Data from the Norwegian Institute of Public Health indicate an overall increase in the prevalence of overweight in Norwegian 9-year-old children in recent years (19). The prevalence of childhood overweight and obesity in a whole region or county of Norway has to our knowledge not been studied previously.

The aim of the current study was therefore to document the prevalence of childhood overweight and obesity in Finnmark and to investigate obesity variations within the county. Furthermore we wanted to explore if differences between municipalities in ethnicity, rural/urban patterns and numbers in full employment, income and educational level were associated with the prevalence of childhood overweight and obesity.

## **Material and methods**

### **Child population**

Finnmark is the northernmost, largest (46,000 km<sup>2</sup>) and most rural county of Norway, with a total population of 73,000 inhabitants. The largest municipality has a population of 19,000, while 13 out of the 19 municipalities have less than 3000 inhabitants. Three main ethnic groups live in this region; the indigenous Sami, the ethno cultural Kvens of Finnish origin, and Norwegians, who represent the majority of the population. Each municipality has one public child health care centre where children are examined regularly from birth to school age in accordance with national preventive health program guidelines. Most child health care centres carry out weight and height measurements in connection with primary school entry at age 5-6 years. We sent a request to all child health care centres in Finnmark during spring 2007 asking for data on height and weight measurements among 1<sup>st</sup> grade school children born during 1999 and 2000. Overall, 18 municipalities provided data; one municipality did not participate because of vacancies at the centre at the time the study was performed. This municipality had a total population of 972 and only 16 children born during 1999 and 2000.

We received data on 1779 children born in 1999 and 2000 who had been examined at the local child health care centre. This number constitutes 85 and 87 per cent respectively, of 1<sup>st</sup> grade children in these municipalities during 2005 and 2006. Weight data were missing for five children and the final number included in the analysis was 1774.

### **Methods**

**Data and measurements:** Local public health nurses performed the measurements as a part of routine examinations. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, with the children wearing light clothing, according to general principles in the routine preventive health program. Anonymised data on age, sex, height, weight and municipality of residence was extracted retrospectively in 2007 from local health records by the staff at the child health care centre. BMI was calculated as  $\text{kg/m}^2$  and the children were categorised as normal weight, overweight or obese according to IOTF reference values (5). Age at last birthday and reference values at midyear were used to classify children as overweight or obese. Throughout this manuscript the term overweight including obesity (OWOB) corresponds to an adult  $\text{BMI} \geq 25 \text{ kg/m}^2$  and the term obese (OB) corresponds to an adult  $\text{BMI} \geq 30 \text{ kg/m}^2$ , based on the IOTF cut-off values for BMI. Underweight was calculated and estimated as defined in a large international survey (11). For the purpose of this survey, the underweight group was combined with the normal weight group for further analysis.

We characterised the municipality as Sami according to the administrative area of the Sami language, as urban if the municipality had an official status as a town and numbers of inhabitants according to Statistics Norway 2011 (20).

Data on education, employment and income level was made available by Statistics Norway, Facts on municipalities. These variables are used by Statistics Norway as key socio-demographic indicators on the municipality level. The percentage of adult population with a high (tertiary) educational level was given for each municipality, defined as more than 13 years of education. This corresponds to education at academy, college or university level. The proportion of inhabitants above the age of



18 who were fully employed and information on mean annual income was also collected for each municipality, and figures from 2008 and 2009 were utilised. For each of the three indicators, we allocated the municipalities into two groups, either above or below the mean value for Finnmark. The mean proportion of inhabitants with a high academic educational level in Finnmark (Norway) was 21 % (26 %), mean level of full employment was 69 % (70 %) and mean annual total income was 306 000 NOK (345 000 NOK).

**Statistics:** All statistical analysis were performed with SPSS, version 15 (SPSS Inc. Chicago, IL, USA) and Stata version 11.0 (StataCorp 4905 Lakeway Drive ,College Station, Texas 77845 USA ). Pearson Chi2 tests were used to analyse differences in proportions. Significance level was set at  $p= 0.05$ . The analyses were also performed on each gender separately.

**Ethics and approval :** As a part of the clinical trial “Activity School in Finnmark”, the study was approved by The Regional Research Ethics Committee.

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## Results

Height and weight measurements of 1774 1st grade school children (896 girls and 878 boys) born during 1999 and 2000 with mean age of 6.2 years (SD 0.6) were available for analysis. The mean BMI was 16.2 kg/m<sup>2</sup> (SD 2.2)

Overall, 19 % (n=331) had a BMI above the IOTF cut-off values for overweight including obesity (OWOB) and 5 % (n=91) of the children had a BMI above the cut-off value for obesity (OB). The prevalence of OWOB was 22 % among girls and 16 % among boys (p<0.01). The prevalence of obesity did not differ significantly between girls and boys (5.8 % versus 4.4 %, p= 0.12) A total of 7.8 % (n=138) children were categorised as underweight; no sex differences were found (girls 7.8 % vs boys 7.7 %) (Table 1).

The prevalence of OWOB ranged from 9 % to 35 % in the municipalities (data not shown), and three municipalities had figures above 30 %. No difference in the prevalence of OWOB was seen between Sami and other municipalities, between municipalities defined as urban or rural, or between municipalities with numbers of inhabitants more than 9000 compared with the others. Furthermore we did not observe any variation in the prevalence of obesity associated with the proportion of inhabitants with higher academic educational level, level of employment or mean annual income at the municipality level (Table 2). We found similar results when analysing each gender separately.

## Discussion

The findings from this survey showed that the prevalence of overweight was 19 % among 6- year-old children in Finnmark and that the occurrence of OWOB was more frequent among girls; 22 % versus 16 % in boys ( $p < 0.01$ ). The prevalence of overweight ranged from 9 % to 35 % in the municipalities and we were not able to identify factors associated with this variation on the population/municipality level.

The study had a high attendance rate and 18 of 19 municipalities of this county were represented. In this survey 86 % of the children attending 1st grade at primary school met at the child health care centre. The corresponding percentages in Norway as a whole were 89 % and 92 % in 2005 and 2006, respectively. Public health nurses involved in this study reported that reasons for non- attendance were non-differential conditions such as illness, family temporarily absent from home, emigration/immigration etc, and there were no indications of an attendance bias based on socio-economic status or ethnicity. The data was collected in connection with routine child health services and no standardised or quality control procedures were performed. Although we cannot exclude the possibility of systematic measurement errors because of unequal routines in the different municipalities, we anticipate such errors to be non-differential, affecting categorisation of weight groups equally (21).

BMI is widely used as an indirect method for measuring body fat and international standard definitions for overweight and obesity were applied in this study (5).

The prevalence of overweight and obesity among children was somewhat higher in our study compared with other surveys performed in other regions of Norway in the same period, using similar criteria. From earlier surveys we know that adult

inhabitants of Finnmark have a lower mean educational level, are to larger extent daily smokers, have higher mortality from coronary heart disease and have a shorter life time expectancy compared with national average for Norway (20, 22). A high prevalence of overweight and obesity among adults and adolescents in the three northernmost counties of Norway has been pointed out in earlier studies (23). A national representative study conducted by the Norwegian Institute of Public Health in 2008 among 9-year-old children classified 17 % of girls and 14 % of boys as OWOB according to IOTF cut-off criteria. Two years later, the OWOB prevalence was 22 % among girls and 17 % among boys in a similar national survey. In the Region North (two counties, n = 371) the overall prevalence of OWOB increased from 19 % to 23 % (p= 0.08). Although Finnmark was not represented in the national surveys, the authors concluded that the results indicated a higher prevalence of overweight and obesity in the Northern and Central part of Norway compared with the other regions (19). In our study, the prevalence of overweight and obesity among 1st grade children in Finnmark was slightly higher than the OWOB prevalence of 15 % among 6-year-old children in Bergen in 2003-2006) (17). The present prevalence estimates were also higher than those among 9-year-old children in Oslo in 2005; ( OWOB prevalence 18 %) (16), but slightly lower than the prevalence among 8- and 12-year-old children in Oslo ( OWOB prevalence 21 %) (15).

A higher prevalence of overweight was observed in girls in the current study in accordance with several other studies of children at preschool age (17, 18, 24, 25) and in contrast to studies among older children (15, 16). The sensitivity of the IOTF-criteria was estimated significantly lower among 7-year-old boys as compared to girls in a study from the United Kingdom, and the author pointed out the risk of

reporting artificial differences in obesity prevalence between the sexes (26). One might speculate whether the higher prevalence among young girls compared to boys are due to the classification criteria, and not due to gender difference as such in the youngest age groups.

On the municipality level we did not find differences in the prevalence of childhood overweight and obesity between Sami and Norwegian municipalities. An increasing prevalence of obesity has been observed among various aboriginal populations such as Inuits from Greenland, Alaska and Canada, and Australian Aboriginal people (27). Nystad et al found that Sami men were less centrally obese than Norwegian men, where as Sami women were more obese than Norwegian women according to standardised measurements of BMI and waist circumference (28). We cannot rule out ethnic differences between Sami and Norwegian children related to overweight and excess body fat, as individual information on ethnicity was not collected for the current study.

Earlier studies have pointed out higher prevalence of obesity in rural than urban areas in Western countries (29). We did not find a difference in obesity prevalence between “urban” and “rural” municipalities and on a global scale Finnmark County would probably be regarded as entirely rural.

In Norway as in other countries, an association has been observed between overweight in children and socio-economic factors, especially parents` education (17, 30). Unfortunately this study lacks individual information on socio-demographic factors. Analysing these factors on a municipality level is a crude approach. The

prevalence of OWOB was higher among school children in the Central and Eastern districts of Oslo, where the socio-economic level is generally lower than in Western districts (15). In our analysis we did not observe any variation in the prevalence of OWOB associated with variation in mean income, proportion of employment and proportion of inhabitants with academic education on the municipality level. These results might be in contrast to a study among 4-year-old children from Sweden (24) which reported higher prevalence of overweight and obesity in municipalities with low socio-economic level, in particular among girls. In order to compare different studies however, standardised measures of socio economic level are needed. Since no association was found by cross tabulation, multilevel analysis was not performed in this study. Larger samples and individual information might be required to detect possible associations between socio-economic factors and the prevalence of OWOB within this county.

The high prevalence rate of childhood obesity in Finnmark may possibly be associated with the lower income and educational level in this region compared with national average for Norway. However, because national county wise comparative studies are lacking, we cannot draw any conclusion on this issue.

In the setting of municipality child health care centres, public health nurses collect data on height and weight of virtually all children in Norway. However, the data is stored locally in electronic records and is not systematised in local or national registries or published on a regular basis. Getting access to and collecting anonymised data was a time consuming process in this study. This valuable information from the general child population could be made more readily available

in order to monitor and explore the epidemiology of childhood obesity. The information could help us to better understand the epidemic, evaluate the effects of former initiatives and address new preventive strategies.

### **Conclusion**

There was a high prevalence of overweight and obesity among 6-year-old children in Finnmark County compared with earlier surveys performed in other regions of Norway. The prevalence of overweight and obesity was significantly higher in girls compared with boys using the IOTF cut-off criteria. Data from child health care centres are important public health indicators and should be made more easily accessible for publication.

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### **Competing interests**

None disclosed

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## Tables

**Table 1** The prevalence of underweight, overweight (OWOB) and obesity (OB) among 6-year-old children, born during 1999 and 2000 Finnmark County, Norway.

Gender	Normal		Underweight*		Overweight (OWOB)*		Obese (OB)*		Total
	n	%	n	%	n	%	n	%	
<b>Girls</b>	629	70.2	70	7.8	197	22.0 <sup>†</sup>	52	5.8	896
<b>Boys</b>	668	76.1	68	7.7	142	16.2 <sup>†</sup>	39	4.4	878
<b>Total</b>	1297	73.1	138	7.8	339	19.1	91	5.1	1774

\* Underweight, overweight including obesity and obesity according to IOTF cut- off criteria and Cole et al (5)(11) .

<sup>†</sup> p< 0.01 Chi-square for gender difference.

**Table 2** Characteristics of the municipalities, proportion inhabitants with higher (tertiary) educational level, inhabitants fully employed, mean average annual income at the municipality level and prevalence of overweight (OWOB) and obesity (OB) among 6- year-old children in Finnmark County, Norway.

Municipality characteristics	Normal*		Overweight (OWOB*)		Obese (OB*)		Total n	p value <sup>‡</sup>
	n	%	n	%	n	%		
<b>Sami</b>	238	84.7	43	15.3	12	4.3	281	0.08
<b>Norwegian</b>	1197	80.2	296	19.8	79	5.3	1493	
<b>Urban</b>	1048	80.8	249	19.2	63	4.9	1297	0.90
<b>Rural</b>	387	81.1	90	18.9	28	5.9	477	
<b>Inhabitants &gt; 9000</b>	838	81.9	185	18.1	51	5.0	1023	0.20
<b>Inhabitants &lt; 9000</b>	597	79.5	154	20.5	40	5.3	751	
<b>Proportion with higher educational level<sup>†</sup> (%)</b>								
≥ 21	1055	80.6	254	19.4	63	4.8	1309	0.60
< 21	380	81.7	85	18.3	28	6.0	465	
<b>Proportion employment (%)</b>								
≥ 69	1007	80.9	238	19.1	61	4.9	1245	0.90
< 69	428	80.9	101	19.1	30	5.7	529	
<b>Average income (NOK)</b>								
≥ 306 000	1010	80.9	239	19.1	62	5.0	1249	1.00
< 306 000	425	80.1	100	19.1	29	5.5	525	

\* Normal and underweight, overweight including obesity and obesity according to IOTF cut-off criteria (5).

<sup>†</sup> Academy, college, university education, ≥ 13 years of education.

<sup>‡</sup> Chi-square, difference in prevalence of overweight between groups of municipalities.