

# Prevalence of overweight and obesity in the Netherlands in 2003 compared to 1980 and 1997

Katja van den Hurk, Paula van Dommelen, Stef van Buuren, Paul H Verkerk, Remy A HiraSing

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See end of article for authors' affiliations

Correspondence to:  
Stef van Buuren,  
TNO Quality of Life,  
PO Box 2215,  
2301 CE Leiden,  
The Netherlands;  
Stef.vanBuuren@tno.nl

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**Objective:** To assess the prevalence of overweight and obesity in children living in the Netherlands and compare the findings with the Third and Fourth National Growth Studies carried out in 1980 and 1997, respectively.

**Design and methods:** Data were obtained from the child health care system. International cut-off points for body mass index (BMI) were used to determine overweight and obesity. Cases were weighted for ethnicity and municipality size in such a way that the sample matched the distribution in the general population. The LMS method was used to calculate the age-related distribution of BMI, and the prevalence was calculated from the fitted distribution.

**Patients:** Data on 90 071 children aged 4–16 years were routinely collected by 11 community health services during 2002–2004.

**Results:** On average, 14.5% of the boys and 17.5% of the girls were overweight (including obesity), which is a substantial increase since 1980 (boys 3.9%, girls 6.9%) and 1997 (boys 9.7%, girls 13.0%). Similarly, 2.6% of the boys and 3.3% of the girls aged 4–16 years were obese, which is much higher than in 1980 (boys 0.2%, girls 0.5%) and 1997 (boys 1.2%, girls 2.0%). At the age of 4, 12.3% of the boys and 16.2% of the girls were already overweight.

**Conclusions:** The prevalence of overweight and obesity in the Netherlands is still rising, and at an even faster rate than before. Evidence-based interventions are needed to counter the obesity epidemic, and there is an urgent need for pre-school intervention programmes.

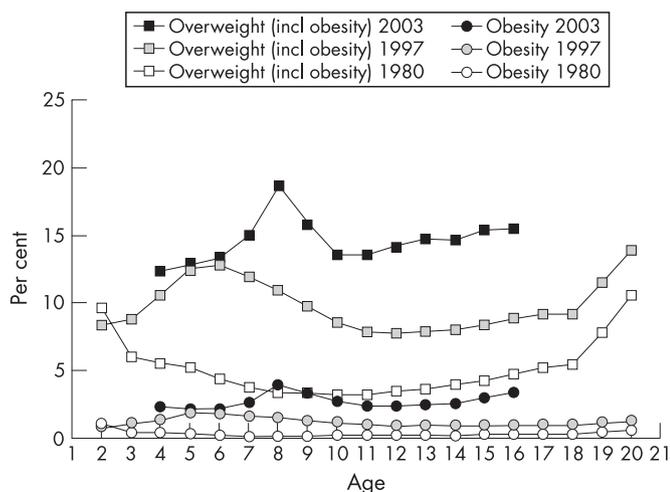
Overweight is a rapidly growing global public health problem. Overweight and obesity increase the risk of early mortality and severe illnesses, such as heart and vascular diseases, diabetes and psychosocial problems.<sup>1–5</sup> Awareness of obesity in the Netherlands has increased, especially after the results of the Fourth National Growth Study in 1997 showed a substantial increase in the prevalence of overweight and obesity since 1980.<sup>6,7</sup> It is not known whether, and if so, how the situation has changed since 1997. The aim of this study was to determine the prevalence of overweight and obesity in 2003, and to compare the results to those of earlier studies carried out in 1980 and 1997.

## METHODS

The child health care system in the Netherlands routinely monitors the health of approximately 95% of all 0–19-year-old children living in the Netherlands.<sup>8</sup> Local community health services examine children aged 4–19 years, and a number of these organisations maintain an electronic record for each child. We obtained from these records data on height, weight, age, gender, and postal code or municipality of residence. Since the child health care system uses standardised methods to measure children, we did not include data on children who were examined on indication.

The body mass index (BMI) of the children was calculated, and they were classified as normal (including underweight), overweight (including obesity) or obese, based on internationally accepted cut-off points.<sup>9</sup> The results are presented according to gender and age. Because the sample was not random, it contained a relatively high number of children from large cities and from Turkish and Moroccan ethnic minorities, populations which are known have a higher prevalence of overweight.<sup>10</sup> The sample was therefore reweighted in such a way that the proportion of cases per combination of city size and ethnicity equalled that in the population of all children living in the Netherlands on January 1, 2003.<sup>11</sup> The LMS model of Cole and Green was used to fit the age-conditional distribution of BMI for all children living in the Netherlands separately for boys and girls.<sup>12</sup> P-splines were used to smooth the distribution over age, the calculations were carried out using the R-function GAMLSS<sup>13</sup> and the worm plot was used to assess the quality of the solution.<sup>14</sup> The prevalence of overweight and obesity according to age and gender was calculated from the fitted L, M and S curves.

The prevalence of overweight and obesity in 1997 for all children living in the Netherlands was calculated as a weighted average of the published Dutch, Moroccan and Turkish prevalences.<sup>10</sup> The weights used were 0.933, 0.031 and 0.036,



**Figure 1** Prevalence of overweight (including obesity) and obesity in boys living in the Netherlands, according to age (in 1980, 1997 and 2003).

**Table 1** Number of children measured during 2002–2004, according to community health service and age (complete years lived)

Health service	Age (years)													Total
	4	5	6	7	8	9	10	11	12	13	14	15	16	
Den Haag	1418	4089	126	1288	1857	12	1	2	2	99	146	36	1	9077
Eemland	30	3074	2968	207	0	0	0	0	271	3084	2129	190	0	11 953
Eindhoven	10	1108	604	0	0	6	906	746	1195	1212	147	8	0	5942
Fryslan	0	0	0	0	0	102	5269	4125	414	2	0	0	0	9912
Groningen	31	625	94	2	14	422	140	2	0	0	0	0	0	1330
Kennemerland	68	2740	1455	177	15	59	1992	1520	180	882	1845	479	59	11 471
Nijmegen	62	1671	394	9	1	22	801	969	1169	966	96	3	0	6163
OZ Limburg	71	1476	680	27	176	2289	710	55	148	895	1192	227	26	7972
Utrecht	33	1950	1977	202	36	1266	1484	331	948	1549	389	36	2	10 203
Z-H Noord	51	1663	627	40	31	100	595	353	56	797	1008	162	2	5485
Z-H Zuid	7	1024	1182	1365	1607	184	712	1057	167	1082	1781	380	15	10 563
Total	1781	19 420	10 107	3317	3737	4462	12 610	9160	4550	10 568	8733	1521	105	90 071

respectively, which correspond to the percentage of Dutch, Moroccan and Turkish children aged 5–15 years living in the Netherlands on January 1, 2003.<sup>11</sup> The prevalence of overweight and obesity in 1980 was calculated from the L, M and S curves of BMI data from the Third Dutch Growth Study in 1980, as published by Cole and Roede.<sup>15 16</sup>

**RESULTS**

Eleven community health services (31% of all the community health services in the Netherlands) provided routinely collected electronic data on height and weight. The total sample consisted of 90 071 children (approximately 3.8% of the child population) measured in the period 2002–2004. Table 1 lists the number of children per service, and their age.

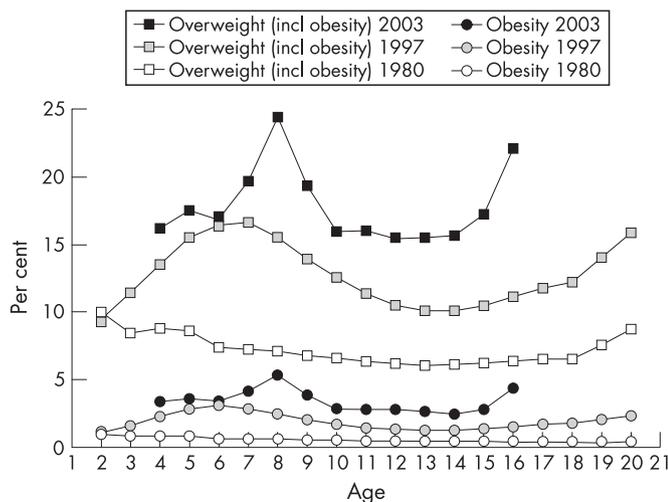
Figures 1 and 2 (boys and girls, respectively) show the prevalence of overweight and obesity in 2003. For comparison, the prevalences in 1980 and 1997 have also been plotted. More girls than boys were overweight and obese at nearly all ages and during all periods. In 1997, a peak occurred around the age of 6, and the prevalence was lower for older children. In 2003, the prevalence at the age of 6 was similar to the peak in 1997, but the peak in 2003 shifted towards the age of 8 (boys 18.7%, girls 24.4%). The differences in prevalence are fairly large during puberty. Children aged 6 in 1997 were approximately 12 years of age in 2003. By shifting the entire 1997 prevalence curves towards the right by 6 years, we can compare the prevalence within the same birth cohort at different time points. It appears

that for nearly all birth cohorts the prevalence in 2003 is equal to or higher than that in 1997. The generation of children born around the year 1995 seems to be particularly at risk of developing overweight and obesity. Note that in 1997, this generation had about the same prevalence as the 2-year-olds in 1980. The increase must thus have occurred between the ages of 2 and 8.

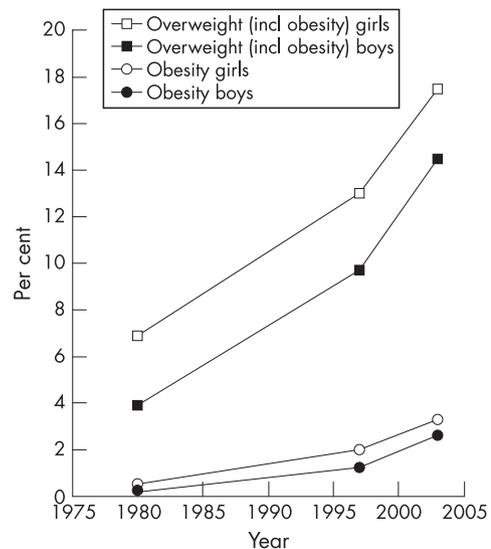
Table 2 shows the estimated prevalences in 1980, 1997 and 2003, with all ages combined. The prevalence of overweight and obesity rose between 1980 and 1997, and rose even faster between 1997 and 2003 (cf fig 3). For boys, the rate of increase in the prevalence of overweight between 1980 and 1997 was approximately +0.34% per year, whereas between 1997 and 2003 it was +0.80% per year. For girls the rate of increase was +0.36% and +0.75% per year, respectively. With regard to obesity, the rate of increase for boys was +0.06% and +0.23% per year, and for girls it was +0.09% and +0.22% per year. The rate of increase generally doubled or tripled between 1997 and 2003.

**DISCUSSION**

The 1997 study reported a large secular increase in the prevalence of overweight since 1980. The 2003 study indicates that this trend is continuing at an even faster rate. This finding is in line with results in other European countries.<sup>17</sup> In 2003, the



**Figure 2** Prevalence of overweight (including obesity) and obesity in girls living in the Netherlands, according to age (in 1980, 1997 and 2003).



**Figure 3** Secular trend in 1980–2003 in the prevalence of overweight (including obesity) and obesity in 4–15-year-old children living in the Netherlands.

**Table 2** Prevalence of overweight (including obesity) and obesity in 4–16-year-old children living in the Netherlands in 1980, 1997 and 2003

Age	Boys overweight (including obesity)			Obesity			Girls overweight (including obesity)			Obesity		
	1980	1997	2003	1980	1997	2003	1980	1997	2003	1980	1997	2003
4	5.5	10.5	12.3	0.3	1.4	2.3	8.8	13.5	16.2	0.8	2.2	3.4
5	5.2	12.6	12.8	0.3	1.9	2.1	8.6	15.5	17.5	0.8	2.9	3.5
6	4.4	12.9	13.2	0.2	1.9	2.1	7.4	16.4	16.8	0.6	3.0	3.4
7	3.7	11.9	15.0	0.1	1.6	2.7	7.3	16.6	19.7	0.6	2.8	4.1
8	3.5	10.9	18.7	0.1	1.4	3.9	7.1	15.5	24.4	0.6	2.5	5.4
9	3.3	9.7	15.8	0.1	1.2	3.4	6.8	13.9	19.3	0.5	2.0	3.9
10	3.2	8.5	13.4	0.1	1.0	2.7	6.6	12.6	15.9	0.5	1.7	2.8
11	3.2	7.9	13.5	0.1	0.9	2.4	6.3	11.4	16.0	0.4	1.4	2.8
12	3.4	7.8	14.1	0.2	0.9	2.3	6.1	10.5	15.5	0.4	1.3	2.8
13	3.6	7.8	14.8	0.2	0.8	2.4	6.0	10.0	15.5	0.4	1.2	2.6
14	3.9	8.0	14.6	0.2	0.8	2.5	6.1	10.1	15.6	0.4	1.2	2.4
15	4.2	8.4	15.4	0.2	0.9	3.0	6.2	10.4	17.2	0.4	1.3	2.8
16	4.7	8.8	15.5	0.3	0.9	3.3	6.4	11.1	22.0	0.4	1.5	4.4

prevalence of overweight in boys aged 4–16 years varied from 12.3% to 18.7% (average 14.5%), and in girls varied from 15.5 to 24.4% (average 17.5%). The prevalence of obesity was also higher among girls: 2.4% to 5.4% (average 3.3%) for girls compared to 2.1% to 3.9% (average 2.6%) for boys.

A particularly worrying aspect is that the dip in the prevalence after the age of 6 that was found in 1997 seems to have vanished in 2003. In 1997, two possible reasons were put forward to explain this: either the prevalence for 5–7-year-olds was higher because the cut-off points for these age-groups were somehow too low (methodological effect) or the cohort of children born since 1990 is structurally different (ie, heavier) than previous cohorts (cohort effect).<sup>7</sup> The 2003 results point strongly towards the second explanation of a structural cohort effect. Given the present analysis, a methodological effect seems highly unlikely.

It is not known what causes the difference in prevalence between girls and boys, which already exists before they go to school. In order to prevent young girls and boys (up to the age of 4) from becoming overweight, there is an urgent need for pre-school intervention programmes.

Two methods can be used to reliably compare the prevalence in regions of the Netherlands, or in other countries, with the prevalence curves presented here. The first option is to apply the methods used in the present study, including the LMS method,

and to compare the resulting age-smoothed prevalence curves directly. The second option is to classify children as normal, overweight or obese, based on the internationally accepted cut-off points for BMI, and then calculate the prevalence and the 95% confidence intervals per age group. An overlap of the confidence interval with the Dutch prevalence at the relevant ages would indicate that the difference between the observed prevalence and the expected prevalence could be due to chance.

## CONCLUSION

The global obesity epidemic is also occurring in the Netherlands, and evidence-based interventions are needed to halt the increase. The Dutch child health care system plays a vital role, because it examines all children living in the Netherlands and therefore provides good opportunities for intervention. Pre-school intervention programmes may be useful.

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## Authors' affiliations

**Katja van den Hurk, Paula van Dommelen, Stef van Buuren, Paul H Verkerk**, TNO Quality of Life, Leiden, The Netherlands  
**Remy A HiraSing**, EMGO Institute, VU Medical Centre, Amsterdam, The Netherlands

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## REFERENCES

- 1 **Fontaine KR**, Redden DT, Wang C, et al. Years of life lost due to obesity. *JAMA* 2003;**289**(2):187–93.
- 2 **Dietz WH**. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 1998;**101**(3 Pt 2):518–25.
- 3 **Wabitsch M**. Overweight and obesity in European children: definition and diagnostic procedures, risk factors and consequences for later health outcome. *Eur J Pediatr* 2000;**159**(Suppl 1):S8–13.
- 4 **International Obesity Task Force**. *Obesity in Europe: the case for action*. London: IOTF, 2002.
- 5 **Renders CM**, Delemarre-van de Waal HA, Dekker JM, et al. Insulin resistance and diabetes type 2 in overweight children. *Ned Tijdschr Geneesk* 2002;**147**(42):2060–3.
- 6 **Fredriks AM**, van Buuren S, Wit JM, et al. Body index measurements in 1996–7 compared with 1980. *Arch Dis Child* 2000;**82**:107–12.
- 7 **HiraSing RA**, Fredriks AM, van Buuren S, et al. Toegenomen prevalentie van overgewicht en obesitas bij Nederlandse kinderen en signalering daarvan aan

## What is already known on this topic

- Overweight is a growing global public health problem.
- Overweight and obesity increase the risk of early mortality and severe illness.
- The prevalence of overweight in Dutch children aged 0–20 doubled from 1980 to 1997.

## What this study adds

- The prevalence of overweight and obesity in the Netherlands is rising at an even faster rate than previously.
- More girls than boys are overweight and obese.
- There is an urgent need for pre-school intervention programmes.

- de hand van internationale normen en nieuwe referentiediagrammen. *Ned Tijdschr Geneesk* 2001;**145**:1303–8.
- 8 **Burgmeijer RJF**, van Geenhuizen YM, Filedt Kok-Weimar T, *et al.* *Op weg naar volwassenheid. Evaluatie jeugdgezondheidszorg 1996*. Leiden: TNO Preventie en Gezondheid/KPMG, 1997.
  - 9 **Cole TJ**, Bellizzi MC, Flegal KM, *et al.* Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;**320**(7244):1240–3.
  - 10 **Fredriks AM**, van Buuren S, HiraSing RA, *et al.* Alarming prevalences of overweight and obesity for children of Turkish and Moroccan origin, according to the international standard. *Acta Paediatr* 2005;**94**(4):496–8.
  - 11 **Netherlands Bureau of Statistics**. Statline. Available from [www.cbs.nl](http://www.cbs.nl) (accessed 8 August 2007).
  - 12 **Cole TJ**, Green PJ. Smoothing reference centile curves: the LMS method and penalized likelihood. *Stat Med* 1992;**11**:1305–19.
  - 13 **Rigby RA**, Stasinopoulos DM. Generalized additive models for location, scale and shape (with discussion). *Appl Stat* 2005;**54**:507–54.
  - 14 **Van Buuren S**, Fredriks AM. Worm plot: a simple diagnostic device for modeling growth reference curves. *Stat Med* 2001;**20**:1259–77.
  - 15 **Cole TJ**, Roede MJ. Centiles of body mass index for Dutch children aged 0–20 years in 1980 - a baseline to assess recent trends in obesity. *Ann Hum Biol* 1999;**26**:303–8.
  - 16 **Roede MJ**, van Wieringen JC. Growth diagrams 1980: Netherlands third nationwide survey. *Tijdschr Soc Gezondheidsz* 1985;**63S**:1–34.
  - 17 **Jackson-Leach R**, Lobstein T. Estimated burden of paediatric obesity and comorbidities in Europe. Part 1. The increase in the prevalence of child obesity in Europe is itself increasing. *Int J Pediatr Obes* 2006;**1**:26–32.

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