

- developed-countries-1950-2010/mortality-from-smoking-in-developed-countries-1950-2010 (1 March 2015, date last accessed).
- 5 WHO global report: mortality attributable to tobacco. [Internet]. Vasa. 2012 [cited 2013 Oct 7]. Available at: <http://medcontent.metapress.com/index/A65RM03P4874243N.pdf> (1 March 2015, date last accessed).
 - 6 Hill C. Mortalité attribuable au tabac. *Actualité et dossier en santé publique* 2012;81: 16–20.
 - 7 Thun MJ, Apicella LF, Henley SJ. Smoking vs other risk factors as the cause of smoking-attributable deaths: confounding in the courtroom. *JAMA* 2000;284: 706–12.
 - 8 Danaei G, Ding EL, Mozaffarian D, et al. The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Med* 2009;6:e1000058.
 - 9 Garfinkel L. Selection, follow-up and analysis in the American Cancer Society prospective studies. *Monogr Natl Cancer Inst* 1985;67:49–52.
 - 10 Peto R, Lopez AD, Boreham J, et al. Mortality from tobacco in developed countries: indirect estimation from national vital statistics. *Lancet* 1992;339: 1268–78.
 - 11 Levin M. The occurrence of lung cancer in man. *Acta Unio Internationalis Contra Cancrum* 1953;9:531–41.
 - 12 Thun MJ, Apicella LF, Henley SJ. Smoking vs other risk factors as the cause of smoking-attributable deaths: confounding in the courtroom. *JAMA* 2000;284:706–12.
 - 13 Hill C, Laplanche A. *Le tabac en France: les vrais chiffres*. Paris: La documentation française, 2004.

.....
European Journal of Public Health, Vol. 25, No. 5, 828–833

© The Author 2015. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved.
 doi:10.1093/eurpub/ckv051 Advance Access published on 13 April 2015

.....

Call for early prevention: prevalence rates of overweight among Turkish and Moroccan children in The Netherlands

Paula van Dommelen¹, Yvonne Schönbeck², Remy A. HiraSing³, Stef van Buuren^{4,5}

1 Department of Life Style, TNO, Leiden, The Netherlands

2 Department of Child Health, TNO, Leiden, The Netherlands

3 EMGO Institute for Health and Care Research, VU Medical Centre Amsterdam, Amsterdam, The Netherlands

4 Department of Life Style, TNO, Leiden, The Netherlands

5 Department of Methodology and Statistics, Utrecht University, Utrecht, The Netherlands

Correspondence: Paula van Dommelen, Department of Life Style, TNO, Schipholweg 77-89, 2316 ZL Leiden, The Netherlands, Tel: +31 88 866 6221, Fax: +31 88 860 613, e-mail: Paula.vanDommelen@tno.nl

Background: Monitoring overweight in risk groups is necessary. Our aim is to assess the trend in overweight and obesity in Turkish and Moroccan children in the Netherlands since 1997 and to monitor the levels of lifestyle-related behaviours in 2009. **Methods:** We selected cross-sectional data of Turkish and Moroccan children aged 2–18 years from two national Growth Studies performed in 1997 and 2009 in the Netherlands. Lifestyle-related behaviours were obtained in the 2009 study by questionnaire. **Results:** In 2009, 31.9% of Turkish and 26.6% of Moroccan children had overweight, whereas this was, respectively, 26.7% and 19.6% in 1997. Already at 2 years, 21.1% in Turkish and 22.7% in Moroccan children had overweight in 2009. The prevalence of obesity was above 4% from 3 years onwards. High (i.e. $\geq 25\%$) prevalence rates of unhealthy lifestyle-related behaviours were found for not having breakfast (26–49%) among Turkish and Moroccan adolescent (i.e. 15–18 years) girls, consuming no fruit (29–45%) and watching TV/PC ≥ 2 h (35–72%) among all Turkish and Moroccan adolescents, no walking/cycling to school/day care among preschool children (2–4 years) (28–56%) and adolescents (34–94%), drinking ≥ 2 glasses of sweet beverages (44–74%) and being < 1 h physically active (29–65%) among all children. **Conclusion:** An upward trend of overweight and obesity occurred in Turkish and Moroccan children. Already at 2 years of age, one out of five Turkish and Moroccan children had overweight, which calls for early prevention with attention to specific lifestyle-related behaviours.

.....

Introduction

Over the past three decades, childhood overweight has reached epidemic proportions in most industrialized countries.^{1,2} Between 1955 and 2009, we conducted five national growth studies in the Netherlands to develop growth charts for youth health care and to study trends in overweight and thinness.^{3–13} These studies show that in 2009, 14% of Dutch children were overweight, 2% were obese and 0.59% were morbidly obese.^{9,10,12} This was a 2–3-fold higher prevalence in overweight, a 4–6-fold increase in obesity and a 7–8-fold increase in morbid obesity since 1980.⁵ In the two most recent studies, performed in 1997 and 2009, we also focused on the two largest ethnic minorities in the

Netherlands originating from Turkey and Morocco.^{7–9} In 1997, 27% of Turkish children and 20% of Moroccan children were overweight, whereas this was 10% in Dutch children.^{7–9} These results show that Turkish and Moroccan children in the Netherlands are at a higher risk for overweight. Therefore, monitoring levels and trends of overweight and obesity in these risk groups are necessary.

Overweight is often attributed to an imbalance between energy intake and energy expenditure.¹ The Dutch guideline for overweight in youth health care provides a changing plan aiming at exercise, playing outside, daily breakfast, fewer sweet beverages and fast food and less time spent in front of the television or computer, with fewer energy-rich snacks.¹⁴ Monitoring the levels of these lifestyle-related behaviours during childhood provides the health professional with

information on the specific behaviours that need special attention to prevent, detect and provide treatment to children with overweight.

The aim of our study is to assess the trend in overweight and obesity in Turkish and Moroccan children in the Netherlands since 1997 and to monitor the levels of lifestyle-related behaviours in 2009. We used the extended International Obesity Task Force (IOTF) cut-offs to define overweight and obesity.¹⁵

Methods

Ethics statement

Data collection for growth studies is one of the tasks of youth health care in the Netherlands. For these growth studies, written consent was not needed. Data were analyzed anonymously. Before measurement, consent was obtained for each child. The study and the way consent was obtained were approved by the Medical Ethical Review Board of Leiden University Medical Centre.

Data

Cross-sectional height and weight data of Turkish and Moroccan children were selected from the Fourth Dutch Growth Study in 1997 ($n=2223$ and $n=2204$ aged 2–20 years, respectively) and the Fifth Dutch Growth Study in 2009 ($n=2148$ and $n=2181$ aged 2–25 years, respectively).^{6–12} Data were obtained at Well Baby Clinics, Municipal Health Services (MHS), schools and a festival. In 2009, two additional samples were provided by the MHS of Amsterdam and The Hague. Children of Turkish and Moroccan descent were oversampled in the four major cities Amsterdam, Rotterdam, The Hague and Utrecht, where most children of Turkish and Moroccan origin in The Netherlands live. Lifestyle-related behaviours in the 2009 sample were obtained from the children or their parents by health professionals by means of a questionnaire ($n=883$ Turkish and $n=896$ Moroccan children). All measurements were standardized and performed by trained health professionals. Height was measured to the nearest 0.1 cm. Children were weighed, wearing underwear only, or a correction was made for clothes, on calibrated mechanical or electronic step scales. Weight was rounded to the nearest 0.1 kg. Children with diagnosed growth disorders and those on medication known to interfere with growth were excluded.

Measurements

Ethnicity was defined according to the country of birth of the parents. Turkish: if mother was born in Turkey or if mother was born in the Netherlands and father was born in Turkey; Moroccan: if mother was born in Morocco or if mother was born in the Netherlands and father was born in Morocco. Parental education was defined as the educational level of the highest educated parent and categorized into low, medium and high.¹⁶ We obtained information on the following lifestyle-related behaviours: having breakfast (yes, no, unknown), eating fruit (yes, no, unknown), the number of sweet beverages (i.e. soft drinks) (<1 glass, 1, 2, 3, >3 glasses, unknown), the duration of time watching TV/PC (<30 min, 30–60 min, 60–120 min, 120–240 min, ≥ 4 h, unknown), the duration of physical activity (e.g. walking, cycling, sports, outdoor playing) (<30 min, 30–60 min, 60–120 min, ≥ 2 h, unknown), transport to school/day care (walking by themselves, cycling by themselves, by car, different, unknown). We asked to give information about the previous day (yesterday). For example, did the child have breakfast yesterday? Potential risk behaviours were defined as not having breakfast, not eating fruit, drinking ≥ 2 glasses of sweet beverages, watching TV/PC ≥ 2 h, <1 h physically active, neither walking nor cycling to school/day care.¹⁴

Statistical analyses

Prevalence rates of overweight (including obesity) and obesity by age, sex, ethnicity and year were calculated using the extended international (IOTF) body mass index (BMI: kg/m²) cut-offs applied to the BMI references from the Dutch national growth studies in 1997 and 2009.¹⁵ The BMI references of the Dutch, Turkish and Moroccan children in 1997 and the Dutch in 2009 have already been published.^{7–10} To obtain the BMI references of the Turkish and Moroccan children in 2009, we used the LMS method in the GAMLSS package.^{17,18} With L (skewness), M (median) and S (coefficient of variation) references, each BMI can be converted into a Standard deviation Score (SDS) or *z* score. SDS of measurement *x* is calculated as $((x/M)^L - 1)/LS$ (when $L \neq 0$) or $\ln(x/M)/S$ (when $L=0$). This SDS expresses the measurement in relation to BMI of children of Turkish or Moroccan origin in the Netherlands in 2009 in units of standard deviations above or below the median and is useful to detect trends in both mean and variability.

Relative risks (RR) and their 95% confidence intervals (95% CIs) were estimated for overweight (including obesity) and obesity between boys and girls between 1997 and 2009. Also, RR (95% CI) were estimated for obesity within overweight between 1997 and 2009.

Similar to overweight, prevalence rates of potential risk behaviours were also calculated by age, sex and ethnicity (in the 2009 sample). To obtain smooth prevalence rates, we performed logistic regression analyses with each behaviour as dependent variable and age (in years), age squared (to include a potential U-shaped relation) centred on mean age, sex, ethnicity, all two-way interactions with sex and origin and the three-way interactions year, sex and ethnicity and age-squared centred on mean age, sex and ethnicity as independent variables. Predicted probabilities were obtained from each model to obtain the prevalence rates. Logistic regression analyses were also performed in subgroups of sex and ethnicity to confirm the found relations.

P values <0.05 (two sided) were considered statistically significant. R version 2.9.0 with GAMLSS package¹⁸ was used to estimate the BMI references for the Turkish and Moroccan children in the Netherlands. All other statistical analyses were performed in SPSS version 20.0 for Windows.

Results

Tables 1 and 2 show the BMI references of, respectively, the Turkish and Moroccan children in 2009. Figure 1 presents the trends of overweight and obesity between 1997 and 2009 in the Netherlands in 2–18-year olds. There have been significant upward trends in overweight in Turkish and Moroccan children [respectively, RR=1.19, 95% CI(1.09–1.31) and RR=1.36, 95% CI(1.22–1.52)]. In 2009, 31.9% of Turkish and 26.6% of Moroccan children had overweight, whereas this was, respectively, 26.7% and 19.6% in 1997. Also for obesity, significant upward trends occurred in children of Turkish and Moroccan origin [respectively, RR=1.40, 95% CI(1.12–1.74) and RR=1.55, 95% CI(1.20–2.00)]. In 2009, the prevalence of obesity was 8.4% in Turkish and 6.5% in Moroccan children, whereas this was, respectively, 6.0% and 4.2% in 1997. Non-significant upward trends were found in the proportion of obesity within overweight children. Obesity increased from 22 to 26% in Turkish overweight children (RR=1.19, 95% CI(0.97–1.45) and from 21 to 24% in Moroccan overweight children [RR=1.14, 95% CI(0.90–1.44)]. Relatively small differences in overweight between low and high educated parents were found in Turkish (33.2% low vs. 27.5% high) and Moroccan children (25.4% low vs. 22.1% high).

Figure 2 shows the prevalence of overweight and obesity in the Netherlands among Turkish and Moroccan children in 2009. Already at 2 years, 21.1% in Turkish and 22.7% in Moroccan children had overweight. No significant differences were found

Table 1 LMS values for the BMI (kg/m²) references in Turkish 0–21-year olds in 2009 by age and sex

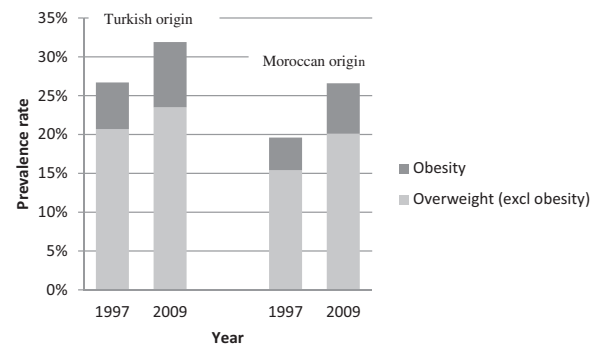
Age (years)	Boys			Girls		
	L	M	S	L	M	S
0.0767 ^a	-0.115	16.78	0.0953	-0.104	15.13	0.0852
0.2500	-0.332	17.29	0.0944	-0.291	16.30	0.0858
0.5000	-0.592	17.74	0.0934	-0.507	17.22	0.0864
0.7500	-0.802	17.90	0.0930	-0.679	17.52	0.0869
1.0000	-0.973	17.85	0.0930	-0.826	17.46	0.0873
1.2500	-1.111	17.69	0.0934	-0.962	17.27	0.0877
1.5000	-1.225	17.48	0.0941	-1.089	17.02	0.0883
1.7500	-1.319	17.30	0.0949	-1.207	16.76	0.0891
2.0000	-1.395	17.15	0.0957	-1.316	16.54	0.0902
3.0000	-1.574	16.69	0.1004	-1.648	16.14	0.0962
4.0000	-1.631	16.39	0.1082	-1.830	16.04	0.1045
5.0000	-1.622	16.25	0.1186	-1.884	15.96	0.1140
6.0000	-1.577	16.42	0.1297	-1.816	16.12	0.1243
7.0000	-1.516	16.89	0.1399	-1.672	16.56	0.1350
8.0000	-1.448	17.50	0.1484	-1.506	17.23	0.1447
9.0000	-1.379	18.16	0.1546	-1.352	18.06	0.1530
10.0000	-1.311	18.82	0.1586	-1.220	18.92	0.1595
11.0000	-1.247	19.45	0.1609	-1.108	19.70	0.1643
12.0000	-1.187	20.03	0.1619	-1.014	20.36	0.1675
13.0000	-1.131	20.58	0.1618	-0.936	20.94	0.1693
14.0000	-1.080	21.09	0.1610	-0.873	21.48	0.1702
15.0000	-1.032	21.57	0.1598	-0.819	21.96	0.1705
16.0000	-0.987	22.03	0.1583	-0.772	22.39	0.1705
17.0000	-0.945	22.45	0.1568	-0.730	22.77	0.1703
18.0000	-0.905	22.86	0.1553	-0.692	23.11	0.1699
19.0000	-0.867	23.25	0.1537	-0.657	23.43	0.1696
20.0000	-0.830	23.62	0.1522	-0.625	23.72	0.1692

L, skewness; M, median; S, coefficient of variation.
a: 0.0767 = 4 weeks.

Table 2 LMS values for the BMI (kg/m²) references in Moroccan 0–21-year olds in 2009 by age and sex

Age (years)	Boys			Girls		
	L	M	S	L	M	S
0.0767 ^a	2.642	15.62	0.0850	-1.705	14.94	0.1029
0.2500	1.990	16.67	0.0861	-1.719	16.08	0.0999
0.5000	1.203	17.59	0.0861	-1.732	17.03	0.0970
0.7500	0.568	17.90	0.0848	-1.739	17.37	0.0947
1.0000	0.060	17.90	0.0833	-1.745	17.40	0.0926
1.2500	-0.351	17.77	0.0822	-1.750	17.26	0.0908
1.5000	-0.685	17.59	0.0818	-1.755	17.09	0.0894
1.7500	-0.954	17.41	0.0822	-1.761	16.95	0.0885
2.0000	-1.169	17.24	0.0831	-1.766	16.83	0.0883
3.0000	-1.666	16.68	0.0871	-1.781	16.28	0.0930
4.0000	-1.861	16.22	0.0922	-1.773	16.05	0.0984
5.0000	-1.883	15.93	0.0983	-1.733	16.02	0.1040
6.0000	-1.792	15.99	0.1065	-1.662	16.14	0.1131
7.0000	-1.649	16.34	0.1165	-1.570	16.48	0.1252
8.0000	-1.506	16.81	0.1279	-1.473	16.98	0.1387
9.0000	-1.388	17.33	0.1393	-1.380	17.59	0.1518
10.0000	-1.304	17.86	0.1496	-1.293	18.23	0.1630
11.0000	-1.259	18.43	0.1575	-1.215	18.89	0.1713
12.0000	-1.242	19.01	0.1629	-1.144	19.56	0.1769
13.0000	-1.240	19.59	0.1663	-1.080	20.21	0.1802
14.0000	-1.245	20.17	0.1682	-1.020	20.84	0.1816
15.0000	-1.253	20.73	0.1691	-0.964	21.42	0.1819
16.0000	-1.262	21.26	0.1695	-0.911	21.95	0.1818
17.0000	-1.271	21.76	0.1698	-0.859	22.44	0.1816
18.0000	-1.279	22.24	0.1701	-0.811	22.89	0.1816
19.0000	-1.286	22.69	0.1705	-0.764	23.31	0.1817
20.0000	-1.291	23.11	0.1709	-0.719	23.71	0.1818

L, skewness; M, median; S, coefficient of variation
a: 0.0767 = 4 weeks.

**Figure 1** Trends in prevalence of overweight and obesity in the Netherlands among boys and girls of Turkish and Moroccan origin in 1997 and 2009

between boys and girls of Turkish origin [32.6% and 31.2%, RR = 0.96 95% CI(0.85–1.09)] and Moroccan origin [24.8% vs. 28.3%, RR = 1.14 95% CI(0.99–1.31)]. In Turkish and Moroccan children, the prevalence of obesity was above 4% from 3 years onwards.

Figure 3A–E shows the prevalence rates of unhealthy lifestyle-related behaviours among Turkish and Moroccan children aged 2–18 years. High (i.e. $\geq 25\%$) prevalence rates of unhealthy lifestyle-related behaviours were found for not having breakfast (26–49%) among Turkish and Moroccan adolescent (i.e. 15–18 years) girls. High rates among all Turkish and Moroccan adolescents were found for consuming no fruit (29–45%), watching TV/PC ≥ 2 h (35–72%) and walking/cycling to school (34–94%). Among all children, high rates were found for drinking ≥ 2 glasses of sweet beverages (44–74%) and being < 1 h physically active (29–65%). The rates for being < 1 h physically active were higher among adolescent girls (57–65%) compared with adolescent boys (29–33%). Among preschool children (2–4 years), high rates were found for drinking ≥ 2 glasses of sweet beverages (50–61%), being < 1 h physically active (39–56%) and no walking/cycling to day care (28–56%).

Discussion

Our study showed a significant increase in overweight and obesity between 1997 and 2009 in 2–18-year-old children of Turkish and Moroccan origin in the Netherlands. In 2009, the prevalence of overweight was 31.9% in Turkish children and 26.6% in Moroccan children. These overweight rates were 2-fold higher than children of Dutch origin in the Netherlands.¹⁰ More than 20% of Turkish and Moroccan children in the Netherlands already had overweight at 2 years of age. High prevalence rates of unhealthy lifestyle-related behaviours were found, also in very young children.

One out of five Turkish and Moroccan 2-year olds in the Netherlands had overweight. This could potentially be attributed to a high maternal BMI before pregnancy,¹⁹ a high weight gain due to composition and amount of food during the first 6 months of life¹⁹ and cultural and religious norms influencing unhealthy lifestyle-related behaviours.²⁰ A low socio-economic status explains part of the differences, but the overweight prevalence rates are still higher among Turkish and Moroccan children compared with Dutch children with a low socio-economic status.^{10,12} The prevalence of unhealthy lifestyle-related behaviours among Turkish and Moroccan children is high and already starts at an early age. Our data reveal that already at 2–4 years of age, high prevalence rates of unhealthy lifestyle-related behaviours were found for daily drinking ≥ 2 glasses of sweet beverages, being < 1 h physically active and no walking/cycling to day care.

The higher rates of obesity in Turkish and Moroccan children compared with Dutch children are in agreement with the

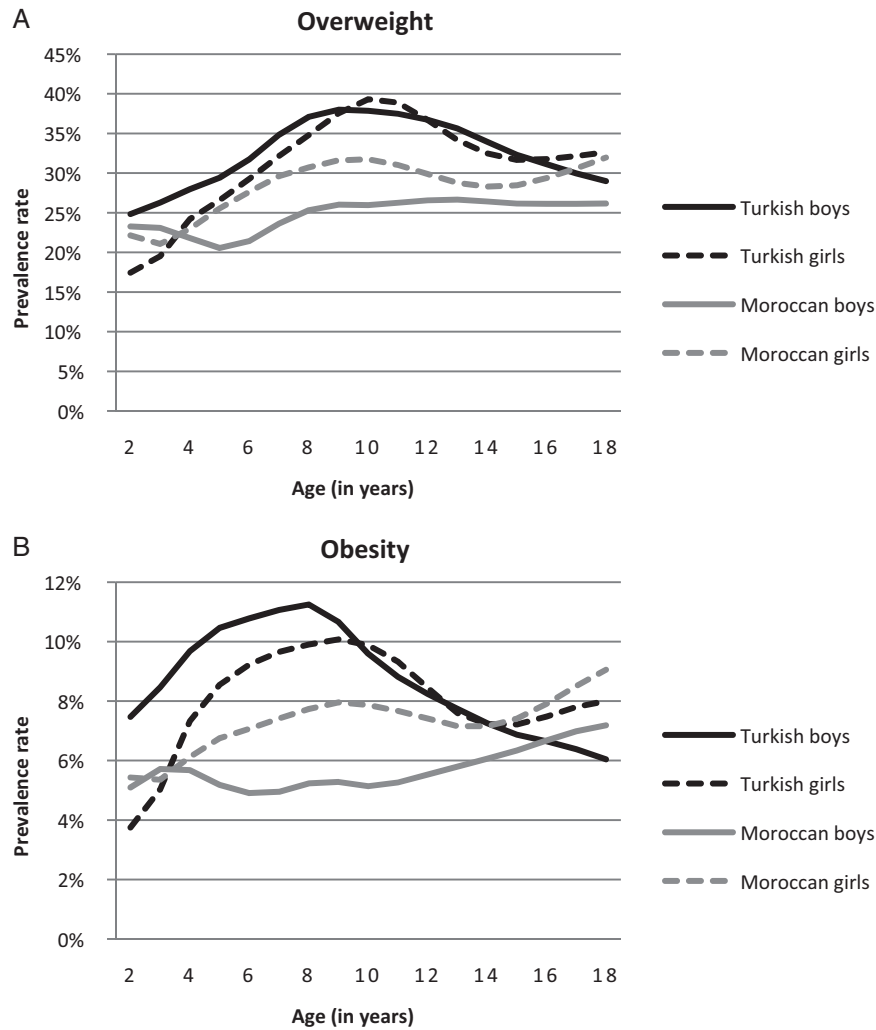


Figure 2 Prevalence of overweight (A) and obesity (B) in the Netherlands among boys and girls of Turkish and Moroccan origin in 2009

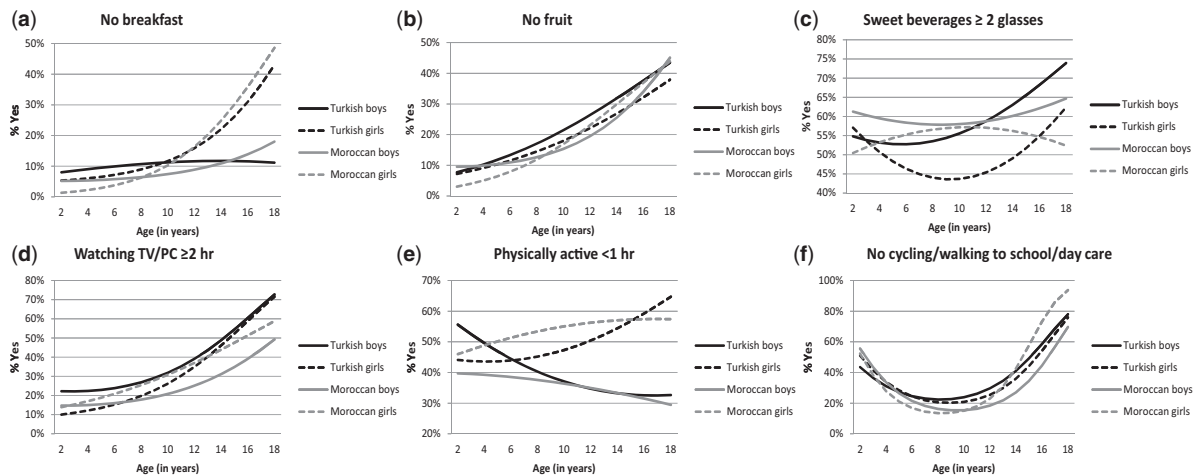


Figure 3 Prevalence of not having breakfast (A), not eating fruit (B), drinking ≥ 2 glasses of sweet beverages (C), watching TV/PC ≥ 2 h (D), < 1 h physically active (E), neither walking nor cycling to school/day care (F). We asked to give information about the previous day (yesterday)

systematic review of obesity and cardiovascular disease risk among Turkish and Moroccan migrant groups in Europe. A general finding is that obesity appears to be more common among Turkish and Moroccan migrant groups in Europe than among the populations of the countries they have emigrated to.²¹ This is in agreement with our study as overweight rates in children and

adolescents in Turkey in 2000–2010 varied between 9.9 and 17.6%,²² which is lower than 31.9% in Turkish children in the Netherlands. Similarly, overweight rates (defined as BMI $> +1$ SD at the WHO chart) in children in Morocco varied between 8.7 and 17.8%,^{23–25} which is lower than 26.6% in Moroccan children in the Netherlands.

Currently, the first signs of stabilizing or even declining overweight and obesity rates in children in developed countries, including a very slow decline in the city of The Hague in the Netherlands, have been published.^{26–28} However, the decline in overweight and obesity in The Hague was most pronounced in children of Dutch origin. In general agreement with our study, the study in The Hague showed that in 3–16-year-old children of Turkish origin, 24.8% were overweight in 1999 and 32.4% in 2011. Compared with the study in The Hague, overweight in our 2009 sample was more pronounced in children of Moroccan origin (26.6% in 2–18-year olds vs. 22.8% in 3–16-year olds in 2011) but less pronounced in our 1997 sample (19.6% in 2–18-year olds vs. 22.1% in 3–16-year olds in 1999). These differences may be caused by regional differences, year of study and age group. Since both studies do not show a decline in overweight among children of Turkish and Moroccan origin in the Netherlands, this further increases the large gap between origins and reveals that current prevention and intervention strategies might not reach and affect all groups equally. Cultural and ethnic differences in parental attitudes, beliefs and norms towards overweight, food, eating practices and exercise exist^{20,29} and need to be acknowledged for prevention and intervention programmes to be adopted by specific groups. Programmes that include a family, community and school component seem most promising to prevent overweight.^{30,31}

A limitation of our study is that we were not able to study associations between lifestyle-related behaviours and overweight, because of the cross-sectional design of our study (no causality) and the fact that we asked questions concerning the previous day (complicates measuring general/consistent behaviour). A strength of our study is the consistent methodology and inclusion/exclusion criteria and objective measurements of height and weight in the large national growth studies in 1997 and 2009.

This study shows that the prevalence rates of overweight, obesity and unhealthy lifestyle-related behaviours among Turkish and Moroccan children, already among the very young ones, are alarmingly high. There is a need for early culturally tailored prevention that already starts during pregnancy (maternal BMI), focuses on nutrition in the first 6 months of life and addresses healthy lifestyle-related behaviours during childhood.

Acknowledgements

We thank all the children, their parents and the community health care workers who participated in this study; ActiZ and GGD-Nederland for their cooperation in the study and ank Deltion College/OPOZ VU-Windesheim and GGD Amsterdam for kindly providing their data sets.

Funding

This study was funded by the Dutch Ministry of Welfare and Sports (grant numbers 312617/315319). The researchers were independent from the funder.

Conflicts of interest: None declared.

Key points

- Significant upward trends of overweight and obesity occurred in Turkish and Moroccan children in the Netherlands. In 2009, the prevalence of overweight was 31.9% in Turkish children and 26.6% in Moroccan children.
- Already at 2 years of age, one out of five Turkish and Moroccan children in the Netherlands had overweight.

- Health professionals should be aware of fast weight gain or a high weight between birth and 2 years of age and start appropriate interventions early.
- Specific lifestyle-related behaviours should be addressed before 2 years of age: <2 glasses of sweet beverages a day, ≥1 h physically active and walk/cycle to day care.

References

- 1 World Health Organization. World Health Organization: Factsheet No. 311, Obesity and overweight, 2011. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/> (7 October 2014, date last accessed).
- 2 de Onis M, Blössner M. Prevalence and trends of overweight among preschool children in developing countries. *Am J Clin Nutr* 2000;72:1032–9.
- 3 de Wijn JF, de Haas JH. Groeidiagrammen van 1:25 jarigen in Nederland [Growth diagrams for ages 1–25 years in the Netherlands]. Leiden: Nederlands Instituut voor Praeventieve Geneeskunde, 1960: 1–29.
- 4 van Wieringen JC, Wafelbakker F, Verbrugge HP, de Haas JH. *Growth diagrams Netherlands*. Leiden/Groningen: Nederlands Instituut voor Praeventieve Geneeskunde/Wolters-Noordhoff, 965: 1–69.
- 5 Roede MJ, van Wieringen JC. Growth diagrams 1980: Netherlands third nationwide survey. *Tijdschr Soc Gezondheidsz* 1985;64:1–34.
- 6 Fredriks AM, van Buuren S, Burgmeijer RJ, et al. Continuing positive secular growth change in The Netherlands 1955–1997. *Pediatr Res* 2000;47:316–23.
- 7 Fredriks AM, van Buuren S, Jeurissen SE, et al. Height, weight, body mass index and pubertal development reference values for children of Turkish origin in The Netherlands. *Eur J Pediatr* 2003;162:788–93.
- 8 Fredriks AM, van Buuren S, Jeurissen SE, et al. Height, weight, body mass index and pubertal development references for children of Moroccan origin in The Netherlands. *Acta Paediatr* 2004;93:817–24.
- 9 Fredriks AM, Van Buuren S, HiraSing RA, et al. Alarming prevalences of overweight and obesity for children of Turkish, Moroccan and Dutch origin in The Netherlands according to international standards. *Acta Paediatr* 2005;94:496–8.
- 10 Schönbeck Y, Talma H, van Dommelen P, et al. Increase in prevalence of overweight in Dutch children and adolescents: a comparison of nationwide growth studies in 1980, 1997 and 2009. *PLoS One* 2011;6:e27608.
- 11 Schönbeck Y, Talma H, van Dommelen P, et al. The world's tallest nation has stopped growing taller: the height of Dutch children from 1955 to 2009. *Pediatr Res* 2013;73:371–7.
- 12 van Dommelen P, Schönbeck Y, van Buuren S, HiraSing RA. Trends in a life threatening condition: morbid obesity in Dutch, Turkish and Moroccan children in The Netherlands. *PLoS One* 2014;9:e94299.
- 13 van Dommelen P, van Buuren S. Methods to obtain referral criteria in growth monitoring. *Stat Methods Med Res* 2013;23:369–89.
- 14 Kist-van Holthe JE, Bulk-Bunschoten AM, Renders CM, et al. Guideline 'overweight' for child health care. *Ned Tijdschr Geneesk* 2013;157:A4718.
- 15 Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes* 2012;7:284–94.
- 16 Verweij A. [Categorising educational level]. In: Volksgezondheid Toekomst Verkenning, editor. [The Dutch 2008 Public Health Status and Forecast Report]. Bilthoven, The Netherlands: RIVM.
- 17 Cole TJ, Green PJ. Smoothing reference centile curves: the LMS method and penalized likelihood. *Stat Med* 1992;11:1305–19.
- 18 Stasinopoulos DM, Rigby RA. Generalized additive models for location scale and shape (GAMLSS) in R. *J Stat Softw* 2007;23:7.
- 19 De Hoog ML, Van Eijsden M, Stronks K, et al. Overweight at age two years in a multi-ethnic cohort (ABCD study): the role of prenatal factors, birth outcomes and postnatal factors. *BMC Public Health* 2011;11:611.
- 20 Kocken PL, Schönbeck Y, Henneman L, et al. Ethnic differences and parental beliefs are important for overweight prevention and management in children: a cross-sectional study in the Netherlands. *BMC Public Health* 2012;12:867.
- 21 Brussaard JH, van Erp-Baart MA, Brants HA, et al. Nutrition and health among migrants in The Netherlands. *Public Health Nutr* 2001;4:659–64.
- 22 Bereket A, Atay Z. Current status of childhood obesity and its associated morbidities in Turkey. *J Clin Res Pediatr Endocrinol* 2012;4:1–7.
- 23 Benjelloun S. Nutrition transition in Morocco. *Public Health Nutr* 2002;5:135–40.

- 24 Musaiger AO. Overweight and obesity in eastern Mediterranean region: prevalence and possible causes. *J Obes* 2011;2011:407237.
- 25 Cherkaoui Dekkaki I, Mouane N, Ettair S, et al. Prevalence of obesity and overweight in children: a study in government primary schools in Rabat, Morocco. *Arch Med Res* 2011;42:703–8.
- 26 Olds T, Maher C, Zumin S, et al. Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *Int J Pediatr Obes* 2011;6:342–60.
- 27 de Wilde JA, Verkerk PH, Middelkoop BJ. Declining and stabilising trends in prevalence of overweight and obesity in Dutch, Turkish, Moroccan and South Asian children 3–16 years of age between 1999 and 2011 in the Netherlands. *Arch Dis Child* 2014;99:46–51.
- 28 Wabitsch M, Moss A, Kromeyer-Hauschild K. Unexpected plateauing of childhood obesity rates in developed countries. *BMC Med* 2014;12:17.
- 29 De Hoog MLA, Stronks K, Van Eijsden M, et al. Ethnic differences in maternal underestimation of offspring's weight: the ABCD study. *Int J Obes* 2012;36:53–60.
- 30 Van Der Kruk JJ, Kortekaas F, Lucas C, Jager-Wittenaar H. Obesity: a systematic review on parental involvement in long-term European childhood weight control interventions with a nutritional focus. *Obes Rev* 2013;14:745–60.
- 31 Bleich SN, Segal J, Wu Y, et al. Systematic review of community-based childhood obesity prevention studies. *Pediatrics* 2013;132:e201–10.

.....
European Journal of Public Health, Vol. 25, No. 5, 833–839

© The Author 2015. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved.
 doi:10.1093/eurpub/ckv071 Advance Access published on 4 April 2015

Prevalence of and contributing factors for overweight and obesity among Montenegrin schoolchildren

Milica Martinovic¹, Goran Belojevic², Gary W. Evans³, Dragan Lausevic⁴, Bogdan Asanin⁵, Mira Samardzic⁶, Natasa Terzic⁷, Snezana Pantovic⁸, Marina Jaksic⁹, Jelena Boljevic⁹

1 Department for Pathophysiology and Laboratory Medicine, Medical Faculty, University of Montenegro, Podgorica, Montenegro

2 Institute of Hygiene and Medical Ecology, Faculty of Medicine, University of Belgrade, Belgrade, Serbia

3 Department of Design and Environmental Analysis and of Human Development, Bronfenbrenner Center for Translational Research, Cornell University, Ithaca, NY, USA

4 Department of Epidemiology, Institute of Public Health of Montenegro, Podgorica, Montenegro

5 Neurosurgery Clinic, Medical Faculty, University of Montenegro, Podgorica, Montenegro

6 Clinical Centre of Montenegro, Institute for Children's Diseases, Podgorica, Montenegro

7 Department of Statistics, Institute of Public Health of Montenegro, Podgorica, Montenegro

8 Department of Biochemistry, Medical Faculty, University of Montenegro, Podgorica, Montenegro

9 Centre for Laboratory Diagnostics, Clinical Centre of Montenegro, Podgorica, Montenegro

Correspondence: Goran Belojevic, Institute of Hygiene and Medical Ecology, Faculty of Medicine, University of Belgrade, Dr Subotica 8, 11000 Belgrade, Serbia. Tel: +38 111 3612762, Fax: +38 111 2682852, e-mail: goran.belojevic@hotmail.com

Background: Newly emerging Western style economic systems provide new opportunities to study the prevalence and predictors of childhood obesity. We also provide for the first time a national study of childhood obesity using all three international anthropometric criteria. **Methods:** The sample included 4097 Montenegrin children, 2076 boys (50.7%) and 2021 girls. Anthropometric measurements were performed in school. The questionnaire for parents included questions on 24 potential contributing factors for childhood obesity. Nutritional status was assessed according to World Health Organization, US Center for Disease Prevention and Control and International Obesity Task Force (IOTF) criteria. **Results:** Overall percentage of Montenegrin children who are overweight or obese (IOTF) is 22.9% of which 5.3% are obese (7.0% boys vs. 3.5% girls). We found 10 factors to be independently associated with child obesity. Positive relations [odds ratio (95% confidence interval)] were found with maternal obesity [2.05 (1.68–2.51)], paternal obesity [1.67 (1.32–2.10)], paternal employment [1.40 (1.12–1.74)], maternal smoking [1.32 (1.08–1.61)], obesity at birth [1.33 (1.04–1.70)] and computer game playing [per hour—1.11 (1.00–1.24)]. Negative relations were found with female gender [0.64 (0.53–0.78)], the number of siblings [0.88 (0.78–0.98)], birth order [0.73 (0.64–0.83)] and age [0.92 (0.88–0.98)]. **Conclusion:** One out of four Montenegrin children is overweight, with two times more frequent obesity among boys compared with girls. Some previously salient predictors did not appear salient in this sample. To enable worldwide comparability, we propose the use of all three childhood obesity criteria in national studies.

Introduction

The prevalence of childhood obesity has doubled or trebled in the last three decades in most economically developed countries and in some low-income countries, predominantly in urban areas.¹ However, more recently the rate of increase of childhood obesity has slowed down, especially in developed countries.² According to OECD reports present prevalences of measured overweight and obesity among children aged 5–17 years equal or exceed 30% in

Greece (44% in boys; 38% in girls), Italy (36% in boys; 34% in girls), New Zealand (34% in boys; 34% in girls) and the USA (30% in boys; 30% in girls).³ Age standardized worldwide estimates among boys and girls aged <20 years show that the highest prevalences of overweight and obesity are in Kiribati (48% in boys; 66% in girls) and in Samoa (42% in boys; 50% in girls).² In Europe, there appears to be a north–south gradient with the highest obesity prevalence in southern European countries.⁴ There are difficulties in comparing national prevalences of childhood obesity