Trends in obesity, overweight and thinness in children in the Seychelles between 1998 and 2016

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Key points

What is already known about this subject?

- The prevalence of children and adolescents with overweight and obesity is increasing, often concomitant with a persistent burden of underweight
- While data for infants and adults exist in many countries, few studies have assessed the secular trends of children and adolescents with overweight or underweight in low and middle income countries
- WHO Member States have agreed on a target of 0% increase in the prevalence of overweight and obesity between 2010 and 2025 in both adults and adolescents

What does the study add?

- Based on yearly school-based surveys between 1998 and 2016, the prevalence of children and adolescents with overweight and obesity has markedly increased in the Seychelles
- The distribution of BMI was increasingly skewed over time, with increasing prevalence of obesity and morbid obesity, modest or null increase in BMI in a substantial proportion of the population, and a continued prevalence of underweight
- The uneven increase of BMI over time in the population underlies the need to study child growth trajectories and their associated determinants in order to tailor weight control strategies

Abstract

Objective: We assessed trends in the prevalence of children and adolescents with obesity, overweight, and thinness in the Seychelles, a rapidly developing nation in the Indian Ocean, and changes in the distribution of body mass index (BMI) over time.

Methods: Between 1998 and 2016, examination surveys were conducted every year in all students of four selected school grades (kindergarten, primary 4, secondary 1 and secondary 4) in all schools. We categorized BMI using the International Obesity Task Force criteria.

Results: Based on 70,187 observations, the prevalence of combined overweight or obesity increased largely and monotonically between 1998 and 2016, from 8.9% to 20.0% in boys and from 12.3% to 23.6% in girls, but the prevalence of underweight did not decrease. BMI increased mostly in the upper range of the BMI population distribution: percentile 5 (P5): -1.7%, P10: -0.8%; P25: 0.3%; P50: 2.5%; P75: 7.4%; P90: 12.7%; P95: 13.3%.

Conclusions: The distribution of BMI was increasingly skewed, with rising prevalence of obesity; modest or null increase in BMI in a substantial proportion of the population; and a continued burden of underweight. Further studies should assess child growth trajectories and their underlying determinants, which may bear significance for weight control strategies.

Introduction

Overweight and obesity are associated with orthopedic and psychosocial problems in childhood and, because obesity tends to track into adulthood, with diabetes, heart disease, certain cancers, osteoarthritis, lower quality of life, and premature death later in life (1). An estimated 108 million children had obesity worldwide in 2015 (an overall 5% prevalence) (2). The prevalence of overweight and obesity is increasing worldwide and the increase is steeper in low and middle income countries (LMICs) than in developed countries (2). However, while data on overweight and obesity in infant and adults are available in many countries, fewer data exist among school-going children and adolescents in LMICs (3) and very few are based on repeated population-based surveys conducted in a same population over extended periods of time in the African region.

While thresholds to define underweight (18.5 kg/m^2), overweight (25 kg/m^2) and obesity (30 kg/m^2) are based on health risk in adults, thresholds in children and adolescents are based on normative data, i.e. derived from the distribution of BMI in healthy pediatric populations. Several recommendations have been developed, including those from the World Health Organization (WHO) (4), the U.S. Centers for Disease Control and Prevention (CDC) (5) and the International Obesity Task Force (IOTF) (6, 7). The IOTF cut offs, which are based on normative data in six countries, have been used most often in public health research (8).

Several calls have been made to address the rising prevalence of overweight and obesity among children (9). In 2013, as part of the World Health Organization Global Action Plan for the Prevention and Control of Noncommunicable Diseases (10), all WHO Member States agreed on 25 targets including a zero percent relative increase in the prevalence of overweight and obesity in adolescents between 2010 and 2025. Countries also agreed to regularly assess and report on the prevalence of overweight and obesity among adolescents (10).

Overweight and underweight often coexist in populations. This double burden of malnutrition tends to be particularly large in countries undergoing socio-economic transition and it has been associated with widening economic disparities and increasing urbanization (11). This underlies the need for assessing changes in the whole BMI distribution in populations and not only focus on the prevalence of high or low categories. A few studies have assessed secular changes in the BMI distribution; they have generally found increasingly positively skewed distributions (12), but we are not aware of such studies in children and adolescents in LMICs. Assessing secular changes in the shape of the BMI distribution in populations is important to develop appropriate targets and interventions to address both overweight and underweight.

In this paper, we present results of annual national examination surveys in school-going children and adolescents aged 5-17 years conducted between 1998 and 2016 in the Seychelles. The study aims to update trends in overweight, obesity and underweight (thinness) between 1998 and 2016 and to assess changes in the distribution of BMI in the population over time. The findings can be relevant for weight control programs and policy in Seychelles and in other LMICs, particularly those undergoing rapid socio-economic transition.

Methods

The Republic of Seychelles is a rapidly developing small island state situated in the Indian Ocean in the Eastern African region. The country has experienced marked socio-economic development in the past few decades, largely driven by tourism, industrial fishing and an increasingly service-orientated economy. The gross national income per capita increased from $8,860 to $25,670 between 1990 and 2015 (13). The population was 97,026 in 2016 with 90% living on the main island of Mahé. The majority of inhabitants are of African descent with small minorities from Caucasian, Indian, Chinese and mixed descent. The government provides free health care to all inhabitants since several decades. Schooling in Seychelles is compulsory up to the age of 15-16 years, including crèche 1 and 2 [i.e. kindergarten], primary years 1 to 6, and secondary years 1 to 5; hence 13 school years in total. School enrolment is nearly 100% with more than 95% of children attending public schools with the others attending private schools.

The Ministry of Health has run a school health program in all schools for several decades. Within this program, around 15-20 school nurses assess a variety of health conditions among all students in crèche 2 (C2), primary year 4 (P4), secondary year 1 (S1) and secondary year 4 (S4) in all schools. Methods of this program, and selected findings up to 2004, were previously described (14-17). Briefly, during the years 1998 to 2016, all students in each of the selected four grades (around 1500 per grade, hence around 6000 students in total each year) were eligible for screening. The screening took place in secluded premises in the schools and a number of health conditions were assessed (eyes, ears, anthropometric variables, blood pressure, etc.). Nurses provide tailored health education and refer children with abnormal conditions to pediatricians. Student participation is on a voluntary basis and is subject to signed parental consent. Less than 1% of parents or students declined the screening.

Since 1998, anthropometric measurements of children were systematically recorded and entered in an electronic database. However, data entry was not performed between 2007 and 2010 due to lack of resources for data entry. In all schools, body weight was measured to the nearest 0.1 kg using precision electronic scales (Seca 870, Seca, Hamburg, Germany) and height was measured to the nearest 0.1 cm using fixed stadiometers (Seca 208). Weight and height were measured with children dressed in light clothes and without shoes. Nurses were trained about the screening procedures and instruments were checked for accuracy every year. BMI was calculated as body weight divided by body height squared (kg/m^2). The age-sex-specific International Obesity Task Force BMI criteria were used to define obesity, overweight, normal weight and thinness grades 1, 2 and 3; these categories are equivalent to the adult BMI cut-off points of 30, 25, 18.5, 17.0 and 16.5 kg/m^2, respectively, at the age of 18 years (6, 7).

A total of 70,826 observations were available between 1998 and 2016 (data entry was not performed between 2007 and 2010, as mentioned above). Information on age, sex, school grade, weight and height was available for 70,726 observations. We excluded 539 students with biologically implausible values for age (n=142), height (n=395) and weight (n=2). We considered height values ± 3 SD from the mean and age ±1.5 years from the grade-specific mean to be implausible. In total, 70,187 observations were available for analysis.

We calculated the prevalence of BMI categories by sex, school grade and calendar year. The overall prevalence by sex and calendar year was calculated by averaging the prevalence in all the 4 school grades. In addition to the analysis by calendar year, we also pooled data in 1998-2000 and in 2014-2016, and analyzed changes in BMI between these two periods. We chose three-year intervals to avoid including repeated observations for a same child (as children moved between Crèche 2, P4, S1 and S4 at intervals of 3-4 years). As there is no preferred method for examining changes in the BMI distribution in children over time (18), we analyzed these changes in three ways. First, we estimated the relative differences in mean BMI and in selected BMI percentiles in 1998-2000 vs. 2014-2016. Statistical significance ($p < 0.05$) was considered when the 95% confidence intervals did not overlap between the sex- and grade-specific mean and percentiles BMI estimates in 1998-2000 vs. 2014-2016. Second, we constructed quantile-quantile plots, plotting percentiles of BMI of the early study period (1998-2000) on the x-axis vs. percentiles of the final study periods (2014-2016) on the y-axis. In these plots, points that lie above and below the line of equality (x=y) represent increases or decreases in BMI over time. Third, we performed quantile regression of BMI over calendar years, for each sex and grade category to estimate the age-adjusted linear changes in BMI per 10 calendar years for each defined BMI percentile (P5, P10, P25, P50, P75, P90 and P95). We performed analyses using Stata IC 14.2. We considered P values less than 0.05 as statistically significant. For quantile regression, p-value <0.001 represent statistical significance after Bonferroni correction for multiple testing. Finally, in the context of the WHO global target of a 0% increase among school-aged children between 2010 and 2025 (10), we also calculated the prevalence of overweight and obesity in 2025, and the relative change in prevalence between 2010 and 2025, assuming sex-specific linear trends (i.e. linear regression) using the yearly prevalence estimates in 1998-2016.

Results

Table 1 provides information on the distribution of the participants and selected characteristics. There were between 3003 and 5774 students examined every year, with yearly participation rates ranging between 49% and 94%. The numbers of boys and girls included in the study were generally similar according to grade and calendar year (Table 1). The mean age of students in grades C2, P4, S1 and S4 was 5.4, 9.2, 12.5 and 15.5 years respectively. Mean age and height values did not change substantially during the study period (Table S1).

Figure 1 shows the mean prevalence of obesity, overweight, normal weight and thinness according to sex, school grade and calendar year. Between 1998 and 2016, the prevalence of overweight and obesity rose markedly and monotonically between 1998 and 2016 in boys (from 8.9% [95%CI: 7.5%-10.3%] to 20.0% [17.9%-21.6%]) and in girls (from 12.3% [10.6%-14.0%] to 23.6% [21.8%-25.7%]). The prevalence of underweight did not decrease significantly, e.g. the prevalence of combined thinness of grades 1, 2 or 3 changed from 23.4% (21.3%-25.6%) to 20.6 (18.8%-22.5%) in boys and from 22.9% (20.7%-25.2%) to 19.9% (18.1%-21.7%). The figure also shows that the secular increase of combined overweight and obesity over time was steeper in boys than in girls.

Comparing data in 1998-2000 vs. 2014-2016, the prevalence of combined overweight and obesity increased from 9.6% (95%CI: 8.9%-10.4%) to 19.6% (18.6%-20.6%) in boys (a relative difference [RD] of 104%) and from 15.1% (14.2%-16.0%) to 23.6% (22.6%-24.7%) in girls (RD 56%). Of note, the prevalence of BMI ≥40 kg/m^2 (which defines morbid obesity and is a criterion for bariatric surgery in adults aged 18 years and above) was as high as 0.97% (95%CI: 0.47%-1.78%) in boys and 0.35% (0.09%-0.88%) in girls in the S4 grade (mean age 15.5 years) in 2014-2016. The prevalence of thinness of grades 1, 2 or 3 did not change significantly, from 22.5% (95%CI: 21.5-23.6) to 21.3% (20.3% -22.3%) in boys and from 20.3% (19.3%-21.3%) to 21.0% (20.0%-22.9%) in girls. However, the prevalence of thinness of grade 3 increased from 1.4% (95%CI: 1.1%-1.7%) to 2.6% (2.2%-3.0%) in boys and from 2.2% (1.8%-2.6%) to 3.2% (2.8%-3.6%) in girls.

Figure 2 illustrates the relative differences (in percent) in mean BMI and in selected BMI percentiles (P5, P10, P50, P75, P90 and P95) in 2014-2016 vs. 1998-2000, based on the average of the changes observed in each of the 4 school grades (Table S2, see the two bottom lines). Mean BMI increased between the 2 periods by 5.4% in boys and 4.3% in girls. BMI increased more in the upper range than in the lower range of the BMI distribution: P5: -1.7%; P10: -0.8%; P25: 0.3%; P50 (median): 2.5%; P75: 7.4%; P90: 12.7%; and P95: 13.3%. The relative changes in mean BMI and in the selected BMI percentiles between the two periods were of grossly similar magnitude, irrespective of grade and sex (Table S2). Expressed in body weight, boys in the S4 grade gained 2.3 kg on average between 1998-2000 vs. 2014-2016, and weight change was -0.7 kg at P10; -1.1 kg at P25; 0 kg at P50; 2.8 kg at P75; 8.6 kg at P90; and 21.3 kg at P95. Girls in S4 took 2.0 kg on average, and weight change was -1.3 kg at P10; -0.9 kg at P25; 0.8 kg at P50; 4.0 kg at P75; 9.7 kg at P90; and 9.4 kg at P95.

Quantile-quantile plots comparing the population distributions of BMI in 2014-2016 vs. 1998-2000 in each school grade also demonstrate the increasingly skewed distribution of BMI over time (Figure S1).

Table 2 shows the linear increase of BMI per 10 calendar years based on linear quantile regression models run separately for each sex and school grade category. For example, mean BMI increased by 3.59 kg/m^2 (SE: 0.50, 95%CI: 2.6-4.6) per 10 calendar years in boys in S4 at P95 of the BMI distribution. The gain in BMI per 10 calendar years was large in the upper range of the BMI distribution (particularly at or above BMI percentile 75), but small at P50, and null or even negative at P10 or below. All changes at P50 or above were statistically significant (except for girls in S4). Regression coefficients were not statistically significant at P5 and P10, except for C2 children at P5 and for S4 girls at P5 and P10. Regression coefficients tended to be larger in boys than in girls, particularly at P75 or above, consistent with a steeper secular increase in BMI in boys than in girls. As expected, change in BMI per 10 calendar years was larger in magnitude in the later school grades (e.g. S4), consistent with increasing BMI with a child's age. When applying the Bonferroni correction for multiple testing for the estimates shown in Table 2, P-value of <0.001 can be considered as statistically significant; this does not alter the interpretation of the main findings described above.

Finally, we estimated the prevalence of overweight and obesity in 2025, in the context of the global WHO target of a 0% increase in the prevalence of overweight and obesity among school-aged children between 2010 and 2025 (10). Assuming linear trends of the yearly prevalence estimates between 1998 and 2016, the prevalence of overweight or obesity is expected to reach 26.3% among boys and 28.3% among girls in 2025, a relative difference of 55% in boys and 74% in girls, compared to 2010. The prevalence of obesity would be 11.6% in 2025 in boys (RD 74.1%) and 12.5% in girls (RD 57.9%).

Discussion

Based on repeated population-based surveys conducted yearly between 1998 and 2016, and using the IOTF criteria to define BMI categories in children, the combined prevalence of overweight and obesity in school-going children in the Seychelles doubled from 10.6% to 22.2% (boys: 8.9% to 20.0%; girls 12.3% to 23.6%). The prevalence of obesity alone tripled from 2.7% to 8.7% (boys 2.2% to 8.8%; girls: 3.2% to 8.4%). The population distribution of BMI was increasingly skewed over calendar years, with increasing BMI over time in the upper range of the BMI distribution, little or no change in BMI in a large proportion of children and adolescents, and a continued burden of underweight. These findings have important implications for weight control and prevention strategies.

The prevalence of combined overweight or obesity was higher in Seychelles (e.g. 22% in 2016) than in many LMICs and high income countries (e.g. <20% in several high income countries such as Japan, Germany, Switzerland, France), but lower than in others (e.g. >30% in Mexico, Brazil, Spain, Portugal, UK, USA, Barbados or Pacific islands) (8, 19-21). The Global Burden of Disease study group generated prevalence estimates for all countries using statistical models (2). The prevalence of combined overweight or obesity in Seychelles was estimated to be 10.6% in boys and 15.1% in girls aged 2-19 years in 2015 (2), which is nearly half of the actual prevalence of 20.0% (17.9%-21.6%) in boys and 23.6% (21.8%-25.7%) in girls in 2014-2016. This important discrepancy shows the limits of estimates relying on inference from scattered data sources and statistical modeling when predicting data at a country level.

In our study, the prevalence of combined overweight or obesity was higher in girls than in boys, consistent with the situation in many LMICs, particularly in Africa, but not in all of them, e.g. China, Mexico (20, 22). However, the prevalence of combined overweight or obesity in Seychelles increased at a steeper rate in boys than in girls in Seychelles so that more boys than girls could have overweight or obesity in the future. A number of factors may have driven the sex-specific secular trends of overweight and obesity in children and adolescents in Seychelles. Consistent with observations in adults in Seychelles (23), factors may include social norms that tend to associate overweight with fertility and social status, as noticed in many LMICs. However, it is possible that ideals of leanness, which are prevalent in western countries, are progressively replacing these traditional beliefs, at least among girls.

A main finding of our study was the increasingly skewed distribution of BMI over time, consistent with findings in other populations (12, 18, 24). This implies a larger increase of BMI over time in the upper tail of the BMI distribution, little change in BMI in the intermediate range, and a lack of increase of BMI in the lower tail of the BMI distribution. The increasingly positively-skewed BMI distribution over time is consistent with evidence that, in an obesogenic environment, individuals with a high BMI further gain weight (25). It has been suggested that individuals with obesity can be trapped in a vicious cycle in which obesity, mechanical complications of obesity such as arthritis and pain, and body dissatisfaction and associated anxiety, discourage physical activity and further increase energy intake (25). Inversely, some factors may help prevent overweight among children. In a cohort study among African Americans, a high quality diet was the strongest factor associated with maintenance of a stable BMI (26). The built environment also plays a role and factors such as safe neighborhood and access to playgrounds, parks, and sidewalks are associated with higher likelihood of BMI maintenance (27). Environmental factors may also trigger epigenetic modifications and result in an increased susceptibility of developing overweight and obesity in individuals exposed to detrimental conditions (28). Genetic factors, maternal factors and early-life factors such as birth weight, breastfeeding, rapid infant growth, sleep duration, meat and sweetened drink consumption, and low vegetables/fruit consumption can also alter the risk of childhood overweight and obesity (29-31). Additional research, particularly cohort studies, should further examine child growth trajectories and their underlying determinants in the population.

Increasing BMI over time in some, but not all children and adolescents, raises a number of issues. From a surveillance perspective, reliance on the sole changes in mean BMI and prevalence of overweight or obesity can only partially depict the epidemiologic trends of BMI in the population. These estimates do not convey information that a substantial proportion of the population may not become overweight or obese over time and that BMI may actually decrease over time in a substantial proportion of the population. It is therefore useful to provide BMI percentiles in addition to mean BMI and prevalence of overweight and obesity.

The increasingly skewed distribution of BMI in the population underlies the need for different weight control interventions. The increasing prevalence of obesity in the population may be considered a predictable biological response to an obesogenic environment (32). Therefore, multisectoral interventions need to address the determinants of the obesogenic environment and to promote settings that are conducive to a healthy diet and regular physical activity (9, 10, 33). Several areas of interventions may be particularly relevant for children and adolescents (9, 34), e.g. health promoting school programs (including healthy meals), regulations on marketing of junk foods, tax on sugar drinks, green areas, and safe roads to schools to favor active commuting. At the individual level, interventions should aim at preventing weight gain in healthy individuals and at controlling weight among overweight children. Children with moderate overweight may benefit from changes in lifestyle behaviors (35). The US Preventive Services Task Force recently recommended screening and referral of children and adolescents with obesity for "comprehensive, intensive behavioral interventions", including nutrition counseling, physical activity and behavioral change techniques, goal setting and problem solving (36). However, the large energy gap required in individuals with obesity to return to a normal BMI makes sustained weight loss difficult to achieve (35). Increasing evidence supports bariatric surgery in selected children with obesity in order to reduce the risk of adulthood obesity and its associated complications (37). With nearly 1% of adolescents aged 15-17 years having a BMI exceeding 40 kg/m^2 (a criterion for bariatric surgery in adults), and this prevalence being likely to further increase over time, our finding also points to the emerging need to address morbid obesity in children and adolescents.

Although the prevalence of thinness is globally lower in Seychelles than in several LMICs, the prevalence of thinness did not decrease in the 19-year study period, and the prevalence of extreme thinness, which is generally associated with malnutrition, has slightly increased. This may reflect factors such as persistent or increasing poverty and social inequality. In countries experiencing rapid economic growth, economic disparities can widen, with the persistence or accentuation of undernutrition in the poorest segments of the populations (11, 38). More generally, limited progress has been achieved towards reducing the prevalence of stunting -a marker of chronic malnutrition- in many LMICs between 2000 and 2015 (39, 40). Of note, several interventions to reduce underweight may benefit all children, including those with overweight, e.g. healthy meals programs in schools.

There are potential limitations of our study. First, the participation to the surveys varied over years. Missing data largely resulted from the inability of school nurses to complete the screening in all schools because of competing duties in health centers. Indeed, school nurses combine activities in both the schools and the nearby primary health care centers, with the priority given to clinical activities over the school heath program. For example, school nurses can be requested to replace nurses in health centers when nurses in health centers are sick, pregnant or absent for other reasons. In such instances, non-participation of children in the screening program in school is not related to children’s characteristics and this is not expected to bias the study estimates. Second, students with obesity might have participated less in screening programs by fear of stigmatization; this could result in some underestimation of the true obesity prevalence. Third, data were not compiled between 2007 and 2010 due to lack of resources. This did not alter the findings in early and late years of the study and would not alter the magnitude of the trends during the study period. Fourth, there may be some inaccuracy in data collection within a routine surveillance system, but random error is not expected to bias central estimates. Fifth, optimal cut-offs to define BMI categories in children and adolescents are still debated. However, our choice to use the IOTF criteria to define BMI categories should not alter the validity of our comparisons over time. Our study has several strengths. Eligible students in our study included all children in four selected grades in the country, which limits selection biases; the study sample sizes were large; the methods to assess anthropometric variables were identical throughout the study period; the surveys were conducted over a long time period; and the age range of the participants between 5 and 17 years was large. Analysis of secular BMI changes throughout the entire BMI distribution is also an important strength of the study.

Conclusions

The prevalence of children and adolescents with overweight or obesity doubled from 10.5% (95%CI: 9.4%-11.6%) to 21.8% (20.4%-23.1%) between 1998 and 2016 in the Seychelles. This large increase is not compatible with the global target of a 0% increase in the prevalence of overweight and obesity in school-going children between 2010 and 2025 agreed by all WHO Member States (10). However, BMI increased markedly only in a limited segment of the population, i.e. mainly among children and adolescents in the upper range of the BMI distribution, with little or no increase in a substantial the other segments of the population in the lower and intermediate ranges of the BMI distribution. Additional studies should further identify child growth trajectories and their determinants, which can bear important implications for weight control interventions. The increasingly skewed distribution of BMI in children and adolescents implies an increasing prevalence of morbid obesity, but also a continued burden of underweight. These findings highlight the need for public health interventions to promote a healthy nutrition and regular physical activity in the entire population as well as tailored individual-level interventions for children and adolescents with underweight or overweight.

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Table 1: Participants according to sex, school grade and calendar year, and overall mean age and height by sex and grade

	C2		P4		S1		S4		All 4 grades			Participation rate	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Total	Eligible	%
1998	379	341	345	314	405	393	443	383	1'572	1'431	3'003	6'161	48.7
1999	647	645	686	720	676	722	668	697	2'677	2'784	5'461	6'321	86.4
2000	447	421	557	553	366	346	423	513	1'793	1'833	3'626	6'465	56.1
2001	589	533	737	720	735	724	637	682	2'698	2'659	5'357	6'135	87.3
2002	616	563	580	577	769	777	569	662	2'534	2'579	5'113	6'269	81.6
2003	659	639	813	789	783	774	630	687	2'885	2'889	5'774	6'147	93.9
2004	631	571	759	709	494	512	551	605	2'435	2'397	4'832	5'761	83.9
2005	587	613	743	704	746	753	702	723	2'778	2'793	5'571	6'178	90.2
2006	580	576	676	617	760	752	727	732	2'743	2'677	5'420	6'178	87.7
2011	537	516	612	628	669	569	479	545	2'297	2'258	4'555	5'755	79.1
2012	611	574	652	596	479	564	601	643	2'343	2'377	4'720	5'799	81.4
2013	580	595	510	523	447	540	492	526	2'029	2'184	4'213	5'618	75.0
2014	637	619	641	652	511	578	474	475	2'263	2'324	4'587	5'866	78.2
2015	623	580	600	544	540	587	337	406	2'100	2'117	4'217	5'765	73.1
2016	593	607	632	637	380	401	217	271	1'822	1'916	3'738	5'845	64.0
Total	8'716	8'393	9'543	9'283	8'760	8'992	7'950	8'550	34'969	35'218	70'187	90'263	77.8
Weight	19.5	19.2	9,543	31.2	43.7	47.2	58.1	55.3					
SD	3.8	3.8	30.5	8.4	12.4	12.5	13.0	12.9					
Height	112.8	112.1	114.1	6.7	129.0	154.6	169.4	160.6					
SD	5.6	5.6	6.4	114.3	8.5	7.2	7.6	6.3					
Age	5.4	5.4	9.2	9.2	12.5	12.5	15.5	15.4					
SD	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5					

Table 2. Quantile regression coefficients of body mass index per 10 calendar years at selected percentiles of the BMI distribution

	P05			**P10**			**P50**			**P75**			**P90**			**P95**		
	Coef	SE	*P*	Coef	SE	*P*	Coef	SE	*P*	Coef	SE	*P*	Coef	SE	*P*	Coef	SE	*P*
Boys																		
C2	-0.09	0.04	*	-0.02	0.04	ns	0.12	0.03	**	0.29	0.05	***	0.60	0.11	***	0.89	0.23	***
P4	-0.03	0.05	ns	0.08	0.04	ns	0.29	0.04	***	0.87	0.10	***	2.05	0.21	***	2.12	0.26	***
S1	0.02	0.06	ns	0.09	0.06	ns	0.66	0.07	***	1.79	0.15	***	2.74	0.28	***	2.97	0.33	***
S4	-0.07	0.09	ns	-0.06	0.07	ns	0.23	0.07	**	0.95	0.13	***	2.30	0.29	***	3.59	0.50	***
Girls																		
C2	-0.15	0.04	***	-0.06	0.06	ns	0.09	0.04	*	0.31	0.06	***	0.53	0.12	***	0.94	0.17	***
P4	-0.01	0.06	ns	0.02	0.05	ns	0.36	0.06	***	0.94	0.12	***	1.43	0.17	***	1.69	0.27	***
S1	-0.07	0.08	ns	0.12	0.06	ns	0.47	0.08	***	1.11	0.14	***	2.04	0.25	***	2.20	0.30	***
S4	-0.44	0.10	***	-0.45	0.08	***	0.12	0.10	ns	0.74	0.17	***	2.00	0.33	***	2.24	0.38	***

Coef: linear quantile regression coefficient; SE: standard error.
ns: p>0.05; * <0.05; ** < 0.01; *** <0.001.