Introduction

The prevalence of obesity has increased dramatically during the past decades worldwide. Between 1980 and 2008, the world prevalence doubled from 5 to 10% among men and from 8 to 14% among women. In 2008, it was estimated that 1 billion adults were overweight and 500 million were obese worldwide.

If the trends continue, a majority of the world’s adult population will be either overweight or obese by 2030. Because obesity is associated with increased morbidity and mortality, this would lead to a great burden on health care systems as well as productivity losses to societies. Also, a growing body of literature indicates that obese individuals are stigmatized and discriminated against in a number of areas, including workplace, school, social settings and health care. Therefore, it is important to monitor national and regional trends in obesity.

Recent studies have suggested that the obesity prevalence has levelled off in several countries since the early 2000s. In an extensive review of the subject, Rokholm et al. concluded that the majority of the studies regarding both children and adolescents showed a stabilization or levelling off in the prevalence of obesity. However, among the included studies of adults, the results were diverging, with some of the studies reporting an increase in the prevalence of obesity and some a levelling off or a decrease.

The aim of the present study was to investigate the trends in body mass index (BMI) and obesity among adults during the period 2002–10 in Stockholm County, Sweden.

Trends in self-reported BMI and prevalence of obesity 2002–10 in Stockholm County, Sweden

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Background: Trends in obesity have been reported to level off in several Western countries. The aim of this study was to investigate trends in body mass index (BMI) and prevalence of obesity between 2002 and 2010 in Stockholm County, Sweden. Methods: Three cross-sectional questionnaires from the Stockholm Health Surveys were used for this study. A total of 31,182, 34,707 and 30,767 men and women aged between 18 and 64 years completed the questionnaire regarding sociodemographic factors, health parameters, physical activity, smoking habits and anthropometry in 2002, 2006 and 2010, respectively (response rate: 62.5, 61.3 and 55.6%, respectively). Linear regression was used to investigate changes in mean BMI. Relative risk regression models were used to investigate changes in prevalence of obesity, defined as BMI ≥ 30 kg/m². All analyses were stratified on age and further adjusted for smoking, education and socioeconomic position. Results: Between 2002 and 2006, a stabilization was found in BMI and prevalence of obesity in both men and women. But from 2006 to 2010, BMI and prevalence of obesity had increased, also among the young. In 2010, the prevalence of obesity was 12.2% among men and 10.3% among women. Conclusion: After a period of stabilization in 2002–06, BMI and prevalence of obesity are increasing in Stockholm County, Sweden.
Methods

Data were used from three cross-sectional questionnaires from the Stockholm Health Surveys from the years 2002, 2006 and 2010.

Study populations

The study populations consisted of individuals aged 18–84 years who were selected using a stratified random sampling design from the Stockholm County population with stratification for residential municipality. The Register of the Total Population, containing unique personal identification numbers for all Swedish citizens, was used to identify the individuals. Data collection was administered by Statistics Sweden.

Overall, 49 909, 56 634 and 55 341 individuals for the years 2002, 2006 and 2010, respectively, were invited by regular mail to participate in the surveys and complete a questionnaire regarding sociodemographic factors, health parameters, physical activity, smoking habits and anthropometry. The invited individuals were able to choose between a questionnaire on the internet (only 2006 and 2010) and a paper questionnaire. There were 31 182, 34 707 and 30 767 individuals, respectively, from the survey years 2002, 2006 and 2010 who completed the questionnaire (response rate: 62.5, 61.3 and 55.6%, respectively).

Variables

Age was stratified into the categories 18–24, 25–44, 45–64, 65–74 and ≥75 years. BMI (kg/m²) was calculated using the self-reported height and weight, where obesity was defined as BMI ≥ 30 kg/m². Smoking was self-reported and categorized into ‘never smoker’, ‘former smoker’ and ‘current smoker’. Socioeconomic position was assessed using data from the questionnaire on profession and categorized into blue collar, white collar, self-employed and other. Data on education were retrieved from the Swedish Register of Education and categorized into <9 years (only mandatory school), 9–12 years (also high school) and >12 years (university level or higher).

Statistical analysis

Linear regression models were used to investigate the change in mean BMI in the study populations during the years 2002, 2006 and 2010. Change in prevalence of obesity (BMI ≥ 30 kg/m²) was investigated with a relative risk regression model i.e. generalized linear model with binomial outcome and log-link, together with robust standard errors, using generalized estimating equations in SAS 9.2 proc genmod. The data sets provided by Statistics Sweden also included calibration weights, which were derived from population registers in order to account for non-response as well as the stratified study design. All regression analyses were weighted using the calibration weights. In the regression analyses, age was included as a categorical variable with an interaction for year of survey and conducted separately for men and women. All analyses were adjusted for age, smoking, education and socioeconomic position.

Ethical approval for the study was granted by the regional ethics committee at Karolinska Institutet, Stockholm, Sweden.

Results

Participant characteristics are shown in table 1. The samples consisted of 14 140 men and 17 042 women in year 2002, 15 623 men and 19 084 women in year 2006 and 13 457 men and 16 340 women in year 2010. Overall, the prevalence of obesity was slightly above 10% for both men and women, whereas the prevalence of overweight was 40% among men but only 25% among women. About 70% of the participants were in the age between 25 and 65 years, and about 50% among men and 60% among women were white collar workers. A higher proportion of the obese was blue collar workers, and a smaller proportion was white collar workers compared with the normal weight. Less than 18% were current smokers with small differences over BMI categories. One-fourth of the participants, mainly those aged ≥65 years, had not continued to high school, and of the remaining, about half had finished high school and the other half had also continued to university. Compared with individuals of normal weight, it was less common among the obese to have continued to high-school or university.

Table 1 Participant characteristics

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<td>BMI</td>
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<tr>
<td>Underweight (%)</td>
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<td>0.7</td>
<td>0.6</td>
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<td>Normal weight (%)</td>
<td>47.1</td>
<td>46.0</td>
<td>43.1</td>
<td>60.6</td>
<td>59.5</td>
<td>57.8</td>
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<td>Overweight (%)</td>
<td>40.9</td>
<td>40.9</td>
<td>41.9</td>
<td>25.5</td>
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<td>Obesity (%)</td>
<td>11.3</td>
<td>12.3</td>
<td>14.3</td>
<td>11.0</td>
<td>12.6</td>
<td>13.3</td>
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<td>18–25 (%)</td>
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<td>8.3</td>
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<td>25–45 (%)</td>
<td>36.5</td>
<td>34.7</td>
<td>30.1</td>
<td>38.8</td>
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<td>45–65 (%)</td>
<td>37.5</td>
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<td>36.2</td>
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<td>65–75 (%)</td>
<td>11.3</td>
<td>12.6</td>
<td>17.8</td>
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<td>&gt;75 (%)</td>
<td>7.3</td>
<td>6.9</td>
<td>7.5</td>
<td>8.1</td>
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<td>Socioeconomic position</td>
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<td>Blue collar (%)</td>
<td>31.7</td>
<td>27.9</td>
<td>27.6</td>
<td>27.6</td>
<td>25.0</td>
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<td>White collar (%)</td>
<td>51.9</td>
<td>49.7</td>
<td>51.9</td>
<td>61.1</td>
<td>57.3</td>
<td>61.9</td>
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<td>Self-employed (%)</td>
<td>10.4</td>
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<td>13.0</td>
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<td>Other (%)</td>
<td>6.1</td>
<td>10.4</td>
<td>7.5</td>
<td>7.2</td>
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<td>8.9</td>
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<td>Education, years</td>
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<td>&lt;9 (%)</td>
<td>25.8</td>
<td>25.9</td>
<td>20.7</td>
<td>24.9</td>
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<td>9–12 (%)</td>
<td>40.2</td>
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<td>40.6</td>
<td>39.0</td>
<td>37.3</td>
<td>38.8</td>
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<tr>
<td>&gt;12 (%)</td>
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<td>38.7</td>
<td>36.0</td>
<td>37.6</td>
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<td>Never smoker (%)</td>
<td>53.5</td>
<td>57.6</td>
<td>56.8</td>
<td>55.5</td>
<td>58.6</td>
<td>56.7</td>
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<tr>
<td>Former smoker (%)</td>
<td>31.1</td>
<td>28.6</td>
<td>31.9</td>
<td>27.0</td>
<td>25.6</td>
<td>30.4</td>
</tr>
<tr>
<td>Current smoker (%)</td>
<td>15.4</td>
<td>13.8</td>
<td>11.4</td>
<td>17.5</td>
<td>15.8</td>
<td>12.9</td>
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Change in mean BMI

Mean BMI increased from 25.0 to 25.1 kg/m² in the period 2002–06 (P = 0.19), and to 25.3 kg/m² in 2010 (P < 0.001).

When stratified on sex and age, mean BMI was stable or even decreasing from 2002 to 2006 (table 2). Between 2006 and 2010, small significant increases in mean BMI were observed for men aged 25–44 years (25.4 to 25.7 kg/m²), 45–64 years (26.4 to 26.7 kg/m²) and a larger increase for men aged ≥75 years (24.7 to 25.7 kg/m²). During the same period for women, significant increases in mean BMI were observed for the age categories 45–64 and ≥75 years (25.1 to 25.5 and 24.4 to 25.2 kg/m², respectively).

Figure 1 displays the BMI distribution of the cohorts from 2002, 2006 and 2010, stratified on sex. For both sexes, it can be seen that the proportion of normal-weight individuals has decreased over the period, the proportion of overweight has been stable, and the proportion of overweight and obese individuals has increased.

Change in prevalence of obesity

Statistical significant increases in prevalence of obesity were observed from 2002 to 2006 (9.0 to 9.6%, P = 0.01) as well as from 2006 to 2010 (to 11.5%, P < 0.001) for the entire population.

When stratified on sex and age, the prevalence of obesity increased for most age categories from 2002 to 2006 (except for young men and women aged 18–24 years and men ≥75 years), and for all categories from 2006 to 2010 (table 3). However, from 2002 to 2006, none of the increases was statistically significant, except for
women aged ≥75 years (from 6.4 to 9.0%). During 2006–10, significant increases in the prevalence of obesity were seen for men aged 18–24 years (2.0 to 4.2%), 25–44 years (9.5 to 11.1%), 45–64 years (14.4 to 16.8%) and for ≥75 years (5.2 to 11.4%). For women during the same period, significant increases were seen in the age-groups 18–24 years (2.1 to 3.7%), 45–64 years (12.4 to 14.7%) and ≥75 years (9.0 to 12.2%).

The prevalence of obesity was slightly higher among blue collar compared with white collar workers during all occasions. The trend of increasing prevalence of obesity over time was present in both groups, but a tendency toward a steeper increase in the blue collar group could be discerned for both men and women (data not shown).

Discussion

The aim of the present study was to investigate the trends in BMI and obesity during the period 2002–10 in Stockholm County, Sweden. Mean BMI for both women and men was unchanged from 2002 to 2006, but it increased from 2006 to 2010. This increase was because overweight and obesity had become more prevalent, rather than a decreasing prevalence of underweight. A stabilization in the prevalence of obesity was found between 2002 and 2006, but from 2006 to 2010, it had increased. In 2010, the prevalence of obesity was 12.2% among men and 10.3% among women.

Similar to the present study, Sundquist et al. found in a nationwide Swedish study that the prevalence of obesity did not increase in any age-group between 2000/2001 and 2004/2005, except for men aged 35–44 years. In the Military Service Conscription Register, which until recently has constituted an unique data source for monitoring trends in obesity among young Swedish men, the prevalence of obesity has increased continuously from 1970 to 2005. This contrasts the stabilization found for young men by Sundquist et al. (16–24 years) and also in the present study (18–24 years), although young men of Stockholm County might not
be representative for the whole country. It is possible that a change in environment or behavior regarding these young men occurred after the military tests, explaining the stabilization of obesity. However, after 2001, the reliability of the Military Service Conscription Register has been reduced, as data were not registered for all young men anymore.

Another nationwide Swedish study suggested that this stabilization continued, finding no statistically significant increase in the prevalence of obesity during the period 2004–08 among women or men. The results from the present study contrast this, with increases in the prevalence of obesity among both women and men from 2006 to 2010. This discrepancy could possibly be explained by an increase in obesity after 2008, or that the sample sizes in the nationwide study were too small to determine whether the moderate increased prevalence of obesity observed was statistically significant.

The results of this study indicated that the prevalence of obesity in Stockholm County has increased more in the lower social classes, as has previously been found among young Swedish men, thereby reinforcing the social inequalities of obesity.

The present study had the strength of large sample sizes, but was limited to individuals in Stockholm County, Sweden. Although Stockholm County is the largest county in Sweden, with 2 million of the total 9.4 million inhabitants, it could be questioned whether the results from this study are representative for the whole country.

Another limitation was that data on height and weight (and thus BMI) were self-reported. Individuals with a high BMI are more prone than individuals with a low BMI to underreport their BMI, which could have caused underestimations of the BMI and prevalence of obesity in this study. This implies that the prevalence of obesity in reality could have increased more than what was observed in this study. However, as these data were self-reported at all occasions, the trends in BMI and prevalence of obesity are reliable in this aspect. Also, the participation rate was 60%. It can be assumed that healthier individuals were more interested in returning the questionnaire, which would have caused a selection bias also leading to underestimation of BMI and the prevalence of obesity. Given that the response rate was declining with time, this bias could hide an increase in obesity greater than what could be detected in the data. Because questions regarding physical activity, sedentary behaviour and diet were not similar in the questionnaires of the years, it was unfortunately not possible to adjust for potential confounding of these factors in the investigations of trends in BMI and prevalence of obesity. However, considering also these factors in the models could have subjected the analyses for overadjustment, as an increase in obesity could originate from these factors, and these factors could have changed over the study period.

In conclusion, the mean BMI and prevalence of obesity were stable from 2002 to 2006 in Stockholm County, Sweden. But thereafter increases were observed, and in 2010, the prevalence of obesity was 12.2% among men and 10.3% among women. These are historically high levels, and as the health consequences of obesity are manifested in middle-age, the effect on the health care system is still to come.

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Conflicts of interest: None declared.

Key points

- A stabilization in prevalence of obesity has been reported from several countries.
- In this Swedish sample, prevalence of obesity was found to be increasing.
- Efforts are still needed to halt the obesity epidemic in Sweden.

References