Short Report

Tracking of overweight from mid-adolescence into adulthood: consistent patterns across socio-economic groups

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Socially differentiated tracking of health and health behaviours may contribute to health inequalities in adulthood. The modifying effect of socio-economic position on the tracking of overweight from mid-adolescence (age 15 years) into adulthood (age 27 years) was assessed in a randomly sampled Danish cohort (n = 561). The tracking was studied by prediction analyses conducted by logistic regression analyses. Strong tracking patterns were found to be independent of socio-economic background.

Introduction

In recent decades, overweight has been considered an important public health burden in the child, adolescent and adult populations.1,2 In many western countries, an inverse social gradient in overweight exists in the adult population3 and it is a challenge to identify the mechanisms that cause this social pattern. According to the Adolescent Pathway Model by Kristensen et al.,4 two potential explanations are the tracking of social patterns already present in adolescence and socially differentiated tracking of overweight. Socially differentiated tracking of overweight implies that the risk of remaining overweight is higher among adolescents from lower than higher socio-economic groups.

Substantial tracking of overweight from childhood into adulthood has been demonstrated.5,6 However, the modifying effect of socio-economic position (SEP) on the tracking patterns of overweight has not been studied extensively. A Danish study by Kristensen et al.7 showed no social patterns of tracking of overweight from childhood (age 8–10 years) into adolescence (age 14–16 years), while another Danish study found that the inverse social relationship between SEP and overweight becomes steeper from a mean age of 14.8 to 21.3 among girls, and also emerges among boys.8

The aim of the present study was to analyse whether the tracking of overweight from age 15 to 19 years and from age 19 to 27 years differed between adolescents from higher and lower socio-economic groups. Tracking patterns were studied by prediction analyses.

Methods

We used data from the Danish Longitudinal Health Behaviour Study. The baseline survey was conducted in 1990 at the age of 15 years, the first follow-up was in 1994 at the age of 19 years and the second follow-up in 2002 at the age of 27 years. The study population was a random sample of the Danish population selected from the National Civic Registration System. Data was collected by anonymous postal questionnaires. Of all the adolescents invited (n = 1100), 9% were left out due to lack of parental consent, leaving 996 participants in the sample. The response rates were 85% in 1990, 87% in 1994 and 81% in 2002. Only participants completing questionnaires in all three surveys were included in the present analyses (n = 561, males = 215, females = 346).

Body mass index (BMI, kg/m²) was calculated from self-reported heights and weights. At the age of 19 and 27 years, overweight was defined by a BMI of ≥25. For 15-year old participants, age- and sex-specific BMI cut-points proposed by Cole et al.9 were applied. Sex and SEP were included in analyses as modifiers. SEP in adolescence was measured when the participants were 15 years old and again by retrospective data at the age of 27 years by two items about the father and mother’s occupations. We used the retrospective data that were most complete and coded the information according to the standards of the Danish National Institute of Social Research into SEP I (high) to V (low) and VI (living on social welfare benefits). Participants were categorized according to the highest-ranking parent into two groups: high SEP (I, II and low SEP (III–V). SEP VI only included a very few individuals (n = 2) and was left out of the interaction analyses. In analyses of loss to follow-up, we used data on parental occupation collected by students’ reports at the age of 15 years.

Statistical analyses

We used logistic regression analyses with odds ratio (OR) estimates (and 95% confidence limits) to assess the predictive power of early overweight for later overweight between the ages of 15 and 19 years, 19 and 27 years and 15 and 27 years. Modifications by sex and SEP were tested by interaction terms in the logistic regression models. Finally, analyses stratified by SEP were conducted. Analyses of loss to follow-up from baseline to second follow-up were conducted with regard to sex, weight and SEP using chi-square tests.

Results

The prevalence of overweight among males and females was 5.2 and 3.6% at the age of 15 years, 12.2 and 10.1% at the age of 19 years and 38.0 and 24.4% at the age of 27 years, respectively. The prevalence of overweight in high- and low SEP was 3.9 and 4.2% at the age of 15 years, 6.7 and 13.0% at the age of 19 years and 21.6 and 33.5% at the age of 27 years.

Among females, inverse associations between SEP and overweight were observed cross-sectionally in all three surveys [age 15 years: OR = 2.32 (0.50–10.77), age 19 years: OR = 2.21 (0.88–5.52), age 27 years: OR = 3.41 (1.76–6.62)]. Among males, cross-sectional data showed that social gradients were less evident [age 15 years: OR = 0.70 (0.21–2.38), age 19 years: OR = 2.04 (0.78–5.37), age 27 years: OR = 1.18 (0.66–2.10)].

Analyses of tracking of overweight showed strong and significant prediction patterns from age 15 to 19 years, from 19 to 27 years, and also over the full study period from the age of 15 to 27 years (table 1). Analyses of interaction terms with sex and SEP revealed no significant
## Table 1 Logistic regression analyses (OR, 95% CI) of prediction of late overweight by early overweight from the age of 15 to 19 years, from the age of 19 to 27 years and from the age of 15–27 years, adjusted by sex and SEP and stratified by SEP

<table>
<thead>
<tr>
<th>Study population</th>
<th>Weight status at the age of 15 years</th>
<th>OR (95% CI) for being overweight at the age of 19 years</th>
<th>OR (95% CI) for being overweight at the age of 27 years</th>
<th>Weight status at the age of 19 years</th>
<th>OR (95% CI) for being overweight at the age of 27 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full population</td>
<td>Normal weight</td>
<td>1.0</td>
<td>1.0</td>
<td>Normal weight</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>P-value for interaction with SEPb</td>
<td>0.8533</td>
<td>0.6747</td>
<td>P-value for interaction with SEPb</td>
<td>0.7963</td>
</tr>
<tr>
<td></td>
<td>P-value for interaction with sexc</td>
<td>0.6005</td>
<td>0.6021</td>
<td>P-value for interaction with sexc</td>
<td>0.7472</td>
</tr>
<tr>
<td>High SEP</td>
<td>Normal weight</td>
<td>1.0</td>
<td>1.0</td>
<td>Normal weight</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>18.24 (2.93–113.71)</td>
<td>8.43 (1.45–48.92)</td>
<td>Overweight</td>
<td>16.86 (3.85–73.78)</td>
</tr>
<tr>
<td></td>
<td>P-value for interaction with SEPb</td>
<td>0.7963</td>
<td></td>
<td>P-value for interaction with SEPb</td>
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<td></td>
<td>P-value for interaction with sexc</td>
<td>0.6021</td>
<td></td>
<td>P-value for interaction with sexc</td>
<td></td>
</tr>
<tr>
<td>Low SEP</td>
<td>Normal weight</td>
<td>1.0</td>
<td>1.0</td>
<td>Normal weight</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>20.38 (5.93–70.04)</td>
<td>13.76 (3.01–62.86)</td>
<td>Overweight</td>
<td>10.61 (4.88–23.09)</td>
</tr>
</tbody>
</table>

a: BMI cut-point of 23.94 valid for girls is applied. This is 0.65 higher than the cut-point valid for boys of the age of 15 years. Some overweight boys may thereby be misclassified as being normal weight.  
b: Adjusted by sex  
c: Adjusted by SEP  
d: The samples in each stratum by SEP do not summarize to the full population. This is due to the fact that participants living on social benefits (e.g. students) and missing values were left out of the stratified analyses

CI: confidence interval.

### Key Points
- Analyses of a Danish cohort show a continuously increasing prevalence of overweight from the ages of 15 to 19 years and from 15 to 27 years and for the full period of the age of 15–27 years  
- Strong patterns of tracking are observed among both men and women. The Danish Cancer Society (1997–2001): The Nordia Foundation.

### Funding


### Conflicts of interest

None declared.

### Discussion

In line with the existing literature, 5,6 the present study identifies strong tracking patterns of overweight from childhood into early adulthood. In accordance with the study by Kristensen et al.7, who covered the years from the age of 8–10 to 14–16, our findings indicate the relevance of socially differentiated tracking as a contributing pathway to inequalities in adult overweight. Rather, they support other studies indicating that overweight among adults is not due to socially differentiated tracking but rather due to patterns of social inequality in adult overweight. The Adolescent Pathway Model 4, which outlines that adult health is patterned health determinants from early life into later life. This pattern supports the second pathway to inequalities in adult overweight as found in the previous Danish study of 14.8 to 21.3 years of age. Conflicts of interest: None declared.

### Analyses of loss to follow-up

Analyses of loss to follow-up from baseline to second follow-up was not associated with SEP. However, a selected uptake of individuals from late adolescence into adulthood was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescence was not associated with SEP. Moreover, a selected uptake of individuals into late adolescent...
Introduction

The body-mass index (BMI) has been widely used to stratify the risk of metabolic and cardiovascular disease because of its simplicity and strong association with body fat. In adults, a BMI of 25 kg/m² originally discriminated the normal corpulence from overweight, which has been associated with increased risk for non-communicable diseases like diabetes mellitus. However, the World Health Organization has pointed out that the risk corresponding to overweight varies from 22 to 25 kg/m² in Asian populations.

Abdominal fat has been implicated in the development of insulin resistance. Then, an increased amount of fat is expected in populations with high diabetes prevalence. This has indeed been observed in Asians in Asia and after migrations. Whether this pattern occurs early in life has not been clearly demonstrated. The body fat distribution of adolescents of Indian origins has not been extensively studied, but the BMI cut-off points published on adolescents from India suggest that the question is relevant.

Our aim was thus to define the nature of the relationship between body composition and body size in India-originating Guadeloupian adolescents (IOG), as a subgroup with increased diabetes risk, and Guadeloupian of other origins, as the control group. The main hypothesis was that part of the normal range of BMI would be associated with a higher quantity of body fat, in particular abdominal fat, in IOG.

Methods

The participants were 178 IOG adolescents and 481 Guadeloupian adolescents of other origins (mainly African and mixed African and European descents) from five schools in Guadeloupe, French West Indies. They were 13.3 ± 1.4 years of age (mean ± SD). They agreed to participate in the experiment running from September 2006 to January 2008. More information was provided in an earlier publication. Subjects were lightly clothed for their stature (cm) and body mass (kg) measurements, used to calculate the BMI (kg/m²) and BMI for age z-scores (BMIZ) from the Centers for Disease Control and Prevention age- and sex-specific references. Waist and hip circumferences (measured in centimetres with tape) and bicipital, tricipital, subscapular and iliac skinfold thicknesses were determined in 178 India-originating Guadeloupian (IOG) adolescents and 481 controls of other origins. Various equations were tested in a regression approach to fit the relationship between BMI and iliac thickness, and BMIZ and sum of skinfold thickness. A shift towards higher iliac thickness for a given BMIZ was observed in IOG adolescents. This supports the idea that the relationship between BMI and risk for non-communicable diseases is ethnicity-dependant.

References