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Social inequalities in obesity and overweight in 11 OECD countries

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Background: Evidence of inequalities in obesity and overweight is available mostly from national studies. This article provides a broad international comparison of inequalities by education level and socio-economic status, in men and women and over time. **Methods:** Data from national health surveys of 11 OECD countries were used. The size of inequalities was assessed on the basis of absolute and relative inequality indexes. A regression-analysis approach was used to assess differences between social groups in trends over time. **Results:** Of the countries examined, USA and England had the highest rates of obesity and overweight. Large social inequalities were consistently detected in all countries, especially in women. Absolute inequalities were largest in Hungary and Spain with a difference of 11.6 and 10% in obesity rates in men, and 18.3 and 18.9% in women, respectively, across the education spectrum. Relative inequalities were largest in France and Sweden with poorly educated men 3.2 and 2.8 times as likely to be obese as men with the highest education (18 and 17 times for women in Spain and Korea, respectively). Pro-poor inequalities in overweight were observed for men in USA, Canada, Korea, Hungary, Australia and England. Inequalities remained virtually stable during the last 15 years, with only small variations in England, Korea, Italy and France. **Conclusion:** Large and persistent social inequalities in obesity and overweight by education level and socio-economic status exist in OECD countries. These are consistently larger in women than in men.

Introduction

Obesity and overweight rates have increased sharply in the last 20–30 years in OECD countries. The rise in obesity has reached epidemic proportions, with over one billion adults worldwide estimated to be overweight and at least three hundred million obese.[1] Many OECD countries have been concerned not only about the pace of the increase in obesity and overweight, but also about inequalities in their distribution across social groups.[2]

Studies have shown a socio-economic gradient in obesity in a number of countries. Rates tend to be higher in disadvantaged

socio-economic groups, whether disadvantage means poor education, low income or low occupation-based social class. Cutler and Lleras-Muney[3] found that people with more years of schooling in USA are less likely to smoke, drink a lot, be overweight or obese or use illegal drugs, and similarly, that the better educated are more likely to exercise and to obtain preventive care such as flu shots, vaccines, mammograms, pap smears and colonoscopies. Jacobsen and Nilsen[4] showed that people with higher education in Norway have less fat and more fibre in their diets. Cross-sectional estimates from a study of twins also confirm the negative relationship between education and the probability of being overweight.[5] Although a socio-economic gradient exists in obesity, it does not appear to be as steep as that observed in general health status and in the prevalence of a number of chronic diseases.[6] This finding may be linked to substantial gender differences in the relationship between socio-economic status and obesity. In fact, the overall socio-economic gradient in obesity observed in many countries is an average of a strong gradient in women and a substantially milder gradient, or even the lack of one, in men.[7] Wardle *et al.*[8] showed on English data that obesity risk was greater in men and women with fewer years of education and in poorer economic circumstances, and among women, but not men, of lower occupational status. A French study also found that, contrary to women, poorer men are less likely to be obese.[9]

Most existing studies focus on individual countries and only few provide international comparisons. Garcia Villar and Quintana-Domeque[10] investigated the relationship between household income and body mass index (BMI) in nine European countries showing an inverse relationship in women and mixed patterns for men, with higher BMI in men from higher income groups in countries such as Finland and Portugal. Mackenbach *et al.*[11] explored health inequalities in 22 European countries in relation to several health outcomes. They focused on education-related inequalities in obesity showing that they were largest in women and in southern European countries. A meta-analysis of fruit and vegetable consumption studies found that adults from disadvantaged socio-economic groups in Europe have less healthy nutrition patterns.[12]

This article contributes to the existing evidence through an international comparison of social inequalities in obesity and overweight across 11 OECD countries, including several European countries, Australia, Canada, Korea and USA. Relative to previous comparative studies, this article broadens the analysis of inequalities to measures of overweight, in addition to obesity, and looks at inequalities by both socio-economic status and education level. Moreover, this article provides an original analysis of trends in inequalities over time, examining the prevalence of obesity and overweight in different social groups over the past 15 years.

Methods

Data

Health survey data were obtained from 11 OECD countries: Australia, Austria, Canada, England, France, Hungary, Italy, Korea, Spain, Sweden and USA. These countries provide a relatively wide geographical spread as well as a varied selection in terms of population rates of obesity and overweight (see File No.1 in Supplementary Data). All cross-sectional survey waves available for the last 15 years were used in the analysis.

Survey-specific sampling weights were used when appropriate (Australia, Canada, Hungary, Sweden and USA) and additional special weights were calculated to account for differences in sample size between survey waves. Analyses focused on respondents aged 16–65 years who reported all the required individual characteristics (gender, age, ethnicity, marital status, education level, socio-economic status, occupation status, smoking status, height and weight). BMI was calculated as weight in kilograms divided by square height in metres. Obesity and overweight were then determined as a BMI equal to or greater than, respectively, 30 and 25.

Education levels were standardized across countries using the ISCED international classification of educational attainment.[13] The relevant variable was categorized into three groups: up to primary school education; lower secondary school education and upper secondary school education or more.

Socio-economic status was determined either on the basis of household income or occupation-based social class. Household income was equivalized to account for differences in household size and composition. Occupation was standardized across countries using the ISCO international classification and grouping occupations into five levels, following the model of the English socio-economic classification.[14,15] Occupation-based social class could be derived for Austria, England, France, Hungary, Italy, Spain and Sweden. An occupation-based social class variable could not be derived for Australia, Canada and Korea, and equivalized household income (in quintiles) was instead used as an indicator of socio-economic status. Finally, a ratio of family income to poverty was used to categorize socio-economic status for USA.

Health examination surveys involving a direct measurement of height and weight were available for England, Korea and USA, whereas other surveys are based on personally administered questionnaires and collect self-reported data on height and weight.

Inequality measures

Absolute and relative indexes were calculated to assess social inequalities in obesity and overweight. These indexes are based on logistic regression estimates of obesity and overweight rates for every socio-economic group. Logistic models were adjusted for a range of relevant covariates: gender, age (assuming a non-linear relationship with obesity and overweight), year of the survey, marital status, ethnicity (when available, i.e. in England and USA), smoking status, occupation status, education attainment, socio-economic status and interaction terms between the latter and gender and between education and gender. The use of regression-based inequality indexes makes cross-country comparisons possible when the relative size of social groups varies in different countries.

The absolute, or slope, index of inequality is defined as the slope of the regression line marking the relationship between obesity (or overweight) and the relevant socio-economic variable. The absolute index is obtained using weighted least squares regression as data are grouped.[16] The slope index provides a measure of the absolute size of inequalities, i.e. the difference between the rates estimated for those at the lowest and those at the highest ends of the social scale.

The relative index of inequality is the ratio of the rates estimated for those at the lowest and the highest ends of the social scale. Therefore, the relative index is not sensitive to the overall prevalence of obesity or overweight within a given country.[17,18]

All analyses were conducted using Stata 10.

Results

Inequalities by education level

Values of the absolute index of inequality in the 11 OECD countries are displayed in figure 1. Differences of up to nearly 12 percentage points in obesity rates are observed in men and up to 19 in women, with Spain and Hungary displaying the largest absolute inequalities. Larger education-related inequalities are consistently observed in women than in men, except in Austria. Absolute inequalities tend to be larger in countries with a higher overall prevalence of obesity and overweight, although a large gap is observed in France, where prevalence is relatively low, especially for obesity in men. The absolute index is negative for Korea, but its value is close to zero.

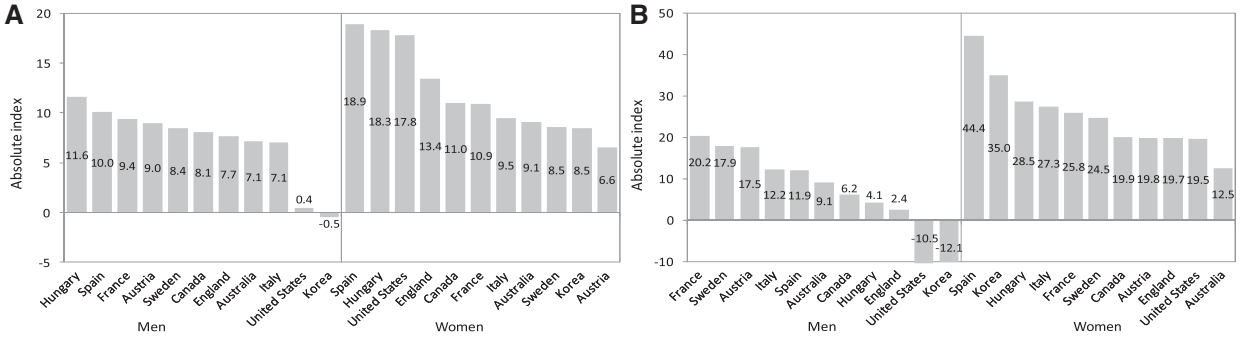

Figure 1 Absolute inequality indexes by education level. (**A**) Inequalities in obesity and (**B**) inequalities in overweight

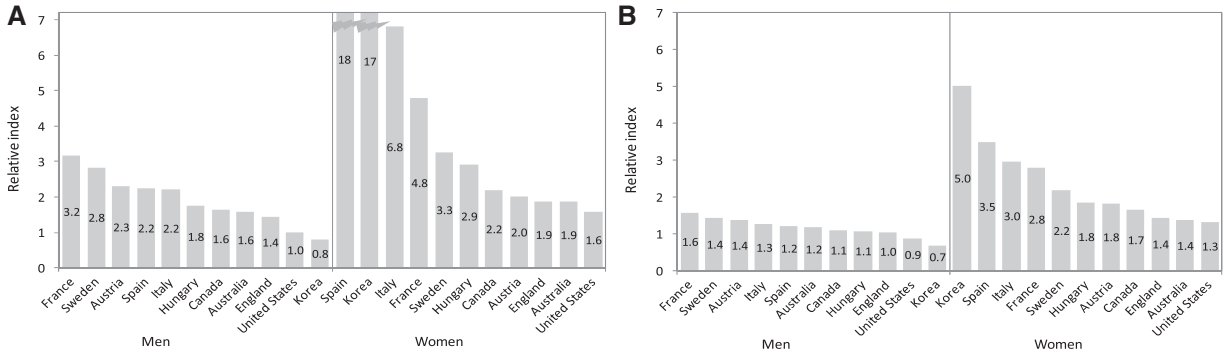

Figure 2 Relative inequality indexes by education level. (**A**) Inequalities in obesity and (**B**) inequalities in overweight. Note: On panel A, bars for Spain and Korea are truncated

Absolute inequalities in overweight (figure 1B) are larger than those in obesity for both genders. France displays the largest inequalities with a 20 percentage point difference in overweight rates between the least and the most educated men. Indexes for Korea and USA are both negative, although the education gradient for USA is not linear, with the highest rates observed in men with intermediate levels of education. The absolute index for overweight in women varies between 12.5 and 44.4, with the largest values for Spain, Korea and Hungary.

Relative inequalities vary substantially across countries (figure 2). France, Sweden, Austria, Spain and Italy present the largest inequalities in obesity. The least educated women in Spain, Korea, Italy and France, are over four times as likely as the most educated ones to be obese. Relative inequalities in overweight (figure 2B) are substantially smaller than those observed in obesity, but the ranking of countries is similar, with the largest inequalities observed in France, Sweden and Austria for men and in Korea, Spain and Italy for women.

Inequalities by socio-economic status

Figure 3 shows values of the absolute index of inequality in obesity. Absolute inequalities for men are largest in France and Austria, and they are virtually absent in USA, Canada and Korea. For women, absolute inequalities are largest in USA and Hungary and smallest in Korea and Italy. Absolute inequalities in overweight are generally larger than in obesity, except for England and USA. The largest absolute inequalities in overweight are observed for men in Austria and France, and for women in Spain and France. However, large inverse (pro-poor) inequalities are observed in men in USA and Canada, while Korea, Hungary, Australia and England have smaller pro-poor inequalities.

Men of the lowest socio-economic status are less than twice as likely to be obese as those at the opposite end of the social spectrum in all countries except France, where the relative index of inequality has a value of 2.4 (figure 4). For women, the variation across countries in relative inequalities is wider, with France and Sweden topping the ranking. Relative inequalities in overweight follow a similar pattern to absolute inequalities, with relatively small gradients in different directions (pro-rich in some countries, pro-poor in others) in men, and larger inequalities in women, consistently in favour of those with a better socio-economic status.

The degree of inequality appears to be inversely related to the overall prevalence of obesity and overweight. Countries with higher prevalence rates tend to have smaller inequalities (see age-standardized prevalence rates in File No.1 in Supplementary data). Men in France and Sweden have a low prevalence of obesity and the largest relative inequalities by education level. Similarly, men in France and Austria have the largest inequalities by socio-economic status. Similar patterns are observed for women.

Trends in inequalities across education levels

The availability of multiple health survey waves for most of the countries examined provided an opportunity to explore trends over time in social inequalities. Obesity and overweight rates for different social groups in eight countries (Australia, Canada, England, France, Italy, Korea, Spain and USA) since the early 1990s are displayed in a series of graphs in File No.2 in Supplementary data. Rates are adjusted for demographic and socio-economic covariates. Trend lines for different groups are broadly parallel in most countries, suggesting that obesity and overweight rates have grown uniformly across the socio-economic spectrum. However, a small narrowing of inequalities by education level was observed in England, France and Korea (interaction Wald-test significant at the 95% confidence level), and a small increase was observed for overweight in Italian men.

Discussion

This article provides evidence of significant social inequalities in obesity and overweight in 11 OECD countries. Disparities in obesity tend to be noticeably larger than disparities in

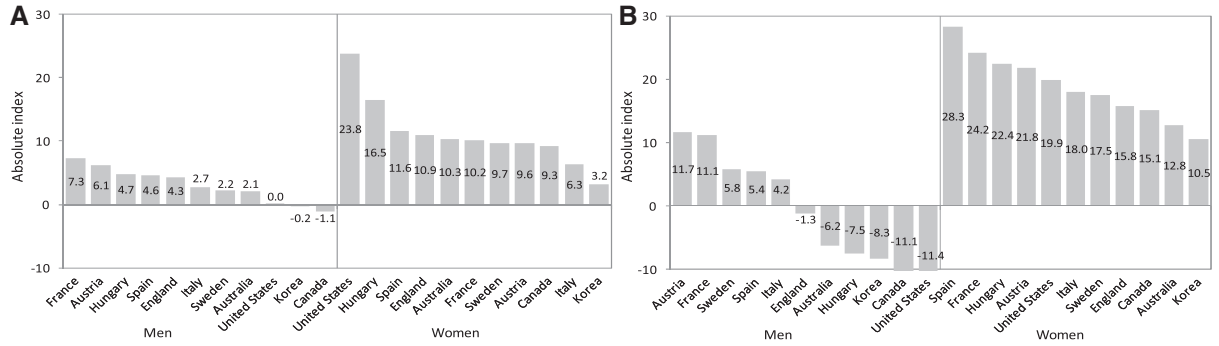

Figure 3 Absolute inequality indexes by socio-economic status. (**A**) Inequalities in obesity and (**B**) inequalities in overweight

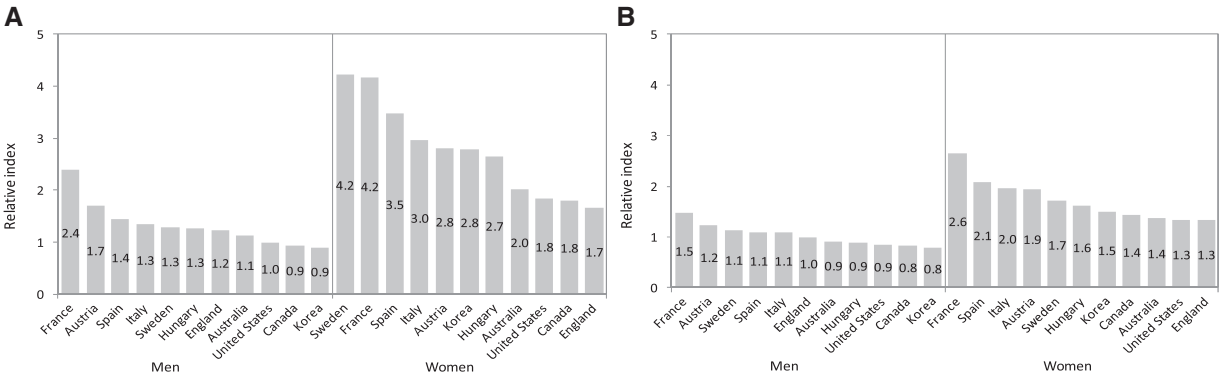

Figure 4 Relative inequality indexes by socio-economic status. (**A**) Inequalities in obesity and (**B**) inequalities in overweight

overweight, both for men and for women. This is in line with the fact that the highest levels of BMI are often observed among the poorly educated and more generally among those in disadvantaged socio-economic circumstances. The size of inequalities varies across countries and between genders. Women in disadvantaged socio-economic groups are consistently more likely to be obese or overweight than more educated and affluent women. In men, smaller or no inequalities by education level were detected, while reverse (pro-poor) inequalities by income or occupation-based social class were found in several countries. The growth in obesity and overweight rates in the last 15 years in the countries examined has been broadly uniform across social groups, and inequalities have remained remarkably stable.

The findings reported here are consistent with previous reports that education-related inequalities in obesity are larger in women and in southern European countries.[11] Gender differences in degrees of inequality observed in this and other studies may be partly explained by a reverse causal effect linking obesity with poor labour market outcomes in women more often than in men. In particular, Garcia Villar and Quintana-Domeque[10] emphasize the potential role played by larger wage penalties suffered by women in the labour market. Other possible explanations include the stronger two-way link between obesity and unemployment in women.[19–21] A further channel through which inequalities develop is marriage and partner selection, as there is evidence that obesity reduces the probability of marriage in women.[21] Similarly, evidence from a longitudinal study has shown that overweight women are more likely to be unmarried, have lower education and lower incomes, while these effects are weaker in men.[22] Men and women in disadvantaged socio-economic groups may also differ with regard to their patterns of physical activity. Low-paid jobs typically reserved to men tend to be more physically demanding than those more often taken up by women. Finally, the link between malnutrition in childhood and obesity in adulthood may be an additional reason since Case and Menendez[23] showed on South African data that women who were nutritionally deprived as children are significantly more likely to be obese as adults, while men who were deprived as children face no greater risk.

Gender differences in socio-economic gradients have important implications. Among other things, the higher prevalence of obesity in women belonging to disadvantaged socio-economic groups means that these women are more likely to give birth and raise children who will themselves be overweight or obese, and in turn will have fewer chances of moving up the social ladder, perpetuating the link between obesity and socio-economic disadvantage. A number of studies gave evidence on mother to child transmission of obesity.[24] Acting on the mechanisms that make individuals who are poorly educated and in disadvantaged socio-economic circumstances so vulnerable to obesity, and those at the other end of the socio-economic spectrum much more able to handle obesogenic environments, is of great importance not just as a way of redressing existing inequalities, but also because of its potential effect on overall social welfare.

Beyond the gender difference, it is observed that education-related inequality indexes are higher than socio-economic inequality indexes. Similarly, Costa-Font and Gil[25] found that formal education captures a large share of the income-related inequality in obesity. The authors suggest as a possible explanation that the effects of unobservable factors like knowledge and social environment may possibly pass through education. More educated people have a better knowledge on health risks, in particular, the risk of obesity, and so, they are less affected by obesity problem.[26] The effects of education on obesity are strengthened by social interactions with similarly educated peers, as there is evidence that health-related behaviours often spread through social networks.[27] In addition, another possible explanation is that the education effect on obesity may reflect unobservable factors like time preference.[25] There is plausible evidence that time preferences

based on a higher discount rate lead to less exercise and greater caloric intake.[28]

It is more difficult to find an explanation for the different degrees of inequality observed across countries. It appears clearly that countries with a higher overall prevalence of obesity and overweight tend to have milder inequalities (but not without exceptions—such as Spain), suggesting that higher socio-economic groups may have caught up with others in terms of obesity and overweight, as overall rates increased. However, our analysis of trends over time in inequalities clearly shows that obesity and overweight have grown in a similar way in all social groups. It is possible that inequalities may have narrowed in countries with a higher prevalence at an earlier stage of the obesity epidemic, when rates were growing faster than they are now. But longer time series are needed to test this hypothesis.

Extensive efforts were made to overcome data heterogeneities, over time and across countries, particularly in relation to education, income and occupation-based social class variables. One remaining issue is the heterogeneous nature of BMI measures used to assess obesity rates (measured in some countries, self-reported in others). Obese and overweight people tend to underestimate self-reported weight.[29–31] To address this problem, algorithms have been proposed to adjust BMI values for self-report bias, based on US data from the National Health and Nutrition Examination Surveys (NHANES).[32,33] Unfortunately similar algorithms are not available for other countries, therefore this approach could not be used here. However, assuming a broadly consistent reporting bias across socio-economic groups, the absolute inequality index may be under-estimated but the relative index should not be affected. A second remaining source of heterogeneity is that socio-economic status was determined on the basis of household income in four countries (Australia, Canada, Korea and USA) and occupation-based social class in the rest. Whether this may contribute to explaining the positive correlation between socio-economic status and overweight observed in the former four countries for men, as well as in Canada and Korea for obesity, is impossible to determine on the basis of existing data period. Recent studies of the relationship between income and BMI lend support to the findings reported here.[9,10]

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Key points

- This study provides a broad comparison of social inequalities in obesity and overweight in 11 OECD countries, including selected European countries, Australia, Canada, Korea and USA.
- Inequalities in overweight and obesity were assessed not only by education level but also by household income and occupation-based social class.
- Large social inequalities in obesity and overweight are shown to exist in OECD countries: obesity and overweight tend to be more prevalent in disadvantaged socio-economic groups, and inequalities are consistently larger in women than in men.
- Social inequalities in obesity and overweight are shown to be persistent and remain virtually stable during the last 15 years with few minor variations.

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Increased health risks of children with single mothers: the impact of socio-economic and environmental factors

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Background: Adverse effects of single parenthood on children's health have been reported before. Socio-economic difficulties are discussed as mediating factors. As child health also depends on environmental conditions, we investigated the impact of environmental exposures and socio-economic factors on differences in health outcomes of children with single mothers vs. couple families. **Methods:** Data on 17 218 pre-school children (47% female) from three cross-sectional surveys conducted during 2004–07 in Germany were analysed. Health and exposure assessment were primarily based on parental report. Effects of socio-economic indicators (maternal education, household income) and environmental factors (traffic load at the place of residence, perceived environmental quality) on associations of four health outcomes (parent-reported health status, asthma, overweight, psychological problems) with single parenthood were determined by logistic regression analyses. **Results:** Children with single mothers showed an increased risk regarding parent-reported poor health status [boys: odds ratio (OR) 1.39 (95% confidence interval (CI): 1.06–1.82), girls: 1.73 (1.28–2.33)], psychological problems [boys: 1.90 (1.38–2.61), girls: 1.58 (1.03–2.42)], overweight [only boys: OR 1.23 (1.01–1.50) and asthma [only girls: OR 1.90 (1.15–3.15)]. Adjusting for socio-economic factors attenuated the strength of the association of family type with child health. Although environmental factors were associated with most health outcomes investigated and children of single mothers were more often exposed, these environmental factors did not alter the differences between children with single mothers and couple families. **Conclusions:** The increased health risks of children from single-mother families vs. couple families are partly explained by socio-economic factors, but not by the environmental exposures studied.

Introduction

The adverse effect of single parenthood on different aspects of child health has been previously shown by several studies, although the contribution of socio-economic factors is still a matter of debate. Two British studies found that material disadvantages could fully or largely explain adverse effects of single parenthood on psychological well-being[1] and physical health.[2] In a large Canadian longitudinal survey, the increased psychiatric and academic problems in children of single mothers were largely explained by household income.[3] In contrast, adjusting for socio-economic status attenuated only moderately the increased