Socioeconomic inequalities in childhood and adolescent body-mass index, weight, and height from 1953 to 2015: an analysis of four longitudinal, observational, British birth cohort studies

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Summary

Background Socioeconomic inequalities in childhood body-mass index (BMI) have been documented in high-income countries; however, uncertainty exists with regard to how they have changed over time, how inequalities in the composite parts (ie, weight and height) of BMI have changed, and whether inequalities differ in magnitude across the outcome distribution. Therefore, we aimed to investigate how socioeconomic inequalities in childhood and adolescent weight, height, and BMI have changed over time in Britain.

Methods We used data from four British longitudinal, observational, birth cohort studies: the 1946 Medical Research Council National Survey of Health and Development (1946 NSHD), 1958 National Child Development Study (1958 NCDS), 1970 British Cohort Study (1970 BCS), and 2001 Millennium Cohort Study (2001 MCS). BMI (kg/m²) was derived in each study from measured weight and height. Childhood socioeconomic position was indicated by the father’s occupational social class, measured at the ages of 10–11 years. We examined associations between childhood socioeconomic position and anthropometric outcomes at age 7 years, 11 years, and 15 years to assess socioeconomic inequalities in each cohort using gender-adjusted linear regression models. We also used multilevel models to examine whether these inequalities widened or narrowed from childhood to adolescence, and quantile regression was used to examine whether the magnitude of inequalities differed across the outcome distribution.

Findings In England, Scotland, and Wales, 5362 singleton births were enrolled in 1946, 17 202 in 1958, 17 290 in 1970, and 16 404 in 2001. Low socioeconomic position was associated with lower weight at childhood and adolescent in the earlier-born cohorts (1946–70), but with higher weight in the 2001 MCS cohort. Weight disparities became larger from childhood to adolescence in the 2001 MCS but not the earlier-born cohorts (p interaction=0·001). Low socioeconomic position was also associated with shorter height in all cohorts, yet the absolute magnitude of this difference narrowed across generations. These disparities widened with age in the 2001 MCS (p interaction=0·002) but not in the earlier-born cohorts. There was little inequality in childhood BMI in the 1946–70 cohorts, whereas inequalities were present in the 2001 cohort and widened from childhood to adolescence in the 1958–2001 cohorts (p interaction<0·05 in the later three cohorts but not the 1946 NSHD). BMI and weight disparities were larger in the 2001 cohort than in the earlier-born cohorts, and systematically larger at higher quantiles—eg, in the 2001 MCS at age 11 years, a difference of 0·98 kg/m² (95% CI 0·63–1·33) in the 50th BMI percentile and 2·54 kg/m² (1·85–3·22) difference at the 90th BMI percentile were observed.

Interpretation Over the studied period (1953–2015), socioeconomic-associated inequalities in weight reversed and those in height narrowed, whereas differences in BMI and obesity emerged and widened. These substantial changes highlight the impact of societal changes on child and adolescent growth and the insufficiency of previous policies in preventing obesity and its socioeconomic inequality. As such, new and effective policies are required to reduce BMI inequalities in childhood and adolescence.

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Introduction

Reducing socioeconomic inequalities in childhood and adolescent obesity is an important public policy goal because of its multiple long-term adverse health consequences. A priority is to understand how health inequalities have changed over time and understand whether policy goals of health inequality reduction are being met. Although socioeconomic inequalities in childhood overweight have been documented in high-income countries, it remains unclear how these inequalities have changed across generations; interpretation of existent data is limited by the short timespan of previous
Evidence before this study
We searched PubMed for articles and reviews published between Jan 1, 1960, and Oct 9, 2017, using the search terms “body mass index” OR “obesity” AND “socioeconomic” OR “inequality” OR “disparity”. We screened published articles by title and abstract to identify relevant studies of how socioeconomic inequalities in body-mass index (BMI) or obesity risk had changed across time. The studies cited in this report are not an exhaustive list of existing research. Published systematic reviews have found many studies that document the existence of socioeconomic inequalities in childhood and adolescence BMI or obesity risk in high-income countries. However, evidence for how these inequalities have changed over time is typically short term and cross-sectional in nature, does not examine the composite parts of BMI (ie, weight and height), and does not examine whether inequalities differ in magnitude across the outcome distribution. To inform public policy—and specific concerns regarding the adverse long-term consequences of childhood obesity and its socioeconomic inequality—robust and nationally representative evidence is required to examine how inequalities have changed in response to shifting policy and societal factors.

Added value of this study
We used four British historic longitudinal studies to examine trends in socioeconomic inequalities in BMI from 1953 to 2015. This study provides added value by enabling a long-run investigation of socioeconomic inequalities in BMI, and more recent data than previously available. Most existing evidence is cross-sectional in nature; however, we used longitudinal data and found that absolute socioeconomic inequalities in BMI widened from childhood to adolescence. We also examined the different components of BMI that yielded new policy-relevant evidence; absolute height inequalities have narrowed in subsequent generations whereas weight inequalities have reversed (ie, changed direction). Finally, we examine how inequalities in these outcomes differ across the outcome distribution using quantile regression, in which we observed that socioeconomic inequalities in BMI were found at the median but were systematically larger at higher BMI quantiles than at lower quantiles.

Implications of all available evidence
The emergence and widening of socioeconomic inequalities in BMI in children and adolescents up to 2015 suggests a renewed need for effective policies to reduce obesity and its socioeconomic inequality in current and future generations; previous policies have not been adequate, and existing policies are unlikely to be either. Without effective intervention, socioeconomic inequalities in BMI are anticipated to widen further throughout adulthood and disproportionately affect those who have higher BMI, leading to decades of adverse health and economic consequences.

investigations (eg, 5–10 years), gaps in timespans investigated, and methodological differences across studies. Additionally, several important aspects of the nature of socioeconomic inequalities in BMI remain poorly understood; in particular, the extent to which socioeconomic inequalities have changed across the composite parts of BMI (ie, weight and height). Because lower socioeconomic position has been associated with shorter childhood height, changes in BMI might be attributable to changes in weight or height, or both. Understanding both components separately is important because of the association between shorter height in childhood and increased premature mortality risk, and the association between shorter height in adulthood and increased adult cardiovascular disease risk. Socioeconomic inequalities in these constituent parts might have changed in different ways over time. For example, improvements in population micronutrient intake and reductions in early life infections might have occurred, as suggested by secular trends towards taller childhood height from 1957 to 2012, and suggestive evidence for reduced prevalence of stunting in Britain. These changes might have also led to narrower height inequalities in recent decades, yet increases in total calorie consumption associated with the recent obesity burden might have led to the emergence and widening of weight and thus BMI inequalities from the 1980s onwards. BMI inequalities might also lead to narrower height inequalities, because obesity can increase the pace of pubertal development. Additionally, existing evidence for how BMI inequalities have changed over time is typically from repeated cross-sectional studies, limiting the understanding of the ages at which inequalities emerge or widen. Finally, the effect of socioeconomic inequalities on the population distribution of BMI, height, and weight is not well understood. A trend towards an increasing BMI across time has been observed, and this increase could be disproportionately attributable to people in disadvantaged socioeconomic groups.

Therefore in this study, we aimed to examine trends in socioeconomic inequalities in BMI, weight, and height across childhood to adolescence using data from four British birth cohort studies, enabling a long-run comparison from 1953 to 2015. We hypothesised that socioeconomically disadvantaged groups had lower bodyweight and shorter height than socioeconomically advantaged groups born in the mid-to-late 20th century; among those born in the early 21st century, we hypothesised that differences in bodyweight would have reversed and that height differences would be narrower.

Methods
Study design and samples
We used data from four longitudinal, observational, British birth cohort studies. These cohorts have been
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