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Educational disparity in obesity among U.S. adults, 1984–2013

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ABSTRACT

Purpose: Examine the annual trends in educational disparity in obesity among U.S. adults aged 18 years and more from 1984 to 2013.
Methods: Secondary data analysis of 6,147,379 participants in a repeated cross-sectional nationally representative health survey of U.S. adults.
Results: The obesity prevalence among people with primary school or lower education increased from 17.46% or 3.41 times the prevalence among college graduates (5.12%) in 1984 to 36.16% or 1.73 times the prevalence among college graduates (20.94%) in 2013. In any given year, the obesity prevalence increased monotonically with lower education level. The obesity prevalence across education subgroups without a college degree gradually converged since early 2000s, whereas that between those subgroups and college graduates diverged since late 1980s. Absolute educational disparity in obesity widened by 60.84% to 61.14% during 1984–2013 based on the absolute concentration index and the slope index of inequality, respectively; meanwhile, relative educational disparity narrowed by 52.06% to 52.15% based on the relative index of inequality and the relative concentration index, respectively. The trends in educational disparity in obesity differed substantially by gender, race/ethnicity, age group, and obesity severity.
Conclusions: There was substantial educational disparity in obesity among U.S. adults and the trend differed across population subgroups.

Introduction

Health disparity is a particular type of health difference that is closely linked with social, economic, and environmental disadvantage. One fundamental goal in the *Healthy People 2020* is to "achieve health equity, eliminate disparities, and improve the health of all groups" [1]. Obesity is a leading risk factor for many adverse health outcomes such as type 2 diabetes, hypertension, dyslipidemia, coronary heart disease, and certain types of cancer [2]. Sweeping across the nation during the past 3 decades, the prevalence of obesity increased from 15% in 1980 to 35% in 2012 among U.S. adults [3]. The obesity epidemic is marked by salient demographic and socioeconomic disparities pertaining to gender, race or ethnicity, education, income, and geographic location [4].

Health disparity is a complex notion with many dimensions that different measures of disparity emphasize to a greater or lesser extent [5]. Choosing a specific measure reflects, explicitly or implicitly, different standpoints on what characteristics or quantities of inequality are believed to be vital to capture. As such, same data examined using different disparity measures may produce different results. There might not always be clear-cut answers about which measures or results are correct and what are wrong, but some measures could be more appropriate than others for the specific disparity issue under examination, and results generated from these measures could bring deeper insights to different stakeholders.

The inverse relationship between education level and risk for obesity has been extensively documented in developed countries, with possible mechanisms through health literacy, health behaviors, occupation, income, and so on [6]. Tracking the national trajectory of educational disparity in obesity is fundamental for policy makers to assess the status quo, monitor progress, and design or modify population-level policy interventions to best achieve the goal of disparity elimination. However, existing studies on disparities in obesity were mostly based on pairwise comparisons such as risk difference (RD) [7–11], risk ratio (RR) [12–14], or odds ratio [10,15–20]. Such comparison alone is insufficient to reveal the overall picture of the population health burden of disparities to policy makers because: (1) These pairwise disparity measures are neither sensitive to the size of the groups in comparison nor the

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change in group size over time, (2) These pairwise comparisons only focus on the "gap" but do not capture the "gradient" in health or illness distribution across social classes with a natural ranking (e.g., education or income level), and (3) The number of pairwise comparisons increases exponentially with the number of groups and time periods involved, and the pattern can quickly become too complex and impede understanding.

In this study, we adopt a "population health" perspective on educational disparities in obesity. A population health perspective has a primary concern for the overall population health burden of disparities by considering the total number of obesity cases that would be prevented or reduced by intervention. To track the long-term trajectory of population health burden of educational disparities in obesity, a population health perspective favors disparity measures that are sensitive to both the change in the size of education subgroups and the change in obesity rate within each subgroup. We selected measures of disparity based on the recommendations of the National Cancer Institute (NCI) [5]. If the social group under investigation has a natural ordering, as with populations grouped by education level, NCI recommends use of the absolute concentration index (ACI) and the slope index of inequality (SII) as measures of absolute health disparity, and the relative concentration index (RCI) and the relative index of inequality (RII) as measures of relative disparity. The two concentration indexes (ACI and RCI) measure the extent to which a health problem is concentrated among specific social groups on the absolute or relative scale. They are measures of the covariance between social rank and health problem and are derived by plotting the cumulative share of the population, ranked by social status, against the cumulative amount of health problem (the cumulative contribution of each subgroup to the mean level of health problem in the population). The two indexes of inequality (SII and RII) measure the relation between the frequency of a health problem in each socioeconomic category and the hierarchical rankings of those categories on the social scale. Both the concentration indexes and the indexes of inequality only apply to social groups that have a natural ordering, such as education or income groups. The major reasons for choosing these four specific measures are as follows: (1) They offer additional influence to the social groups with the poorest health outcomes; (2) They account for changes in the underlying population distributions in the social groups over time (through weighting by population size in each time period); (3) They use information across the entire range of social groups, as opposed to pairwise contrasts between the "best" and "worst" groups like the RD, RR, or odds ratio; and (4) They are sensitive to the direction of the social gradient in health [5,21].

Methods

Survey setting and participants

Individual-level data came from the Behavioral Risk Factor Surveillance System (BRFSS) 1984–2013 surveys. The BRFSS is a state-based system of annually repeated cross-sectional telephone surveys that collect information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. Detailed information about the BRFSS including questionnaires, survey design, and data can be found on its Web portal (http://www.cdc.gov/brfss/).

Among the 6,484,535 adults, 18 years of age and more who participated in the BRFSS 1984–2013 surveys, 337,156 (5.20%) were excluded from the analyses because of missing data on body height and/or weight, education, gender, age, and/or race and/or ethnicity. The remaining 6,147,379 survey respondents were included in the analytic sample.

Measure of obesity

Body mass index (BMI) was calculated based on self-reported height and weight. Obesity is defined as BMI $\geq$30 kg/m^2 in accordance with the international classification of body weight status [22]. In addition, grade 2 and grade 3 obesity combined is defined as BMI $\geq$35 kg/m^2 and grade 3 obesity BMI $\geq$40 kg/m^2.

Education level

Survey participants' educational attainment was classified into five categories: primary school (eighth grade) and below, some high school (nineth–eleventh grade), high school graduate or equivalent, some college, and college graduate and above.

Individual demographics

The following individual demographics were adjusted in regression analyses: gender, age group (18–24 years, 25–29 years, 30–34 years, 35–39 years, 40–44 years, 45–49 years, 50–54 years, 55–59 years, 60–64 years, 65–69 years, 70–74 years, 75–79 years, and 80 years of age and more), and race and/or ethnicity (non-Hispanic white, non-Hispanic African American, non-Hispanic Asian or Pacific Islander, non-Hispanic other race or multirace, and Hispanic).

Measures of disparity

The two concentration indices (ACI and RCI) measure the degree to which health or disease is concentrated among ordered social groups [23]. The RCI is defined as follows:

$$\mathrm{RCI} = \frac{2}{\mu}\left[\sum_{j=1}^{J} p_j \mu_j R_j\right] - 1$$

where p_j is group j's population share, μ_j is group j's mean health status (obesity rate), and R_j is group j's relative rank defined as follows:

$$R_j = \sum_{j=1}^{J} p_r - \frac{1}{2} p_j$$

where p_r is the cumulative share of the population up to and including group j. In absence of any inequality, the RCI equals zero. A negative RCI indicates higher ranking (higher education level) to be associated with better health outcome (lower obesity rate), whereas a positive RCI indicates higher ranking (higher education level) to be associated with worse health outcome (higher obesity rate). Given a binary health outcome such as obesity, the absolute value of RCI is bounded by the prevalence of disease (obesity rate).

The ACI is calculated by multiplying the RCI by the mean rate of the health variable:

$$\mathrm{ACI} = \mu \mathrm{RCI}$$

where μ is the average level of health (obesity rate) in the population.

The indices of inequality (SII and RII) measure the difference in predicted values of a health outcome between the bottom and top of the social group hierarchy [5]. To calculate the SII, social groups are ordered from most disadvantaged to least disadvantaged (lowest to highest education level). Each social group is assigned a value (mean relative rank) equal to the midpoint of its range in the cumulative distribution in the population. The SII is obtained by