# Income Inequality in Health at All Ages: A Comparison of the United States and England

Melissa L. Martinson, PhD

*Objectives.* I systematically examined income gradients in health in the United States and England across the life span (ages birth to 80 years), separately for females and males, for a number of health conditions.

*Methods.* Using data from the National Health and Nutrition Examination Survey for the United States (n = 36 360) and the Health Survey for England (n = 55 783), I calculated weighted prevalence rates and risk ratios by income level for the following health risk factors or conditions: obesity, hypertension, diabetes, low high-density lipoprotein cholesterol, high cholesterol ratio, heart attack or angina, stroke, and asthma.

*Results.* In the United States and England, the income gradients in health are very similar across age, gender, and numerous health conditions, and are robust to adjustments for race/ethnicity, health behaviors, body mass index, and health insurance.

*Conclusions.* Health disparities by income are pervasive in England as well as in the United States, despite better overall health, universal health insurance, and more generous social protection spending in England. (*Am J Public Health.* 2012;102:2049–2056. doi:10.2105/AJPH.2012.300929)

Population health is worse in the United States than England, despite the much higher level of health care spending in the United States.[1–3] Well-documented health differentials between the 2 countries exist for a wide variety of health measures at all ages.[3] However, questions remain about the extent of cross-country differences in health disparities, in particular whether income inequalities in health are higher in the United States than in England across the life span.

Health comparisons between the United States and England are interesting because, despite many societal similarities, there are differences in health care provision, social protection policies, and societal inequality between the 2 countries.[4–6] In particular, previous studies have postulated that differences in health care systems between the United States and England (as well as other European countries) may account for the relatively poorer health in the United States as well as the greater health inequalities among Americans.[2,7–9] Additionally, whereas both countries have liberal, residual welfare states, Britain has slightly lower income inequality and a greater focus on alleviating poverty, particularly among children, although it still lags behind many other European countries.[5,10]

A handful of studies have examined the magnitude of socioeconomic disparities in health in the United States and England, and the results are decidedly mixed. Banks et al. concluded that income- and education-based health gradients among older adults are steeper in the United States than in England,[1] whereas Avendano et al. found that the wealth gradient for older adults is similar in the 2 countries.[2] A series of articles examining the income gradient in health among children has produced conflicting findings.[7,11,12] One comparative study of self-rated health by income, occupational, and poverty status in the United States and United Kingdom included middle-age adults; it found better health in the United Kingdom than in the United States, as well as a greater likelihood of health improving over time in the United Kingdom.[13] However, that study did not examine the income gradient in health. No study to date has compared socioeconomic gradients in health throughout the life span in the United States and England.

There is reason to believe that the income gradient in health is largest in middle to later adulthood, because the income gradient in health widens with age among children and narrows with age among the elderly because of increased mortality among low-income people.[11,12,14,15] This widening of income disparities with age would likely be similar in the United States and England if the income gradient age pattern is being driven by a higher vulnerability to health shocks among low-income individuals than among high-income individuals. However, if an increase in income disparities with age is due to low-income individuals' lack of ability to respond to health shocks (e.g., through lack of insurance), one would expect to see a more rapid increase in income-based health inequalities in the United States than in England because of the highly variable US health care system.

The extent to which income gradients in health and health trajectories differ in the 2 countries by age is not known, but it represents an important area of inquiry for understanding the processes leading to the well-documented cross-country differences in health. In this study, I describe and compare the extent of income-based socioeconomic gradients in health in the United States and England from birth to 80 years, for both females and males, using a large set of biological and self-reported health measures. This study provides a comprehensive description of the magnitude of income inequalities in health in the 2 countries.

## METHODS

The National Health and Nutrition Examination Survey (NHANES) for the United States and the Health Survey for England (HSE) were used in this study. Both are large, nationally representative health surveys that have

comparable measures of health assessed through both physical examinations and interviews.

The NHANES is a comprehensive survey conducted by the National Center for Health Statistics in the United States continuously since 1999.[16] For the analyses presented here, I used data from years 1999 to 2006 of the continuous survey. Of the 41 474 participants from 1999 to 2006, individuals aged older than 80 years were removed. Additionally, about 8% of the sample was missing income data. The final analytic sample was 36 360. Sample sizes varied by health measure because some conditions were assessed only for certain age groups.

The HSE is an annual cross-sectional survey of private households in England conducted by the Joint Health Surveys Unit of the National Centre for Social Research and University College London.[17–20] I used the 2003–2006 surveys for these analyses because, starting in 2003, weights became available making it possible to pool multiple years of data while maintaining the representativeness of the English population. The number of respondents in the 2003–2006 surveys was 71 717. The analysis sample excluded individuals older than 80 years. Approximately 19% of respondents had missing income data and were excluded from the analytic sample. The final analytic sample was 55 783. It is worth noting that older adults were more likely to have missing data on income in both the US and English samples. Some biological measures were collected from representative subsamples and some questions were asked only of participants in certain age groups.

## Measures of Health

There were several comparable health measures based on physical examinations or laboratory reports in the NHANES and HSE. I included the following risk factors or conditions in this study: obesity, hypertension, diabetes, low high-density lipoprotein (HDL) cholesterol, high cholesterol ratio, and high C-reactive protein. The NHANES and HSE documentation indicated that very similar protocols were used in the 2 countries. Obesity was calculated for respondents aged 4 to 80 years, C-reactive protein was measured for respondents aged 18 to 80 years, and the other conditions were measured for individuals aged 12 years and older. An advantage of using the biological measures was the ability to capture health risk among individuals who were young and for whom illness was relatively rare.

For adults, the categories of body mass index (BMI; defined as weight in kilograms divided by the square of height in meters) were based on the World Health Organization's standard.[21] The categories were normal (BMI = 18.5–24.9 kg/m$^2$), overweight (BMI = 25–29.9 kg/m$^2$), obese (BMI ≥ 30 kg/m$^2$), and underweight (BMI < 18.5 kg/m$^2$). Obesity was specifically examined as a health risk. For children (through age 17 years), age- and gender-specific thresholds were determined using the International Obesity Taskforce definition of the BMI categories (normal, overweight, and obese), which was based on BMI curves in 6 countries, including the United States and Great Britain.[22]

I defined hypertension as a mean systolic blood pressure of 140 millimeters of mercury or higher, mean diastolic blood pressure of 90 millimeters of mercury or higher, or reports of current treatment of hypertension with prescription medication.[23] I assessed diabetes from glycosylated hemoglobin tests (HbA1c ≥ 6.5%).[24] I categorized HDL as low (< 40 mg/dL), normal (40–59 mg/dL), or high (> 59 mg/dL); in addition, I used a binary measure of low vs normal or high HDL.[25] In the absence of a low-density lipoprotein cholesterol measure, I used the total-cholesterol-to-HDL-cholesterol ratio.[26] High cholesterol ratio was defined as a total-cholesterol-to-HDL-cholesterol ratio of 5:1 or above, although results were not sensitive to the ratio cutoff used. I used high C-reactive sensitivity protein, a biomarker for inflammation,

**TABLE 1—Sample Characteristics of Survey Respondents in the United States and England, by Income Tercile: US National Health and Nutrition Examination Survey (1999–2006) and Health Survey for England (2003–2006)**

| | United States (n = 36 360) | | | England (n = 55 783) | | |
|---|---|---|---|---|---|---|
| | Low | Middle | High | Low | Middle | High |
| Mean age (SE), y | 33.7 (0.4) | 35.1 (0.4) | 34.5 (0.4) | 36.1 (0.3) | 35.9 (0.3) | 35.3 (0.3) |
| Gender, % | | | | | | |
| Male | 46.8 | 49.8 | 51.1 | 44.9 | 51.0 | 52.2 |
| Female | 53.2 | 50.2 | 48.9 | 55.1 | 49.0 | 47.8 |
| Race/ethnicity, %[a] | | | | | | |
| Non-Hispanic White | 50.7 | 70.1 | 82.6 | 79.2 | 90.0 | 91.8 |
| Hispanic | 24.7 | 13.1 | 6.0 | NA | NA | NA |
| Asian | NA | NA | NA | 10.5 | 4.7 | 4.8 |
| Non-Hispanic Black | 18.7 | 11.0 | 6.4 | 8.2 | 3.9 | 2.4 |
| Other | 5.9 | 5.8 | 4.9 | 2.1 | 1.4 | 1.0 |
| Cigarette smoking, % | 31.2 | 23.7 | 15.8 | 36.9 | 23.3 | 16.9 |
| Drinking ≥ 5 d/wk (age ≥20 y), % | 4.5 | 6.6 | 9.5 | 12.5 | 18.7 | 26.6 |
| No health insurance, % | 29.9 | 14.5 | 5.9 | NA | NA | NA |
| Education, % | | | | | | |
| 0–12 y (US), 0–11 y (England) | 64.6 | 45.1 | 24.7 | 50.4 | 29.9 | 14.4 |
| 13–15 y (US), 12–13 y (England) | 27.0 | 33.3 | 30.4 | 23.1 | 26.3 | 17.5 |
| ≥ 16 y (US), ≥ 14 y (England) | 8.4 | 21.6 | 44.9 | 26.6 | 43.8 | 68.1 |

*Note.* NA = not applicable. Because obesity was categorized differently for those younger than 18 years than for adults and because C-reactive protein was assessed only for those at least 18 years old, the adolescent group was categorized as 12–17 years and the young adult group as 18–34 years for measures of obesity and C-reactive protein. Unless otherwise noted, all figures pertain to individuals aged birth to 80 years.

[a]Hispanic ethnicity was not available for England (individuals who are Hispanic could have classified themselves in any of the racial groups). Asian race was not available for the United States (individuals who are Asian are included in the "other" race/ethnic category).

**TABLE 2—Prevalence of Health Outcomes Among Female Respondents, by Income Tercile and Age Group: US National Health and Nutrition Examination Survey (1999–2006) and Health Survey for England (2003–2006)**

| | United States (n = 36 360), % | | | England (n = 55 783), % | | |
|---|---|---|---|---|---|---|
| Health Outcome and Age, Years | Low | Middle | High | Low | Middle | High |
| Diabetes | | | | | | |
| 12–19 | 0.6 | 0.3 | 0.5 | 0.0 | 0.0 | 0.0 |
| 20–34 | 1.1 | 2.2* | 0.5 | 1.1 | 1.2 | 1.1 |
| 35–49 | 6.3** | 2.2 | 1.7 | 2.5** | 1.2 | 0.5 |
| 50–64 | 15.0** | 7.3 | 5.5 | 8.8** | 3.3 | 2.1 |
| 65–80 | 14.3** | 15.0** | 7.4 | 13.5** | 12.9** | 5.7 |
| Obesity | | | | | | |
| 4–11 | 15.3** | 10.9 | 10.2 | 9.3 | 6.3 | 5.6 |
| 12–17 | 17.3** | 18.0** | 10.5 | 10.8 | 6.0 | 9.0 |
| 18–34 | 35.5** | 31.6** | 21.4 | 19.2** | 13.0* | 8.4 |
| 35–49 | 45.2** | 35.0 | 30.8 | 26.6** | 22.1** | 15.8 |
| 50–64 | 47.4** | 41.5* | 31.9 | 28.3 | 25.5 | 23.7 |
| 65–80 | 38.4* | 40.6** | 29.4 | 24.8 | 27.2* | 20.6 |
| Low HDL | | | | | | |
| 12–19 | 13.6** | 11.9* | 7.4 | 5.0 | 6.9 | 9.7 |
| 20–34 | 16.2** | 11.4* | 6.6 | 9.9** | 5.7 | 3.1 |
| 35–49 | 14.6** | 11.5* | 6.6 | 8.1** | 3.3 | 2.3 |
| 50–64 | 13.0** | 7.0 | 5.1 | 6.3** | 2.0 | 1.4 |
| 65–80 | 10.9** | 6.7 | 5.4 | 5.3* | 3.4 | 2.4 |
| High cholesterol ratio | | | | | | |
| 12–19 | 6.0** | 5.1** | 2.4 | 3.6 | 3.3 | 4.8 |
| 20–34 | 12.0* | 12.3* | 7.8 | 8.7** | 4.9 | 2.3 |
| 35–49 | 21.8** | 14.4 | 11.4 | 12.2** | 7.3 | 5.3 |
| 50–64 | 21.8** | 18.6** | 12.1 | 17.0** | 11.8 | 11.0 |
| 65–80 | 19.3* | 15.4 | 13.4 | 15.9 | 11.9 | 14.4 |
| High C-reactive protein | | | | | | |
| 18–34 | 41.3 | 39.9 | 38.1 | 34.7 | 29.2 | 29.4 |
| 35–49 | 51.7** | 44.1 | 39.7 | 32.0** | 27.7* | 22.3 |
| 50–64 | 55.8** | 50.6* | 39.7 | 44.5** | 33.6 | 29.9 |
| 65–80 | 54.9* | 49.6 | 45.7 | 44.9* | 45.6* | 37.5 |
| Hypertension | | | | | | |
| 12–19 | 0.4 | 0.3 | 0.5 | 1.2 | 1.1 | 0.5 |
| 20–34 | 3.6* | 2.6 | 1.3 | 4.1 | 3.3 | 3.6 |
| 35–49 | 23.8* | 17.0 | 17.8 | 14.7 | 14.7 | 11.7 |
| 50–64 | 53.0** | 50.0** | 38.6 | 48.0** | 33.8 | 30.0 |
| 65–80 | 78.9* | 76.1 | 70.1 | 70.5** | 65.5 | 61.2 |
| Asthma ever diagnosed | | | | | | |
| Birth–3 | 11.7** | 6.4 | 4.9 | 2.9 | 1.6 | 1.0 |
| 4–11 | 13.7* | 9.7 | 8.6 | 8.1* | 8.2* | 3.3 |
| 12–19 | 17.4 | 16.4 | 19.5 | 7.2 | 4.8 | 5.2 |
| 20–34 | 17.4 | 13.4 | 15.8 | 7.5 | 5.9 | 6.2 |
| 35–49 | 15.8 | 15.6 | 14.3 | 9.7** | 6.0 | 5.0 |
| 50–64 | 15.6** | 14.2* | 9.7 | 9.4 | 7.2 | 6.6 |
| 65–80 | 15.1* | 12.3 | 10.7 | 8.7 | 9.8 | 5.8 |

*Continued*

to classify individuals as low risk (< 1 mg/L), medium risk (1–3 mg/L), or high risk (> 3 mg/L) and to create a binary measure of high vs low or medium health risk.[27–29]

The self-reported health conditions were based on participants' responses to standard survey questions. These were chosen because of comparability between the 2 data sets and were used in previous research comparing health in the United States and England.[3] Responses indicated whether the individual was ever told by a doctor that he or she had had a heart attack or angina, a stroke, or asthma (in England, the HSE simply asks whether the individual has asthma). Except asthma, all of these measures were available for individuals at least 20 years of age. Asthma was available for all ages.

### Age Groups and Income Measure

I categorized age into broad groups that correspond to the Centers for Disease Control and Prevention's Stages of Life. The categories were as follows: infants (birth–3 years), children (4–11 years), adolescents (12–19 years), young adults (20–34 years), middle-age adults (35–49 and 50–64 years), and older-age adults (65–80 years).

The primary independent variable of interest in this study was income-based socioeconomic status, which I constructed from the family income variable available in both the HSE and NHANES at present value, adjusted by the Organisation for Economic Co-Operation and Development's (OECD) square root equivalence scale, and then divided into equal terciles by using the sample weights.[30] The square root equivalence scale has been used in OECD publications on international income inequality and poverty since 2008. Additionally, because of the pooling of multiple years of data in the NHANES and HSE, I adjusted the measure for cost of living to the year 2006 using the Consumer Price Indexes for the United States and the United Kingdom.[31,32] Use of terciles rather than absolute income adjusted for differences in average levels and the income distribution across the 2 countries; previous studies of older adults have used this method.[1,2,33] I also adjusted the terciles by age group because of the fluctuations in income throughout the life span.

**TABLE 2—*Continued***

| | | | | | | |
|---|---|---|---|---|---|---|
| Heart attack | | | | | | |
| 20–34 | 0.7 | 0.5 | 0.3 | 0.3 | 0.0 | 0.1 |
| 35–49 | 2.3 | 1.4 | 1.2 | 1.0* | 1.5* | 0.2 |
| 50–64 | 8.9** | 4.4 | 2.0 | 5.4** | 3.1* | 1.7 |
| 65–80 | 18.4** | 10.4 | 7.6 | 11.2* | 15.4** | 7.1 |
| Stroke | | | | | | |
| 20–34 | 0.7 | 0.5 | 0.2 | 0.3 | 0.0 | 0.1 |
| 35–49 | 2.5* | 1.6 | 0.6 | 0.5 | 0.4 | 0.3 |
| 50–64 | 5.1** | 3.2 | 1.3 | 3.9** | 0.9 | 0.8 |
| 65–80 | 10.0** | 8.3* | 4.1 | 6.6 | 7.2 | 5.3 |

*Note.* HDL = high-density lipoprotein cholesterol.
*$P < .05$; **$P < .01$ (for prevalence among low- and middle-income vs high-income individuals).

**TABLE 3—Prevalence of Health Outcomes Among Male Respondents, by Income Tercile and Age Group: US National Health and Nutrition Examination Survey (1999–2006) and Health Survey for England (2003–2006)**

| | United States (n = 36 360), % | | | England (n = 55 783), % | | |
|---|---|---|---|---|---|---|
| Health Outcome and Age, Years | Low | Middle | High | Low | Middle | High |
| Diabetes | | | | | | |
| 12–19 | 0.6 | 0.4 | 0.7 | 1.0 | 1.1 | 0.0 |
| 20–34 | 1.8 | 0.8 | 1.0 | 1.1 | 0.5 | 0.3 |
| 35–49 | 7.7** | 4.5 | 3.5 | 5.7** | 2.0 | 2.0 |
| 50–64 | 17.0** | 10.2 | 8.3 | 9.0 | 7.4 | 6.9 |
| 65–80 | 19.6** | 14.6 | 10.2 | 13.7 | 16.0** | 9.5 |
| Obesity | | | | | | |
| 4–11 | 14.1** | 11.9** | 6.2 | 9.2 | 7.2 | 5.9 |
| 12–17 | 19.3** | 15.1 | 11.5 | 8.1 | 6.3 | 3.5 |
| 18–34 | 24.0 | 27.0* | 21.6 | 13.2 | 13.8 | 14.8 |
| 35–49 | 32.5 | 35.8 | 31.2 | 27.6 | 19.9 | 25.0 |
| 50–64 | 38.2 | 36.8 | 34.7 | 30.6 | 25.1 | 25.2 |
| 65–80 | 33.1 | 35.8** | 28.6 | 21.0 | 24.8* | 17.8 |
| Low HDL | | | | | | |
| 12–19 | 22.4 | 22.5 | 23.4 | 21.0 | 20.3 | 16.9 |
| 20–34 | 33.0** | 30.3* | 23.4 | 18.6 | 14.4 | 13.6 |
| 35–49 | 33.1 | 32.7 | 30.0 | 17.9** | 15.2* | 11.5 |
| 50–64 | 31.6** | 28.1 | 23.5 | 14.7 | 14.1 | 16.7 |
| 65–80 | 31.3* | 27.6 | 23.8 | 18.1* | 20.2** | 12.3 |
| High cholesterol ratio | | | | | | |
| 12–19 | 9.5 | 8.1 | 10.1 | 7.4 | 8.7 | 3.8 |
| 20–34 | 28.8 | 27.8 | 24.7 | 22.9 | 18.4 | 17.6 |
| 35–49 | 41.0 | 40.6 | 37.8 | 32.1 | 30.5 | 27.8 |
| 50–64 | 42.0** | 36.1 | 32.4 | 28.5 | 25.7* | 31.2 |
| 65–80 | 30.4** | 28.8** | 19.6 | 21.1 | 21.8 | 19.1 |

*Continued*

One set of sensitivity analyses contained education terciles, categorizied them as follows: low education (0–12 years of education in United States, 0–11 years of education in England), medium education (13–15 years of education in United States, 12–13 years of education in England), and high education (≥ 16 years of education in United States, ≥ 14 years of education in England). Although the education categories were not directly comparable, these categories are the same as those used in previous literature comparing the 2 countries.[2]

Other covariates included race/ethnicity (White, Black, Hispanic, and other for the United States; White, Black, Asian, and other for England), smoking, frequent alcohol drinking, and health insurance. I included these factors as they may influence health differently in the 2 countries and have been used in previous research on the gradient among older adults.[1] All are described in Table 1.

### Analysis

In this study I used Stata statistical software version 11.0 SE (StataCorp LP, College Station, TX) to conduct all analyses. I used the SVY commands to adjust for complex sampling design in both studies and to produce robust standard errors and weighted all analyses to produce nationally representative results. I calculated weighted percentages for each health condition, separately for males and females, in each age group by income tercile. I used modified Poisson models to estimate risk ratios demonstrating the risk of morbidity faced by low- and medium-income individuals relative to the high-income individuals within each country. These models are well suited to the estimation of risk ratios, particularly in studies using complex sampling design, where generalized linear binomial regression models have documented convergence problems.[3,4]

## RESULTS

The US and England samples are described by income tercile in Table 1. There was variation in the representation of age in the 3 income groups. For this reason, all subsequent analyses in this article were either adjusted by age or stratified by age group. In both countries, there was a slight gender difference by

**TABLE 3—*Continued***

| | | | | | | |
|---|---|---|---|---|---|---|
| High C-reactive protein | | | | | | |
| 18–34 | 22.4 | 23.8 | 19.5 | 20.5 | 16.8 | 15.0 |
| 35–49 | 34.3** | 26.2 | 24.0 | 25.8** | 19.0 | 18.2 |
| 50–64 | 44.1** | 33.0 | 30.2 | 41.8** | 27.7 | 27.7 |
| 65–80 | 46.7** | 37.2 | 35.9 | 39.8** | 45.0** | 29.9 |
| Hypertension | | | | | | |
| 12–19 | 2.3 | 1.2 | 1.0 | 3.0 | 2.7 | 2.4 |
| 20–34 | 9.5 | 8.5 | 9.8 | 10.0 | 11.5 | 13.9 |
| 35–49 | 24.6* | 24.5* | 18.5 | 26.2* | 21.2 | 21.2 |
| 50–64 | 49.9** | 42.3 | 39.6 | 48.6 | 42.9 | 44.7 |
| 65–80 | 66.5* | 64.2 | 59.5 | 63.7 | 66.0 | 61.8 |
| Asthma ever diagnosed | | | | | | |
| Birth–3 | 13.4* | 10.8 | 8.4 | 9.2 | 4.4 | 3.7 |
| 4–11 | 17.8 | 20.7 | 17.8 | 13.2* | 10.1 | 7.6 |
| 12–19 | 17.7 | 18.1 | 17.1 | 11.4 | 6.7 | 11.6 |
| 20–34 | 12.0 | 10.9** | 16.3 | 6.0 | 6.1 | 5.9 |
| 35–49 | 10.9 | 10.8 | 9.3 | 6.4 | 5.0 | 4.2 |
| 50–64 | 12.0 | 9.5 | 10.8 | 6.7 | 4.2 | 4.9 |
| 65–80 | 7.9 | 8.2 | 7.8 | 6.2 | 4.8 | 6.3 |
| Heart Attack | | | | | | |
| 20–34 | 0.5 | 0.7 | 0.0 | 0.0 | 0.2 | 0.0 |
| 35–49 | 3.4 | 2.0 | 2.1 | 1.2** | 0.9 | 0.4 |
| 50–64 | 13.0** | 8.2 | 5.8 | 13.7** | 6.9 | 5.2 |
| 65–80 | 26.8** | 19.6 | 16.1 | 27.2* | 26.8* | 17.4 |
| Stroke | | | | | | |
| 20–34 | 0.4 | 0.5 | 0.4 | 0.4 | 0.0 | 0.0 |
| 35–49 | 1.0 | 1.1 | 0.3 | 0.7 | 0.0 | 0.3 |
| 50–64 | 4.7** | 1.2 | 1.1 | 3.4** | 0.7 | 1.0 |
| 65–80 | 10.6* | 9.4 | 6.1 | 10.3** | 11.1** | 5.4 |

*Note.* HDL = high-density lipoprotein cholesterol.
*$P < .05$; **$P < .01$ (for prevalence among low- and middle-income vs high-income individuals).

income. Females were more likely to be low income in both countries, whereas males were more likely to be high income. For this reason, I stratified the analysis by gender. There was a marked pattern in the race distribution by income. Non-White race and ethnic groups were more likely than Whites to be in the lowest income tercile in both countries. Additionally, as expected, those with the lowest education were much more likely to be low income, whereas those with higher levels of education were much more likely to be high income.

Health behaviors were also variable by income. Smoking (or being exposed to household smoke for those younger than 18 years) was most prevalent among low-income individuals and least prevalent among high-income people in both countries. There was also a clear gradient for drinking alcohol on 5 or more days per week for those aged 20 years and older, although this gradient went in the opposite direction, with high-income respondents drinking more. Finally, health insurance was distributed highly unevenly by income in the United States. Almost one third of low-income individuals were uninsured, whereas less than 6% of high-income individuals did not have health insurance. The entire English sample was provided health insurance through the National Health Service (NHS).

The unadjusted prevalence percentages are presented for all relevant health conditions for females (Table 2) and males (Table 3). These tables show a significant income gradient in health in both the United States and England and no systematic variation in this gradient by age in either country. Because there were no clear patterns in the income gradient by age, Tables 4 and 5 present results for all relevant ages, adjusted by age. This also facilitated the interpretation of the results. The risk ratios in Table 4 (females) and Table 5 (males) illustrate the relative levels of risk for health risk factors or disease among low- or medium-income versus high-income individuals within the same country. Models 1 and 4 represent the risk ratios adjusted only by age in the United States and England. The results demonstrate that the gradient in the 2 countries was quite similar. Despite the different health care systems and overall population health within each country, health inequality was pervasive in both the United States and England. These results were not sensitive to age group specification (available upon request).

For females (Table 4: models 1 and 4), the gradient for heart attack and stroke appeared steeper in the United States than in England. For diabetes, low HDL cholesterol, high C-reactive protein, and asthma, the difference between those with high and low incomes was greater in England than in the United States. The gradients appeared identical for obesity, high cholesterol ratio, and hypertension. The difference in the gradient between the United States and England was not statistically significant for any outcome.

The risk ratios demonstrated a steeper gradient for US males than for English males for obesity, diabetes, high cholesterol ratio, and hypertension (Table 5: models 1 and 4). There was no difference in the heart attack and stroke gradients, and the gradient was steeper in England for low HDL cholesterol, high C-reactive protein, and asthma. The only statistically significant differences in the gradient in health between US and English males were for obesity among middle-income individuals and hypertension among low-income individuals. In these 2 cases, the gradient was steeper in the United States than in England. Importantly, the income gradient appeared to be more

**TABLE 4—Risk Ratios for Low- and Middle-Income Females Compared With High-Income Females: US National Health and Nutrition Examination Survey (1999–2006) and Health Survey for England (2003–2006)**

| | United States | | | England | | |
|---|---|---|---|---|---|---|
| Health Outcome and Income Level | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Obesity | | | | | | |
| Low | 1.51** | 1.38** | 1.41** | 1.49** | 1.46** | 1.43** |
| Middle | 1.30** | 1.27** | 1.27** | 1.25** | 1.24** | 1.26** |
| Diabetes | | | | | | |
| Low | 2.50** | 1.94** | 1.75** | 2.70** | 2.30** | 1.95** |
| Middle | 1.71** | 1.57** | 1.44** | 1.87** | 1.83** | 1.66** |
| Low HDL | | | | | | |
| Low | 2.24** | 2.31** | 1.67** | 2.60** | 2.41** | 2.32** |
| Middle | 1.59** | 1.60** | 1.31 | 1.36 | 1.35 | 1.41 |
| High cholesterol ratio | | | | | | |
| Low | 1.72** | 1.86** | 1.33** | 1.70** | 1.72** | 1.34** |
| Middle | 1.39** | 1.43** | 1.17 | 1.11 | 1.12 | 0.99 |
| Hypertension | | | | | | |
| Low | 1.21** | 1.15** | 1.14** | 1.23** | 1.21** | 1.14** |
| Middle | 1.13* | 1.11 | 1.08 | 1.06 | 1.06 | 1.01 |
| High C-reactive protein | | | | | | |
| Low | 1.24** | 1.18** | 1.07 | 1.32** | 1.32** | 1.17** |
| Middle | 1.13* | 1.11* | 1.02 | 1.14** | 1.14** | 1.08 |
| Asthma | | | | | | |
| Low | 1.21* | 1.26** | 1.30** | 1.58** | 1.56** | 1.43** |
| Middle | 1.04 | 1.06 | 1.07 | 1.25 | 1.25 | 1.15 |
| Heart attack | | | | | | |
| Low | 2.62** | 2.67** | 2.35** | 2.06** | 2.04** | 1.88** |
| Middle | 1.52* | 1.53* | 1.42 | 2.12** | 2.10** | 1.93** |
| Stroke | | | | | | |
| Low | 3.03** | 3.09** | 2.41** | 1.91** | 1.99** | 1.78** |
| Middle | 2.29** | 2.30** | 2.04** | 1.23 | 1.22 | 1.15 |

*Note.* HDL = high-density lipoprotein cholesterol. Columns 1 and 4 control for age only; models 2 and 5 control for age and race/ethnicity; columns 3 and 6 control for age, race/ethnicity, health behaviors, body mass index, and health insurance (US only).
*$P < .05$; **$P < .01$ (risk ratio for low- and middle-income vs high-income individuals).

pronounced for females than for males in both countries, particularly for obesity, diabetes, low HDL cholesterol, high total cholesterol ratio, hypertension, asthma, and heart attack or angina.

In Tables 4 and 5, models 2 and 5 added controls for race/ethnicity and models 3 and 6 added additional controls for the following health behaviors: smoking (adults) or being exposed to household smoking (aged ≤ 18 years), frequent drinking (≥ 20 years), BMI (≥ 4 years), and health insurance (for the United States only; all ages). In the models controlling for race/ethnicity, it was clear that racial and ethnic differences explained little of the within-country income gradient. Diabetes was the only outcome for which there was an attenuation of the risk ratios in both countries for both genders when race/ethnicity was added to the models, although there was no change in statistical significance. Likewise, controlling for health behaviors and insurance had little consistent impact on the income gradient (models 3 and 6), although high C-reactive protein for US females and low HDL cholesterol for English males were exceptions. Overall, both countries had large, significant income gradients in health that could not be explained by the factors available here.

Age-specific analyses yielded similar findings, with little variation in the potential explanatory factors by age group. Additionally, I conducted sensitivity analyses using education rather than income as the socioeconomic measure of interest and restricting the sample to Whites only. The results were not sensitive to these alternate specifications (available upon request).

## DISCUSSION

Inequality in health by income was quite similar within both the United States and England, despite the healthier population in England. Americans and the English were affected by the income gradient in health at all ages, from childhood through to later adulthood. Factors such as race/ethnicity, smoking, frequent alcohol consumption, BMI, and health insurance could not explain the magnitude of the income gradient in either country.

### Potential Explanations for Health Inequalities

The comparability of the gradient in the United States and England—2 countries with very different health care and social protection systems—is surprising and not easily explained. However, several potential mechanisms can be ruled out. It is clear that differences in race/ethnicity did not account for the income gradient in the 2 countries. Additionally, the analysis excluded both frequent alcohol consumption and smoking behaviors as possible explanations for the gradient among the English and Americans. Obesity and overweight did not appear to explain income inequality in health in either country.

Perhaps most crucially, it is difficult to ascertain the extent to which health care differences in the 2 countries also influence the level of income inequalities within the United States and England. Despite the universal health care provided by the NHS in England, its income gradient in health appears similar to that of the United States, where health care access is very uneven.[35] Additionally, since the gradient is equally steep for both the biological and self-reported measures based on a doctor's diagnosis, country-level differences

**TABLE 5—Risk Ratios for Low- and Middle-Income Males Compared With High-Income Males: US National Health and Nutrition Examination Survey, 1999–2006, and Health Survey, 2003–2006**

| | United States | | | England | | |
|---|---|---|---|---|---|---|
| Health Outcome and Income Level | 1 | 2 | 3 | 4 | 5 | 6 |
| Obesity | | | | | | |
| Low | 1.16** | 1.15** | 1.19** | 1.13 | 1.16* | 1.20* |
| Middle | 1.19** | 1.19** | 1.19** | 0.97 | 0.97 | 0.97 |
| Diabetes | | | | | | |
| Low | 2.01** | 1.74** | 1.69** | 1.64** | 1.45** | 1.32* |
| Middle | 1.25 | 1.18 | 1.10 | 1.32* | 1.32* | 1.17 |
| Low HDL | | | | | | |
| Low | 1.21** | 1.27** | 1.26** | 1.29** | 1.24** | 1.12 |
| Middle | 1.14* | 1.16** | 1.12* | 1.16 | 1.15 | 1.09 |
| High cholesterol ratio | | | | | | |
| Low | 1.17** | 1.21** | 1.20** | 1.11 | 1.08 | 1.02 |
| Middle | 1.1 | 1.12* | 1.08 | 1.01 | 1.01 | 0.97 |
| Hypertension | | | | | | |
| Low | 1.20** | 1.19** | 1.26* | 1.02 | 1.01 | 1.03 |
| Middle | 1.09 | 1.09 | 1.08 | 0.98 | 0.98 | 0.97 |
| High C-reactive protein | | | | | | |
| Low | 1.35** | 1.32** | 1.25** | 1.41** | 1.39** | 1.27** |
| Middle | 1.11 | 1.10 | 1.04 | 1.14* | 1.14* | 1.07 |
| Asthma | | | | | | |
| Low | 1.00 | 1.05 | 1.13 | 1.31* | 1.32* | 1.27 |
| Middle | 0.98 | 0.99 | 0.94 | 0.96 | 0.96 | 0.98 |
| Heart attack | | | | | | |
| Low | 1.81** | 2.03** | 1.94** | 1.81** | 1.92** | 1.90** |
| Middle | 1.23 | 1.27 | 1.21 | 1.46* | 1.53** | 1.51** |
| Stroke | | | | | | |
| Low | 2.22** | 2.07** | 2.05** | 2.19** | 2.47** | 2.34** |
| Middle | 1.52* | 1.49* | 1.40 | 1.41 | 1.40 | 1.34 |

*Note.* HDL = high-density lipoprotein cholesterol. Columns 1 and 4 control for age only; columns 2 and 5 control for age and race/ethnicity; columns 3 and 6 control for age, race/ethnicity, health behaviors, body mass index, and health insurance (US only).
*$P < .05$; **$P < .01$ (risk ratio for low- and middle-income vs high-income individuals).

in access to health care also cannot be confounding the results. However, one cannot conclusively eliminate the possibility that differences in the type of health care provided in each country may be influencing individuals differently at each point across the income distribution. Finally, it may be that the NHS improves health for the entire English population, but that overall income inequalities in both countries translate directly into health inequalities. If this is the case, the income gradient will be very difficult to reduce until overall income inequality is reduced.

Previous studies have not conducted comparisons separately by gender. The finding that the income gradient is in fact steeper for women in both countries is intriguing and suggests that future comparative studies should investigate gender differences. Recent work by Martinson et al. also found that the health differential between individuals in the United States and England is greater for females.[3] Health inequalities appear to affect women more than men, and this is an area ripe for further research.

Finally, there is no systematic variation in the magnitude of the gradient in health by age in either country. Depending on the health outcome of interest, the gradient may be steepest for children, young and middle-age adults, or the oldest adults. The gradient varies by gender and country as well. By young adulthood, the income gradient in health is well established in both of these countries. This suggests that income-based health inequalities affect both the young and old in societies and are probably not the result of stress accumulation and a compounding of disadvantage and health shocks throughout the life course. It would be fruitful for future research to examine gradients across the life span using longitudinal data to understand both the development of health disparities and the relationships between trends in social policy and health inequalities.

## Limitations

There are some limitations to this study that suggest future directions for comparative studies in health disparities between the United States and England. The first limitation is the questionable comparability of self-reported health in different countries. In this study, however, the high degree of comparability of the biological measures is a strength in both sets of data, as these measures are less susceptible to measurement error than self-reported survey measures.[1,3,19] The results are similar among the self-reported and biological measures.

Second, large health surveys such as the HSE and NHANES, while providing very high-quality comparable health outcomes, have limited sociodemographic and behavioral measures to examine as potential mechanisms. Additionally, this study was unable to disentangle age and cohort effects in examining the income gradient by age group. To this end, one cannot definitively conclude that the relationship between income and health does not strengthen throughout the life course—more evidence that future studies using longitudinal data are sorely needed to examine the health trajectories in the United States compared with other countries, such as England. Third, although using income terciles allows for the examination of relative health inequalities in each country, the difference between high- and low-income individuals is

greater in the United States than in England as reflected by the Gini coefficient.[5] Finally, to further elucidate the remarkably similar income inequalities in health found in these 2 countries, studies such as this should be extended to other countries. Although England has less income inequality than the United States, its citizens still experience a higher level of inequality than many other European countries.

## Conclusions

The similarity of the income gradient in health in the United States and England is notable at all ages for a number of conditions. Although the English enjoy better overall health than Americans, both countries still grapple with large health inequalities. This comparison of the income gradient in health suggests that the policy discussion on reducing health disparities requires attention to broader social conditions, not simply health insurance and health care. Understanding disparities in an international context, especially by extending this comparison with other countries, will help shed light on the pervasiveness of health inequalities by income. ■


## About the Author

*At the time of the study, Melissa L. Martinson was with the Office of Population Research, Princeton University, Princeton, NJ.*

*Correspondence should be sent to Melissa L. Martinson, University of Washington, School of Social Work, Seattle, WA 98195 (e-mail: melmart@uw.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.*



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Because this study employed only the analysis of de-identified secondary data, no protocol approval was needed.

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