Disease and Disadvantage in the United States and in England

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Context The United States spends considerably more money on health care than the United Kingdom, but whether that translates to better health outcomes is unknown.

Objective To assess the relative heath status of older individuals in England and the United States, especially how their health status varies by important indicators of socioeconomic position.

Design, Setting, and Participants We analyzed representative samples of residents aged 55 to 64 years from both countries using 2002 data from the US Health and Retirement Survey (n=4386) and the English Longitudinal Study of Aging (n=3681), which were designed to have directly comparable measures of health, income, and education. This analysis is supplemented by samples of those aged 40 to 70 years from the 1999-2002 waves of National Health and Nutrition Examination Survey (n=2097) and the 2003 wave of the Health Survey for England (n=5526). These surveys contain extensive and comparable biological disease markers on respondents, which are used to determine whether differential propensities to report illness can explain these health differences. To ensure that health differences are not solely due to health issues in the black or Latino populations in the United States, the analysis is limited to non-Hispanic whites in both countries.

Main Outcome Measure Self-reported prevalence rates of several chronic diseases related to diabetes and heart disease, adjusted for age and health behavior risk factors, were compared between the 2 countries and across education and income classes within each country.

Results The US population in late middle age is less healthy than the equivalent British population for diabetes, hypertension, heart disease, myocardial infarction, stroke, lung disease, and cancer. Within each country, there exists a pronounced negative socioeconomic status (SES) gradient with self-reported disease so that health disparities are largest at the bottom of the education or income variants of the SES hierarchy. This conclusion is generally robust to control for a standard set of behavioral risk factors, including smoking, overweight, obesity, and alcohol drinking, which explain very little of these health differences. These differences between countries or across SES groups within each country are not due to biases in self-reported disease because biological markers of disease exhibit exactly the same patterns. To illustrate, among those aged 55 to 64 years, diabetes prevalence is twice as high in the United States and only one fifth of this difference can be explained by a common set of risk factors. Similarly, among middle-aged adults, mean levels of C-reactive protein are 20% higher in the United States compared with England and mean high-density lipoprotein cholesterol levels are 14% lower. These differences are not solely driven by the bottom of the SES distribution. In many diseases, the top of the SES distribution is less healthy in the United States as well.

Conclusion Based on self-reported illnesses and biological markers of disease, US residents are much less healthy than their English counterparts and these differences exist at all points of the SES distribution.

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THE UNITED STATES HAS A CONsiderably greater expenditure on medical care (US $5274 per capita) than in the United Kingdom (US $2164 adjusting for purchasing power).[1] To determine whether that expenditure translates into better health outcomes for the adult US population, data on the degree of morbidity in each country beyond the childhood years are needed.

Given the strong link between socioeconomic position and health in both countries, cross-country comparisons of morbidity should examine variation of morbidity according to comparable measures of socioeconomic position. Cross-country comparison of social differences in illness provides some insight into potential causal explanations. Access to health care is a particular case in point. Although publicly funded health care is available in both countries to citizens older than 65 years, the UK National Health Service has no age criterion for eligibility. Thus, British households are more isolated from any financial impacts of out-of-pocket medical expenses. A similar argument applies to earnings and job losses, for which the more generous UK income maintenance system should mitigate any effects of health changes on income and wealth there compared with what is available in the United States.

We compare measures of morbidity according to 2 salient measures of socioeconomic status (SES)—education and household income—in nationally representative samples in the United States and England. One common prob-

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lem with attempting international analysis is the need to use self-reported morbidity measures and that might result in international differences simply due to reporting or diagnosis differences across countries. This study combines self-reported data with biological data that suffer less from such ambiguities.

METHODS

Data

Despite the analytical advantages of making international health comparisons, until recently good micro data measuring both SES and health in comparable ways have not been available for both countries. Fortunately, that problem has been remedied with the fielding of 4 surveys—each designed to have comparable measures of SES and self-reported and biological health outcomes.

For the United States, our study is based on the Health and Retirement Survey (HRS), a nationally representative survey that currently includes more than 20 000 individuals in the older-than-50-years populations.[2] The HRS began in 1991 and new cohorts have been added subsequently to maintain population representation of this age segment and respondents are reinterviewed biannually. To be comparable with the English survey fielded in the same year, we use the 2002 wave of HRS.

Because biological measures are unavailable in HRS, we use the most recent National Health and Nutrition Examination Survey (NHANES), fielded between 1999 and 2002.[3] NHANES contains data obtained through personal interviews, physical and laboratory examinations (blood, urine, and swabs) for individuals aged 2 months and older. NHANES 1999-2002 contains 21 004 interviews with medical examinations on 19 759 respondents. To ensure that any differences between countries that emerge are not due to special issues that exist in the black or Hispanic communities in the United States or the Asian and black immigrant communities in England, all data in our study are restricted to non-Hispanic whites. Ethnicity was self-reported by the participants in each of the 4 studies.

For England, we use the English Longitudinal Survey of Aging (ELSA), which contains approximately 12 000 respondents recruited from 3 separate years of the Health Survey for England (HSE) survey providing a representative sample of the English population aged 50 years and older.[4] The health data were supplemented by collection of social and economic data in the first ELSA wave fielded in 2002. Like HRS, follow-ups are every 2 years. The authors of this article were involved in the design and creation of HRS and ELSA, and we only selected key health and SES constructs where strong a priori comparability existed in measurement. The institutional review board of RAND approved our research project.

Biological measures for England were obtained from the 2003 HSE, which contains 18 553 respondents of all ages.[5] The survey protocols included an interview visit followed by a nurse visit who collected saliva and blood samples. The blood samples were analyzed for high-density lipoprotein cholesterol (HDL-C), fibrinogen, C-reactive protein, and glycosylated hemoglobin; measures also available in NHANES.

Measures of SES

All 4 surveys are comparable in their SES measurement with each containing individual attributes such as age, sex, race, ethnicity, household income, and education. The quality of the SES baseline data are high.[3] Two key SES measures used are years of schooling and household income, each divided into 3 groups. In the United States, education is separated into high school or less (0-12 years), more than high school but not a college graduate (13-15 years of schooling), and college or more (≥16 years). In the United Kingdom the 3-way education division is qualified to a level lower than "O-level" or equivalent (typically 0-11 years of schooling), qualified to a level lower than "A-level" or equivalent (typically 12-13 years of schooling), and a higher qualification (typically >13 years of schooling). In both countries, family income (adjusted for household size) is divided into 3 equally sized income tertiles so that one third of the population is in each group.

To eliminate the obvious effects of age on health, our HRS-ELSA comparative analysis is limited to those aged 55-64 years. Sample sizes were 4386 for HRS and 3681 for ELSA. To provide adequate sample size, our NHANES-HSE comparisons are carried out on respondents between the ages of 40 and 70 years. Sample sizes were 2097 for NHANES and 5526 for HSE.

Self-reported Measures of Health Outcomes and Risk Factors

All 4 surveys collect data on individual self-reports of specific diseases of the general form: "Did a doctor ever tell you that you had . . . ?" The specific diseases we analyzed are diabetes, hypertension, heart disease, myocardial infarction, stroke, chronic lung diseases, and cancer. The HRS and ELSA also collect several health-related behaviors that are in common including smoking (currently and ever smoke), alcohol consumption (heavy drinking defined as drinking >4 days per week in HRS and ≥twice a day or daily or almost daily in ELSA), and weight and height (so that body mass index, obesity, and overweight can be calculated; body mass index is calculated as weight in kilograms divided by the square of height in meters). Although other risk factors may be important, due to the comparative nature of this research, we only used those comparably measured in our data in both countries.

Biological Measures of Health Outcomes

Our biological measures include plasma fibrinogen, glycosylated hemoglobin A_{1c} (HbA_{1c}), C-reactive protein, and HDL-C. In addition, respondents had examinations during which their blood pressure was taken. Such measures can be used to validate respondents' self-reports of specific diseases. More spe-

cifically, both NHANES and HSE respondents were evaluated for diabetes with an HbA_{1c} test. Although not usually a screener for diabetes, HbA_{1c} is highly correlated with fasting plasma glucose levels. Although there is no strict diagnosis threshold value, we followed the US convention by using values greater than or equal to 6.5% as indicating clinical diabetes. Our results on intercountry and intracountry differences are not sensitive to the specific threshold chosen.

For hypertension, we follow the recommendations in the Sixth Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure of 1997—systolic blood pressure equal to or greater than 140 mm Hg and/or diastolic blood pressure equal to or greater than 90 mm Hg and/or taking medication.[6]

For the 3 remaining biological measures, there is no direct matching to respondent self-reports. The primary issue becomes whether variation in these biological measures by SES and across countries is similar to those obtained for self-reports on heart diseases, for which these biological measures are well-established markers.[7-9] C-reactive protein is separated into 3 groups (≥3 mg/L indicates high risk, between 1 but <3 is moderate risk, and <1 is low risk). For fibrinogen, the normal range is 200-400 mg/dL (5.88-11.76 µmol/L), and higher than 400 mg/dL is considered a high risk for heart disease. Finally, we divide HDL-C levels into 3 groups (≥60 mg/dL [1.55 mmol/L]is described as high; 40-59 mg/dL [1.03-1.53 mmol/L], normal; and <40 mg/dL (low). High-density lipoprotein cholesterol levels in our high-range stratum are associated with reduced risk of heart disease.[3]

Statistical Methods

In HRS and ELSA, age-specific disease prevalence of diabetes, hypertension, all heart disease, myocardial infarction, stroke, lung disease, and cancer in both countries is modeled as a function of the 3 education and income indicators, sex, and indicators for smoking, alcohol consumption, overweight, and obesity using ordinary least squares regression (OLS) models and STATA statistical software version 9.0SE (STATA Corp, College Station, Tex). All models use the appropriate sample weights and all coefficients are allowed to differ between England and the United States. Our main conclusions are unchanged if multiple logistic or multivariate probit models are used or if separate models are estimated for women and men. Tests of statistical significance between the countries are provided in all Tables. $P<.05$ was considered statistically significant.

RESULTS

Health Disparities Within and Between Countries

For England (using ELSA) and the United States (using HRS), TABLE 1 lists

Table 1. Self-reported Health by Education and Income in England and the United States, Ages 55-64 Years*

	England				United States			
	Low	Medium	High	Total	Low	Medium	High	Total
	Years of Schooling, Percent Distribution							
Unweighted sample size	1745	969	967	**3681**	2293	1003	1090	**4386**
Diabetes	7.0	4.8	5.7	6.1	14.3†	12.3†	9.5†	12.5†
Hypertension	36.6	31.4	31.0	33.8	46.3†	40.8†	37.0†	42.4†
All heart disease	11.6	7.7	7.8	9.6	17.1†	14.8†	12.0†	15.1†
Myocardial infarction	4.5	3.6	3.4	4.0	6.7†	4.1	4.4	5.4†
Stroke	2.7	2.2	1.6	2.3	4.8†	4.2‡	1.7	3.8†
Lung disease	8.2	5.2	3.7	6.3	10.9†	8.3†	3.1	8.1†
Cancer	5.2	5.5	6.3	5.5	8.9†	10.0†	10.0†	9.5†
	Income, Percent Distribution							
Unweighted sample size	1204	1212	1259	3681	1574	1484	1328	**4386**
Diabetes	7.3	6.7	4.4	6.1	17.4†	11.8†	8.2†	12.5†
Hypertension	36.7	34.6	30.3	33.8	46.3†	43.6†	37.1†	42.4†
All heart disease	13.7	8.7	6.5	9.6	20.0†	13.3†	12.0†	15.1†
Myocardial infarction	6.5	3.1	2.4	4.0	8.5	4.6	3.2	5.4†
Stroke	3.6	1.8	1.4	2.3	6.0†	3.8†	1.5	3.8†
Lung disease	8.1	6.4	4.4	6.3	13.2†	7.1	4.1	8.1†
Cancer	5.9	5.2	5.5	5.5	9.6†	9.6†	9.3†	9.5†

*English data are from the first wave of English Longitudinal Survey of Aging, and US data are from the 2002 wave of the Health and Retirement Survey. Within each country, weekly family income adjusted for family size is divided into 3 equally sized income tertiles with one third of the weighted population in each group. In the United States, the range of the middle income group is $322-$635 while in England the range of the middle income group is £127-£241. In the United States, education is separated into high school or less (0-12 years), more than high school but not a college graduate (13-15 years), and college or more (≥16 years). In England the 3-way education division is qualified to a level lower than "O-level" or equivalent (typically 0-11 years of schooling), qualified to a level lower than "A-level" or equivalent (typically 12-13 years), and a higher qualification (typically >13 years). All data are weighted.
†$P<.01$ vs data with England.
‡$P<.05$ vs data with England.

the fraction of individuals who self- report that they have 7 specific diseases—diabetes, hypertension, heart disease, myocardial infarctions, strokes, diseases of the lung, and cancer. To ensure that patterns are not confounded by age, comparisons are limited to those aged 55 through 64 years old. Within this age span, the average age of both samples is identical.

The total columns list rates of disease prevalence based on individual self-reports of having each disease. All analyses were also conducted separately for men and women and the principal substantive conclusions are unaltered. Americans report higher levels of disease than the English, and in most cases much higher levels. These total prevalence differences for all diseases are always statistically significant. Diabetes prevalence is twice as high in the United States (12.5%) compared with England (6.1%). This between-country differential exists for both sexes, but male prevalence rates are higher in both countries. Similarly, all forms of cardiovascular diseases have self-reported prevalence considerably higher in the United States than in England. To illustrate, hypertension is about 10 percentage points more common and all heart disease 6 percentage points higher in the United States. And although heart-related conditions are more common among men in both countries a higher prevalence is observed in the United States for each sex. Finally, both lung disease and cancer exhibit a similar cross-country differential—higher prevalence rates for both sexes in the United States but now the disease is more common among women in both countries.

The second salient pattern highlighted in Table 1 concerns the health gradient across the 2 classifiers of SES—education and income. With the sole exception of cancer, there exists a sharp negative gradient across both education and income groups in both countries. That is, disease prevalence is reported to be much higher among those at the bottom of either the education or income ladder compared with those at the top of each classification. Although not universally true, income and education gradients generally are steeper in the United States than in England. As a result, country differences are larger and tend to be more statistically different at the bottom of the social hierarchy than at the top. Level differences between countries are sufficiently large that individuals in the top of the education and income strata in the United States have comparable rates of diabetes and heart disease as those in the bottom of the income and education strata in England.

Differences in Risk Factors by SES

TABLE 2 lists the proportion of population smoking, heavy drinking, and with being overweight. On average, smoking behavior is remarkably similar in both countries with about 1 in 5 people in this age group who currently smoke. Strong negative gradients across income and education exist in both countries, but the gradients appear equally as large in both countries. Thus differential smoking behavior by itself seems unlikely to explain the higher concentration of disease (particularly those related to smoking) in the United States than in England or the particularly high levels at the lower rungs of the SES classification in United States.

In contrast, obesity is much higher in the United States, an across-country differential especially pronounced in the lowest education and income groups. In both countries, rates of obesity decline with income and with education. Finally, there are higher rates of heavy drinking in England. Because heavy drinking is more common among those at the top of the education and income strata, it is an unlikely explanation for the concentration of disease among those at the bottom in either country, although more moderate drinking in high SES groups could contribute to lower heart disease risk.

Table 2. Risk Factors in England and the United States, Ages 55-64 Years*

	England				United States			
	Low	Medium	High	Total	Low	Medium	High	Total
	Years of Schooling, Percent Distribution							
Current smoker	28.6	18.2	13.3	21.9	24.9†	20.5	11.4	20.1
Ever smoke	69.1	64.0	62.6	66.1	64.5‡	65.0	54.8‡	61.9‡
Obese	26.5	20.9	18.6	23.0	33.6‡	34.5‡	24.0‡	31.1‡
Overweight	38.8	42.4	43.2	40.9	38.2	37.8	40.5‡	38.8
Heavy drinker	21.8	32.8	42.2	30.0	10.6‡	13.2‡	21.9‡	14.4‡
	Income, Percent Distribution							
Current smoker	28.6	22.2	15.2	21.9	26.9	21.8	11.6†	20.1
Ever smoke	69.1	65.8	63.4	66.1	66.1	62.6	56.9‡	61.9‡
Obese	25.3	23.2	20.5	23.0	35.6‡	32.9‡	24.8†	31.1‡
Overweight	38.9	41.8	42.1	40.9	35.8	39.0	41.4	38.8
Heavy drinker	22.6	26.2	40.6	29.9	8.7‡	14.3‡	20.2‡	14.1‡

*Source: English data are from first wave of English Longitudinal Survey of Aging, and US data are from the 2002 wave of the Health and Retirement Survey. See Table 1 for sample sizes and definitions of income and education groups. All data weighted.
†$P<.05$ vs data with England.
‡$P<.01$ vs data with England.

To determine to what extent differences in these risk factors can explain any salient differences in morbidity across countries, we estimated ordinary least squares regression models on each disease listed in Table 1. The explanatory variables included all risk factors listed in Table 2, indicator variables for the 3 education and 3 income groups used to stratify in these Tables, and sex.

By and large, the risk factors perform in the expected direction. For example, being obese tends to be associated with higher rates of diabetes, hypertension, and myocardial infarctions; and having ever smoked is strongly associated with lung disease, cancer, and myocardial infarctions.

These models were then used to simulate what health conditions would be if all individuals in both countries had the same level of behavioral risk factors as the average American in this age group. Risk-factor adjusted prevalence rates are displayed in TABLE 3. In these simulations, we hold the population sex distribution at US levels.

A comparison of these adjusted prevalence rates with those in Table 1 indicates how much of between-country difference in illness and how much of the variation by SES in each country is due to different levels of behavioral risk factors. This comparison demonstrates that very little of the overall between-country differences in health conditions are due to differences in this subset of behavioral risk factors. To illustrate, less than one fifth of the difference in diabetes between the United States and England is explained by these risk factors.

With the sole exception of cancer, for which there was no within-country SES gradient to begin with, after controlling for these risk factors there remains a steep income gradient in both countries with those in the lower income quintiles experiencing worse health. Risk factors tend to account for some of the differences in illness across education groups, but for most diseases the essential nature of the negative health gradient remains intact.

Differences in Reporting Health Outcomes

Because controlling for a standard set of behavioral risks does not explain why Americans are less healthy than the English with health disparities largest at the bottom of the SES hierarchy, the principal explanations must lie elsewhere. One possibility is that our description of comparative health outcomes is exaggerated by relying on individual self-reports. Perhaps due to limited contact with the medical system, individuals in different countries or across different SES groups may be unaware that they have a particular disease or may think they are cured when the disease is only under control. Protocols and thresholds for specific disease diagnosis may differ so that a similarly ill patient may be diagnosed with a disease in one country but not in the other. The language by which physicians in the 2 countries communicate health problems to their patients may be different. For example, in England, physicians may tell their patients that they have problems with blood glucose levels, which may not be understood to imply diabetes.

One way of addressing reporting issues involves examining biological markers of disease risk in both countries. TABLE 4 summarizes results using 5 biological measures based on simi-

Table 3. Self-reported Health by Education and Income in England and the United States, Ages 55-64 Years*

	England				United States			
	Low	Medium	High	Total	Low	Medium	High	Total
Years of Schooling, Percent Distribution								
Diabetes	7.7	6.2	7.4	7.2	13.9†	11.9†	10.6‡	12.5†
Hypertension	37.6	32.9	32.5	35.1	46.0†	40.2†	38.0‡	42.4†
All heart disease	12.2	8.3	7.9	10.1	17.1†	14.9†	11.9	15.1†
Myocardial infarction	4.8	4.0	3.3	4.2	6.7‡	4.2	4.3	5.4‡
Stroke	2.7	2.3	1.8	2.3	4.7†	4.1‡	2.0	3.8†
Lung disease	7.7	5.4	4.3	6.2	10.4†	7.9‡	4.4	8.1†
Cancer	4.9	5.3	6.5	5.4	8.8†	9.7†	10.5†	9.5†
Income, Percent Distribution								
Diabetes	8.1	7.7	6.0	7.2	16.8†	11.4†	9.2†	12.5†
Hypertension	37.9	35.8	31.6	35.1	46.1†	42.8†	38.2†	42.4†
All heart disease	14.3	9.1	6.9	10.1	20.2†	13.1†	12.1†	15.1†
Myocardial infarction	6.7	3.3	2.5	4.2	8.6	4.3	3.3	5.4‡
Stroke	3.5	1.9	1.6	2.3	5.8‡	3.7†	1.8	3.8†
Lung disease	7.6	6.3	4.8	6.2	12.3†	7.0	5.1	8.1†
Cancer	5.7	5.1	5.5	5.4	9.3†	9.8†	9.5†	9.5†

*Adjusted for risk factors so that everyone has same as average US risk factors but coefficients are country specific. Source: English data are from first wave of English Longitudinal Survey of Aging, and US data are from the 2002 wave of the Health and Retirement Survey. See Table 1 for sample sizes and definitions of income and education groups. All data are weighted
†$P<.01$ vs data from England.
‡$P=.05$ vs data from England.

larly aged subsamples from NHANES and HSE. Within our 40- to 70-year-old age span, English respondents are less than a year older than American respondents so that age differences cannot explain the better health in England. The findings from the self-reports are generally confirmed. Diabetes prevalence is considerably higher in the United States than in England, but differences in hypertension prevalence are much smaller in this broader age group. In addition to overall rates of disease, Table 1 and Table 4 indicate that a strong income or education gradient exists in diabetes and hypertension prevalence in both countries whether self-reports or biological measures are used.

Although there is not a direct correspondence between a disease self-report and biological measures, the other 3 biological measures provide additional evidence about health in the 2 countries and how it varies across SES categories. Several studies have shown that C-reactive protein, fibrinogen, and HDL-C all serve as good markers for future cardiovascular events.[6,7]

There are 2 striking patterns in Table 4 and TABLE 5. First, all 3 biological measures indicate much higher and statistically significant risk levels in the United States. In this age group, 40.1% of Americans have C-reactive protein levels within the high-risk group compared with only 30.4% of English people. Similarly, 24% of the American sample has measured fibrinogen levels that place them at high risk—the comparable English rates are 10%. On the other hand, 27.9% of Americans have high levels of HDL-C compared with 43.6% for the English.

Second, SES health gradients remain in both countries for education (Table 4) and income (Table 5) in all 3 biological measures. Using C-reactive protein, in the United States 57.8% in the lowest education group are at high risk compared with 34.6% of those in the highest schooling class. In England, the comparable numbers are 40.2% and 25%, respectively. Especially along the income divide, there is a somewhat steeper gradient in the United States compared with England. Among all biological measures, fibrinogen exhibits perhaps the sharpest SES gradients, a statement equally true with education or income. These social gradients are steeper in the United States than in England. Finally, for income and especially for education, there are sharper gradients in HDL-C levels in the United States than in England. Although we purposely selected assays that were similar in nature and exhibit similar normal ranges of varia-

Table 4. Comparison of Self and Clinical Reports by Education, Ages 40-70 Years*

	England				United States			
	Low (n = 1598)	Medium (n = 1858)	High (n = 2070)	All (n = 5526)	Low (n = 324)	Medium (n = 554)	High (n = 1219)	All (n = 2097)
Diabetes, HbA_{1c} >6.5%, %								
Prevalence, self-report	4.9	4.2	3.6	4.1	12.3†	8.0†	5.6‡	7.1†
Prevalence, clinical report	5.6	3.3	3.0	3.8	13.5†	7.5†	4.5	6.4†
Hypertension, systolic blood pressure ≥140 mm Hg, diastolic ≥90mm Hg, or taking medication, %								
Prevalence, self-report	38.9	32.7	28.5	32.8	40.4	35.7	26.4	30.6
Prevalence, clinical report	40.1	31.5	27.0	32.2	43.2	39.9†	30.4	34.5
C-reactive protein, mg/L								
High risk, ≥3, %	40.2	28.7	25.0	30.4	57.8†	44.3†	34.6†	40.1†
Moderate risk, 1-3, %	36.9	39.0	35.2	37.0	27.7†	33.2‡	34.1	33.3†
Low risk, ≤1, %	22.9	32.4	39.8	32.6	14.6†	22.5†	31.4†	26.9†
Mean	0.40	0.31	0.28	0.32	0.59†	0.45†	0.34†	0.40†
Median	0.23	0.16	0.13	0.17	0.37†	0.26†	0.18†	0.22†
Fibrinogen, mg/dL								
High risk, ≥400, %	14.1	8.8	8.6	10.0	37.1†	26.6†	20.1†	24.0†
Mean	322	302	292	303	384†	358†	347†	355†
Median	310	290	280	290	374†	351†	338†	347†
HDL cholesterol, mg/dL								
High, ≥60, %	39.1	45.3	45.4	43.6	18.0†	25.5†	31.0†	27.9†
Normal, 40-60, %	51.6	45.7	48.5	48.4	55.6	49.7	50.0	50.5
Low, ≤40, %	9.3	9.0	6.1	8.0	26.4†	24.9†	19.1†	21.6†
Mean	58	60	60	59	49†	51†	54†	52†
Median	54	58	58	58	46†	47†	52†	49†

Abbreviations: HbA_{1c}, glycosylated hemoglobin; HDL, high-density lipoprotein.
SI conversion factors: to convert fibrinogen from mg/dL to µmol/L, multiply by 0.0294 and HDL cholesterol from mg/dL to mmol/L, multiply by 0.0259.
*Source: United States National Health and Nutrition Examination Survey 1999-2002; England: Health Survey for England, 2003. See Table 1 for definitions of income and education groups.
†$P<.01$ vs data from England.
‡$P<.05$ vs data from England.

tion, an important priority for comparative international research is that tests be performed by laboratories in both countries on the same blood and serum samples. We also modeled these across-country differences in assays controlling for smoking behavior, obesity, and being overweight. Controlling for these risk factors did not eliminate the statistically significant differences between the countries.

COMMENT

Establishing basic facts about a less healthy America and steep negative SES health gradients is a first step toward understanding reasons for the differences that emerge. Health disparities between the United States and England are not solely due to special health problems in the Latino and especially the black communities in the United States since those important subpopulations were excluded from this analysis. And, important as they are for better population health, a standard set of risk factors (smoking, drinking, and obesity) do not fully account for morbidity differences between and within each country.

Because screening rates for cancer are generally higher in the United States than in England, this may play a role in the higher rates of cancer in the United States. Greater incident mortality from cancer in England may also be important.[10,11] The magnitude of across-country differences in cancer prevalence appears too large to be fully explained by these factors alone. Differences in cancer prevalence also exist in the high education and income groups for whom differential detection should play a weaker role. Moreover, higher rates of detection do not account for the higher rates of other illnesses in lower socioeconomic groups.

Although access to health care is important,[12-14] differential access can only offer a partial explanation for our findings. Among non-Hispanic whites aged 55 through 64 years, only 6.6% in the United States do not report having access to health insurance (calculations by J.P.S. from HRS). Even in the bottom third of the income distribution, in this subpopulation only 13.1% did not have some form of health insurance (calculations by J.P.S. from HRS). Because only 2.6% of those in the top income tertile did not have health insurance (calculations by J.P.S. from HRS), there is a gradient to access, which may explain part of the steeper US health gradient. But it is equally important to recognize that health insurance cannot be the central reason for the better health outcomes in England because the top SES tier of the US population have close to universal access but their health outcomes are of-

Table 5. Comparison of Self and Clinical Reports by Socioeconomic Status and Income, Ages 40-70 Years*

	England				United States			
	Low (n = 1673)	Medium (n = 1516)	High (n = 1455)	All (n = 4644)	Low (n = 880)	Medium (n = 599)	High (n = 618)	All (n = 2097)
Diabetes, HbA_{1c} >6.5%, %								
Prevalence, self-report	6.5	3.5	2.8	4.1	10.7†	5.9‡	4.0	7.1†
Prevalence, clinical report	5.8	2.6	2.8	3.8	10.7†	4.5‡	3.4	6.4†
Hypertension, blood pressure ≥140 mm Hg, diastolic ≥90 mm Hg, or taking medication, %								
Prevalence, self-report	41.1	30.8	27.6	32.8	37.7	27.2	25.7	30.6
Prevalence, clinical report	38.1	30.0	26.8	32.2	41.7	31.7	28.9	34.5
C-reactive protein, mg/L								
High risk, ≥3, %	37.6	27.7	24.1	30.4	49.1†	38.7†	31.4†	40.1†
Moderate risk, 1-3, %	37.3	37.2	37.0	37.0	30.1‡	36.0	33.4	33.0†
Low risk, ≤1, %	25.1	35.1	38.9	32.6	20.8‡	25.3†	35.1	26.9†
Mean	0.38	0.30	0.28	0.32	0.49†	0.37†	0.34‡	0.40†
Median	0.21	0.15	0.14	0.17	0.29†	0.22†	0.15	0.22†
Fibrinogen, mg/dL								
High risk, ≥400, %	13.7	9.6	8.0	10.0	33.6†	21.6†	15.5†	24.0†
Mean	318	301	292	303	374†	352†	336†	355†
Median	310	290	280	290	366†	342†	332†	347†
HDL cholesterol, mg/dL								
High, ≥60, %	42.1	43.4	47.1	43.6	25.0†	27.2†	31.6†	27.9†
Normal, 40-60, %	48.6	48.8	46.0	48.4	50.2	51.3	50.4	50.5
Low, ≤40, %	9.2	7.8	6.9	8.0	24.7†	21.5†	18.0†	21.6†
Mean	58	60	60	59	51†	52†	53†	52†
Median	58	58	58	58	48†	48†	52†	49†

Abbreviations: HbA_{1c}, glycosylated hemoglobin; HDL, high-density lipoprotein.
SI conversion factors: to convert fibrinogen from mg/dL to µmol/L, multiply by 0.0294 and HDL cholesterol from mg/dL to mmol/L, multiply by 0.0259.
*Source: United States National Health and Nutrition Examination Survey 1999-2002; England: Health Survey for England, 2003. See Table 1 for definitions of income and education groups.
†$P<.01$ vs data from England.
‡$P<.05$ vs data from England.

ten worse than those of their English counterparts.

Our list of comparably measured behavioral risk factors is incomplete and a fuller set may offer additional explanatory power. Because the analysis has been cross-sectional, past differences in risk factors may be partially underlying observed differences in health conditions for the older adults in our samples. Smoking rates have historically been higher in the United Kingdom than the United States, but only in recent years has the obesity epidemic hit the United Kingdom, where prevalence of obesity rose from 7% to 23% between 1980 and 2003, whereas the corresponding changes for the United States were from 15% to 31%.[15]

Related, a growing body of recent research indicates that disease onset in later adulthood is related to childhood illness.[16-18] The considerable differences in adult health between England and the United States could well have their origins in differential childhood experience of disease in the 2 countries.

Much evidence points to the social determinants of health—the circumstances in which people live and work—as explanation for social gradients in health.[19] Low status is related to adverse conditions at work, in residential areas, and in general, to lack of empowerment—all are plausible links between SES and disease.[20] Whether the same set of social determinants account for higher rates of morbidity in the United States is difficult to say. Certainly the US-England difference is more pronounced for those in the lowest social groups, but the high status Americans are also at a disadvantage. This is fertile ground for additional exploration.

The finding of social gradients in plasma levels of C-reactive protein, fibrinogen, and HDL-C, and adverse levels in the United States compared with England serve as an indirect validation of the morbidity findings and a guide to potential explanations. The metabolic syndrome is linked to autonomic activity[21] and to psychosocial factors.[22] Inflammatory markers, C-reactive protein and fibrinogen, have been shown to have an inverse association with socioeconomic position and may be linked with psychosocial factors.[23] Adjusting for obesity did not abolish either the international or the socioeconomic differences in these biological markers.

The influence of inequality in economic resources on health remains controversial.[24,25] Income inequality is indeed much higher in the United States than in England,[26] but the rapidly increasing levels of inequality in the United States do not appear to have had a dramatic effect on the health of those at the bottom.[17,19] A more promising explanation may lie rather in the effects of more permanent measures of rank and status in the 2 countries.[16]

An emphasis on the pathway whereby health reduces work and lowers income would suggest a steeper SES income gradient in the United States. New onsets of disease have relatively large impacts on family income and wealth in the United States, especially in the age group studied herein.[27,28] To a much greater extent, England has set up programs whose goal is to isolate individuals from the economic consequences of poor health in terms of medical expenditures and especially earnings and wealth reductions. Part of the greater association of health and economic resources in the United States may reflect the greater impact of health on economic resources.

Two simple but powerful conclusions follow from our comparisons using biological and self-reports of disease in England and the United States. First, Americans are much sicker than the English. Self-reports of disease are not deceiving us about the reality of the situation on one side of the Atlantic vs the other. Second, the SES-health gradient is also not a reporting mirage; a by-product of differential ability by standard SES markers to recognize and report disease in surveys, an ability that has been thought might differ even among the western industrialized countries. Instead, the SES health gradient appears with equal force in either self-reports or biological measures of health.

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REFERENCES

1. Human Development Report. *International Cooperation at a Crossroads.* New York, NY: United Nations Development Program; 2005.
2. Juster FT, Suzman R. An overview of the Health and Retirement Study. *J Hum Resour*. 1995; 30(suppl):S7-S56.
3. *NHANES Analytical Guidelines: June 2004 Version*. Hyattsville, Md: National Center for Health Statistics; 2004. Available at: http://www.cdc.gov/nchs/data/nhanes/nhanes_general_guidelines_june_04.pdf. Accessed March 2005.
4. Marmot MG, Banks J, Blundell R, Lessof C, Nazroo J. *Health, Wealth, and Lifestyles of the Older Population in England—The 2002 English Longitudinal Study of Ageing*. London, England: Institute for Fiscal Studies; December 2003.
5. Sproston K, Primatesta P, eds. *Health Survey for England 2003 Methodology and Documentation*.

vol 3. London, England: Dept of Health; 2003. Series HS, No. 13. Available at: http://www.dh.gov.uk/assetRoot/04/09/89/12/04098912.pdf: Accessed March 2005.
6. National Heart, Lung, and Blood Institute. *Sixth Report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure*. Bethesda, Md: 1997. NIH publication 98-04080.
7. Steptoe A, Marmot MG. Socioeconomic status and coronary heart disease: a psychobiological perspective. *Popul Dev Rev*. 2004;30:133-150.
8. Mendall MA, Patel P, Ballam L, et al. C-reactive protein and its relation to cardiovascular risk factor. *BMJ*. 1996;312:1061-1065.
9. Danesh J, Collins R, Appleby P, Peto R. Association of fibrinogen, C-reactive protein, albumin or leukocyte count with coronary heart disease: meta-analysis of prospective studies. *JAMA*. 1998;279:1477-1482.
10. Melia J, Moss S, Johns L. Rates of prostate-specific antigen testing in general practice in England and Wales in asymptomatic and symptomatic patients: a cross-sectional study. *BJU Int*. 2004;94:51-56.
11. Sirovich BE, Schwartz LM, Woloshin S. Screening men for prostate and colorectal cancer in the United States: does practice reflect the evidence? *JAMA*. 2003; 289:1414-1420.
12. Ayanian JZ, Weissman MS, Schneider EC, et al. Unmet health needs of uninsured adults in the United States. *JAMA*. 2000;285:2061-2069.
13. Baker DW, Sudano JJ, Albert JM, et al. Lack of health insurance and decline in overall health in late middle age. *N Engl J Med*. 2001;345:1106-1112.
14. Committee on the Consequences of Uninsurance; Board on Health Care Services, Institute of Medicine. *Care Without Coverage: Too Little, Too Late*. Washington, DC: National Academy Press; 2002.
15. *OECD Health Data 2005: Statistics and Indicators for 30 Countries*. Paris, France: Organisation for Economic Co-operation and Development; June 2005. Available at: http://www.oecd.org/document/30/0,2340,en_2649_34631_12968734_1_1_1_1,00.html. Accessed March 2005.
16. Barker JD. Maternal nutrition, fetal nutrition and diseases in later life. *Nutrition*. 1997;13:807-813.
17. Wadsworth MJ, Kuh DJ. Childhood influences on adult health: a review of recent work from the British 1946 National Birth Cohort Study, the MRC National Survey of Health and Development. *Paediatr Perinat Epidemiol*. 1997;11:2-20.
18. Case A, Lubotsky D, Paxson C. Economic status and health in childhood: the origins of the gradient. *Am Econ Rev*. 2002;92:1308-1334.
19. Marmot MG, Wilkinson RG, eds. *Social Determinants of Health*. 2nd ed. London, England: Oxford University Press; 2005.
20. Marmot MG. *The Status Syndrome: How Social Standing Affects Our Health and Longevity*. New York, NY: Henry Holt & Co Inc; 2004.
21. Hemingway H, Shipley M, Brunner E, Britton A, Malik M, Marmot MG. Does autonomic function link social position to coronary risk? the Whitehall II Study. *Circulation*. 2005;111:3071-3077.
22. Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. *BMJ*. 2006;332:521-525.
23. Steptoe A, Kunz-Ebrecht S, Owen N, et al. Influence of socioeconomic status and job control on plasma fibrinogen responses to acute mental stress. *Psychosom Med*. 2003;65:137-144.
24. Deaton A. Policy implications of the gradient of health and wealth. *Health Aff (Millwood)*. 2002;21: 3-30.
25. Lynch JW, Harper S, Smith GD, et al. Is income inequality a determinant of population health? I: a systematic review. *Milbank Q*. 2004;82:5-99.
26. Banks J, Blundell R, Smith JP. Understanding Differences in Household Financial Wealth between the United States and Great Britain *J Hum Resour*. 2003; 38:241-279.
27. Smith JP. Healthy bodies and thick wallets. *J Econ Perspect*. 1999;13:145-167.
28. Smith JP. Unraveling the SES-health connection. *Popul Dev Rev*. 2004;30:133-150.

> To correct the evils, great and small, which spring from want of sympathy and from positive enmity among strangers, as nations or as individuals, is one of the highest functions of civilizations.
> —Abraham Lincoln (1809-1865)