Technical Report for
Overcoming Obstacles to Health: Report from the Robert Wood Johnson Foundation to the Commission to Build a Healthier America

Economic Value of Improving the Health of Disadvantaged Americans[*]

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Abstract
This report describes the method used to estimate the foregone monetary benefits associated with health disparities that were reported in Overcoming Obstacles to Health: Report from the Robert Wood Johnson Foundation to the Commission to Build a Healthier America. We estimate the annual dollar value of the benefits that would accrue to disadvantaged American adults if they experienced the lower mortality rates and better health of more advantaged Americans. The measure of advantaged/disadvantage is based on education, which is strongly related to economic status, closely associated with health and mortality, and has been widely studied. Our estimates suggest a quite large potential benefit of improving the health of disadvantaged Americans: raising the health of all Americans to that of college educated Americans would result in annual gains of just over 1 trillion dollars worth of increased health as of 2006. These estimates are not designed to be a full accounting of the social costs and benefits of particular policies and programs that could reduce health disparities. Rather, they provide a metric for comparing the order of magnitude of health disparities in relation to other social issues vying for attention. Our results suggest large potential aggregate payoffs to identifying cost-effective ways of improving the health of low SES groups.

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Introduction

Large health disparities across socioeconomic (SES) groups in the United States have received increasing attention in recent years from researchers, the health policy community, and the general public. Adults ages 25-50 that have a college degree will on average live 5 years longer than those with less than a high school education. And at every age while alive, health is better for the more highly educated: for example, 75% of college educated adults report being in very good or excellent health, compared to 40% of those with less than a high school education (Robert Wood Johnson Foundation 2008).

This report quantifies foregone economic value associated with worse health among low SES groups compared to the health of high SES groups. More specifically, we estimate the annual dollar value of the benefits that would accrue to disadvantaged American adults if they experienced the lower mortality rates and better health of more advantaged Americans. A recent European Commission report (Mackenbach, Meerding, and Kunst 2007) studied the foregone benefits of lower health among low SES groups in Europe, estimating the value at 9.5% of GDP. We use an approach slightly different from that of Mackenbach et al., but with the same research objective.

Our modeling approach relies on estimation of SES differentials in mortality using the National Longitudinal Mortality Study, as well as secondary estimates of SES differentials in health from published studies. The primary measure of advantage/disadvantage in our study is based on education, which is strongly related to economic status, closely associated with health and mortality, and the causal effect of which has been widely studied. We rely on existing literature for estimating the value of a Quality Adjusted Life Year (QALY). We then build a simulation model to estimate the potential benefits of improving the health of low SES groups in the United States.

The foregone benefits arise from two components: the greater number of years lived, and the higher quality of health status for any given year of life lived by more educated individuals. Estimates are restricted to the population 25 and older because a substantial share of the population under 25 has not completed their education.

The value of longer life (improved mortality)

Estimates for 2006 are generated in five major steps. First, we calculate age-specific mortality rates by education for 2006. Four education groups are considered: less than a high school education, high school education, some college but less than a bachelor's degree, and bachelor's degree or higher. The rates are calculated for 5-year age groups (25-29, 30-34, … , 80-84, and 85 and older) using the National Longitudinal Mortality Study (NLMS).

The most recent NLMS data to construct estimates by socioeconomic group covers the 1988 to 1998 period. Because mortality has declined since 1998, we adjust downward the

estimated mortality rates from the NLMS. Specifically, for each of the age groups we calculate the change in mortality between 1993 (the midpoint of the 1988-1998 NLMS estimates) and the most recent available mortality data, 2004. To produce estimates for 2006, we applied the age-group specific average annual percent decline in mortality over the 1993-2004 period to the subsequent two-year period, 2004-2006. We assume that the estimated age-specific percent decline in mortality between 1993 and 2006 applies to each of the education groups equally (SES-specific mortality data after 1998 are not currently available). Because our analyses of the NLMS for the two periods 1979-1989 and 1988-1998 found somewhat larger declines in mortality for the more advantaged groups, our assumption of identical declines across education groups from 1993 to 2006 is likely conservative, understating the value of foregone benefits to raising health to the level of the college educated.

A limitation of the NLMS is that it does not include the institutionalized population. As a result, the number of deaths and the death rates estimated in the NLMS are low. Specifically, the NCHS vital statistics reports 37% more deaths than the simulated number of deaths based on the NLMS. To account for this fact, we scaled up the NLMS death rates by an age-specific factor, with that factor derived so as to equate the predicted number of deaths to the actual number of deaths reported by the National Center for Health Statistics in 2004. (We assume that the actual number of deaths to persons 25 and older in 2006 will be the same as it was in 2004, which is a reasonable approximation given recent trends in the numbers of deaths. For example, the number of deaths to persons 25 and older was 2,324,639 in 2004 with preliminary estimates for 2005 only slightly higher at 2,373,297 (NCHS website, www.cdc.gov/nchs/fastats/deaths.htm)). In doing so, we scaled up the death rates for all education groups, within 10-year age groups, by the same factor or percent. Because disadvantaged populations are more likely to be in institutions (primarily correctional facilities and nursing homes), this assumption is conservative. The true death rates among the disadvantaged populations are likely to be higher than we estimate, implying that our estimate of foregone benefits is again understated.

The second step in our calculation is to estimate the number of people in the United States population, by age and educational attainment, in 2006. We used estimates drawn from the 2006 March Current Population Survey (CPS), which is the best source of recent information on educational attainment of Americans. Like the NLMS, the CPS does not include the institutionalized population, thus under-stating the number of disadvantaged people in the U.S. who would benefit from increased health, hence again under-stating aggregate benefits.

Third, we multiply the mortality rates generated in step 1 by the population totals generated in step 2 to estimate of the number of deaths in 2006, by 5-year age group, for each of the educational groups. Table 1 reports the population estimates, by age and education group, along with the estimated number of deaths.

In the fourth step we simulate the number of life-years that would be gained if people with less than a college degree experienced the lower mortality rates of those with at least

a college degree. We do this by projecting the number of deaths by age for mortality rates at current education levels, and then compare this to the number of deaths simulated when instead applying the mortality rates experienced by people with a college degree. These estimates are reported in the final sets of columns in Table 1. We then further take into account the fact that those individuals whose lives would be saved in 2006 would be expected to live many more years beyond 2006, on average. Using mortality estimates from the NLMS analyses described above, life expectancies by 5-year age groups for each of the four education categories are estimated. The total number of life years saved is equal to the number of lives saved in 2006 multiplied by remaining life expectancy, for each age and education group.

The final step estimates the average health state in which the additional life-years gained would be lived, and then ascribes a monetary value to those quality-adjusted life years (QALYs). We estimate the health state by using Nyman et al.'s (2007) estimate of health-related quality of life for various groups, from data collected in the national Medical Expenditure Panel Survey (MEPS). In the MEPS, health-related quality of life was estimated using an index that assigns weights to different health states on a scale of 0 to 1, where 0 represents the state of being dead and 1 the state of optimal health. Nyman et al's estimates are used to calculate the health-related quality of life for individuals with at least a college degree. Our age and education-specific valuations are based on their Table 4 column 4 (evaluating all other control variables at their means). The scale that is calculated from this model is then multiplied by a $100,000 valuation for each life year in optimal health, leading to an estimate of the quality-adjusted monetary value of a life year at a given age, for persons with at least a bachelor's degree. We use $100,000 as the benchmark because it is a common, arguably conservative, value of a healthy life year (Cutler, Richardson, Keeler, and Staiger, 1997).[1] This approach leads to an estimate of $94,066 for the value of a life year for a person 25-34 years old with at least a bachelor's degree (i.e., that demographic group's average health-related quality of life index value is 0.94).

Note that Nyman et al's (2007) education categories were collapsed in order to map them into three categories available in the March CPS and the NLMS. Specifically, GED, high school degree, and "other degree" categories are collapsed into "high school or some college," and bachelor's degree and graduate degree are collapsed into "at least a bachelor's degree." Individuals with less than a high school education remain a single group.

To express future amounts in present value terms, a discount rate of 3% is used, consistent with US Office of Management and Budget guidelines for economic

[1] Assessing sensitivity to the $100,000/QALY assumption is straightforward. Using a lower measure of $50,000/QALY (commonly used dating back to the early 1980s, when nominal prices were half of today's level) would cut our dollar estimates in half. Using a higher measure such as $200,000/QALY would double our estimates. Evidence suggests that even $200,000 may be conservative. Hirth et al.'s (2000) literature review finds a median estimate of $265,000 per QALY in 1997 dollars using willingness-to-pay methods. Furthermore, Ubel et al (2003) argue that QALY estimates need to be adjusted for inflation, implying an even higher threshold when expressed in today's dollars.

evaluations (Office of Management and Budget, 2003, Circular A-4, *Regulatory Analysis.* Washington, DC: Office of Management and Budget).

The estimates imply substantial foregone benefits associated with disparities in mortality. Bringing the mortality rates of people with less than a high school education down to the rates of individuals with at least a bachelor's degree would lead to benefits in 2006 of $217 billion. The benefits that would accrue to improving the mortality of persons with a high school or some college amounts to $264 billion. In summing across all groups with less than a bachelor's degree, the mortality gain would be $481 billion per year (Table 2).

The value of improved health status

Apart from mortality differences, at every year before they die the less educated groups also suffer from worse health than higher educated groups. Estimates of the value of foregone benefits arising from the poorer health status among disadvantaged populations are again based on estimates of health-related quality of life for various education groups reported in Nyman et al. (2007), as described above. On average, health-related quality of life for individuals with at least a bachelor's degree differs from that of individuals with less than a high school education by 0.062 points on the 0 to 1 scale; the gap between individuals with at least a bachelor's degree and individuals with a high school education or some college (but not a bachelor's degree) is 0.032. Continuing to assume that a year lived in optimal health is valued at $100,000, the weights imply monetary value of differential health of $6,200 and $3,200, respectively, per year per person.

These differentials are then multiplied by the number of adults 25 and older with less than a high school education (27,864,000 in Table 1) and the number with a high school education or some college (60,896,000 plus 49,369,000 in Table 1), respectively, and then added together. This sum represents the monetary value of foregone health due to disparities. That is, to bring the health status of all adults with less than a bachelor's degree up to the health of those who do have at least a bachelor's degree would create gross benefits of $527 billion. Adding this value to the foregone benefits due to the mortality effect ($481 billion) leads to an estimated total foregone benefit of $1.007 trillion, annually.

Discussion

Our estimate implies a large foregone benefit associated with the relatively poor health of less educated populations. Despite the challenges inherent in estimating foregone benefits, a recent study conducted for the European Union that took a similar approach also found very large estimates. In addition, the limitations of our approach are likely causing us to under-estimate foregone benefits; if anything, annual foregone benefits are likely to be greater than $1.007 trillion.

In a study to estimate the economic impact of health disparities related to educational attainment in the European Union, Mackenbach, Meerding, and Kunst concluded that the foregone benefits associated with differences in mortality and health status between the top and bottom halves of the education distribution totaled roughly $1 trillion euros per year, or 9.5% of the EU GDP (2007). The analogous calculation for the US, using our

estimate of foregone benefits, is 7.6% of GDP (which was $13.195 trillion in 2006). While the approaches in our US and the EU studies are not strictly comparable, both estimates imply that the foregone benefits are very large.

One component of foregone benefits is lost earnings. Some additional years of life would have been spent working and earning income. In addition, for those alive, healthier people are likely to have higher earnings. This study did not directly estimate the lost earnings and reduction in GDP associated with health disparities, although the value of lost earnings is subsumed in the $100,000/QALY figure. The EU study, however, did attempt to quantify lost earnings (which they term "capital goods", in contrast to their "consumption goods" that are analogous to our estimated foregone benefits), and its estimates imply lost earnings that are 1.35% of EU GDP. The ratio of lost earnings ("capital goods") to foregone benefits ("consumption goods") in the EU study is 1 to 7. Applying the EU ratio to the US estimate of foregone benefits suggests that lost earnings from education-based health disparities in the US would be roughly $144 billion annually (i.e., $1.007 trillion/7).

For several reasons, the estimate of foregone benefits is most likely a lower bound on the foregone benefits to society as a whole. First, the estimates do not reflect the broader economic benefits to families and society of reducing health disparities; they only represent estimates of the foregone benefits to individuals themselves. Second, the estimated gaps in health across education groups rely on Nyman et al.'s (2007) models that control for income, marital status, and race/ethnicity. Simple age-adjusted gaps in health across education groups, which would be our preferred approach, are likely to be larger. Third, the estimates do not include disparities in health status among people under 25, a group that was excluded because many have not completed their education. Fourth, the estimates do not fully capture the institutionalized population. By scaling up the NLMS-based mortality estimates so that the predicted number of deaths equaled the number of deaths (institutionalized plus non-institutionalized) as estimated by NCHS using vital statistics, the mortality estimates account for this limitation of the NLMS data. However, the value of foregone health status among those alive is based on population estimates from the CPS, which does not include the institutionalized population and, as a result, our estimate is low.

There are also counterbalancing factors that may tend towards over-estimation of benefits that would accrue from raising education. Some portion of education gradients capture effects due to omitted factors other than education, or reverse causation; for example, some of the less educated individuals may have obtained less education due to congenital health problems unrelated even to mother's SES. However, a vast literature has consistently found education effects on health to be robust after controlling for a wide range of confounders. Furthermore, analyses such as instrumental variables estimates in Lleras-Muney (2005) have found cross-sectional education effects to *under-estimate* the education effects found in more plausibly causal models. Thus substantial evidence supports the validity of using cross-sectional educational differences in health and mortality, such as the estimates that we rely on from Nyman et al.

It is important to recognize that our use of QALYs for analyzing the value of health is an imperfect approach. Health-related quality of life is difficult to measure and even harder to value. Furthermore, the theoretical basis for using QALYs is not well developed except under strong assumptions (Garber, 2000). Despite the concerns, however, the use of the QALY metric for decision-making is widely embraced by both the research community and government agencies, as it is judged to be superior to the alternatives (IOM, 2006). We do caution readers that all empirical work relies on assumptions and approximations, and the assumptions in the current analysis are many. While the exact estimates vary with the specific parameters chosen, the order of magnitude appears robust.

Importantly, the estimates do not include the costs of policies and program that would be needed to achieve these gains (for related work that compares health benefits to educational costs see Levin et al. 2007a, 2007b, and Muennig and Woolf 2007). Moreover, the gaps in health and mortality that are reported should not be interpreted as representing causal effects on health and mortality of raising education. But the estimates highlight the substantial value of the healthier and longer life that socioeconomically disadvantaged Americans are missing, compared to their better-off counterparts. A full accounting of costs and benefits of any treatments, programs, or policies designed to improve the situation of disadvantaged populations should be conducted to determine its cost effectiveness.

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Table 1. Estimates of Population and Number of Deaths Under Alternative Scenarios, Persons 25 and Older in 2006

	Population Estimates: 2006 March CPS					Predicted Number of Deaths: NLMS					Predicted Number of Deaths if Less Educated Persons Faced Mortality of people with College Degree				
Age group	< High School	High School	Some College	College Degree	Total	< High School	High School	Some College	College Degree	Total	< High School	High School	Some College	College Degree	Total
25-29	2,733,000	5,768,000	5,916,000	5,719,000	20,136,000	4,773	6,700	4,159	2,880	18,512	1,376	2,904	2,979	2,880	10,139
30-34	2,409,000	5,533,000	5,311,000	6,087,000	19,340,000	4,823	8,044	5,014	3,851	21,732	1,524	3,501	3,360	3,851	12,236
35-39	2,497,000	6,055,000	5,457,000	6,762,000	20,771,000	6,582	11,373	8,167	6,365	32,487	2,350	5,699	5,137	6,365	19,551
40-44	2,619,000	7,081,000	6,025,000	6,626,000	22,351,000	11,075	18,344	11,828	10,576	51,823	4,180	11,302	9,617	10,576	35,674
45-49	2,524,000	7,339,000	6,236,000	6,418,000	22,517,000	13,728	30,382	21,267	13,078	78,455	5,143	14,955	12,707	13,078	45,884
50-54	2,366,000	6,159,000	5,600,000	6,152,000	20,277,000	19,917	34,891	21,967	20,876	97,650	8,029	20,900	19,003	20,876	68,807
55-59	1,966,000	5,414,000	4,905,000	5,512,000	17,797,000	22,926	39,383	33,116	26,989	122,413	9,626	26,509	24,017	26,989	87,142
60-64	1,938,000	4,511,000	3,182,000	3,523,000	13,154,000	30,555	50,676	34,061	25,707	141,000	14,141	32,916	23,219	25,707	95,983
65-69	1,994,000	3,752,000	2,215,000	2,269,000	10,230,000	47,895	66,457	35,448	30,886	180,686	27,143	51,073	30,151	30,886	139,254
70-74	1,912,000	3,160,000	1,569,000	1,683,000	8,324,000	65,171	81,455	35,344	37,185	219,155	42,245	69,819	34,666	37,185	183,916
75-79	2,006,000	2,824,000	1,403,000	1,417,000	7,650,000	106,312	114,707	56,493	55,357	332,869	78,367	110,324	54,810	55,357	298,858
80-84	1,533,000	1,905,000	980,000	899,000	5,317,000	117,557	123,367	60,688	51,813	353,424	88,352	109,792	56,481	51,813	306,438
85+	1,367,000	1,395,000	570,000	658,000	3,990,000	246,953	230,899	88,994	108,451	675,296	225,308	229,923	93,947	108,451	657,628
25+	27,864,000	60,896,000	49,369,000	53,725,000	191,854,000	698,267	816,676	416,545	394,014	2,325,502	507,786	689,617	370,094	394,014	1,961,511

Table 2. Foregone Benefits Associated with Health Disparities by Education, 2006

Education group	Mortality Effect	Morbidity/Health Status Effect	Total
< High school	$217 billion	$173 billion	$390 billion
High school and some college	$264 billion	$354 billion	$618 billion
Total	$481 billion	$527 billion	$1,008 billion