

The Dynamics of Health Disparities;
U.S. Mortality Disparities by Education, 1989-2005.

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Inequality is a major cause of death in the United States. Around 130,000 fewer deaths would have occurred in 2005 among adults aged 25-64 if the death rate for people with 12 or fewer years of education had been the same as it was for people with 13 or more years more education (Kung, Hoyert, Xu, and Murphy 2008; National Center for Health Statistics 2009). This level of magnitude is about the same as the third leading cause of death in the U.S. (National Center for Health Statistics 2009).

Inequality's level of impact on mortality has changed over time and most likely continues to change today. However, almost all information on the trends in education and mortality is descriptive and comes from reports in public health or medical journals (included in the review below). A sociological perspective holds the potential to contribute unique and important insights into these changes, but has yet to be extensively applied to this topic (for an important exception see Phelan, Link, Diez-Roux, Kawachi, and Levan 2004). This lack of attention is surprising in light of the centrality of inequality to the field of sociology and the importance of mortality disparities as a social problem (cite xx; NIH xx).

In this study we take a unique approach and use the concept of a 'balance-scale' for the analysis of trends in mortality disparities by education from 1989 to 2005. By 'balance-scale' we refer to a scale that makes use of a balance beam to determine which of two weights is heavier – e.g. the type of scale held out by the blindfolded Lady Justice. We focus on the approximately 100 major causes of death and examine the extent to which causes of death with increases in disparities have outweighed those with decreases, or vice-versa.

This approach is a departure from customary studies in this field, which typically present detailed information for only a handful of specific causes of death, if any at all. We highlight the fact that forces to increase and decrease mortality disparities are working simultaneously and are in competition with one another, and the results from this study will indicate both their relative influence and also which of the two currently prevails.

The analysis centers on three specific predictions. The first is that disparities are simultaneously increasing and decreasing across different causes of death during the study period. The second is that the overall disparity is constant or increasing. We develop this hypothesis on the basis of the 'fundamental cause' perspective, which leads us to expect that mortality disparities in the causes of death that are gaining influence offset any declining disparities in other causes of death. The third, alternative hypothesis is that the overall mortality disparity by education has been decreasing in recent years. We develop this hypothesis on the basis of 'diffusion of innovation' theory, which leads to the expectation that the sum influence of decreasing disparities outweighs that of

increasing disparities as medical innovations that improve health gradually diffuse across all socioeconomic levels and as we reach the upper limits of human life expectancy.

The Trends

Mortality disparities by education have been steadily increasing since at least the 1960s, a finding robust across studies that use different data sets and different analytical methods. While life expectancy has increased for all demographic groups in recent decades, its faster increase among high education and income groups has led to a widening disparity, particularly among men.

Evidence for increasing mortality disparities between the 1960s and the 1980s comes from multiple sources. From 1960 to 1971 an increase in mortality disparities for men is noted by Feldman et al. (1989), who used the National Health and Nutrition Examination Survey (NHANES 1) and the Matched Record Study. Concurring evidence for an increase in mortality disparities by socioeconomic status from 1960 to 1986 comes from Pappas et al. (1993), who examined trends in mortality disparities using the National Mortality Followback Survey and the National Health Interview Survey. Further evidence for an increasing mortality by education across the 1960s and 1980s for men (but not women) comes from Preston and Elo (1995), who used the National Longitudinal Mortality Survey.

Increases in mortality disparities by education have continued through the 1990s into at least the year 2001. Using death certificate information from 43 states and Washington D.C., Ahmedin et al. (2008) report that from 1993 to 2001 the all-cause mortality rate ratio of the least v. most educated increased from 2.9 to 4.4 among white men, from 2.1 to 3.4 for black men, and from 2.6 to 3.8 for white women. Studies of healthy life expectancy (Crimmins and Saito 2001) and cohort patterns of survival (Lauderdale 2001) confirm earlier studies by demonstrating widening disparities through 1990 but do not extend their analysis to the last decades. Singh (2004) and Singh and Siahpush (2002; 2006) find widening disparities at the county level through 2000 but do not study individual differences in mortality by education. Steenland Hu, and Walker (2004) examine occupational disparities in all-cause mortality for employed persons in 27 states between 1984 and 1997. They find that mortality differences were sustained through the 1990s and increased for men, but the results are limited in geographic coverage, focus only on workers, and do not compare trends by cause. Steenland, Henley, and Thun (2002) compare a few cause-specific death rates by education for two cohorts over the period from 1959-1996. They find increasing disparities for heart disease, diabetes, and, for women only, lung cancer, but the sample, based on American Cancer Society volunteers, is not representative the population.

A pattern of widening mortality disparities by education in recent decades is not unique to the United States – it also documented in Austria, Finland, Norway, Denmark, and New Zealand (Schwarz 2007).

Theory and Predictions

Whether these increases in mortality disparities by education have continued in recent years is not known, and this study updates these trends from 1989 to 2005. This analysis differs from customary studies in this field because we focus on the distribution of disparity trends across approximately 100 major causes of death, a focus guided by sociological theory, as described below, that leads us to empirically test three predictions.

Heterogeneity in Disparity Trends

We first test the prediction that substantial heterogeneity is present in disparity trends across causes of death, with some disparities increasing, some decreasing, and some unchanging during the same study period. One reason to expect heterogeneity is that many behaviors and treatments have consequences that are disease-specific and therefore different diseases are subject to different forces that may impact mortality disparities by education over time. Another reason to expect heterogeneity is that different diseases have different lag times between onset and death, so that a common influence -- such as a national decrease in smoking rates -- may have a more immediate effect for one disease, such as heart disease, as compared to another, such as lung cancer.

Persistent or Growing Disparities

A second prediction we test is that mortality disparities by education have continued at previous levels or increased because the sum influence of disparities that have increased over the study period offset or even outweigh the sum influence of disparities that decreased. This prediction is supported by the 'fundamental cause' perspective, which posits that health disparities are ultimately linked to the unequal distribution across social strata of resources such as money, power, and beneficial social connections (Link and Phelan 1995). Importantly, these resources are flexible, which means that they continue to advantage the health of people in the upper social strata even as the health profile of a population changes over historical time. As long as these flexible resources are distributed unequally within society, people in the upper social strata will use them to their health advantage and substantial health disparities in mortality are expected to persist or grow in the U.S. Because almost all measures of inequality in the U.S. indicate constant or increasing inequality in recent decades (xx), mortality disparities are expected to have remained constant or increased in recent years.

A key element of the fundamental cause perspective is its prediction that health disparities will persist in the future, even though no one knows the diseases and conditions that will be in force at that time. As background, Link and Phelan (1995) point out that 100 years ago the top killers in the U.S. were tuberculosis, diarrhea, and pneumonia, and these diseases disproportionately affected people in the lower social strata. A person living 100 years ago might reasonably have thought that a substantial reduction in the influence of these top killers would also lead to substantial reduction in mortality disparities by socioeconomic strata. As it turns out, in the subsequent 100 years the influence of these top killers did indeed substantially diminish, but mortality disparities did not. The old killers were replaced by new ones -- specifically, cardiovascular disease, cancer, and stroke (Heron, Hoyert, Murphy, Xu, Kochanek, and Tejada-Vera 2009; Omran 2005) (xx) -- which each disproportionately affect people in the lower socioeconomic strata (cite xx). This perspective predicts that when the U.S.

successfully counters the top killers of today then whatever new ones replace them will have substantial mortality disparities because people in the upper social strata will have more resources to avoid them, whatever they may be.

This insight of the fundamental cause perspective allows us to further specify this second prediction. Not only should increasing disparities outweigh decreasing disparities, but these increasing disparities should be particularly acute among causes of death that are becoming more prominent over time. If disparities were not present in the new, prominent causes of death that replace old ones, then disparities by socioeconomic strata would have disappeared many decades ago.

Equalization

A third prediction, which is in contrast to the fundamental cause prediction, is that overall mortality disparities by education have decreased in recent years because the sum influence of decreasing mortality disparities outweighs the influence of any disparities that are increasing or constant. This prediction is based on the “diffusion of innovation” perspective, which posits a catch-up process in which more advantaged groups first gain the benefits of progress in knowledge and treatment but less advantaged groups eventually follow in changing health behavior and receiving the latest treatments. This price-of-progress argument sees increases in disparities as the short-term result of advances, but one that is self-correcting in the long run. From this perspective the increases in mortality disparities in recent decades set the stage for decreases in the future.

The mechanism underlying this argument focuses on the adoption and diffusion of innovations. In the classic model described by Rogers (2003), highly educated people adopt innovations most quickly, while less educated persons follow in adoption after a lag period. In the area of health, the educated have resources that help them identify new ways to improve their health, change their behavior in accordance with recent research and recommendations, and gain access to the most up-to-date health care. With fewer resources, the less educated depend on widespread publicity about health behaviors, the guidance of health professionals, and imitation of more educated groups. The diffusion of health innovations moves slowly but eventually reaches disadvantaged groups and thereby helps moderate disparities. Rising disparities several decades ago likely resulted from changes in patterns of smoking and new treatments for heart disease that have had a major impact on longevity. With lower education groups also coming in more recent years to enjoy health advantages from lower smoking and treatment for heart disease, disparities should decline.

A trend toward equalization fostered by diffusion of knowledge and medical innovations may have special force the last few decades for another reason. As high education groups reach longer life expectancies, an outcome brought about by progress in the 1970s and 1980s, further progress comes more slowly. Advances in public health and medical technology during a period of delayed degenerative diseases (Olshansky and Ault 1986) extend the ages at which degenerative diseases tend to kill mortality and bring some groups closer to a possible ceiling in longevity. Because the high likelihood of

death overwhelms other influences at older ages, the impact of socioeconomic characteristics tends to decline (House, Lepkowski, Kinney, Mero, Kessler, and Herzog 1994). Continued progress in lowering mortality, extending life, and concentrating death at older ages should particularly affect high education groups that have already enjoyed the most progress. As their progress slows, lower education groups with more room to grow move closer to the mortality of high education groups.

METHODS

The analysis is based on two main data sets to calculate death rates for adults age 40-64 by causes of death. The first is the U.S. Vital Statistics, which consists of yearly data from all death certificates issued in the United States. The data contain information on the race, age, and sex of decedents. The data also contain information on the contributing causes of death. In 1989 – the first year in which the educational attainment of the decedent was included on the death certificates – the U.S. Vital statistics included about 2.1 million records and by 2005 the number of deaths increased to about 2.5 million.

The analysis calculated the number of deaths for each cause of death as categorized in the ICD-113 codes (cite xx). For every year in the study the analysis counted how many times each cause of death appeared in the death certificates, either as an underlying cause of death or as a contributing cause of death. Consequently, death certificates with multiple, contributing causes of death were counted more than once in the analyses that take into consideration causes of death.

The second main source of data is the U.S. Census. To calculate mortality rates the Census data provided information for the denominator. For the purposes of this analysis it was necessary to derive from the Census estimates of the *total* population of the United States. Consequently, we supplemented information on the size of the civilian population – for which the Census provides yearly information – with information on the population that living in group quarters. For this latter information we imputed data from the decennial 1990 and 2000 censuses.

All analyses are age-standardized by five-year age groups to the year 2000 population.

RESULTS

Figure 1 shows the trend in overall mortality disparity by education from 1989 to 2005 for males and females, regardless of cause of death. Consistent with past trends, the mortality disparity increased over this time period. This increase is evident in Figure 1 by a widening distance over time between the mortality rates of people with the lowest and highest education levels. This widening is present in both analyses of men and women.

In analyses not shown we considered whether the widening was the result of a specific age group. We ran analyses parallel to those that we ran for Figure 1, but for

each separate five year age group from 40 to 65, separately for men and women. A widening disparity in mortality rates by educational attainment was present for every single five-year age group, suggesting that the trend is a historical period effect and cannot readily be explained as a cohort effect.

Figure 2 disaggregates the trends in Figure 1 by race and ethnicity. A widening mortality disparity by education is present for all demographic groups. The increase in the disparity is smallest for Hispanic men and women.

To examine these trends in more detail we focused on the approximately 100 main causes of death as coded in the U.S. Vital statistics. We focused on the period from 1999 to 2005, which is when all deaths were coded to the same nosology of the ICD-10. In 1998 and beforehand deaths were coded to the substantially different system of the ICD-9. Figures 1 and 2 indicate that the trend in widening disparity continued throughout 1999 and 2005 and therefore the time period is strategic for investigation of the widening of socioeconomic disparities in mortality.

Figure 3 is a histogram of changes in mortality disparities for men and women by causes of death. Disparity change is defined as the size of the mortality disparity in 2005 minus the size of the mortality disparity in 1999. If the disparity increased then the value of the disparity change was positive, and if it decreased then it was negative.

Figure 3 shows that for men the number of causes of death with increasing mortality disparities by education from 1998 to 2005 was about equal to the number of those with decreasing ones. Specifically, 48 of 102 causes of death has increasing disparities and 54 had decreasing disparities.

Figure 3 shows that for women the number of causes of death with increasing mortality disparities by education was substantially greater than those with decreasing ones. Specifically, increasing disparities outnumbered decreasing disparities by a factor of more than two to one, with 74 increasing and 32 decreasing.

DISCUSSION

This study set out to update trends in mortality disparities by education using the U.S. Vital Statistics and the U.S. Census. The analysis is unique because to our knowledge it is one of the first to consider in detail the relative influence of increasing and decreasing mortality disparities across major causes of death. Consistent with findings from previous eras, we find that the mortality disparity by education has increased in recent decades, for both men and women.

Our analysis highlights that the increasing mortality disparity is not uniform across causes of death, and that substantial variability is present, particularly among men. For males the number of causes of death with increasing mortality disparities was about equal to the number with decreasing mortality disparities. This is an encouraging finding for those who seek to reduce mortality disparities, because it suggests that such reduction can and is possible. If the forces that are reducing mortality disparities can be extended

to additional causes of death then it is possible that overall mortality disparities can start to be reversed – a reversal that has been desired by not experienced for at least fifty years.

For women the number of causes of death with increasing mortality disparities outnumbered those with decreasing disparities by more than two to one. These results therefore suggest that whatever forces are increasing mortality disparities have had a greater influence on women than men. Of particular interest – and an issue that will be considered in later versions of this paper – are causes of death that had increasing disparities for men by decreasing disparities for women.

This study has considerably further to go before it is finished, but hopefully the results thus far are sufficient to give the PAA reviewers an idea of where we are headed and what we hope to accomplish.

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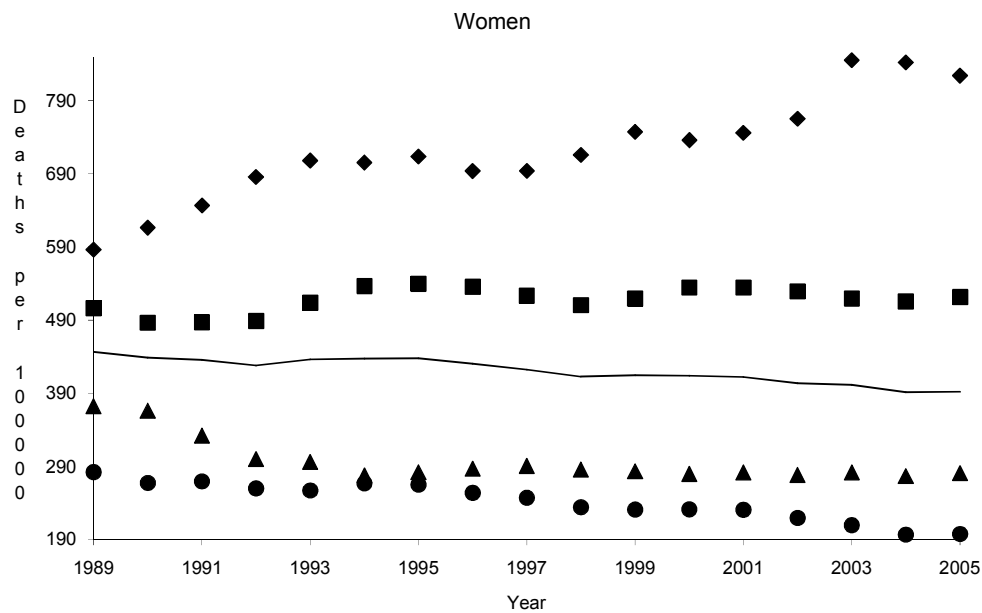
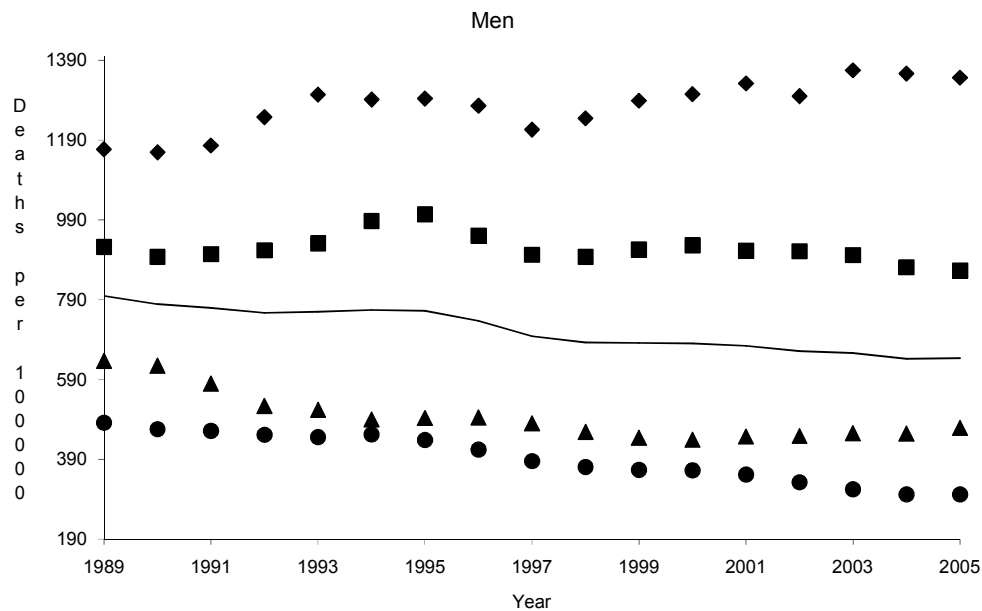
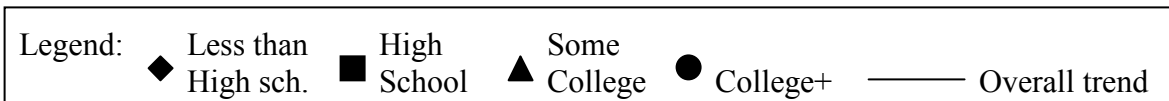
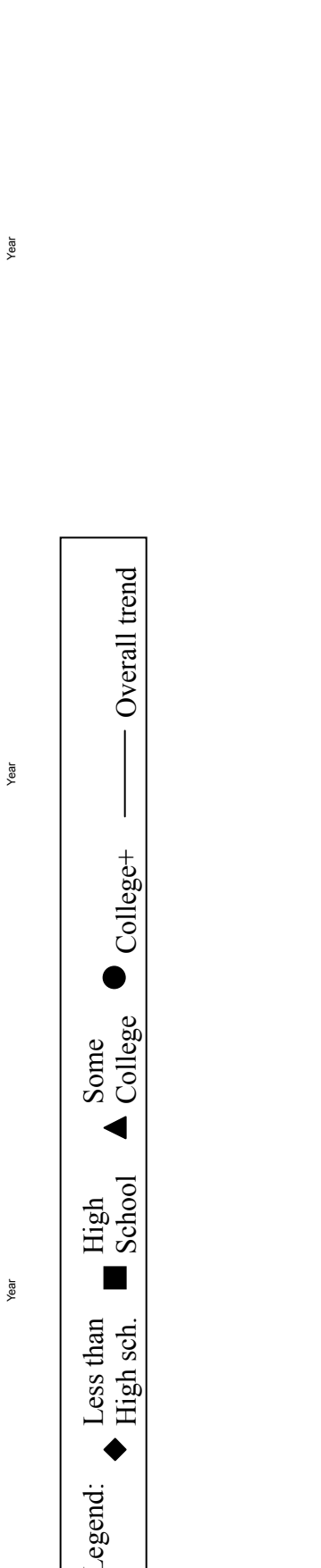
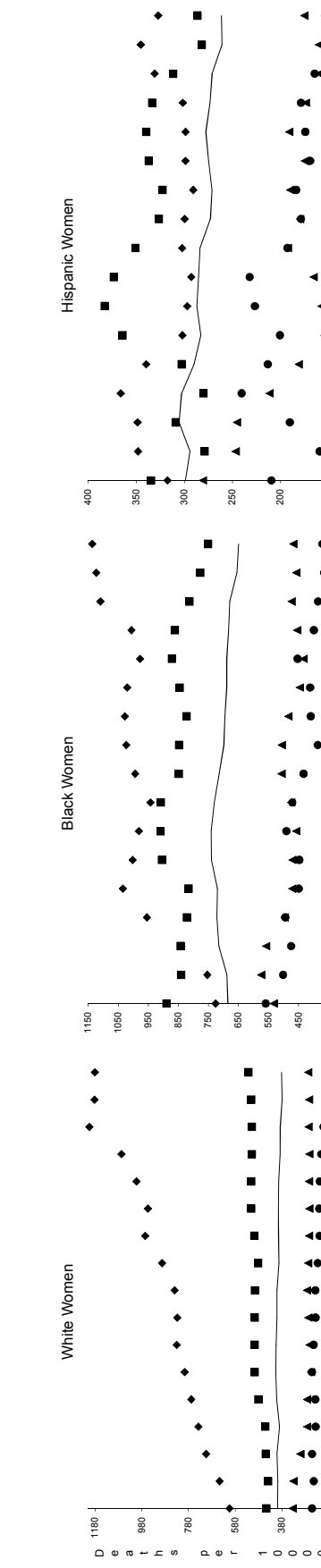
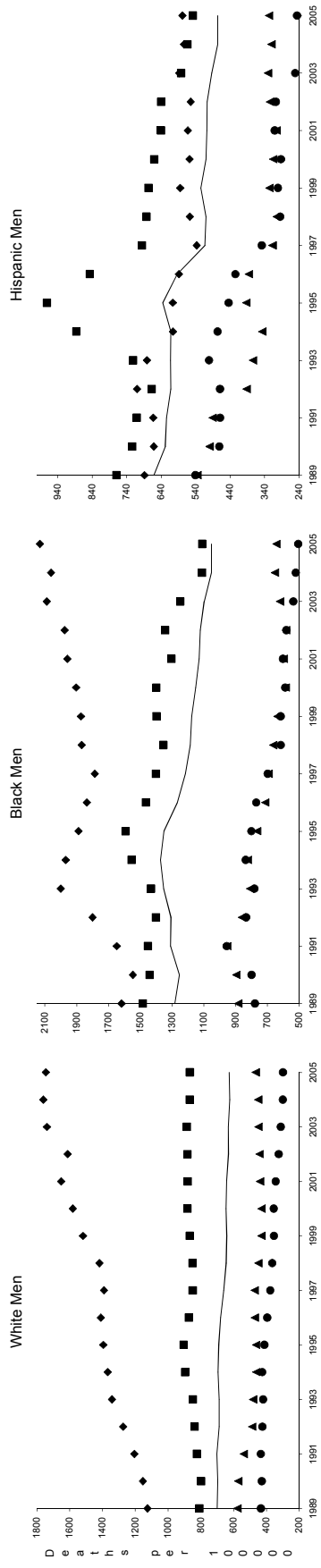


Figure 1: Trends in Mortality Levels by Education for Men and Women Age 40-64 for the Years 1989-2005



Source: U.S. Vital Statistics and U.S. Census
 Note: Age standardized to year 2000 U.S. Population



Legend: ◆ Less than High sch. ■ High School ● Some College ▲ College+ — Overall trend

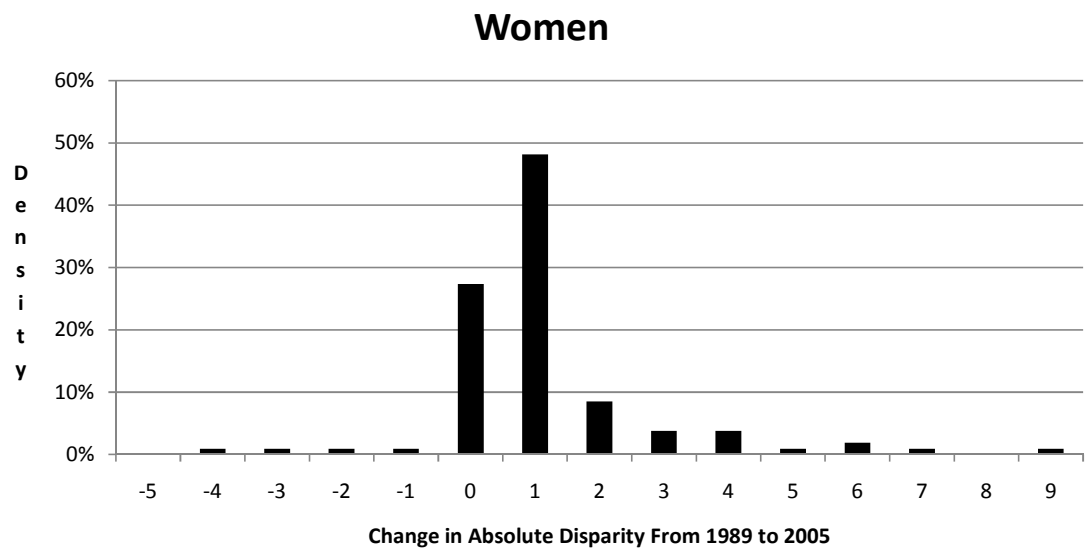
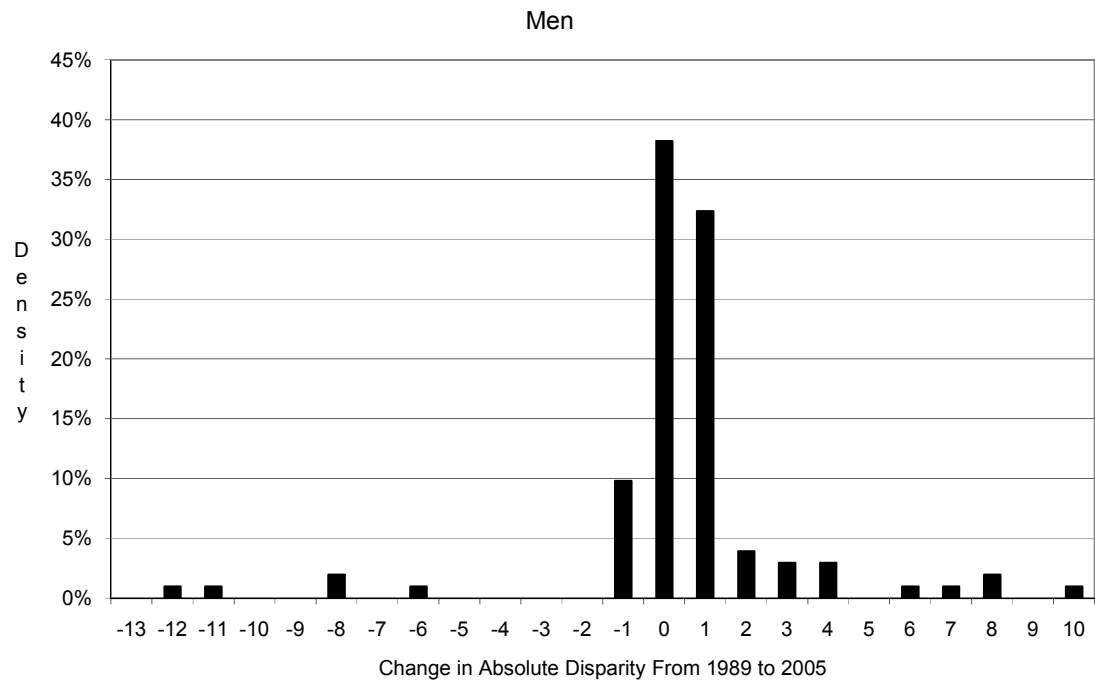


Figure 3: Histograms of Change in Mortality Disparities from 1999 to 2005. Changes Measured in Deaths per 100,000.

