Trends in SES Differentials in Child Mortality Across the 20th Century*

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ABSTRACT

Did socioeconomic inequalities in mortality increase, decrease, or remain constant in the United States over the course of the 20th century? Important debates in epidemiology, public health, and the social sciences hinge on this empirical question. For example, traditional epidemiological approaches to reducing socioeconomic inequalities in mortality and morbidity have focused on identifying and eradicating risk factors that give rise to those inequalities. These approaches are generally premised on the understanding that previous efforts to identify and eradicate risk factors have reduced socioeconomic inequalities in mortality and morbidity over time. In contrast, Link and Phelan's (1995) theory of "fundamental social causes" is expressly designed to explain long-term stability in SES differentials in mortality and morbidity.

Unfortunately, existing studies of "long-term" trends go back in time to only 1960 in the US and World War II in Western Europe. In this project we use data from the 1910 US Census and the 1990 and 1995 June Current Population Surveys to estimate changes over the 20th century in the association between SES and child mortality. Each survey asks women about the number of children they have ever had and the number who are still surviving; using this information it is possible to estimate the probability that a baby will survive to particular ages (Brass 1975). Our proxy for SES is the occupational prestige of the head of women's households' jobs. Occupational prestige hierarchies have remained essentially stable since the mid-19th century (Hauser 1982). Consequently, our indicator of SES is measured consistently over time and carries the same conceptual meaning at both the beginning and end of the 20th century.

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The inverse association between socioeconomic status (SES) and mortality rates has been recognized for centuries (Antonovsky 1967; Chaplin 1924; McKeown 1976; Villerme 1840; Virchow 1848), but there is virtually no evidence about how the ***strength*** of that association ***changed*** across the 20th century. Research and practice in epidemiology, public health, and the social sciences traditionally aims at identifying and eradicating the mediating factors that link SES and mortality. For example, a 1998 NIH program announcement (98-098) sought "specification of the processes through which SES influences cumulatively and contemporaneously physical and mental health, disability, morbidity, and mortality outcomes." Such targeted approaches to eradicating socioeconomic inequalities in mortality have contributed to dramatic overall declines in mortality rates in the US. However, trends in socioeconomic inequalities in mortality may have increased, decreased, or remained stable even as aggregate mortality rates declined.

If socioeconomic inequalities in mortality rates ***remained stable*** or ***grew*** across the 20th century, then we might ask whether such targeted approaches to eradicating socioeconomic inequalities in mortality rates should be supplemented with broader efforts to more fully consider the roles of macro-economic, political, or social structural factors in shaping the relationship between SES and mortality. On the other hand, if socioeconomic inequalities in mortality ***declined*** across the 20th century, then the current emphasis on identifying and eradicating the mechanisms that link SES and mortality may eventually lead to a situation in which socioeconomic inequalities in mortality are no longer an important social or public health problem. In short, the results of our proposed research have important practical and strategic implications for those interested in understanding and addressing socioeconomic inequalities in mortality rates.

How did socioeconomic inequalities in mortality in the US change across the 20th cen-

tury? To address this question we will use data from the 1910 US Census[1] and from the June supplements to the 1990 and 1995 Current Population Surveys (CPS). Long-term comparisons of socioeconomic inequalities in mortality rates require measures of SES and mortality that are *technically* consistent over time and across data sources. It is equally important that long-term comparisons employ measures of SES that have the same *conceptual meaning* over time. If the conceptual meaning of an SES measure changes over time, then it becomes impossible to meaningfully compare associations between SES and mortality rates over time.

Measuring Mortality: Each of the data sources we will use includes information about the number of children to which female respondents have ever given birth and the number and age of those children who are still surviving at the time of mothers' interviews. It is possible to use such seemingly limited information to estimate the probability that a child will survive from birth to age ***a*** (Brass 1975; Preston and Haines 1991; Preston and Palloni 1978). These procedures are described in more detail below. We will produce such estimates for 1910, 1990, and 1995.[2]

Measuring SES: Each source of data also includes information about the occupation of the head of each household. Occupation entries in the 1990 and 1995 CPS and the Minnesota Population Center's version of the 1910 US Census are all coded to the standards of the 1980 US Census occupational classification. Occupation codes will then be mapped onto the occupational prestige scale developed by Nakao and Treas (1994) for use with data coded to the standards of the 1980 US Census occupational classification. As described below, occupational prestige hierarchies have been remarkably stable in the US since at least the late 19th century (Hauser 1982). Consequently, SES is measured in a *technically* consistent manner over time and also carries the same *conceptual* meaning

[1] Ultimately we will supplement these analyses with data from the 1900 U.S. Census as well.

[2] Again, we will ultimately also include results for 1900.

over time.

The proposed project will make three important contributions. First, the empirical results will provide evidence about trends in socioeconomic inequalities in child mortality rates in the US across the entirety of the 20th century; previous research in the US and Western Europe has documented such trends only since mid-century. Second, the project will employ an SES measure that is technically *and* conceptually consistent across the 20th century. Third, the results will speak to important differences within the epidemiology, public health, and social science literatures regarding how to understand and react to socioeconomic inequalities in mortality. If 20th century political, social, and public health initiatives which *should* have reduced the association between SES and child mortality by eliminating the intervening mechanisms (e.g. improved public sanitation, eradication of many infectious diseases) have not done so, then it may be important to think more broadly about the role of social and economic inequality in stratifying mortality rates.

Background

It is important to consider the association between SES and mortality rates within the context of the dramatic long-term overall decline in mortality rates across the 20th century in the US and elsewhere. Both crude and age-adjusted mortality rates declined over the course of the 1900s; morbidity rates declined as well (Fingerhut, Wilson, and Feldman 1980; McKinlay and McKinlay 1977). Moreover, the leading causes of death have shifted from infectious diseases to chronic diseases over the same time period (Fingerhut, Wilson, and Feldman 1980; McKeown 1976; McKinlay and McKinlay 1977; Williams 1990). There is considerable debate about the root causes of these general improvements in public health (Colgrove 2002; Link and Phelan 2002; McKeown 1976; McKinlay and McKinlay 1977; Preston 1982; Szreter 1988; Szreter 2002).

In the context of these improvements in public health, there are two basic approaches to un-

derstanding SES inequalities in mortality and morbidity rates. First, epidemiologists, public health researchers, social scientists, and others have foused on investigating the behavioral and biological mechanisms that account for associations between SES and morbidity and mortality rates (Antonovsky 1967; Fingerhut, Wilson, and Feldman 1980; Stockwell 1961; Williams 1990; Williams and Collins 1995). A general presumption of this "mechanism-driven" approach is that by identifying the mechanisms that link SES with mortality and morbidity we can move toward a society in which there are fewer SES inequalities in these outcomes. For example, Kadushin (1964: 75) noted that

> …[a]s countries advance in their standard of living, as public sanitation improves, as mass immunization proceeds and as Dr. Spock becomes even more widely read, the gross factors which intervene between social class and the exposure to disease will become more and more equal for all social classes.

This mechanism-driven approach has been described as being founded in a fundamentally romantic view of social progress. Antonovsky (1967) wrote that

> …the scientist, no less than the lay person, often seems, in considering the question of the relationship between class and health, to be beset by a nineteenth century notion of perpetual progress. Ideologically committed, in this area, to the desirability of the disappearance of the class gap, he tends to assume, with or without data, that the historical picture is unilinear; the history of mankind, in his view, shows steady progress in this respect.

Below I describe prior research that almost uniformly demonstrates that socioeconomic inequalities in mortality have either remained stable or increased since 1960 (in the US case) or the end of World War II (in the case of Western Europe). These results, particularly if they also hold true for earlier decades, challenge an underlying supposition of the mechanism-driven approach --- that eliminating the mechanisms linking SES and health can effectively end socioeconomic inequalities in health. If sweeping initiatives such as improving public sanitation and working conditions, implementing programs like Medicare and Medicaid (in the US) or the National Health Service (in the UK), and controlling numerous infectious diseases have not reduced SES inequalities in mortality and morbidity rates, then why should future initiatives be any more successful? Of course, this assessment of the efficacy of the mechanism-driven approach in reducing SES inequalities in mortality

rates hinges on a key empirical question: Have socioeconomic inequalities in mortality declined, increased, or remained stable over the long term?

Although the mechanism-driven approach has undoubtedly improved public health and morbidity and mortality rates, one of the central premises of that approach has been questioned in recent years: that SES rarely affects health directly, but rather does so indirectly via mechanisms or "risk factors" that need to be identified and eradicated. This premise is questioned for two reasons. First, even net of known risk factors there are still sizable SES-health associations; at the same time, it seems unlikely that there are major risk factors that have yet to be identified or studied. Second, this approach ignores potential "basic causes" (Lieberson 1985) of morbidity and mortality, such as social and economic circumstances (Lantz, House, Lepkowski, Williams, Mero, and Chen 1998; Link and Phelan 1995; Link and Phelan 1996; McKeown 1976). The result is renewed interest in conceptualizing SES as a central and primary force driving population health and a reassessment of the mechanism-driven approach. The practical and policy implication of this new approach to understanding SES inequalities in mortality and morbidity rates is that policymakers need to do more to reduce social and economic inequalities in order to more effectively reduce SES inequalities in these mortality and morbidity. As Colgrove (2002: 725) recently asked, "are public health ends better served by targeted interventions or by broad-based efforts to redistribute the social, political, and economic resources that determine the health of populations?"

A central example of this new approach to understanding SES inequalities in mortality and morbidity rates is Link and Phelan's theory of "fundamental social causes" (Link and Phelan 1995; Link and Phelan 1996). This theory arose in part in reaction to mechanism-driven approaches and is explicitly designed to explain temporally *persistent* SES differentials in mortality and morbidity rates. It is also founded on the observation that there is change over time in the particular mecha-

nisms or risk factors that account for SES differentials in mortality and morbidity. Whereas issues like sanitation, water quality, and food safety were among the key mechanisms linking SES to morbidity and mortality rates several decades ago, researchers now focus on factors like smoking, obesity, and access to health care as primary explanations for associations between SES and morbidity and mortality. As a result, the associations between SES and morbidity and mortality rates persist despite changes over time in intervening mechanisms. As Link and Phelan (2000: 39) explain,

> …the reason SES has been so consistently associated with disease is that it embodies resources like knowledge, money, power, and prestige that can be used in different ways in different situations to avoid risks for disease and death (Link and Phelan 1995; Link and Phelan 1996). People who are relatively better off use their advantage to avoid risks and to adopt protective strategies that enhance health and well-being no matter what the risk and protective factors happen to be at a given point in time.

This more dynamic view of the role of SES in creating inequalities in mortality and morbidity rates acknowledges shifting sets of risk factors over time and examines the impact of unequal access to valued resources needed to avoid new risk factors. This emphasis on the direct effects of SES on health is an explicit challenge to more traditional approaches that exclusively focus on the mechanisms intervening between SES and health. However, we contend that ***both*** of these general approaches rest on relatively untested assumptions about long-term trends in the magnitude of socioeconomic inequalities in mortality and morbidity. The logic of mechanism-driven approaches implies that socioeconomic inequalities in mortality and morbidity rates should have *declined* over the long term as some of the major mechanisms linking SES and these outcomes have been eliminated. On the other hand, approaches like Link and Phelan's are explicitly premised on the understanding that SES inequalities in these outcomes have *remained constant* (or perhaps even increased) over the long term. Neither of these trends has been sufficiently established. The central objective of our proposed research is to document trends across the entire 20th century in the magnitude of SES differentials in *child* mortality. Because of its ability to adjudicate between these two perspectives, this straightforward empirical objective has important theoretical and practical implications for epi-

demiology, public health, and the social sciences.

Previous Evidence

Most prior research on US trends in SES inequalities in mortality rates has operationalized SES in terms of individuals' *income* or *educational attainment*. As I demonstrate below, this is in contrast to research on these trends in Western Europe in which SES is typically operationalized in terms of broad *occupational classes*.

In the US, researchers consistently find that associations between income and mortality rates have either remained steady (Duleep 1989) or have increased since the 1960s (Pappas, Queen, Hadden, and Fisher 1993), particularly for men (Schalick, Hadden, Pamuk, Navarro, and Pappas 2000). The same general pattern appears to hold for education in the United States. Since at least 1960, educational gradients in mortality rates have either held steady (Duleep 1989) or increased (Crimmins and Saito 2001; Pappas, Queen, Hadden, and Fisher 1993). There is some evidence that increases in educational inequalities in mortality rates in the US may also be especially acute among men (Feldman, Makuc, Kleinman, and Cornoni-Huntley 1989; Preston and Elo 1995). Although most US research operationalizes SES in terms of income or educational attainment, there are exceptions. Steenland, Hu, & Walker (2004), for example, find that mortality differences by "usual occupation" increased for men in the US between 1984 and 1997.

An obvious limitation of research on US trends in SES inequalities in mortality rates concerns its limited time horizon. The research dating the furthest back in time builds on the Matched Record Study of 1960 (Kitagawa and Hauser 1973) which linked death certificates registered between May and August of 1960 to records from the 1960 US Census. Some research considers large spans of time since 1960; for example, Preston and Ilo (1995) contrast the 1960 results with results from the early 1980s. However, no US research on trends in socioeconomic inequalities in mortality

rates takes a longer-term view. If we believe that public health initiatives such as immunizations, workplace safety, public education, improved sanitation, and others may have altered *long-term* trends in the association between SES and mortality rates in the US, then we clearly need information about trends in socioeconomic gradients in mortality that begin well before 1960.

While research on SES gradients in mortality rates in the US typically operationalizes SES in terms of income or education, such research in Great Britain almost invariably operationalizes SES in terms of the Register-General's Social Class scheme (which is fundamentally an occupational classification). For example, under a typical formulation "Class I" consists of professionals, "Class IIIN" consists of skilled non-manual occupations, and "Class V" consists of unskilled occupations (Marmot, Kogevinas, and Elston 1987), and individuals' class positions are based on their place in this occupational system. British researchers using this social class scheme have almost uniformly concluded that SES gradients in mortality have remained stable or increased since at least World War II (Antonovsky 1967; Black, Morris, Smith, and Townsend 1982; Marang-van de Mheen, Smith, Hart, and Gunning-Schepers 1998; Wilkinson 1986; Williams 1990) and there is similar evidence for England and Wales, Italy, Finland, Sweden, Norway, and Denmark in the 1980s (Mackenbach, Bos, Andersen, Cardano, Costa, Harding, Reid, Hemström, Valkonen, and Kunst 2003). Although some researchers have considered limited British data from as early as the 1920s (Koskinen 1985; Pamuk 1985), pre-World War II trends in Western European SES gradients in mortality or morbidity are not well documented. In the end, the bulk of evidence from Western Europe is subject to the same limited time horizon as evidence from the United States.

Measuring and Conceptualizing Socioeconomic Status

Beyond the limited time horizon of most research on temporal trends in socioeconomic inequalities in mortality rates, much of this research has also suffered from inadequate conceptualiza-

tions of SES. To be sure, a number of observers have carefully explicated the theoretical and practical issues involved in operationalizing and measuring SES for use in health research (Oakes and Rossi 2003), sociological research (Hauser and Warren 1997), and elsewhere. Oakes and Rossi (2003) note:

> With few exceptions, this methodological issue [regarding how to conceptualize/operationalize SES] has been ignored by health researchers and social epidemiologists. Yet if we wish to know about the relationship between SES and health outcomes, and understand the mechanisms through which SES affects health, we must critically evaluate our measurement of SES. To do otherwise may yield spurious relationships and undermine the credibility of social epidemiology.

Beyond the issues described by Oakes and Rossi (2003) and others, we contend that there are other challenges facing researchers interested in historical trends in the association between SES and mortality. At a minimum, researchers need to measure both SES and mortality in a strictly consistent manner over time. The basic structure of the US education system has not changed dramatically in the last several decades; nor has the basic racial classification system. It seems possible, therefore, to use major educational credentials or crude racial classifications as proxies for SES in studying long-term trends in the association between SES and mortality rates in the United States. One could imagine, for example, pooling more than 100 years of US Census data and modeling inter-cohort changes in racial inequalities in age-specific mortality rates since the mid-19th century.

However, even if researchers measure SES in a technically consistent manner over time, the *social meaning* and *consequences* of particular components of SES change in important ways over time; some become less indicative of SES over time, while some become more indicative of SES over time. For example, Chaplin's (1924) comparison of death rates among tax-payers and non-taxpayers in Providence, Rhode Island made good sense for 1865, because at that time tax-payer status served as a good proxy for property ownership and because property ownership was an important indicator of social and economic standing. However, comparing tax-payers to non-taxpayers in 2005 would mean something completely different. In a similar fashion, the social meaning of race in

the US has changed in important ways over time. In the hypothetical model (above) of inter-cohort changes in racial inequalities in age-specific mortality rates in the US since the mid-19th century, one could measure race in a crude but consistent manner (e.g., "White," "Black," or "other"), but the social and economic implications of falling into one of these racial categories has changed since the mid-19th century. Although blacks and whites most certainly do not enjoy equal social and economic rewards in American society, the Black-White-other divides in political, economic, and social power look different today than they did 100 or even 50 years ago.

The same is true for education and income: Even if one measured education (as a proxy for SES) in a technically consistent manner over time, the social and economic advantages associated with completing different levels of formal schooling have changed over the long term. For example, in the early 20th century the lack of a high school diploma did not carry the dire lifetime economic consequences that it does today. In this light, US research on trends in educational or income gradients in mortality rates faces an additional challenge. As noted above, this research has suffered from narrow time horizons. However, if it were technically possible to extend that research back to the beginning of the 20th century, researchers using education or income as indicators of SES would face real conceptual problems. Even if they were measured consistently over time, would educational credentials or labor-market income *mean the same thing* now as when most people completed only primary schooling and made their living from farming (in the early 20th century)? Even the research reviewed above on US trends since 1960 in educational inequalities in mortality may be affected by temporal changes in the social and economic consequences of failing to complete levels of schooling; since 1960 the US has seen declining rates of high school dropout and an expansion of post-secondary education.

Contributions of the Proposed Research

Whereas previous research has documented trends in socioeconomic inequalities in mortality only since the mid-20th century, our results will provide evidence about US trends in socioeconomic inequalities in child mortality between 1910[3] and 1995. Given that many of the major advances in public health that may have reduced socioeconomic inequalities in child mortality occurred in the first half of the 20th century, the longer time horizon of my research means that our results will supplement the existing literature in important ways. Second, as described below, we will utilize an indicator of SES that is measured in a consistent manner and that carries the same conceptual meaning over time. This measurement issue is especially salient in research on long-term trends in SES inequalities in mortality rates. Third, our results will speak to important differences within the epidemiology, public health, and social science literatures in how to understand the role of SES in stratifying mortality outcomes. Did socioeconomic gradients in child mortality in the US decline over the 20th Century, such that continued attention to identifying and eliminating the mechanisms that link SES and mortality might further reduce these gradients? Or have socioeconomic inequalities in child mortality remained stable or increased over the 20th century? If the latter is true, then epidemiologists, public health researchers, and others might do well to direct more attention to reducing broader socioeconomic inequalities as a means of reducing socioeconomic inequalities in child mortality rates.

Research Design and Methods

The first part of our analyses will involve comparisons of SES-group specific child mortality rates at three points in time: 1910, 1990, and 1995.[4] The second part of the analyses will involve

[3] Ultimately we will take our analyses back to 1900.

[4] Again, we will ultimately include 1900 as a fourth point in time.

multivariate regressions of child mortality, in which child mortality is modeled as a function of both SES and interactions between SES and year of observation. In both parts of the analyses the core question is whether socioeconomic inequalities in child mortality rates declined, increased, or remained stable between 1910 and 1995.

Data Sources

Data from the *early* 20th century will come from Public Use Microdata Samples (PUMS) extracted from the 1910 US Census; eventually we will also include data from the 1900 census. We will make use of PUMS files produced by the Minnesota Population Center; these well-documented and publicly-available PUMS files are "harmonized" such that variables are coded consistently across years. The 1910 PUMS file represents a 1 in 250 national random sample of the population, and contains about 89,000 household records and 366,000 person records.

Data from the *late* 20th century will come from the 1990 and 1995 Current Population Surveys (CPS). The CPS is a monthly survey of more than 50,000 households, and is conducted by the Bureau of the Census for the Bureau of Labor Statistics. Individuals in the CPS are representative of the civilian, non-institutionalized US population. In addition to the basic demographic and labor force questions that are included in each monthly CPS survey, questions on selected topics are included in most months. Since 1971 the June CPS has obtained detailed information about fertility and marital histories. Because we will use measures (described below) of SES and child mortality that are comparable across Census and CPS files, we can only make use of June CPS data from 1990 and 1995.

Following Preston and Haines (1991) and others we will restrict all samples to women between the ages of 15 and 35 --- that is, women who are relatively unlikely to have adult children. We are interested in the association between SES and *child* mortality. Including women older than 35

makes it hard to rule out the possibility that these women's children died as young adults after leaving their childhood homes.

There are two important differences between the census and CPS samples. First, the census data are representative of the *entire* US population, whereas the CPS data are representative of the *non-institutionalized* population. Second, the survey items that allow me to estimate child mortality were asked of *all* women above the age of 15 in the CPS, but were asked only of *ever-married* women above the age of 15 in the census. In our analyses we will produce child mortality estimates for *ever-married*, non-institutionalized women ages 15-35 in 1910, 1990, and 1995. We will also produce estimates for *all* non-institutionalized 15-35 year old women in 1990 and 1995.

Measuring Mortality

Each data source includes information about the number of children to which female respondents have ever given birth and the number and age of those children who are still surviving at the time of their Census or CPS interviews. In the 1910 Census household heads were asked to report all live births by all fathers to each ever-married woman beyond the age of 11, and whether or not the children were still living. They were to exclude stillbirths, adopted children, and stepchildren. They were then asked to report the number of these children who were still living on census day, regardless of the child's current place of residence. In the 1990 June CPS each household head was asked, "How many babies has [reference woman above age 14] ever had, (if any)? (Does not include stillbirths)." In 1995 the June CPS question was slightly different: "How many live births, if any, has [reference woman above age 14] ever had? (No stillbirths)." In both 1990 and 1995 the June CPS inquired about the current place of residence for the first five children born to the reference woman. One category for "place of residence" was "deceased." Although we are forced to restrict the CPS analyses to the first five babies born to each woman, this restriction will have a minimal impact; only

0.3% of women in the 1990 and 1995 June CPS had more than 5 children. As described below, we will use this information about the number of children ever born to female respondents, and the number and age of those children who are still surviving, to produce child mortality estimates using procedures introduced by Brass (1975) and developed by Preston and Palloni (1978) and Preston and Haines (1991). We will also use these measures to construct the dependent variable for our multivariate regression models; that dependent variable will express whether or not each child died.

Measuring SES

As described by Hauser and Warren (1997), the occupation that a person holds is a strong indicator of that person's general socioeconomic standing. Knowing what a person does in their job tells you a lot about the education and training that the person brings to the labor market and even more about the economic and social status that they enjoy. What is more, occupation can generally be measured more reliably than earnings or other more direct measures of economic standing. There is a long and profitable sociological tradition of using occupational information to characterize the socioeconomic standing of individuals and their families and households. As described above, there is also a long history of using occupational information as a proxy for SES in Western European research on the association between SES and mortality (Antonovsky 1967; Black, Morris, Smith, and Townsend 1982; Marang-van de Mheen, Smith, Hart, and Gunning-Schepers 1998; Wilkinson 1986; Williams 1990).

Our strategy is to ascertain the occupation of the head of household for each non-institutionalized 15 to 35 year old woman in each sample. In most cases this will be the woman's husband, but in some instances it may be other household members or (particularly in the late 20th century) the woman herself. In 1910 enumerators were asked to record the following information for each person: "Trade or profession of, or particular kind of work done by this person, as spinner,

salesman, laborer, etc." In the 1990 June CPS household heads were asked the following about each household member who had ever worked for pay: "What kind of work was [reference person] doing? (For example: electrical, engineer, stock clerk, typist, farmer)." In 1995 the June CPS asked two questions of each household head regarding each household member who had worked or looked for work in the preceding 12 months: First, "[w]hat kind of work (does/did) [reference person] do, that is, what (is/was) (his/her) occupation? (For example: plumber, typist, farmer)." Second, "[w]hat (are/were) (his/her) usual activities or duties at this job? (For example: typing, keeping account books, filing, selling cars, operating printing press, laying brick)." Although these open-ended survey questions are not asked in exactly the same way across surveys, they all yield responses that can be coded to a variety of classification schemes. In the US, researchers typically code occupational data to the standards of classifications developed by the US Census Bureau. Census occupational classifications change from enumeration to enumeration, sometimes dramatically. It is thus necessary to code occupational data to a single, consistent classification scheme if comparisons are to be made. For this project, the 1910 US Census (as released by the Minnesota Population Center) and the 1990 and 1995 June CPS have been coded to the standards of the 1980 US Census.[5]

Occupation entries from the 1900 and 1910 US Census and the June 1990 and 1995 CPS will then be mapped onto an occupational prestige scale. Occupational prestige is the "general level of social standing enjoyed by the incumbents of an occupation" (Hauser and Warren 1997). Occupational prestige scales are constructed by presenting a list of occupation titles to survey respondents and then asking them to sort them by their level of prestige; in general, respondents to prestige surveys are given little or no information about how to define "prestige." Ratings are then averaged

[5] We are currently seeking funding to code 1900 US Census occupational data to these same standards.

across respondents, and occupations are scaled from highest to lowest.

Occupational prestige scales have several remarkable properties. One is that prestige scores are highly correlated (on the order of 0.95) across studies in which raters were given different instructions about how to rate occupations' levels of prestige. Another is that prestige scores are also highly correlated across geographic areas and *over time*. For example, Hauser (1982) reports correlations between occupational prestige scores constructed in *national* surveys in the *1960s* by the National Opinion Research Center (NORC) with *city-specific* studies conducted in the *1860s* by Hershberg and colleagues (1974) in Philadelphia (Pennsylvania), Hamilton (Ontario), Kingston (New York), Buffalo (New York), and Poughkeepsie (New York). Despite being separated by a century, and despite referring to different geographic areas, the NORC occupational prestige scores were correlated at between 0.74 and 0.77 with the five city-specific scores. This remarkable consistency of occupational prestige scores over long periods of time makes occupational prestige an ideal measure of SES for this project: It can be measured in a technically consistent manner in the 1900, 1910, 1990, and 1995 data, but as importantly it carries essentially the same conceptual meaning at each point in time.

We will utilize the occupational prestige scale developed by Nakao and Treas (1994) for use with data coded to the standards of the 1980 (or 1990) US Census occupational classification. In our analyses we will divide each of the four samples into occupational prestige quartiles (or tertiles, if there are insufficient numbers of women experiencing the death of child in particular prestige quartiles), where, for example, the first quartile contains women whose heads of households are in the top 25% of the occupational prestige distribution.

Analytic Technique

Child Mortality Estimates: Our child mortality estimates will be based entirely on information about the number of children ever born to each woman and the number of those children who

were still surviving at the time of the Census or CPS survey. We will use this information to estimate $q(a)$, the probability that a child will survive from birth to age a (Brass 1975; Preston and Haines 1991; Preston and Palloni 1978). Specifically, we will use the "surviving-child" method developed by Preston and Palloni (1978). The surviving-child procedure is based on the equation:

$$B/(B-D) = \int_0^{\alpha} [C_S(a)/(1-q(a))]da,$$

where B is the number of children born to women in the sample; D is the number of deaths among those children; $C_S(a)da$ is the proportion of surviving children who were between a and $a+da$ years of age at the time of the mother's interview; $q(a)$ is the probability of death for a child born to a mother a years before the survey date; and a is the number of years since women gave birth to their first child (Preston and Haines 1991). We will estimate the equation separately for women in each of the quartiles of the distribution of occupational prestige in their survey year. The measures of B and D were described above. $C_S(a)$ can be estimated from the age distribution of surviving children as reported by household heads; this is only possible because of the restriction that mothers' ages fall within the range 15 to 35. Throughout, "children" will be restricted to mothers' own biological children.

With B, D, and $C_S(a)$ in hand, it is possible to identify values for $q(a)$ within a model life table system that satisfy Equation 1 above. Preston and Haines (1991) use the Coale and Demeny (1966) "West" model life table system in their analyses of parallel data from the 1900 US Census; we will begin with this model life table system, but may experiment with others. However, Preston and Haines (1991: 64) note that "alternative model life table systems applied to the same set of data will produce identical values of $q(a)$ at some age A^*." In particular, those authors note that $q(1)$ is best identified among women between the ages of 15 and 19, $q(2)$ is best identified among women between the ages of 20 and 24, $q(3)$ is best identified among women between the ages of 25 and 29,

and $q(5)$ is best identified among women between the ages of 30 and 34. All models can be estimated in MORTPAK 4.0, a software program developed by the Department of Economic and Social Affairs of the United Nations Population Division (United Nations 2003). Using these procedures we will produce estimates of $q(1)$, $q(2)$, $q(3)$, and $q(5)$ for each quartile of the prestige distribution in 1910, 1990, and 1995. These estimates will allow us to draw inferences about changes across the 20th century in socioeconomic inequalities in child mortality.

In the second part of the analyses we will pool cases across the three data sets and conduct multivariate models in which children are the unit of analysis (after weighting cases inversely proportional to the number of children born to their mothers). In these logistic regression models, we will regress the log odds that a child died on (1) dummy variables indicating the quartile of the prestige distribution into which their household head fell in their survey year; (2) dummy variables indicating the year in which the child was observed (either 1910, 1990, or 1995); (3) effect modifiers (or interaction terms) relating location in the prestige distribution to year of survey; and (4) an indicator of mother's age. The results for the effect modifiers (their direction and statistical significance) will be particularly important. For example, if the consequences of being in the bottom quartile of the occupational prestige distribution decrease over time (as indicated by the direction and statistical significance of the effect modifiers), then this would be evidence that socioeconomic inequalities in child mortality declined over the 20th century. These multivariate analyses should yield substantively similar results as the analyses in which we estimate $q(a)$ for individuals at different points on the occupational prestige distribution in different survey years. However, the multivariate analyses have the advantage of allowing us to assess the statistical significance of apparent changes over time.

How did differences in the values of $q(a)$ across quartiles of the occupational prestige distribution change between 1910 and 1995? What do multivariate analyses reveal about changes across

the 20th century in the consequences for child mortality of falling into particular quartiles of the occupational prestige distribution? Sound answer to these questions will make three important contributions. First, the results will constitute the first information about US trends in socioeconomic inequalities in mortality that span the entire 20th century. Second, occupational prestige --- our indicator of SES --- is measured consistently over time and had the same conceptual meaning in 1995 that it did in 1910. As argued above, using an SES measure that has the same technical and conceptual meaning over time is especially important in research on long-terms trends in SES differentials in mortality. Third, as described above our results will speak to important differences within the epidemiology, public health, and social science literatures in how to understand the role of SES in stratifying mortality outcomes.

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