Health, Income, and Inequality:
Review and Redirection for the Wisconsin Russell Sage Working Group

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1. INTRODUCTION

As noted in the overall motivation for this series of studies funded by the Russell Sage Foundation, increases in income and earnings inequality over the past 25 years have been well documented. What we do not know is whether or not there have been associated increases in inequality in other dimensions, such as health status. Health status may have a reciprocal relationship with income inequality. Health can affect human capital and hence the ability to earn, to engage more productively in nonmarket activities, and to enjoy consumption more or less fully. In turn, health can be affected by income inequality through a number of potential pathways.

Both analysts and policymakers are devoting increasing attention to various "disparities" in health and health care. One of the two main goals of the *Healthy People 2010* initiative is to reduce inequalities in health. The role of economic inequality in causing these disparities is not well understood, although there is a growing literature exploring ties between income, income inequality, and health.

What do we mean by "health"? While mortality is the "health" measure most commonly discussed—and arguably most precisely measured—in this literature, other measures of health may clearly be more important to consider in order to inform particular questions about the relationships between income (inequality) and health. Mortality's relationships with income may be quite distant in time; they may also be coarse or noisy, particularly if mortality from all causes is the focus. Alternative nonmortality health measures may have more proximate temporal relationships with income and they may in some instances also be less noisily related to income. Nonmortality measures of health ("biological well-being") may be of many types: cellular or molecular (e.g., LDL cholesterol levels, measles antibody titres); subclinical (e.g., systolic blood pressure); clinical (e.g., body mass index, birthweight, FEV scores); functional (e.g., ADL or IADL scores, restricted activity days); self-rated (e.g., EVGFP, HRQOL); and

others. The manner in which income influences such measures of health is likely to vary enormously in the population. For instance, some measures of health may be largely determined by genetic factors (e.g., risk for schizophrenia) while others may depend quite directly on factors that are closely related to income (e.g., health outcomes that are dependent on clinical access, which in turn are associated with income, such as risks for immunizable communicable diseases). The main point here is to recognize that the focus on any particular health measure should stem from the nature of the health-income question being posed; mortality may be an appropriate measure in some instance, while in others it may not.

In this paper, we attempt to unify our own group's understanding of the literature on income inequality and health by synthesizing the empirical and review literature in this area, and by pointing to some of the directions to which we believe we and others should turn next. We proceed in two sections.

In the first section, we review the recently burgeoning empirical and review literature on income inequality and health. We start by differentiating between several hypotheses that attempt to link income inequality to health inequality: the absolute income hypothesis, absolute deprivation or poverty hypothesis, relative income or relative position hypothesis, and an income inequality hypothesis. We conclude that the strongest evidence suggests that those with low levels of income have poorer health than those with more income. This evidence predicts that if the increase in inequality has meant a decrease in the income of those at the bottom end of the income distribution, then we would expect some decline in their health and hence an increase in inequality in health. The evidence that income inequality directly decreases health is far weaker. We critique the existing literature on the health effects of income inequality per se, raising a number of issues that need to be addressed further. In our second section, we pay particular attention to several measurement issues that we think will be crucial to explore in future work on income inequality and health. We set up a simple model that is designed to assist us in thinking about the links between health, income, and income inequality.

2. INCOME INEQUALITY AND HEALTH: REVIEW AND REDIRECTION

The question of whether or not income inequality is related to health and hence health inequality has received a good deal of attention with considerable debate about the nature of ties between income, income inequality, health, and health inequality. There have been a number of recent reviews of the literature by researchers in a variety of disciplines, such as economics, sociology, and epidemiology (e.g., Wagstaff and van Doorslaer, 2000; Deaton, 2001; Robert and House, 2000a, 2000b; Lynch, Smith, Kaplan, and House, 2000) and we build upon them in the literature review that follows. We begin with a brief summary differentiating the various hypotheses linking income and income inequality to health.

The basic idea that income is associated with health goes back a long way in the literature, though perhaps the most influential work affecting contemporary work in this area is by Preston (1975),[1] who observed that the impact of additional income on health (as measured by mortality) is greater on those with low income than those with higher income. This is illustrated in Figure 1, which shows the health of individuals on the vertical axis, plotted against the income of the individual's family group on the horizontal axis. The concave shape of the curve conveys the idea that a dollar transferred from the rich to the poor will improve the health of the poor person more than it will decrease the health of the higher-income person, so that this transfer will increase the average level of health of the members of a community.

This is called the *absolute income hypothesis* and in its simplest form argues that if all that matters to health at the level of an individual is income, a community with more equal income will tend to have better average health than a community with more inequality when comparing two communities with equal average income. In an international context, Deaton (2001) points out that according to the absolute income hypothesis, redistribution can improve health even if average income is not increased, and that redistribution from rich to poor countries would in principle improve worldwide average health.

A related concept is the *absolute deprivation* or *poverty hypothesis*. According to this hypothesis, those with the lowest incomes face poorer health and a greater risk of mortality owing to a variety of factors associated with extreme poverty, such as inadequate nutrition, lack of quality health care, exposure to a variety of physical hazards, and heightened stress. In this hypothesis, a dollar redistributed from rich to poor would improve the health of the poor and improve the average health of the entire population.

The *relative income hypothesis* focuses on an individual's income relative to others in his or her "group" rather than an individual's absolute income. According to this hypothesis, if the income of everyone but one in a group increases, that one person's health is expected to deteriorate. A related hypothesis is the *relative position hypothesis*. According to this concept it is one's relative rank in society that is tied to health outcomes. This is very similar to, and includes, the relative income hypothesis, but it extends the concept of relative position to measures of rank other than income, such as occupational rank or educational rank. These hypotheses are consistent with some research in the United States and the United Kingdom that demonstrates that the association between socioeconomic position and health occurs at all levels of the socioeconomic hierarchy, with even those in the highest socioeconomic groups having better health than those just below them in the socioeconomic hierarchy—referred to as a "gradient effect" of socioeconomic position on health (Adler et al., 1994; Marmot et al., 1991).

This hypothesis implies that it is not just the conditions experienced by those in absolute poverty that lead to poor health. Rather, there are psychosocial and other factors that remain unevenly distributed all the way up the income scale that perpetuate income inequalities in health. Perceptions of being relatively deprived ("keeping up with the Joneses"), stress, and other more psychosocial, rather than material factors, may play a role in perpetuating income inequalities in health at the upper income levels.

The hypothesis that focuses most directly on the tie between health inequality and income inequality is the *income inequality hypothesis.* According to the strong version of this hypothesis, societies

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[1]Preston compared mortality rates across countries.

with greater inequality produce worse health among their citizens, holding constant the average income of societies. Although at first these arguments compared income inequality between countries, research has more recently examined whether regions, states, counties, and cities with greater income inequality have worse health than their more equal counterparts.

A Brief Review of the Evidence

Although the hypotheses described above initially seem testable, controversy arises because the hypotheses are not always mutually exclusive. For example, tests of the income inequality hypothesis at the aggregate level may be empirically consistent with tests of the absolute poverty or relative income hypotheses at the individual level. Such overlap continues to obscure our understanding of the relationship between income, income inequality, and health. Without a clearer conceptual and empirical understanding of these relationships, the potential program and policy recommendations about how to reduce income-related inequalities in health remain elusive and hotly debated.

In general, there have been two empirical approaches to examining the hypotheses described above. Research examining the *absolute deprivation, relative income,* and *relative position hypotheses* has usually examined individual-level data on income and health or mortality to examine the existence and shape of the income-health relationship among individuals. In contrast, research examining the *income inequality hypothesis* has employed aggregate data either exclusively or at least at the level of measuring income inequality. We divide our brief review of the literature into these two general types of studies, focusing particularly on the recent research testing the income inequality hypothesis.

Income and Health

Voluminous empirical studies and reviews demonstrate a robust association between income and morbidity and mortality, using various measures of both income and health, across samples, and at various time points (Adler et al., 1993, 1994; Antonovsky, 1967; Feinstein, 1993; Williams and Collins, 1995; Robert and House, 2000a). To date, most of the evidence demonstrates a nonlinear rather than linear

gradient relationship between income and mortality (Backlund et al., 1996; McDonough et al., 1997; Ettner, 1996) and morbidity (House et al., 1990, 1994; Mirowsky and Hu, 1996).

Although most research on income and health is cross-sectional, there is some evidence that there may be widening socioeconomic inequalities in health in the United Kingdom (Black et al., 1982), the United States (Pappas et al., 1993), and other developed countries (Evans et al., 1994; Marmot et al., 1987). However, Deaton (2001) suggests that the rapid increases in income inequality in the 1970s and 1980s in Britain and the United States "have not been associated with any slowdown in the rate of mortality decline." To date, data sets have been of insufficiently long duration or incomplete in terms of longitudinal information on both income and health to effectively explore the relationship between income, income inequality, and health over time.

Figure 2 reports on trends in family income from 1974 to 1996. It illustrates the growing share of income received by the top 5 percent of families and shows the proportion of U.S. families below the official poverty line and the proportion who are poor or near poor (those below 125 percent of the poverty line.) The growing share of the top 5 percent is indicative of growing inequality; the proportion poor and near poor shows a more complicated picture—an increase from 1974 to 1983, a decline through 1989, followed by a smaller increase to 1991, with little change in the next few years.

Figure 3 reports the proportion of the population who report poor or fair health by income group over these same years. Consistent with the absolute income hypothesis and the deprivation hypothesis, the health of the poor is always worse than that of the nonpoor, and the health of the near poor is between the two. The trends over time show a continual improvement in the health of the nonpoor, but not among the poor and near poor: in both cases, after some improvement over the period 1974 to 1989, there is some deterioration in health from 1991 to 1996. (Caution should be used in viewing these trends, however, for the way that these health statistics are reported changed over this time period; hence the "jump" may be

due to the reporting change. The increase after 1991 cannot, however, be explained by the change in reporting, since there were no further changes.)[2]

Health status also differs systematically by race, and increasing attention is being paid to racial inequalities in health in the United States. There is a strong but far from complete overlap between racial and income inequalities in health. Although this overlap is often acknowledged, it is not explicitly examined in much research on income and health (see more discussion on race and health in later sections).

Figure 4 presents the trend in poverty and in poor and fair health for white (panel a) and African-American respondents (panel b.) This highlights the well-known higher poverty rates among African Americans and the higher proportion of African Americans with poor or fair health relative to the white population. The trends in health are of interest, for they are consistent with a tie between poverty and overall health for whites but not for African Americans. After 1983, the two lines track closely for whites. For African Americans the figure shows generally improving health, while the poverty rate fluctuates more. In this case, the figure does not illustrate or suggest a link between the two, although if the trend lines began in 1983, both would show some steady decline and hence improvement in health and reduction of poverty. Clearly, more attention should be paid to measuring trends in the relationship between income, race, and health and mortality over time in the United States.

Some recent research examines not only the relationship between individual or family income and health, but the potential relationship of neighborhood or community income level on individual health. This research finds evidence that living in communities with a higher proportion of poverty households, or

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[2]For the years 1991 forward, poor is defined as family income below the poverty threshold, near poor is income between 100 and 200 percent of the poverty threshold and not poor is income 200 percent or greater than the poverty threshold. For the years before 1991, the income categories are defined as follows: 1974: poor—family income less than $5,000; near poor—family income from $5,000–6,999; not poor—family income from $10,000—14,999; 1979: poor—family income less than $7,000; near poor—family income from $7,000–9,999; not poor—family income from $15,000—24,999. 1983–1986: poor—family income less than $10,000; near poor—family income from $10,000–14,999; not poor—family income from $20,000—34,999. 1989: poor—family income less than $14,000; near poor—family income from $14,000–24,999; not poor—family income from $35,000–49,999.

with overall lower income (e.g., low median family income), is associated with poor health and mortality, over and above the effects of individual or family income levels in the United States (Haan et al., 1987; Waitzman and Smith, 1998a; Robert, 1998; Diez-Roux et al., 1997; O'Campo et al., 1997; Anderson et al., 1997). Living in poorer communities may be detrimental to the health of all residents, regardless of their own income.

However, most of this research finds that individual, or family-level variables are more significant correlates of health than are community variables (Robert, 1998; Brooks-Gunn et al., 1997; Elliot et al., 1996). A number of challenges obscure our full understanding of these community effects, most notably issues regarding selection, causation, and race. To what extent do poor individuals select into poor communities, and to what extent do poor communities cause low income among residents? Similarly, to what extent does poor health cause both low income and residential selection, or vice versa? Moreover, since the United States is racially segregated residentially (Jargowsky, 1997; Haan et al., 1987; Massey and Denton, 1993; Wilson, 1987), what role does racial distribution, concentration, and segregation play in determining or explaining community-, family-, and individual-level income inequalities in health? A number of researchers have demonstrated the necessity of exploring more explicitly how community racial context and individual race are related to community and individual income and health (Deaton and Lubotsky, 2001; Collins and Williams, 1999; Robert and House, 2000b; Haan et al., 1987; LeClere et al., 1997, 1998).

Research exploring explanations for the relationship between income and health investigates various potential medical, material, social, psychological, behavioral, environmental, and biological pathways that may link income to health. A number of these factors may be responsible for a link between income and health; no single one seems to consistently stand out as offering the primary path by which income is tied to health. It seems that there is no one "magic bullet" that provides the key to understanding and alleviating income inequalities in health (Robert and House, 2000a).

Income Inequality and Health

While the evidence for a relationship between individual income and health is strong and relatively consistent, the evidence for a relationship between aggregate measures of income inequality and health is weak and controversial. There has been much focus in recent years on the latter research, with heated and excited debate about the importance to health and well-being of living in more or less unequal places. Ironically, the focus on this latter, more speculative, research may have unwittingly diverted attention away from the former, more consistent, research.

The literature regarding the income inequality hypothesis must refer to Richard Wilkinson, given the influence of his writings on the field. In various writings over the last decade (e.g., 1992, 1994, 1996) he provides evidence, of a relationship between income inequality in a country and life expectancy, both at a point in time and over time. However, other researchers have raised questions about this evidence, calling into doubt the reliability of the data he used to measure income inequality (Gravelle, Wildman and Sutton, 2000; Mellor and Milyo, 2001). Judge, Mulligan and Benzeval (1998) who use data generally considered superior (Luxembourg Income Study, or LIS, data) do not find a significant relationship between income inequality and life expectancy across developed countries.[3]

The idea that income inequality per se may influence health has caught the attention of many researchers, and there is a growing body of literature that tests this hypothesis not only at the level of countries, but across regions, states, counties, and cities within nations. For example, using states as the unit of comparison, Kaplan et al. (1996) and Kennedy, Kawachi and Prothrow-Stith (1996) find a significant relationship between several mortality rates and income inequality. Kennedy et al. find similar associations between self-rated health and income inequality (Kennedy et al., 1998). Kaplan and colleagues found a tie between inequality in household income at the state level in the United States, which held even when median incomes were included. Kennedy and colleagues (1996) used an alternative index

[3]Only for infant mortality do they find any evidence of a significant tie between income inequality and health.

of inequality, the "Robin Hood Index," also using state data for the United States. In their analysis of a variety of mortality rates, inequality was a statistically significant predictor. A follow-up study by Kawachi and Kennedy (1997) explored additional measures of inequality and mortality with similar results: a statistically significant link between measures of income inequality at the state level and health as measured by mortality rates. Lynch and colleagues (1998) similarly look at the relationships between multiple measures of inequality and mortality, although they examine 283 metropolitan areas as the unit of analysis rather than the state. The inequality measures predict mortality over and above other community-level factors, such as per capita income and proportion of the population with incomes under 200 percent of the poverty level. Using county and tract-level data, LeClere and Soobader (2000) found independent income inequality effects primarily at the county level, but only for some specific subgroups by age, race, and gender. In these studies, various controls are added for median income, for proportion below the poverty line or near poverty, per capita income and average household size.

Although most researchers accept this raw association between income inequality and health, even after controlling for median income levels or poverty, debate arises primarily over potential *explanations* for this relationship. Lynch and colleagues (2000) describe three potential types of explanations for the association between income inequality and health: the *individual income interpretation*, the *psychosocial environment interpretation*, and the *neo-material interpretation*. According to the *individual income interpretation*, aggregate associations between income inequality and health simply reflect the nonlinear (concave) relation between income and health at the individual level. According to the *psychosocial environment interpretation*, perceptions of inequality produce instabilities in social capital—perceived mistrust, lack of social cohesion, etc.—that work through behaviors and psychosocial responses that affect one's biological responses and ultimate health. The *neo-material interpretation* suggests that places with the greatest income inequality are places that also have inequalities in human, physical, health, and social infrastructure that ultimately affect health.

The *individual income interpretation* suggests that, theoretically, if the relationship between individual income and health is nonlinear, then there should be an aggregate-level association between income inequality and health (Ecob and Davey Smith, 1999; Gravelle, 1998; Preston, 1975; Rodgers, 1979). Empirically, this has been tested in several studies that have controlled for individual income when examining the association between income inequality and health. The association between income inequality and health sometimes remains after controlling for individual SES (Daly et al., 1998; Waitzman and Smith, 1998b; Soobader and LeClere, 1999; Fiscella and Franks, 2000; Kennedy et al., 1998; LeClere and Soobader, 2000), and sometimes it does not (Fiscella and Franks, 1997, 2000; Mellor and Milyo, 1999; LeClere and Soobader, 2000). It seems crucial to explore further the question of to what extent the relationship between measures of inequality at the aggregate level and health reflect the nonlinear association between individual income and health. However, even if the aggregate relationship is fully explained by the individual-level relationship, the interpretation of this finding would still be open for debate. Should the aggregate relationship then be seen as an artifact of the individual-level data, and therefore not meaningful, or does income inequality at more macro levels play a more causal role in producing or reproducing income inequalities in health?

Much of the heated debate in the literature on income inequality and health seems to stem from reactions to the so-called *psychosocial environment interpretation*. A number of researchers have explored the possibility that inequality per se produces a social environment that ultimately affects one's health (e.g., Wilkinson, 1996). For example, Kawachi and colleagues (1997) suggested that high income inequality within states is associated with low social cohesion and disinvestment in social capital, which then affect mortality. Examples of this would be the relative income and deprivation hypotheses that suggest that one's perceived relative income or position may affect health through psychosocial pathways (Adler et al., 1994).

Proponents of the *neo-material interpretation* believe that more consideration should be given to factors that exist outside of, or as precursors to, psychosocial pathways. For example, Lynch and

colleagues (2000) point out that there are structural, political, and economic processes that generate inequality, and that these processes exist before individuals experience or perceive their effects. Therefore, focusing on the structural, political, and economic processes that both produce and result from inequality may be more appropriate than attending primarily to individual perceptions or experiences that occur more downstream from these processes.

Examples of research exploring neo-material interpretations of the link between income inequality and health include research that explores the potential intermediating role of public investment in things such as health care, public safety, education, and environmental quality. To the extent that such investments are concentrated in higher-income areas, or in less unequal areas, then living in such areas will mean more access to such goods and services (Kaplan et al., 1996; Lynch et al., 1998; Davey Smith, 1996).

The neo-material interpretation implies that greater income inequality in society will lead to greater differences in resources across communities that will be associated with greater differences in health across communities. This finding highlights deprivation, but in this view deprivation at the individual level is compounded by deprivation at the community level as socioeconomic segregation and greater income inequality make the indirect costs of acquisition of health care and a healthy lifestyle more expensive to those with the lowest incomes. This suggests interaction effects between income inequality and individual income level. A number of studies suggest that income inequality may be significant determinants of health, but only for those with the lowest incomes (Mellor and Milyo, 1999; Soobader and LeClere, 1999).

Critiquing the Literature on Income Inequality and Health

To summarize our primary understanding of the literature on income, income inequality, and health: there is a strong relationship between individual income and health that persists, and perhaps strengthens, over time. The shape of the relationship between income and health appears to be nonlinear, such that increases in income among those at the low end of the distribution should have greater positive

consequences for their health than similar increases in income would have for the health of those at the top end of the income distribution. There has been much recent attention to the possibility that income inequality, per se, is related to health. The results of this research are still tenuous, though deserving of further study. However, it appears that the recent attention to the latter, more tenuous research has unwittingly diverted attention away from the former research on individual income and health. We conclude that: (1) more research is needed to examine the relationship between income inequality and health, although (2) the greater advances in our understanding of the relationship between income and health will come from research which refocuses attention on the relationship between individual income level and health. Nevertheless, even if the primary relationship between income and health should be examined at the individual level, mediators of this relationship may very well operate at more aggregate levels such as households or neighborhoods.

Further Research Is Needed on the Relationship between Income Inequality and Health

Much of the recent focus of research on income inequality and health has centered on the question of whether there are "independent effects" of income inequality on health. Is living in an area with greater income inequality associated with poor health over and above other individual- and area-level factors? Certainly, if the answer to this question is yes, there are interesting implications for how to reduce disparities in health—implications that may involve interventions entirely different from those that have traditionally been considered. Therefore, this question is important to address, and even more crucial to address *well*. As others point out, multiple limitations of existing data have prevented us from having definitive evidence regarding independent effects of income inequality on health and mortality. Future research needs to examine better data, particularly on income, health, race, racial concentration and segregation, community boundaries, and all of this information needs to be collected over time.

However, perhaps an even greater limitation of current work in the area of income inequality and health has been this narrow focus on testing for independent effects of income inequality on health. The

current literature conveys the message that if there are no "independent effects" of income inequality on health, then there is no need to think about income inequality at these more macro levels—the relationship between income inequality and health is simply spurious and has no meaning in and of itself. Surprisingly inadequate attention has been paid to either conceptualizing or examining the *indirect* role income inequality may play in affecting health. Moreover, even if income inequality has no independent effect on health and has small indirect effects, it may be the case that understanding income inequality and its links to the factors that more directly affect health may actually provide important clues about how to either improve the health of the poor, reduce health disparities, or reduce the link between income and health.

Therefore, we agree with Lynch and colleagues (2000) that the direction to head in is one which more clearly examines whether and how the individual income and neo-material interpretations combine to explain links between income inequality and health. Lynch and colleagues summarize:

> An unequal income distribution is one result of historical, cultural, and political-economic processes. These processes influence the private resources available to individuals and shape the nature of public infrastructure—education, health services, transportation, environmental controls, availability of food, quality of housing, occupational health regulations—that form the "neo-material" matrix of contemporary life. … Thus income inequality per se is but one manifestation of a cluster of neo-material conditions that affect population health. This implies that an aggregate relation between income inequality and health is not necessary—associations are contingent on the level and distribution of other aspects of social resources. If income inequality is less linked to investments in health related public infrastructure, the aggregate level association between income inequality and health may break down. (p. 1202)

In this scenario, reducing health disparities may not require a reduction in income inequality, if the distribution of resources in society is decoupled from the income inequality of one's area. However, this does not mean that income inequality itself becomes insignificant to understand. A number of authors (Kaplan et al., Mellor and Milyo, Wagstaff and van Doorslaer) raise the issue of whether income inequality is associated with public policies (toward the poor, in particular) which then affect health. What is curious is that some of these authors then imply that income inequality is not important to understand if its relationship to health is mediated by these policies—it is only the policies that then must be understood and changed. However, in reality it may be impossible to understand and change these policies without

understanding and considering how the context of income inequality shaped or maintained the policies. For example, if health care providers are not willing to practice in low-income areas, simply providing more coverage to the lower income population may do little to improve access to health care. The U.S. policy to encourage such relocation seems to have come face to face with this "reality."

The main point here is that even if the relationship between state-level income inequality and health is "explained" by state-level policy generosity, it might be imperative to understand whether or how income inequality affects or reflects this policy generosity. Greater contributions from political science on these subjects, such as research on interstate competition in health and welfare programs (e.g., Bailey and Rom, 2001), or Coburn's (2000) recent work on neo-liberalism as a cause of income inequality, may extend our understanding of whether and how income inequality and racial distribution and composition contribute to regional variations in access to resources that ultimately affect health.

We believe that although new research on income inequality and health is needed, such new research will be more useful to the extent that it explicitly integrates issues of race and ethnicity. A fuller consideration of the association between racial composition, racial segregation, and health and mortality is likely to help us understand the link between income inequality and health specifically, the link between income and health more generally, and patterns of health inequalities most importantly. Several researchers (Deaton and Lubotsky, 2001; LeClere and Soobader, 2000; Robert and House, 2000b) point out that places with the greatest income inequality are the same places with the greatest percentage of black people in the population (percent black). Income inequality and percent black in a state or county are so highly correlated that it seems odd that the literature on income inequality and health has focused on income inequality quite separate from racial composition of a state or county. Moreover, no research has explored the role of *racial residential segregation*, income inequality, and health using multilevel data. Whereas *racial concentration* focuses on the percentage of a population that is black, for example, racial residential segregation refers to the differential distribution of black individuals across smaller residential units (e.g., census tracts) within a larger geographical unit (e.g., a city, county) (Massey and Denton, 1988a). In the

United States, research has examined how racial segregation produces and reinforces the economic segregation of black people (Massey 1990; Massey and Denton, 1989; Massey and Denton, 1988b; Alba and Logan, 1993; Wilson, 1987; Jargowsky, 1997). However, little research examines the *health* consequences of living in racially segregated communities.

There is aggregate-level evidence that racially segregated communities have higher adult and infant mortality rates (McCord and Freeman, 1990; LaVeist, 1992, 1993; Collins and Williams, 1999; Polednak, 1993, 1996; Guest et al., 1998; Shihadeh and Flynn, 1996; Bird, 1995). Most of this research examines whether racial segregation is associated with mortality rates over and above community socioeconomic context. For example, in a recent study, Collins and Williams (1999) examined black and nonblack mortality rates for those ages 15–64, in cities with a black population of 10 percent or greater (107 cities). They tested whether high racial segregation (using the Dissimilarity Index and Isolation Index (Massey and Denton, 1988a) was associated with mortality rates (all-cause, heart disease, cancer, and homicide), controlling for proportion of the population in poverty, proportion of persons not employed in managerial or professional positions, and city population size. They found independent associations between high racial segregation and both black and white adult mortality, though the association is stronger and more consistent across different types of black mortality, particularly for black males. Other aggregate-level studies similarly have found that high racial segregation predicts mortality rates over and above community socioeconomic context (Polednak, 1991; Guest et al., 1998; Shihadeh and Flynn, 1996; LaVeist, 1989; Bird, 1995; Bird and Bauman, 1998).

Combining the literature on income inequality and health with the literature on racial concentration and segregation and health seems crucial in order to move forward our understanding of income and racial inequalities in health in the United States. For instance, some first-order research questions would involve asking: How does state-level inequality relate to policy generosity? If one actually wanted to make changes to the policies, might it make sense to understand how social and political processes work differently in more unequal states? Are there more competing interests in more unequal states, a competition that

ultimately never gets won by those representing the poorest in society? Is it politics based on racial conflict that result in less generous policies? Why is it that the most unequal places also tend to be the ones with the highest concentration of racial/ethnic minorities?

In sum, we agree with others that income inequality per se is not the main factor affecting health status in the United States or other countries. We agree that other factors at either individual or aggregate levels appear to account for the relationship between income inequality and health. However, we do not then conclude that variations in income inequality provide no useful information about how and why health is unequally distributed within the United States and between the United States and other countries. We suspect that there are complex causal links between income inequality, income level, racial distribution, residential segregation, and social and political decision-making that provide the more complete picture of how and why income and income inequality are related to health.

The Greatest Advances in Our Understanding of the Relationship between Income and Health Will Come from Research That Refocuses Attention on the Links between Individual Income and Health

Individual or family income dominates aggregate income inequality or aggregate income level as a direct determinant of individual health. The recent focus on income inequality at aggregate levels is useful in that it may (1) demonstrate economic factors beyond individual income that affect health, (2) highlight macro-social processes that indirectly affect health by shaping individual income, (3) highlight political and economic processes that distribute resources unequally, and (4) shift our attention to potential macro-social interventions that might have micro-social benefits. However, it still remains most important that we understand and attend to the strong direct link between income level and health.

In particular, we need to focus on understanding how and why *low* income produces and reproduces poor health. Because people with high income, on average, may be approaching the biological limits of improvement in health and longevity, increases in their income have diminishing returns for individual and population health. Therefore, the greatest determinant of individual and population health is

the absolute and relative income and position of those in the lower range of the income distribution, and it is here that we need to focus attention.

What are the factors that link low income to health in consistent, reciprocal relationships? We know that others in the Russell Sage initiative are investigating some of the mediators in the relationship between income and health (e.g., Lisa Berkman and colleagues). As they and we understand, although we may refocus on explaining the relationships between individual-level income and health, the mediators in this relationship may exist on several levels—not just at the individual level. The link between income and health should be explored by investigating potential mediating individual-level, family-level, community-level, and state- or system-level factors. This focuses our attention on explaining *why* poor people have poor health, but does not limit explanatory factors to those possessed by the individual. A poor individual may have characteristics that "explain" his or her poor health (such as health behaviors—smoking, lack of exercise, etc.). However these individual characteristics may be determined in part by "exogenous" factors (availability and marketing of cigarettes, lack of safe venues for exercise). Additional extra-individual factors, such as local policies, programs, and resources, affect multiple individuals' access to health-promoting resources. Understanding both the individual- and community-level mediators of the relationship between income and health, and their interactions, will be important in helping us understand what our most effective policy or program options might be. Finally, attention needs to be paid to the various dimensions of health that are likely to be tied to income and income inequality.

3. A BRIEF EXPLORATORY SURVEY OF EMPIRICAL APPROACHES TO UNDERSTANDING HEALTH INEQUALITIES

To guide our future work, we propose a simple model that we believe will help us attempt to explore more completely the links between income, income inequality and a variety of dimensions of health. We recognize various empirical obstacles, and list here just a few such considerations:

- Does the model apply to individuals or to a group?

- What measure of income is relevant? Personal income? Family income adjusted for needs? Family income? Permanent income?
- How should a comparison group be defined? (What level of aggregation? A population that is somehow similar to the individual? How should similar be defined?)
- What time span is relevant for testing the hypotheses?
- What other factors should be taken into account (controlled for) in testing the hypotheses?
- What measure of health does the hypotheses include? All? Mortality and life expectancy? Acute health problems? Chronic?

We begin with a simple model of health (h) and income (m). One supposes that health and income have the following distributional properties:

a. they are in some manner jointly distributed;

and

b. in general there will be temporal relationships involved in this joint distribution.

As such, let $\mathbf{h}=\mathbf{h}_i=[h_{i1},...,h_{iT}]$ denote a vector describing some health status measure for a representative individual i tracked over T time periods, and let $\mathbf{m}=\mathbf{m}_i=[m_{i1},...,m_{iT}]$ denote the corresponding vector of income measures. One then posits a joint probability model $\phi(\mathbf{h},\mathbf{m};\theta)$, which is the basic foundation for inferences about

a. health;

b. health inequality;

c. how health or health inequality relates to income or income inequality;

and

d. how the relationship between health (inequality) and income (inequality) may entail some lagged structure.

(Unless necessary for clarity, we ignore conditioning on exogenous covariates $\mathbf{x}$.)

To clarify the terms of discussion used henceforth, it is helpful to appeal to properties of $\phi(\mathbf{h}_i,\mathbf{m}_i;\theta)$. First, considerations of health at some point in time entail properties of the marginal

distributions $\phi_{h_t}(h_t)=\int \phi(\mathbf{h},\mathbf{m};\theta)dh_1...dh_{t-1}dh_{t+1}...dh_T dm_1...dm_T$. It is from such marginals that concepts like mean health at t ($E[h_t]$) and the variance of health at t ($Var(h_t)$) can meaningfully and precisely be described, thence discussions about health inequality might concretely begin. Analogously, considerations of the role of income and/or income inequality would logically require reference to the population marginals $\phi_{m_t}(m_t)$ in order to make statements about mean income, income inequality, etc.

So, for instance, if the objective is estimation of a model that sets out to describe time trends (denoted by τ) in the contemporaneous relationship between income inequality and health outcomes, one can then appeal to this statistical framework to specify a model such as

$$h_{it} = \alpha + (\beta + \gamma\times\tau)\times var(m_t) + ... + u_t$$

where β would capture the main effect and γ the time trend. Such conceptual clarity, we feel, is of considerable importance, since it is our experience that some confusion can easily creep into discussions about these topics.

One feature of the health inequality phenomenon we have considered is its intertemporal character. In the context of the earlier formulation, one might then be concerned with not just how a concept like mean health ($E[h_t]$) evolves over time, but also with how variations in health (e.g., $var[h_t]$) change over time. One may also be concerned with the intertemporal covariance structure of the probability distribution $\phi(\mathbf{h_i},\mathbf{m_i};\theta)$ (c.f. Abowd and Card, 1989; Staiger, 1998). For example, one might find interesting covariances of $\phi(\mathbf{h},\mathbf{m};\theta)$ of the form $Cov(h_t,m_{t-j})$ for $j\neq0$, suggesting (although obviously not proving) some lagged dependence of h on m (for $j>0$) or of m on h ($j<0$).

If one could build a coherent and representative longitudinal data set containing information on h and m (along with other salient covariates like age, gender, etc.), then one could begin to explore the covariance structure of health and income (or health and wealth, etc.). Some of our effort to this point has been devoted to determining what data sources might be best utilized toward such an objective or, if not practical, whether alternative methods like repeated cross-sections (e.g., for nonmortality measures,

National Health Interview Survey, NHIS, for Years of Healthy Life, YHL, Behavioral Risk Factors Surveillance System, BRFSS for Healthy Days, etc. could—perhaps suitably aggregated—be informative along these lines.

In assessing time trends in health inequality using survey-based data, one important aspect of our research to date suggests the importance of accommodating survivor bias over time if health measures other than mortality are of concern. Specifically, surveys of *living* individuals will fail to account for the fact of differential mortality patterns over time. To be concrete, suppose the health status measure is some health-related quality of life indicator measured (as is common) on a [0,1] scale, with "1" indicating perfect health and "0" indicating the equivalent of dead. Suppose further that there is an intervention or shock at time t' that—due perhaps to a redistribution of resources—increases mortality probabilities for some segments of the population but simultaneously increases health-related quality of life for other population segments.

A survey of the surviving members of this population at some date after t' may then reveal (a) an *increase* in mean health-related quality of life (as is well known from the demographic literature); and (b) a *decrease* in health inequality as more individuals in the surviving population are compressed towards the higher end of the [0,1] scale (a result not so commonly appreciated in the demographic literature). Yet for many interesting purposes, one's intuition is that health inequality should have been viewed as *increasing* from before t' to after t' (since such intuitions may often be based more on cohort-related questions than on period-related ones). As such, as part of our effort to measure time trends in nonmortality measures of health and health inequality, we are considering various approaches to correct for such "biases."

Conceptualizing Health

As noted earlier, an important limitation of the existing literature is the lack of systematic examination of how income and income inequality are associated with *multiple* dimensions of individual health and well-being. Most multilevel studies have focused on mortality; fewer have examined measures

of morbidity (number of chronic conditions, self-rated health, functional health). Moreover, illness or the *lack* of health has been the focus of most "health" research, using mortality and morbidity as physical outcomes and depression as a mental health outcome, rather than viewing and examining health as the presence of something *positive* (Ryff and Singer, 1998a, 1998b; Singer and Ryff, 2000).[4] Studying the determinants of *positive* health and well-being may provide added insight into the link between income inequality and health. (Ryff et al., 1999; Singer and Ryff, 2000).

We are convinced of the importance of examining properties of health outcomes other than mortality. For one thing, mortality outcomes may be relatively sluggish indicators of the underlying health of a population at any one point in time. Moreover, there is increasing appreciation of the fact that health-related quality of life is in some sense as important as longevity when summarizing the health of a population at a point in time (e.g., the *Healthy People 2010* initiative). Of course, measurement issues will tend to be more problematic when dealing with outcomes other than mortality (which is generally measured very accurately). Such measures may also often require particular attention in attempts to measure central tendencies or inequalities given their sometimes noncardinal metrics (e.g., self-reported health status: excellent, very good, good...; see Allison and Foster, 1999). Nonetheless, measures like self-reported health status, self-rated disability status, healthy days (Centers for Disease Control, 2000), etc. are likely to be of considerable interest and will occupy much of our attention during the next phase of the project.

There are additional reasons to differentiate health. Certain types of health may be genetically determined and, as of a point in time, not treatable. These are not likely to be influenced by a change in income inequality or improved access to health care. Acute illnesses and contagious illnesses may be influenced by exposure and by prevention activities. We would expect these to be far more likely to

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[4]This idea is also consistent with the recent National Academy of Sciences report by the Committee on Future Directions for Behavioral and Social Sciences Research at the National Institutes of Health, which suggests: "As a much needed counterpoint to long standing focus on illness and disease, we urge the NIH to invest significant new resources in advancing knowledge of positive health" (Singer and Ryff, 2000, p. 45).

respond to decreases in income inequality or, more directly, by improved access to care including preventive services. A third category of illness may be those that, while not contagious, are treatable; again we might expect some improvement in health if income inequality and/or access to care is improved. Accidents and suicides may also be responsive to changes in income inequality, as may certain types of mental illness. The important point then is that the tie between income, income inequality and health is likely to differ for different dimensions of health and ill health, health outcomes vs. health care, etc.

4. SUMMARY

As we reflect on some of the exchanges that occur in this field, we believe that some of the debate attending the roles played by income and income inequality as determinants of health and health inequality stems from conflicting goals. Researchers may want to understand, for instance, whether, why, and how income inequality is related to health. Policy makers may want to reduce income-related disparities in health. Only by understanding the complex relationships between income, income inequality, and health will we be able to fully understand our choices for best addressing disparities in health in the United States.

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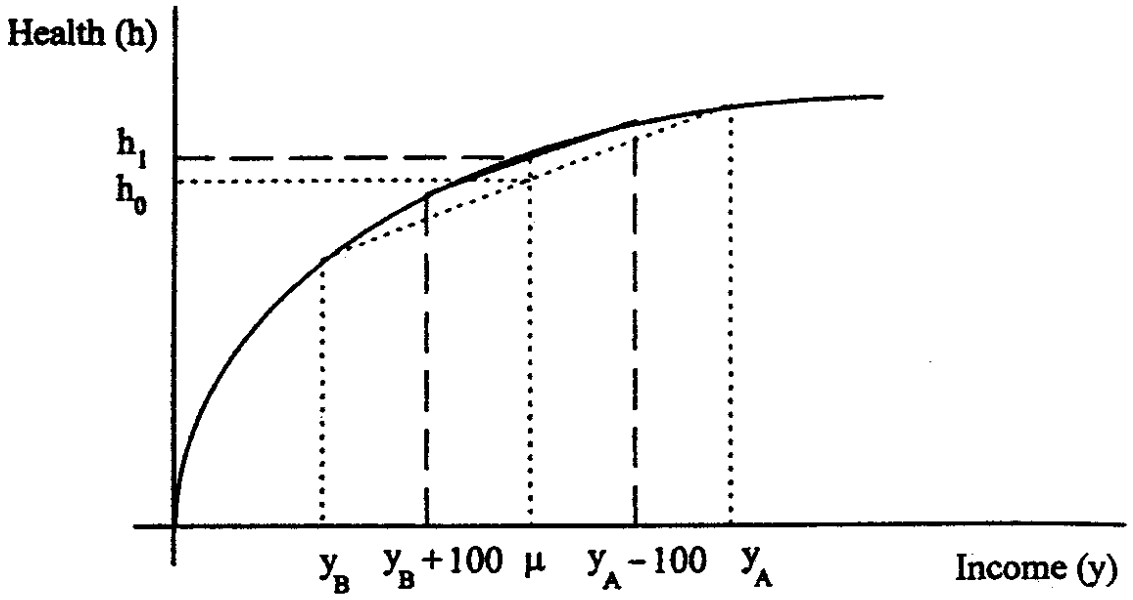
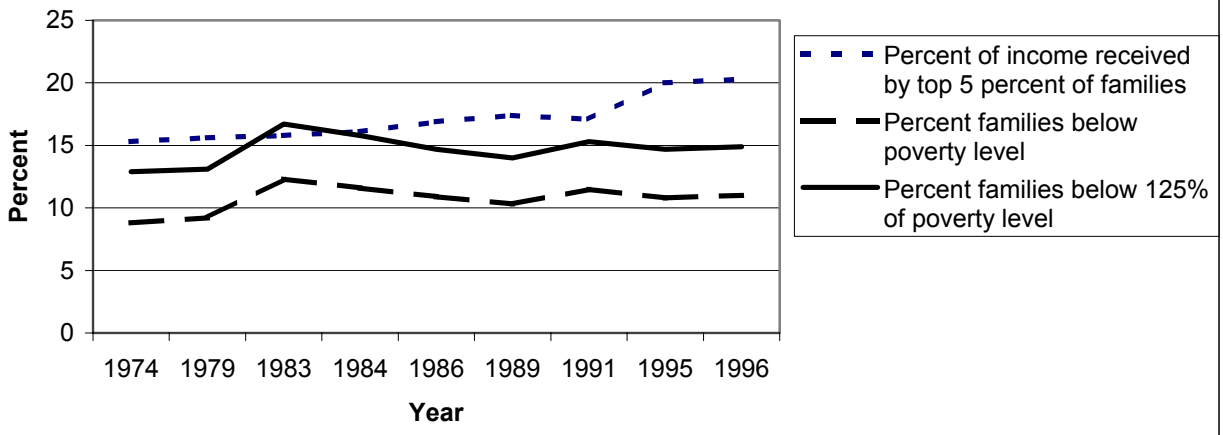
Figure 1

Implications of the Concavity of the Health-Income Relationship



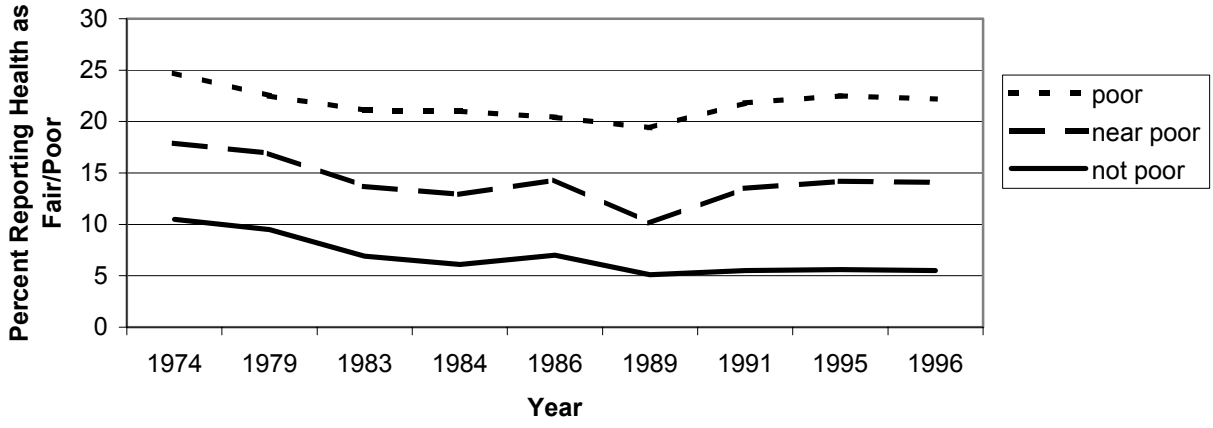
Source: Wagstaff and Van Doorslaer (2000), Figure 2, p. 546.

Figure 2
Trends in Income - United States 1974-1996



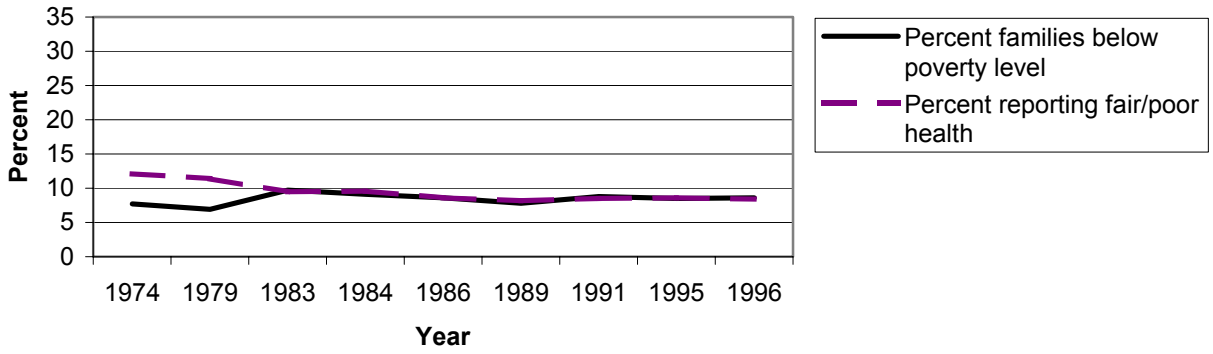
SOURCE: U.S. Census Bureau, Statistical Abstract of the United States: 2000, Tables 745 and 760.

Figure 3
Trends in Self-Reported Health by Family Income



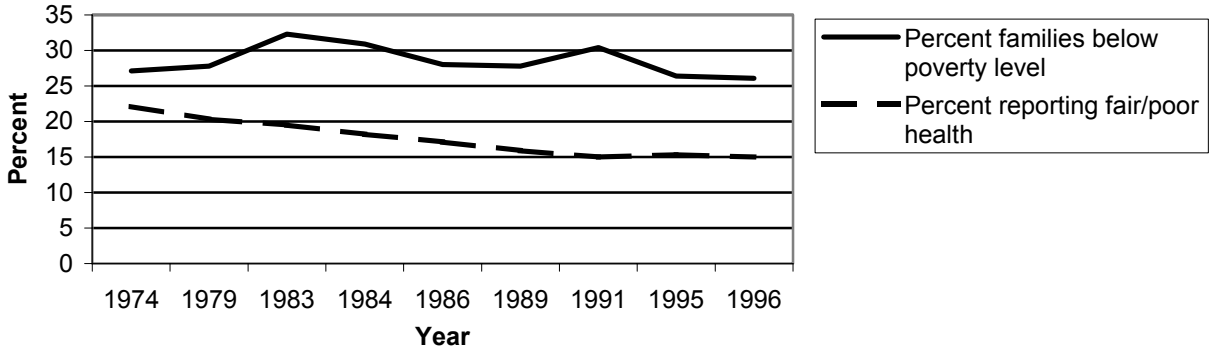
SOURCE: Health, United States years 1981-1999.

Figure 4A
Comparing Self-reported Health and Poverty Status: White Families



SOURCES: U.S. Census Bureau, Statistical Abstract of the United States: 2000. Health, United States years 1981-1999.

Figure 4B
Comparing Self-reported Health and Poverty Status: African-American Families



SOURCES: U.S. Census Bureau, Statistical Abstract of the United States: 2000. Health, Unites States years 1981-1999.