MEASURING HEALTH INEQUALITIES

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[Subsequent further development of the ideas presented in this paper may be found by means of the Measuring Health Disparities and Scanlan's Rule pages of jpscanlan.com.]

In recent decades, substantial resources have been devoted to the study of racial and socioeconomic differences in health outcomes and whether those differences have been increasing or decreasing. The general consensus has been that these differences, termed "health inequalities" in most of the world and "health disparities" in the United States, have been increasing, at least in the case of mortality. With minor exception, however, this research is suspect because not undertaken with an appreciation of the ways relationships between the rates at which two groups experience or avoid some outcome are affected by the prevalence of the outcome. The implications of changes in the prevalence of an outcome with respect to standard measures of health inequalities are described below. Also addressed below is the issue of whether by taking these implications into account one might draw meaningful conclusions regarding changes in the size of health inequalities.

A. Standard Patterns of Changes in Group Differences When the Prevalence of an Outcome Changes

The most notable problem in the analyses of health inequalities to date involves the failure to recognize the tendency whereby when two groups differ in their susceptibility to an outcome, the rarer the outcome the greater the relative difference in experiencing it and the smaller the relative difference in avoiding it (Scanlan 1991, 1994, 2000, 2006a). This tendency can be found in virtually any data set that allows one to examine the rates at which of two groups fall above or below various points on a continuum of factors associated with some outcome. Table 1 is based on the situation of two groups having normal distributions of some factor where the distributions have the same standard deviation and where the average of the advantaged group (AG) is half a standard deviation greater than that of the disadvantaged group (DG). Columns 1 and 2 show the proportion of each group that falls above each of 15 points defined on the basis of proportions of AG falling above or below the point.

For conceptual purposes, one might regard these data as reflecting performance on an examination and regard the implications of moving down the table in terms of the lowering of the cutoff. It should be recognized, however, that the patterns illustrated with the data in the table would be observed in any set of data where two groups have different, more or less regularly-shaped, distributions of factors associated with experiencing or avoiding some outcome. For example, the patterns described below would also be found in income data showing the rates at which various groups fall

below or above certain ratios of the poverty line (Scanlan 1991, 2000, 2006a). Moreover, the patterns described below would obtain even in situations where the underlying distributions cannot be directly observed, as in the case of the varied factors underlying distributions of risks of mortality. It should also be recognized that the changes effected by lowering a cutoff score from one point to another are the same as those that would occur if, rather than lowering a cutoff score, test performance were improved such that everyone scoring between the two points was enabled to achieve the higher score.

Relative Differences in Adverse Outcomes

Column 3 presents the ratio of DG's rate of falling below each point to AG's rate of falling below the point (which ratio is also illustrated by the diamond marker in Figure 1). And we observe that the ratio increases as we move down the table. For example, at Point J, DG's failure rate (49.2%) is 1.63 times AG's failure rate (30.0%); at Point K, DG's failure rate (36.7%) is 1.83 times AG's failure rate (20.0%). Thus, as cutoffs are lowered, and failure becomes rarer, the relative difference in failure rates increases. Further, viewing the matter in terms of improvement in performance rather than lowering the cutoff, the failure ratio could increase even when a higher proportion of DG than AG scoring between two points was able to score above the higher point. For example, consider the situation where, with a cutoff at Point J, improvements in performance enabled 100% of DG but only 90% of AG previously scoring between Points J and K now to score above Point J. That would seem to reflect a genuine improvement in the situation of DG relative to that of AG. Yet, such change would leave DG's failure rate at 36.7% and AG's failure rate at 21.0%. Thus, the ratio of DG's failure rate to AG's failure rate still would rise to 1.75 from the 1.63 it had been before the change.

The opposite, of course, would occur if a cutoff is raised rather than lowered. That is, the ratio would decline. And, viewing the matter in terms of a deterioration of performance, the ratio could decline even when 100% of DG but some smaller percent of AG originally falling between two points moved from the pass category to the fail category. Thus, the ratio of DG's failure rate to AG's failure rate would decline even though the relative situation of DG had worsened.

Inferable from the table is a corollary to the increasing difference in failure rates effected by lowering a cutoff. As a result of lowering the cutoff, AG experiences a larger proportionate decline in its failure rate than DG does. For example, lowering the cutoff from Point J to Point K would reduce AG's failure rate by 33.3% (30% reduced to 20%), while it would reduce DG's failure rate by only 29.8% (49.2% reduced to 36.7%). Conversely, raising the cutoff back to Point J would increase AG's failure rate by 50.0% (20% increased to 30%), while it would increase DG's failure rate by only 33.9% (36.7% increased to 49.2%).

Another corollary to the increasing ratio of rates of falling below each increasingly lower point on the table is that DG comprises a higher proportion of the population falling below each point. For example, assuming groups of equal size, DG would comprise 62% of the population falling below Point J but 65% of the population falling below Point K. Recognizing this aspect of the matter is important to understanding why ratios of rates of experiencing some adverse outcome tend almost invariably to increase as the outcome declines. For progress in virtually every area of human well-being, including reductions in mortality, is generally a matter of serially restricting adverse outcomes to the points where only the most susceptible segments of the overall population continue to experience those outcomes – until, in an ideal

world, the adverse outcomes disappear entirely. And disadvantaged groups comprise larger proportions of each increasingly more susceptible segment of the overall population. Thus, the closer a society comes to eliminating an adverse outcome, the more the outcome will be concentrated within disadvantaged groups, and the greater will be the differences between the rates at which advantaged and disadvantaged groups experience it.

Relative Differences in Favorable Outcomes

Now consider the other side of the picture – the relative differences in experiencing the favorable outcome. Columns 4 and 5 show the proportion of each group falling above each point, which proportions would be the pass rates on a test. Column 6 then shows the ratio of AG's rate of falling above the line to DG's rate of falling above the line (which is also shown by the square marker in Figure 1). That ratio declines – *i.e.*, the difference grows smaller – as we move down the table.[1] Thus, we observe that the size of relative differences in experiencing an outcome and in avoiding the outcome tend to move systematically in opposite directions as the prevalence of the outcome changes.

It might initially seem counterintuitive that the same change in prevalence that causes differences in experiencing an outcome to increase also causes differences in avoiding the outcome to decline. In fact, however, the latter pattern is implied in the former, if, indeed, it is not exactly the same thing. For if declines in prevalence of an outcome lead to increasing differences in experiencing the outcome, it follows that increases in prevalence of the outcome will decrease differences in experiencing it. And if an adverse outcome is declining, it follows that the favorable outcome is increasing, which means that differences in experiencing the favorable outcome will decline.

In any case, that increasing differences in experiencing an adverse outcome in times of declining prevalence of the outcome are attended by declining differences in avoiding the outcome has the following important implication with respect to the evaluation of changes in the size of inequalities. Some might be inclined to maintain that an increase in the difference between rates of experiencing an adverse outcome reflects some true worsening of the relative status of the disadvantaged group, even when the increase results solely from a general decline in the prevalence of the outcome. Even allowing the validity of the point for a moment, one would have to regard such a change as a much different occurrence – and a far less consequential occurrence – than a change that went beyond the usual consequences of the overall decline in the outcome. Indeed, one might say we have an interest only in the changes that are more than or less than the usual consequence of an overall decline in the outcome. But it becomes difficult even to maintain that an increase in the difference in adverse outcomes flowing solely from a decrease in prevalence reflects a true worsening of the relative situation of the disadvantaged group when one

[1] In a variety of publications I have generally presented the relative difference in experiencing the favorable outcome in terms of the ratio of the success rate of the disadvantaged group to that of the advantaged group (Scanlan 1991, 1994, 2000, 2006), mainly because that is the ways relative success is usually examined in various American legal settings. Presented that way, a decrease in the relative difference would be reflected by an increase in the ratio. I have presented the opposite ratio here solely to facilitate the presentation of the relative failure rates and relative success rates in the same figure (Figure 1). The manner of presentation, however, is irrelevant to the patterns of change of the size of the difference.

recognizes that, if one appraises the same matter in terms of the favorable outcome, one has to conclude that the inequality has declined.

As it happens, relative differences in many indicators have traditionally been measured in terms of the favorable outcome. In the United States, where laws limit the use of employment tests on which minorities or women do not perform as well as whites or men, relative performance on tests has generally been examined in terms of pass rates. And because the lowering of cutoffs tends to reduce relative differences in pass rates, the lowering of cutoffs has been universally regarded as reducing the disproportionate impact of such tests on minorities of women, even though lowering cutoffs increases differences in failure rates.[2] Beneficial health procedures (*e.g.*, prenatal care, immunization, mammography) have traditionally been evaluated in terms of differences in rates of receiving the procedure. Thus, the increased availability of such procedures has led to a perception that inequalities are declining, even as that same increased availability, by reducing certain types of mortality, has led to the perception that racial differences in those types of mortality are increasing.

In the United States, last year the National Center for Health Statistics (NCHS) issued a major report on the measurement of health inequalities, in which it recognized that changes in health inequalities might be interpreted differently depending on whether one examines the adverse or the favorable outcome (Keppel *et al.* 2005). The report, however, merely recommended that all inequalities be measured in terms of adverse outcomes. It neither acknowledged nor attempted to address the implications of either the tendency for the sizes of inequalities in adverse and favorable outcomes to move systematically in opposite directions as the prevalence of an outcome changes or the crucial tendency for the size of the relative difference in experiencing an adverse outcome to increase as the outcome grows less prevalent.[3] On the other hand, a health inequalities measurement handbook recently issued in the United Kingdom recognized these patterns (Carr-Hill and Chalmers-Dixon 2005). It failed, however, to explore all the implications of that recognition.

Odds Ratios

[2] There is not perfect consistency in the way such issues have been addressed in comparable settings. For example, racial differences in mortgage lending patterns have been analyzed in terms of differences in rejection rates. This approach has persisted even though lenders have been encouraged to relax lending criteria that disadvantage minorities. Thus, the lenders that respond to such encouragement reduce racial differences in acceptance rates, but increase the racial differences in rejection rates that tend to make them targets for litigation (Scanlan 2000).

[3] Later in the year two of the authors of the NCHS report published an article devoted to the issue of measurement of inequalities in terms of adverse outcomes (Keppel and Pearcy 2005). Responding to a letter of mine expressing the views in the text above (Scanlan 2006), the authors did not contest the existence of these tendencies. They simply maintained that there can be departures from the tendencies when there occur changes in the risk distributions of advantaged and disadvantaged groups (Keppel and Pearcy 2006). That is of course true, as discussed infra and in other places (Scanlan 1991, Scanlan 2000, Scanlan 2006a). But during times of declining mortality, difference in mortality rates typically increase. And reliance on relative mortality rates as the main indicator of the size of an inequality, without regard to these tendencies, will lead to interpreting these changes as reflecting meaningful increases in inequality without consideration of whether the changes are greater than or less than would be expected solely as a consequence of declining mortality.

Now consider odds ratio, the ratio of one group's odds (*i.e.*, the rate of experiencing and outcome divided by the rate of avoiding it) divided by the odds of the other group. Some commentators favor the use of odds ratios because one gets the same result whether one focuses on the adverse or the favorable outcome (Cornfield 1951, Gastwirth 1998). And, given that odds ratios are functions of rates of both experiencing and avoiding an outcome, it warrants consideration whether the odds ratio might offer a useful means of evaluating changes in the relative well-being of two groups vis-à-vis experiencing and avoiding some outcome.

But in order to determine whether inequalities in outcomes like mortality (or survival) are changing in ways that are not solely functions of changes in the prevalence of the outcome, one needs a measure that does not change when there occurs a simple across-the-board change in prevalence – "across the board" meaning a change akin to changing the cutoff from Point J to Point K in Table 1. As shown in Column 7 of the table (and by the triangle marker in Figure 1), however, the odds ratio is very large when the failure rate is very large, grows smaller as the failure rate declines towards the area where a majority of AG passes the test, then grows large again as failure becomes rare. (Ratios of the odds of avoiding the outcome, which are the reciprocals of the odds ratios shown in Column 7, would reflect the same patterns with respect to the size of the differences.) Thus, while the odds ratio of experiencing an adverse outcome behaves like the relative risk of experiencing the outcome when the outcome is rare (and like the relative risk of avoiding the outcome when the outcome is pervasive), it changes in less predictable ways when the outcome is relatively common. For example, serially lowering the cutoff from Point E would cause the odds ratio (2.53) to decline for a time, but then return to approximately the same level at Point K (2.50). In any event, the odds ratio does not provide a ready means of identifying changes that are not solely the function of changes in the prevalence of an outcome.

Absolute Differences

Some favor using absolute differences rather than relative differences to measure health inequalities. Reasons for this preference include (1) that the absolute difference is the same whether one examines the adverse or the favorable outcome and (2) that the absolute difference gives a better picture than the relative difference of the proportion of the disadvantaged group that is harmed by its greater susceptibility to an adverse outcome. But we see in Column 8 of Table 1 (and Figure 2) that, as with each of the other measures just described, absolute differences also change when there occurs an across-the board change in the prevalence of the outcome. The absolute difference is small at the point where almost everyone from both groups experiences the adverse outcome, grows larger as the adverse outcome becomes less common, and then grows small again as the adverse outcomes becomes rare. And, as with the other measures, absolute differences can change in one direction, even when there is genuine change in the other direction. That is, for example, with a cutoff at Point J, if 100% of AG but a lesser percent of DG scoring between Points J and K was enabled to reach Point J, the absolute difference between failure (and pass) rates still could decline. Thus, absolute differences cannot provide an efficient and reliable means of identifying changes in the relative status of two groups with respect to some outcome that are not solely a function of changes in prevalence of the outcome.

B. Implications of Misunderstanding the Described Tendencies

Understanding the tendencies described above, we can see flaws in virtually all efforts to appraise the size health inequalities, with respect both to evaluating change over time and to comparing inequalities in different settings. To begin with, we see it observed that despite declining mortality, relative inequalities in mortality are increasing (Ferrie *et al.* 2002, CDC 2002). But increasing relative differences between the mortality rates of more and less advantaged groups are near inevitable consequences of declining mortality. Whether the observed increases in relative differences are greater than or less than those that should be expected to occur solely as a result of declining mortality has gone unexamined. We also see an expectation that trends that would be expected to affect health adversely will increase relative inequalities in poor health (Krokstad *et al.* 2002). But the opposite should be the expectation.

We see it observed that whether mortality inequalities are increasing or decreasing, or are larger or smaller in different settings, depends on whether one examines relative differences or absolute differences in mortality (Vagero and Eriksson 1997, Anand *et al.* 2001, Bostrom and Rosen 2003). Yet, given the range of overall mortality rates in most studies of mortality inequalities, in times of declining mortality, absolute differences typically decline as well. Thus, in times of declining mortality neither increases in relative differences nor declines in absolute differences can tell us whether we are observing something other than the usual consequence of declining mortality. Similarly, in settings where mortality is relatively rare, relative inequalities will tend to be large while absolute inequalities will tend to be small.

We also see it observed that relative inequality in mortality is greater among the young while absolute inequality is greater among the old (Mackenbach *et al.* 2003, Huisman *et al.* 2005). But this is no more than the expected pattern given that mortality is rarer among the young. Similarly, the rarer the condition being examined, the greater the relative inequality in experiencing it is likely to be (Scanlan 2000).[4]

[4] The ways relative rates of experiencing (or avoiding) an outcome are affected by the prevalence of an outcome also has implications with respect to the interpretation of the impact of exacerbating (or ameliorative) factors on different groups, with the tendency for exacerbating factors to increase mortality proportionately more for the group with lower mortality but reduce survival proportionately more for the group with higher mortality, and vice-versa for ameliorative factors (Scanlan 1994, 2000). Thus, studies find that obesity increases death rates more among women (for whom mortality is lower) than men (for whom mortality is higher), and more among those who had never smoked (where mortality is lower) than among those who had smoked (where mortality is higher) (Calle *et al.* 2003). High body-mass index increases the risk of death more for whites than for blacks and more for the young than the old (Calle *et al.* 1999). Prescott *et al.* (1998) showed that smoking increases the risk of death more for women than for men. Data presented in that study also showed, however, that, while the increased mortality risk for heavy smokers compared with non-smokers is greater among women than among men, decrease in survival rates is greater among men than among women. The data underlying the other studies, but not presented, might well also show contrasts between relative mortality increases and relative survival declines.

These patterns, of course, will not hold in every case. The prevalence of an outcome is not the only thing affecting the size of relative differences between rates of experiencing or avoiding the outcome. Both differences are also functions of the similarity of the risk distributions of two groups, and the similarity of those distributions will vary from setting to setting (with the greater similarity causing relative differences in experiencing an outcome, relative differences in avoiding the outcome, odds ratios, and absolute differences all to be smaller with respect to each point on Table 1). One apparent departure from the expected pattern involves socioeconomic inequalities in mortality among men and among women. Since mortality is lower among women than among men, the described tendency suggests that socioeconomic inequalities would be greater among women than among men. Yet that seems not to be the case (Sacker *et al.* 2000, Martikainen *et al.* 2001, Huisman *et al.* 2005, Khang *et al.* 2005). But in industrialized societies, among others, it is understandable that the differences between the conditions and physical strain associated with the occupations of the lower and higher social classes would have a greater impact with respect to men than to women. Such greater impact seems to be sufficient usually to outweigh the tendency for relative differences in mortality rates to be greater in settings where early mortality is less common.

Other departures from expected patterns may occur because the risk distributions are in fact growing more similar or less similar during periods of changing prevalence, which can accentuate the usual pattern of change in differences in rates of experiencing (or avoiding) the outcome while diminishing the usual pattern of change of differences in the opposite outcome, or because the distributions have irregularities at certain points. But the tendency for inequalities in experiencing an outcome to increase, and inequalities in avoiding an outcome to decline, in times of declining prevalence (and the opposite in times of increasing prevalence) are pervasive enough and strong enough that it is not possible to intelligently interpret changes in inequalities without taking the tendency into account.

The above discussion addressed only the more common measures of health inequalities. Many other measures are used to appraise the size of health inequalities, some of which attempt also to take into account the way the sizes of various groups change over time (Mackenbach *et al.* 1997, Anand *et al.* 2001, Carr-Hill and Chalmers-Dixon 2005). Like the measures discussed earlier, however, all such measures apparently suffer from the problem that the measure can be expected to change in one manner or another solely as a result of changes in prevalence of an outcome. Hence, none can provide an efficient means of identifying changes that are not solely the consequence of changes in prevalence of an outcome.

C. Interpreting Changes in Light of Expected Patterns

So when, if ever, can we draw conclusions about the meaning of changes in relative susceptibility to mortality or survival, given that we cannot effectively observe the risk distributions of the groups being compared? When the rate of experiencing an adverse outcome is increasing for one group, while that rate is declining for another group, the discussion above, as well as common sense, suggests that such change would be a meaningful one. But such situations are likely to be relatively uncommon in any case and extremely uncommon when the change in either direction is substantial.

According to the tendencies described above, during a period when an outcome is generally declining the relative difference in rates of experiencing it should increase and the relative difference in rates of avoiding it should decline. Hence, in theory, if

both the relative difference in the adverse outcome and the relative difference in the favorable outcome are increasing, that would suggest a true worsening of the status of the disadvantaged group (with the opposite interpretation when both differences are declining). Also, in circumstances where the absolute difference does not decline when a relatively rare outcome is declining, that would seem to suggest a true worsening of the status of the disadvantaged group. More broadly, we might interpret any departure from an expected pattern to reflect a meaningful change in the relative well-being of the disadvantaged group, either for better or for worse.

But there are difficulties with such interpretations. For example, the discussion above would suggest that a decline in the relative difference in experiencing an adverse outcome during a period when an outcome was declining would suggest a genuine improvement in the relative well-being of the disadvantaged group. But consider a relatively rare outcome like infant mortality. As infant mortality rates have continued to decline in recent decades in the developed world, racial and socioeconomic inequalities have increased (CDC 2002, Frisbie *et al.* 2004, Gisselmann 2005). But in some cases, infant mortality rates among advantaged groups have approached a level where they may not be significantly lowered regardless of the quality of medical care and the favorableness of other conditions surrounding a birth. In Sweden, for example, a recent study showed that, following a continuing pattern of declines in infant mortality for mothers with both lower and higher education, the rate during the 1985-90 period examined had reached 6.3 deaths per thousand live births, while the rate for the those with higher education had reached 3.9, and the relative risk had risen to 1.62 (Gisselmann 2005). The most recent Swedish data show the overall infant mortality rate to be just under 3 deaths per thousand live births. Suppose that regardless of the favorableness of conditions surrounding births, the rate cannot reasonably be reduced below 1 death per thousand live births. Suppose also that at the point where the infant mortality rate for the higher educated group reached 2.0, the rate for the lower educated group reached 3.0. The relative risk would be 1.5, down from the 1.62 in 1985-90. Yet underlying the relative risk of 1.5 would be a relative risk of reasonably avoidable mortality of 2.0 ((3.0 minus 1.0, or 2.0) over (2.0 minus 1.0, or 1.0)), while underlying the relative risk of 1.62 in 1985-90 would be a relative risk of reasonably avoidable mortality of 1.8 ((6.3 minus 1.0, or 5.2) over (3.9 minus 1.0, or 2.9)). Thus, it might be a mistake to regard the seeming reduction in relative risk as reflecting a meaningful improvement in the relative health of infants born to mothers with lower education.

It may seem that considerations regarding absolute minimums would be limited to situations like infant mortality where rates like the Swedish rate of 3 deaths per thousand facially seem extremely low. Yet among the older population, which is responsible for a substantial part of overall mortality, it would seem that a significant part of a 10% yearly mortality rate is not reasonably avoidable. Hence, considerations concerning irreducible minimums may have a role even in the interpretation of patterns in situations where the possibility of an irreducible minimum is less apparent. And whether or not the existence of irreducible minimums is the best way to conceptualize the matter, it is evident that mortality rates can decline to a point where it becomes increasingly difficult to achieve progress in additional reductions, allowing groups not yet to that level an opportunity to gain ground vis-à-vis relative mortality. The point is that such circumstances, like others described above, are simply the natural consequences of declining mortality and ought not to be mistaken for a change in the relative situation of two groups that is not such a consequence.

Further, the age standardized mortality rates we observe in studies are typically composites from subpopulations among which the overall mortality rates may vary

substantially. At a minimum, the overall rates vary from quite low rates among young subpopulations to sometimes quite high rates among older subpopulations. Thus, for example, in times of declining mortality, among both the younger subpopulations and the older subpopulations, the patterns of changing inequalities may be exactly as would be expected; yet the composite age-standardized result may show a departure from those patterns.

An additional word is warranted on absolute differences. While Figure 2 might suggest that when relatively low mortality rates are declining further, an increase in the absolute difference, being contrary to the usual pattern, would suggest a genuine worsening of the relative situation of the disadvantaged group. In addition to the factor noted in the preceding paragraph, however, one needs to recognize that seemingly low overall mortality rates even among the relatively old are functions of the convention of reporting yearly rates. For example, a yearly mortality rate of 8% for the 75-to-84 year-old group might seem in the range where we should expect that, in times of declining mortality in the age group, absolute differences would ordinarily behave in the manner we see around Points L and M in Table 1 and Figure 2. Yet the fact is that 80% of the age group will be dying during a ten-year period. Hence, the expectation of the types of changes we observe in the area of Points D to G may be more warranted. In sum, while one must understand the usual patterns of change of the various measures of inequalities in order not to be misled by them, it is also necessary to exercise considerable caution in order to avoid misinterpreting departures from the usual patterns.

D. Morbidity

Morbidity requires a few paragraphs of separate treatment. To the extent that the study of morbidity involves acute conditions, the observed patterns will be much the same as with mortality. And inasmuch as most, though not all, acute conditions have tended to decline in the same way that mortality has declined, the expectation would be that relative differences in acute condition morbidity rates will have been increasing.

But inequalities in morbidity are frequently studied in terms of self-assessments of general health and whether one has long-term limiting conditions. Such studies raise a number of additional issues. First, in contrast to the generally consistent decline in overall mortality rates, the overall rates of self-assessments of poor health and having long-term limiting conditions frequently have been stable or increasing. Such factor likely accounts for a significant part of the view that, in contrast to consistently increasing inequality in mortality, there has not been a consistent pattern of increasing inequalities in morbidity. Indeed, typically studies finding no increase in relative inequalities in health tend to be studies of self-assessed health (Dahl *et al.* 2001, Lissau *et al.* 2001, Lundberg *et al.* 2001, Manderbacka *et al.* 2001, Ferrie *et al.* 2002, Westert *et al.* 2005).[5]

Second, studies of self assessments of general health usually examine responses to surveys that allow one to indicate whether his or her health falls into five categories ("very good," "good," "neither good nor bad," "poor," or "very poor"), with the results dichotomized such that the last three categories would be deemed "less than good" health (Dahl *et al.* 2001, Lissau *et al.* 2001, Manderbacka *et al.* 2001, Khang *et al.* 2004, Westert *et al.* 2005). But studies also use other approaches to phrasing, number

[5] In the United States, dramatic increases in obesity have been accompanied by dramatic declines in socioeconomic differences in rates of obesity (Zhang and Wang 2004).

of total categories, and number deemed less than good health (Lundberg *et al.* 2001, Krokstad *et al.*, 2002, Ferrie *et al.* 2002). The different approaches will cause different proportions of the total population to be deemed to have less than good health, which would tend also to yield different relative (and absolute) inequalities for reasons unrelated to any actual differences in the nature of the inequalities.

Third, relative differences in morbidity seem almost invariably to be presented in terms of odds ratios. This is often the case for the presentation of inequalities in mortality rates as well. Mortality rates, however, tend to be presented in terms where the rates are low enough that odds ratios approximate relative risks. Rates of less than good health, however, sometimes cover a substantial part of the population. In such circumstances, it is difficult even to know the expected direction of odds ratio changes solely as a consequence of increases or decreases in the prevalence of the outcome. Thus, interpreting changing inequalities in self-assessed health is even more difficult than interpreting changing inequalities in mortality.

Nevertheless, self-assessed health may offer a means of comparing the size of health inequalities over time that may avoid most or all of the problems identified above. Consider, for example, having individuals rank their health on a continuous scale. Changes in the effect size of the difference between the average scores of the two groups (*i.e.*, the difference divided by the pooled standard deviation) as a measure of the difference in the relative health of the two groups may indicate changes in the relative health of the two groups that are unaffected by the overall level of health within a society.[6]

That is not to suggest that such an approach will prove to be an entirely satisfactory one or that devoting resources to such studies will necessarily prove to be worthwhile. The key consideration, however, is that, in order to be of any real value, studies of the changing nature of health inequalities must be approached with an eye toward identifying changes that are not simply the consequences of a change in the prevalence of an outcome. The measures presently used seem ill-suited to that end. And, as matters now stand, resources continue to be devoted to study of health inequalities without even consideration of the impact of changes in prevalence upon these measures.[7]

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[6] Among seemingly similar approaches that do not rely on self-assessment would be comparisons on scores on risk indexes, such as that used in Osler (2000). Yet, whether one smokes would seem a crucial element of any such index, and, as with other binary criteria, the difference in rates among groups would be affected by the prevalence, implicating the problematic issues addressed above.

[7] Some journals publish studies of health inequalities at least once month. Recent examples, where my on-line responses raised issues with the failure to consider the implications of changes in prevalence as they pertain to the particular setting, include, Ananth *et al.* 2005 (response at http://www.ajph.org/cgi/eletters/95/12/2213), Pickett *et al.* 2005 (response at http://www.ajph.org/cgi/eletters/95/11/1976), Satcher *et al.* 2005 (response at http://content.healthaffairs.org/cgi/eletters/24/2/459#720), Shaw *et al.* 2005 (response at http://jech.bmjjournals.com/cgi/eletters/59/8/638?ck=nck#347), Geronimus 2006 (response at http://www.ajph.org/cgi/eletters/96/5/826), Regidor *et al.* 2006 (response at http://www.ajph.org/cgi/eletters/96/1/102), Low and Low 2006 (responses (two) at http://bmj.bmjjournals.com/cgi/eletters/332/7547/967), Adams *et al.* 2006 (response at http://jech.bmjjournals.com/cgi/eletters/60/3/218), Lynch *et al.* 2006 (response at http://jech.bmjjournals.com/cgi/eletters/60/5/436), Wilkinson and Pickett 2006 (response at http://www.thelancet.com/journals/lancet/article/PIIS0140673606684894/comments?action=view&totalComments=1).

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Table 1 *Illustration of Relationships of Rates of Falling Below and Above 15 Points for Two Groups with Normal Distributions with Half a Standard Deviation Difference between Means*

Cut Point	(1)AG Fail%	(2)DG Fail%	(3)Ratio DGF%/ AGFail%	(4)AG Pass%	(5)DG Pass%	(6)Ratio AGP%/ DGP	(7)Odds Ratio	(8)Abs Diff
A	99.00	99.76	1.01	1.00	0.24	4.24	4.27	0.78
B	97.00	99.13	1.02	3.00	0.87	3.47	3.55	2.14
C	95.00	98.38	1.04	5.00	1.62	3.12	3.23	3.43
D	90.00	96.25	1.07	10.00	3.75	2.67	2.86	6.27
E	80.00	90.99	1.14	20.00	9.01	2.22	2.53	11.03
F	70.00	84.61	1.21	30.00	15.39	1.96	2.37	14.77
G	60.00	77.34	1.29	40.00	22.66	1.77	2.29	17.47
H	50.00	69.15	1.38	50.00	30.85	1.62	2.24	19.15
I	40.00	59.48	1.48	60.00	40.52	1.48	2.19	19.36
J	30.00	49.20	1.63	70.00	50.80	1.37	2.24	19.05
K	20.00	36.69	1.83	80.00	63.31	1.26	2.31	16.65
L	10.00	21.77	2.17	90.00	78.23	1.15	2.50	11.74
M	5.00	12.71	2.52	95.00	87.29	1.09	2.74	7.66
N	3.00	8.38	2.79	97.00	91.62	1.06	2.95	5.37
O	1.00	3.44	3.38	99.00	96.56	1.03	3.47	2.42

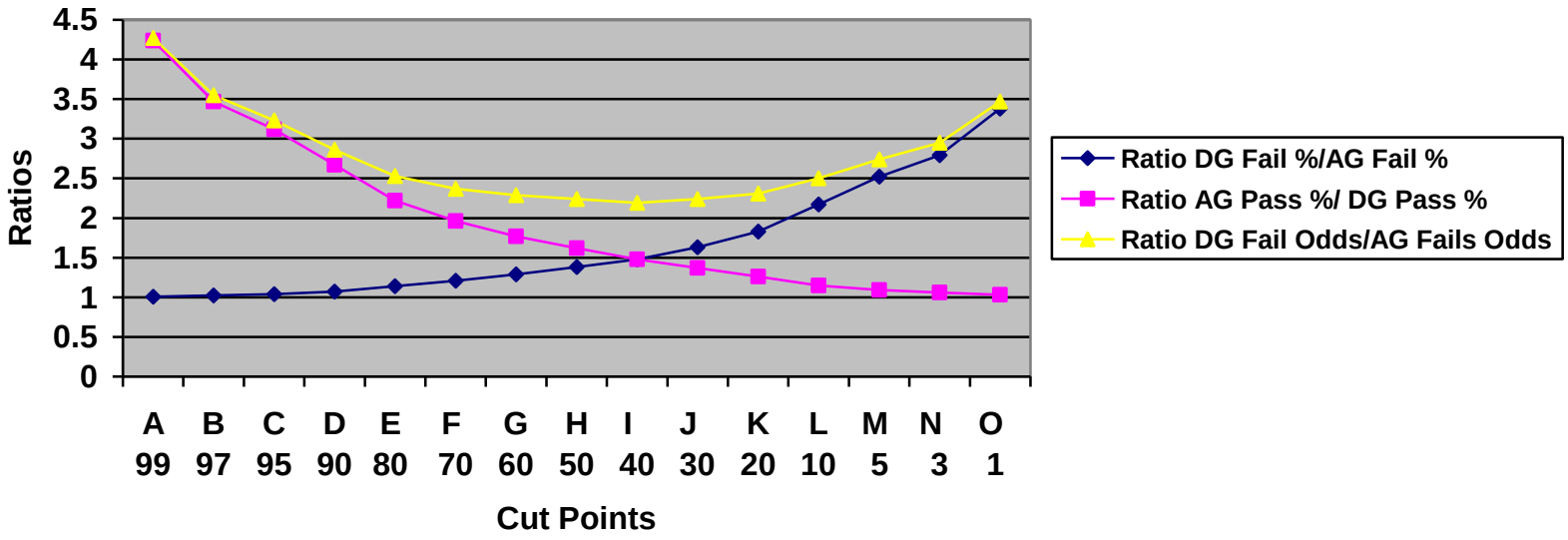

Figure 1 *Illustration of Changes in Relative Failure Rates, Relative Pass Rates, and Odds Ratios Based on Data in Table 1*

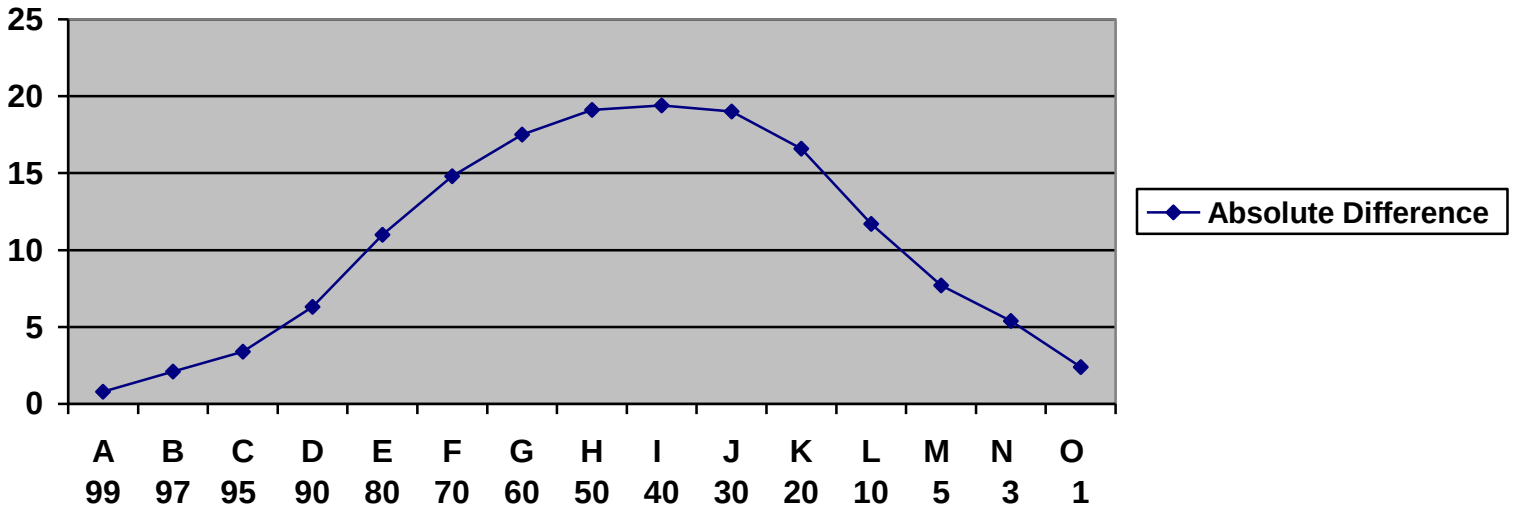

Figure 2 *Illustration of Changes in Absolute Differences at Fifteen Cut Points Based on Data in Table 1*