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Understanding the ways factors tend to increase outcome rates proportionately more among groups with lower base rates

The finding by Thurston et al.[1] that the socioeconomic gradient in cardiovascular disease is greater for women than for men must be appraised with a recognition of the tendency whereby the rarer an outcome, the greater the relative difference between rates of experiencing it and the smaller the relative difference between rates of avoiding it.[2-6] A corollary to that tendency is that a factor that increases the rate of experiencing an outcome tends to increase it proportionately more in the less susceptible group (that is, the group with the lower base rate for the outcome) while reducing the rate of avoiding the outcome proportionately more in the more susceptible group.[3-6]. For example, increasing a cutoff score on a test will tend to increase the failure rate of the higher-scoring group proportionately more than the failure rate of the lower-scoring group but reduce the pass rate of the lower-scoring group proportionately more than the pass rate of the higher-scoring group; increasing poverty will tend to increase the white poverty rate proportionately more than the black poverty rate but reduce the black rate of avoiding poverty proportionately more than the white rate. The same patterns would tend to occur if some factor caused a general reduction in test performance or a general reduction in income. In such circumstances, neither the proportionately larger increases in one outcome rate for one group nor the proportionately larger decrease in the opposite outcome rate for the other group should be regarded as indicating that the factor affects one group more than another in some meaningful way – that is, by modifying the risk distribution of one group more than the other.

Examples of the standard patterns are common enough. Data from the United Kingdom show, for example, that being in Social Class V compared with Social Class I increases mortality proportionately more among younger age groups (where mortality is lower) but decrease survival rates proportionately more among older age groups.[7] (e.g., 1991 data from Table 4.13 at 133). Correspondingly, age increases mortality proportionately more among Social Class I (where mortality is lower) but reduces survival proportionately more among Social Class V. In the United States, where mortality is lower among whites than blacks, age tends to increase mortality proportionately more for whites than blacks but reduce survival proportionately more for blacks than whites (at least from ages 45 to 74 for men and from ages 45 to 79 for women).[8]

There will be departures from these patterns, both because of irregularities in risk distributions and because some meaningful differential effects are strong enough to overcome the statistical tendencies. Among the notable of what seem to be the latter situations is the pattern referenced by Thurston et al. whereby the socioeconomic gradient in mortality is usually found to be greater among men than among women (even though mortality is lower among women). That lower socioeconomic status increases mortality more among men (the group with the higher base rate) than among women, because it is

a departure from the standard pattern of a greater increase among the group with lower base rate, would suggest that in a meaningful sense – that is, in the sense that the risk distributions of higher and lower socioeconomic status women are more similar than the risk distributions of higher and lower socioeconomic status men – lower socioeconomic status has a greater impact upon men than upon women.[3, 9]. Similarly, the data regarding blacks and whites in the United States underlying the point in the preceding paragraph show that within each group from 45-59, though mortality is lower among women, the racial difference in mortality rates is greater among men, as is the racial difference in survival rates, which would seem to indicate that racial difference in risk distributions is greater among men than women. Between ages 60 and 79, the racial difference in mortality is slightly larger for women, though the racial difference in survival rates continues to be larger for men. That does not mean that in these age groups, the black and white female risk distributions ceased to be more similar than the black and white male risk distributions. It merely means that such difference as there may be is insufficient to outweigh the statistical tendency for the relative risk in mortality to be greater in the gender where mortality rates are lower.

In the case of the potential differential effects of socioeconomic status on cardiovascular disease risk of men and women addressed by Thurston et al., since the described patterns of relative risk are what one would expect simply because cardiovascular disease is less common among women, the larger relative risk among women cannot by itself support a conclusion that the risk distributions among higher and lower socioeconomic groups are more dissimilar among women than among men. The article does not present absolute risk information. Hence, it is not possible to determine whether lower socioeconomic status caused a proportionately greater decrease in survival rates among men or among women. If it caused a greater decrease in rates of avoiding cardiovascular disease for women than men, such fact would tend to support an inference that lower socioeconomic status affected the female cardiovascular risk distribution more than the male cardiovascular risk distributions. But if there exists the more common pattern whereby the lower socioeconomic status reduced the rates of avoiding cardiovascular disease more for the group with the lower base rates of avoiding cardiovascular disease, such pattern would be equally consistent with (a) the absence of a meaningful differential effect, (b) a meaningfully greater effect upon men or (c) a meaningfully greater effect upon women (though, in case (b) or (c), a differential effect not sufficiently large to outweigh the purely statistical tendencies).

Finally, in considering issues of differential effects, it would be useful also to keep two things in mind. First, where two groups have different base rates, there is no reason ever to expect a factor to have the same relative effect on outcome rates of each group (save by happenstance). Indeed such expectation would be illogical. For certainly there is no more reason to expect a factor to cause an equivalent proportionate increase on both groups' rates of one outcome (say, mortality) than there is to expect it to cause an equivalent proportionate decrease in rates of the opposite outcome (survival), and it is mathematically impossible to do both (as should be evident from the tables in references 2,3, and 5, and as shown in a simple example in reference 9). Hence, one should be very

cautious about attaching significance to the any observed lack of equivalence in the effect of some factor on the rates of two groups with different base rates.

Second, when one observes an apparent differential effect of a certain magnitude (for example, where a factor increases a rate for the less susceptible group twice as much as for the more susceptible group), and one is able to conclude that the apparent differential effect was a meaningful one (say, because the less susceptible group also experienced a larger proportionate decline in the rate of avoiding the outcome), that does not mean that the magnitude of the differential effect is what it seems. Rather, some part, and perhaps the overwhelming majority, of the differential will be a function of the tendency for the less susceptible group generally to experience a larger increase. The opposite, of course, holds for the appraisal of the magnitude of a change that departs from the standard pattern. Thus, for example, in the case of the seeming larger effect of lower socioeconomic status on mortality among men than among women that we might infer to be a meaningful one on the basis of the departure from the standard pattern, the true magnitude of the differential effect is larger than it appears, since it has been somewhat offset by the statistical tendency for the relative difference in mortality to be larger among women.

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