SERIES ON STATISTICS

Risk Interpretation, Perception, and Communication

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IN A RECENT STATISTICS EDITORIAL, I DISCUSSED THE definition of a disease risk and various ways of comparing risks across groups.[1] Beyond the necessary statistical tools to estimate and compare risk, as health professionals we need to understand how physicians, counselors, and the general public understand and interpret risk information. The success of scientific studies on risk factors and appropriate interventions depends on a researcher's skills in appropriately interpreting risk from data sources, communicating that risk effectively, and on consumers perceiving the information correctly.[2] In passing, note that researchers may use subtle alternatives to risk—for example, expected years of life lost, or quality of life measures—to quantify comparison of different exposure groups, concepts that may carry different implications and interpretation.

SIZE MATTERS

AS DISCUSSED IN MY EARLIER EDITORIAL, IT IS IMPORTANT to stress the size of an underlying risk when making comparative statements, particularly when relative measures such as relative risk and odds ratio are used.[1] There is extraordinary variation in how people perceive risks associated with various actions or exposures and a considerable tendency to overestimate risks in many situations and occasionally to underestimate them.

Albeit self-evident, it is important to stress that size matters when discussing risk.[3] If I tell you that routinely eating a certain food doubles your intake of a certain toxin, your first question should focus on how much of the toxin you already consume. So it is with risk–doubling a very small risk may not cause much concern or necessarily induce significant lifestyle changes, whereas doubling a sizable risk ought to stimulate discussion on how this increase in risk can be avoided.

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RISK INTERPRETATION

TO EMPHASIZE THE IMPORTANCE OF UNDERSTANDING THE level of risk, recall recent media accounts of the mortality effects of eating red meat.[4] It was widely reported, for example, that the (adjusted) mortality risk for males, aged 51 to 70 years, increased by 31% over 10 years of follow-up when comparing the highest quintile of red meat eaters with the lowest quintile. Translating this difference into easily accessible information is important but requires additional information and calculation: in this case, the estimated (unadjusted) excess risk[1] of 0.11 over the 10 years (or 0.011 per year) suggests that, among 100 high red meat consumers, approximately one fewer men (in this age group) would die per year if they all changed to the lowest level of red meat consumption. This manner of counting and describing risk is usually absorbed more easily.

RISK PERCEPTION

IN EVERY ASPECT OF OUR LIVES, WE TOLERATE A CERTAIN level of risk in part because many fruitful activities necessarily involve the possibility of harm. You can avoid death from airplane crashes if you refuse to fly; for many, however, the low risks associated with flying are more than offset by the convenience, advantages, and pleasure associated with travel. However, there is considerable research on how and why individuals fail to perceive or assess risks accurately. Of course, very small risks rarely should worry us, particularly if avoidance significantly decreases the quality of our lives. This year in the United States, more than 300 people will die in their bathtubs, and more than 300 will die as a result of falling off ladders, at least if past causes of mortality hold true. However, this information will not prevent most of us from taking a bath or using a ladder, albeit after taking simple precautionary measures to mitigate even these low-risks. However, ignoring what we eat and how much we exercise can change our future well-being significantly because risks of serious cardiovascular outcomes are considerably higher.

Individuals often tacitly estimate a risk by anchoring their estimate to a familiar outcome. Although this is a common view of how individuals assess unfamiliar risks, it is also clear that we often make ineffective modifications when moving from an anchor to the outcome in question.

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Providing clear and useful contextual benchmarks for risk may be useful in communication. For example, in my classes, although students are well aware of the increased risk of infant mortality (death in the first year of life) as compared with the rest of childhood and young adulthood, very few can quantify accurately the actual size of the risk. I find it useful to point out that, for males, for example, mortality risk in the first year of life is roughly equal to 1-year mortality for a 60-year-old.[5] This observation benchmarks the risk into something more comprehensible without actually having to remember the actual size of the risk. Care must always be taken in choosing an appropriate and relevant risk comparison.[6]

Individuals tend to overestimate risks that they hear about more frequently. Thus, we tend to exaggerate the risks of shark attacks because the latter are almost always widely reported in the press. This is an important current issue given that many individuals often assess the risks of surgical procedures, for example, by turning to internet sources where bad outcomes are much more likely to be reported than good ones.

Extensive literature on risk perception also has illuminated other natural tendencies: to underestimate risks associated with activities we enjoy while overestimating risks for those we dread; to overestimate risks we are exposed to involuntarily (eg, pesticides in food, air quality) as compared with activities we choose. For example, individuals tolerate the risk associated with skiing while objecting to the potential adverse effects of food preservatives, even though the risk of injury from skiing is roughly 1,000 times higher.[7] Finally, we tend to be risk averse when gains are involved and to be risk takers when we face losses ("It won't happen to me"). This latter issue is particularly relevant to health promotion messages that tend to focus on avoiding bad outcomes rather than promoting good results.

COMMUNICATING RISK NUMBERS AND COMPARISONS

HOW, THEN, SHOULD WE REPORT RISK INFORMATION IN scientific articles? Basing risk comparisons on counts rather than on relative comparisons, as in the meat eating and mortality example above, is a good place to start, because this information usually is better understood by general consumers.

Paradoxically, note that small increases in risk at an individual level can translate into important effects in large populations. For example, having one extra alcoholic drink a day is thought to raise a woman's risk of breast cancer by approximately 6%, perhaps not necessarily large enough to modify behavior. (To use the counting approach already noted, an additional approximately 1 in 200 women would suffer from breast cancer if they all increased their alcohol consumption by 1 drink per day.) However, at the population level, an increase—or decrease—of 6% in breast cancer incidence is an important effect. This raises challenges for health promotion efforts focused on individual behaviors.

Finally, it is extremely beneficial for health communicators to provide widely available assessments of risk. As an example, a recent report[8] provided 10-year mortality risks for men and women (smokers and nonsmokers separately) of all age categories. This simple information allows individuals to understand easily the various risks they face and to use this information to make lifestyle choices. These charts exhibit certain facts clearly: for nonsmoking men older than 50 years, the risk of death as a result of cardiovascular causes is more than three-fold greater than the risk of death from the 3 major cancers (lung, prostate, and colon) combined: for example, at age 50 years, the 10-year cause-specific mortality risks are 12 per 1,000 men for cardiovascular causes and 4 per 1,000 for the 3 primary cancers; at age 70 years, these same 10-year mortality risks are 105 and 28 per 1,000 for cardiovascular causes and the 3 cancers, respectively.

For male smokers, however, the risk of death as a result of lung cancer and other lung diseases is roughly the same as the risk resulting from cardiovascular causes. Again, at age 50 years, the 10-year cause-specific mortality risks are 34 per 1,000 men for cardiovascular causes and 21 per 1,000 for lung diseases; at age 70 years, these same 10-year mortality risks are 126 and 158 per 1,000 for cardiovascular causes and lung diseases, respectively.

For a nonsmoking woman, however, cardiovascular and breast cancer mortality risks are approximately the same until postmenopausal ages (older than 60 years) where cardiovascular risks completely overwhelm the risk of death resulting from breast cancer. For example, at age 50 years, the 10-year cause-specific mortality risks are 5 per 1,000 women for cardiovascular causes and 4 per 1,000 for breast cancer; at age 70 years, the 10-year mortality risks are now 60, and 9 per 1,000 for cardiovascular causes and breast cancer, respectively.

While we have used easily recognizable examples, the above ideas apply equally well to risks associated with ophthalmologic conditions and exposures.

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