Accuracy of Perceptions of Heart Attack Risk: What Influences Perceptions and Can They Be Changed?

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Abstract: Using perceived risk of a heart attack, we examined the relative importance of perceived risk factors and sociodemographic variables on subjects' perception of heart attack risk, the relationship between perceived and objectively measured heart attack risk, and the effect of health risk appraisal (HRA) feedback on risk perceptions. Data derive from a random sample of 732 Greater Boston, Massachusetts area men and women ages 25–65 years, who participated in a field trial of health risk appraisal instruments. At baseline and approximately two months later, all respondents completed a questionnaire assessing their own health-related behavior, risk factors, and perception of heart attack risk. At baseline, respondents also completed one of four HRA instruments. Physiologic measures of cholesterol, blood pressure, and weight were taken at either baseline or follow-up visit. Results showed that respondents used established risk factors in estimating overall risk; that compared to objective measures of risk, a high percentage of respondents displayed an optimistic bias; and that HRA feedback had some effect on perception of heart attack risk for those at high risk. Implications of these results for health promotion are discussed. (*Am J Public Health* 1989; 17:1608–1612.)

Introduction

A person's beliefs about his or her perceived susceptibility to a condition or disease figure prominently in models of health behavior such as the Health Belief Model,[1,2] the Theory of Reasoned Action,[3] Subjective Expected Utility Theory,[4,5] and Protection Motivation Theory.[6,7] These models assume that perceived susceptibility (also referred to as vulnerability or risk) is essential in motivating behavior.

Previous research, however, has shown that people tend to underestimate their own risk of developing certain conditions or diseases[8–17]—or they have what Weinstein[13] refers to as an "optimistic bias." This underestimation has important implications for health promotion and behavior change programs. If people do not perceive themselves as vulnerable to a disease or condition, they are less likely to adopt recommended behaviors.[1,18] It is therefore important to understand what determines a person's perception of risk and how these perceptions can be made more realistic.

Most of the research on perceived susceptibility uses comparative risk judgments to examine how people compare their risk for a particular condition or disease to that of their peers.[8–10,13–16] This method, however, does not address the accuracy of an individual's risk perception. In an attempt to examine this issue, Weinstein conducted two studies[15,16] in which an individual's comparative risk judgments were correlated with his or her relevant risk factors. Weinstein found that these associations were often weak or nonexistent. However, the measures of risk factors lacked precision and were based only on self-report. In addition, each risk factor was separately correlated with perceived risk, rather than combined to form an overall estimate of risk. One purpose of this study is to use epidemiologically based models to examine the relation between perceived risk and objectively measured risk for heart attacks.

Optimistic biases may have several sources. They may be due to cognitive errors (e.g., lack of information or experience with a condition) or motivational needs (e.g., self-esteem enhancement or defensive denial).[16] To the extent that they result from cognitive errors, individualized feedback about risk may overcome these biases. Health risk appraisal instruments (HRAs) are designed to estimate a person's mortality or morbidity risk for various diseases based on characteristics such as medical history, blood pressure, and smoking habits.[19] One of the goals of HRAs is to provide risk-related feedback that will enable a person to reduce risk in areas amenable to modification.[20] Another purpose of this study is to examine the effect of individualized risk feedback on risk perception.

Methods

Procedure and Sample

The data used in this study were collected during a field trial of health risk appraisal instruments conducted by the Cambridge Research Center of the American Institutes for Research in 1987. Detailed descriptions of the procedure and sample characteristics are reported in the article in this issue by Smith, McKinlay, and McKinlay.[21] Briefly, respondents were identified through random digit dialing of residential households in 15 neighborhoods and towns in the Boston metropolitan area. Eligibility was restricted to adults between the ages of 25 and 65 who did not have a history of coronary heart disease, diabetes, or hypertension. Following a telephone screening, baseline interviews were conducted by trained field technicians in respondents' homes. After completion of the baseline interview, respondents were randomly assigned to complete one of four risk appraisal (HRA) instruments (CDC, Arizona Heart Test, RISKO, and Determine Your Medical Age), or were assigned to a "no HRA" condition. (See Smith, *et al*,[21] for details of the HRAs). Field technicians were not permitted to help respondents complete HRA items or compute risk scores. Follow-up home visits were conducted seven to 12 weeks after the baseline to monitor changes in health status, health practices, and medical care utilization. During one of the two home visits (randomly determined), technicians measured blood pressure, height and weight, and drew a venous blood sample for cholesterol analysis.

Measures

Perceived risk of heart attack or stroke was assessed by the question: "Compared with persons of your own age and

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sex, how would you rate your risk of having a heart attack or stroke within the next 10 years?" Respondents answered on a 5-point scale ranging from "much lower than average" to "much higher than average."

Respondent characteristics that might be related to perceived risk were divided into sociodemographic characteristics, self-perceptions of health, and cardiovascular risk factors. Sociodemographic factors included education, race, gender, and age (although gender and age can also be considered risk factors). Self-perception of health status was measured on a 5-point scale ranging from excellent to poor.

Cardiovascular risk factors were measured as follows. Family history of heart disease was based on having a biological parent die of heart disease or stroke before age 65. Smoking was based on self-report of how many cigarettes per day the person currently smoked. Self-report of smoking is generally thought to be reliable, especially for respondents who are not in a smoking reduction program.[22] All respondents who smoked at least one cigarette per day were classified as smokers. The Harvard Alumni Activity Scale,[23] which measures recreational physical activity in terms of kilocalories (kcal) expenditure per week, provided the measure of exercise. Stress was determined by the number of stressful events (e.g., death of partner or spouse, divorce, loss of job, major change in health of family member), as derived from the Holmes and Rahe Scale[24] that were reported by the respondent as occurring within the past two months. Self-reports of weight, cholesterol, and blood pressure as compared to average were also obtained.

Results

Perceived Heart Attack Risk

Almost 56 percent of the respondents rated their risk as lower than average, 29 percent rated it about average, and only 13 percent rated their risk as higher than average. With over half the respondents rating their risk as lower than average, these results support previous findings that people tend to rate their own risk as lower than that of their peers—that people have an optimistic bias. Although respondents were healthier than their peers because those with hypertension, diabetes, and other chronic diseases were excluded from the study, this optimistic bias is confirmed when compared to objective risk (see below).

To examine the relative importance of perceived risk factor status, sociodemographic factors, and perceived health in people's perception of heart attack risk, a multiple regression analysis was performed in which perceived risk of a heart attack reported at baseline was the dependent variable. These results show associations between perceived heart attack risk and the following risk indicators: number of cigarettes smoked, death of a parent due to heart disease; and self-assessments of weight, blood pressure and cholesterol compared to average levels (see Table 1). Neither amount of exercise nor number of recent stressful events was related to perceptions. These results suggest that people do make use of cardiovascular risk indicators in estimating overall risk. These risk factors accounted for 24 percent of the variance in perceived risk. Self-reported health and education were also positively related to perceived risk and, combined with the risk factors already included, accounted for 30 percent of the variance. The correlation between self-reported health and risk is partly a function of the way in which self-reported health was scored (i.e., a 5-point scale). The Pearson correlations between these variables and perceived risk show a pattern similar to the multiple regression, suggesting that multicollinearity is not a problem in this analysis.

TABLE 1—Results of Multiple Regression on Variables Related to Perceived Heart Attack Risk at Baseline

Variable	Unstandardized Regression Coefficient	S.E.
Self-reported risk factors		
Cigarettes smoked per day	.02	.00
Cholesterol relative to average	.24	.05
Weight relative to average	.23	.05
Death of parent due to CHD	.38	.10
Blood pressure relative to average	.19	.06
Exercise	−.03	.03
Number of recent stressful events	−.02	.06
Perceived Health	.34	.05
Sociodemographic Factors		
Education	.08	.03
Age	−.01	.00
Minority	−.22	.13
Female	.12	.08

Education was positively related to perceived risk in the regression model, yet had a negative Pearson correlation with perceived risk. Because Pearson correlations revealed that education was related to self-perceived health, exercise, smoking, and blood pressure, and because we thought education might modify these effects, we also performed a multiple regression that included the interactions between education and these variables. The only significant result was an interaction between education and smoking, such that those with more education who smoked perceived their risk to be greater.

Perceived and Objective Heart Attack Risk

The risk equation from the new Carter Center Healthier People HRA was used to obtain an objective measure of coronary heart disease risk.[25] This logistic risk model builds on the results of the Risk Factor Update Project but takes into account more recent epidemiological data from the Framingham Heart Study. The variables included in the logistic equation to predict mortality from myocardial infarction are: sex, total cholesterol, age, number of cigarettes smoked per day, systolic blood pressure, relative weight, HDL cholesterol, and presence of diabetes. Family history and exercise are not included in the model because it is thought that their effects operate through other risk indicators in the model (cholesterol, blood pressure, and weight).[25]

Because respondents were instructed to answer the risk perception question in comparison to other people of the same age and sex, we adjusted the objective measure of risk for age and sex. Each respondent received a risk ratio which was based on the logistic estimate from the model divided by the average risk for that person's age, sex, and race. A ratio of 1.0 meant a person was at average risk for his or her age, sex, and race.

Respondents were then classified as to whether they were at above average, average, or below average risk. A ratio below .75 was considered below average risk, .75 to 1.25 average risk, and over 1.25 above average. In order to create a symmetric distribution, these ratios were transformed onto a log scale, in which the cut-offs became ln(.75) and ln(1.33). These ratios represent equal "risk distances" from the null value of 0.0 on the log scale [$\ln(1.33) = -\ln(.75) = .29$]. Using this distribution, 39 percent of the respondents were classified as below average risk, 24 percent as having average risk, and 36 percent as above average risk.

Perceived risk was then compared with the objectively measured risk categories. In Table 2, the rows indicate the percentage of respondents in each risk perception category, while the columns indicate the percentage of respondents in each objectively measured category. Summing over cells, a total of 42 percent of the respondents underestimated their risk (15% + 17% + 10%), while only 18 percent (11% + 3% + 4%) overestimated risk, and 40 percent (25% + 9% + 6%) were accurate. Based on these results, when using an objective measure of risk, this analysis also found evidence of an optimistic bias—a high percentage of respondents underestimated their risk.

We next performed two logistic regressions: one to predict the probability that risk was overestimated (pessimists), and the other to predict underestimation of risk (optimists). Variables included as predictors were the same variables listed in Table 1 that were used to predict perceived heart attack risk. The variables associated with pessimism were death of parent due to heart disease (O.R. = 2.72, 95% CI = 1.52, 4.87), self-assessed health status (O.R. = 1.80, 95% CI = 1.25, 2.58), and age in years (O.R. = 1.06, 95% CI = 1.02, 1.08). Thus, pessimists were more likely to be in worse health, have had a parent die of heart disease, and be older. The result for death of a parent may reflect the fact that people give weight to this risk factor while the Carter Center model does not include it. The variables that predicted optimism were age (O.R. = .90, 95% CI = .87, .92) and education (O.R. = .80, 95% CI = .66, .98). Those who were younger and had less education were more likely to be optimists.

Effect of Health Risk Feedback

Table 3 shows the effect of feedback on *change* in perceived risk. In this table, the columns indicate the type of feedback received, while the rows indicate whether perceived risk increased, did not change, or decreased from baseline to follow-up. The numbers in parentheses are the percentage of respondents who did not change their perceptions and whose perceptions accurately reflected their HRA feedback. In reading this table, it is important to keep in mind that those who received feedback that they were below average risk should have either been accurate or decreased their perceived risk, while those who received feedback that they were above average risk should have either been accurate or increased their perceived risk.

As seen in Table 3, the majority of respondents did not change their risk perceptions. Those who changed the most received feedback that they were above average risk. They were more likely to increase their perceived risk (21.8 percent of those receiving above average feedback). This group, however, was also the least accurate in their risk perceptions. Those who received feedback that they were at below average or average risk, or did not receive any HRA feedback were as likely to increase their perceived risk as to decrease it. It should be pointed out that because respondents tended to underestimate their risk at baseline, there were more respondents in the "above average" feedback category with the potential to change. While HRA feedback had its greatest effect on those at above average risk, 12 percent of those with above average risk changed their perceptions in the opposite direction of the feedback.

To further explore whether receipt of HRA feedback altered risk perception, we looked at follow-up risk perception as a function of baseline risk perception, the same variables examined in the baseline risk perception analysis (this time using follow-up responses) plus HRA feedback. A multiple regression was performed in which follow-up risk perception was regressed on baseline risk, follow-up perceptions of risk factors, sociodemographic factors, perceived health, and HRA feedback. Feedback was measured by a scale relating HRA risk category to the respondent's initial perception. The respondent's initial perception was taken into account because feedback should only have an effect when it differs from the person's original perception. The feedback scale ranged from 1 to 5, where 1 meant the HRA risk category was much lower than the individual's perception, and 5 meant the HRA risk category was much higher than the respondent's perception.

These results, shown in Table 4, reveal only feedback from the Arizona Heart Institute (AHT) HRA had a significant impact on heart attack risk perception. Compared to the other three HRAs, the feedback from this HRA was presented in a concrete fashion directly related to heart disease risk. Respondents were clearly told that they were above average, average, or below average risk for developing heart disease. Thus, respondents may be more likely to understand and use the feedback from the AHT.

Risk Perception and Behavior

Although it was not a primary purpose of the study, because data on respondents' risk-related behavior were available, it was possible to examine the relationship between change in perceived risk from baseline to follow-up and corresponding behavior change. As previously mentioned, models of health behavior often assume a relationship between perceived susceptibility and behavior.[1-6] It follows from this assumption that increases in perceived risk should be related to risk-reducing behaviors. To address this issue,

TABLE 2—Relationship between Perceived and Estimated Risk as Measured by the Carter Center Model

Perceived Risk[a]	Risk Ratio Below %	Average %	Above %	Total
Lower than Average	25	15	17	57
Average	11	9	10	30
Higher than Average	3	4	6	13
Total	39	28	33	100
n	(226)	(138)	(205)	(569)

[a]As compared to persons of same age and sex.

TABLE 3—Relationship between HRA Feedback and Change in Perceived Risk

Change in Perceived Risk	HRA Feedback[a] No Feedback	Below Average Risk	Average Risk	Above Average Risk
Increase	16.9	10.4	14.9	21.8
No Change	69.7	78.7	74.5	66.3
(accurate)		(60.8)	(26.6)	(16.8)
Decrease	13.5	11.0	10.6	11.9
	100%	100%	100%	100%
n	89	347	94	101

[a]Scored 1 = below average, 2 = average, 3 = above average.

TABLE 4—Results of Multiple Regressions on Variables Related to Perceived Heart Attack Risk at Follow-Up

Variables	Unstandardized Regression Coefficient	S.E.
Baseline Risk Perception	.56	.04
Risk Factors		
Cholesterol relative to average	−.12	.04
Cigarettes smoked per day	.01	.002
Weight relative to average	.11	.04
Death of parent due to CHD	.11	.08
Blood pressure relative to average	.09	.05
Exercise	−.02	.03
Number of recent stressful events	−.05	.04
Self-reported health	.12	.04
Sociodemographic Factors		
Education	.03	.03
Minority	−.04	.10
Female	−.03	.06
Age	.003	.003
Health Risk Appraisal Feedback[a]		
CDC	.01	.07
RISKO	.07	.07
Arizona Heart Institute	.26	.10
Medical Age	.09	.07

[a]Scored relative to baseline perception of risk.

we looked at behavior change from baseline to follow-up as a function of change in risk perception. The behaviors we analyzed were: smoking, exercise, weight; self-reports of reduction in salt, fat, and calories; and recent blood pressure or cholesterol screening. Results showed that those who increased their perceived risk of a heart attack were no more likely to change their behavior than those whose risk perception either decreased or remained the same.*

Discussion

Our results showed that people do use established epidemiologic risk factors in estimating their overall risk of heart attack, but that additional factors also influence a person's risk perception. One such variable is self-perceived health status: those people who perceive their overall health as worse are more likely to rate their risk as higher. This finding is consistent with other research in which people who were sick estimated their risk for other illnesses as higher.**

Using an objective measure of individual risk, a high percentage of respondents exhibited an optimistic bias, providing additional support for previous studies.[9,10,13–16] Those who were younger and less educated tended to be more optimistic, consistent with suggestions that younger people feel less vulnerable to conditions or diseases.[16] The finding that family history of heart disease is associated with pessimism suggests that people weigh this factor heavily and is consistent with Becker and Levine's[8] study of high risk siblings of patients with coronary heart disease that found less optimistic bias than seen in other studies.

The effect of health risk feedback on risk perceptions was greatest for those who were above average in risk: twice the percentage of respondents who were above average risk *increased* their perceived risk. These findings suggest that HRA feedback can effectively change the perceptions of those at high risk. It is important, however, to add a cautionary note: 12 percent of those who received high risk feedback actually *decreased* their perceived risk and this above average group was the *least* accurate to begin with. Furthermore, the results of the multiple regression showed that only feedback from the AHT was significantly associated with change in risk perception. Clearly, feedback did not always have consistent effects on risk perception and these effects differed by HRA.

With respect to various explanations of the optimistic bias, to the extent that feedback had the desired effect on accuracy, the cognitive explanation of this bias is supported. However, it is also clear that information did not have the desired effect for the majority of respondents.

In the present study we did not find a relation between increases in perceived risk and behavior change. Although some models of health behavior predict a relation between perceived susceptibility and behavior,[1–6] support for this association is strongest for disease prevention behaviors that do not require modification of health habits.[26] Our behavioral measures consisted of changes in personal health habits such as smoking, diet, exercise, and weight. Models of health behavior also suggest that factors other than cognitions (e.g., social support, social norms and self-efficacy) may be important in health habit modification.[3,26,27] It should be pointed out, however, that this analysis was based on limited statistical power as only 87 respondents increased their perceived risk.

Two important aspects of this study need to be pointed out. One is that the logistic model of actual risk is based on mortality from heart attack, while respondents were asked about their chances of *having* a heart attack or stroke. It is possible that they may have responded differently if asked about their chances of dying from a heart attack or stroke, although we feel it is unlikely the respondents made this distinction. The other important point has to do with HRA feedback. Respondents were only given the feedback provided by the HRA and did not receive any additional counseling or education, as is often done with HRAs. In some cases, respondents may not have understood the feedback.*** Thus, HRAs may not be effective for use in mass screenings, but may have a greater effect on risk perception when feedback is easier to understand, or when they are given in conjunction with a health education program, a conclusion also drawn by Schoenbach, *et al,*[28] in a review of the effectiveness of HRAs.

In conclusion, this study suggests that people do make use of established risk factors in estimating cardiovascular risk; that compared to objective measures of risk, a high percentage of people display an optimistic bias; and that risk feedback has some effect on risk perception for those at high risk, but such feedback is not optimally effective.

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*Data available on request to author.

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NCHSR Grants $4 Million for Patient Outcome Research

The National Center for Health Services Research and Health Care Technology Assessment (NCHSR) has awarded new grants totaling nearly $4 million in first-year costs in a series that will measure the effectiveness of alternative medical procedures in treating specific health conditions. Total spending on the nationwide DHHS program will be $5.9 million this fiscal year, with $52 million proposed for FY 1990.

The new grants will support research for treatment of conditions that affect a large number of Americans every year—prostate gland enlargement, heart attack, cataracts, and lower back pain—for which millions of Medicare beneficiaries are treated every year. The research projects—expected to require about five years to complete—will assess comparative effects of alternative therapies on patient survival, quality of life, costs, and other factors. Research teams will consist of practicing clinicians and other experts.

Grants to support patient outcome research assessment teams were awarded to:

Richard Deyo, MD, University of Washington ($896,049), nonsurgical interventions for low back pain and different types of lumbar surgery;

Barbara J. McNeill, MD, Harvard Medical School ($900,000), for a national data base for outcomes from myocardial infarction treatment;

Earl P. Steinberg, MD, Johns Hopkins University ($899,986), assess cataract procedures;

John E. Wennberg, MD, Dartmouth Medical School ($933,535), transurethral resection, open prostate surgery, and nonsurgical interventions for enlargement of prostate gland.

Planning grants of $50,000 each awarded to seven research teams included:

Fred Featherstone, MD, American Academy of Orthopedic Surgery, hip replacement/disease; *Alvan Feinstein,* MD, Yale University, use of colonoscopy; *Emmett B. Keeler,* PhD, Rand Corporation, treating peripheral vascular diseases; *David B. Matchar,* MD, Duke University, prevention and management of stroke; *Lawrence W. McMahon, Jr.,* MD, University of Michigan, use rates and appropriateness of cholecystectomy, and screening/treatment for colon cancer; *David B. Pryor,* MD, coronary artery disease; and *Sanford Schwartz,* MD, University of Pennsylvania, gallstone disease.

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