Perceived Effectiveness among College Students of Selected Statistical Measures in Motivating Exercise Behavior

Ray M. Merrill, Amanda Chatterley and Eric C. Shields

ABSTRACT

This study explored the effectiveness of selected statistical measures at motivating or maintaining regular exercise among college students. The study also considered whether ease in understanding these statistical measures was associated with perceived effectiveness at motivating or maintaining regular exercise. Analyses were based on a cross-sectional survey of 546 students. Students identified the total number of disease cases as the most effective measure for motivating behavior change, followed by the risk ratio of developing disease, percentage of disease cases, ratio lifetime risk of developing disease, percentage lifetime risk of developing disease, and then lethality. The ordering of these statistical measures in terms of ease in understanding was total number of disease cases, risk ratio, percentage of disease cases, ratio lifetime risk, lethality, and finally percentage lifetime risk. Students who identified total number of disease cases as the best statistical measure for motivating behavior change were also significantly more likely to identify that measure as the easiest, of those considered, to understand. Likewise, students tended to consider the statistical measure they perceived as being easiest to understand as the best measure for motivating behavior change.

INTRODUCTION

Statistical measures that characterize the risk or burden of disease and health-related events are pervasive in scientific literature and the media/popular press.[1-3] Public health practitioners commonly use statistical measures as part of their health message. Through effective health communication, individuals can make informed health behavior choices based on the facts. Yet among the many statistical measures available to health educators (e.g., means, counts and rates), it remains unclear how effective they are at motivating behavior change. Despite the extensive use of health statistics, few formal studies have been conducted to determine the effectiveness of these health statistics in motivating behavior change.

Many behavior change models are based on the belief that knowledge itself is not a motivating factor in changing problem behaviors. This is a widely accepted premise in health behavior change theory.[4] According to the cognitive-motivational Health Belief Model, behavior change requires a rational decision-making process that considers perceived susceptibility to illness, perceived consequences or seriousness of the illness, belief that recommended action is appropriate or efficacious to reduce risk, and belief that the benefits of action outweigh the costs.[5-7] For example, an individual may be aware of potential adverse health outcomes associated with physical inactivity, such as obesity, cardiovascular disease and cancer, but unless these health outcomes are perceived to be personally threatening and serious, the potential benefits from becoming physically active may not outweigh the perceived costs of this behavior.

Social marketing is a consumer-oriented approach that attempts to develop effective interventions from consumer inputs. In the context of exercise among college students, for example, it seems reasonable that the students would be best able to identify the

Ray M. Merrill, PhD, MPH, MS, is associate professor, Department of Health Science, Brigham Young University, 229-A Richards Building, Provo, Utah 84602; E-mail: Ray_Merrill@byu.edu. Amanda Chatterley, MPH, and Eric C. Shields, BS, are with the Department of Health Science, 221 Richards Building, College of Health and Human Performance, Brigham Young University, Provo, Utah, 84602.

factors that would motivate them to be physically active. Perhaps their primary concerns are that a lack of exercise might lead to excessive weight gain, poor body image and an inadequate social life. A health educator could then use this information to develop an effective exercise promotion program tailored specifically to college students. The health message may choose to focus on the potential health benefits of behavior change[8,9] or may use fear appeals, which are messages that attempt to motivate action by delineating the negative consequences of inaction.[10-13] Research has shown that a health message that incorporates well-planned fear tactics is likely to be effective because it conveys reality, is clear and thought-provoking.[14]

It seems likely that including statistical measures in the health message that characterize the potential health consequences associated with selected behaviors can improve the persuasive power of the message. These health statistics may provide an accurate description of the level of risk associated with a given behavior such that informed decisions can be made when considering the costs and benefits associated with the behavior. The health literature is replete with health messages that include statistical measures that convey risks associated with physical inactivity. For example, the World Health Organization indicates that being physically inactive increases one's risk of coronary heart disease and ischemic stroke by approximately 1.5 times, and that worldwide physical inactivity causes about 1.9 million deaths, 20% of cardiovascular disease and 22% of coronary heart disease.[15] A social marketing approach that attempts to obtain consumer input from a specific audience may also identify the statistical measure(s) that are most effective at motivating behavior change in this population.

The purpose of this study was to identify statements, each containing a different type of statistical measure, most likely to motivate increased levels of exercise or maintain regular exercise among a group of undergraduate college students. Selected statistical measures considered are total number of cases, percentage of cases, risk ratio, percentage lifetime risk, ratio lifetime risk and lethality. We also evaluated whether an association existed between the statistical measure identified as most likely to motivate increased levels of exercise or maintained regular exercise and the perceived ease in understanding the measure. The statistics considered in this study are presented in statements explaining how lack of exercise may be associated with depressive disorders, obesity or poor social life. Each of these conditions has been previously associated with physical inactivity[16] and identified as a concern to young people.[17]

METHODS

Questionnaire

A cross-sectional study design was used. The questionnaire included sections on demographics, stages of change for exercise, motivational statements for exercise and statistical health measures. The demographics section asked questions about age, sex, race/ethnicity, marital status, academic major, whether they had previously taken a basic statistics course, and the percentage of time the health messages they observed in the media/popular press included statistical measures. The students' stage of change[4,18] section of the questionnaire began by defining regular exercise as at least 30 minutes of exercise per day, 3 to 5 days per week. A multiple-choice question was then asked with the options: I currently do not exercise and do not intend to start exercising in the next six months; I currently do not exercise, but am thinking about starting to exercise in the next six months; I currently exercise some, but not regularly; I currently exercise regularly, but have only begun doing so within the last six months; and I currently exercise regularly and have done so for longer than six months. The next section presented six motivational statements for moving individuals through the stages of change for exercise or motivating them to maintain regular exercise. The first three statements used risk ratios and associated lack of exercise with depression, obesity and poor social life, respectively. For example, the first statement said: "Adults who do not exercise regularly are twice as likely to have symptoms of depression as are those who do exercise regularly." The second three statements used percentages and associated lack of exercise with depression, obesity and poor social life, respectively. For example, the fourth statement said: "15% of adults who do not exercise regularly suffer from depression." Responses to each of these statements ranged from 1 (Strongly Disagree) to 7 (Strongly Agree). The final section presented six statements about depressive disorders, with a different type of statistical measure in each statement. The selected statistical measures for this section are commonly observed in the media/popular press and scientific literature. They included total number of cases, percentage of cases, risk ratio, percentage lifetime risk, ratio lifetime risk (e.g., 1 in 18 will develop chronic, mild depression in one's lifetime) and lethality. Students were asked to rank these statistical measures according to their perceived ability to motivate increased exercise or to encourage maintenance of regular exercise. Students were also asked to rank these statistical measures according to their understandability.

Ten doctoral-trained experts in survey design, statistical methods and health behavior change research examined the questionnaire to establish face and content validity and that the instrument supported predictions based on established theories. Cronbach's standardized coefficient alpha was used to indicate how well the six motivational statements for exercise correlated with one another. The resulting alpha of 0.87 indicated high correlation. The study was approved by the Internal Review Board at Brigham Young University.

Participants

The questionnaire was administered in all (n = 23) 300 and 400 level health science undergraduate classes offered at Brigham Young University during winter semester, 2003. The authors administered the questionnaire at the beginning of the class period. No personal identifying information

was collected on the questionnaire. Students were told that the questionnaire was meant to obtain information about their behaviors and attitudes related to exercise. They were also told that completing the questionnaire was voluntary, that their responses would remain anonymous, and that the estimated time of completion was 5 to 10 minutes. No student refused to participate. Five hundred forty-six students completed the questionnaire.

Data Analysis

Frequency distributions, multivariate analysis of variance (MANOVA) and analysis of covariance (ANCOVA) were employed to summarize and describe the data. Means were statistically evaluated for significant difference based on Student's *t* and *F* statistics. Bivariate analyses of discrete variables were statistically evaluated for independence based on the χ^2 statistic. Assessment of significance of the global effects of selected variables in the MANOVA was based on Wilks' lambda. Evaluation for significance of selected variables in the ANCOVA was based on the *F* statistic under Type III Sums of Squares. Data were analyzed using the Statistical Analysis System (SAS) for personal computers, release 9.0 (SAS Institute Inc., Cary, NC, USA, 2003). All tests of significance were based on the 0.05 level.

RESULTS

Of the 546 students participating in the study, the mean age was 22.3 years (*SD*=3.7; *Range* 18-51). A majority of students were aged 20-23 years (68%); women (79%); White, non-Hispanic (93%); never married (69%); of majors other than community or school health education (56%); and had taken a basic statistics course (61%).

The mean percentage of health messages including statistical measures, according to that observed by the study population in the media/popular press, was 67% (*SD* = 24%). The mean percentage of health messages observed to contain statistical measures did not significantly differ among majors (F = 2.4, p = 0.09). The median percentage of health information observed by the students in the media/popular press that included statistical measures was 75% (*Range* = 0 to 100). Students were asked to indicate their level of agreement, on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree), with whether selected statements would motivate them to move from one stage of exercise behavior to the next or to continue exercising regularly. The mean level of agreement with each of the six statements is presented in Table 1. The first three statements involved risk ratios and the second three statements involved percentages. Statements 1 and 4 indicate the protective effect exercise has against depression; statements 2 and 5 indicate the protective effect exercise has against obesity; and statements 3 and 6 indicate the protective effect exercise has against a poor social life. Multivariate analysis of variance showed there was no overall effect of student's majors, having taken a statistics class or demographic variables on agreement with the statements presented in the table (Wilks' Lambda p-value > 0.05).

Mean level of agreement with statements involving risk ratios was compared with statements involving percentages. On the basis of mean difference scores, statements involving risk ratios were significantly preferred over statements involving percentages (Table 2). This was true for all the statements taken together as well as within topics (i.e., depression, obesity and social life). The stronger preference for risk ratios was smallest for obesity, which may be because of the relatively large percentage presented. Although stage of change for exercise among the students was significantly positively as-

Table 1. Level of agreement with selected statements for motivating increased exercise or maintenance of regular exercise

This statement would motivate me to move from one stage of exercise behavior to the next:	Mean (SD)	Median (Range)
1. Adults who do not exercise regularly are twice as likely to have symptoms of depression as are those who do exercise regularly.	5.31 (1.57)	6 (1, 7)
2. Adults who do not exercise regularly are four times as likely to be obese than are those who do exercise regularly.	5.34 (1.66)	6 (1, 7)
3. Single adults who do not exercise regularly are half as likely to feel good about their social lives as those who do exercise regularly.	4.95 (1.53)	5 (1, 7)
4. 15% of adults who do not exercise regularly suffer from depression.	4.84 (1.44)	5 (1, 7)
5. 63% of adults who do not exercise regularly suffer from obesity.	5.19 (1.57)	5.5 (1, 7)
6. 17% of adults who do not exercise regularly feel good about their social lives.	4.43 (1.41)	4 (1, 7)

sociated with agreement with each of the statements (Student's *t*-statistic p-values < 0.002), the stage of change was not significantly associated with mean difference scores (*F*-statistic p-values > 0.05), indicating that preference for the risk ratio versus the percentage was consistent across the stages of change for exercise.

Students were then asked to select the statement they thought would best motivate increased or maintained regular exercise from six statements involving the relationship between exercise and depressive disorders, with each statement containing a specific type of statistic (Table 3). The most commonly selected statement involved the total number (18.8 million), followed by the risk ratio (twice as many), then the ratio lifetime risk from age 18 onward (1 in 18), then the percentage (9.5%), then the percentage lifetime risk from age 18 onward (5.4%), and then lethality (2% commit suicide). Preference of statistical measure was not associated with stage of change for exercise [$\chi^2(20) = 23.22$, $p = 0.28$]. Students were also asked to rank these statistics from easiest (= 1) to most difficult (= 6) to understand (Table 4). The statistic most frequently selected as easiest to understand was the total number (18.8%), followed by the risk ratio (twice as many), then the percentage (9.5%), then the ratio lifetime risk from age 18 onward (1 in 18), then lethality (2% commit suicide), and finally percentage lifetime risk from age 18 onward (5.4%).

Using multivariate analysis of variance, an overall mean order effect on these statements was observed for sex (Wilks' lambda $p = 0.02$), marital status (Wilks' lambda $p < 0.01$), and having had a basic statistics course (Wilks' lambda $p = 0.05$). Adjusting for these variables, the mean rank order assigned to each of these six statements is presented according to the type of statistic thought to be most effective in motivating increased exercise or maintained regular exercise in Table 5. Mean rank order assigned to total number (18.8 million) was significantly lower (i.e., easier to understand) than for each of the other statistics among those who identified this as the most effective statistic for motivating increased exercise or maintained regular exercise. In general, when individuals identified a statistic as most effective for motivating increased exercise or maintained regular exercise, they also identified that statistic as easiest to understand.

DISCUSSION

The Health Belief Model indicates that behavior change requires knowledge in ad-

Table 2. Mean difference in the level of agreement between statements involving risk ratios and statements involving percentages

	Depression Statements (1 vs. 4)	Obesity Statements (2 vs. 5)	Social Life Statements (3 vs. 6)	All Statements (1, 2, 3 vs. 4, 5, 6)
Mean Difference	0.47	0.15	0.52	1.14
Standard Deviation	1.30	1.08	1.51	2.76
Student's t	8.38	3.29	8.01	9.66
P value	< 0.0001	0.0011	< 0.0001	< 0.0001

Table 3. Number and percentage identifying selected statements as best for motivating increased exercise or encouraging maintenance of regular exercise

	N	%
Approximately 18.8 million American adults experience depressive disorders.	182	34.08
Approximately 9.5% of American adults experience depressive disorders.	68	12.73
Nearly twice as many women as men suffer from depressive disorders.	157	29.40
The chance of experiencing chronic, mild depression for an American from age 18 onward is approximately 5.4%.	27	5.06
The number experiencing chronic, mild depression for an American from age 18 onward is about 1 in 18.	73	13.67
Approximately 2% of American adults with depressive disorders commit suicide each year.	27	5.06

Source: National Institutes of Mental Health: The Numbers Count: Mental Illness in America. Science on our Minds Fact Sheet Series. 2001. URL: http://www.nimh.nih.gov/publicat/numbers.cfm.

Table 4. Mean order assigned to selected statistics from easiest (= 1) to most difficult (= 6) to understand

	Total Number (18.8 million)	Percentage (9.5%)	Risk Ratio (Twice as many)	Percentage Lifetime Risk From Age 18 Onward (5.4%)	Ratio Lifetime Risk From Age 18 Onward (1 in 18)	Lethality 2% (Commit Suicide)
Mean (SD)	2.40 (1.66)	2.98 (1.35)	2.91 (1.57)	4.50 (1.40)	4.02 (1.63)	4.06 (1.57)
Median (Range)	2 (1, 6)	3 (1, 6)	3 (1, 6)	5 (1, 6)	4 (1, 6)	4 (1, 6)

dition to consideration of other factors.[6] The knowledge component of this study was provided through a series of comments involving statistics. These statistics related the potential protective effect of exercise against depression, obesity and poor social life, with these outcomes selected because of their relevance to our study population. Of interest was whether certain statistical measures were more effective than others at motivating increased exercise or helping maintain exercise behaviors.

The few previous studies that have examined the relative effectiveness of statistics have focused on cancer patients and survival data and the use of absolute risk (probability a disease or health-related event will occur in a given time period) versus relative risk (ratio of the absolute risk of a disease or health-related event among an exposed group compared with an unexposed group). In general, absolute risk is preferred to relative risk when health care workers are sharing information with patients, because relative risk tends to exaggerate the short-term benefits and risks of a treatment while downplaying longer term effects.[19,20] The differential effect of these statistics in motivating behavioral decisions was demonstrated in a survey of patients attending a general medicine out-patient clinic. Participants were asked to choose between two equivalent drugs to treat a hypothetical disease, with the benefits of one described in relative terms and the other in absolute terms. Although the drugs were equally efficacious, a dramatically larger proportion of participants indicated that they would take the drug whose benefits were explained in relative terms, presumably because the benefits were perceived as being larger when they were framed in relative terms.[21] Preventing this framing bias by using the absolute risk will help patients make more informed decisions regarding their care.[20]

In a focus group discussion of health statistics and data presentation issues, absolute risks were preferred over relative risks, and the lifetime risk was preferred over shorter term risk estimates.[19] In focus groups of adult women, participants preferred ratio lifetime risk (1 in 10 people will get the disease) to percentages (10% of people will get the disease) because these ratios were perceived as being more "people-oriented," and percentages were perceived as being "mathematical" and "difficult."[22] This is consistent with our results, where students preferred risk ratios (also called relative risks), which provide a comparable group and tend to be more "people oriented," to percentage cases of disease.

The wording of statistics also affects individuals' reactions to a health message.[19,23] Framing risk information graphically as the chance of death (mortality curves) over time resulted in lower levels of understanding and less interest in preventive surgery than framing as chance of survival over time.[23] This suggests a need for health educators to pilot test their health messages using both loss-framed and gain-framed messages to ensure they are presenting statistics most accurately.

The results showed that the most effective statistical measures at motivating exercise or maintaining regular exercise among college students are those that are easiest to understand. This is consistent with published preferences of cancer patients, who preferred simple graphs and text depicting survival information to more complex graphical information; this effect was observed regardless of patients' level of education.[24] In addition, studies reviewed by Edwards, et al., showed that providing greater quantities of information that is more understandable to patients is associated with increased willingness to adhere to treatments and participate in clinical trials.[25] In the current study, the statistical measure identified most frequently as being the best for motivating increased exercise or encouraging maintenance of regular exercise was the total number of disease cases. Students who chose this statistical measure were significantly more likely to identify it as the easiest to understand. Similarly, for each selection group, those within that group, on average, identified that statistic as the easiest to understand.

The choice to include the selected statistics in statements relating exercise to depression, obesity and social life is based on the fact that these health outcomes pose an immediate concern to many of the participating students. Of the students in our study, 11% had previously been diagnosed with clinically diagnosed depressive disorders, 18% described themselves as overweight and 35% rated their social life as good, fair or poor compared with excellent or very good. The public health consequences associated with depressive disorders and obesity are well established. Suicide is often linked with depression.[26]

Table 5. Mean rank order assigned to selected statistics, from easiest (= 1) to most difficult (= 6) to understand, stratified according to which type of statistic they thought would best motivate increased or maintained regular exercise*

Strata		1	2`	3	4	5	6
Total Number (18.8 million)		1.57	2.39	2.53	2.50	2.86	3.07
	1		0.0004	<0.0001	0.0047	<0.0001	<0.0001
	2			0.5526	0.7558	0.0817	0.0628
	3				0.9373	0.1449	0.1072
	4					0.3191	0.1894
	5						0.5522
Percentage (9.5%)		2.61	1.53	2.98	3.08	3.17	2.44
	1		< .0001	0.0075	0.0708	0.0014	0.5459
	2			< .0001	< .0001	< .0001	0.0020
	3				0.7193	0.3031	0.0471
	4					0.7516	0.0691
	5						0.0128
Risk Ratio (twice as many)		3.56	3.64	2.66	3.80	3.48	3.46
	1		0.6588	<0.0001	0.4257	0.6985	0.7463
	2			<0.0001	0.6588	0.4905	0.5711
	3				0.0003	0.0001	0.0125
	4					0.3338	0.3979
	5						0.9503
Percentage lifetime risk		4.24	4.18	4.31	3.21	4.15	4.64
from age 18 onward (5.4%)	1		0.7672	0.6540	0.0003	0.6469	0.1657
	2			0.5322	0.0022	0.9019	0.1504
	3				0.0002	0.4278	0.2583
	4					0.0026	0.0002
	5						0.1216
Ratio lifetime risk from age		4.28	4.35	3.77	3.57	2.38	4.25
18 onward (1 in 18)	1		0.7498	0.0025	0.0233	<0.0001	0.9230
	2			0.0097	0.0247	<0.0001	0.7756
	3				0.5301	<0.0001	0.1380
	4					<0.0005	0.1026
	5						<0.0001
Lethality (2% commit suicide)		3.90	4.07	4.00	3.93	4.29	2.43
	1		0.4585	0.5777	0.9295	0.0666	<0.0001
	2			0.7621	0.6998	0.3835	<0.0001
	3				0.8362	0.1774	<0.0001
	4					0.2952	0.0003
	5						<0.0001

Note: Bold typed are statistically significant at the 0.05 level.
*Means adjusted for sex, marital status, and whether a basic statistics course had been taken.

Depression is also the leading cause of disability in the U.S. and the cause of more than two-thirds of suicides each year.[26] Similarly, obesity is a major contributor to many preventable causes of death, as well as social stigmatization, discrimination and lowered self-esteem.[26] Obesity also has various social implications, including a lack of self-esteem, a lower probability of marriage

and a lower probability of achieving professional success.[27]

Different statistical measures may be used to convey different aspects of a health condition. Specifically, the public health burden of disease may be effectively communicated by the total number, which is useful for understanding the magnitude of the health problem. Health officials often rely on these estimates for health planning and resource allocation. The percentage of disease cases indicates the burden of disease per 100 people. Percentage lifetime risk and ratio lifetime risk have also been referred to as measures of burden.[28] Lethality is a statistic that conveys the probability of the ultimate burden of disease: death. The risk ratio allows us to associate a risk behavior with a disease outcome. For example, the risk ratio says how much more likely symptoms of depression are among people who do not exercise compared with people who do exercise.

The current study has implications for social marketing. Social marketing is a program-planning process that is consumer-oriented. A social marketing approach attempts to strategically understand a specific audience in order to utilize their input in program development. This approach not only ensures that the intervention involves consumer input, but that the intervention is tested on the targeted audience before being implemented. Historically social marketing has focused on a diverse range of issues, including diabetes self-management, physical activity, fruit and vegetable consumption, family planning, agricultural reforms, immunizations and nutrition.[29-31] With respect to including statistical measures in the health message, a social marketing approach would let a specific target audience identify which statistical measures are most effective at motivating behavior change.

Since few studies of this nature have been previously conducted, repeating the survey in other populations may strengthen the results found here, or determine that alternate populations respond better to other types of statistics. Similarly, the findings may vary for other disease categories, even in the same population. This study also utilized a limited number of statistical categories (i.e., number, percentage, risk ratio, disease burden, etc.). It is possible that statistics not considered here may be better at influencing behavior change. For example, the use of creative epidemiology has not been addressed in this study. Creative epidemiology involves translating raw numbers into attention-grabbing statements. Thus, instead of saying "18.8 million Americans suffer from depressive disorders," a statement involving creative epidemiology might say "The number of Americans suffering from depressive disorders would fill 200 college football stadiums." The use of creative epidemiology is often more effective at grabbing the attention of the audience than are raw numbers.[32]

Potential limitations of this study need to be examined. Sampling entire classrooms minimized selection bias. Further, accurate and honest responses were more likely to result because the survey was anonymous and required only 5 to 10 minutes to complete. No student refused to complete the questionnaire. However, some students were enrolled in multiple health science classes. To avoid receipt of multiple questionnaires from the same students, students were asked not to complete the questionnaire more than once. Students were also asked to remain quiet and in their seats until everyone had completed the questionnaire. It is possible that although no student openly refused to complete the questionnaire, some may have led us to believe they had in order to avoid participation. Finally, the study population was limited to undergraduate college students and generalizing the results to other populations may be misleading.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The risk ratio was consistently preferred over the percentage of cases, regardless of whether exercise was associated with a decreased risk of depression, obesity or a less favorable social life. The choice of a statistical measure as best for motivating increased exercise or encouraging maintenance of regular exercise was influenced by ease in understandability. This result indicates that statistical measures most likely to motivate behavior change are those that are easiest to understand.

These findings may be useful when considering the use of statistics in health information presented by the media. Although more complex statistical measures might seem more interesting to report, this study concludes that ease of understanding is most important in motivating behavior change. Appropriate statistical measures for selected target audiences may be determined using the methods of social marketing.

FUTURE RESEARCH

The statements about exercise were negatively framed, emphasizing selected negative consequences that may result from a lack of exercise. It is unknown whether statistical measures that emphasize negative consequences from inaction are more effective in motivating behavior change than statistical measures that emphasize positive consequences from action. Second, it may be that adding a statistical measure to the health message lends more credibility to the message, such that behavior change is more likely to follow. On the other hand, a statistical measure may better show that the personal risk of experiencing a negative health outcome from inaction is sufficiently low to discourage behavior change. Third, statistical measures perceived as easier to understand were also considered to be more effective at motivating behavior change. Understanding how different statistical measures convey different types of information (e.g., counts represent the magnitude of a health problem whereas incidence rates represent the risk of developing a disease) are influenced by ease in understanding needs further study. Fourth, the results in this study are relevant to college students and may not hold for other populations. Exploration of whether selected statistical measures are effective at motivating behavior change in other audiences and in other

health contexts is warranted.

REFERENCES

1. Emerson JD, Colditz GA. Use of statistical analysis in the New England Journal of Medicine. *N Engl J Med.* 1983; 309: 709-713.

2. Levy PS, Stolte K. Statistical methods in public health and epidemiology: A look at the recent past and projections for the next decade. *Stat Methods Med Res.* 2000; 9: 41-55.

3. Wang Q, Zhang B. Research design and statistical methods in Chinese medical journals. *JAMA.* 1998; 280: 283-285.

4. Prochaska JO, DiClemente CC. Stages of change in the modification of problem behaviors. *Prog Behav Modif.* 1992; 28: 184-218.

5. Rosenstock IM. Why people use health services. *Milbank Mem Fund Q.* 1966; 44: 94-127.

6. Rosenstock IM. Historical Origins of the Health Belief Model. *Health Educ Q.* 1974; 2: 328-335.

7. Janz NK, Becker MH. The health belief model: A decade later. *Health Educ Q.* 1984; 11: 1-47.

8. Jakicic JM, Clark K, Coleman E, et al. American College of Sports Medicine: American College of Sports Medicine position stand. Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc.* 2001; 33: 2145-2156.

9. Williams-Piehota P, Cox A, Silvera SN, et al. Casting health messages in terms of responsibility for dietary change: increasing fruit and vegetable consumption. *J Nutr Educ Behav.* 2004; 36: 114-120.

10. Witte K, Berkowitz JM, Cameron KA, McKeon JK. Preventing the spread of genital warts: using fear appeals to promote self-protective behaviors. *Health Educ Behav.* 1998; 25: 571-585.

11. Witte K, Allen M. A meta-analysis of fear appeals: implications for effective public health campaigns. *Health Educ Behav.* 2000; 27: 591-615.

12. Stephenson MT, Witte K. Fear, threat, and perceptions of efficacy from frightening skin cancer messages. *Public Health Rev.* 1998; 26: 147-174.

13. Prentice-Dunn S, Floyd DL, Flournoy JM. Effects of persuasive message order on coping with breast cancer information. *Health Education Res.* 2001; 16: 81-84.

14. Montazeri A, McEwen J. Effective communication: perception of two anti-smoking advertisements. *Patient Educ Couns.* 1997; 30: 29-35.

15. Risk factor: physical inactivity. Available at: http://www.who.int/cardiovascular_diseases/en/cvd_atlas_08_physical_inactivity.pdf. Accessed November 3, 2004.

16. US Department of Health and Human Services: *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

17. Waters E, Wake M, Toumbourou J, Wright M, Salmon L. Prevalence of emotional and physical health concerns amongst young people in Victoria. *J Paediatr Child Health.* 1999; 35: 28-33.

18. Prochaska JO, Velicer WF, Rossi JS, et al. Stages of change and decisional balance for 12 problem behaviors. *Health Psychol.* 1994; 13: 39-46.

19. Fortin JM, Hirota LK, Bond BE, O'Connor AM, Col NF. Identifying patient preferences for communicating risk estimates: a descriptive pilot study. *BMC Medical Informatics and Decision Making* [serial online]. 2001; 1: 2.

20. Epstein RM, Alper BS, Quill TE. Communicating evidence for participatory decision making. *JAMA.* 2004; 291: 2359-2366.

21. Malenka DJ, Baron JA, Johansen S, Wahrenberger JW, Ross JM. The framing effect of relative and absolute risk. *J Gen Intern Med.* 1993; 8: 543-548.

22. Schapira MM, Nattinger AB, McHorney CA. Frequency or probability? A qualitative study of risk communication formats used in health care. *Med Decis Makin,* 2001; 21: 459-467.

23. Armstrong K, Schwartz JS, Fitzgerald G, Putt M, Ubel PA. Effect of framing as gain versus loss on understanding and hypothetical treatment choices: survival and mortality curves. *Med Decis Making.* 2002; 22: 76-83.

24. Brundage M, Leis A, Bezjak A, et al. Cancer patients' preferences for communicating clinical trial quality of life information: a qualitative study. *Qual Life Res.* 2003; 12: 395-404.

25. Edwards A, Elwyn G, Covey J, Matthews E, Pill R. Presenting risk information—a review of the effects of "framing" and other manipulations on patient outcomes. *J Health Commun.* 2001; 6: 61-82.

26. US Department of Health and Human Services: *Healthy People 2010: Understanding and Improving Health. 2nd ed.* Washington, DC: U.S. Government Printing Office, November 2000.

27. Bettelheim A. Obesity and Health. *CQ Researcher.* 1998;9:19-36.

28. Merrill RM, & Weed DL. Measuring the public health burden of cancer in the United States through lifetime and age-conditional risk estimates. *Ann Epidemiol.* 2001; 11: 547-53.

29. Thackeray R, Neiger BL. Using social marketing to develop diabetes self-management education interventions. *Diabetes Educ.* 2002; 28: 536-540, 542-544.

30. Neiger BL, Thackeray R, Merrill RM, Miner KM, Larsen L, Chalkley CM. The impact of social marketing on fruit and vegetable consumption and physical activity among public health employees at the Utah department of health. *Soc Mar Q.* 2001; 7: 9-28.

31. Walsh DC, Rudd RE, Moeykens BA, Moloney TW. Social marketing for public health. *Health Aff.* 1993; 12: 104-19.

32. US Department of Health and Human Services. *Media Advocacy*. Available at: http://www.health.org/govpubs/phd627/media.aspx. Accessed: July 6, 2004.