

RESEARCH PAPER

Smokers' unrealistic optimism about their risk

N D Weinstein, S E Marcus, R P Moser

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See end of article for authors' affiliations

Correspondence to:
Neil D Weinstein,
PhD, Department of
Human Ecology, Rutgers
University, Cook Office
Building, 55 Dudley Road,
New Brunswick, NJ
08901-8520, USA;
neilw@aesop.rutgers.edu

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Objective: Past studies have produced ambiguous or inconsistent results when testing whether smokers actually underestimate their own risks of experiencing tobacco related illness. Whereas smokers claim that they are less at risk than the average smoker on self administered questionnaires, this unrealistic optimism has not been found in telephone or face-to-face interviews. We avoided the measurement problems of past studies and examined responses to a number of new questions to assess different aspects of smokers' perceptions.

Methodology: A US national telephone survey (n = 6369; 1245 current smokers) posed a variety of questions designed to examine beliefs about the risks of smoking. For key questions, separate samples of smokers were asked either about their own risk or about the risk of the average smoker.

Results: Smokers underestimated their relative risk compared to non-smokers and, contrary to previous interview surveys, believed they have a lower risk of developing lung cancer than the average smoker. Furthermore, their perceived risk of lung cancer and of cancer in general barely increases with the number of cigarettes smoked per day, and their estimates of their risk of cancer are actually slightly lower than their estimates of their risk of lung cancer. Substantial proportions of smokers and former smokers agree with several myths, more than half agreeing that exercise undoes most smoking effects.

Conclusion: Smokers underestimate their risk of lung cancer both relative to other smokers and to non-smokers and demonstrate other misunderstandings of smoking risks. Smoking cannot be interpreted as a choice made in the presence of full information about the potential harm.

The familiar idea that people begin to smoke cigarettes or continue smoking because they fail to appreciate the risks has received considerable attention. Numerous studies have examined smokers' risk perceptions, but only a limited number provide clear evidence that smokers underestimate their own risks. For example, Ayanian and Cleary¹ found that many smokers, even heavy smokers, did not acknowledge that their risks of cancer and heart disease were above average. Many other studies reveal that smokers judge smoking to be less dangerous than do non-smokers.² This difference could arise because smokers underestimate the risks or because non-smokers overestimate the risks.

Comparing smokers' numerical risk estimates with objective statistics may seem like a better way to assess the accuracy of their risk perceptions. However, this approach is problematic. Most lay people have difficulty understanding risk statistics³⁻⁵ and almost never make decisions in everyday life that involve the use of numerical probabilities.

In fact, we know that numerical estimates of smoking risks by lay people can be highly unstable, so that small variations in the ways these estimates are elicited can dramatically change the answers given.⁶ Furthermore, when people are asked to estimate smoking risks on a numerical probability scale, such as the number of smokers out of 100 who will develop lung cancer,⁷ a suspicious spike in the distribution of answers often appears at 50% (or 50 out of 100). Research indicates that many of these estimates should be interpreted as "don't know" responses rather than as actual risk judgments.^{8,9} Thus, judging accuracy solely from a lay person's numerical risk estimates is highly questionable.

Another way of assessing biases in smoking risk perceptions derives from the finding that even when people acknowledge risks for others, they nearly always claim that their own risk is less.¹⁰ There is a large literature demonstrating the prevalence of this "unrealistic optimism" and examining the attributes of hazards that make it larger or smaller.¹¹ To demonstrate unrealistic optimism about smoking, a representative sample

of smokers would be asked about their relative risk of illness on a scale that ranges from "much below the average smoker" to "much above the average smoker". If these risk comparisons were unbiased, the mean of the responses would be "average". A mean shifted significantly in the "below average" direction would indicate unrealistic optimism.

Many studies do find unrealistic optimism in such comparative risk judgments (that is, on average, smokers claim that their own risk is lower than the risk of their smoking peers) but a few do not. Nearly all of the studies that assessed risk perceptions via self administered questionnaires found unrealistic optimism.¹²⁻¹⁵ Most of the studies that used phone or face-to-face interviews did not.^{16,17*} † Because answers to questions that might be influenced by social desirability, social approval, or self presentation are usually viewed by survey researchers as more honest when generated in private,²⁰⁻²² it is reasonable to suggest that the questionnaire results should be assigned greater weight than the interview results. However, the variation with data collection methods is puzzling.

*Sutton SR. Are smokers unrealistically optimistic about the health risks? Findings from two national surveys. Unpublished manuscript, Institute of Public Health, University of Cambridge.

†Unpublished data from Sutton¹⁷ and Weinstein *et al.*¹⁸ In Sutton¹⁷ smokers were asked, "How do you think your own risk of dying from an illness caused by your smoking compares to the risk of the average smoker?". The response scale ranged from "a lot less" coded as -2 to "a lot more" coded as +2. The mean response for smokers aged 15-19 (n = 191) was -0.66, which was significantly less than zero, $t = 8.5$, $p < 0.0001$ and for smokers over 19 (n = 164), the mean was -0.01, NS. In Weinstein *et al.*,¹⁸ smokers were asked, "Compared to the average smoker, do you think you are more likely to get sick from smoking [coded as +1], less likely to get sick from smoking [coded as -1], or that your chance of getting sick from smoking is about the same as the average smoker [coded as 0]?" Mean responses were -0.05, NS, from smokers aged 14-22 (n = 478) and 0.00, NS, from smokers over 22 (n = 310).

We believe that smokers are reluctant to claim that their risk is lower than that of other smokers (that is, that they are “better” than other smokers) if they must make this claim to an interviewer who might ask them to defend such a claim. This assertion is consistent with the suggestion made by Sutton¹⁷ that, “It is possible that the face-to-face interview imposes limits on the extent to which respondents feel that they can claim to be at lower risk than others whereas a self-completion questionnaire allows respondents more freedom to exempt themselves from such risks”. If these views are correct, indirect approaches for eliciting risk comparisons may reveal unrealistic optimism when questions that ask for direct self or other comparisons do not. Supporting this hypothesis, three studies, two of smoking^{16, 17} and one of tornado hazards,²³ found no bias or even a slight pessimistic bias when respondents generated direct risk comparisons, but found unrealistic optimism when respondents generated separate risk estimates for themselves and for others.

Given these findings, it appears that asking smokers two separate questions, one about their own risk and another about the risk of an average smoker, may be a more sensitive way of assessing unrealistic optimism than using a single comparative risk question. Posing the first of these questions to one group of smokers and the second question to a *different* group of smokers would be even better. With this second strategy, respondents in neither group of smokers would feel that they are making claims about their superiority to others—a belief that they appear reluctant to express in interviews—and this method might also demonstrate that biases in perceived personal risks are present even when smokers are thinking about only their own situation, not just when they are making comparisons. This is the assessment approach followed in the survey reported here.

METHOD

Sample

The HINTS (Health Information National Trends Survey) is a telephone survey of the USA conducted in 2003 that used random digit dialling to achieve a sample of 6369 respondents, ages 18 years and older. African Americans and Hispanics were over-sampled.

The category called “current smokers” included both “daily smokers”, defined as individuals who said they now smoke “every day” and had smoked at least 100 cigarettes in their lives, and “occasional smokers”, defined as individuals who said they now smoke “some days” and had smoked at least 100 cigarettes in their lives. “Former smokers” had smoked at least 100 cigarettes but did not smoke now, and “never smokers” were defined as individuals who had not smoked 100 cigarettes.

Instruments

The HINTS survey covered a wide range of topics relating to cancer communication, cancer knowledge, and cancer related behaviour. Only those questions relevant to the present article will be described here.

Core smoking risk questions

Three questions concerned the risk of lung cancer. The first asked smokers about other smokers of the same sex: “How likely do you think it is that the average (male/female) cigarette smoker (that you) will develop lung cancer in the future?” The response options and the numerical codes assigned to them were: “very low” 1, “somewhat low” 2, “moderate” 3, “somewhat high” 4, or “very high” 5. The second question asked: “Overall, how many people who develop lung cancer do you think are cured? Your best guess is fine.” Choices were “less than a quarter”, “about a quarter”, “about half”, “about three quarters”, or “nearly

all”. Finally, the third question asked: “Would you say the average smoker has (you have) about the same lung cancer risk as a non-smoker, a little higher lung cancer risk than a non-smoker, twice the non-smoker’s risk, five times the non-smoker’s risk, or 10 or more times the non-smoker’s risk?”

Other smoking and cancer questions

All respondents were asked about their chances of developing cancer before any smoking questions were posed, using the same “very low” to “very high” scale employed for the absolute risk of lung cancer. Four other questions posed to current and former smokers presented myths or risk minimising statements about smoking. “Exercise can undo most of the effects of smoking.” “Vitamins can undo most of the effects of smoking.” “There’s no risk of getting cancer if someone only smokes a few years.” “Whether a person gets lung cancer depends more on genes than anything else.” The response options and associated numerical codes were “strongly agree” 1, “somewhat agree” 2, “somewhat disagree” 3, and “strongly disagree” 4.

Other questions

Respondents were asked about their smoking status and, for daily smokers, the average number of cigarettes smoked per day. Current smokers were asked about their interest in quitting, with response options “plan to quit”, “don’t plan to quit”, and “undecided”. Other questions asked about age, sex, education, and race.

Procedure

The core risk questions were asked only of people who did not have lung cancer. For the first core question, half of current and former smokers were randomly assigned to be asked about the average smoker and half were asked about themselves. The same procedure was followed for the third core risk question, though only for current smokers.

Analysis

The HINTS data were weighted to be nationally representative (see Nelson *et al*²⁴ for more details regarding the sampling plan for HINTS). For analytic purposes, variances of parameter estimators were obtained using a jack knife method.²⁵ A total of 50 replicate weights were computed for each sample unit and this number—obviously much smaller than the sample size—will be the denominator degrees of freedom in the appropriate statistical tests.

The following results refer to data weighted to be representative of the US population. Because of the multiple tests conducted, only results with $p < 0.01$ will be considered significant.

RESULTS

Sample characteristics

Weighted and unweighted sample characteristics are shown in table 1.

Absolute risk of lung cancer

As expected, respondents showed unrealistic optimism in their judgments of the absolute risk of lung cancer. The verbal risk descriptors in the absolute risk questions were assumed to form an interval scale and were assigned values 1 (“very low”) to 5 (“very high”). Current smokers judged their own risk of developing lung cancer significantly lower than they judged the risk of the average smoker ($M = 3.17$ v 3.77 , respectively, $F(1, 50) = 61.6$, $p < 0.0001$). In addition, it was found, not surprisingly, that former smokers judged their risk of lung cancer to be much lower than they judged the risk of the average smoker ($M = 2.14$ v 4.05 , respectively, $F(1, 50) = 971.6$, $p < 0.0001$).

Table 1 Respondent characteristics

	Unweighted n's	Unweighted values	Weighted values
Sex			
Female	3848	60.4%	51.9%
Male	2521	39.6%	48.1%
Age (mean, range) (years)	-	47.7 (18-95)	45.2
Education			
High school or less	2575	41.9%	48.9%
Some college	1637	26.6%	26.8%
College graduate	1927	31.4%	24.3%
Ethnicity*			
Black	736	12.1%	10.7%
Hispanic	764	12.5%	11.7%
White not Hispanic	4331	71.0%	72.6%
Other	265	4.4%	5.0%
Smoking status			
Never smoker	3277	51.4%	50.3%
Former smoker	1676	26.3%	25.4%
Current occasional smoker	303	4.8%	5.2%
Current daily smoker	942	14.8%	16.4%
Cigarettes/day (mean; daily smokers)	17.5		

*First race mentioned if respondents cited more than one.

Relative risk of cancer

Respondents' estimates of relative lung cancer risk (that is, smoker's risk compared to non-smoker's risk) are shown in table 2. Current smokers assigned different relative risks to the average smoker than they did to themselves ($\chi^2(4) = 26.0, p < 0.001$). Furthermore, the risk was substantially underestimated for both groups. Over half of current smokers, 55.0%, thought that their own risk was only twice as high as non-smokers or less.

Next, relative risk values were assigned to the verbal response options: same 1; little higher 1.5; twice 2; five times 5; 10 or more times 15. With these assignments, the mean of current smokers' ratings of their own relative risk was 5.45. Their mean rating of the average smoker's relative risk was significantly higher at 7.03 ($F(1,50) = 14.9, p < 0.001$), again demonstrating unrealistic optimism.

Absolute risk of cancer

Perceived risk for cancer in general increased from never smokers to former smokers to current smokers, with means of 2.38, 2.51, and 2.98, respectively ($F(2, 50) = 77.2, p < 0.0001$). It is worth noting that current smokers gave slightly higher ratings for their chances of developing lung cancer than for their chances of developing cancer in general ($M = 3.17$ v 3.02 , respectively), with the difference in ratings being almost significant ($t(50) = 2.58, p < 0.013$). (This comparison was based on those current smokers who answered both questions.)

Risk perceptions and smoking frequency

The association between perceived personal absolute risk and number of cigarettes smoked per day was very weak ($r = 0.09, p < 0.01$), and the correlation of perceived personal relative risk with daily cigarettes smoked was 0.07

Table 2 Perceived relative risk of smoking

Risk rated	Perceived risk compared to non-smoker's risk*				
	Same	Little higher	Twice as high	Five times	10 or more times
Own risk	11.1	20.7	23.1	22.0	23.2
Average smoker	8.1	11.7	19.0	27.9	33.3

*Percentage choosing each response option.

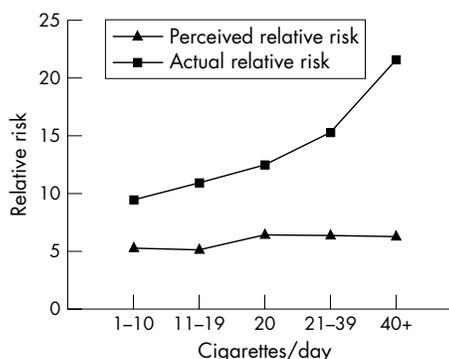


Figure 1 Actual and perceived relative risk of lung cancer (smokers' risk compared to non-smokers' risk).

(NS). The correlation between cigarettes per day (daily smokers only) and perceived personal risk of cancer in general was significant ($r = 0.19, p < 0.0001$), but still weak.

Next, respondents' daily smoking rates (cigarettes per day) were grouped into the categories used in the National Cancer Institute's (NCI) smoker's risk website (<http://cancercontrol.cancer.gov/ncbcr/smokersrisk>): 1-10, 11-19, 20, 21-39, and 40+. This grouping permits a comparison of risk perceptions at different smoking levels with actual risk. The actual relative risk figures are derived from data in the NCI website for the group aged 75-79 (smokers and non-smokers). The website gives the number of smokers out of 10 000 and non-smokers out of 10 000 expected to die of lung cancer by this age as a function of sex, cigarettes per day, and age of initiation. The separate male and female data from the site were weighted to correspond to the proportion of males and females in the present weighted sample of daily smokers. To provide conservative estimates of actual risk, the statistics in table 3 and fig 1 represent the values for people who began smoking between 18-21 years of age, even though the majority of smokers begin earlier. (Age of smoking initiation was not available from the HINTS survey.)

Table 3 and fig 1 reveal that: (1) actual lung cancer risk changes greatly with the rate of smoking; (2) perceptions of personal relative risk are substantially below the actual relative risk at all smoking levels; (3) perceptions of relative

Table 3 Risk perceptions of daily smokers and actual risk

	Cigarettes per day				
	1-10	11-19	20	21-39	40+
Actual relative risk of lung cancer*	9.48	11.23	12.52	15.25	21.62
Perceived personal relative risk of lung cancer*	5.32	4.25	6.92	6.58	5.12
Perceived personal absolute risk of lung cancer†	3.15	3.38	3.26	3.53	3.58
Perceived personal absolute risk of cancer†	2.89	2.99	3.11	3.57	3.40

*Relative to risk of non-smoker.

†Assessment scale: 1 very low, 2 somewhat low, 3 moderate, 4 somewhat high, 5 very high.

and absolute lung cancer risk and of absolute cancer risk change very little as the number of cigarettes per day increases.

Curability of lung cancer

Since fewer than 10% of lung cancer patients are alive 10 years after diagnosis²⁶ “less than a quarter” was considered the correct answer for the question concerning the curability of lung cancer. This answer was given by 44% of respondents, 29.3% said “about a quarter” were cured, and 26.7% said one half or more. The percentage of those answering correctly varied with smoking status. The correct option was chosen by 47.1% of never smokers, 43.2% of former smokers, and 37.9% of current smokers ($\chi^2(2) = 24.8, p < 0001$).

Myths

Agreement with the smoking myths and risk minimising beliefs is shown in table 4. Substantial proportions of current smokers and, to a lesser extent, former smokers, agreed with these ideas. For example, more than half of current smokers mistakenly believe that exercise can reverse most of the effects of smoking.

Risk perceptions and interest in quitting

Although not a central issue in this paper, the HINTS survey also provided an opportunity to examine the relation between risk beliefs and plans to quit among current smokers. People who planned to quit judged their absolute risk of lung cancer higher than did people who did not plan to quit (3.24 v 2.52, respectively), which is nearly significant ($F(1,50) = 6.8, p = 0.012$). People who planned to quit also judged their relative risk of lung cancer higher ($\chi^2(4) = 13.9, p = 0.014$). Among those not planning to quit, 57.3% said that their risk was “the same” as or “a little higher” than non-smokers. Among those planning to quit, only 22.8% gave these responses and the remainder gave higher relative risk estimates. People who did not plan to quit were also more likely to believe that lung cancer is determined primarily by genes (2.23 v 3.00, respectively, $F(1, 50) = 19.6, p = 0.0001$), where “strongly agree” is coded as 1 and “strongly disagree” is coded as 4. No significant differences

Table 4 Agreement with smoking myths and risk minimising beliefs*

Belief	Current smokers (n = 1014-1144)	Former smokers (n = 1421-1528)
Exercise undoes most smoking effects	51.7	35.6
Vitamins undo most smoking effects	28.0	17.6
No risk of cancer from smoking a few years	13.4	13.4
Lung cancer depends more on genes than anything else	35.8	31.1

*Percentage agreeing strongly or somewhat.

in quitting plans were found as a function of perceived curability of lung cancer, overall personal cancer risk, or myths about exercise, vitamins, or the risk of short term smoking.

DISCUSSION

The present survey provides clear evidence that smokers engage in risk minimisation by convincing themselves that they are not as much at risk as other smokers. This unrealistic optimism was observed even when individuals were only asked to make a single estimate—for themselves or for the average smoker—and it held true whether smokers estimated their chances of developing lung cancer on an absolute, verbal risk scale or compared their lung cancer risk to that of non-smokers on a numerical scale. Our results are consistent with the hypothesis that several previous phone and face-to-face studies failed to find unrealistic optimism because they asked for direct self other comparisons and respondents were reluctant to claim lower risk in the presence of an interviewer.

In addition to this optimism in comparisons to other smokers, the data clearly indicate that smokers underestimate the extent to which smoking elevates lung cancer risk above that of non-smokers. More than half of current smokers in this survey regarded their lung cancer risk as no more than twice that of smokers, when, as shown in table 3 and fig 1, even for light smokers in the sample, the relative risk would be about nine times the non-smoker's risk. This underestimation of the magnitude of the increased risk is consistent with other studies that find smokers rate their risk of lung cancer to be no greater than that of non-smokers²⁷⁻³⁰ or only slightly elevated.^{17 31}

Other findings reveal how imperfectly the amount of tobacco consumed is taken into account in judging personal risk. Perceived personal risks of lung cancer—both absolute and relative—were unrelated with the number of cigarettes smoked per day even though the actual risk varies greatly. This is not to say that smokers think risk is unrelated to the number of cigarettes smoked. Rather, the data show that their sense of the size of the risk is so vague, that their self perceptions (whether asked in verbal or numerical terms) do not reflect this relation.

Furthermore, the overall cancer risk estimates given by respondents were actually slightly lower than the estimates they gave for their risk of one particular kind of cancer, lung cancer. Since less than half of cancer deaths in smokers are from lung cancer (48% for males and 36% for females[‡]), it is obvious that the total cancer risk ought to be perceived as greater than the lung cancer risk.

Finally, many smokers agree with ideas that minimise the seriousness of smoking, such as believing that smoking effects can be reversed by exercise or vitamins, and that lung cancer is mainly determined by one's genes. It is interesting

‡Personal communication from Michael Thun and Jane Henley of the American Cancer Society concerning lung cancer risk data from Cancer Prevention Study II.

What this paper adds

Although smokers give lower estimates of smoking risks than do non-smokers, it is difficult to demonstrate that this is caused by smokers underestimating the risks. Smokers show clear unrealistic optimism by claiming that they are less at risk than the average smoker on self administered questionnaires, but this unrealistic optimism has not been found in interview surveys.

Using a large national sample and careful measurement, we showed that unrealistic optimism about lung cancer is present in interview surveys as well. The data collected also expanded the range of smoking risk issues addressed, with smokers clearly underestimating their relative risk of lung cancer compared to non-smokers. Smokers' perceptions of their own risk of lung cancer and of cancer in general barely increased with the number of cigarettes smoked per day, and their estimates of their total risk of cancer were actually slightly lower than their estimates of their risk of lung cancer. Substantial proportions of smokers and former smokers agreed with several myths, with more than half agreeing that exercise undoes most smoking effects.

that substantial agreement occurs both with statements that overemphasise the controllability of the risks (by exercise and vitamins) and that minimise responsibility by claiming uncontrollability (determination of risk by genetic factors).

Several of these risk perceptions—absolute and relative risk of lung cancer and beliefs that lung cancer is genetically determined—were positively associated with intentions to quit. It should be kept in mind that we did not ask smokers about their risk *if they continued to smoke*. Consequently, some who plan to quit may have anticipated a lower future risk, thereby diminishing the association between perceived risk and quitting plans. Although the direction of causality cannot be determined from these correlational findings, the data are consistent with other studies³² that find perceived risk to be positively correlated with quit attempts.

Data from other studies show that smokers hold a number of beliefs that distance themselves from others' risk. Smokers claim that, compared to the average smoker, they smoke fewer cigarettes, smoke cigarettes with less tar and nicotine, inhale less deeply, are less addicted, and have a healthier lifestyle.³³ Smokers also know relatively little about the nature of the illnesses caused by smoking and—as revealed in the present research with respect to the curability of lung cancer—underestimate their severity.¹⁸ They also greatly overestimate the likelihood that their next quit attempt will be successful.³⁴

Together, the accumulated data demonstrate convincingly that smokers have a very imperfect understanding of the risks of smoking and of risk statistics in general. Furthermore, regardless of what they may acknowledge about the risks faced by other smokers, they believe that their own risk is less. Given the accumulated evidence, the argument that people begin to smoke or continue to smoke with adequate knowledge of the potential risks appears indefensible.

Authors' affiliations

N D Weinstein, Department of Human Ecology, Rutgers University, New Brunswick, New Jersey, USA

[§] Unpublished data from Sutton¹⁷ and Weinstein *et al.*¹⁸

S E Marcus, R P Moser, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, Maryland, USA

REFERENCES

- 1 **Ayanian JZ**, Cleary PD. Perceived risks of heart disease and cancer among cigarette smokers. *JAMA* 1999;**281**:1019–21.
- 2 **Weinstein ND**. Accuracy of smokers' risk perceptions. *Nicotine Tob Res* 1999;**1**:S123–30.
- 3 **Black WC**, Nease RF Jr, Tosteson ANA. Perceptions of breast cancer risk and screening effectiveness in women younger than 50 years of age. *J Natl Cancer Inst* 1995;**87**:720–31.
- 4 **Lipkus IM**, Samsa G, Rimer BK. General performance on a numeracy scale among highly educated samples. *Medical Decision Making* 2001;**21**:37–44.
- 5 **Yamagishi K**. When a 12.86% mortality is more dangerous than a 24.24%: implications for risk communication. *App Cognitive Psych* 1997;**11**:495–506.
- 6 **Slovic P**. Smokers: rational actors or rational fools? In: Slovic P, eds. *Smoking: risk, perception, & policy*. Thousand Oaks, California: Sage, 2001:97–124.
- 7 **Viscusi WK**. Do smokers underestimate risks? *J Political Econ* 1990;**98**:1253–69.
- 8 **Bruin de Bruin W**, Fischhoff B, Halpern-Flesher B, *et al*. Expressing epistemic uncertainty: "It's a fifty-fifty chance". *Organizational Behavior and Human Decision Processes* 2000;**81**:115–31.
- 9 **Fischhoff B**, De Bruin WB. Fifty-fifty = 50%? *J Behavioral Decision Making* 1999;**12**:149–63.
- 10 **Weinstein ND**. Unrealistic optimism about susceptibility to health problems: conclusions from a community-wide sample. *J Behavioral Med* 1987;**10**:481–500.
- 11 **Weinstein ND**. *References on optimistic biases about risk, unrealistic optimism, and perceived invulnerability 1998*, Unpublished bibliography, Department of Human Ecology, Rutgers University. Available from the author..
- 12 **Boney-McCoy S**, Gibbons FX, Reis TJ. Perceptions of smoking risk as a function of smoking status, *et al*. *J Behavioral Med* 1992;**15**:469–88.
- 13 **Hansen WB**, Malotte CK. Perceived personal immunity: the development of beliefs about susceptibility to the consequences of smoking. *Prev Med* 1986;**15**:363–72.
- 14 **Lee C**. Perceptions of immunity to disease in adult smokers. *J Behavioral Med* 1989;**12**:267–77.
- 15 **McKenna FP**, Warburton DM, Winwood M. Exploring the limits of optimism: the case of smokers' decision making. *Brit J Psychology* 1993;**84**:389–94.
- 16 **Rise J**, Strype J, Sutton S. Comparative risk ratings and lung cancer among Norwegian smokers. *Addiction Res Theory* 2002;**10**:313–20.
- 17 **Sutton SR**. Influencing optimism in smokers by giving information about the average smoker. *Risk Decision Policy* 2002;**7**:165–74.
- 18 **Weinstein ND**, Slovic P, Gibson G, *et al*. Public understanding of the illnesses caused by cigarette smoking. *Nicotine Tob Res* 2004;**6**:1–7.
- 19 **Jamieson P**, Romer D. A profile of smokers and smoking. In: Slovic P, eds. *Smoking: risk, perception, & policy*. Thousand Oaks, California: Sage, 2001:29–47.
- 20 **Babbie E**. *The practice of social research*. Belmont, California: Wadsworth/Thomson, 2004.
- 21 **Frey FJ Jr**. *Survey research methods*, 2nd ed. Newbury Park, California: Sage, 1993.
- 22 **Turner CF**, Ku L, Rogers LD. Adolescent sexual behavior, drug use, and violence: Increased reporting with computer survey technology, *et al*. *Science* 1998;**280**:867–73.
- 23 **Weinstein ND**, Lyon JE, Rothman AJ. Changes in perceived vulnerability following natural disaster, *et al*. *J Soc Clin Psych* 2000;**19**:372–95.
- 24 **Nelson DE**, Rimer BK, Kreps GL, *et al*. The Health Information National Trends Survey (HINTS): development, design, and dissemination. *J Health Communication* 2004;**9**:443–60.
- 25 **Wolter KM**. *Introduction to variance estimation*. New York: Springer-Verlag, 1985.
- 26 In: **Ries LAG**, Eisner MP, Kosary CL, *et al*. *SEER Cancer Statistics Review 1973–1998*, (Table XV-10. Lung and bronchus cancer (invasive) incidence, mortality, and survival rates.) Bethesda, Maryland: National Cancer Institute, 2001.
- 27 **Cohn LD**, Macfarlane S, Yanez C, *et al*. Risk-perception: differences between adolescents and adults. *Health Psych* 1995;**14**:217–22.
- 28 **Hahn A**, Renner B, Schwarzer R. Perception of health risk: how smoker status affects defensive optimism. *Anxiety, Stress, & Coping: An International Journal* 1998;**11**:93–112.
- 29 **Strecher VJ**, Kreuter MW, Kobrin SC. Do cigarette smokers have unrealistic perceptions of their heart attack, cancer, and stroke risks? *J Behavioral Med* 1995;**18**:45–54.
- 30 **Sutton S**, Bolling KD. Adolescents' perceptions of the risks and prevalence of smoking. *Zeitschrift für Gesundheitspsychologie* 2003;**11**:107–11.
- 31 **Repucci JD**, Revenson TA, Aber M. Unrealistic optimism among adolescent smokers and nonsmokers. *J Primary Prevention* 1991;**11**:227–36.
- 32 **Klesges RC**, Brown K, Pascale RW, *et al*. Factors associated with participation, attrition, and outcome in a smoking cessation program at the workplace. *Health Psych* 1988;**7**:575–89.
- 33 **Segerstrom SC**, McCarthy WJ, Caskey NH. Optimistic bias among cigarette smokers. *J App Social Psych* 1993;**23**:1606–18.
- 34 **Weinstein ND**, Slovic P, Gibson G. Accuracy and optimism in smokers' beliefs about quitting. *Nicotine Tob Res* 2004;**6**(suppl 3):S375–80.