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# SMOKING RISKS IN SPAIN: PART I – PERCEPTION OF RISKS TO THE SMOKER

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# Smoking Risks in Spain: Part I – Perception of Risks to the Smoker

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*Abstract*

Survey evidence for the Spanish population indicates that perceptions of lung cancer risk and life expectancy loss due to smoking are similar to estimates found in the United States. This paper also presents new evidence on the relative lung cancer risk for smokers, the perceived risk of lung disease for smokers, the heart disease risk for smokers, and the relative heart disease risk for smokers, all of which indicate substantial risk perceptions. Risk beliefs are particularly high for younger respondents, but are lower for better educated respondents.

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**Smoking Risks in Spain: Part I – Perception of Risks to the Smoker**

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## 1. Introduction

The adequacy of public risk perceptions is an essential component of the assessment of the rationality of smoking decisions. The key ingredient for choices to be rational is that individuals must be cognizant of the risks. Evidence for the United States presented in Viscusi (1992, 1998) suggests that not only is there substantial risk awareness but in fact there is substantial overestimation of smoking risks. This evidence is, however, restricted to the U.S. smoking environment. The United States has undertaken a vigorous antismoking campaign that has provided information to smokers in a variety of ways. For several decades the public has received information through

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hazard warnings, annual reports by the U.S. Surgeon General, as well as substantial media coverage. Moreover, efforts by the tobacco industry to advertise on television and radio have been severely restricted. Thus, the level of smoking risk beliefs in the United States may not necessarily accord with the experiences in other countries.

This paper considers the level of smoking risk beliefs for the Spanish population, the determinants of these beliefs, and the effect of these beliefs on smoking behavior. Further implications of the effect of risk perceptions on smoking behavior are discussed in Viscusi et. al. (2000). The survey questions on overall lung cancer questions and life expectancy loss due to smoking follow closely those used in Viscusi (1990, 1991, 1992, 1998), thus enabling a direct comparison between the results for Spain and those for the United States. Some of the policy implications of these findings for Europe and elsewhere have been discussed by Zweifel (1999), but this paper provides the first empirical evidence on European risk beliefs. Moreover, this paper also considers other health ailments that have not been considered in any previous studies. In particular, it examines perceptions of lung disease overall and perceptions of heart disease risks. Moreover, in addition to considering the frequency of lung cancer and heart disease risk perceptions, the survey also elicited separate assessments of the relative risk levels of each of these diseases, thus providing another quantitative metric to assess the level of risk perceptions. These estimates for risk beliefs will be the subject of Section 3, which follows the discussion of the Spanish smoking risk environment in Section 2.

The subsequent regression analysis of these risk beliefs in Section 4 explores the different influences that affect the levels of risk beliefs. Chief among those are variations with individual age, as younger respondents in the sample tend to have different risk

perceptions than the older age groups, which is consistent with the different informational environment to which they have been exposed. Respondent education also proves to be a primary influence, but in an unexpected direction, as better educated respondents sometimes have lower (but more accurate) risk beliefs. Section 5 concludes the paper.

## 2. The Smoking Risk Information Environment in Spain

The smoking risk information efforts in the United States have been much more ambitious and much more extensive than they have been in Spain. Beginning in 1965, the U.S. Congress mandated on-product warnings on cigarette packages, where the text of the warnings was amended in 1969 and in 1994. The 1994 warnings also provided for a series of rotating warnings alerting people to a variety of smoking risks. In addition, after the landmark report on lung cancer risks of smoking in 1964,[1] the government began to issue annual reports on smoking hazards beginning in 1967. These reports in conjunction with other media coverage have generated substantial awareness of smoking risks. In addition, there have been substantial restrictions on smoking advertising in the United States, both in terms of the media on which advertising is permitted as well as the requirement that print ads include the text of smoking hazard warnings.

The pace of regulation of tobacco advertising and smoking risk information in Spain was not as rapid as that in the United States, but it shared many characteristics with the U.S. approach. In 1978 the first constraint on tobacco advertising was established. Tobacco advertisements were only allowed after 9:00 p.m. on television, and ads were also banned for certain programs (e.g., those for children, government sponsored, and pedagogic). Children were not allowed to appear in advertisements. In 1982 it was

further established that tobacco could not be advertised in media under the control of public institutions. Finally, in 1994 a law was enacted following a 1989 EU directive banning any direct or indirect form of tobacco promotion on television.

Cigarette on product warnings followed the initial efforts to restrict advertising. The text below presents our translation of the warnings into English, but an appendix provides the actual wording in Spanish. A Royal Decree of 1982 established that all cigarette packages should include the following warning: "The General Directorate on Public Health warns you that the use of tobacco may be detrimental to health." This language is similar to the U.S. warning – "Caution: Cigarette Smoking May Be Hazardous to Your Health." A 1983 Decree modified the previous warning in the following way: "The General Directorate on Public Health warns that the use of tobacco is detrimental to your health." Compare the 1983 language in Spain with that in place in the United States at the same time – "Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health."

Later in 1988 the compulsory legend in the Spanish warning was modified again. It had to include a warning consisting of the fixed phrase "Health authorities warn that" followed by any of these phrases: "smoking seriously endangers health," "smoking causes cancer," "smoking causes cardiovascular diseases," and "smoking during pregnancy harms your baby." The sentences should be expressed at least in Spanish, be easy to read, and appear in a font not smaller than three millimeters. They should cover at least 5% of the external surface of the package and be located in a place that is not destroyed when opening the package. They cannot be on the bottom of the package.

[1] U. S. Department of Health, Education and Welfare (1964)

The advent of the four rotating warnings in Spain in 1988 followed the introduction of four rotating warnings in the United States in 1984, which stated: "SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, and May Complicate Pregnancy," "SURGEON GENERAL'S WARNING: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health," "SURGEON GENERAL'S WARNING: Smoking by Pregnant Women May Result in Fetal Injury, Premature Birth, and Low Birth Weight," and "SURGEON GENERAL'S WARNING: Cigarette Smoke Contains Carbon Monoxide."

In 1993 Spain modified its warnings text again. All packages should contain on one side the warning "Health authorities warn that smoking seriously endangers health," and on the other side "Health authorities warn that" followed by any of these phrases: "smoking causes cancer," "smoking causes cardiovascular diseases," "smoking during pregnancy harms your baby," "smoking causes cancer, chronic bronchitis and other lung diseases," "smoking harms those around you," or the independent sentence "Protect children: don't allow them to breathe tobacco smoke." Norms on the size and location f the labels, similar to the previous ones, were also included.

Other smoking regulations pertained to the character of cigarettes as well. In 1979 low nicotine and tar levels in cigarettes were defined and in 1988 limits were set to the nicotine and tar content of cigarettes. Moreover, nicotine and tar content were included among the information to be printed on the packages.

Some autonomous communities have established additional or more stringent constraints on tobacco advertising. For instance, since 1985 advertising is not permitted on streets, parks, roads, cinemas, theaters, and public transports in Catalonia. In 1991 the

ban was extended to additional places: public administrative offices, health care centers, waiting rooms, shopping centers, places where food is processed or sold, etc. Moreover, automatic dispensing machines should have a label with the sentence: "Smoking seriously damages your health." In smoking areas, labels should be placed with the warning: "Tobacco smoke damages the health of the active and of the passive smoker." Between 1994 and 1998, eight additional autonomous communities introduced their own regulations which do not differ significantly from the Catalan one.

Regulated messages do not include any quantitative information on the risks of smoking. However, this kind of information can often be found on media news in highly heterogeneous formats. A random selection of press articles found statements such as: "An average of 5.5 minutes of life is lost for every cigarette smoked," "Female smokers of over 40 cigarettes a day have twice the risk of contracting cancer of the uterus than nonsmokers," "Every ten seconds a person dies from a smoking related disease," "Smoking causes 500,000 victims only in Europe," "Tobacco is responsible for 16 percent of total deaths in Catalonia, that is approximately 8,400 deaths per year," and "Passive smokers double the risk of having a coronary disease."

Besides the above mentioned regulations, authorities have set up antismoking information and educational campaigns. Educational campaigns are especially intensive among school children.

There is almost no previous research on the knowledge or perception of the risks associated to smoking among the Spanish population. Apart from this study, the only source we have been able to find on that issue is the Centro de Informaciones Sociológicas surveys. In two broad multi-topic surveys, people were asked to answer the

question: "Smoking is detrimental to health and therefore it is desirable that authorities take measures for reducing its consumption." Overall, 84 percent of the people chose the option "I rather agree," 12 percent chose "I rather disagree," and 4 percent chose "Don't know" in 1995 respectively.[2] Unfortunately, the double questioning of the sentence – smoking is detrimental to health and it is desirable that authorities take measures – does not allow to obtain a clear interpretation of the results in terms of change of risk perceptions over time.

As in the United States, there is also a substantial relevant literature referring to antismoking policies in Spain. Many of these studies have examined risks of smoking in particular as well as epidemiological evidence on the risks associated with smoking behavior, as in Rovira and Escribano (1989), Salleras and Pardell (1985), Ministerio de Sanidad y Consumo (1989), B. González et. al. (1997), J. González et. al. (1997), García, Hernández and Alvarez-Dardet (1991), Pardell et al. (1997), and Casas, Lorenzo, and López (1996).

## 3. Risk Beliefs

### *3.1. Sample Characteristics*

The survey discussed below was preceded by a pilot study. A preliminary questionnaire was designed and validated by means of a pilot telephone survey. Based on these results, described in a report by Rovira (1997), some of the questions were modified and a definitive questionnaire was designed. The final telephone survey was undertaken on residents in Spain of both genders aged 18 and over. In all, 2,571

[2] In 1988, 78 percent of the people chose the option "I rather agree," 13 percent chose "I rather disagree," and 9 percent chose "Don't know" respectively.

interviews were undertaken, with a sample proportional to the size of the specific autonomous community, province, and municipality. The selection of each household was random within each municipality. The fieldwork was carried out between the 9th and 20th of June, 1997.

Table 1 summarizes the sample characteristics for the analysis. The first set of information included in Table 1 pertains to the demographic background of the sample. Information is available concerning respondent age, for which we have established dummy variables (d.v.) for the two younger age brackets from 18-25 and for ages 25-50. People who are over age 50 constitute the excluded dummy variable group in the subsequent regressions. Individual age has been found to have a substantial positive effect on risk beliefs in Viscusi (1991, 1992), as people who have grown up in the more recent smoking environment tend to have higher risk perceptions than their more senior counterparts. Research by Hersch (1996) suggests that respondent gender also may be influential to the extent that men have a different attitude toward risks than do women. Just over half of current smokers in Spain are men. Mean years of schooling reflect the level of the respondent's education, where education potentially could affect knowledge or understanding of smoking risks. In the United States smoking rates decline substantially with the level of education, which potentially could reflect the effect of education on smoking risk awareness or on smoking preferences. The other principal personal characteristic variable included in the analysis is whether the respondent is a head of household.

Information about the respondent's consumption habits of whiskey, beer, chewing gum, and coffee allows the generation of other variables that pertain to aspects of

personal activities that may reflect attitudes toward risks. These variables include whether the respondent prefers whiskey to beer, whether the respondent is not a whiskey or beer drinker, whether the respondent is a coffee drinker, or whether the respondent has no habits except perhaps for smoking.

A final variable other than the smoking risk measures that will prove to be particularly influential is whether the respondent believes that smoking is a diabetes risk factor. This variable, which may reflect consistent misperception of risks or strong attitude against smoking, will prove to be an important explanatory variable used as an instrument in the subsequent regression analysis.

Comparison of the characteristics of current smokers to those who have never smoked yields some substantial differences, all of which are statistically significant at the 95 percent confidence level. Smokers are almost 10 years younger, are 20 percent more likely to be male, are better educated, are much more likely to prefer whiskey to beer and to be whiskey drinkers, and are more likely to drink coffee. Many of these characteristics are strongly correlated with gender, but the subsequent statistical analysis will distinguish the roles of each.

The bottom panel of Table 1 summarizes the various smoking risk belief questions by smoking status. We will analyze each of these below. It is noteworthy that for every risk measure indicated, smokers have a lower risk assessment than do respondents who have never smoker.

Table 2 summarizes the Spanish version of the survey text and English translation of the wording of the various risk belief questions. The questions pertained primarily to the probabilities of various health outcomes. Whereas Viscusi (1992, 1998) focused on

the lung cancer probability, the lung cancer mortality probability, the overall smoking mortality probability, and life expectancy loss, the Spain survey elicited information regarding the probabilities of lung cancer, lung disease, and heart disease, as well as some relative risk assessments and life expectancy loss estimates. The lung cancer question in the Spanish survey was similar to Viscusi's (1990, 1991, 1992, 1998) lung cancer risk question in that it asked respondents to assess the number of cases of lung cancer attributable to smoking that would be found in a population of 100 smokers. More specifically, the wording was the following: "Among 100 cigarette smokers, how many of them do you think will get lung cancer because they smoke?"

Moreover, the Spain survey posed additional questions that were somewhat different, asking respondents to assess their relative risk level. Ideally, one might like respondents to assess the risk faced by smokers relative to the background risk. Instead, the survey asked respondents to assess the total number of ailments (e.g., lung cancer cases) experienced by smokers relative to the number for nonsmokers. The question was posed in this manner to facilitate respondent understanding of this difficult concept within the context of a telephone interview. Answering this question also brings into play the proportion of each group in society. Thus, if S is the number of smokers, $r_s$ is the risk to smokers, NS is the number of nonsmokers, and $r_{ns}$ is the background risk, respondents indicate a relative risk of

$$\text{Relative Risk Survey Value} = \frac{S\, r_s}{NS\, r_{ns}}, \tag{1}$$

whereas the conventional relative risk estimate is $r_s/r_{ns}$. Based on the number of smokers and nonsmokers in the survey, the ratio S/NS is 0.69. Thus, if all respondents have the same belief of the size of the smoking population, the assessed relative risk values equal

0.69 times the relative risk value of $r_s/r_{ns}$ as is calculated in the scientific literature.[3] For a relative risk value ($r_s/r_{ns}$) of 1.0, the relative risk probability posed by smokers would be the same for that of nonsmokers. Thus, there will be no incremental risk due to smoking. Similarly, for a relative risk value of 2.0, it will be more probable than not that the respondent's ailment is attributable to smoking. In the U.S. litigation system, a threshold of 2.0 is the typical threshold for triggering liability.

Phrasing of the relative risk question as was done requires respondents to assess the size of the smoking population as well as the background risk that nonsmokers face. The difficulty with this question is that it compounds the respondent's understanding of both the incremental smoking hazard as well as the background risk, in addition to an understanding of the prevalence of smoking. It may be that the incremental smoking probability, which is what drives decisions, is well understood, but the background risk is not, nor is the smoking rate. In that event, this variable will be a less accurate index of the incremental smoking risk beliefs because the response potentially also reflects misunderstandings of the background risk levels and smoking rates. Moreover, to the extent that these misunderstandings are systematically correlated with smoking status or with smoking risk perceptions, there will be important biases in these responses.

The final question pertains to life expectancy loss. In Viscusi (1992, 1998) life expectancy was approached by giving respondents information regarding normal life expectancy and then asking them what the life expectancy would be had the person not smoked. The wording of the question in the Spain survey was different in that respondents were asked to compare two trajectories of life expectancy for twin brothers,

[3] This calculation assumes that nonsmokers do not also include former smokers in the scientific studies of relative risk ratios.

one of whom smoked and another who did not. The survey gives respondents a detailed smoking scenario of a pack a day and asks respondents how long the smoking and nonsmoking twin brothers will live. The life expectancy loss due to smoking would be the difference between the two scenarios. This approach has the advantage of not including risk characteristics correlated with smoking status in the assessment. However, if respondents do not know what the normal life expectancy is, then this question tests that knowledge as well as the effect of smoking.

*3.2. Lung Cancer and Lung Disease*

The first set of risks analyzed in this survey consist of risks of lung cancer attributable to smoking. This risk was the subject of the landmark 1964 report by the U.S. Department of Health, Education and Welfare and has been prominently discussed in the media internationally. Moreover, this hazard is perhaps the most well documented risk from smoking in the medical literature.

The format for the question is patterned after that in Viscusi (1992) in which respondents indicate out of a population of 100 how many of these smokers would get lung cancer because they smoke. This approach of asking questions using as a denominator a reference population has proven to be an effective way to enable people to think about probabilities within the context of a telephone interview. As indicated in Table 1, the mean response was that people thought that 46 out of 100 smokers would get lung cancer from smoking, whereas never smokers believe that 53 out of 100 was the true risk level.

Two observations are most striking. First, these estimated risk assessment levels for the Spanish population are higher than the ones for the United States. Results from a 1997 survey reported in Viscusi (1998) indicate that in the United States current smokers believe the lung cancer risk probability is 0.40, whereas the full sample believes the probability is 0.47. The assessed probabilities are about six percentage points higher for the Spanish population than in the United States for a comparable time period. Second, the estimated risk levels dwarf the actual risk values. Estimates based on studies by the U.S. Surgeon General reported in Viscusi (1992) indicate that the lung cancer mortality risk due to smoking is in the range of 0.06 to 0.13. Even the upper bound of this range is less than a third as great as the lung cancer risk beliefs of current smokers in Spain.

Table 3 presents the distribution of lung cancer risk beliefs. Even though the level of mean risk beliefs is high, one would also want to analyze the distribution across the population to determine whether there is a sizeable minority who exhibits substantial errors in their risk beliefs. The figures shown in Table 3 indicate the cumulative distribution of the percentage of people in each smoking group who have risk beliefs below the indicated level. For smokers, fewer than seven percent of the sample believe that the risk is less than 10 out of 100, and about 18 percent believe that the risk is less than 20 out of 100. Thus, the overwhelming majority of current smokers overestimate the risk rather than underestimate it. Moreover, while there is some clustering in the middle of the distribution, other than the few people who believe that lung cancer is a certainty resulting from smoking there is a substantial distribution of responses even at very high risk levels, such as being above 90 out of 100.

Comparison of the cumulative distributions in Table 3 across smoking status reflects the expected patterns given the lower risk perception on the part of current smokers. The cumulative distribution of risk beliefs for current smokers always lies above the value for those who have never smoked. Thus, for any risk level it is always the case that there is a higher fraction of people who have never smoked who believe that the risk is greater than this level than people who are currently smoking. The distributions for current smokers and former smokers are very similar and in fact cross at the lower risk levels.

The survey also asked respondents about the relative lung cancer risk for smokers, rather than simply asking about the risk for a population out of 100. In asking about the relative risk, respondents in effect are put into the position of having to determine the incremental risk to smokers relative to the background risk for lung cancer in the entire population. This approach to asking the question is not as satisfactory from a conceptual basis because it requires that respondents assess the baseline risk which they may not understand. Moreover, the question does not ask for relative probabilities but for the relative number of cases of lung cancer, which requires knowledge of the size of the smoking population. Inaccurate perceptions of the baseline risk need not imply a failure to understand the risks associated with smoking. What is pertinent to decisions is the incremental probability of the risk associated with smoking behavior rather than the risk relative to other risks of that type that the person may face.

Notwithstanding these caveats, the relative lung cancer risk perception questions do reveal some interesting patterns that are consistent with the earlier responses. In every instance people believe that there is a significant risk, where mean assessed relative risk

ranges from 9.4 for current smokers to 13.1 for never smokers. A response of 1.0 would indicate an equal total of lung cancer cases among smokers and nonsmokers.

Table 4 summarizes the distribution of the relative lung cancer risk beliefs for smokers as a function of smoking behavior. In every instance there is a substantial proportion of the population that believes that the relative risk value does not exceed three, and for current smokers 78 percent believe that the risk does not exceed seven.

The scientific reference suggests that the relative risk level depends on gender. Consider first the relative risk ratios, which do not take into account the size of the smoking population. Results from the 1959-1964 American Cancer Society study (CPS-I) indicate that the relative risk of lung cancer for current smokers is 11.35 for males and 2.69 for females. The 1982-1986 follow-up of the American Cancer Society study (CPS-II) found a much higher relative cancer risk value of 22.36 for male smokers and 11.94 for female smokers. These values are for smokers age 35 years or more with a history of regular cigarette smoking.[4] To convert these values into the relative number of lung cancer cases, which is what the survey asked, one must multiply these values by 0.69. Thus, there is little evidence of underassessment of relative risks overall. Moreover, the questions themselves are difficult because people may not properly understand that the background risk of lung cancer is in fact quite low, so that cigarette smoking is the dominant contributor to lung cancer.

While lung cancer is the most prominent smoking-related ailment, there are other diseases of the lung that also are related to smoking, such as emphysema and bronchitis. These are the ailments specifically mentioned in the lung disease survey question, which does not refer to lung cancer. The summary responses in Table 1 indicate that the

assessed lung disease probability is about five percentage points greater than the lung cancer probability for each of the smoking group categories. Casual observation of the joint distribution of lung cancer and lung disease risk suggests that respondents did not always consider lung cancer risk as a subset of lung diseases more generally when assessing the risk of lung diseases. For only 40 percent of respondents, lung disease risk was higher than lung cancer risk.

The estimates for the relative lung disease risk for smokers are similar to those for the relative lung cancer risk. Average relative lung disease risk ranges from 9.63 for current smokers to 12.92 for those who have never smoked. The relative risk levels for lung cancer reported above exceed these values. The relative risks for other lung diseases are lower so that the direction of bias in the relative risk figure cannot be determined without ascertaining which diseases the respondent was assessing. For example, the relative risk of bronchitis and emphysema in CPS-I is 8.81 for males and 5.89 for females, while the comparable risk of influenza and pneumonia is 1.82 for males and 0.91 for females. The estimates in CPS-II for other respiratory diseases (includes influenza and pneumonia) are 1.99 for males and 2.18 for females.[5] Once again all relative risk ratios must be multiplied by 0.69 to calculate the relative number of lung disease cases for smokers.

*3.3. Heart Disease*

The survey in Spain also explored the public's risk perceptions concerning the heart disease risks associated with smoking. Heart disease has been among the most

[4] These statistics are from the U.S. Department of Health and Human Services, (1989), p. 148-151.

prominent risks identified in the medical literature, but it has never been subject to a previous survey analysis to determine the level of risk beliefs.

The general approach to heart disease was identical to that for lung cancer. Respondents first considered a heart disease question in terms of the risk per 100 smokers, and they also considered a relative heart disease risk question as well. Risk beliefs followed a pattern similar to those for lung cancer in that current smokers always had lower risk beliefs than did never smokers, as is shown in Table 1. What is striking about these results is that the level of heart disease risk beliefs is considerable. Even current smokers believe that 42 out of 100 smokers will get heart disease because they smoke, and they assess the relative risk of heart disease as being 7.3. Current smokers consequently believe that the risks of lung cancer and the risks of heart disease are each almost 50/50 propositions for current smokers.

The results in Table 5 indicate that these strong results regarding risk beliefs are not due to only a few smokers with very high risk assessments. Under nine percent of all smokers believe that the incremental heart disease probability from smoking is less that 10 percent, and just over half of the smoking population believes that the incremental heart disease risk is under 50 percent.

Attitudes across the different groups also seem to be quite similar in many respects. Current smokers and former smokers have cumulative distributions of heart disease risk beliefs that are very similar, with former smokers having a higher cumulative percentage in four of the categories shown. While the distribution of current smoker heart disease risk beliefs always lies above that for never smokers, the differences

[5] All these relative risk statistics are from the U.S. Department of Health and Human Services, (1989), p. 148-151.

become quite narrow as one reaches the very high risk levels, as only about 15 percent of current smokers and never smokers believe that the heart disease risk for smokers is 80 out of 100 or above.

The relative heart disease risk beliefs for smokers ranges from an assessment of 7.3 for current smokers to 10.8 for never smokers. Analysis of the distribution of these responses in Table 6 indicates that more than half of current smokers and just under half of never smokers believe that the relative risk is not greater than three. Thus, there is a substantial concentration of responses in the low relative risk range, even more so than in the case of lung cancer risks.

It is instructive to compare these relative risk responses with estimates for various heart disease risks. Let us consider the relative risks of coronary heart disease for current smokers with a history of regular cigarette smoking who are age 35 or higher. These values pertain to relative risk probabilities so that conversion to relative number of cases requires multiplication by 0.69. Evidence from CPS-I indicates that for current male smokers this relative risk value is 1.8, and for current female smokers this value is 1.40. Evidence from CPS-II is quite similar, with the risk for males of 1.94 and females of 1.78.[6] Thus, the substantial number of respondents with relatively low risk assessments is consistent with actual relative risk values. Moreover, the mean relative risk assessments for heart disease are many times greater than the actual relative risks.

These results, which suggest an overperception of the relative heart disease risk, are not surprising given the structure of the relative risk questions. In the case of heart disease, there is a substantial heart disease risk that people face regardless of their smoking status. Therefore, there is less of a tendency to understate the background risk of

heart disease for the heart disease relative risk question than there was for the comparable assessment of lung cancer and its associated background risk. Nevertheless, in each case, the relative risk questions are instructive but they are not as informative as would be a question that enabled respondents to focus exclusively on the incremental risk of smoking, rather than requiring their understanding about a background risk level that is essential for answering the question but not for making an informed smoking decision.

*3.4. Life Expectancy Loss*

Even if people understand the probability of various adverse events associated with smoking, one might well question whether they understand the extent of life at risk due to smoking. The questions in Viscusi (1992, 1998) explore this issue by presenting individuals with information on either normal life expectancy or on normal incremental life expectancy and asking people to assess what this life expectancy would be for smokers. By giving people this background information regarding normal life expectancy the question would not simultaneously be an understanding of the incremental risk effect of smoking as well as their understanding of life expectancy tables, thus enabling them to focus on the smoking risk per se. The approach taken in the survey in Spain did not provide this life expectancy information, but did describe in detail the smoking profile (see Table 2). The question referred to how long twin brothers would live, one of whom smoked. Analysis of the responses indicated that they viewed the question as referring to expected life expectancy rather than maximum life duration (e.g., the mean life expectancy value was 78.0 for nonsmokers). Moreover, some respondents apparently adapted the question to their own gender.

[6] These statistics are taken from the U.S. Department of Health and Human Services, (1989), p. 148-151.

The results differ significantly by gender because of the greater life expectancy at risk for females. As is indicated in Table 1, male smokers assess the life expectancy loss at 8.3 years, and males who have never smoked assess the loss at 11.5 years. The assessed life expectancy loss by female respondents is somewhat greater, ranging from 8.7 years for current smokers to 12.9 years for those who have never smoked.

By comparison, for current smokers in the United States in 1997 the assessed life expectancy loss reported in Viscusi (1998) was 7.9 years for males and 12.3 years for females, which is more of a gender difference than is indicated by the Spanish respondents. Similarly, for those who have never smoked, the assessed life expectancy loss is 11.6 years for males and 15.8 years for females, which once again is a greater gender gap than for the Spanish population. This smaller gender gap in Spain derives from the character of the question, which refers to brothers. The overall life expectancy loss for the full sample is 10.9 years in Spain as compared to 12.6 years in the United States. Thus, whereas the lung cancer risk beliefs were considerably higher for the Spanish sample, the life expectancy loss estimates are lower. This difference does not appear to be attributable to differences in life expectancy across the two countries. In Spain, life expectancy at birth is 74.7 years for men and 81.9 years for women,[7] whereas in the United States it is 73.0 for men and 79.0 for women.[8]

The life expectancy loss estimates in Table 7 indicate some intriguing responses. Somewhat strikingly, 11 percent of smokers believe that smoking does not diminish life expectancy, but in fact enhances it. This result could, of course, be the consequence of a misunderstanding of the life expectancy question, which involved a more complicated

[7] National Institute of Statistics (Spain), 1999. Data pertain to 1996.
[8] See the U.S. Bureau of the Census (1998).

comparison than was required to answer, for example, the lung cancer risk belief question. However, these errors are not random, but in fact are correlated with smoking status, as 11 percent of current smokers believe that smoking enhances life expectancy, as compared to only three percent of never smokers and four percent of former smokers.

For the most part, respondents in all categories believe that the life expectancy loss is considerable. Overall, 72 percent of all current smokers believe that the life expectancy loss is at least five years, and 90 percent of never smokers believe that the life expectancy loss is at least that great. These results suggest that underestimation of life expectancy loss is very little likely to be a problem. Scientific estimates of the life expectancy loss due to smoking are in the range of 3.6-7.2 years in the United States, so that the midpoint life expectancy loss estimate is under six years.[9]

*3.5. Relationship Among Risk Beliefs*

To what extent do respondents have similar risk beliefs across the major categories of hazards from smoking? If people believe that smoking is dangerous, presumably they believe it is hazardous in more than one way. Thus, one would expect a positive correlation between the various risk perception measures. To the extent that there is not a perfect positive correlation, beliefs in some kinds of hazards of smoking, such as lung cancer risk, can discourage smoking sufficiently even if the heart disease risk is underestimated.

Evidence in Table 8 takes the assessed lung cancer risk level as the basic reference point for analysis, but similar results are found with other variables as reference point. The table presents the mean heart disease risk and life expectancy loss assessments

for respondents at any given interval of lung cancer risk beliefs. As one would expect, one's assessment of heart disease risks increase steadily with one's lung cancer risk belief. Similarly, one's assessment of life expectancy loss due to smoking also steadily increases with is one's lung cancer risk belief. This positive relationship among the responses is expected and indicates that there are often other risk beliefs to bolster the effect of lung cancer risk perception.

However, it is noteworthy how multiple risks often discourage smoking, even in situations in which there is inadequate appreciation of lung cancer risks for smokers. Consider, for example, the extreme case of respondents who believe that the lung cancer risk for smokers is under 0.05. For that category of respondents, the assessed heart disease risk for smokers is 0.10, and the assessed life expectancy loss for smokers is 4.4 years. Similarly, if respondents believe that the lung cancer risk is below 0.10, there is nevertheless a heart disease risk perception of 0.13 and an assessed life expectancy loss for smokers of 8.1 years. At very high levels of risk, heart disease risk lies below the lung cancer risk level. It is at the extremes of the distribution that these relationships among the various risk perceptions are most interesting from the standpoint of rational choice. For people who have very low lung cancer risk assessments, other risk beliefs often serve to establish personal risk awareness and deter smoking. However, for people with very high lung cancer risk beliefs, the other risk perceptions are also high but are not the driving force in making risk perceptions relatively more extreme. The group of respondents at the extremely high end who believe that the lung cancer risk is at least 0.9 also have an assessed heart disease risk of 0.7 and a life expectancy loss of 14.2 years so that these respondents have an extremely negative view of smoking across the board.

[9] These estimates appear in Viscusi (1992), p. 80, and are based on reports by the U.S. Surgeon General.

*3.6. Risks of Diabetes*

The final risk question serves as a control for whether respondents have strong antismoking attitudes. Besides asking about the risk of lung cancer out of 100 smokers, the survey also asked whether cigarettes smoking was a diabetes risk factor. Unlike lung cancer and heart disease, there is no established statistical linkage between cigarette smoking and diabetes in the medical literature. This survey serves much the same function as did a question as to whether smoking causes flat feet that appeared in the 1997 survey reported in Viscusi (1998).

Although there is no established cigarette smoking-diabetes linkage, almost one fourth of all respondents believed that such a causal relationship exists. This risk assessment is almost twice as great for those who have never smoked as for current smokers, since diabetes risk assessment for never smokers is 0.28 whereas for current smokers the number is 0.15. These responses will be used in the subsequent analysis to control for potentially strong antismoking attitudes overall.

## 4. Regression Estimates of the Determinants of Risk Beliefs

Cigarette smokers are more likely to be males, to drink whiskey, and have lower risk beliefs overall. As was apparent from the results in Table 1, there are many significant relationships of this type, but it is also likely that these influences are highly correlated with one another since they may, for example, represent gender differences in various tastes and activities. In an effort to isolate these differences, the regression

estimates, presented below in Table 9, will analyze the determinants of various measures of risk perception as a function of these background characteristics.

The explanatory variables included will be a pair of dummy variables for the respondent age categories of age 18-25 and age 25-50, where the omitted age group is respondents who are age 51 and above. Respondent gender is indicated by dummy variables for whether the respondent is a male. The other two personal characteristic variables included are the years of schooling of the respondent and whether the respondent is a head of household (0-1 d.v.). There are several taste variables included in the analysis to include possible preferences for risky consumption decisions. Each of these variables is a 0-1 dummy variable by construction. They include whether the respondent prefers whiskey to beer, whether the respondent is not a whiskey or beer drinker, whether the respondent is a coffee drinker, and whether the respondent has no habit other than perhaps smoking. The two other variables that will be included in some of the regressions are whether the respondent believes that smoking is a diabetes risk factor and whether the respondent is a smoker.

The age variables are potentially interesting to the extent that they capture differences in the informational regime of the respondent. Antismoking information and medical research concerning the hazards of smoking has been increasing over time. Thus, as was found in Viscusi (1991, 1992), one would expect to find higher risk assessments by those in the younger age groups to the extent that they have been raised in a stronger antismoking environment. These results are in fact quite consistent for lung cancer and for lung disease, but the results are not statistically significant for heart disease. Respondents age 18-25 have higher assessed risks for both of the lung ailments

described in the survey, and those age 25-50 also have higher risk assessments for lung cancer as well for two of the three regression estimates, where these values are compared to the omitted age group. It is also noteworthy that the age 18-25 coefficients are always above those for the age 25-50 age groups for both lung cancer and lung disease, indicating a larger assessment of the risk for the lower age group as compared to the intermediate age group. Once again, however, such differences are not evident for heart disease, where one encounters the somewhat surprising result that those age 25-50 believe that the heart disease risk for smokers is lower than those assessed by people above age 50.

The results for gender are especially interesting to the extent that they reflect gender differences in attitude towards risk, as has been found by Hersch (1996). To the extent that men are more risk taking generally, it may be because of a lower assessed risk. For lung cancer and lung disease, male respondents have significantly lower risk assessments that are 0.03 to 0.04 lower in terms of the assessed probability. The results for heart disease once again are not statistically significant. These results are consistent with previous findings regarding gender differences in risk taking behavior, and also help explain why males in the Spanish population are more likely to be smokers than are females. The differences stem perhaps not only from a difference in tastes for smoking but also from a difference in the underlying risk beliefs associated with the activity.

The education of the respondent is a variable of substantial importance to the extent that it reflects the ability of the respondent to understand the risks of smoking. As education levels have risen over time, cigarette smoking has declined. Moreover, in the United States cigarette smoking diminishes substantially as one moves to the higher

educated groups. As was found in Table 1, however, this pattern is not exhibited in Spain as smokers have higher mean levels of education than do those who have never smoked. These differences may, however, be due to gender or other factors such as income effects with smoking being a normal good.

The results in Table 9 indicate that years of schooling is a powerful contributor to smoking risk beliefs, as it is statistically significant in almost every instance, except equation 4 in which it is significant at the 95 percent level only using a one-tail test. However, instead of better educated people having higher risk beliefs, their risk beliefs are consistently lower. These results do not indicate a misunderstanding of the risk, but rather a more accurate perception of it. To the extent that the sample overall greatly overestimates the hazards associated with smoking, the lower risk beliefs on the part of those who are better educated reflects more accurate risk perception, closer to the scientific estimates of the risk level than are the risk beliefs of less educated people. What these results show is that to the extent that one might hypothesize that cigarette smoking is due to inadequate risk beliefs, it is not an underlying lack of educational background that seems to be the contributing factor to any underassessment of smoking risks that exists.

It is also noteworthy that heads of household also have strongly negative coefficients in both the lung cancer and lung disease equations, but not in the heart disease equations. Male respondents tend to be better educated and also are more likely to be heads of household so that the overall effect of being male, a head of household, and to have 10 years of schooling is to have a risk belief that is 0.13 lower in terms of the probability of lung cancer.

The taste variables seem to be less influential in driving risk perceptions. Respondents who prefer whiskey to beer assess a higher risk of lung cancer, which is not what one might expect to the extent that whiskey is a more hazardous beverage because of its greater alcohol content. Coffee drinkers have consistently lower assessed risks of heart disease associated with smoking, which could reflect either a taste phenomenon or a belief in the heart disease risks associated already with their coffee drinking status.

People who believe that smoking is a diabetes risk factor are likely to have stronger antismoking attitudes more generally. This negative attitude toward smoking is in fact borne out by the results, as this variable increases the assessed probability of lung cancer by 0.06, the assessed probability of lung disease by 0.08, and heart disease risk belief by 0.02. As with all the preceding results, the strongest influences are for lung cancer and lung disease rather than for heart disease.

The final variable reported in Table 9 is the coefficient on smoking status, which is potentially endogenous. Cigarette smokers have lower risk beliefs controlling for other influences. This discrepancy for smokers ranges from 0.03 for heart disease to a high of 0.06 for the second lung cancer equation reported. Most of the difference between the risk beliefs for smokers and other population groups that was found in Table 1 consequently persists even after controlling for the other demographic characteristics reported in Table 1 as well as the series of regional and background variables that were included in the survey but were not reported.[10]

Table 10 presents analogous results for estimates of the natural logarithm of the relative risks for smokers. The effects of the demographic and taste background variables

are quite similar. However, an interesting exploration is to determine the extent to which the natural logarithm of the assessed risk influences the value of the log of the relative risk. The relationship is in fact definitional, as

$$\ln(\text{relative lung cancer risk}) = \ln(\text{lung cancer risk due to smoking}) - \ln(\text{background risk of lung cancer}). \quad (2)$$

As indicated in Equation 1, respondents did not assess the relative risk but the relative number of smokers and nonsmokers who developed the particular ailment, such as lung cancer. For any given level of smokers and nonsmokers, their responses equal

$$\ln(\text{relative number of lung cancer cases}) = \ln(S/NS) + \ln(\text{relative lung cancer risk}). \quad (3)$$

Thus, the survey variation of the relative risk question adds a constant term to the equation if all respondents have the same perception of S and NS. Given the definitional relationship, the expected magnitude of the lung cancer risk variable in relative lung cancer risk equation 2 should be 1.0. One should find similar coefficients for the lung disease and heart disease variables as well. The first set of estimates in Table 10 omit the log of the lung cancer risk and the comparable variables for lung disease and heart disease. The principal results here are that age has a consistently strong negative effect on risk beliefs as those in the lower age groups have a lower risk assessment than do their older counterparts. The results for the other variables are more mixed.

The second specification in each case presents the ordinary least squares estimates for the risk numerator in the relative risk calculation. The responses are sufficiently similar in that there is a consistent positive influence of these variables on the relative

[10] Notice that the goal of this empirical exercise is testing behavioral hypotheses regarding smoking risk beliefs, not predicting smoking risk perceptions. Therefore, the low reported $R^2$ values do not indicate problems.

risk value, with coefficients ranging from 0.23-0.34. These values lie below the hypothesized value of 1.0 if the respondent's responses were fully consistent.

To control for the potential endogeneity of the smoking-related risk beliefs, the third set of estimates in each case includes an instrumental variables estimate of the risk variable. The instrument used for these very exploratory IV estimates is whether the respondent "believes smoking is a diabetes risk factor." These coefficients are also statistically significant, with estimates ranging from 1.64 to 1.75. In each case, however, one cannot reject the hypothesis that the coefficient is 1.0, as hypothesized in Equation 2.

## 5. Conclusion

Cigarette smoking poses a considerable risk to those who smoke. Evidence for the United States indicates that there is widespread public awareness of these hazards. However, it is possible that this strong risk awareness stems from the specific risk information efforts and hazard warnings in place in the United States and are not generalizable to other countries.

This paper extended our understanding of smoking risk beliefs in two ways. First, by utilizing data from Spain it examined the determinants of risk perceptions in another major developed country, but one with a much different smoking risk information regime. Although substantial qualitative differences remain in the informational efforts in Spain as compared to the United States, there are many parallels in these efforts as well, with the principal difference being that the warnings in Spain follow much the same pattern as those in the United States, but with a substantial lag.

The second extension of our analysis was in terms of the character of the risk perception questions asked and the analyses pertaining to them. Whereas studies for the United States have focused on perceptions of lung cancer risk, mortality risk, and life expectancy loss, this article also included perceptions of the risks of lung disease and heart disease. Moreover, in addition to asking objective risk questions, the survey in Spain also elicited information pertaining to relative risk assessments for smokers as compared to nonsmokers.

The results were consistent across all different measures of risk belief. There was strong evidence of substantial risk beliefs for all forms of risks that have been linked to smoking. Moreover, for the question that was most comparable to that posed in U.S. surveys – that pertaining to lung cancer – the estimates for Spain indicated a higher level of risk belief than in the United States, where risks are also overassessed.

The variations in risk belief and the different determinants of smoking behavior also generated intriguing results, some of which are contrary to one's expectations based on casual observation and the experience in the United States. Most noteworthy is that risk beliefs of better educated smokers are lower rather than higher. This result is not surprising given the substantial overassessment of risk by the population at large, as better educated respondents' risk beliefs are more accurate. However, it does run contrary to the popular misconception that smoking decisions are the consequence of inadequate risk information, which in turn is attributable to the lack of education among smokers.

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*Table 1*. Sample Characteristics

| | Mean (Standard Error of Mean) | | | |
|---|---|---|---|---|
| | Current Smoker | Former Smoker | Never Smoked | Total |
| Personal Characteristics | | | | |
| Age | 36.60 (0.43) | 48.70 (0.72) | 46.18 (0.51) | 43.54 (0.33) |
| Male | 0.55 (0.02) | 0.66 (0.02) | 0.34 (0.01) | 0.47 (0.01) |
| Years of schooling | 10.64 (0.11) | 10.04 (0.16) | 9.45 (0.10) | 9.95 (0.07) |
| Head of household | 0.40 (0.02) | 0.62 (0.02) | 0.31 (0.01) | 0.40 (0.01) |
| Prefers whiskey to beer | 0.28 (0.02) | 0.22 (0.02) | 0.11 (0.01) | 0.19 (0.01) |
| Not a whiskey or beer drinker | 0.29 (0.02) | 0.34 (0.02) | 0.53 (0.01) | 0.41 (0.01) |
| Coffee drinker | 0.84 (0.01) | 0.71 (0.02) | 0.68 (0.01) | 0.74 (0.01) |
| No habit, maybe smoking | 0.014 (0.004) | 0.10 (0.01) | 0.13 (0.01) | 0.09 (0.01) |
| Smoking Risk Beliefs | | | | |
| Lung cancer risk x 100[a] | 46.26 (0.97) | 47.76 (1.25) | 52.82 (0.76) | 49.67 (0.54) |
| Relative lung cancer risk for smokers[b] | 9.40 (0.59) | 11.04 (0.83) | 13.10 (0.59) | 11.47 (0.38) |
| Lung disease risk x 100 | 51.19 (0.98) | 53.35 (1.27) | 56.77 (0.77) | 54.25 (0.55) |
| Relative lung disease risk for smokers | 9.63 (0.60) | 9.50 (0.77) | 12.92 (0.60) | 11.17 (0.38) |
| Heart disease risk x 100[c] | 42.01 (0.96) | 43.42 (1.27) | 47.05 (0.79) | 44.66 (0.55) |
| Relative heart disease risk for smokers | 7.33 (0.53) | 8.53 (0.74) | 10.77 (0.56) | 9.18 (0.35) |
| Diabetes risk x 100 | 17.56 (1.07) | 23.97 (1.65) | 28.58 (1.06) | 23.92 (0.70) |

*Table 1* cont.

| | Mean (Standard Error of Mean) | | | |
|---|---|---|---|---|
| | Current Smoker | Former Smoker | Never Smoked | Total |
| Life expectancy loss[d] | 8.48 (0.31) | 11.46 (0.36) | 12.42 (0.24) | 10.94 (0.17) |
| Males | 8.30 (0.38) | 11.22 (0.41) | 11.48 (0.36) | 10.18 (0.23) |
| Females | 8.70 (0.51) | 11.90 (0.70) | 12.90 (0.31) | 11.61 (0.25) |
| Believes smoking is diabetes risk factor x 100 | 15.05 (1.23) | 22.22 (1.84) | 28.25 (1.29) | 22.71 (0.83) |
| Observations | 844 | 513 | 1,214 | 2,571 |
| | Median Values | | | |
| Relative lung cancer risk for smokers | 4 | 4 | 5 | 5 |
| Relative lung disease risk for smokers | 4 | 4 | 5 | 4 |
| Relative heart disease risk for smokers | 3 | 3 | 4 | 3 |

(a) Number of smokers out of 100 who get lung cancer during their lifetime because they smoke.
(b) Reported ratio of the risk for smokers and non-smokers of getting lung cancer during their lifetime.
(c) Number of smokers out of 100 who get heart disease during their lifetime because they smoke.
(d) Difference in life expectancy between non-smokers and smokers.
Notes: The means of all variables for current smokers are statistically significantly different for the means for never smokers

*Table 2*. Summary of English translation of the text of survey questions pertaining to smoking risks

| | Spanish Text | English Translation |
|---|---|---|
| 8a. | ¿cree usted que los que son fumadores contraen más cáncer de pulmón que los no fumadores? | Do you believe that smokers get more **lung cancer** than nonsmokers? |
| 8b. | Por cada persona no fumadora que muere de cáncer de pulmón, ¿cuántos cree usted que mueren por ser fumadores? | For each nonsmoker that dies of **lung cancer**, how many smokers die? |
| 8c. | De cada 100 fumadores, ¿cuántos piensa usted que acabarán teniendo cáncer de pulmón debido al hábito de fumar? De 0 a 100. | Out of 100 smokers, how many do you think will get **lung cancer** due to their smoking habit? From 0 to 100. |
| 8d. | Dígame la cifra que espontáneamente parezca más lógica. De 0 a 100. | [*If answer "don't know" to question 8c*.] Tell me which number spontaneously seems more logical. From 0 to 100. |
| | Imagine dos personas que son hermanos gemelos y que han vivido toda su vida de la misma manera, en la misma cuidad, con las mismas costumbres y hábitos, solo que uno fuma un paquete de cigarrillos diarios desde los 20 años y el otro no ha fumado nunca. | Imagine two twin brothers that have lived their entire lives in the same way, in the same city, with the same customs and habits, except one has smoked a pack of cigarettes a day for 20 years and the other has never smoked. |
| 14. | ¿Hasta qué edad piensa que puede llegar a vivir el hermano gemelo que no fuma? | Until what age do you think the twin brother who does not smoke will live? |
| 15. | ¿Hasta qué edad piensa que puede llegar a vivir el hermano gemelo que fuma? | Until what age do you think the twin brother who smokes will live? |
| 16. | Hasta qué edad piensa que puede llegar a vivir el hermano gemelo que no fuma si vive en la misma casa que el que fuma? | Until what age do you think the twin brother who does not smoke will live if he lives in the same house as the brother who smokes? |

Notes: Questions 9.1-9d. are the same as 8a.-8d. but for the term in bold letters, which is **heart disease** for these questions. Questions 10.1-10d. are the same as 8a.-8d. but for the term in bold letters, which is **lung disease (for example: bronchitis, emphysema)** for these questions. Questions 11.1-11d. are the same as 8a.-8d. but for the term in bold letters, which is **diabetes** for these questions.

*Table 3*. The distribution of lung cancer risk beliefs for smokers as a function of smoking behavior

| | Cumulative Percentage | | | |
|---|---|---|---|---|
| Lung Cancer Risk for Smokers x 100 | Current Smoker | Former Smoker | Never Smoked | Total |
| 0≤Risk<5 | 3.74 | 3.48 | 1.03 | 2.41 |
| 5≤Risk<10 | 6.86 | 7.58 | 3.87 | 5.59 |
| 10≤Risk<20 | 18.21 | 16.60 | 9.97 | 13.99 |
| 20≤Risk<30 | 31.43 | 29.92 | 20.46 | 25.93 |
| 30≤Risk<40 | 38.66 | 35.86 | 27.94 | 33.02 |
| 40≤Risk<50 | 46.14 | 45.08 | 36.02 | 41.13 |
| 50≤Risk<60 | 64.72 | 62.09 | 55.54 | 59.84 |
| 60≤Risk<70 | 72.33 | 70.29 | 65.00 | 68.44 |
| 70≤Risk<80 | 81.06 | 81.56 | 77.73 | 79.57 |
| 80≤Risk<90 | 90.91 | 89.55 | 88.31 | 89.39 |
| 90≤Risk<100 | 98.39 | 97.54 | 97.77 | 97.91 |
| Risk=100 | 100.00 | 100.00 | 100.00 | 100.00 |
| Total Number in Group | 802 | 488 | 1163 | 2453 |

*Table 4*. The distribution of relative lung cancer risk beliefs for smokers as a function of smoking behavior

| Relative Lung Cancer Risk for Smokers | Cumulative Percentage | | | |
|---|---|---|---|---|
| | Current Smoker | Former Smoker | Never Smoked | Total |
| 1<Risk≤3 | 42.40 | 37.93 | 33.98 | 37.54 |
| Risk≤7 | 78.44 | 77.50 | 69.36 | 73.99 |
| Risk≤10 | 91.75 | 89.72 | 85.55 | 88.44 |
| Risk≤50 | 98.26 | 99.01 | 96.92 | 97.78 |

*Table 5*. The distribution of heart disease risk beliefs for smokers as a function of smoking behavior

| | Cumulative Percentage | | | |
|---|---|---|---|---|
| Heart Disease Risk for Smokers x 100 | Current Smoker | Former Smoker | Never Smoked | Total |
| Risk<5 | 5.22 | 5.10 | 3.37 | 4.33 |
| Risk<10 | 8.88 | 8.07 | 6.01 | 7.37 |
| Risk<20 | 20.37 | 19.75 | 15.58 | 18.00 |
| Risk<30 | 35.12 | 36.31 | 28.16 | 32.10 |
| Risk<40 | 43.74 | 44.59 | 36.00 | 40.28 |
| Risk<50 | 51.96 | 53.08 | 42.38 | 47.69 |
| Risk<60 | 72.59 | 67.52 | 63.44 | 67.27 |
| Risk<70 | 78.86 | 74.53 | 73.74 | 75.58 |
| Risk<80 | 85.91 | 84.72 | 84.13 | 84.83 |
| Risk<90 | 93.48 | 91.73 | 92.33 | 92.58 |
| Risk<100 | 98.44 | 98.52 | 98.07 | 98.28 |
| Risk=100 | 100.00 | 100.00 | 100.00 | 100.00 |
| Total Number in Group | 766 | 471 | 1097 | 2334 |

*Table 6*. The distribution of relative heart disease risk beliefs for smokers as a function of smoking behavior

| Relative Heart Disease Risk for Smokers | Percentage | | | |
|---|---|---|---|---|
| | Current Smoker | Former Smoker | Never Smoked | Total |
| 1<Risk≤3 | 55.72 | 50.61 | 46.41 | 50.34 |
| Risk≤7 | 78.44 | 77.50 | 69.36 | 73.99 |
| Risk≤10 | 91.75 | 89.72 | 85.55 | 88.44 |
| Risk≤50 | 98.26 | 99.01 | 96.92 | 97.78 |

*Table 7.* The distribution of life expectancy loss beliefs for smokers as a function of smoking behavior.

| | Cumulative Percentage | | | |
|---|---|---|---|---|
| Life Expectancy Loss | Current Smoker | Former Smoker | Never Smoked | Total |
| $x<0$ | 11.30 | 4.03 | 3.38 | 6.15 |
| $0\leq x<1$ | 25.25 | 11.49 | 8.07 | 14.40 |
| $1\leq x<3$ | 27.26 | 12.27 | 8.98 | 15.64 |
| $3\leq x<5$ | 28.33 | 13.44 | 9.72 | 16.57 |
| $5\leq x<10$ | 45.04 | 30.01 | 25.62 | 32.87 |
| $10\leq x<15$ | 75.37 | 64.71 | 58.32 | 65.19 |
| $x>15$ | 100.00 | 100.00 | 100.00 | 100.00 |
| Total | 844 | 513 | 1214 | 2571 |

*Table 8*. Mean risk assessments, conditional on different levels of lung cancer risk

| Lung Cancer Risk for Smokers x 100 | Heart Disease Risk for Smokers x 100 | Life Expectancy Loss for Smokers |
|---|---|---|
| Risk<5 | 10.44 | 4.42 |
| 5≤Risk<10 | 13.14 | 8.12 |
| 10≤Risk<20 | 19.69 | 8.72 |
| 20≤Risk<30 | 27.30 | 9.77 |
| 30≤Risk<40 | 32.32 | 10.32 |
| 40≤Risk<50 | 37.22 | 10.48 |
| 50≤Risk<60 | 45.61 | 11.31 |
| 60≤Risk<70 | 51.40 | 12.20 |
| 70≤Risk<80 | 60.53 | 12.56 |
| 80≤Risk<90 | 63.51 | 12.69 |
| 90≤Risk<100 | 71.00 | 14.15 |
| Risk=100 | 75.68 | 14.49 |

*Table 9*. Regression estimates of the risk assessment equation

| | Coefficient (standard error) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lung Cancer | | | Lung Disease | | | Heart Disease | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Constant | 54.727 | 57.767 | 55.159 | 47.522 | 51.497 | 47.825 | 14.776 | 15.702 | 14.982 |
| | (2.404)** | (2.321)** | (2.397)** | (2.450)** | (2.373)** | (2.448)** | (0.756)** | (0.726)** | (0.749)** |
| Age 18-25 | 5.039 | 6.138 | 6.395 | 4.499 | 5.041 | 5.423 | -0.701 | -0.081 | -0.014 |
| | (2.158)* | (2.178)** | (2.172)** | (2.183)* | (2.214)* | (2.201)* | (0.684) | (0.685) | (0.684) |
| Age 25-50 | 1.988 | 2.985 | 3.376 | 1.223 | 1.683 | 2.221 | -1.159 | -0.547 | -0.443 |
| | (1.429) | (1.459)* | (1.458)* | (1.453) | (1.494) | (1.488) | (0.447)** | (0.453) | (0.453) |
| Male | -3.800 | -3.369 | -3.501 | -3.783 | -3.445 | -3.596 | -0.783 | -0.605 | -0.642 |
| | (1.312)** | (1.313)* | (1.309)** | (1.334)** | (1.341)* | (1.333)** | (0.414) | (0.411) | (0.410) |
| Years of schooling | -0.402 | -0.520 | -0.438 | -0.352 | -0.496 | -0.377 | -0.191 | -0.229 | -0.208 |
| | (0.181)* | (0.180)** | (0.180)* | (0.185) | (0.185)** | (0.185)* | (0.056)** | (0.056)** | (0.056)** |
| Head of household | -5.355 | -5.456 | -5.233 | -3.644 | -3.825 | -3.541 | -0.177 | -0.172 | -0.104 |
| | (1.380)** | (1.378)** | (1.375)** | (1.414)* | (1.421)** | (1.412)* | (0.434) | (0.431) | (0.430) |
| Prefers whiskey to beer | 2.692 | 3.188 | 3.287 | 2.215 | 2.392 | 2.550 | -0.014 | 0.265 | 0.287 |
| | (1.515) | (1.520)* | (1.515)* | (1.531) | (1.542) | (1.533) | (0.479) | (0.477) | (0.476) |
| Not a whiskey or beer drinker | 0.354 | 0.121 | 0.151 | 0.704 | 0.418 | 0.529 | 0.813 | 0.680 | 0.693 |
| | (1.309) | (1.310) | (1.305) | (1.324) | (1.332) | (1.323) | (0.412)* | (0.409) | (0.408) |
| Coffee drinker | -1.377 | -0.895 | -0.702 | -0.242 | -0.001 | 0.219 | -1.275 | -0.954 | -0.902 |
| | (1.433) | (1.440) | (1.436) | (1.448) | (1.462) | (1.453) | (0.453)** | (0.453)* | (0.452)* |
| No habit, maybe smoking | -1.404 | -1.232 | -1.592 | -1.458 | -0.832 | -1.561 | -1.000 | -0.977 | -1.077 |
| | (2.453) | (2.450) | (2.444) | (2.509) | (2.518) | (2.505) | (0.766) | (0.760) | (0.759) |
| Believes smoking is diabetes risk factor | 5.820 | | 5.380 | 7.581 | | 7.291 | 1.785 | | 1.553 |
| | (1.297)** | | (1.295)** | (1.305)** | | (1.307)** | (0.411)** | | (0.408)** |
| Smoker | | -5.845 | -5.454 | | -4.270 | -3.756 | | -2.934 | -2.821 |
| | | (1.228)** | (1.227)** | | (1.252)** | (1.248)** | | (0.384)** | (0.384)** |
| R-squared | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 |
| Observations | 2452 | 2452 | 2452 | 2333 | 2333 | 2333 | 2569 | 2569 | 2569 |

Notes: * significant at 5% level, two-tailed test; ** significant at 1% level, two-tailed test. Coefficients on indicators for living in a city with more than 100,000, but less than 1 million inhabitants, living in a city with more than 1 million inhabitants, blue collar job and living in a metropolitan area are not reported.

*Table 10*. Regression estimates of the log of relative risks for smokers

| | Coefficient (standard error) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lung Cancer | | | Lung Disease | | | Heart Disease | | |
| | OLS | OLS | IV | OLS | OLS | IV | OLS | OLS | IV |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Constant | 1.873 (0.093)** | 0.981 (0.138)** | -4.879 (1.867)** | 2.020 (0.093)** | 1.091 (0.149)** | -4.768 (2.076)* | 1.706 (0.097)** | 0.487 (0.135)** | -4.380 (1.365)** |
| Age 18-25 | -0.248 (0.086)** | -0.282 (0.085)** | -0.509 (0.152)** | -0.194 (0.086)* | -0.238 (0.085)** | -0.476 (0.151)** | -0.247 (0.089)** | -0.295 (0.086)** | -0.440 (0.135)** |
| Age 25-50 | -0.221 (0.057)** | -0.218 (0.057)** | -0.232 (0.090)* | -0.206 (0.058)** | -0.212 (0.057)** | -0.234 (0.084)** | -0.229 (0.060)** | -0.240 (0.058)** | -0.254 (0.088)** |
| Male | 0.042 (0.052) | 0.062 (0.052) | 0.202 (0.093)* | -0.023 (0.053) | -0.015 (0.052) | 0.068 (0.082) | 0.007 (0.055) | 0.049 (0.052) | 0.204 (0.090)* |
| Years of schooling variable | -0.002 (0.007) | 0.000 (0.007) | 0.016 (0.012) | -0.016 (0.007)* | -0.016 (0.007)* | -0.016 (0.011) | -0.007 (0.008) | -0.005 (0.007) | 0.006 (0.011) |
| Head of household | -0.033 (0.056) | 0.001 (0.055) | 0.231 (0.114)* | -0.062 (0.056) | -0.030 (0.055) | 0.183 (0.111) | -0.057 (0.058) | 0.017 (0.056) | 0.242 (0.105)* |
| Prefers whiskey to beer | 0.050 (0.061) | 0.050 (0.060) | 0.017 (0.095) | 0.049 (0.061) | 0.058 (0.060) | 0.026 (0.090) | 0.042 (0.063) | 0.016 (0.060) | -0.092 (0.095) |
| Not a whiskey or beer drinker | 0.027 (0.052) | 0.024 (0.052) | -0.010 (0.082) | -0.075 (0.053) | -0.085 (0.052) | -0.143 (0.080) | 0.008 (0.054) | -0.001 (0.052) | -0.050 (0.080) |
| Coffee drinker | -0.085 (0.057) | -0.069 (0.056) | -0.003 (0.091) | -0.034 (0.057) | -0.039 (0.056) | 0.014 (0.085) | -0.054 (0.059) | -0.037 (0.056) | -0.013 (0.085) |
| No habit, maybe smoking | -0.091 (0.099) | -0.079 (0.098) | -0.104 (0.156) | 0.033 (0.100) | 0.041 (0.099) | 0.157 (0.152) | 0.055 (0.105) | 0.042 (0.100) | 0.037 (0.151) |
| Ln(lung cancer risk) | | 0.230 (0.027)** | 1.737 (0.479)** | | | | | | |
| Ln(lung disease risk) | | | | | 0.245 (0.030)** | 1.754 (0.533)** | | | |
| Ln(heart disease risk) | | | | | | | | 0.337 (0.026)** | 1.644 (0.365)** |
| Observations | 2195 | 2174 | 2174 | 2162 | 2148 | 2148 | 2076 | 2012 | 2012 |
| R-squared | 0.02 | 0.05 | | 0.02 | 0.05 | | 0.02 | 0.10 | |

Notes: * significant at 5% level, two-tailed test; ** significant at 1% level, two-tailed test. Coefficients on indicators for living in a city with more than 100,000, but less than 1 million inhabitants, living in a city with more than 1 million inhabitants, blue collar job and living in a metropolitan area are not reported. The instrument used for the IV estimates is “believes smoking is diabetes risk factor”.

**Appendix**

Original Spanish Text of Cigarette Product Warnings

| Legislation | Warning Text |
|---|---|
| 1982 Royal Decree (Real Decreto 709/1982) [1] | Advertencia: La Dirección General de Salud Pública advierte que el uso del tabaco puede ser perjudicial para su salud» |
| 1983 Royal Decree (Real Decreto 2072/1983) [1] | Advertencia: La Dirección General de Salud Pública advierte que el uso del tabaco es perjudicial para su salud» |
| 1988 Royal Decree (Real Decreto 192/1988) [1] | Advertencia: Las autoridades sanitarias advierten que:<br>-Fumar perjudica seriamente la salud<br>-Fumar provoca cáncer<br>-Fumar provoca enfermedades cardiovasculares<br>-Fumar en el embarazo daña al futuro hijo |
| 1992 Royal Decree (Real Decreto 510/1992) [1] | Advertencias:<br>1. Las Autoridades Sanitarias advierten que el tabaco perjudica seriamente la salud<br>2. Las Autoridades Sanitarias advierten:<br>-Fumar provoca cáncer<br>-Fumar provoca enfermedades cardiovasculares<br>-Fumar durante el embarazo daña al futuro hijo<br>-Proteja a los niños; no les haga respirar el humo del tabaco<br>-Fumar provoca cáncer, bronquitis crónica y otras enfermedades pulmonares<br>-Fumar perjudica a los que le rodean |
| 1991 Catalan Legislation [2] | 1. Fumar perjudica seriamente su salud<br>2. El humo del tabaco perjudica la salud del fumador activo y pasivo |

[1] Source: Official Bulletin of the State (Boletín Oficial del Estado)
[2] Source: Official Bulletin of Catalonia (Boletín Oficial de Catalunya)