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# The Efficacy of Cigarette Warning Labels on Health Beliefs in the United States and Mexico

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*Concern over health risks is the most common motivation for quitting smoking. Health warnings on tobacco packages are among the most prominent interventions to convey the health risks of smoking. Face-to-face surveys were conducted in Mexico (n = 1,072), and a web-based survey was conducted in the US (n = 1,449) to examine the efficacy of health warning labels on health beliefs. Respondents were randomly assigned to view two sets of health warnings (each with one text-only warning and 5–6 pictorial warnings) for two different health effects. Respondents were asked whether they believed smoking caused 12 different health effects. Overall, the findings indicate high levels of health knowledge in both countries for some health effects, although significant knowledge gaps remained; for example, less than half of respondents agreed that smoking causes impotence and less than one third agreed that smoking causes gangrene. Mexican respondents endorsed a greater number of correct beliefs about the health effects of smoking than did the U.S. sample. In both countries, viewing related health warning labels increased beliefs about the health risks of smoking, particularly for less well-known health effects such as gangrene, impotence, and stroke.*

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Tobacco use remains the leading preventable cause of death worldwide (World Health Organization, 2008a). Smoking-related diseases, including respiratory diseases, various forms of cancer, and cardiovascular disease, account for more than 5 million deaths per year. It is estimated that this number will rise to 8 million by 2030 if current patterns remain unchanged.

Concern about the health risks of smoking is among the most common motivations to quit among current and former smokers (Curry, Grothaus, & McBride, 1997; Hammond, McDonald, Fong, Brown, & Cameron, 2004; Hyland et al., 2004). Previous studies have demonstrated that smokers with greater knowledge of the health risks of smoking were more likely to intend to quit and were more successful in their quit attempts (Nourjah, Wagener, Eberhardt, & Horowitz, 1994; Romer & Jamieson, 2001). Although it is generally assumed that smokers are well aware of the health risks associated with smoking and tobacco use, significant gaps in health knowledge remain, even in high-income countries such as Canada and the United States (Hammond, Fong, McNeill, Borland, & Cummings, 2006; Health Canada, 2007). Risk perceptions are lower in most low- or middle-income countries, which are characterized by limited access to health information, less exposure to mass media campaigns, and lower literacy levels (World Health Organization, 2008b).

Communicating the health effects of smoking remains a primary objective for tobacco control. Health warnings on cigarette packages are an excellent medium for communicating health information given their reach and frequency of exposure, at the point of purchase and at the time of smoking behavior. Findings from experimental and population-based studies have demonstrated that pictorial health warnings are more likely to be noticed and read by smokers than are text-only warnings, and they are associated with greater motivation to quit smoking (Hammond, 2011).

Despite the evidence demonstrating a consistent association between health knowledge and smoking cessation, few studies have examined the influence of pictorial health warning labels directly on health knowledge. Further, most of this research has been conducted in high-income countries and it is unknown whether these findings would apply to low- or middle-income countries. For example, graphic pictures of disease may violate cultural norms or simply prove to be too offensive in populations with little or no exposure to strong health communications. Cultural groups also vary in their focus on different organ systems as responsible for illness, as well as in the anxiety that they associate with different kinds of bodily symptoms (Good & Good, 1981; McElroy & Jezewski, 2003). For example, graphic pictures of disease may violate cultural norms or simply prove to be too offensive in populations with little or no exposure to strong health communications. As a result, the effectiveness of pictorial health warnings may differ with respect to the type of health effect they communicate.

The present study examined the efficacy of health warning labels on health beliefs among samples of adults and youth in the United States and Mexico. At the time this study was conducted, text-only warnings appeared on cigarette packages in both countries. In Mexico, text-only warnings covered 50% of the back of cigarette packages and included the following three messages that have remained the same since 2004: "Smoking causes cancer and emphysema," "Quitting smoking reduces significant health risks," and "Smoking during pregnancy increases risk of premature birth and low birth weight babies." U.S. labeling policy requires that text-only warnings cover one side panel of cigarette packages and include the following four messages that have remained the same since 1984: "Surgeon General's warning: Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy"; "Quitting smoking now greatly reduces

serious risks to your health”; “Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight”; and “Cigarette smoke contains carbon monoxide.” This study aimed to (a) assess knowledge that smoking causes death, lung cancer, throat cancer, emphysema, mouth cancer, heart disease, harm to unborn babies, wrinkling and aging of skin, stroke, lung cancer from second-hand smoke exposure, impotence in male smokers, and gangrene; (b) determine whether health warnings increase health knowledge that is specific to warning label content; (c) determine the extent to which health beliefs differ by socioeconomic and individual-level factors, such as gender, age, education, and ethnicity; and (4) examine potential country-level differences in health knowledge and effects of warnings between the United States and Mexico.

## **Method**

In Mexico, face-to-face surveys were conducted between June and August 2010 using computer-assisted personal interviewing. Respondents were recruited using a standardized intercept technique (Sudman, 1980), whereby people were counted as they passed a geographical landmark and every third individual was approached by a trained interviewer. Study sites included two public parks, a bus terminal, and outside five WalMart stores in Mexico City. Respondents were given a 50-peso phone card (equivalent to approximately US\$4) as a token of appreciation.

In the United States, a web-based survey was conducted in December 2010. Respondents were recruited via email from a consumer panel maintained by Global Market Institute, with a panel reach of more than 2.8 million individuals. Respondents received points from Global Market Institute (equivalent to approximately US\$3) in appreciation of their time. (Additional panel details can be found at <http://www.gmi-mr.com>).

All respondents were at least 16 years of age. Two groups of people were recruited for the study: (a) adult (19 years of age and older) smokers, and (b) youth (16–18 years of age), including smokers and nonsmokers. Before beginning the interview, all respondents were provided with information about the study and asked to provide verbal consent (in Mexico) or by clicking a box on screen (in the United States). No personal information identifiers were collected; respondents remained anonymous. The study was reviewed by and received ethics clearance from the Office of Research Ethics at the University of Waterloo.

## **Protocol**

After completing questions on sociodemographics and smoking behavior, participants viewed a series of health warnings. Each respondent was randomly assigned to view 2 of 15 sets of health warnings, each for a different health effect of smoking (note that the Mexico study included an additional two sets of warnings on tobacco smoke constituents that are not reported in the current paper). Each set included five to seven warnings on the same health effect, in a variety of executional styles. These included a text-only warning, as well as a variety of approaches to pictorial warnings, including graphic health effects (i.e., physical effect on the body), “lived experience” (i.e., individual suffering the consequences of smoking), symbolic (i.e., metaphorical representation of risk), or other popular approaches used in other countries. The text used in the warnings was the same for each warning within a particular set, with the exception of the testimonials. Testimonials featured the same picture as one of the “lived experience” warnings but with a brief narrative describing a personal aspect of

the same content, written as a quote from a person in the image, whose name and age were also included.

After viewing health warnings, respondents were asked whether they believed that smoking causes the following 12 health effects: lung cancer, heart disease, stroke, mouth cancer, throat cancer, emphysema, gangrene, impotence in male smokers, wrinkling and aging of the skin, death, harm to unborn babies, lung cancer in nonsmokers from breathing cigarette smoke. Warnings were kept as similar as possible across countries, but were adapted for local use. Adaptation of the warnings included the following: (a) translation into the local language; (b) use of racially appropriate models in images, where relevant and possible; and (c) locally-appropriate names for the testimonials. All local versions of the warnings were checked by the local research team for appropriateness. (All warnings included in the study can be viewed at <http://www.tobaccolabels.ca/study>).

## Measures

### Demographics

Demographic variables included gender, age, education level, income level, and ethnicity. For the respondents in Mexico, we categorized adult education level as *low* (primary, middle, technical/vocational school, or less), *moderate* (high school or some university), or *high* (university degree or higher). For the respondents in the United States, we categorized adult education level as *low* (high school or less), *moderate* (technical/trade school or community college, or some university), and *high* (university degree or higher). Income information, collected only for U.S. respondents, was categorized as *low* (less than \$30,000), *moderate* (\$30,000 to \$59,999), or *high* (\$60,000 or more). Ethnicity details were also collected only for U.S. respondents and were categorized as *minority* (included Black or African American, Hispanic or Latino, Asian or Pacific Islander, Native American Indian, mixed race, and other) or *nonminority* (White).

### Smoking Behavior

Respondents were asked about their smoking behaviour, including smoking frequency and quit intentions. To assess smoking frequency, respondents were asked "In the last 30 days, how often did you smoke cigarettes?" We categorized those who responded with "every day" as *daily smokers*, those who responded with "at least once a week" or "at least once in the last month" as *nondaily smokers*, and those who responded with "not at all" as *nonsmokers*. Adult samples in both the United States and Mexico did not include *nonsmokers*. To assess quit intentions, we asked adult and youth smokers, "Are you planning to quit ... 1) 'Within the next month'; 2) 'Within the next 6 months'; 3) 'Some time in the future, beyond 6 months'; or 4) 'Not planning to quit.'" We dichotomized response options into 0 (*not planning to quit*) and 1 (*planning to quit*), which included the first three options.

### Health Beliefs

After presentation of the health warnings, we prompted respondents with the following in Mexico:

I am going to read you a list of health effects and diseases that may or may not be caused by smoking cigarettes. Based on what you know or believe,

does smoking cause ... [lung cancer, heart disease, stroke, mouth cancer, throat cancer, emphysema, gangrene, impotence in male smokers, wrinkling and aging of the skin, death, harm to unborn babies, lung cancer in nonsmokers from breathing cigarette smoke].

This was worded differently in the United States because of the self-complete web-based survey design "You will now be presented with a list of ..." Response options included "yes," "no," and "don't know" and were dichotomized as follows: 0 for "no" and "don't know" and 1 for "yes."

A Health Belief Index was created to measure respondents' level of health knowledge. The index was calculated on the basis of the number of correct health beliefs each participant endorsed for the 12 health effects presented in the study (range = 0 to 12). Higher values correspond to higher levels of health knowledge. Lastly, a variable was created to capture whether respondents had viewed the set of health warnings specific to one of the 12 health effects presented in the study (coded as 1) or not (coded as 0).

### *Analysis*

Statistical analyses were conducted using SPSS version 19.0. Logistic regression models were conducted to examine correlates of health belief outcomes for each of the 12 health effects caused by smoking: lung cancer, heart disease, stroke, mouth cancer, throat cancer, emphysema, gangrene, impotence in male smokers, wrinkling and aging of skin, death, harm to unborn babies, and lung cancer in nonsmokers from breathing cigarette smoke. The standard set of covariates included in the regression models for adults were as follows: age (continuous), gender, smoking status (daily vs. nondaily), education, income (U.S. sample only), and ethnicity (U.S. sample only). Covariates in the youth regression models included age (continuous), gender, and smoking status (nonsmoker, daily smoker, nondaily smoker). Linear regression models were conducted to examine the influence of potential predictors of health knowledge using the Health Belief Index scale as the outcome.

## **Results**

### *Sample Characteristics*

Table 1 presents the sample characteristics of adults and youth from the United States and Mexico included in our analysis. The total sample consisted of 544 adult smokers and 528 youth in Mexico City, and 772 adult smokers and 677 youth from the United States.

### *Levels of Health Knowledge After Viewing Nontargeted Health Warning Labels*

Table 2 presents the proportion of respondents who believe smoking causes each of 12 health effects only among those who had not viewed the health warnings to the health effect in question. In the United States and Mexico, beliefs about the risks of lung cancer were high (86% to 99%); however, less than half agreed that smoking causes male impotence, and less than one third that smoking causes gangrene.

### *Differences Between Adults and Youth*

Chi-square tests were conducted for Mexico and the United States to examine age group (adult vs. youth) as a predictor for each of the 12 health belief outcomes. In

**Table 1.** Sample characteristics

| Characteristics                      | Mexico, % ( <i>n</i> )      |                            |                                | United States, % ( <i>n</i> ) |                            |                                |
|--------------------------------------|-----------------------------|----------------------------|--------------------------------|-------------------------------|----------------------------|--------------------------------|
|                                      | Adults<br>( <i>n</i> = 544) | Youth<br>( <i>n</i> = 528) | Overall<br>( <i>n</i> = 1,072) | Adults<br>( <i>n</i> = 772)   | Youth<br>( <i>n</i> = 677) | Overall<br>( <i>n</i> = 1,449) |
| Gender                               |                             |                            |                                |                               |                            |                                |
| Male                                 | 51.7 (281)                  | 50.0 (264)                 | 50.8 (545)                     | 47.3 (365)                    | 53.3 (361)                 | 50.1 (726)                     |
| Female                               | 48.3 (263)                  | 50.0 (264)                 | 49.2 (527)                     | 52.7 (407)                    | 46.7 (316)                 | 49.9 (723)                     |
| Age in years, <i>M</i> ( <i>SD</i> ) | 29.3 (11.6)                 | 16.9 (0.9)                 | 23.2 (10.3)                    | 47.2 (12.5)                   | 16.7 (0.7)                 | 32.9 (17.7)                    |
| Education level <sup>a</sup>         |                             |                            |                                |                               |                            |                                |
| Low                                  | 18.2 (99)                   | —                          | 18.2 (99)                      | 28.0 (216)                    | —                          | 28.0 (216)                     |
| Moderate                             | 51.9 (262)                  | —                          | 51.9 (262)                     | 41.3 (319)                    | —                          | 41.3 (319)                     |
| High                                 | 29.8 (162)                  | —                          | 29.8 (162)                     | 30.7 (237)                    | —                          | 30.7 (237)                     |
| Income (annual net household)        |                             |                            |                                |                               |                            |                                |
| Low (less than \$30,000)             | —                           | —                          | —                              | 26.6 (203)                    | —                          | 26.6 (203)                     |
| Moderate (\$30,000 to \$59,999)      | —                           | —                          | —                              | 36.2 (276)                    | —                          | 36.2 (276)                     |
| High (\$60,000 and over)             | —                           | —                          | —                              | 37.1 (283)                    | —                          | 37.1 (283)                     |

|                       |            |            |            |            |            |              |  |  |  |
|-----------------------|------------|------------|------------|------------|------------|--------------|--|--|--|
| Smoking frequency     |            |            |            |            |            |              |  |  |  |
| Daily                 | 51.7 (281) | 12.9 (68)  | 32.6 (349) | 88.1 (680) | 12.1 (82)  | 52.6 (762)   |  |  |  |
| Nondaily              | 48.3 (263) | 36.0 (190) | 42.3 (453) | 11.9 (92)  | 19.4 (131) | 15.4 (223)   |  |  |  |
| Nonsmoker             | 0          | 51.1 (270) | 25.2 (270) | 0          | 68.5 (464) | 32.0 (464)   |  |  |  |
| Quit intentions       |            |            |            |            |            |              |  |  |  |
| Not planning to quit  | 45.4 (247) | 35.3 (91)  | 42.1 (338) | 20.9 (156) | 20.0 (41)  | 20.7 (197)   |  |  |  |
| Planning to quit      | 54.6 (297) | 64.7 (167) | 57.9 (464) | 79.1 (589) | 80.0 (164) | 79.3 (753)   |  |  |  |
| Ethnicity             |            |            |            |            |            |              |  |  |  |
| Nonminority           | —          | —          | —          | 83.4 (644) | 75.5 (511) | 79.7 (1,155) |  |  |  |
| Minority <sup>b</sup> | —          | —          | —          | 16.5 (127) | 24.4 (165) | 20.2 (292)   |  |  |  |

<sup>a</sup>Low = high school or less (United States) and primary, middle, or technical/vocational school or less (Mexico); moderate = technical/trade school or community college or some university (United States) and high school or some university (Mexico); and high = university or postgraduate degree (United States, Mexico).

<sup>b</sup>Minority includes Black or African American, Hispanic or Latino, Asian or Pacific Islander, Native American Indian, mixed race, and other.  
— refers to no data.

**Table 2.** Percentage of respondents who believe smoking causes various health effects<sup>a</sup>

| Based on what you know or believe, does smoking cause ... | Mexico              |                     |                      | United States       |                     |                         |
|---|---------------------|---------------------|----------------------|---------------------|---------------------|-------------------------|
|   | Adults<br>(n = 443) | Youth†<br>(n = 450) | Overall<br>(n = 893) | Adults<br>(n = 667) | Youth†<br>(n = 590) | Overall*<br>(n = 1,257) |
| Lung cancer?  | 99.3                | 98.9                | 99.1                 | 86.1                | 94.7†               | 90.1*                   |
| Heart disease?  | 85.1                | 73.2†               | 79.1                 | 76.8                | 79.4                | 79.4                    |
| Stroke?   | 43.2                | 30.1†               | 36.6                 | 61.7                | 65.3                | 63.4*                   |
| Mouth cancer?   | 79.2                | 74.2                | 76.7                 | 78.1                | 84.1†               | 80.9*                   |
| Throat cancer?  | 92.8                | 85.7†               | 89.2                 | 83.7                | 89.6†               | 86.5                    |
| Emphysema?  | 93.5                | 85.9†               | 89.7                 | 88.5                | 80.5†               | 84.8*                   |
| Gangrene?   | 27.1                | 24.7                | 25.9                 | 13.7                | 20.3†               | 16.8*                   |
| Impotence in male smokers?                                | 56.9                | 41.2†               | 49.0                 | 25.9                | 29.1                | 27.4*                   |
| Wrinkling and aging of the skin?                          | 71.2                | 61.5†               | 66.3                 | 73.8                | 76.6                | 75.1*                   |
| Death?  | 96.4                | 96.2                | 96.3                 | 79.9                | 91.1†               | 85.1*                   |
| Harm to unborn babies?                                    | 97.1                | 96.7                | 96.9                 | 75.5                | 87.4†               | 81.0*                   |
| Lung cancer in nonsmokers from breathing cigarette smoke? | 89.4                | 84.7†               | 87.1                 | 51.1                | 75.1†               | 62.4*                   |

Data are shown only from respondents who did not view the health warnings specific to the health effect listed. Within this population, logistic regression models were conducted for each health effect to examine whether beliefs differed by age group (youth vs. adults) and by country (Mexico vs. United States).

<sup>a</sup>Percentage responding “yes”; remainder include “no” and “don’t know” responses.

†Significant differences between adults and youth within each country ( $p < .05$ ).

\*Significant differences “overall” between Mexico and the United States ( $p < .05$ ).

the United States, youth reported significantly higher levels of health knowledge than adults for 7 of the 12 health effects listed in Table 2: lung cancer, mouth cancer, throat cancer, gangrene, death, harm to unborn babies, and lung cancer in non-smokers from breathing cigarette smoke. Adults were more likely than youth were to believe that smoking causes just one of the health effects: emphysema. In contrast, adults in Mexico were more likely than youth to endorse 7 of the 12 health effects of smoking: heart disease, stroke, throat cancer, emphysema, impotence in male smokers, wrinkling and aging of the skin, and lung cancer in nonsmokers from breathing cigarette smoke.

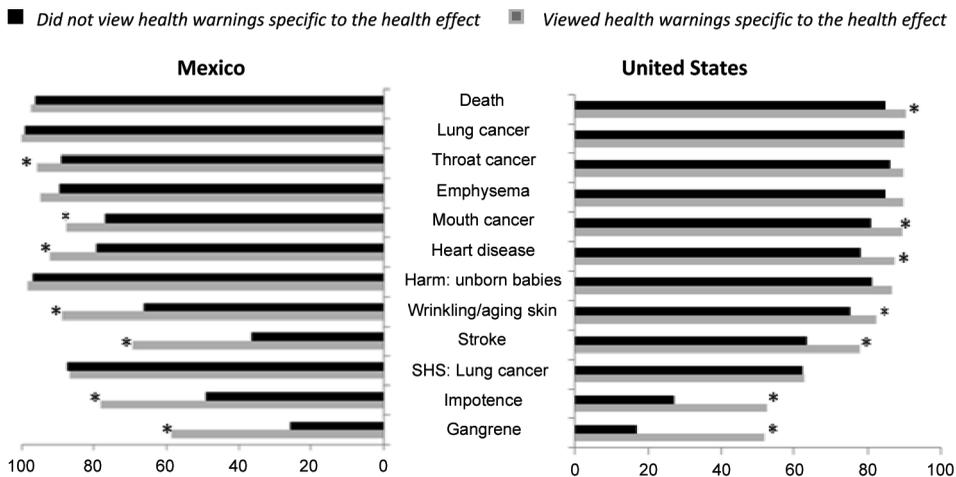
#### *Differences Between the United States and Mexico*

To examine country differences for each of the 12 health belief outcomes, we conducted a chi-square analysis including youth and adults from Mexico and the United States. Significant differences between the United States and Mexico were observed for 10 of the 12 health beliefs. Mexican respondents were significantly more likely to endorse 7 of the 10 health effects, including: lung cancer, emphysema, gangrene, impotence in male smokers, death, harm to unborn babies, and lung cancer in nonsmokers from breathing cigarette smoke. U.S. respondents were more likely to believe that smoking causes: stroke, mouth cancer, and wrinkling and aging of the skin.

#### *Levels of Health Knowledge After Viewing Targeted Health Warning Labels*

We conducted chi-square tests for each health effect, separately by country, to examine whether health beliefs differed between respondents who had viewed the health warning labels targeted to that health effect, and those who had not (Figure 1).

In the United States, those who viewed the relevant warning set were more likely to endorse 7 of the 12 health effects relative to those who had not viewed the relevant warning set: death (OR = 1.70, 95% CI [1.02, 2.83]), lung cancer (OR = 2.09, 95% CI [1.28, 3.43]), heart disease (OR = 1.97, 95% CI [1.26, 3.09]), wrinkling and



**Figure 1.** Percentage of respondents who believe smoking causes various health effects, by health warnings viewed. \*Significant differences ( $p < .05$ ) between those who viewed the health warnings specific to the health effect versus those who did not view the health warnings specific to the health effect.

aging of skin (OR = 1.53, 95% CI [1.03, 2.27]), stroke (OR = 2.02, 95% CI [1.41, 2.88]), impotence in male smokers (OR = 2.92, 95% CI [2.14, 3.98]), and gangrene (OR = 5.27, 95% CI [3.83, 7.25]).

In Mexico, respondents who viewed the health warning labels specific to the health effect were also more likely to endorse 7 of the 12 health beliefs: throat cancer (OR = 2.72, 95% CI [1.08, 6.83]), mouth cancer (OR = 2.09, 95% CI [1.19, 3.66]), heart disease (OR = 3.14, 95% CI [1.56, 6.32]), wrinkling and aging of skin (OR = 4.12, 95% CI [2.27, 7.43]), stroke (OR = 3.93, 9% CI [2.61, 5.92]), impotence in male smokers (OR = 3.70, 95% CI [2.37, 5.79]), and gangrene (OR = 4.09, 95% CI [2.75, 6.07]).

A second set of logistic regression models, which pooled the U.S. and Mexico samples, were conducted for each health effect. Step 1 of the models included only the health warnings viewed variable. Step 2 of the models adjusted for the following covariates: age, gender, smoking status, quit intentions, and country. The interaction term between "Health warnings viewed" and country was also tested in this model. Between-country differences were observed for 2 of the 12 health effects: after viewing health warnings specific to the health effect, respondents in Mexico were more likely than U.S. respondents to endorse the belief that smoking causes wrinkling and aging of the skin (OR = 2.72, 95% CI [1.33, 5.56]) and that smoking causes stroke (OR = 1.91, 95% CI [1.10, 3.30]), compared to respondents in the United States. No other significant associations were observed.

### ***Predictors of Health Knowledge***

The Health Belief Index indicates the number of correct health beliefs (0 to 12) endorsed by respondents. In the United States, the average Health Belief Index score for adults was 8.0 ( $SD = 3.1$ ), significantly lower than the youth score of 9.0 ( $SD = 2.6$ ),  $p < .001$ . In contrast, in Mexico the mean Health Belief Index score for adults was significantly higher, 9.4 ( $SD = 1.8$ ), than that for youth, 8.8 ( $SD = 1.8$ ),  $p < .001$ .

We conducted linear regression models, separately by country and age group, to examine the influence of various covariates on level of health knowledge (as measured by the Health Belief Index). The youth models included the following covariates: age, gender, and smoking status. The adult models included age, gender, smoking status, quit intentions, education, income, and ethnicity.

#### ***Predictors of Health Knowledge Among Youth in Mexico and the United States***

Among youth in Mexico, age emerged as a predictor of health knowledge: older respondents reported higher levels of health knowledge than did younger respondents ( $\beta = 0.29$ ,  $p < .001$ ). Nonsmokers also reported lower levels of health knowledge than daily and nondaily smokers ( $\beta = -0.75$ ,  $p < .001$ ;  $\beta = -0.35$ ,  $p < .033$ , respectively). Among youth in the United States, girls reported higher levels of health knowledge ( $\beta = 0.42$ ,  $p < .034$ ). In contrast with Mexican youth, nonsmoking youth in the United States reported higher levels of health knowledge than did daily and nondaily smokers ( $\beta = 0.96$ ,  $p < .002$  and  $\beta = 1.40$ ,  $p < .001$ , respectively).

#### ***Predictors of Health Knowledge Among Adults in Mexico and the United States***

Education was the only significant predictor of health knowledge among adult smokers in Mexico. Those with high levels of education (university degree or higher) reported greater levels of health knowledge compared with those with low (primary,

middle, or technical/vocational school) or moderate (high school or some university) levels of education ( $\beta=0.63, p < .009$ ;  $\beta=0.62, p < .001$ , respectively).

Among adults in the United States, age, gender, quit intentions, and income were significant predictors of health knowledge. Older individuals reported lower levels of health knowledge than did younger individuals ( $\beta=-0.03, p < .001$ ). Female respondents reported higher levels of health knowledge than did male respondents ( $\beta=0.54, p < .018$ ). Respondents who were planning to quit were more likely to report higher levels of health knowledge than were those who were not planning to quit ( $\beta=1.00, p < .001$ ). High-income respondents were more likely than were low- and moderate-income respondents to report higher levels of health knowledge ( $\beta=1.12, p < .001$  and  $\beta=0.82, p < .003$ ).

## Discussion

It is generally assumed that smokers are well aware of the health risks of smoking. Despite widespread endorsement of some more prominent health risks of smoking, such as lung cancer, findings from the present study highlight significant gaps in health knowledge. Most notable is that less than half of adult smokers in either country agreed that smoking can cause stroke, one of the leading causes of death from smoking, and only half of U.S. adult smokers agreed that second-hand smoke can cause lung cancer. In addition, less than half of respondents in Mexico and the United States believed that smoking causes impotence in male smokers and less than one third believed that smoking causes gangrene.

Mexican respondents reported significantly higher overall levels of health knowledge compared to U.S. respondents. It is noteworthy that the health effects (lung cancer, emphysema, and health risks to unborn babies) with higher levels of endorsement in Mexico were those which appeared on cigarette packages at the time this study was conducted.

The less prominent placement of the text-only U.S. health warnings, coupled with the fact that the same four messages have been in rotation for the past 27 years, may help account for the lower levels of health knowledge found in the United States. Pictorial health warning labels were implemented after this study was conducted in Mexico (September 2010) and were scheduled to be implemented in the United States in September 2012. However, the tobacco industry was granted an injunction and the implementation of pictorial warnings is uncertain. The new pictorial warnings in Mexico cover 30% of the front and 100% of the back and one side of cigarette packages ([www.tobaccolabels.org](http://www.tobaccolabels.org)), and they appear to have increased knowledge about health effects and toxic tobacco constituents addressed in the new warnings (Thrasher, Arillo-Santillán, Pérez-Hernández, Sansores, & Regalado-Piñeda, 2011). In the United States, the proposed graphic health warnings were to be placed on the top 50% of the front and back of cigarette packages (U.S. Food and Drug Administration, 2011).

Sociodemographic factors were associated with health knowledge in Mexico and the United States. Education emerged as a predictor in the Mexican sample (income was not measured); in the United States, income, but not education, was associated with health knowledge. Income and education are typically correlated with each other and positively associated with health knowledge. Overall, despite slightly different patterns of sociodemographic predictors in the U.S. and Mexican sample, our findings are consistent with previous research demonstrating the socioeconomic gradient in health knowledge.

In the United States, youth reported higher levels of health knowledge than adults, whereas the opposite pattern was observed in Mexico. In the United States,

nonsmokers (youth) held higher levels of health knowledge than daily and nondaily smokers. In contrast, Mexican nonsmokers (youth) held lower levels of health knowledge than daily and nondaily smokers. Previous research in the United States and in other countries has generally found that nonsmokers endorse a greater number of health effects, mostly likely because of higher levels of education among nonsmokers and cognitive dissonance among smokers (Hammond et al., 2006). The opposite pattern in Mexico could potentially be a result of its shorter history of tobacco education campaigns, in addition to the warning labels themselves, which smokers were more likely to have seen.

After viewing the relevant health warnings, respondents in the United States and Mexico were more likely to endorse related health beliefs. Increases were greatest for health effects with lower levels of belief, such as gangrene and stroke. These findings are consistent with previous research in which a strong association was found between pictorial health warning labels and health knowledge (Liefeld, 1999; O'Hegarty et al., 2006).

### ***Limitations***

The studies in Mexico and the United States were conducted through different survey modes. The face-to-face surveys in Mexico may have encouraged more socially desirable responses among Mexican respondents and may account, in part, for the higher levels of health knowledge, for targeted and nontargeted health warnings. In addition, the surveys were not conducted with representative samples of smokers, although a heterogeneous cross-section of respondents was recruited in each country.

All respondents in the study viewed two sets of health warnings prior to answering the health knowledge questions. As a result, the levels of health knowledge when respondents viewed nontargeted health warnings are likely to be an overestimate of health knowledge in the general population given that viewing health warnings for other health effects may increase health beliefs in a nonspecific manner. Research conducted after the implementation of pictorial warnings should confirm whether naturalistic exposures to pictorial warnings in each country will produce results that are consistent with those found here. Cross-country research suggests that this will be the case (Hammond et al., 2006; Thrasher, Hammond, Fong, & Arillo-Santillán, 2007).

### ***Implications***

Overall, the findings suggest that consumers and the general public are far from fully informed regarding the health effects of tobacco use. In August 2011, five major tobacco companies filed a lawsuit against the U.S. Food and Drug Administration challenging the nine new graphic warning label images that were to be implemented on cigarette packages in 2012 (R.J. Reynolds Tobacco Company, Lorillard Tobacco Company, Common Wealth Brands, Liggett Group, and Santa Fe Natural Tobacco Company v. U.S. Food and Drug Administration, 2011). The Motion argues that U.S. smokers and the general public are fully informed of the health risks of smoking and new warnings, therefore, would have no effect. The present study highlights the effectiveness of health warning labels in increasing health knowledge, particularly for less well-known health effects, such as gangrene, impotence in male smokers, and stroke.

Lastly, although we observed some differences between the samples in Mexico and the United States, the general pattern of the results—including the effect of viewing health warnings—was generally similar across the two countries. These findings add to the evidence base on the potential effect of health warnings.

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