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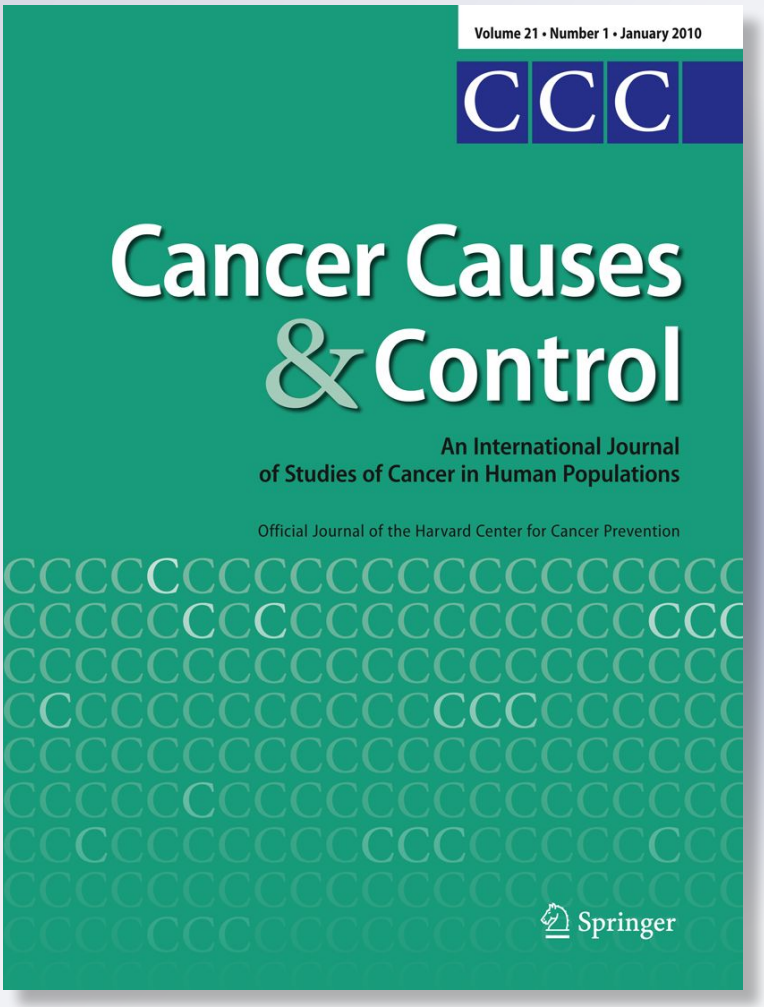

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ORIGINAL PAPER

Can pictorial warning labels on cigarette packages address smoking-related health disparities? Field experiments in Mexico to assess pictorial warning label content

James F. Thrasher · Edna Arillo-Santillán · Victor Villalobos · Rosaura Pérez-Hernández · David Hammond · Jarvis Carter · Ernesto Sebrié · Raul Sansores · Justino Regalado-Piñeda

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Abstract

Objective The objective of this study was to determine the most effective content of pictorial health warning labels (HWLs) and whether educational attainment moderates these effects.

Methods Field experiments were conducted with 529 adult smokers and 530 young adults (258 nonsmokers; 271 smokers). Participants reported responses to different pictorial HWLs printed on cigarette packages. One experiment involved manipulating textual form (testimonial narrative vs. didactic) and the other involved manipulating image type (diseased organs vs. human suffering).

Results Tests of mean ratings and rankings indicated that pictorial HWLs with didactic textual forms had equivalent or significantly higher credibility, relevance, and impact than pictorial HWLs with testimonial forms. Results from mixed-effects models confirmed these results. However, responses differed by participant educational attainment: didactic forms were consistently rated higher than testimonials among participants with higher education, whereas the difference between didactic and testimonial narrative forms was weaker or not statistically significant among participants with lower education. In the second experiment, with textual content held constant, greater credibility, relevance, and impact was found for graphic imagery of diseased organs than imagery of human suffering.

Conclusions Pictorial HWLs with didactic textual forms seem to work better than those with testimonial narratives. Future research should determine which pictorial HWL content has the greatest real-world impact among consumers from disadvantaged groups, including assessment of how HWL content should change to maintain its impact as tobacco control environments strengthen and consumer awareness of smoking-related risks increases.

Keywords Product labeling · Health communication · Tobacco · Health policy

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Introduction

Policies that establish prominent, pictorial health warning labels (HWLs) on tobacco packaging are a key intervention promoted by the World Health Organization—Framework Convention on Tobacco Control (WHO-FCTC) [1, 2]. HWL

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messages on tobacco packaging can inform consumers and potential consumers about toxic constituents in tobacco and tobacco smoke, the health effects of smoking, and methods for quitting smoking. In public health information campaigns [3–5], HWLs can convert tobacco packaging into a powerful public health intervention because of its broad reach, ability to frequently expose target audiences to an array of HWL messages, and the potential for periodic refreshing of HWL content and design.

For countries with few resources to conduct media campaigns and educational interventions, HWLs can be critical for disseminating information on the risks of tobacco products [6]. By the end of 2011, 39 countries had implemented pictorial HWLs; 22 of these countries were lower-middle and upper-middle-income countries [7]. Eight of these countries are in Latin America, and include Mexico and Uruguay, whose HWLs cover more package surface area than anywhere else in the world (80 and 65% of primary pack surfaces, respectively) [8]. Research is needed to inform for selection of pictorial and textual content for countries that newly implement pictorial HWL policies, and for countries that have adopted this policy and can periodically change HWL content.

Low and middle-income countries face a growing morbidity and mortality burden from tobacco-attributable disease [9]. In many of these countries, smoking has been more prevalent in higher socioeconomic status (SES) groups, but smoking is becoming more concentrated among disadvantaged populations [10], Survey data indicate that this process may be occurring in Mexico. Socioeconomic status (SES) is not associated with smoking prevalence among men, and prevalence of smoking is only slightly higher for women in high SES strata than for women in low SES strata [11, 12]. To ensure that smoking does not further exacerbate impoverished conditions and associated health-disparities [13], HWL policies and other WHO-FCTC policies, should be designed to ensure equivalent or greater impact among disadvantaged groups. Otherwise, low and middle-income countries may follow the pattern of some Western countries, in which smoking prevalence and the smoking-related disease burden has become increasingly concentrated in disadvantaged groups with lower education and fewer resources [14, 15].

Experimental and survey research on HWLs has mostly focused on the added impact of pictorial content compared with text-only content, and pictorial HWLs perform better at engaging smokers, increasing knowledge about tobacco-related risks, promoting thoughts about quitting, and reducing demand for cigarettes [16–23]. Pictorial HWLs may overcome literacy issues [17, 24], which are more prevalent in disadvantaged groups [25]. Panel and cross-sectional data from Australian, UK, and Brazilian smokers after implementation of prominent HWLs with graphic, evocative imagery found that HWL impact was greater among smokers with lower educational attainment [24, 26]. Education was not associated with HWL impact in the United Kingdom and Mexico, where text-only HWLs had been implemented, or in Uruguay, where prominent pictorial HWLs included symbolic imagery of danger (e.g., time bomb to represent impending danger) [24, 26]. These results suggest that pictorial warnings with evocative, graphic imagery have a greater impact among lower SES groups than only text or nongraphic, abstract imagery. This is consistent with US research indicating that cessation advertisements on television that include emotionally evocative content and testimonials have a greater impact among smokers from lower SES groups than among those from higher SES groups [27].

This study builds upon field experiments conducted among adolescents and adult smokers in Mexico [28]. HWLs with graphic imagery (i.e., vivid depiction of the physical effects of smoking) were more effective than other visual strategies. Furthermore, pictorial HWLs that included testimonial content (i.e., a brief narrative describing a personal consequence of smoking, written as a quote from a person in the image, accompanied by their name and age) had a greater impact than the same HWL image with a simple didactic statement (e.g., *Smoking causes lung cancer*). Although educational attainment did not moderate these effects, the sample was more highly educated than the general population.

In this study two experiments were conducted to determine the relative impact of pictorial HWLs with different textual forms (i.e., Experiment 1: testimonial narrative vs. didactic) and different imagery types (i.e., Experiment 2: imagery of diseased organs vs. human suffering). Our secondary objective was to determine whether the effects for different pictorial HWL content varied across levels of educational attainment. On the basis of previous findings [28], we hypothesized that message acceptance (i.e., credibility, relevance) and perceived impact would be greater for testimonial forms than for didactic forms, with stronger effects found for participants with lower educational attainment, because of lower health literacy in this group. Our studies respond to the broader need for research on the methods and contexts in which narrative communication may be more effective than didactic forms for cancer prevention and health promotion more generally [29].

Materials and methods

Development and design of experimental stimuli

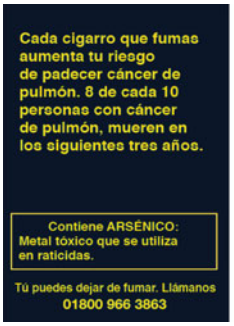
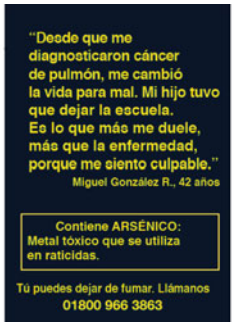
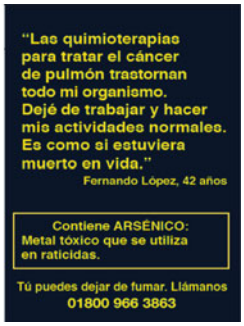
Cigarette packages were designed in accordance with Mexican law: 30% of the upper front face of the pack included both pictures and text, and 100% of the back and one side of the

pack contained only text. A graphic artist designed the packs, including imagery for a fake cigarette brand (Fig. 1). We selected HWL topic areas and imagery that previous research indicated to have the greatest impact among Mexican adult smokers and adolescents (see [28]). Pictorial HWLs were printed on packages that contained 20 cigarettes, so that the weight and feel of the pack was realistic.

Experiment 1 stimuli

For each of six different smoking-related health effects (i.e., lung cancer, throat cancer, stroke, heart disease, premature birth, and addiction), three packs were designed that had the same HWL image, textual content on toxic constituents [30], and textual "call to action" for a free telephone quitline. The primary experimental manipulation involved textual form (testimonial vs. didactic) of the text that appeared in the upper 2/3 of the back of the cigarette package (Fig. 1). The content across manipulations was explicitly linked to knowledge and expectancies regarding susceptibility and severity of the health effect topic illustrated in the HWL image that appeared on the pack. For any particular health effect topic and corresponding image, three textual variants were developed: (1) two warnings contained testimonial narratives gathered from real people, which briefly described the impact of the health effect on the lives of smokers themselves or their family members (mean of 29 words; range 21–34 words); testimonials appeared in quotes and included attribution to a person with a name and age; (2) one warning contained didactic text that described the impact of smoking on the smoker's body and daily functioning (mean 32 words, range 27–39

Fig. 1 Example cigarette package warning label specifications for the health effects of lung cancer

HWL characteristics	HWL with Didactic content	HWL with Testimonial content 1	HWL with Testimonial content 2
30% of the front of the pack contains pictorial content and brand imagery • Didactic title phrase is short (i.e., Smoking causes…) • Testimonial title uses the same testimonial fragment			
	Cancer causes lung cancer	"…it is as if he is dead, while he's still living"	"…it is as if he is dead, while he's still living"
100% of the back of the pack contains only textual content			
• The upper 2/3 is didactic or testimonial textual form	Every cigarette that you smoke increases your risk of getting lung cancer. 8 of every 10 people with lung cancer die within the next three years.	"Since they diagnosed me with lung cancer, my life has changed for the worse. My son had to leave school. This is what is most painful, more than the sickness, because I feel responsible"	"The chemotherapy to treat the lung cancer messes up my entire body. I had to stop working and doing normal things. It's as though I'm dead, while still living."
• The box contains toxic constituent information	Contains ARSENIC: A toxic metal used to kill rats	Contains ARSENIC: A toxic metal used to kill rats	Contains ARSENIC: A toxic metal used to kill rats
• The bottom contains a call to action	You can quit. Call us 1800 966 3863	You can quit. Call us 1800 966 3863	You can quit. Call us 1800 966 3863

words), which was adapted from HWL content from other countries (e.g., Australia) and educational material.

Experiment 2 stimuli

The second experiment involved manipulation of the graphic imagery (i.e., damaged organs or human suffering). For each of two different health effects (i.e., gangrene and emphysema), two packs were designed that varied HWL imagery, while maintaining the same testimonial and accompanying textual content.

Field experiment procedure

In November and December 2010, field experiments were conducted in supermarkets and public parks in Mexico City and Cuernavaca, Mexico. Systematic selection procedures were used to invite every third person to participate. Members of two groups were eligible: (1) 18–24 years old; (2) older than 25, who had smoked in the previous month and had smoked 100 or more cigarettes in their lifetime. For the group of young adults, we established equal quotas of sex and smoking status (i.e., having smoked in the previous 30 days), with a target of 500 complete interviews. For the group of adult smokers, we had no subsample quotas for our target of 500 complete interviews. The survey and experimental procedure were interviewer-administered and lasted 15–20 min, with participants receiving a $50 peso (approximately $4 USD) voucher for use in diverse stores. The protocol was approved by the IRB at the Mexican National Institute of Public Health.

Experiment 1

The entire sample participated in the first experiment, which involved evaluation of nine different HWLs representing three of six possible health effect topics (i.e., three textual manipulations per topic). Participants were randomized to evaluate one of two blocks of HWLs (i.e., Group A1 topics = addiction, stroke, and lung cancer; Group B1 topics = throat cancer, premature birth, and heart attack). Within each health topic, participants were presented with all three HWLs stimuli in random order; however, because of computer programming constraints, the order of presentation of the health effect topics was the same within either of the blocks of HWLs. Before evaluating HWLs for a subsequent topic, participants rank-ordered the three HWLs they had just individually evaluated according to how much the HWLs made them want to not smoke (i.e., to not start for nonsmokers and to quit for smokers).

Experiment 2

The second experiment was conducted only with the subsample from the first experiment that participated in the initial fieldwork period (a different HWL manipulation replaced the one under consideration and is irrelevant to this study). Participants were randomized to evaluate one of two possible health effect topics (i.e., Group A2 topic = gangrene; Group B2 topic = emphysema). Within each health effect topic, participants evaluated two different HWL stimuli presented in random order. After individually rating each of these HWL stimuli, participants selected the HWL that made them most want to not smoke (i.e., to not start for nonsmokers and to quit for smokers).

Measurement

All participants began by responding to validated questions on sociodemographics (i.e., age; sex; educational attainment—primary school or less; secondary school; technical or commercial school; high school; college or more) tobacco use, and attitudes about smoking [31]. Smoking questions included frequency of current consumption, and participants who had smoked in the previous month were classified according to previous research on tertiles of smoking intensity in Mexico (i.e., nondaily; daily, but less than 5 cigarettes per day; daily, 5 or more cigarettes per day) [32]. Participants who had not smoked in the previous month were classified as nonsmokers.

Ratings of HWLs were based on characteristics of effective communication [3, 31]. Indicators of message acceptance included credibility (i.e., Is this HWL believable?) and relevance (i.e., Is this HWL message for someone like you) [3, 29]. Perceived impact was assessed with four questions (i.e., This HWL would: …make people more worried about the harms of smoking; …keep kids from starting to smoke; …motivate smokers to quit; Overall, how effective is this HWL). Response options for all of these questions involved a 10-point scale with verbal anchors at either end (i.e., Not at all/*Para nada*; Extremely/*Totalmente*), and another verbal anchor between 5 and 6 (moderately/*en el medio*). The projected impact indicators had high internal consistency (Cronbach alpha range 0.88–0.93) and were averaged to create a single measure. For ranking all HWLs within health effect topics, smokers were asked which HWL motivated them most to quit smoking, whereas nonsmokers were asked which HWL motivated them most to not smoke. A single variable was also derived to indicate selection of either HWL with a testimonial as more effective than the HWL with the didactic textual form. For experiment 1, warning labels were classified as having either testimonial or didactic textual form. For experiment 2, warning labels were

classified as containing either graphic imagery of human suffering or of diseased organs. Before fieldwork, all questions were assessed with cognitive interviewing techniques [33, 34] and adjustments were made to address potential response error issues.

Analysis

STATA, version 11.0 was used for all analysis. Sociodemographic and smoking-related characteristics were examined for the entire study population, and within low and high educational attainment groups (i.e., technical school or less and high school or more, respectively). Ratings and rankings were assessed for each HWL within a block of material (i.e., health effect topic), while stratifying the analyses by educational attainment level. For ratings of message credibility, relevance, and impact, paired *t*-tests were used to determine the statistical significance of mean differences between ratings of HWLs within a block. The percentage selecting each HWL as most effective within a block was also determined. To determine statistical significance of differences in these percentages, separate logistic mixed-effects models were estimated for observations within each block, regressing selection as most effective on dummy variables indicating HWLs content (e.g., didactic vs. testimonial 1 vs. testimonial 2).

Mixed-effects models were also estimated in order to determine whether testimonial or didactic HWL content was more effective. The sample for these analyses involved pooling adult smoker and young adult samples, and including all observations associated with HWL topics that had both testimonial and didactic content as alternatives. The mixed-effects models were specified to adjust for within-individual correlation of responses across HWLs, and the fixed-effects data were examined as representing the average effects of covariates within the population. When examining a rating as the dependent variable, bivariate and adjusted linear mixed-effects models included person-level characteristics (i.e., sociodemographics, smoking behavior) and HWL characteristics (i.e., dummy variables for health effect topics; dummy variable for didactic vs. testimonial content). In adjusted models, we also tested a multiplicative interaction between the HWL textual form variable and educational attainment (in its original, ordinal format). When this interaction was statistically significant, bi-variate and adjusted models were re-run after stratifying the sample by education level (technical school or less vs. high school or more). Bivariate and adjusted logistic mixed-effects models were also estimated for selecting HWLs as most effective, pooling all observations from smokers and nonsmokers. Bivariate and adjusted models involved the same variables as in the linear mixed-effects models, including the test of interaction between HWL textual content and education. Finally, sensitivity analyses were conducted with these logistic models, stratifying data for smokers and nonsmokers, to determine the consistency of results across these subpopulations.

Results

Sample description

Of 2,928 people approached, 1,066 (36%) were eligible and agreed to participate. The Experiment 1 sample had an average age of 26.6 years (range 18–80), and more than half of the participants (56%) were males. About one quarter of the sample (23%) had a secondary education, 11% had completed technical school, half (50%) had a high school education, and 16% had completed a university degree or higher. Approximately a quarter were nonsmokers (26%), a third were nondaily smokers (34%), and of the daily smokers, 58% smoked five or fewer cigarettes and 42% smoked more than five cigarettes a day. Sex was the only sample characteristic for which there was a significant difference between populations assigned to evaluate different blocks of HWL stimuli ($p = 0.007$; Table 1). Sample characteristics for Experiment 2 (which is a subsample of the Experiment 1 population) were similar. There were no differences between the populations assigned to either HWL condition (Table 1).

Experiment 1: credibility, relevance, and impact of textual narrative genre

Mean ratings of credibility, relevance, and overall impact were assessed for HWLs that manipulated the form of textual content (Table 2). Participants with higher educational attainment (i.e., high school or more) consistently rated as stronger the HWLs with didactic text compared to HWLs with testimonial text. For those with lower educational attainment, at least one and sometimes both of the HWLs with testimonial text were rated as strongly as the HWLs with didactic textual content.

To assess the independence of these differences, adjusted linear mixed-effects models were estimated with each person contributing one observation for each HWL evaluated. Bivariate coefficients were estimated regressing ratings for credibility, relevance, and overall impact on a dummy variable indicating didactic compared with testimonial HWL content, and on other person-level and HWL-level characteristics. In bivariate and multivariate models, higher ratings were found for HWLs that contained didactic text compared with testimonials, for people with lower compared with higher educational attainment, and for nondaily smokers compared with daily smokers (Table 4). Interactions between

Table 1 Characteristics of samples randomly allocated to evaluate different groups of pictorial health warning labels in Experiment 1 and 2

Characteristics	Experiment 1 (textual content)		Experiment 2 (imagery type)	
	Group A1[a] ($n = 510$)	Group B1[b] ($n = 556$)	Group A2[c] ($n = 320$)	Group B2[d] ($n = 341$)
Age (mean and range)	26.9 (18–72)	26.4 (18–80)	26.9 (18–72)	26.5 (18–68)
*Sex**				
Female	48%	40%	53%	48%
Male	52%	60%	47%	52%
Education				
Secondary or less	23%	24%	23%	20%
Technical school	13%	10%	13%	8%
High school	50%	50%	50%	54%
University or more	15%	16%	13%	18%
Smoking behavior				
Nonsmoker	26%	26%	23%	23%
Nondaily smoker	32%	36%	33%	39%
Daily smoker, <5 per day	24%	23%	27%	24%
Daily smoker, 5 or more per day	19%	15%	18%	14%

[a] Group A1 evaluated three textual variants for each of three topics (throat cancer, premature birth, heart attack)

[b] Group B1 evaluated three textual variants for each of three topics (addiction, stroke, lung cancer)

[c] Group A2 evaluated two image variants (diseased organs, human suffering) for the topic of gangrene

[d] Group B2 evaluated two image variants (diseased organs, human suffering) for the topic of emphysema

* Males less likely to have been assigned to evaluate stimuli in Group A1 than stimuli in Group B1 ($p = 0.007$). No other statistically significant differences were found for sample characteristics, comparing Groups A1 with B1 and A2 with B2

the textual form dummy variable and education were statistically significant across all indicators, so analyses were rerun after stratifying the population into low and high educational strata (i.e., technical school or less; high school or more).

Bivariate and adjusted models were re-run within educational strata. In all models for participants with higher education, ratings for HWL acceptance and impact were significantly higher when textual forms were didactic compared with testimonial. Among people with lower educational attainment, the bivariate model results indicated that the narrative genre had no statistically significantly association with any indicators. However, in the adjusted models, some of the HWL ratings that were higher for didactic than for testimonial text became statistically significant (i.e., credibility, impact). Post-hoc stepwise elimination of covariates in the adjusted model indicated that this suppression effect was because of inclusion of the dummy variables for the health effect topics, particularly health effects where the testimonials were rated most similarly to didactic text.

Experiment 1: prevalence and correlates of selecting HWLs with testimonials as more effective than HWLs with didactic textual content

Table 2 shows the percentage of participants selecting pictorial HWLs with didactic and testimonial forms as most effective in motivating them to quit (for current smokers) or to not start smoking (for current nonsmokers). The didactic text was selected more frequently than either of the testimonial options among those with higher educational attainment, whereas those with lower education selected the testimonial textual form equally or more often than the didactic textual form.

We estimated logistic mixed-effects models, with the dependent variable as selection of the HWL as the most effective (model results not shown). Crude and adjusted odds ratios (ORs) were estimated to indicate likelihood of the didactic HWL texts selected as better than the testimonial texts. Both were statistically significant (OR = 1.72, 95% CI 1.57, 1.88; AOR 1.68, 95% CI 1.53, 1.88). A statistically significant interaction with education was found, and in stratified models both crude and adjusted ORs indicated greater likelihood of didactic text being selected among participants with higher educational attainment (OR = 2.21, 95% CI 1.98, 2.47; AOR = 2.14, 95% CI 1.91, 2.40). No association was found in models that included only participants with lower educational attainment (OR = 1.06, 95% CI 0.91, 1.23; AOR = 1.06, 95% CI 0.91, 1.23). Sensitivity analyses produced the same pattern of results for smokers as for nonsmokers (results not shown).

Experiment 2: ratings and rankings of image type

Mean ratings of HWL material for two health effects (i.e., emphysema and gangrene) involved evaluating two HWL

Table 2 Mean ratings and top rankings for warning labels by narrative form for each health effect, among Mexicans with low and high educational attainment

Label and sample characteristics			Ratings			Ranking (% chosen as most effective)
Health effect	Education attainment*	Narrative type	Credibility	Relevance	Overall impact	
Stroke	Low	Didactic	7.7[a,d]	4.7	7.0[e]	39
		Testimonial 1	7.4	4.7	6.8	36
		Testimonial 2	7.4	4.4	6.7	24
	High	Didactic	7.4[c,f]	4.8[b,f]	6.6[c,f]	50
		Testimonial 1	6.8	4.4	6.2	22
		Testimonial 2	6.8	4.3	6.3	28
Premature birth	Low	Didactic	7.6	4.5	6.7	35
		Testimonial 1	7.6	4.4	6.6	30
		Testimonial 2	7.6	4.4	6.8	35
	High	Didactic	7.9[c,f]	4.7[a,d]	6.8[c,f]	48
		Testimonial 1	7.3	4.5	6.4	22
		Testimonial 2	7.5	4.5	6.6 [h]	30
Lung cancer	Low	Didactic	8.3[a]	5.3[b]	7.4[a,d]	36
		Testimonial 1	8.0	4.8	7.2	38
		Testimonial 2	8.1	5.3 [g]	7.2	26
	High	Didactic	8.0[c,f]	5.2[c,f]	7.0[c,f]	47
		Testimonial 1	7.2	4.6	6.5	24
		Testimonial 2	7.4 [h]	4.8	6.6	29
Heart attack	Low	Didactic	7.6[b]	5.5[c]	6.9[c]	36
		Testimonial 1	7.2	5.0	6.5	38
		Testimonial 2	7.5 [g]	5.5[i]	6.8 [g]	26
	High	Didactic	7.7[c,f]	5.3[c]	6.7[c,e]	46
		Testimonial 1	6.9	4.6	6.1	24
		Testimonial 2	7.3[i]	5.2[i]	6.5[i]	30
Addiction	Low	Didactic	7.4	4.8	6.6	34
		Testimonial 1	7.5	5.2	6.7	34
		Testimonial 2	7.4	4.8	6.6	33
	High	Didactic	7.0[e]	4.8[a,e]	6.0	41
		Testimonial 1	6.8	4.4	5.9	24
		Testimonial 2	6.6	4.3	6.0	35
Throat cancer	Low	Didactic	7.4	4.7	6.5	28
		Testimonial 1	7.3	4.7	6.5	45
		Testimonial 2	7.3	4.5	6.5	27
	High	Didactic	7.5[c,f]	4.7[a,e]	6.5[b,f]	43
		Testimonial 1	6.9	4.5	6.2	33
		Testimonial 2	6.8	4.3	6.0[h]	24

Didactic versus testimonial 1: [a]$p < 0.05$; [b]$p < 0.01$; [c]$p < 0.001$

Didactic versus testimonial 2: [d]$p < 0.05$; [e]$p < 0.01$; [f]$p < 0.001$

Testimonial 1 versus testimonial 2: [g]$p < 0.05$; [h]$p < 0.01$; [i]$p < 0.001$

* Low educational attainment is at least technical or secondary school; high educational attainment is high school or more

alternatives that had the same testimonial content, but varied the graphic image (Table 3). Within both strata of educational attainment, the HWL with the image of diseased organs mostly had significantly higher ratings than the HWL with the image of human suffering. The only exception was the lack of a statistically significant difference in ratings for relevance among participants with lower education. People in both educational strata selected as more effective the HWLs with graphic imagery of diseased organs over those with imagery of human suffering at a 3:1 ratio.

Table 3 Mean ratings and top rankings for warning labels by graphic image type and health effect, among Mexicans with low and high educational attainment

Label and sample characteristics			Ratings			Ranking (% chosen as most effective)
Health effect	Education attainment*	Graphic image type	Credibility	Relevance	Overall impact	
Emphysema	Low	Damaged organs	8.1[c]	5.2	7.0[c]	83
		Human suffering	7.4	4.8	6.6	17
	High	Damaged organs	8.3[c]	5.3[c]	7.3[c]	82
		Human suffering	7.5	4.6	6.2	18
Gangrene	Low	Damaged organs	7.8[a]	4.4	7.4[c]	73
		Human suffering	7.4	4.4	6.8	27
	High	Damaged organs	7.0[a]	4.5[a]	6.8[c]	78
		Human suffering	6.7	4.2	6.1	22

[a] Damaged organs versus human suffering, $p < 0.05$

[b] Damaged organs versus human suffering, $p < 0.01$

[c] Damaged organs versus human suffering, $p < 0.001$

* Low educational attainment is at least technical or secondary school; high educational attainment is high school or more

Discussion

Our study results suggest that graphic pictorial HWLs with textual risk-information (i.e., susceptibility, severity) in didactic form is generally perceived as having greater credibility, relevance, and impact than HWLs with testimonial narrative forms. These results were unexpected, given previous research indicating that testimonials have a greater impact than standard HWL text [28]. However, this previous research used short, didactic phrasing (e.g., *Smoking causes gangrene*), whereas our didactic texts were more elaborate, more comparable in length to the testimonial forms, and involved more similar content than in the previous study. Other research that has tested the effects of presenting more comparable narrative and didactic forms of risk information has found no difference in their relative impacts on attitudes, beliefs, and intentions, even though testimonial-type narrative forms were perceived as more relevant than "statistical" forms [35, 36]. The fact that participants showed more resistance against messages in the testimonial narrative form than in the didactic form may reflect the need for clear and simple propositional language on pictorial HWLs, at least during the early stages of strengthening the tobacco-control environment and implementing communication interventions. Indeed, one topic for future research not considered in a recent review of the use of narrative in cancer prevention [29] concerns whether narratives work better than didactic forms after repeated exposure to messages or when narratives are transmitted through nonprint media or other types of print media that allow for a greater quantity of information than warning labels typically allow (e.g., pamphlets). Future research should also examine the utility of testimonials for different types of HWL content, for example messages regarding self-efficacy to quit, for which narrative forms may be more effective than didactic text for conveying risk information [29].

Differences in the stimuli used across our study and the previous study may also help explain divergence in findings regarding the most effective textual content. In other experimental research [28, 37] participants viewed HWLs on a computer screen without brand imagery, whereas our textual content appeared on realistic cigarette packs. In our study, a fragment of testimonial text was overlaid on the picture that appeared on the front of the pack, and the primary testimonial text appeared on the back of the pack, with additional information (i.e., toxic constituents, call to action). Unlike in the previous study, participants who read the testimonial narrative could not simultaneously view the HWL picture, which may account for its reduced its impact. Our testimonial material also may not have been as powerful as that used in the previous study; however, testimonials came from real patients suffering from smoking-related disease, and their content was similar to that of the previous study. In the end, our results suggest that elaborate didactic texts on HWLs with graphic imagery will have a broader, population impact in Mexico than testimonial forms. Indeed, this conclusion was supported in subsequent focus groups conducted with populations that had similar educational and age profiles as our sample [28].

It is noteworthy that daily smokers generally perceived the pictorial HWLs as less credible and having lower impact than nondaily smokers, even though daily and nondaily smokers had similar perceptions of the relevance of the pictorial HWLs. This may be because of greater resistance to health risk messages among heavier smokers, as they may be more likely to engage in rationalizing beliefs and unrealistic optimism regarding smoking risks [38]. Future research should determine whether the effects

Table 4 Bivariate and adjusted linear mixed-effects model results for ratings of health warning label credibility, relevance and impact

	Credibility		Relevance		Perceived impact	
	Bivariate B (SE)	Adjusted B[d] (SE)	Bivariate B (SE)	Adjusted B[d] (SE)	Bivariate B (SE)	Adjusted B[d] (SE)
Age (continuous)	0.02 (0.01)[c]	0.04 (0.01)[c]	0.06 (0.01)[c]	0.07 (0.01)[c]	0.02 (0.01)[c]	0.04 (0.01)[c]
Sex						
Female	Ref.	Ref	Ref.	Ref	Ref.	Ref.
Male	−0.05 (0.11)	−0.05 (0.11)	0.23 (0.17)	0.12 (0.17)	0.14 (0.12)	0.15 (0.12)
Education						
Secondary or less	Ref.	Ref	Ref.	Ref	Ref.	Ref.
Technical school	−0.41 (0.20)[a]	−0.45 (0.20)[a]	−0.47 (0.30)	−0.53 (0.30)[a]	−0.25 (0.21)	−0.3 (0.21)
High school	−0.49 (0.14)[b]	−0.39 (0.14)[b]	−0.53 (0.21)[a]	−0.34 (0.21)	−0.50 (0.15)[b]	−0.40 (0.15)[b]
University or more	−0.54 (0.16)[b]	−0.58 (0.17)[c]	0.03 (0.24)	−0.12 (0.24)	−0.42 (0.17)[a]	−0.47 (0.17)[b]
Smoking behavior						
Nonsmoker	−0.03 (0.15)	0.14 (0.15)	0.02 (0.22)	0.43 (0.22)[a]	−0.04 (0.15)	0.15 (0.16)
Nondaily smoker	Ref.	Ref	Ref.	Ref	Ref.	Ref
Daily smoker, <5 per day	−0.36 (0.16)[a]	−0.46 (0.16)[b]	0.19 (0.24)	0.03 (0.24)	−0.40 (0.17)[a]	−0.50 (0.17)[b]
Daily smoker, 5 or more per day	−0.34 (0.15)[a]	−0.52 (0.15)[b]	0.71 (0.23)[b]	0.37 (0.23)	−0.38 (0.16)[a]	−0.58 (0.16)[b]
Warning topic						
Throat cancer	Ref.	Ref	Ref.	Ref	Ref.	Ref.
Stroke	0.05 (0.12)	0.05 (0.12)	0.01 (0.18)	−0.01 (0.17)	0.22 (0.12)	0.23 (0.12)[a]
Premature birth	0.39 (0.06)[c]	0.39 (0.06)[c]	−0.02 (0.07)	−0.01 (0.07)	0.31 (0.04)[c]	0.31 (0.04)[c]
Lung cancer	0.54 (0.12)[c]	0.60 (0.12)[c]	0.38 (0.17)[a]	0.40 (0.17)[a]	0.55 (0.12)[c]	0.60 (0.12)[c]
Heart attack	0.12 (0.05)[a]	0.19 (0.05)[c]	0.53 (0.06)[c]	0.57 (0.06)[c]	0.19 (0.04)[c]	0.23 (0.04)[c]
Addiction	−0.10 (0.12)	−0.11 (0.12)	0.14 (0.18)	0.12 (0.17)	−0.09 (0.12)	−0.09 (0.12)
Textual content						
Testimonial	Ref.	Ref	Ref.	Ref	Ref.	Ref
Didactic	0.36 (0.03)[c]	0.41 (0.03)[c]	0.23 (0.04)[c]	0.31 (0.04)[c]	0.22 (0.03)[c]	0.27 (0.03)[c]
Interaction[d]						
Text X Education		0.14 (0.02)[c]		0.08 (0.03)[b]		0.07 (0.018)[c]
Low education stratum[e]						
Testimonial	Ref.	Ref	Ref.	Ref	Ref.	Ref
Didactic	0.03 (0.11)	0.13 (0.07)	0.10 (0.08)	0.15 (0.05)[b]	0.08 (0.08)	0.13 (0.04)[c]
High education stratum[e]						
Testimonial	Ref.	Ref	Ref.	Ref	Ref.	Ref
Didactic	0.33 (0.08)[c]	0.40 (0.05)[c]	0.49 (0.06)[c]	0.55 (0.04)[c]	0.30 (0.06)[c]	0.55 (0.03)[c]

[a] $p < 0.05$

[b] $p < 0.01$

[c] $p < 0.001$

[d] Adjusted model results include all variables shown in the table, except for the interaction coefficient. Adjusted models with interactions were estimated in a separate model that included all covariates (coefficients not shown)

[e] Results from analyses stratified by education level, with low education having technical, secondary education or lower, and high education having high school or higher. Adjusted models included the same variables described above (covariate coefficients not shown)

of pictorial HWLs are modified by level of addiction and other characteristics related to motivation to process messages about smoking risks, for example intention to quit.

Educational attainment moderated evaluations of pictorial HWL content for indicators of message acceptance (i.e., credibility and relevance) and perceived impact. In populations with high school or greater educational attainment, the didactic textual form was clearly rated as more effective than testimonial form; however, in populations with lower educational attainment, testimonials generally produced similar responses as found for didactic texts. Studies of smoking cessation media campaigns in the US

have found that evocative testimonials have a greater impact among adult smokers with lower than higher SES [27]. Television advertisements and videos that contain testimonial elements may produce stronger emotional responses and effects than static, textual HWL content. Evidence from Australia [39, 40] and Mexico [41] suggests that media campaigns can create synergistic effects with pictorial HWLs, perhaps making their content more salient, credible, and relevant. Research should determine complementary campaign and HWL content that works best among disadvantaged populations. In Mexico, half the population has a secondary school education or less, and this population may require novel communication strategies to promote understanding of the risks of smoking. In this regard, future research should more squarely focus on the issue of literacy and health literacy, which have been shown to mediate the relationship between educational attainment and health knowledge and behavior [42, 43], although not always [44, 45]. Indeed, some of our study participants may not have had the requisite literacy to adequately distinguish didactic and testimonial textual forms when presented on cigarette packs, which could help explain why no difference was found within the less-educated population.

Interpretation of study results should be tempered by some limitations. The study procedure directed participants to attend to HWLs, an experience which differs from exposure in everyday life. To make exposure naturalistic, participants were recruited from public settings in or around places where cigarettes were sold, and the HWLs were printed on realistic cigarette packages with brand imagery. Nevertheless, participation in the study procedure and self-reported evaluations may have biased the results in unpredictable ways. The order of presenting health effect topics was not randomized, which may have introduced an ordering effect that could bias results; however, we expect that any bias is minimal, because of the random order in which HWL stimuli were presented with regard to primary study manipulations (i.e., didactic vs. testimonial textual form; diseased organ vs. human suffering imagery type). Furthermore, we also assessed participants' first exposure to novel HWL material, and their responses to HWL material will change as exposure is frequently repeated [26]. The first pictorial HWLs in Mexico had not yet saturated points of sale when this study was conducted, and populations already exposed to prominent pictorial HWLs may respond differently after they habituate to these stimuli. Research on strategies to stave off "wear out" is sorely needed as governments face the issue of selecting new content for their pictorial HWLs.

A number of issues are likely to compromise the external validity of our study, including focused recruitment in six sites in two major Mexican cities, thereby limiting our ability to generalize results. Indeed, participants were generally more highly educated and younger than the general population of smokers [46–48]. A more representative sample might have enabled more detailed examination of how education modifies HWL responses, particularly at lower education levels where our sample was too small to conduct stratified analysis. Nevertheless, the prevalence of nondaily smokers and low intensity daily smokers was similar to that in the broader Mexican population [48], and the consistency of effects generally suggests that the use of elaborated didactic textual forms is an appropriate messaging strategy. Finally, Mexico is somewhat unique for the great amount of space dedicated to text only HWLs (100% of the back and 100% of one side) compared with pictorial elements (30% of the front). Our results may have differed if the HWLs had a different allocation of space, content, and design features.

This study suggests that pictorial HWLs with didactic textual forms and graphic imagery of diseased organs are likely to have broad impact on the population of Mexico. The consistency of this result across population groups suggests that a diversified messaging strategy that differently targets smoker subgroups is currently unnecessary for ensuring maximum effects among disadvantaged groups of smokers. However, the greater impact found for the didactic form among people with higher as opposed to lower educational attainment suggests that this strategy may ultimately produce smoking-related disparities among people with lower educational attainment. Future research should continue to examine the textual and pictorial content, as well as the design elements, that will have a greater impact among disadvantaged groups, in order to stave off smoking-related disparities in countries that are only beginning to experience shifts toward greater concentration of smoking among more disadvantaged populations.

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