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Effects of Large Cigarette Warning Labels on Smokers' Expected Longevity

Lucy Popova, PhD,

Assistant Professor, School of Public Health, Georgia State University, Atlanta, GA

Johannes Thrul, PhD, and

Assistant Professor, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Stanton A. Glantz, PhD

Professor, Department of Medicine, Center for Tobacco Control Research and Education, Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco, CA

Abstract

Objectives—Smokers underestimate the health risks of smoking and overestimate their expected longevity. Warning labels on cigarette packs might help correct these misperceptions.

Methods—Online study with 1,200 smokers (18–62 years old), randomized to 3 conditions: text warning labels, pictorial warning labels, and a control group (water bottle labels). Warning labels were based on those proposed by the U.S. Food and Drug Administration in 2010. Participants in each condition saw 4 randomly selected labels and rated their expected longevity and chances of surviving to age 75 after exposure. Analyses of covariance controlled for cigarettes per day and self-rated health.

Results—Compared to control, both text and pictorial warnings reduced participants' expected longevity (text: mean = 76.8 years, pictorial: 77.3, control 79.4) and their estimated chances of living to 75 (text: 62.0%, pictorial: 63.0%, control 66.5%). The contrast between text and pictorial labels combined and control showed significantly reduced expected longevity ($p = .011$) and chances of living to 75 ($p = .004$). Differences between text and pictorial conditions were non-significant.

Conclusions—Large text or pictorial warnings on cigarette packs might help smokers develop a more accurate understanding of the effects of smoking on their longevity.

Keywords

smoking; tobacco control; warning labels; expected longevity

Correspondence: Dr Popova; lpopova1@gsu.edu.

Human Subjects Statement

An institutional review board at the University of California San Francisco approved all study procedures.

Conflict of Interest Statement

All authors of this article declare they have no conflicts of interest.

INTRODUCTION

Smoking kills 480,000 people in the US every year,¹ with smokers on average losing 10 years of life.² Yet smokers underestimate the health risks of smoking. While most smokers agree that smoking is dangerous to health and have knowledge of some risks of smoking such as lung cancer and heart disease, their knowledge is more limited regarding other smoking-caused diseases, such as blindness, stroke, impotence, gangrene, and other cancers.^{3,4} Smokers also have low knowledge of the harmful constituents in tobacco smoke.⁵ Schoenbaum⁶ found that heavy smokers (those who smoked 25 or more cigarettes per day) aged 50-62 overestimated their chances of living to age 75 by a factor of two or more.

Warning labels on cigarette packs are one way governments educate smokers about the health risks of smoking.⁷ Extensive research on cigarette warning labels has compared effects of pictorial and textual warning labels. Experimental studies show that compared to text-only warnings, pictorial warnings are more effective at attracting attention, eliciting stronger cognitive and emotional reactions, and increasing the motivation and intentions to not start or to quit smoking.^{8,9} Systematic review of longitudinal observational studies concluded that introduction of pictorial labels led to increased knowledge, quitline calls and reduced smoking.¹⁰ In randomized clinical trials, smokers exposed to pictorial warning labels had increased intentions to quit, were more likely to forgo cigarettes, attempt to quit, and successfully quit smoking.¹¹⁻¹³

Large warning labels that include pictures and text are recommended by the World Health Organization Framework Convention on Tobacco Control.¹⁴ The 2009 Family Smoking Prevention and Tobacco Control Act required the US Food and Drug Administration (FDA) to issue a regulation mandating pictorial warning labels on cigarettes.¹⁵ The first set of pictorial warning labels developed by the FDA was struck down in a split (2-1) court in 2012 as violating the tobacco companies' free speech rights under the First Amendment.¹⁶ In making this decision, the majority found that the FDA failed to show sufficient evidence that the pictorial warnings would directly advance the government's interest to reduce smoking rates.¹⁶ However, the dissenting judge argued that an "interest in informing or educating the public about the dangers of smoking might be compelling."¹⁷ The majority's dismissal of the government's interest in effectively communicating about the consequences of tobacco use was subsequently criticized by legal¹⁸ and public health organizations.¹⁹ Thus, in the next round of the legal challenges to the new pictorial warning labels the FDA is currently developing,²⁰ the role of new warnings in effectively informing the public about harms of smoking might come to the forefront.

In order to convince judges that pictorial labels effectively inform the public, it is necessary to conduct studies demonstrating the effects of warnings on knowledge and perceptions of risk, particularly on more concrete measures of risk perceptions. Expectations about one's length of life is one such measure, which might be more concrete compared to the more abstract questions, such as "How harmful is smoking to health?" Expected longevity could be conceptualized under a broader construct of perceived susceptibility or likelihood of risk, beliefs about one's likelihood of personally experiencing the risk.²¹ Currently, findings on

the effects of pictorial vs. text warning labels on perceived likelihood of risk are mixed⁸ and studies on the effects of pictorial warnings on expected longevity are non-existent.

This study evaluates the effects of brief exposures to large text and pictorial warning labels on cigarette packages on smokers' expected longevity (also called "subjective longevity expectations"²²), operationalized as expectations about how long one might live, and one's expected chances of living to the age of 75.

METHODS

Participants

1,200 adult (18-62 years old) smokers (defined as those who smoked over 100 cigarettes in their lifetime and were currently smoking every day or some days) participated in this study. The survey and market research company Toluna (www.toluna-group.com) recruited participants in exchange for points and cash rewards. Examples of procedures for data quality control included participants having to enter their zip code in the beginning and end of the survey and retaining only participants writing identical codes, as well as additional standard procedures described at <http://us.toluna-group.com/toluna-difference/quality/>. All participants completed electronic informed consent in protocols approved by the University of California San Francisco Committee on Human Research.

Procedure

After participants provided demographic information and completed measures of current and past tobacco use, they were stratified into daily and non-daily smokers, then participants in each stratum were randomized to one of 3 groups: 1) text warning labels, 2) pictorial warning labels, 3) control group. In the first 2 conditions, participants saw 4 images of cigarette packs with either text or pictorial warning labels presented in random order to mitigate order effects and randomly drawn from the 9 labels that the US Food and Drug Administration (FDA) proposed and that have been used in other studies²³ (S1 Figure). Warning labels were placed on the top 50% of the total area of the cigarette pack as required by the 2009 Family Smoking Prevention and Tobacco Control Act. Text messages on the text and pictorial labels were the same.

Labels were shown on branded packs to match a smoker's usual brand for those who smoked Marlboro, Newport, or Camel (46.4%, 18.6%, and 13.7% of participants respectively, Table 1). Those whose usual brand was "other" or those who did not have a usual brand (21.4%) were shown the labels on the brand drawn at random from the 3 main brands. Participants in the control group saw water bottles with different labels (S1 Figure).

Participants could look at each image as long as they wanted, but could not go back to the previous image. After seeing 4 images, participants were asked questions about outcome measures (expected longevity). Median time to complete the study was 6 minutes (interquartile range [IQR]: 5-9 minutes).

Measures

The main outcome measures were expected longevity (“How old will you be when you die? Estimate if unsure” with participants writing in any whole number) and, following Schoenbaum,⁶ we asked participants, “What is the percent chance that you will live to be 75 or more?” with answers on an 11-point scale ranging from 0 (absolutely no chance) to 100 (absolutely certain) in 10-point increments. (We used the age of 75 for consistency with Schoenbaum et al.⁶) We also measured demographics (see Table 1 for operationalization), cigarettes per day, days smoked in the past month, intentions to quit smoking, and self-rated health, on a scale of 1 (poor) to 5 (excellent).

Analysis

We first examined the interaction effect between the condition and cigarette brand package, which was not significant ($F(6,1188) = 1.04, p = .40$ and $F(6,1188) = 0.79, p = .58$ for the 2 main outcomes), and therefore all brands were analyzed together. To analyze the effect of condition on life expectancy outcomes, univariate analyses of covariance (ANCOVAs) were conducted with condition as predictor, cigarettes per day and self-rated health as covariates, and expected longevity and chance of surviving to age 75 as dependent variables. We also ran analyses with cigarettes per day adjusted by the number of days smoked per month, but the results were essentially the same as the final results presented here. We examined post-hoc pairwise comparisons for all 3 conditions using Holm-Sidak corrected ANCOVAs and contrasts to compare the effect of any label (text label and pictorial label conditions combined with equal weights) to the control condition. We tested whether the effects of warning labels on outcomes were moderated by sex, age, being a daily vs. nondaily smoker, and intentions to quit smoking, by including the interaction terms of these variables with the condition in separate analyses. Analyses were conducted using SPSS V.23.

RESULTS

Participants were 51.7% female; 17.8% Hispanic; 71.3% White, 15.0% African American, 8.3% Asian; the median age was 34 (IQR: 27-49) years (Table 1). The median number of cigarettes per day was 10 (IQR: 4.3-15.0) and 45.1% were non-daily smokers (smoked on 1-29 days out of past 30).

Expected longevity by experimental condition was: control 79.4, text 76.8, and pictorial 77.3 years (Figure 1). The one-way analysis of covariance on participants' expected longevity controlling for cigarettes per day and self-rated health was significant ($F(2,1195) = 3.35, p = .036, \eta_p^2 = .006$). Post-hoc pairwise comparisons suggest that text warnings ($F(1,1195) = 6.0$, uncorrected $p = .014$, Holm-Sidak corrected $p = .041, \eta_p^2 = .005$) differed from control, but not from pictorial warning labels ($F(1,1195) = 0.25$, uncorrected $p = .618$, corrected $p = .618, \eta_p^2 = .00$). The difference between pictorial warning labels and control approached statistical significance ($F(1,1195) = 3.81$, uncorrected $p = .051$, corrected $p = .099, \eta_p^2 = .003$). The contrast between text and pictorial warning labels combined and control showed significantly reduced expected longevity in comparison to the control group ($F(1,1195) = 6.45, p = .011, \eta_p^2 = .005$).

Chance of living to age 75 or more was: control 66.5%, text 62.0%, and pictorial 62.9% (Figure 1). There were significant differences between conditions ($F(2,1195) = 4.32, p = .014, \eta_p^2 = .007$) with participants in the text warning label condition yielding significantly lower likelihood compared to control ($F(1,1195) = 7.78, \text{uncorrected } p = .005, \text{corrected } p = .015, \eta_p^2 = .006$). The difference between pictorial warnings and control approached significance ($F(1,1195) = 4.83, \text{uncorrected } p = .028, \text{corrected } p = .055, \eta_p^2 = .004$); and text and pictorial warning groups were not different from each other ($F(1,1195) = 0.35, \text{uncorrected } p = .553, \text{corrected } p = .553, \eta_p^2 = .00$). The contrast of text and pictorial warning labels combined significantly reduced estimates of chances of living to age 75 in comparison to the control group ($F(1,1195) = 8.28, p = .004, \eta_p^2 = .007$).

To assess whether text and pictorial warning labels affect life expectations differently based on sex, age, intentions to quit smoking, and daily vs. non-daily smoking, we tested whether the interaction between experimental condition and these variables were significant in predicting expected longevity and chance of living to age 75. For both outcomes, none of the interactions were significant (all p s $> .05$; data not shown).

DISCUSSION

In this study, brief one-time exposure to both large text and pictorial warning labels similarly reduced smokers' expected longevity by about 2 years and estimated likelihood of living to age 75 by 4%, compared to control (Figure 1). These effects compare with the fact that smokers lose an average 10 years of life² and overestimate the probability of living to age 75 by 26% (weighted average between men and women).⁶ Our results suggest that these warning labels increase understanding of the effects of smoking on these concretely measureable outcomes. Both text and pictorial warning labels reduced longevity expectations in smokers in comparison to their current perceptions, which are created by, among other things, the current weak warning labels on the sides of US cigarette packs. This research contributes to a growing body of evidence to support US Food and Drug Administration, as well as similar authorities in other countries, to implement new large warnings on cigarette packages to educate smokers about the effects of smoking on their life expectancy.

We found no significant differences between large new text or pictorial warnings on expected longevity. Estimates about how long one might live and one's own chances of living to a certain age address perceptions of susceptibility – beliefs about the likelihood of personally experiencing the negative outcomes. Past studies that compared effects of pictorial and text warning labels on perceived likelihood of health-related harms also found no significant differences (results of a meta-analysis of 8 studies, $d = 0.02, p = .65$).⁸ The reason for this could be that most warnings in our and other studies focused on communicating the seriousness of health harms (ie, severity) rather than on communicating to smokers that these harms can happen to them personally (susceptibility). Past studies that successfully changed perceived susceptibility presented warning labels in form of a question (eg, "What are the consequences of smoking for your lung?"),²⁴ used the word "you,"²⁵ or used personalized language by showing the risks to people similar to the respondents.²⁶

Future studies investigating the impact of warning labels on expected longevity may want to test mediational pathways through perceived severity or susceptibility.

Effects of warning labels on expected longevity is just one of several relevant outcomes; we did not evaluate perceptions of the warnings, or effects of warnings on intentions to quit, or actual quitting behavior. Other studies show that large, pictorial warning labels are effective for those outcomes.^{8,10} Warning labels affect multiple outcomes besides perceptions of risk that ultimately result in behavior change on a population level.⁷ Future randomized trials and observational studies of implemented warning labels should include measures of expected longevity to evaluate whether large warning labels on cigarette packs correct smokers' misperceptions about the effects of cigarette smoking on longevity.

The non-probability sample may not be representative of all US smokers, limiting the generalizability. However, the sample was demographically diverse. The proportion of non-daily smokers in this study (45.1%) is comparable to the proportion of non-daily smokers in the nationally representative samples, such as 2014 NSDUH, where 40.5% of current smokers 18 and older were non-daily smokers.²⁷

The experimental design with the forced exposure limits the generalizability of the findings to the real world. On one hand, the effect sizes found in this study might be inflated because participants' attention was directed to the warning labels. On the other hand, the effect sizes might be deflated because smokers are exposed to warning labels in real life multiple times a day, not only on their own packs, but also on advertisements, in stores, and on packs of other smokers. Future studies with multiple exposures (randomized trials) and observational studies in countries that implement large warning labels should evaluate the effects of warning labels on expected longevity.

While we controlled for cigarettes per day and self-rated health, future studies should also include other measures that might be influencing expected longevity, in particular the number of years a person smoked.

A strength of this study is an inclusion of a control condition with no exposure to the image of cigarette pack or a warning label. Studies comparing pictorial and text warnings typically do not have a no-exposure group. Comparing participants who saw warnings to participants who saw unrelated images (in our case, bottled water labels) allowed us to tap into existing perceptions and expectations of smokers that are not primed or modified by exposure to cigarettes or warnings.

In conclusion, smokers underestimate the full extent of the risks of tobacco use, including overestimating their chances of living to 75 years of age. Brief exposure to a text or pictorial warning labels covering 50% of the front of cigarette packs might help smokers develop a more accurate understanding of the effects of smoking on their longevity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Smokers' expected longevity and chance of living to age 75 are similarly reduced (made more accurate) by exposure to large text and pictorial warning labels. Mean $\pm$ standard error of the mean (*SEM*) for 1,200 smokers, p values from post-hoc pairwise comparisons using Holm-Sidak corrected ANCOVAs.

Table 1

Participating Smokers' Characteristics (N = 1,200).

Characteristic	N	%	Pictorial (N = 402)	Text (N = 400)	Control (N = 398)
Sex					
Male	580	48.3	49.3%	45.5%	50.3%
Female	620	51.7	50.7%	54.5%	49.7%
Age, years					
18-29	415	34.6	36.1%	34.8%	32.9%
30-49	495	41.3	39.8%	41.0%	43.0%
50-62	290	24.2	24.1%	24.3%	24.1%
Race (Census categories)					
White	856	71.3	70.9%	69.3%	73.9%
Black or African American	180	15.0	15.9%	16.5%	12.6%
American Indian or Alaskan Native	25	2.1	3.0%	2.3%	1.0%
Asian	99	8.3	7.7%	8.0%	9.0%
Native Hawaiian/Pacific Islander	5	0.4	0.5%	0.5%	0.3%
More than one race	25	2.1	1.7%	3.0%	1.5%
Ethnicity					
Hispanic	214	17.8	14.4%	20.3%	18.8%
Non-hispanic	986	82.2	85.6%	79.8%	81.2%
Education					
High school or less	465	38.8	39.8%	40.6%	35.9%
Some college	364	30.3	25.9%	30.8%	34.4%
Bachelor's degree or higher	371	30.9	34.3%	28.7%	29.6%
Income (thousand \$)					
<25	350	29.2	29.90%	27.80%	29.90%
25-59.9	435	36.3	35.30%	38.50%	34.90%
>60	415	34.6	34.80%	33.80%	35.20%
Smoking behavior in the past 30 days					
Non-daily smoker (1-29 days)	541	45.1	43.3%	46.3%	45.7%
Daily smoker	659	54.9	56.7%	53.8%	54.3%

Characteristic	N	%	Pictorial (N = 402)	Text (N = 400)	Control (N = 398)
Regular brand					
Camel	164	13.7	14.9%	12.0%	14.1%
Marlboro	557	46.4	47.0%	47.3%	45.0%
Newport	223	18.6	17.7%	20.5%	17.6%
Other brand	225	18.8	17.2%	18.5%	20.6%
Don't have regular brand	31	2.6	1.8%	2.8%	2.6%
Intention to quit smoking					
Never expect to quit	116	9.7	9.5%	9.5%	10.1%
Will quit in future but not in the next 6 months	536	44.7	45.3%	43.3%	45.5%
Will quit in the next 6 months	209	17.4	18.4%	18.5%	15.3%
Will quit in the next month	66	5.5	4.2%	6.0%	6.3%
Currently trying to quit	273	22.8	22.6%	22.8%	22.9%
Cigarettes per day, Median (IQR)	10 (4-15)		10 (5-15)	10 (4-15)	10 (4-18)
Self-rated health, Median (IQR)	3 (3-4)		3 (3-4)	3 (3-4)	3 (3-4)

Note: No significant differences existed among conditions on participant characteristics (all p s > .05).

IQR – interquartile range (25th – 75th percentile).