

Negative affect, message reactance and perceived risk: how do pictorial cigarette pack warnings change quit intentions?

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ABSTRACT

Objective Pictorial warnings on cigarette packs increase motivation to quit smoking. We sought to examine the potential mediating role of negative affect, message reactance (ie, an oppositional reaction to a message) and perceived risk in shaping quit intentions.

Methods In 2014 and 2015, we randomly assigned 2149 adult US smokers to receive either pictorial warnings or text-only warnings applied to their cigarette packs for 4 weeks. Analyses used structural equation modelling with bootstrapped SEs to test our theorised mediational model.

Findings Pictorial warnings increased negative affect, message reactance and quit intentions (all $P < 0.001$), but not perceived risk (ie, perceived likelihood and severity of harms of smoking). Negative affect mediated the impact of pictorial warnings on quit intentions (mediated effect=0.16, $P < 0.001$). Message reactance weakened the impact of pictorial warnings on quit intentions, although the effect was small (mediated effect=-0.04, $P < 0.001$). Although pictorial warnings did not directly influence perceived risk, the model showed additional small mediation effects on quit intentions through negative affect and its *positive* association with perceived risk (mediated effect=0.02, $P < 0.001$), as well as reactance and its *negative* association with perceived risk (mediated effect=-0.01, $P < 0.001$).

Conclusions Pictorial cigarette pack warnings increased quit intentions by increasing negative affect. Message reactance partially attenuated this increase in intentions. The opposing associations of negative affect and reactance on perceived risk may explain why pictorial warnings did not lead to observable changes in perceived risk.

INTRODUCTION

Tobacco use is the leading cause of preventable morbidity and mortality worldwide, causing nearly six million deaths each year.¹ The WHO Framework Convention on Tobacco Control calls for its signatory countries to implement large pictorial images on cigarette packs based on evidence that pictorial warnings are more effective than text-only warnings.² Indeed, systematic reviews and a recent randomised controlled trial demonstrate that pictorial warnings elicit stronger quit intentions^{3,4} and increase subsequent cessation behaviour, compared with text-only warnings.⁵ Characterising how pictorial warnings strengthen quit intentions can help policymakers design more effective warnings.

The 2009 Family Smoking Prevention and Tobacco Control Act requires pictorial warnings on cigarette packs in the USA.⁶ However, a 2012 lawsuit brought forth by the tobacco industry stalled implementation of this facet of the law.⁷ In the court case, the warnings were criticised for being ‘unabashed attempts to evoke emotion.’⁷ Indeed, research has shown that pictorial warnings elicit fear and other negative emotions.^{4,8–12} These negative emotions may serve an important information-processing role by making the warning content accessible and salient, thereby more effectively influencing outcomes such as risk perceptions and quit intentions.^{8,9} Emotional responses are typically formed with greater confidence and more quickly than cognitive appraisals and are therefore likely to precede cognitive responses such as perceived risk.¹³ Affect may also help people process risk information.^{14–18} Understanding the role of negative affective responses to pictorial warnings may be relevant to future legal battles in the USA and may also inform the creation of strong warnings in countries that are implementing new pictorial warning policies or changing their existing pictorial warnings.

In addition to negative affect, pictorial warnings may elicit *message reactance*, defined as cognitive and emotional resistance to a health message in response to a perceived threat to one’s freedom.^{19–21} Several studies have found that pictorial warnings elicit greater reactance than text-only warnings.^{22–25} However, the extent to which reactance weakens the impact of pictorial warnings on outcomes such as quit intentions remains an important research gap. Moreover, research is needed to understand whether negative emotions and message reactance are associated with changes in perceived risk.

In the current study, we sought to determine the psychological mechanisms by which pictorial cigarette pack warnings elicit stronger quit intentions using experimental data. Specifically, we aimed to understand whether pictorial warnings heightened negative affect and reactance and whether, in turn, negative affect and reactance were associated with quit intentions via perceived risk (ie, perceived likelihood of harm from smoking and perceived severity of harm from smoking).

METHODS

Participants

From September 2014 to August 2015, we recruited²⁶ a convenience sample of adult smokers



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Figure 1 Intervention warnings (left) and control warnings (right).

in North Carolina and California, USA to participate in a trial comparing the impact of pictorial and text versus text-only warnings.³ Participants were aged 18 or older, proficient in English and current smokers, defined as having smoked at least 100 cigarettes during their lifetime and now smoking every day or some days. Exclusion criteria included pregnancy, current enrolment in a smoking cessation trial, smoking only roll-your-own cigarettes, smoking fewer than seven cigarettes per week and living in the same household as another trial participant. Details regarding recruitment, design and methods have previously been reported.³

Procedures

In our study, smokers received warnings on their own cigarette packs for 4 weeks using a protocol developed by our team.^{3 27} Participants brought in an 8-day supply of cigarettes weekly. At baseline, we randomly assigned participants to receive one of eight warnings: four pictorial warnings with text and four text-only controls in a two-arm trial testing pictorial versus text-only warnings. The four pictorial warnings contained text required by the Tobacco Control Act and a picture to illustrate a health harm of smoking selected from the Food and Drug Administration (FDA)'s originally proposed set of images (figure 1).²⁸ We chose these four warning images because they performed well in a previous internet study and avoided many of the criticisms in the lawsuits (eg, using a cartoon or a rare health harm of smoking).^{29 30} We removed the FDA quitline number from the images, which was a source of contention in litigation against the warnings.^{7 31} Study staff applied the pictorial warning labels to the top half of the front and back panels of participants' cigarette packs, in accordance with the FDA requirements.⁶ The four text-only control warnings used the US Surgeon General's warning statements that have been required on the side of cigarette packs since 1985. Study staff applied the text-only warning labels on the side of the packs covering the existing US Surgeon General's warnings. We applied the new warning labels on top of

the existing warnings to control for the effect of putting a label on smokers' packs. Randomisation created groups that did not differ on demographics assessed (all $P > 0.05$).³ For this reason, we did not adjust analyses for demographics. Trial participants were diverse, including a substantial number of sexual minority, African American, low-education and low-income smokers (table 1).

Participants completed two computer surveys at the first visit (ie, baseline and immediately after seeing their assigned warning, which was immediate post-test) and one survey at each visit thereafter for 4 weeks. Participants received a cash incentive at the end of each visit, totalling up to US\$185 in North Carolina and US\$15 higher in California due to the higher cost of living. At the end of the final follow-up appointment, participants received information about local smoking cessation programmes.

Measures

The baseline survey and the week 2 follow-up survey assessed perceived likelihood of harm from smoking and perceived severity of harm from smoking. We measured negative affect elicited by the warning at immediate post-test.³² We originally planned to examine fear alone as a mediator given its importance in the extended parallel process model,³³ but sensitivity analyses revealed that fear and the other negative affect items exhibited a nearly identical pattern of associations, and confirmatory factor analysis supported treating negative affect as a single latent factor. The immediate post-test survey also assessed message reactance using the Brief Reactance to Health Warnings Scale.²⁵ This measure captures the three main components of reactance: anger toward the warning, perceived threat to freedom and counterarguing against the warning.^{19 20 24} Finally, we measured quit intentions at baseline, immediate post-test and all follow-up surveys.³⁴ Item wording, response scales and factor loadings for all measures appear in table 2.

Table 1 Participant characteristics (n=2149)

	Text-only warnings (n=1078)		Pictorial warnings (n=1071)	
	n	(%)	n	(%)
Demographics				
Age				
18–24 years	171	(16.1)	152	(14.5)
25–39 years	377	(35.5)	398	(37.9)
40–54 years	338	(31.8)	304	(29.0)
55+ years	176	(16.6)	195	(18.6)
Mean (SD) years	39.7	(13.4)	39.8	(13.7)
Gender				
Female	548	(51.2)	512	(48.2)
Male	507	(47.4)	532	(50.0)
Transgender	15	(1.4)	19	(1.8)
Gay, lesbian or bisexual	173	(16.3)	195	(18.8)
Hispanic	92	(8.6)	89	(8.5)
Race				
Black or African American	484	(45.8)	510	(48.9)
White	393	(37.2)	358	(34.3)
Other/multiracial	134	(12.7)	117	(11.2)
Asian	28	(2.7)	42	(4.0)
American Indian or Alaska Native	7	(0.6)	11	(1.0)
Native Hawaiian or other Pacific Islander	11	(1.0)	6	(0.6)
Education				
High school graduate or less	333	(31.1)	344	(32.5)
Some college	519	(48.5)	502	(47.4)
College graduate	156	(14.6)	156	(14.7)
Graduate degree	63	(5.9)	58	(5.5)
Household income, annual				
US\$0–\$24 999	566	(53.3)	589	(55.8)
US\$25 000–US\$49 999	272	(25.6)	266	(25.2)
US\$50 000–US\$74 999	110	(10.3)	92	(8.7)
US\$75 000+	115	(10.8)	109	(10.3)
Low income (≤150% of Federal Poverty Level)				
No	506	(47.0)	477	(44.8)
Yes	570	(53.0)	589	(55.2)
Trial site				
California	594	(55.1)	592	(55.3)
North Carolina	484	(44.9)	479	(44.7)
Cigarettes smoked per day, mean (SD)	8.8	(6.6)	8.7	(7.3)
Smoking frequency				
Non-daily	211	(19.6)	207	(19.3)
Daily	866	(80.4)	864	(80.7)
Mediators and outcome at baseline, mean (SD)				
Perceived likelihood of harm from smoking	3.3	(0.9)	3.3	(0.9)
Perceived severity of harm from smoking	3.7	(0.6)	3.7	(0.6)
Quit intentions	2.2	(0.9)	2.3	(0.9)

Study characteristics, mediators and outcomes at baseline did not differ by trial arm.³ Missing demographic data ranged from 0.7% to 2.2%. The baseline surveys could not assess negative affect or message reactance as participants had not yet seen the warnings.

Data analysis

Analyses used Stata/SE V.14.1 and Mplus V.7.4 with two-tailed tests and a critical alpha of 0.05. Analyses used measures of negative affect and message reactance taken at immediate post-test and measures of perceived likelihood and perceived severity taken at week 2 follow-up (table 2). The outcome was quit intentions at week 4 follow-up.

First, we examined associations among the constructs using bivariate correlations; this analysis used mean scores for each construct. Next, we examined the association between the individual items and their latent constructs using a measurement model that treated the mediators and outcome as latent variables. The model specification process pointed toward modelling perceived risk as a second-order latent variable that was a function of perceived likelihood and perceived severity. Then, we examined the impact of pictorial warnings on quit intentions in an unadjusted structural model. Finally, we examined the simultaneous influence of the hypothesised mediator and suppressor variables using a final, adjusted structural model. Suppression occurs when the direct and mediated effects have opposite signs, in this case demonstrating that the mediator detracts from the effectiveness of pictorial warnings.³⁵ In contrast, a direct and mediated effect with the same sign signals mediation, indicating that the mediator contributes to the effectiveness of pictorial warnings.³⁵ Candidate mediator/suppressor variables were negative affect, message reactance and perceived risk. The model tested theoretically driven predictions^{4 15 33 36} about the indirect effects of pictorial warnings on quit intentions first via negative affect and message reactance and then through perceived risk.

Intent-to-treat analyses included all participants randomised, using the last observation available.³⁷ Participants who had quit smoking at week 4 did not answer the quit intentions items, so we used the last observation available for them as well. When data remained missing, the models employed full information maximum-likelihood estimation, an approach commonly recommended for structural equation models that makes use of all available observations.^{38–40} We report results as standardised path coefficients (βs). Mediation analyses used bootstrapped 95% CIs with 1000 repetitions, as this approach does not assume that indirect effects are normally distributed.⁴¹ We evaluated several indicators of acceptable model fit, including the root mean square error of approximation (RMSEA <0.08),⁴² the Tucker-Lewis Index (TLI >0.95)⁴³ and the Bentler Comparative Fit Index (CFI >0.95).⁴⁴

RESULTS

The measurement model fit the data well (RMSEA=0.040 (90% CI 0.036 to 0.043), CFI=0.997, TLI=0.997; table 2). Factor loadings for the indicator variables were all statistically significant and ranged from 0.75 to 0.98. Bivariate correlations between the model constructs ranged from –0.24 to 0.38 (table 3). Pictorial warnings increased negative affect, message reactance and quit intentions (all P<0.001, table 3). Pictorial warnings did not increase perceived risk (P=0.65, table 3).

The final structural model exhibited excellent fit (RMSEA=0.038 (90% CI 0.034 to 0.041), CFI=0.997, TLI=0.997; figure 2 and online supplementary table 1). Pictorial warnings generated higher quit intentions than text-only warnings (β=0.086, P<0.001). As expected, negative affect mediated the impact of pictorial warnings on quit intentions, such that pictorial warning exposure increased negative affect (β=0.40, P<0.001; figure 2) which, in turn, was associated with greater quit intentions (β=0.41, P<0.001; mediated effect=0.16, P<0.001; table 4). Negative affect was also

Table 2 Latent variables used in the measurement and structural equation models (n=2149)

Latent variable (timepoint used in analysis)	Indicator item wording (response scale)	Factor loading
Negative affect (immediate post-test)	How much did the warning on your cigarette packs make you feel...	
	Scared? (Not at all (coded as 1), a little (2), somewhat (3), very (4), extremely (5))	0.93
	Regretful? (Not at all (1), a little (2), somewhat (3), very (4), extremely (5))	0.91
	On edge? (Not at all (1), a little (2), somewhat (3), very (4), extremely (5))	0.88
	Disgusted? (Not at all (1), a little (2), somewhat (3), very (4), extremely (5))	0.88
Message reactance (immediate post-test)	Sad? (Not at all (1), a little (2), somewhat (3), very (4), extremely (5))	0.86
	Please say how much you agree or disagree with each statement below about the warning we put on your packs.	
	The health effect on this warning is overblown. (Strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4), strongly agree (5))	0.82
Perceived risk* (week 2)	This warning is trying to manipulate me. (Strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4), strongly agree (5))	0.77
	This warning annoys me. (Strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4), strongly agree (5))	0.75
	Perceived likelihood of harm from smoking †	
Perceived likelihood of harm from smoking †	What is the chance that you will one day get heart disease if you continue to smoke cigarettes? (No chance (1), low chance (2), moderate chance (3), high chance (4), certain (5))	1.00
	What is the chance that you will one day get cancer if you continue to smoke cigarettes? (No chance (1), low chance (2), moderate chance (3), high chance (4), certain (5))	0.94
	What is the chance that you will one day get a permanent breathing problem if you continue to smoke cigarettes? (No chance (1), low chance (2), moderate chance (3), high chance (4), certain (5))	0.93
Perceived severity of harm from smoking	How much would getting a permanent breathing problem if you continue to smoke cigarettes? (No chance (1), low chance (2), moderate chance (3), high chance (4), certain (5))	0.87
	How much would getting heart disease because of smoking affect your life? (Not at all (1), a little (2), a moderate amount (3), a lot (4))	0.56
	How much would getting cancer because of smoking affect your life? (Not at all (1), a little (2), a moderate amount (3), a lot (4))	0.97
Quit intentions (week 4)	How much would getting a permanent breathing problem because of smoking affect your life? (Not at all (1), a little (2), a moderate amount (3), a lot (4))	0.97
	How much do you plan to quit smoking in the next month? (Not at all (1), a little (2), somewhat (3), very much (4))	0.98
	How interested are you in quitting smoking in the next month? (Not at all interested (1), a little interested (2), somewhat interested (3), very interested (4))	0.95
Quit intentions (week 4)	How likely are you to quit smoking in the next month? (Not at all likely (1), a little likely (2), somewhat likely (3), very likely (4))	0.94

Table reports standardised factor loadings.

*Modelled as a second-order latent factor.

†For purposes of estimation, we fixed the value of the loading for perceived likelihood at 1.

associated with greater perceived risk ($\beta=0.30$, $P<0.001$), and perceived risk was associated with greater quit intentions (mediated effect through negative affect and perceived risk=0.02, $P<0.001$).

Pictorial warnings also increased message reactance ($\beta=0.25$, $P<0.001$), and message reactance was associated with lower quit intentions ($\beta=-0.17$, $P<0.001$; mediated effect=-0.04, $P<0.001$, table 4). Message reactance was associated with lower perceived risk ($\beta=-0.36$, $P<0.001$), which was in turn associated with greater quit intentions (mediated effect through reactance and perceived risk=-0.01, $P<0.001$).

DISCUSSION

Pictorial cigarette pack warnings elicited stronger quit intentions than text-only warnings. Negative affect (which included fear, guilt, disgust, anxiety and sadness) was a key driver of the

effect of pictorial warnings on quit intentions. Compared with text-only warnings, pictorial warnings elicited more negative affect, which was associated with greater quit intentions. We also found in adjusted analyses that negative affect was associated with greater perceived risk of harm from smoking. Reactance, however, was associated with lower perceived risk. Perceived risk was associated with stronger quit intentions, building on prior work showing associations between risk perceptions and intentions and behaviour.⁴⁵⁻⁴⁸ The opposing associations of negative affect and reactance with perceived risk may offer insight into the well-established finding that pictorial cigarette pack warnings do not cause observable changes in risk perceptions.^{48 9 49}

Our study suggests that the emotion evoked by the warnings may be a precursor to beneficial changes in quit intentions, building on prior research about emotional reactions to pictorial

Table 3 Means and bivariate correlations among variables in the multiple mediation model (n=2093)

	Mean (SD)	1	2	3	4	5
Pictorial warnings (1)	-	-	-	-	-	-
Negative affect (2)	2.25 (1.21)	0.38**	-	-	-	-
Message reactance (3)	2.08 (0.89)	0.22**	0.03	-	-	-
Perceived risk (4)	3.55 (0.63)	0.01	0.20**	-0.24**	-	-
Quit intentions (5)	2.57 (1.07)	0.08**	0.35**	-0.15**	0.23**	-

Analyses excluded 56 participants with missing data on at least one of the variables. Pictorial warnings coded as 1 (vs. text-only, coded as 0). Mediators were measured at immediate post-test (negative affect, message reactance) or the week 2 follow-up survey (perceived risk). Quit intentions were measured at week 4.

* $P<0.05$, ** $P<0.001$.

Table 4 Mediation of association between pictorial warning exposure and quit intentions (n=2149)

Mediation path	Mediated effect	95% CI
Pictorial warning → negative affect → quit intentions	0.16	0.14 to 0.19
Pictorial warning → negative affect → perceived risk → quit intentions	0.02	0.01 to 0.02
Pictorial warning → reactance → quit intentions	-0.04	-0.06 to -0.02
Pictorial warning → reactance → perceived risk → quit intentions	-0.01	-0.02 to -0.01

Table reports standardised path coefficients for mediated effects. Mediators were measured at immediate post-test (negative affect, message reactance) or the week 2 follow-up survey (perceived risk). Quit intentions were measured at week 4.

warnings.^{4 8-12} This is an important point that the US courts did not acknowledge when criticising pictorial warnings simply for evoking emotion.⁷ A recent legal analysis of the pictorial warning lawsuits in the USA concluded that the ‘warnings do not bypass reason simply by reaching for the heart’ and that the emotions evoked by the warnings should not deem them unconstitutional.⁵⁰ Indeed, we found pictorial warnings were effective *because* of the emotions they elicited.

Some have argued that discrete negative emotions fall into distinct categories and therefore play unique roles in shaping intentions and behaviours.⁵¹⁻⁵³ The extended parallel process model argues that fear is the most important affective motivator of behaviour change.³³ However, we found support for a constructionist view of emotion⁵² because—in the context of pictorial cigarette pack warnings—fear, guilt, disgust, anxiety and sadness were highly correlated and functioned quite similarly. However, in contrast with negative affect, anger (a facet of reactance) was associated with *lower* quit intentions. This finding builds on previous research indicating that anger and fear produce opposite effects on intentions and behaviour.⁵⁴⁻⁵⁶ In the context of pictorial warnings, the distinctions between fear, guilt, disgust, anxiety and sadness may not be meaningful,

but it is crucial to distinguish between anger and other types of negative affect. Message reactance, which includes anger, works against the warnings’ purpose to motivate quitting, while increasing other types of negative affect advances this purpose.

As predicted, message reactance weakened the effect of pictorial warnings on quit intentions, although the magnitude of the mediated effect was small. Message reactance was also associated with lower perceived risk. Previous studies have found that pictorial warnings cause greater reactance than text-only warnings,^{4 22-24} but few studies have examined whether message reactance or other forms of defensive processing are associated with deleterious consequences, such as lower quit intentions.^{24 57 58} Our experimental test of the suppression effects of message reactance following repeated exposure to pictorial warnings adds to this body of research. However, given research demonstrating the effectiveness of pictorial warnings, it would be unwise to conclude that pictorial warnings are counterproductive simply because they produce reactance, as others have argued.²³ In fact, the best warnings may be those that elicit strong reactions of all kinds, including reactance. Reactance had a small effect in the model, and its influence did not undo the positive effects of warnings. Measuring message reactance can help to better identify the types of individuals who are resistant to the warnings and therefore may benefit from alternative interventions. Moreover, message reactance could be a particularly useful as a way of vetting candidate warnings in the early stages of message development and testing. Given a choice between two warnings that elicit similar levels of negative affect, message designers might choose the warning that elicits less reactance.

Study strengths include the use of an experimental design, a large and diverse sample of smokers who received the warnings on the cigarette packs they used every day and the 4 week data collection period that allowed us to establish the temporality of mediated effects. However, the trial examined the potential effect of adding pictorial warnings to cigarette packs as well as implementing other label formatting changes required by the 2009 Tobacco Control Act compared with the present text-only

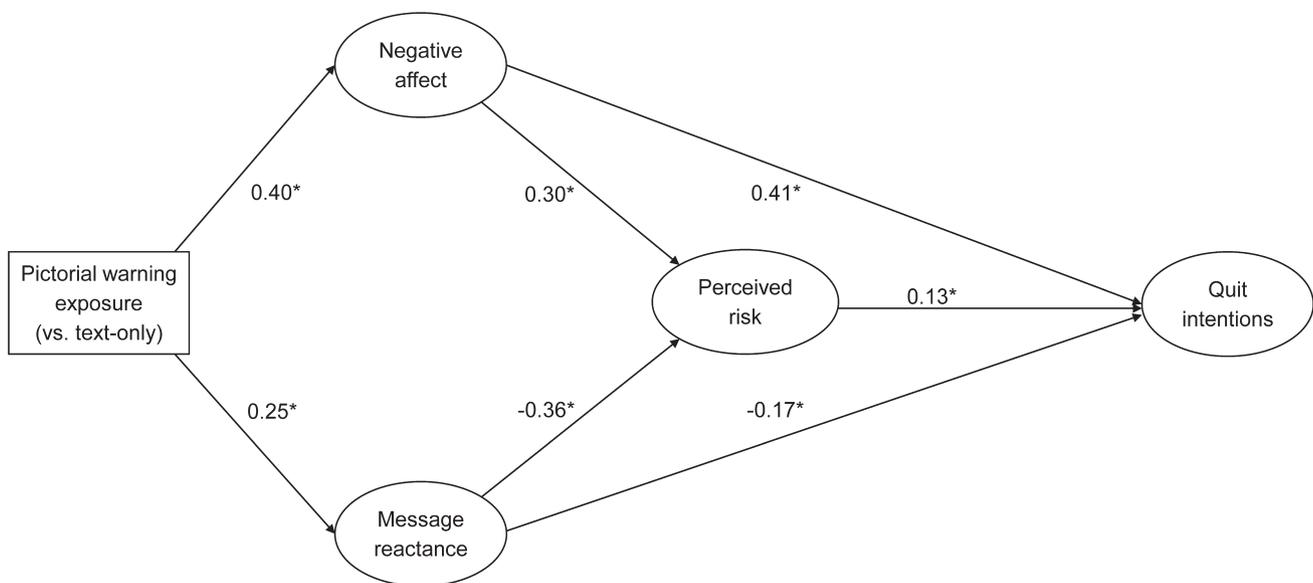


Figure 2 Structural equation model assessing the impact of pictorial warnings on quit intentions (n=2149). To simplify presentation, the figure omits factor loadings, non-significant pathways and residuals. Root mean square error of approximation=0.038 (90% CI 0.034 to 0.041), Comparative Fit Index=0.997, Tucker-Lewis Index=0.997. *P<0.05

What this paper adds

- ▶ In a 4-week trial with smokers, we found that pictorial warnings increased quit intentions.
- ▶ Negative affect was a key driver of the association between pictorial warnings and quit intentions. Message reactance weakened this association, although pictorial warnings were more effective than text-only warnings on the whole.
- ▶ Negative affect and reactance had opposite and offsetting associations with perceived risk, which may explain why pictorial cigarette pack warnings do not change perceived risk.

warnings in the USA. While the trial aimed to compare the current warning policy with the new one in the Act, the use of this research design leaves open the possibility that the observed effects on mediators and intentions may be due to the combination of adding pictures and other changes (eg, location, size and content). The generalisability of these findings to different contexts (eg, outside the USA) or over a longer period of time has yet to be established. Finally, some of the mediated pathways were based on observational data, limiting our ability to assume causal associations between the model factors.

Conclusions

Understanding how pictorial warnings exert their influence can help researchers and policymakers design more effective warnings. Pictorial warnings elicited stronger quit intentions in the present study. However, message reactance partially suppressed pictorial warnings' effect on quit intentions. We found that increased negative affect was a key mechanism by which pictorial warnings changed quit intentions. Negative affect was also associated with stronger perceived risk, which was in turn, associated with stronger quit intentions. Thus, negative affect is a vital and productive result of pictorial warning exposure.

Correction notice This article has been corrected since it was published Online First. "Humberto Parada" has been corrected to "Humberto Parada Jr".

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Contributors MGH analysed the data and drafted the manuscript, with oversight and input from NTB, NTB, SMN, KMR and MGH designed the study and developed the measures. NTB, SMN, KMR, MGH and TOJ implemented and oversaw data collection. PS, MHB, HP and NTB provided input on the statistical analyses. All authors critically revised the manuscript.

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Competing interests NTB and KMR have served as paid expert consultants in litigation against tobacco companies.

Patient consent Obtained.

Ethics approval The University of North Carolina institutional review board approved the procedures for this study.

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