The role of negative affect and message credibility in perceived effectiveness of smokeless tobacco health warning labels in Navi Mumbai, India and Dhaka, Bangladesh: A moderated-mediation analysis

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ABSTRACT

Objective: There is strong evidence showing that pictorial health warnings are more effective than text-only warnings. However, much of this evidence comes from high-income countries and is limited to cigarette packaging. Moreover, few studies have identified mechanisms that might explain the impact of warnings.

Methods: The current study examined the potential mediating role of negative affect and the moderating influence of message credibility in perceived effectiveness of smokeless tobacco warnings in two low- and middle-income countries (LMICs). Field interviews were conducted in India and Bangladesh, with adult (19 + years) smokeless tobacco users (*n* = 1053), and youth (16–18 years) users (*n* = 304) and non-users (*n* = 687). Respondents were randomly assigned to view warnings in one of four conditions: (1) Text-only, (2) pictorial with symbolic imagery, (3) pictorial with graphic images of health effects, or (4) pictorial with personalized graphic images plus a personal testimonial.

Results: The findings provide support for the mediating influence of negative affect in perceived effectiveness, for adult and youth smokeless tobacco users who viewed pictorial warnings (vs. text-only), and graphic health warnings (vs. personal testimonials). Among adults, message credibility moderated the indirect effect; the association was stronger when credibility was high and weaker when it was low. Among youth users and non-users, message credibility did not moderate the indirect effect.

Conclusions: Consistent with research from high-income countries, these findings highlight the importance of selecting imagery that will elicit negative emotional reactions and be perceived as credible. Differential effects among adults and youth highlight the importance of pre-testing images.

1. Introduction

Globally, smokeless tobacco use is disproportionately concentrated in India and Bangladesh. These two countries account for about 80% of the approximately 300 million smokeless tobacco users worldwide (National Cancer Institute, 2014). Despite considerable evidence linking smokeless tobacco use with oral cancer and other adverse health outcomes (International Agency for Research on Cancer, 2007) knowledge of the health risks of smokeless tobacco use remains low in the Indian subcontinent, as well as in migrant South Asian communities worldwide (Gupta & Ray, 2003; Kakde, Bhopal, & Jones, 2012; Khawaja et al., 2006; Rahman et al., 2012; Messina et al., 2013). Indeed, India

has one of the highest incidences of oral cancer in the world (Khan, 2012).

Health warnings on product packaging are one example of a cost-effective, population-wide strategy to inform populations about the health risks associated with tobacco use (Hammond, 2011). The World Health Organization's Framework Convention on Tobacco Control (WHO FCTC) established international standards for packaging and health warnings: FCTC Article 11 Guidelines call for pictorial warnings covering at least 50% or more of the pack (World Health Organization, 2008). India and Bangladesh, both signatory countries to the FCTC, differ with respect to their tobacco control environments. Despite numerous delays in implementation (Arora, Tewari, Nazar, Gupta, & Shrivastav, 2012; Oswal, Raute, Pednekar, & Gupta, 2011), in 2009, India became the first country in the world to require pictorial health warnings (a symbolic image of a scorpion) on smokeless tobacco packages. In 2011, the symbolic image of a scorpion was replaced with four different graphic images, but recent longitudinal evidence indicated that this change from a symbolic warning in 2009, to graphic warnings in 2011, did not result in significant increases in effectiveness (Gravely et al., 2016). However, India has committed to increasing warning size from the current 40% of the front surface to 85% of the principal display area (i.e., front and back). As of March 2016, Bangladesh has implemented pictorial health warnings covering 50% on smokeless tobacco packages.[2]

In terms of message content, there is strong evidence supporting the superiority of pictorial health warnings over text-only warnings in promoting smoking cessation, and increasing health knowledge and perceptions of risk (Hammond, 2011; Noar et al., 2015). Pictorial warnings often contain graphic, fear-arousing images that elicit negative emotion. Empirical research suggests that strong, fear-arousing messages are most likely to alter beliefs about health risks, as well as appeal and general acceptability of tobacco products (Emery, Romer, Sheerin, Jamieson, & Peters, 2014; Evans et al., 2015; Hammond, 2011; Netemeyer, Burton, Andrews, & Kees, 2016; Noar et al., 2015). Alongside gruesome images of disease caused by tobacco use, graphic health warnings may also include narratives, such as personal "testimonials" from tobacco users. However, findings are mixed with respect to the efficacy of testimonials on health warnings (Hammond et al., 2012; Thrasher et al., 2012).

With few exceptions, much of this research has been conducted in high-income countries and is almost entirely based on cigarette package warnings. To our knowledge, only three studies (one from the US, one from Canada, and one based on the current dataset), have experimentally tested attributes of health warnings for smokeless tobacco (Adkison, Bansal-Travers, Smith, O'Connor, & Hyland, 2014; Callery, Hammond, O'Connor, & Fong, 2011; Mutti et al., 2015). The current study is a follow-up analysis to an experimental study conducted by Mutti et al. (2015), which examined the perceived effectiveness of health warning labels with different message content for smokeless tobacco packages in India and Bangladesh. The previous analysis found that text-only messages were rated as less effective than all of the styles of warnings tested, including warnings with symbolic imagery, graphic health effects, and personal testimonials. Further, among the pictorial style warnings, graphic health warnings were rated as more effective than symbolic and personal testimonial warnings. Overall, the findings from this and other studies on smokeless tobacco health warnings support previous findings based on health warnings for cigarette packaging; pictorial warnings are more effective than text-only warnings, and warnings including graphic images may be most effective overall.

Despite these promising findings, to date, no studies have explicitly examined the role of negative emotion or other factors that might

determine the effectiveness of smokeless tobacco warnings in developing countries. Thus, while the central question of whether graphic images of health effects are the best approach for smokeless tobacco warnings is starting to be addressed, the secondary question of whether this effect is mediated or moderated by other underlying factors has yet to be examined in the context of LMICs. Overall, the evidence from studies based on cigarette health warnings indicates that cognitive and affective mediators underlie the effectiveness of health warnings. These studies have consistently found that compared to text-only warnings, warnings with graphic images elicited greater fear arousal, which in turn increased intentions to quit (Kees, Burton, Andrews, & Kozup, 2010), perceived risk (Emery et al., 2014), as well as perceived and actual effectiveness (Byrne, Katz, Mathios, & Niederdeppe, 2015).

According to the Extended Parallel Process Model (Witte, 1992), it is possible that a high level of fear arousal could result in message rejection. In addition, dual-process theories of attitude change such as the Elaboration Likelihood Model (Petty & Cacioppo, 1986) underscore the importance of engaging not only affective pathways, but also cognitive pathways by ensuring that warnings are credible and believable (Strahan et al., 2002). Thus, it is possible that a highly credible message could enhance warning label effectiveness, as well as diffuse heightened emotional responses that might otherwise lead to message rejection. To our knowledge, only one experimental study examined the role of message credibility as a moderator of warning label impact (Emery et al., 2014). Based on a sample of smokers, Emery et al. found that message credibility interacted with affect in predicting a positive attitude towards quitting. Additional studies have examined message credibility as an outcome (Thrasher et al., 2012) and as a mediator (Evans et al., 2015). Overall, negative affect and message credibility appear important in understanding how cigarette warnings work, and are likely to apply to smokeless tobacco package health warnings as well.

The primary aim of the current study was to extend the analysis conducted by Mutti et al. (2015) by examining potential affective and cognitive factors that may influence the warnings' effectiveness. Based on the fear appeal literature, as well as previous findings, it was hypothesized that negative affect would mediate the association between health warning type and ratings of perceived effectiveness; warnings which elicit higher levels of negative affect would elicit higher perceived effectiveness ratings. Therefore, based on the original study (Mutti et al., 2015), it was expected that all of the pictorial styles (symbolic, graphic, and personal testimonial) would elicit greater levels of negative affect compared to text-only warnings. Furthermore, it was expected that graphic health warnings would elicit greater negative affect compared to warnings with personal testimonials (H1). It was also hypothesized that the association between negative affect and perceived effectiveness would vary as a function of message credibility; the association would be stronger when message credibility was high, and weaker when it was low (H2).

2. Methods

An experimental study was conducted in India ($n = 1002$) and Bangladesh ($n = 1081$), with adult (19 + years) smokeless tobacco users, and youth (16 to 18 years) users and non-users. Adults and youth represent critical sub-groups in which to evaluate perceptions of health warnings, given that warnings may have differential effects with respect to promoting cessation among current smokeless tobacco users and discouraging uptake of smokeless tobacco use among youth. Ethical clearance was received from the University of Waterloo Office of Research Ethics, the Healis-Sekhsaria Institute for Public Health and the Bangladesh Medical Research Council. Equal proportions of male and female respondents were recruited; no quota limits were placed on users and non-users. Respondents were recruited using the intercept technique (Sudman, 1980), whereby a physical landmark was selected, and every other person to pass it was approached in Navi Mumbai,

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[2] These changes occurred after data collection for the current study (April to August 2012).

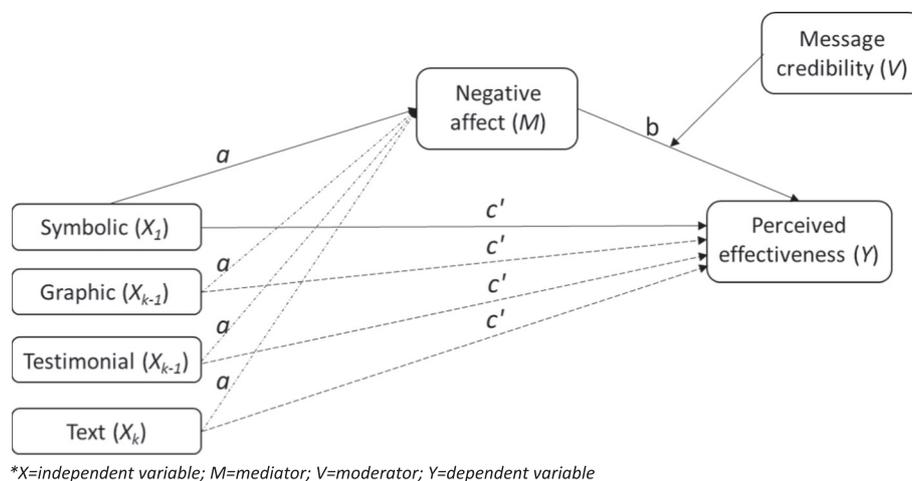**X=independent variable; M=mediator; V=moderator; Y=dependent variable*

Fig. 1. Conceptual moderated-mediation model with a multicategorical predictor variable*.

India. In Dhaka, Bangladesh, every third person to pass the landmark was approached in busy locations, which was increased to every person in locations with less pedestrian traffic. After verbal consent was given, trained interviewers conducted face-to-face interviews using tablets. Interviewers read questions aloud to respondents and entered their responses on tablets.

3. Measures

3.1. Multicategorical predictor variable: message theme

A between-subjects design was used, randomly assigning respondents to view smokeless tobacco health warnings in one of four experimental conditions: (1) Text-only (2) pictorial with symbolic imagery representing danger or caution, (3) pictorial with a graphic health effect depicting a diseased body part/organ, or (4) pictorial with a personalized graphic image of a "real" person, with an accompanying personal testimonial. Please see online Supplementary Fig. 1 for all health warnings tested in this study. Each respondent viewed five warnings within that condition, one for each of the following health effects: oral cancer, mouth disease, heart disease, addiction, and death. All warnings included the text "TOBACCO KILLS" at the bottom.[3] Condition 1 warnings consisted of five text-only warnings corresponding to each of the five health effects (i.e., "tobacco causes oral cancer", "tobacco causes mouth disease", etc.). The same text, corresponding to the five health effects, was used in all conditions. In Condition 1 (text-only), this text occupied the main panel of the warning, while Conditions 2, 3, and 4 featured images, and Condition 4 also included personal testimonial text with name and age. Warnings within each set were shown in random order on a tablet screen, and rated one at a time, while each warning appeared onscreen. In India, approximately 125 respondents were allocated to each of the four experimental conditions (502 adults, and 500 youth). In Bangladesh, approximately 130 respondents were allocated to each condition (569 adults, and 512 youth). For a full description of the methodology, see Mutti et al., 2015.

3.1.1. Mediator and moderator: negative affect and message credibility

Using a numeric scale, from 1 to 10, with anchors 1 = "not at all", 5 = "in the middle", and 10 = "extremely", warnings were rated on the following measures: "Please tell me whether this warning message…" "is believable"; "is surprising"; "is frightening"; "is disgusting"; and, "is unpleasant". The item "is believable" was used as the measure of credibility. The four measures conceptualized as 'negative affect'

(fright, disgust, surprise, and unpleasant) were highly correlated across all experimental conditions (Cronbach's α ranged from 0.97 to 0.98). No differences were observed when each of these measures was tested separately. Thus, the *Negative Affect Scale* was created, whereby these four measures were summed across the five warnings within each experimental condition and then divided by twenty, yielding a mean score ranging from 1 to 10 for each condition.

3.1.2. Outcome variable: perceived effectiveness

Using the same question root and scale, four items measured perceived effectiveness, including whether the warning would: 1) "make people more concerned about the health risks of using smokeless tobacco"; 2) "help prevent young people from starting to use smokeless tobacco"; and 3) "make smokeless tobacco users want to quit"; as well as, 4) "overall, on a scale of 1 to 10, how effective is this health warning?" These four measures were highly correlated across experimental conditions (Cronbach's α = 0.95 to 0.97); thus, only the measure of "overall effectiveness" was used in the analysis. The "overall effectiveness" measure was summed across the five warnings within each experimental condition and then divided by five (number of warnings in each condition), yielding a mean score between 1 and 10 for each condition.

3.1.3. Covariates

The following covariates were entered into the model examining the adult sample: country, age, sex, education, income, smokeless tobacco use (*daily users* and *nondaily users*), mixed use (i.e., use of both smokeless and smoked tobacco), and quit intentions (any intention to quit vs. none). Covariates in the model examining youth smokeless tobacco users included country, age, sex, and smokeless tobacco use (*daily users* and *nondaily users*), mixed use, and quit intentions. For youth non-users covariates included country, age, sex, and susceptibility to smokeless tobacco use (non-susceptible vs. susceptible) (Pierce, Choi, Gilpin, Farkas, & Merritt, 1996). Covariates were added to all paths (a, b, and c′ in Fig. 1) in the model. In interviews, all covariates were assessed prior to viewing the health warnings. For a full description of the measures used, refer to Mutti et al., 2015.

3.2. Analytic approach

Chi-square tests (for categorical variables), one-way ANOVA and *t*-tests (for continuous variables) were conducted to examine differences between the Indian and Bangladeshi samples, using SPSS version 24.0. Mediation and moderated-mediation analyses were conducted using the SPSS PROCESS macro, developed by Hayes (2013). The PROCESS macro is designed to test conditional process models using ordinary

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[3] 'TOBACCO KILLS' was the text on Indian smokeless tobacco health warning labels at the time of the study.

least squares regression-based path analysis to test for direct and indirect effects. The predictor variable was multicategorical, with four levels: (1) text-only, (2) symbolic, (3) graphic health effect, and (4) personal testimonial.[4] Respondents with missing data on any of these covariates or outcome measures (n = 39) were excluded from analyses on a list-wise basis.

To examine whether negative affect mediated the effect of health warning content on perceived effectiveness ratings, mediation analyses were conducted (Model 4, PROCESS macro). The indirect effect (mediation) was estimated with bias-corrected (BC) 95% confidence intervals (CI) of 5000 bootstrapped samples (Hayes, 2013; Preacher & Hayes, 2004). For statistical inference of indirect effects (mediation), confidence intervals that do not include zero indicate significance. To examine whether message credibility moderated the indirect effect, the interaction term of *negative affect* by *message credibility* was included in the model (Model 14, PROCESS macro). For the moderator of message credibility, significant interactions were probed further by using the 'pick-a-point approach', meaning that the conditional indirect effect of the moderator was examined at one standard deviation (SD) above and below the mean; levels corresponded to 'low', 'moderate', and 'high' levels of message credibility (Hayes, 2013). Fig. 1 presents the conceptual moderated-mediation model with a multicategorical predictor variable.

4. Results

4.1. Sample characteristics

Table 1 presents the characteristics of the adult and youth samples, by country, noting significant differences between countries.

4.2. The mediating influence of negative affect

As shown in Table 2, for adults and youth, viewing any style of the pictorial style warnings (symbolic, graphic, or testimonial) elicited greater levels of negative affect compared to text-only warnings (Path a in Fig. 1). In addition, for adult and youth smokeless tobacco users, viewing graphic warnings elicited greater levels of negative affect compared to viewing testimonial warnings. In contrast, among youth non-users, viewing symbolic warnings did not elicit significantly higher levels of negative affect compared to text-only warnings, nor did viewing graphic warnings compared to personal testimonials. However, across all subsamples, a significant positive association was found for Path b, indicating that greater levels of negative affect elicited greater levels of perceived effectiveness.

With respect to the inferential test of the indirect effect (the product of Path a and Path b), the findings suggest that negative affect mediated the effect of viewing health warnings and ratings of perceived effectiveness across all message theme contrasts, for adults and youth smokeless tobacco users. Among youth non-users, a mediating effect was not present for those who viewed symbolic warnings, compared to text-only, nor for those who viewed graphic warnings compared to testimonials.

Full mediation occurred among adults, and youth smokeless tobacco users. Specifically, the effect of viewing graphic health warnings (vs. personal testimonials) on ratings of perceived effectiveness became non-significant when controlling for negative affect, indicating that the effect was explained entirely by the mediating variable (adults Path c: 0.53, p < 0.001 to Path c′: 0.09, p = 0.34; youth users Path c: 0.64, p = 0.007 to Path c′: 0.23, p = 0.09). In addition, the effect of viewing

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[4] In order to estimate the direct and indirect effects of all k X variables, PROCESS is executed k times, with each run putting one X_i in the model as X and the remaining $k - 1$ X variables as covariates. In addition, the random number generator is seeded with a common (arbitrary) seed (we chose 3050) so that at each run, the bootstrap confidence intervals were based on the same set of 5000 resamples from the dataset (Hayes, 2013).

symbolic warnings (vs. text-only) on ratings of perceived effectiveness became non-significant when controlling for negative affect, for both adults and youth users (adults Path c: 0.35, p = 0.007 to Path c′: 0.10, p = 0.28; youth users Path c: 0.43, p = 0.03 to Path c′: 0.11, p = 0.43). For all other significant indirect effects, Path c to Path c′ was reduced but remained significant, indicating partial mediation.

4.3. The moderating influence of message credibility

To examine the potential moderating influence of message credibility, the interaction term of negative affect by message credibility was added to the model. Message credibility was found to moderate the indirect effect in the adult sample, but not among the younger sample.

Among adults, this interaction term was significant (β = 0.045, SE = 0.007, p < 0.001), and confirmed by a formal test using the index of moderated mediation (0.02 (bias-corrected 95% CI: 0.01, 0.04)), indicating that the mediating influence of negative affect on perceived effectiveness ratings, varied as a function of message credibility. The interaction term was not significant among youth (users: β = −0.003, SE = 0.014, p = 0.85; non-users: β = −0.001, SE = 0.008, p = 0.89), and was confirmed by the index of moderated mediation (users: −0.001 (bias-corrected 95% CI: −0.02, 0.01); non-users: −0.001 (bias-corrected 95% CI: −0.004, 0.002)).

The significant interaction from the adult sample was probed to assess the conditional indirect effect, at three levels of the moderator (message credibility): one SD below the mean, the mean, and one SD above the mean—corresponding to 'low', 'moderate', and 'high' levels of credibility. Table 3 presents the results from this analysis. Overall, the results in Table 3 indicate that the indirect effect was stronger when message credibility was high and weaker when it was lower, among adults.

5. Discussion

Overall, the findings support the broader literature suggesting that negative emotions such as fear underlie the effectiveness of warnings (Wang et al., 2015; Hammond, Fong, McDonald, Brown, & Cameron, 2004; Borland et al., 2009; Peters et al., 2007; Witte & Allen, 2000; BRC Marketing and Social Research, 2004; Elliot & Shanahan Research, 2003; Environics, 1999; Environics, 2000; Kees et al., 2010). The findings on the desirable effects of negative emotional responses to warnings are also in line with recent experimental field studies (Evans et al., 2015) and observational research (Cho et al., 2016), including research based on nationally representative longitudinal data from four high-income countries (Yong et al., 2014). Yong et al. (2014) used mediational analyses to identify factors that explained the impact of warnings on key indicators of cessation among adult smokers. They found that large, graphic warnings work indirectly through several underlying factors: they encouraged smokers to think about the risks of smoking, which elicited emotional responses such as worry about health risks, which in turn increased intentions to quit and encouraged subsequent quitting behavior. In addition, contrary to the idea that extreme fear arousal results in message rejection (Kessels, Ruiter, & Jansma, 2010; Kessels, Ruiter, Wouters, & Jansma, 2014), avoidance behavior was associated with *increased* frequency of thinking about health risks (Yong et al., 2014) and subsequent cessation attempts (Thrasher et al., 2016). Together, these findings support the use of graphic, fear-arousing tobacco health warnings.

Mediation analyses revealed that smokeless tobacco users, both adults and youth, responded similarly to warnings. The finding related to youth is of particular importance given the limited research focused on this age cohort, as well as previous mixed findings with respect to the effectiveness of pictorial warnings among youth (Noar et al., 2015; Pepper, Cameron, Reiter, McRee, & Brewer, 2013). However, for non-using youth, a mediating effect was not found among those who viewed symbolic warnings (vs. text), nor for those who viewed graphic

Table 1
Characteristics of the adult and youth samples in Navi Mumbai, India and Dhaka, Bangladesh.

	Adults (n = 1071)			Youth non-users (n = 704)			Youth users (n = 308)		
	India (n = 502)	Bangladesh (n = 569)	Test statistic[a] (p-value)	India (n = 326)	Bangladesh (n = 378)	Test statistic[a] (p-value)	India (n = 174)	Bangladesh (n = 134)	Test statistic[a] (p-value)
Age (mean; SD)	36.0 (9.2)	38.6 (12.5)	$t = 3.8$ ($p < 0.001$)	17.4 (0.7)	17.1 (0.8)	$t = -5.9$ ($p < 0.001$)	17.3 (0.8)	17.6 (0.6)	$t = -4.0$ ($p < 0.001$)
Sex (n; %)									
Female	250 (49.8)	261 (45.9)	$X^2 = 1.6$	185 (56.7)	222 (58.7)	$X^2 = 0.28$	65 (37.4)	32 (23.9)	$X^2 = 6.4$
Male	252 (50.2)	308 (54.1)	($p = 0.22$)	141 (43.4)	156 (41.3)	($p = 0.65$)	109 (62.6)	102 (76.1)	($p = 0.01$)
Smokeless tobacco use (n; %)									
Daily user	470 (93.6)	537 (94.4)	$X^2 = 0.3$	–	–		145 (83.3)	74 (55.2)	$X^2 = 29.1$
Non-daily user	32 (6.4)	32 (5.6)	($p = 0.61$)	–	–		29 (16.7)	60 (44.8)	($p < 0.001$)
Non-user susceptible	–	–		106 (32.5)	79 (20.9)	$X^2 = 12.2$ ($p = 0.001$)	–	–	
Non-user non-susceptible	–	–		220 (67.5)	299 (79.1)		–	–	
Mixed use (n; %)[b]	85 (16.9)	141 (24.8)	$X^2 = 9.9$ ($p = 0.002$)	–	–		32 (18.4)	29 (21.6)	$X^2 = 0.50$ ($p = 0.56$)
Quit intentions (n; %)									
Plans to quit	350 (69.7)	284 (50.1)	$X^2 = 42.5$	–	–		142 (81.6)	66 (49.6)	$X^2 = 35.3$
No plans to quit	152 (30.3)	283 (49.9)	($p < 0.001$)	–	–		32 (18.4)	67 (50.4)	($p < 0.001$)
Income (n; %)									
Low	193 (38.5)	412 (72.8)	$X^2 = 131.0$	–	–		–	–	
Moderate	175 (34.9)	101 (18.0)	($p < 0.001$)	–	–		–	–	
High	53 (10.4)	17 (3.0)		–	–		–	–	
Not stated	81 (16.2)	35 (6.2)		–	–		–	–	
Education (n; %)				–	–		–	–	
Low	19 (3.8)	179 (31.5)	$X^2 = 247.2$	–	–		–	–	
Moderate	223 (44.4)	316 (55.6)	($p < 0.001$)	–	–		–	–	
High	260 (51.8)	73 (12.9)		–	–		–	–	

Missing: Quit intentions (Bangladeshi adults, $n = 2$; Bangladeshi youth users, $n = 1$); income (Indian adults, $n = 1$; Bangladeshi adults, $n = 4$); education (Bangladeshi adults, $n = 1$).
For a full description of the measures used, please refer to Mutti et al., 2015.
[a] Test statistic denotes between-country differences (India vs. Bangladesh), within adult or youth user/non-user sample. Significant differences bolded.
[b] Represents respondents who reported using both smoked and smokeless products.

warnings (vs. personal testimonials), indicating potential differential effects between youth smokeless tobacco users and non-users. We can only speculate as to the mechanism driving this effect, but one explanation might be that for non-using youth, there may be a lack of immediacy of the risk compared to youth users.

Although the results provide support for the potential mediating role of negative affect for both adults and youth, support for the second hypothesis regarding the moderating effect of message credibility on the association between negative affect and perceived effectiveness was found only among adults. Specifically, the strength of the association between negative affect and perceived effectiveness varied as a function of message credibility across all message theme contrasts, even when comparing graphic health warnings and personal testimonials. This finding is consistent with research based on a sample of smokers who were assigned to view warnings in one of three conditions: text-only, graphic image with basic text, and a graphic image with elaborated text. In their study, Emery et al. (2014) found that message credibility interacted with affect in predicting a positive attitude towards quitting.

One possible explanation for the finding that message credibility did not moderate the indirect effect for youth could be that graphic health warnings and warnings with personal testimonials featured older individuals, thus rendering the health effects of smokeless tobacco as too remote for youth, and not as believable. Furthermore, it is possible that these younger respondents may have not been able to identity with the depicted individual (Kreuter et al., 2007; Larkey & Hecht, 2010), nor with the experience conveyed (i.e, the death of a spouse in the personal testimonial condition—see Supplementary Fig. 1). Future research might consider examining this potential issue of personal relevance, in addition to message credibility. Overall, this set of findings related to the differential effects among adults and youth,

and users and non-users, highlights the need to pre-test images with the target audience.

Overall, the findings from the current study demonstrate the mechanism underlying the effect established in the original study by Mutti et al. (2015); that is, negative affect and message credibility underlie the perceived effectiveness of graphic health warnings when compared to all other warning styles, including personal testimonials. However, it is important to note that the true efficacy of personal testimonials may have been underestimated. Personal testimonials may not have the same hard-hitting impact as warnings showing graphic health effects. The images used for personal testimonial warnings in this study depicted a 'lived experience', rather than a gruesome image (as in the graphic health effect condition), and also included additional text in the form of a personal testimonial (see Supplementary Fig. 1). It is possible that warnings with personal testimonials take longer to process, and may have greater long-term impacts rather than immediate impacts. Future research should consider examining the potential longer-term impacts of personal testimonials.

Lastly, these findings replicate evidence from high income countries, meaning that if existing graphic images can be used on warnings, development costs may be reduced, as novel images will not need to be created or culturally adapted. This is of utmost importance in developing countries, where financial resources for public health initiatives may be limited.

5.1. Limitations

It is difficult to imply a true mediational relationship, given that the current study is based on cross-sectional data (Winer et al., 2016). However, the temporal order of variables in the proposed model were

Table 2

Regression coefficients for mediation analyses examining the effect of message theme (X) on perceived effectiveness (Y) via negative affect (M), in Navi Mumbai, India and Dhaka, Bangladesh.

Path a

Message theme (X)	Adults ($n = 1053$) $X \rightarrow$ Negative affect (M)		Youth users ($n = 304$) $X \rightarrow$ Negative affect (M)		Youth non-users ($n = 687$) $X \rightarrow$ Negative affect (M)	
	Coeff. (SE)	p value	Coeff. (SE)	p value	Coeff. (SE)	p value
Symbolic (v. text)	0.48 (0.17)	0.006	0.55 (0.25)	0.03	0.08 (0.19)	0.68
Graphic (v. text)	2.14 (0.18)	< 0.001	2.55 (0.24)	< 0.001	2.48 (0.19)	< 0.001
Testimonial (v. text)	1.28 (0.18)	< 0.001	1.82 (0.24)	< 0.001	2.10 (0.19)	< 0.001
Graphic (v. testimonial)	0.86 (0.18)	< 0.001	0.72 (0.24)	0.002	0.37 (0.18)	0.05

Path b

	$M \rightarrow$ Perceived effectiveness (Y)		$M \rightarrow$ Perceived effectiveness (Y)		$M \rightarrow$ Perceived effectiveness (Y)	
	Coeff. (SE)	p value	Coeff. (SE)	p value	Coeff. (SE)	p value
Negative affect (M)	0.51 (0.02)	< 0.001	0.58 (0.03)	< 0.001	0.51 (0.02)	< 0.001

Path c / Path c′

Message theme (X)	Path c $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value	Path c′ $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value	Path c $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value	Path c′ $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value	Path c $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value	Path c′ $X \rightarrow$ Perceived effectiveness (Y) Coeff. (SE)	p value
Symbolic (v. text)	0.35 (0.13)	0.007	0.10 (0.09)	0.28	0.43 (0.20)	0.032	0.11 (0.14)	0.43	0.21 (0.15)	0.18	0.17 (0.12)	0.16
Graphic (v. text)	2.24 (0.13)	< 0.001	1.14 (0.10)	< 0.001	2.53 (0.19)	< 0.001	1.05 (0.15)	< 0.001	2.63 (0.16)	< 0.001	1.36 (0.14)	< 0.001
Testimonial (v. text)	1.70 (0.13)	< 0.001	1.05 (0.10)	< 0.001	1.88 (0.19)	< 0.001	0.83 (0.14)	< 0.001	2.25 (0.15)	< 0.001	1.17 (0.13)	< 0.001
Graphic (v. testimonial)	0.53 (0.13)	< 0.001	0.09 (0.09)	0.34	0.64 (0.19)	0.007	0.23 (0.13)	0.09	0.37 (0.15)	0.15	0.19 (0.12)	0.12

Indirect effect of X on Y (test of mediation)

Message theme (X)	Adults	Youth users	Youth non-users
Symbolic (v. text)	0.25 (bias-corrected 95% CI: 0.06, 0.44)	0.32 (bias-corrected 95% CI: 0.03, 0.61)	0.04 (bias-corrected 95% CI: − 0.14, 0.21)
Graphic (v. text)	1.10 (bias-corrected 95% CI: 0.90, 1.33)	1.47 (bias-corrected 95% CI: 1.14, 1.86)	1.27 (bias-corrected 95% CI: 1.01, 1.55)
Testimonial (v. text)	0.66 (bias-corrected 95% CI: 0.48, 0.86)	1.05 (bias-corrected 95% CI: 0.74, 1.40)	1.07 (bias-corrected 95% CI: 0.84, 1.35)
Graphic (v. testimonial)	0.44 (bias-corrected 95% CI: 0.28, 0.62)	0.42 (bias-corrected 95% CI: 0.16, 0.71)	0.19 (bias-corrected 95% CI: − 0.01, 0.40)

Notes. Unstandardized regression coefficients presented in table. X = independent variable, M = mediating variable; Y = dependent variable. Path a = $X \rightarrow M$; Path b = $M \rightarrow Y$; Path c (total effect) = $X \rightarrow Y$; Path c′ (direct effect) = $X \rightarrow Y$, controlling for M. Indirect effect of X on Y (mediation) is the product of Path a and Path b.

Results shown are from the final model including all covariates. R^2 change between the baseline model (no covariates in model) and the final conditional model (including covariates): Adults R^2 baseline model = 0.60, R^2 final model = 0.67, R^2 change = 0.07; youth users R^2 baseline model = 0.74, R^2 final model = 0.75, R^2 change = 0.01; youth non-users: R^2 baseline model = 0.61, R^2 final model = 0.64, R^2 change = 0.03.

Bias-corrected 95% confidence intervals (CI) that do not contain zero indicate significance of the indirect effect (mediation).

based on a theoretical framework, including affect heuristic, which posits that emotions, such as fear, guide our cognitive responses and decision-making (Slovic, Finucane, Peters, & MacGregor, 2007). Nonetheless, future research should endeavor to address this issue of temporality, and examine whether these associations persist over time.

With respect to the graphic health effect and personal testimonial warnings, the text *and* image were different in each of these conditions, thus, it was not possible to distinguish whether the observed effect was due to the image or the additional text in the form of a personal testimonial. Future research should aim to examine the mechanism driving this effect. In terms of the nature of the stimuli, images for the

current study were selected and allocated to experimental conditions based on previous research and local consultation (see Supplementary Fig. 1 for images and their respective sources). Images were also pre-tested locally prior to conducting the study.

Given the experimental nature of the study, it was not possible to mimic the effects of "real-world" exposure to health warnings, where users see the warnings multiple times over prolonged periods of time on the product, rather than viewing them once on a screen (out of the context of use) and not on a pack for added context. Exposure to health warnings in real-world settings tends to be more passive than in the context of an experimental study. This immediate, forced exposure may

Table 3
Conditional indirect effects of message theme (*X*) on perceived effectiveness ratings (*Y*) via negative affect (*M*), at different values of the moderator (*V*) among adults in Navi Mumbai, India and Dhaka, Bangladesh (*n* = 1053).

Credibility (V)	Coefficient (bootstrapped SE)	Bias-corrected 95% bootstrapped CI
Symbolic (v. text)		
Low	0.14 (0.06)	0.04–0.26
Moderate	0.18 (0.07)	0.05–0.33
High	0.23 (0.09)	0.07–0.41
Graphic (v. text)		
Low	0.62 (0.10)	0.43–0.84
Moderate	0.82 (0.10)	0.64–1.04
High	1.02 (0.11)	0.82–1.26
Testimonial (v. text)		
Low	0.37 (0.08)	0.24–0.54
Moderate	0.49 (0.08)	0.35–0.66
High	0.61 (0.09)	0.45–0.80
Graphic (v. testimonial)		
Low	0.25 (0.06)	0.14–0.28
Moderate	0.33 (0.07)	0.20–0.48
High	0.41 (0.09)	0.25–0.59

The three levels of the moderator correspond to one SD below the mean, the mean, and one SD above the mean. Thus, low credibility = 4.37, moderate credibility = 6.48, high credibility = 8.59.
Bias-corrected 95% confidence intervals (CI) that do not contain zero indicate significance of the conditional indirect effect (moderated-mediation).

have led to stronger reactions to warnings, particularly those with graphic health effects. Given that India and Bangladesh have committed to implementing larger, graphic warnings, research should seek to evaluate their actual effectiveness, over time.

6. Conclusion

This set of findings adds to the evidence base in LMICs that graphic, fear-arousing images have potential as an effective tool for health communication within tobacco control. Graphic pictorial health warnings were shown to elicit the greatest levels of negative affect, and in turn, were perceived as most effective. Of particular importance is that these findings mirror patterns found in high-income countries with respect to cigarette warnings, suggesting that individuals' responses to different types of message content may be similar across diverse cultural environments.

Contributors

DH, JLR and SMP conceptualized, designed and coordinated the study in India and Bangladesh. DH and SMP designed the analysis with important contributions from GTF, JFT, and DR. SMP performed the analysis. JLR, GTF, JFT, DR, and DH consulted on the analysis, and all authors interpreted the results. SMP prepared the first draft of the manuscript. PCG and MSP were involved in the design and coordination of the study in India. PCG and MSP oversaw the data collection in India, and reviewed, edited and contributed to the manuscript. NN was involved in the design and coordination of the study in Bangladesh, oversaw data collection and reviewed, edited and contributed to the manuscript. All authors contributed to and have approved the final version.

Conflict of interest

None declared.

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