Criterion validity of measures of perceived relative harm of e-cigarettes and smokeless tobacco compared to cigarettes

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HIGHLIGHTS

- In tobacco research and regulation, measures of perceived relative harm of products vary.
- On direct measures, people compare the harms of products (e.g., e-cigarettes vs. cigarettes).
- On indirect measures, people rate the harms of products separately, and ratings are compared.
- Direct measures had higher validity than indirect measures, based on product use associations.
- Tobacco research and regulation would benefit from more perceived harm measure validation work.

ARTICLE INFO

ABSTRACT

Beliefs about the relative harmfulness of one product compared to another (perceived relative harm) are central to research and regulation concerning tobacco and nicotine-containing products, but techniques for measuring such beliefs vary widely. We compared the validity of direct and indirect measures of perceived harm of e-cigarettes and smokeless tobacco (SLT) compared to cigarettes. On direct measures, participants explicitly compare the harmfulness of each product. On indirect measures, participants rate the harmfulness of each product separately, and ratings are compared. The U.S. Health Information National Trends Survey (HINTS-FDA-2015; $N = 3738$) included direct measures of perceived harm of e-cigarettes and SLT compared to cigarettes. Indirect measures were created by comparing ratings of harm from e-cigarettes, SLT, and cigarettes on 3-point scales. Logistic regressions tested validity by assessing whether direct and indirect measures were associated with criterion variables including: ever-trying e-cigarettes, ever-trying snus, and SLT use status. Compared to the indirect measures, the direct measures of harm were more consistently associated with criterion variables. On direct measures, 26% of adults rated e-cigarettes as less harmful than cigarettes, and 11% rated SLT as less harmful than cigarettes. Direct measures appear to provide valid information about individuals' harm beliefs, which may be used to inform research and tobacco control policy. Further validation research is encouraged.

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1. Introduction

Beliefs about harm are important determinants of health behavior (Brewer et al., 2007; Glanz, Rimer, & Viswanath, 2008; Janz & Becker, 1984; Weinstein, 1988) such as tobacco and nicotine product use. For example, a systematic review of research on electronic cigarette (e-cigarette) use identified the belief that e-cigarettes are less harmful than cigarettes as a common reason for using e-cigarettes (Pepper & Brewer, 2014). Some studies suggest that U.S. adults tend to overestimate the harms of e-cigarettes and smokeless tobacco (SLT) compared to cigarettes, which may discourage smokers from switching to less

harmful alternatives (Borland, Cooper, McNeill, O'Connor, & Cummings, 2011; Biener, Nyman, Stepanov, & Hatsukami, 2014; Kiviniemi & Kozlowski, 2015). Low perceptions of harm may also encourage uptake among non-users or prevent cessation among current users of products (Hughes, 1998; Kozlowski et al., 1998; Song et al., 2009). Due to practical and theoretical importance, harm beliefs are often the focus of public health research and educational campaigns, and are used to assess the impacts of marketing, advertising, and tobacco control policies (Borland et al., 2011; Biener et al., 2014; Chapman & Liberman, 2005; Choi & Forster, 2013; Hamilton et al., 2004; Kiviniemi & Kozlowski, 2015; Kozlowski, Goldberg, & Yost, 2000; Pearson, Richardson, Niaura, Vallone, & Abrams, 2012; Pepper, Emery, Ribisl, Rini, & Brewer, 2015; Slovic, 2000; Weinstein, 1998).

The choice of measures can strongly influence research results on perceived harm (Kaufman, Suls, & Klein, 2016; Popova & Ling, 2013;

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Wackowski, Bover Manderski, & Delnevo, 2016), but, despite the importance of measuring harm beliefs, public health researchers lack standard, well-validated measures. Two types of measures include *direct* measures (e.g., where people rate the harm of using e-cigarettes as lower or higher than the harm of using cigarettes in a single question) and *indirect* measures (e.g., where people rate the harms of using e-cigarettes and cigarettes on two separate questions, and then ratings are compared to determine whether the harm for one product was rated lower than the other). Studies indicate that cigarette smokers are more likely to rate e-cigarettes and SLT as less harmful than cigarettes on indirect rather than direct measures (Popova & Ling, 2013; Wackowski et al., 2016). In one study, nearly 52% of smokers rated snus – a type of SLT – as less harmful than cigarettes on an indirect measure compared to only 22% on a direct measure (Popova & Ling, 2013). Moreover, direct and indirect measures of perceived harm may correlate only moderately (e.g., $r = 0.3$) (Popova & Ling, 2013).

Researchers have hypothesized that direct measures may bias people toward giving a "socially appropriate answer" (i.e., that non-combustible products are just as harmful as cigarettes) (Popova & Ling, 2013; Wackowski et al., 2016), thus underestimating the extent to which people believe non-combustible products are less harmful than cigarettes. However, no studies have tested this hypothesis to examine whether one type of measure more accurately reflects public perceptions than the other, or whether each type may reflect a unique aspect of harm perception.

This study compared the construct validity of direct and indirect measures of perceived harm of e-cigarettes and SLT compared to cigarettes. Construct validity–described informally as the accuracy of a measure–refers to the extent to which a measure assesses the construct it is intended to assess (Cronbach & Meehl, 1955). We focused on an aspect of construct validity called *criterion validity*, or "the extent to which a measure is empirically associated with relevant criterion variables" (Westen & Rosenthal, 2003, p. 609). In studies evaluating criterion validity, the criterion variables are selected based on theoretical predictions about how a measure should be associated with them (e.g., researchers studying nicotine dependence would want to show that the measure correlates negatively with smokers' likelihood of successfully quitting smoking) (Etter, Duc, & Perneger, 1999; Westen & Rosenthal, 2003).

We expected perceived relative harm of products to be associated with product use behavior. This expectation was based on the known effects of perceived harm on behavior (e.g., people who perceive little harm in using a product tend to be more likely to try it) and the known effects of behavior on perceived harm (e.g., people who use a product become more likely to perceive little harm in using it) (Amrock, Zakhar, Zhou, & Weitzman, 2015; Brewer, Weinstein, Cuite, & Herrington, 2004; Brose, Brown, Hitchman, & McNeill, 2015; Morrell, Song, & Halpern-Felsher, 2010; Pepper et al., 2015; Song et al., 2009; Wackowski & Delnevo, 2015). Indeed, public health interest in harm beliefs is predicated on the notion that harm beliefs have implications for product trial and use (Amrock et al., 2015; Kaufman et al., 2016; Kiviniemi & Kozlowski, 2015; Kozlowski et al., 2000; Kropp & Halpern-Felsher, 2004; Slovic, 2000; Wackowski & Delnevo, 2015). Therefore, people who have tried a particular non-cigarette product should, in theory, be more likely than others to believe that the product is less harmful than cigarettes (Amrock et al., 2015; Brewer et al., 2004; Brose et al., 2015; Janz & Becker, 1984; Morrell et al., 2010; Song et al., 2009; Wackowski & Delnevo, 2015). Thus, we selected as criterion variables measures of product use, including ever-trying e-cigarettes, ever-trying snus, and current and former use of SLT, and we examined whether direct and indirect measures of relative harm were associated with these variables. When the expected associations emerged between a measure of relative harm and the criterion variables, we took this as evidence in favor of the validity of the measure (Etter et al., 1999; Westen & Rosenthal, 2003).

2. Methods

2.1. Data source

The National Cancer Institute's Health Information National Trends Survey (HINTS-FDA 2015) is a cross-sectional mail survey assessing health-related beliefs and behaviors. HINTS-FDA 2015 is nationally representative of the non-institutionalized U.S adult population. Data were collected between May and September 2015. Households were selected using a random sample of U.S. addresses; within households, one adult was selected based on proximity of birthdate to survey date. A complex sampling design was employed, with an effort to oversample residential strata with high proportions of current and former cigarette smokers. The overall weighted response rate for HINTS-FDA 2015 was 33%. In total, 3738 individuals returned eligible surveys. Additional details can be found elsewhere (Blake et al., 2016; Westat, 2015).

2.2. Measures

2.2.1. Direct and indirect measures of perceived relative harm

The direct measure of e-cigarette relative harm stated, "Compared to smoking cigarettes, would you say that electronic cigarettes are…" Options included "Much less harmful," "Less harmful," "Just as harmful," "More harmful," "Much more harmful," "I've never heard of electronic cigarettes," and "I don't know enough about these products." Participants selecting "Much less harmful" or "Less harmful" were coded as rating e-cigarettes lower than cigarettes. Those selecting any other option were coded as not rating e-cigarettes as lower than cigarettes (Brose et al., 2015).

The direct measure of SLT relative harm stated, "In your opinion, do you think that some smokeless tobacco products, such as chewing tobacco, snus and snuff, are less harmful to a person's health than cigarettes?" Options were "Yes," "No," and "Don't know." Participants selecting "Yes" were coded as rating SLT as less harmful than cigarettes. Those selecting any other option were coded as not rating SLT as less harmful than cigarettes.

Indirect measures of e-cigarette and SLT relative harm were created based on the question: "How harmful do you think each of the following is to a person's health?" Participants separately rated the harms of "Cigarette smoking," "Electronic cigarette use," and "Smokeless tobacco use," each on a single item with options: "Not at all harmful," "Moderately harmful," and "Very harmful." Participants were coded as rating e-cigarettes as less harmful than cigarettes if their rating for "Electronic cigarette use" was lower than their rating for "Cigarette Smoking," and were coded as not rating e-cigarettes lower than cigarettes if their rating for "Electronic cigarette use" was equal to or higher than their rating for "Cigarette Smoking."[1] Similarly, participants were coded as rating SLT as less harmful than cigarettes if their rating for "Smokeless tobacco use" was lower than their rating for "Cigarette Smoking," and as not rating SLT lower than cigarettes if their rating for "Smokeless tobacco use" was equal to or higher than their rating for "Cigarette Smoking."[2]

Perceived harm measures were located together on the survey with indirect measures directly preceding the direct measures.

2.2.2. Criterion variables

Criterion variables included all relevant product use variables in HINTS-FDA 2015: ever-trying e-cigarettes, ever-trying snus, and SLT use status.[3]

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[1] Only 20 participants (0.70%) rated e-cigarettes as more harmful than cigarettes on the indirect measure. Thus, participants rating e-cigarettes as equally or more harmful than cigarettes were combined into a single category.

[2] Only 32 participants (0.72%) rated SLT as more harmful than cigarettes on the indirect measure. Thus, participants rating SLT as equally or more harmful than cigarettes were combined into a single category.

[3] The analysis did not examine e-cigarette use status and ever-trying SLT because these variables were not available in HINTS-FDA 2015.