



# The effect of e-cigarette warning labels on college students' perception of e-cigarettes and intention to use e-cigarettes

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## HIGHLIGHTS

- The warning label proposed by FDA was more effective than it created by companies.
- FDA warning label reduced e-cigarette use intention by increasing risk perception.
- Companies' own label had lower readability and comprehensibility.

## ARTICLE INFO

**Keywords:**  
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## ABSTRACT

**Objective:** This study examined the effect of two e-cigarette warning labels on college students' perceived advantages and risks of e-cigarette use, as well as students' intentions to use e-cigarettes. The company-produced e-cigarette warning label carries abundant information with small font size while the governmental warning label has only two sentences presented in large font size. The effect of both labels have not yet been examined and verified.

**Methods:** Data were collected in October 2015 from college students at a Midwestern university. A pretest-posttest design was employed with 338 students exposed to the warning label proposed by the FDA and 328 students exposed to the label created by e-cigarette companies. Structural equation modeling analysis was implemented to examine the effect of warning labels with the analytical model grounded in the Theory of Planned Behavior.

**Results:** Findings showed that college students' perceived advantages of e-cigarette use were positively related to their intentions to use e-cigarettes, while perceived risks were negatively associated with their intentions. When comparing two labels, the governmental label was found to reduce college students' intentions to use e-cigarettes via increasing perceived risks of e-cigarette use ( $\beta = 0.10, p < 0.05$ ), however, not via decreasing perceived advantages of e-cigarette use. The warning label currently used by e-cigarette companies showed no influence on beliefs about or intentions to use e-cigarettes.

**Conclusions:** The warning label proposed by the FDA is more effective than that created by e-cigarette companies, however, has room for improvement to make a greater impact on e-cigarette use intention.

## 1. Introduction

The electronic nicotine delivery system (also known as the e-cigarette) entered the United States (US) in 2006; (Dockrell, Morrison, Bauld, & McNeill, 2013) however, it has not yet been fully regulated by the government. Because of this lack of regulation, e-cigarettes were heavily advertised in media, leading to the high awareness of e-cigarette (Kim, Arnold, & Makarenko, 2014; King, Patel, Nguyen, & Dube, 2015). According to the results of previous studies, it is estimated that > 70% of US adults were aware of e-cigarettes by 2012 (Adkison,

O'Connor, Bansal-Travers, et al., 2013), while about 14% used e-cigarettes between 2012 and 2013 (Agaku, King, Husten, et al., 2014). The emergence of the e-cigarette has aroused a rigorous debate over its health effects. Supporters believe that the e-cigarette is a safer alternative to smoking (Barbeau, Burda, & Siegel, 2013; Dawkins, Turner, Roberts, & Soar, 2013), while opponents are concerned that e-cigarettes will re-normalize smoking behavior (Fairchild, Bayer, & Colgrove, 2014; Hajek, Etter, Benowitz, Eissenberg, & McRobbie, 2014). Even though the long-term health effects of e-cigarette use have not yet been observed, giving an early warning to the public about the potential risks

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## a. Warning label created by e-cigarette companies

This product is not a smoking cessation product and has not been tested as such. This product is intended for use by persons of legal age or older, and not by children, women who are pregnant or breastfeeding, or persons with or at risk of heart disease, high blood pressure, diabetes, or taking medicine for depression or asthma. Nicotine is addictive and habit forming, and it is very toxic by inhalation, in contact with the skin, or if swallowed. Nicotine can increase your heart rate and blood pressure and cause dizziness, nausea, and stomach pain. Inhalation of this product may aggravate existing respiratory conditions. Ingestion of the non-vaporized concentrated ingredients in the cartridges can be poisonous.

## b. Warning label proposed by the FDA

**WARNING:**  
This product contains  
nicotine derived from  
tobacco.  
Nicotine is an addictive  
chemical.

Fig. 1. Warning labels produced by e-cigarette companies and proposed by the FDA shown in real size. a. Warning label created by e-cigarette companies. b. Warning label proposed by the FDA.

of e-cigarette use beforehand is still necessary.

Warning labels on cigarette packages have been used to decrease smoking rates (Borland, Wilson, Fong, et al., 2009; Hammond et al., 2007; Moodie, MacKintosh, & Hammond, 2010). Previous studies found that smokers' desire to consume cigarettes decreased after warning labels were launched (Devlin, Anderson, Hastings, & MacFadyen, 2005; Emery, Romer, Sheerin, Jamieson, & Peters, 2014). For non-smokers, warning labels could reduce their likelihood of initiating cigarette use (Singh, Owusu-Dabo, Britton, Munafò, & Jones, 2014). Because e-cigarettes are not fully regulated by the (US Food and Drug Administration (FDA), 2009), manufacturers are not obligated to include warning labels on packages. Nevertheless, some e-cigarette companies created their own warning label and place it on packages. One commonly used e-cigarette warning label example is shown in Fig. 1a. The content of this warning label reads:

"This product is not a smoking cessation product and has not been tested as such. This product is intended for use by persons of legal age or older, and not by children, women who are pregnant or breastfeeding, or persons with or at risk of heart disease, high blood pressure, diabetes, or taking medicine for depression or asthma. Nicotine is addictive and habit forming, and it is very toxic by inhalation, in contact with the skin, or if swallowed. Nicotine can increase your heart rate and blood pressure and cause dizziness, nausea, and stomach pain. Inhalation of this product may aggravate existing respiratory conditions. Ingestion of the non-vaporized concentrated ingredients in the cartridges can be poisonous." (Nu Mark LLC, n.d.)

Although the company-produced warning label carries abundant information, the effect on users' perception and behavior has not been examined. Moreover, the lengthy text and small font size may lead to doubtful validity. In 2014, the FDA proposed a requirement for tobacco products, including e-cigarettes, to place a warning label on the packages (US Food and Drug Administration, 2014). Based on this

proposal, the warning label should be addressed as "WARNING: This product contains nicotine derived from tobacco. Nicotine is an addictive chemical." and has to cover at least 30% of the package with contrasting colors and maximum font size (as shown in Fig. 1b) (US Food and Drug Administration, 2014). Nonetheless, this regulation has not yet been passed, and the anticipated effect of this label on consumers' e-cigarette related beliefs and behaviors is unknown.

Although tobacco companies claimed that their warning labels is a way to communicate with consumers honestly regarding possible adverse health effects (Richtel, 2014), without examining the effect, their influence on consumers' beliefs and behaviors of e-cigarette use remains unknown. On the other hand, although the e-cigarette warning label created by FDA was based on current mandatory tobacco warning label design, there is no direct evidence showing this label to be as well effective on e-cigarettes.

This study aimed to investigate the effect of e-cigarette warning labels on college students' beliefs about and intention to use e-cigarettes, given that college students have a high prevalence rate of using non-traditional tobacco products (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014) and previous studies show the highest rate of ever-use e-cigarettes among this age group (Baeza-Loya, Viswanath, Carter, et al., 2014; Trumbo & Harper, 2013). The purpose of this study was to examine the effect of the two warning labels, generated by FDA and e-cigarette companies, on college students' perceived advantage and risk of e-cigarette use as well as their intention to use e-cigarettes. To the best of our knowledge, this was the first study examining whether or not e-cigarette warning labels have impacts on consumers' beliefs and behaviors. The findings of this study not only provided evidences showing the effect of e-cigarette warning labels, but also provided insightful information for future warning label design.

## 2. Methods

### 2.1. Conceptual framework

Constructs of the Theory of Planned Behavior were used for the structural equation modeling (SEM) in this study. The key concept is that subjects' behavioral intention is influenced by subjective evaluation of the risks and benefits of the expected outcome (Ajzen, 1985). Therefore, we hypothesized that college students' intention to use e-cigarettes was influenced by their subjective evaluation of the risks and relative advantages of e-cigarette use, which could be swayed by the warning label. Regarding determinants influencing warning label effect, previous studies have demonstrated that label design, such as readability, had impact on warning label effect (O'Hegarty, Pederson, Yenokyan, Nelson, & Wortley, 2007; Wogalter, Conzola, & Smith-Jackson, 2002). Furthermore, the effect of the health message was associated with readers' comprehension and level of believability. Hence, we further hypothesized that the effect of warning labels is influenced by label design, including readability, comprehensibility, and believability of the content. Consumers' intention to use cigarettes was not only influenced by information they acquired from the warning labels but also predisposed by their knowledge and using experiences. Previous tobacco studies confirmed the association between knowledge about smoking and smoking intention (Romer & Jamieson, 2001; Tyc, Hadley, Allen, et al., 2004). Sutfin, McCoy, Morrell, Hoepfner, & Wolfson, 2013 reported similar findings for e-cigarette use, although they did not specify the direction of the relationship between knowledge and e-cigarette use. Accordingly, we hypothesized that college students' intention to use e-cigarette is influenced by their knowledge about e-cigarettes. Lastly, demographic variables such as gender, age, and race (white/non-white) were included as covariates.

### 2.2. Research design and experiment administration

This study used pretest-posttest design to examine the effect of e-

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