Perceptions about e-cigarette safety may lead to e-smoking during pregnancy

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Electronic cigarettes (e-cigarettes) are nicotine-delivery devices that are increasingly used, especially by young people. Because e-cigarettes lack many of the substances found in regular tobacco, they are often perceived as a safer smoking alternative, especially in high-risk situations such as pregnancy. However, studies suggest

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that it is exposure to nicotine that is most detrimental to prenatal development. The authors studied perceptions of tobacco and e-cigarette health risks using a multiple-choice survey. To study the perceived safety of e-cigarettes versus tobacco cigarettes, 184 modified Global Health Youth Surveys (WHO, http://www.who.int/tobacco/surveillance/gyts/en/) were completed electronically or on paper. Age range, smoking status, and perceptions about tobacco cigarettes and e-cigarettes were studied. The results verified that younger people use e-cigarettes more than older people. Tobacco cigarettes were perceived as more harmful than e-cigarettes to health in general, including lung cancer and pregnancy. Although more research is necessary, the authors postulate that the perception that e-cigarettes are safer during pregnancy may induce pregnant women to use these devices more freely. Given that nicotine is known to cause fetal harm, pregnant mothers who smoke e-cigarettes could cause even greater harm to the fetus because e-cigarettes are perceived as being safer than tobacco cigarettes. Until more data about the effects of nicotine during pregnancy are available, the authors advocate for labeling of e-cigarettes as potentially harmful, at least during pregnancy. (Bulletin of the Menninger Clinic, 78[3], 243–252)

Electronic cigarettes (e-cigarettes) are devices that provide nicotine to users through vaporization of a nicotinic solution (Cahn & Siegel, 2011). In the past few years, e-cigarettes have become increasingly popular among adolescents, young adults, and tobacco cigarette smokers who want to quit or look for nicotine alternatives without the harmful side effects of tobacco (King, Alam, Promoff, Arrazola, & Dube, 2013). E-cigarettes have surpassed alternative tobacco products in online popularity (Ayers, Ribisl, & Brownstein, 2011), indicating an increase in both awareness and interest in these products.

Detailed research on the patterns of e-cigarette use is necessary and ongoing. The possible health effects of e-cigarette use are poorly understood, but educated guesses can be made using our knowledge of nicotine's effects on the body. Most studies regarding the safety of e-cigarettes compare the risks of using e-cigarettes relative to tobacco cigarettes. Young people in focus groups were unsure if alternative nicotine products, including

e-cigarettes, were less harmful than cigarettes due to the lack of information about these products (Choi, Fabian, Mottey, Corbett, & Forster, 2012). Because e-cigarettes are thought to lack many of the harmful constituents associated with regular tobacco, including carcinogens known to cause diseases such as lung cancer (Hecht, 2012), people may reach the conclusion that e-cigarettes are a safer smoking alternative.

Given that individuals' perceptions affect their behavior (Ajzen, 2011), the perception that e-cigarettes are generally less harmful than tobacco cigarettes may lead to an increase in e-cigarette use during pregnancy. However, the safety of nicotine replacement devices, such as e-cigarettes or nicotine patches, is not supported by evidence from animal studies, which indicate that the dose of nicotine presents a great hazard to prenatal development (Wickstrom, 2007). Tobacco cigarette smoking is injurious during prenatal development because of direct delivery of nicotine to the fetus. Spontaneous abortions, neonatal intensive care unit admissions, perinatal and natal deaths from Sudden Infant Death Syndrome (SIDS), increased risk of learning disabilities, behavioral problems, attention–deficit/hyperactivity disorder (ADHD), and increased risk of addiction later in life may be attributed to the effects of nicotine during prenatal development (Ernst, Moolchan, & Robinson, 2001; Slotkin, 1998; Slotkin, Tate, Cousins, & Seidler, 2006). Given that these are nicotine's effects, it follows that e-cigarettes will probably cause similar effects to fetuses.

The primary aim of this study was to determine possible differences among the perceptions of the health risks of tobacco cigarettes and e-cigarettes. We were particularly interested in the perceived safety of the use of e-cigarettes during pregnancy.

Methods

Survey

A cross-sectional study was carried out using a version of the Global Youth Tobacco Survey (WHO, http://www.who.int/tobacco/surveillance/gyts/en/) modified to include questions about

both tobacco cigarettes and e-cigarettes. The first section contained questions about participants' use of tobacco cigarettes and/or e-cigarettes. The next section included questions about the participants' perceptions of tobacco cigarettes and e-cigarettes. The following questions were of particular interest because of the potential health implications: "*Do you think that tobacco cigarettes are harmful for pregnant women to use?"* compared to "*Do you think that e-cigarettes are harmful for pregnant women to use?"* And "*Do you think that tobacco cigarettes can give you lung cancer?"* compared to "*Do you think that e-cigarettes can give you lung cancer?"* Each question could be answered "definitely yes," "probably yes." "probably not," or "definitely not."

Participants

Participants (184) were recruited during the year 2013 via electronic means (e.g., e-mail, Facebook) and word-of-mouth. Consent was included as part of the questionnaire. The survey was administered anonymously either electronically or on paper. No identifiable information was collected. Demographic information related to participant age range was acquired for the following age groups: 18–20, 21–25, 26–30, and 31+ years old (the 21–25 and 26–30 groups were pooled during analysis to equalize the number of respondents per group). This study was reviewed and approved by the Baylor College of Medicine Institutional Review Board.

Data analyses

No participant had missing data in any of the scores reported here. Scores of 0, 1, 2, and 3 were assigned to the answers "definitely yes," "probably yes," "probably not," and "definitely not," respectively. The Wilcoxon Sign Rank test was used to compare answer distributions.

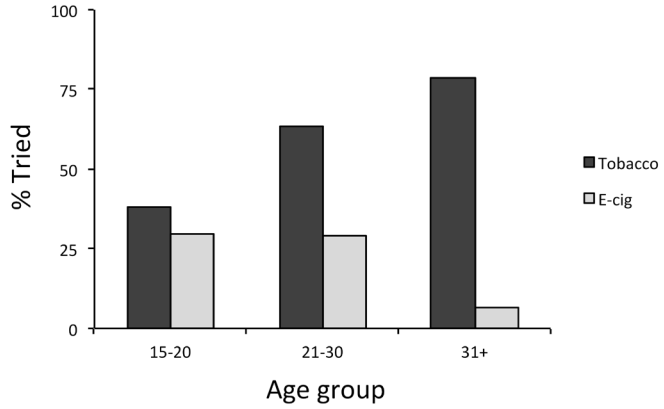

Figure 1. **Percent of "Yes" answers to the questions "Have you ever tried a tobacco cigarette, even one or two puffs?" (dark bars) and "Have you ever tried an e-cigarette, even one or two puffs?" (light bars) according to age range: 18–20 years old (*n* = 68), 21–30 years old (*n* = 55), 31+ years old (*n* = 61).**

Results

In total, 184 people responded to the questionnaire. Of those, 68 were young adults (18–20 years old), 55 were adults (21–30 years old), and 61 were older adults (31 or older). Across age groups, 109 respondents had smoked at least one tobacco cigarette and 40 had tried an e-cigarette.

As shown in Figure 1, we found that younger respondents tended to have tried e-cigarettes more and tobacco cigarettes less than older adults ($p < 10^{-12}$). This finding has been reported elsewhere (Choi & Forster, 2013; Pepper et al., 2013). When we examined health perceptions, we found that people of all ages perceive e-cigarettes as significantly less dangerous than tobacco cigarettes. This was true for questions about lung cancer (Figure 2A, $p < 10^{-33}$), harm during pregnancy (Figure 2B, $p < 10^{-32}$), and difficulty quitting (Figure 2C, $p < 10^{-10}$). On other health-related questions, similar results were obtained. Interestingly, there were no clear perception differences between age groups.

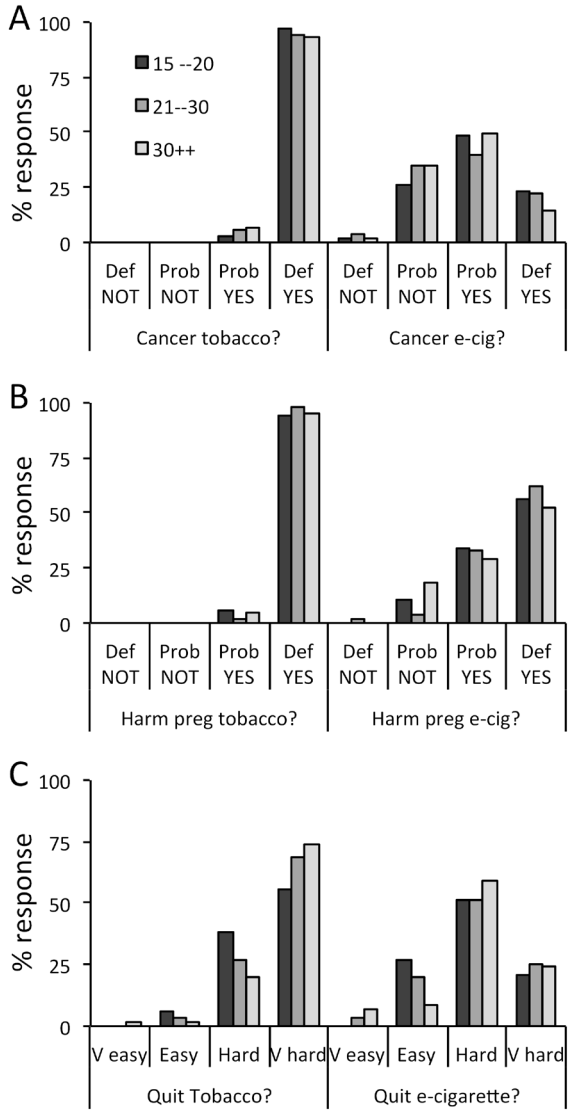

Figure 2. **Percent of answers to three representative health-related questions, separated by age groups: A, Do you think that tobacco cigarettes (or e-cigarettes) can give you lung cancer?; B, Do you think that tobacco cigarettes (or e-cigarettes) are harmful for pregnant women to use?; C, Once someone has started smoking tobacco cigarettes (or e-cigarettes), how easy or hard do you think it is to quit? The p values were calculated by comparing the distributions using the Wilcoxon sign rank test.**

To verify that perceptions correlate with behavior in this setting, we divided the sample into "tried e-cigarettes" (N = 40) and "have not tried e-cigarettes" (N = 144) and compared perceptions of the link between smoking e-cigarettes and lung cancer. Responders who had tried e-cigarettes were more likely to answer "definitely not" and "probably not" to the question "Do you think that e-cigarettes can give you lung cancer?" than responders who had not tried e-cigarettes ($p < 10^{-4}$).

Discussion

Our findings suggest that e-cigarettes are perceived as less harmful than tobacco cigarettes. Given the vast literature on the deleterious effects of tobacco (Centers for Disease Control and Prevention, 2004; Talhout et al., 2011), it is not surprising that most people think tobacco-free e-cigarettes are safer than tobacco cigarettes. The link between tobacco and lung cancer/respiratory diseases was acknowledged by survey respondents. This relationship has been well documented (Hecht, 2012). Less well known is the potential relationship between nicotine and lung cancer (Catassi, Servent, Paleari, Cesario, & Russo, 2008). Thus, e-cigarettes may be perceived to have much lower effects on lung cancer than tobacco cigarettes, if any. Another interesting question concerns differences in nicotine addiction in e-cigarettes and tobacco cigarettes. Nicotine is known to be the main addictive component of tobacco (Picciotto & Mineur, 2014), but other components present in tobacco cigarettes may also promote addiction, including monoamine oxidase inhibitors (Guillem, Vouillac, Koob, Cador, & Stinus, 2008; Malin et al., 2013). Whether the nicotinic solution used in e-cigarettes could be used to deliver other addictive compounds beyond nicotine is an open question. Regardless, we show here that e-cigarettes are perceived as less addictive than tobacco cigarettes.

We sought to determine if men and women perceive e-cigarettes as less harmful than tobacco cigarettes in the context of pregnancy. Perceptions that e-cigarettes are safer may lead women to trade tobacco cigarettes for e-cigarettes during pregnancy, eliminating intake of tobacco-related carcinogens while

maintaining nicotine habits. Unfortunately, many of the negative fetal effects of tobacco have been specifically linked to nicotine, rather than to tobacco more generally (Ernst et al., 2001; Slotkin, 1998; Slotkin et al., 2006). Thus, e-cigarettes may be at least as deleterious as tobacco cigarettes, if not more harmful due to the potential for increased use during pregnancy in women who perceive e-cigarettes as a safer smoking alternative.

Although we did not collect demographic information related to level of education, our 184-person sample likely includes a high percentage of undergraduates, graduate students, and postdoctoral fellows living near and working in a major medical center. In this highly educated population, e-cigarettes were perceived to be safer than tobacco cigarettes. It is thus likely that similar perceptions on the safety of e-cigarettes exist in the general population, who do not have ready access to information about the negative effects of nicotine on fetal development, lung cancer, and other health risks. However, it is possible that our sample is skewed in the other direction, which highlights the need for further study on the possible effects of e-cigarettes on public health and perceptions of associated risks of e-cigarette smoking.

More research is necessary to understand the possible effects of e-cigarettes on public health. In the meantime, we advocate for a label on e-cigarettes to warn against e-smoking at least during pregnancy.

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