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High International Electronic Cigarette Use Among Never Smoker Adolescents

Lauren M. Dutra, Sc.D. and **Stanton A. Glantz, Ph.D.**

Center for Tobacco Control Research and Education, University of California San Francisco, San Francisco, California

Discussion of electronic cigarettes (e-cigarettes) has focused primarily on their potential as a less dangerous alternative to cigarettes or as a smoking cessation aid for adult smokers. But because regular e-cigarette use is low among never smokers, these discussions have so far failed to consider seriously the rapidly rising e-cigarette use among adolescents [1–6]. Indeed, in its 2014 policy statement on e-cigarettes, the American Heart Association stated, “Among never smokers, 0.7% were currently users (past 30 days), which indicates that few never smokers who try e-cigarettes continue their use” [7].

Results from Poland [8] challenge this assumption (Table 1). Goniewicz et al. [8] found rapidly rising e-cigarette use among adolescents aged 15–19 years. Ever e-cigarette use increased from 16.8% in 2010–2011 to 62.1% in 2013–2014, and current e-cigarette increased from 5.5% to 29.9%. This increase in prevalence was nearly twice (1.7 times) the increase in prevalence for smoking conventional cigarettes (23.9%–38.0%). Prevalence of dual use of e-cigarettes and conventional cigarettes also increased from 3.6% in 2010–2011 to 21.8% in 2013–2014, with 72.4% of current e-cigarette users also smoking cigarettes in 2013–2014. If adolescents were adopting e-cigarettes as alternatives to conventional cigarettes, conventional cigarette smoking and dual use of e-cigarettes and cigarettes would have declined.

This increase in adolescent use of e-cigarettes is higher than that observed in 2011 and 2012 in the United States. Among high school students in the U.S. National Youth Tobacco Survey (NYTS), ever and current e-cigarette use doubled between 2011 and 2012, with high levels of dual use of cigarettes and e-cigarettes [9] (Table 1). Ever and current e-cigarette use also rapidly increased among Korean adolescents 13–18 years old between 2008 and 2011 [10,11]. In Paris in 2012, 8.1% of students (ages 12–19 years) had tried an e-cigarette. [12] These data from Poland and three other countries show rapid growth of the adolescent e-cigarette market and high levels of dual use of e-cigarettes and cigarettes (Table 1).

High levels of dual use raise the question of whether e-cigarettes are a “gateway” to smoking or whether adolescents start using e-cigarettes as a harm reduction strategy [2,13]. Unfortunately, because all existing studies on adolescents, including Goniewicz et al. [8], are cross-sectional, we do not know what fraction of dual users start with e-cigarettes and move on to smoke conventional cigarettes and vice versa.

This issue does not, however, apply to e-cigarette use among never smokers. Consistent with other studies (Table 1) [9,10,12,14,15], the Polish data show a rising prevalence of e-

cigarette users who have never smoked cigarettes. In 2010–2011, 1.6% were ever e-cigarette users who had never smoked and .6% were current e-cigarette users who had never smoked. By 2013–2014, these rates had increase to 7.1% and 2.0%, respectively. Never cigarette smokers made up a substantial portion of adolescent e-cigarette users in both years. In 2010–2011, 9.8% of ever e-cigarette users and 11.3% of current e-cigarette users were never smokers. In 2013–2014, 11.4% of ever e-cigarette users and 6.8% of current e-cigarette users were never smokers (M. Goniewicz, written communication, August 18, 2014),.

These results are similar to those obtained from the 2012 U.S. NYTS high school sample [9] (Table 1). In addition, ever e-cigarette use among never smokers more than tripled among middle and high school students (the entire NYTS sample) from 79,000 students in 2011 to more than 263,000 in 2013 [16]. Also consistent with findings by Goniewicz et al. on never smoking were findings from high school students in the Northeastern United States in 2010/2011 [14], Korean students (13–18 years old) in 2011 [10], and Parisian students (ages 12–19 years) in 2012 [12]. These results reveal that a substantial portion of adolescents are first exposed to nicotine through e-cigarettes.

These numbers are lower bounds for the prevalence of youth who initiate nicotine addiction with e-cigarettes because some of the dual users of cigarettes and e-cigarettes also likely started nicotine use with e-cigarettes. Pooled data from the 2011, 2012, and 2013 NYTS samples of middle and high school students revealed that, among never cigarette smokers, e-cigarette users (43.9%) were more likely than never e-cigarette users (21.5%) to intend to smoke cigarettes in the future [16]. The fact that in the 2012 NYTS a larger percentage of middle school students were e-cigarette only users (20.3%) than high school students (7.2%) is consistent with a pattern of younger students initiating nicotine use with e-cigarettes then becoming dual users.

For many youth, their first introduction to the addictive drug nicotine is e-cigarettes. Although switching established adult nicotine-addicted cigarette smokers to e-cigarettes would, at least in theory, be an improvement over the status quo, adolescent initiation of nicotine addiction with e-cigarettes is not.

The health consequences of nicotine include cardiovascular diseases, immune suppression and related disorders, poor reproductive health outcomes, and perhaps cancer [17]. Perhaps even more important, the adolescent brain is very vulnerable to nicotine addiction [18–20].

The heavy marketing of e-cigarettes to youth has likely contributed to the increasing popularity of e-cigarettes among adolescents [21–23]. In addition to claims that e-cigarettes are safer than cigarettes and may provide health benefits, e-cigarettes come in youth-appealing candy flavors such as cotton candy and gummy bear, and e-cigarette advertisements include messages that appeal to youth, such as adult themes, independence, and rebellion [21,23,24]. E-cigarette television advertising is rapidly increasing in the United States, particularly on channels and television programs with large youth audiences [25].

Because of the advertising claims that promote e-cigarettes as a safer alternatives to cigarettes [21,23,26–28], some adolescents (similar to adults) may view e-cigarettes as smoking cessation aids. However, no longitudinal data has been published on e-cigarette use

and smoking cessation among adolescents. Although the Goniewicz et al.[8] data did not include information on abstinence from cigarette smoking, cross-sectional data from the U.S. NYTS [29] and Korea [10] showed that adolescent ever and current e-cigarette users were more likely to be planning to quit smoking but less likely to have actually recently abstained from smoking conventional cigarettes. In addition, youth who used e-cigarettes and had already tried smoking (one puff or more) were more likely to be lifetime cigarette smokers (100 cigarettes or more in lifetime) [29]. These results are consistent with a recent meta-analysis of e-cigarette use and smoking cessation among adults [30] (mostly based on longitudinal studies) that found that, among all smokers, e-cigarette use was associated with significantly less cigarette cessation.

E-cigarette use is increasing rapidly among youth around the globe. Although some public health researchers are hopeful about e-cigarettes' potential as a harm reduction product [1–3,6], the business model that tobacco companies use to promote e-cigarettes (promoting addiction to maintain a strong consumer base) is inconsistent with the concept of e-cigarettes as a harm reduction tool [31]. In combination with the existing literature, findings by Goniewicz et al. [8] emphasize the fact that rapid penetration of the youth market, including use of e-cigarettes among never smokers, may be accompanied by increasing youth smoking with potential long-term health impacts.

The same types of policies used to protect youth from cigarettes included in the World Health Organization Framework Convention on Tobacco Control [32] need to be implemented for e-cigarettes. E-cigarette advertising should be prohibited, as should sponsorship of events attended by youth (such as sporting and music events). The use of e-cigarettes should be prohibited wherever smoking cigarettes is prohibited, age restrictions should be placed on e-cigarettes for purchase, and the prices of e-cigarettes should be increased through taxation. Policy makers and researchers need to base e-cigarette policies on the fact that they are a source of nicotine initiation among youth not just a possible tool to help adult smokers quit smoking.

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Table 1

Prevalence of electronic cigarette (e-cigarette) use and never cigarette smoking in cross-sectional samples of adolescents^a

Country	Authors	Year(s) data collected	Ages of participants (years)	E-cigarette use (%)		E-cigarette use and never smoking (%) ^b	
				Ever e-cigarette use	Current e-cigarette use	Ever e-cigarette use	Current e-cigarette use
Poland	Goniewicz et al. [8]	2010–2011	15–19	16.8	5.5	1.6 ^d	.6 ^e
		2013–2014	15–19	62.1	29.9	7.1 ^h	2.0 ⁱ
United States	Corey et al. [9] (high school only)	2011	14–18	4.7	1.5		
		2012	14–18	10.0	2.8	.7 ^l	
United States	Bunnell et al. [17] (middle and high school)	2011–2013 pooled	11–18	6.1		.7 ^m	.2 ⁿ
New York and Connecticut	Camenga et al. [14]	2010–2011	14–18		2.4		.2 ^p
Utah	Utah Dept. of Health [15]	2011	13–18		1.9		
		2013			5.9		
Korea	Cho et al. [11]	2008	13–18	0.5		.1 ^q	
	Lee et al. [10]	2011	13–18	9.4	4.7	1.4	.5 ^s
Paris, France	Dautzenberg et al. [12]	2012	12–19	8.1		1.4 ^v	

^aFootnotes provide detailed calculations for percentages not explicitly stated in manuscripts but that were calculable based on figures presented in the articles. As a result, these figures are unweighted.

^bNumber of e-cigarette users who were never cigarette smokers/participants in sample.

^cNumber of e-cigarette users who were never cigarette smokers/total number of e-cigarette users.

^d29 ever e-cigarette users who were never smokers of 1,760 adolescents.

^e11 current e-cigarette users who were never smokers of 1,760 adolescents.

^f29 never-smoking ever e-cigarette users of 296 (16.8% of 1,760 students) ever e-cigarette users.

^g11 never-smoking current e-cigarette users of 97 (5.5% of 1,760) current e-cigarette users.

^h140 ever e-cigarette users who were never smokers of 1,970 adolescents.

ⁱ40 current e-cigarette users who were never smokers of 1,970 adolescents.

^j140 never-smoking ever e-cigarette users of 1,223 (62.1% of 1,970) ever e-cigarette users.

^k40 never-smoking current e-cigarette users of 589 (29.9% of 1,970) current e-cigarette users.

l_{178} (7.2% of 2,466) ever e-cigarette users who were never smokers/24,658.

m_{288} never smoking ever e-cigarette users (.9% ever e-cigarette use among 32,027 [73.0% of 43,873] never smokers)/43,873.

n_{96} (.3% current e-cigarette use among 32,027 [73.0% of 43,873]) never smokers/43,873.

o_{288} (.9% of 32,027) ever e-cigarette users who were never smokers/2,676 ever e-cigarette users.

p_7 (9.2% of 76) current e-cigarette users who were never smokers/3,102.

q_5 ever e-cigarette users who were never smokers/4341 students.

r_5 never-smoking e-cigarette users/22 e-cigarette users in sample.

s_{348} (.63% of 55,295) current e-cigarette users who were never smokers/72,285.

t_1 1.4% ever e-cigarette only users (never smokers)/9.4% e-cigarette users.

u_{348} (.63% of 55,295) never smoking current e-cigarette users who were never smokers/3,555 (4.7% of 75,643) current e-cigarette users.

v_{47} never-smoking e-cigarette users/3,409.