Prevalence and risk factors of electronic cigarette use among adolescents: Data from four Swedish municipalities

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ABSTRACT

AIMS – To assess the prevalence rates and risk factors of electronic cigarette (e-cigarette) use, with special focus on e-cigarettes containing nicotine, among grade 9 students (aged 15–16 years) in four different municipalities in Sweden. METHODS – A cross-sectional sample of 665 adolescents was collected in April 2014. The data was analysed using binary logistic regression analysis. RESULTS – The results show that 26% of adolescents in this study have smoked e-cigarettes (have ever used), while 19% have smoked e-cigarettes with nicotine or do not know whether or not they contained nicotine. The strongest risk factor for ever having used e-cigarettes (any type or with nicotine) was smoking conventional cigarettes. Having tried cigarettes and having tried snus, as well as using or having used alcohol and having smoked a water pipe were also statistically significant risk factors for ever use of any type of e-cigarettes but not for use of e-cigarettes with nicotine. There was no gender difference. CONCLUSIONS – Our result show that the use of e-cigarettes tends to cluster with the use of other substances, such as other tobacco products and alcohol. As a relatively large share of the participating adolescents, more than a fourth, had smoked e-cigarettes, this rather new phenomenon requires monitoring as a part of the tobacco control. KEYWORDS – adolescents, e-cigarette, electronic cigarette, smoking, prevalence, predictors

Introduction

The use of electronic cigarettes (also known as e-cigarettes or electronic nicotine delivery systems) is a growing worldwide trend among adolescents. Young people's awareness and use of e-cigarettes is increasing rapidly (Carroll Chapman & Wu, 2014; Durmowicz, 2014), and in Finnish and Polish data, nine out of ten students were aware of e-cigarettes (Goniewicz & Zielinska-Danch, 2012; Kinnunen et al., 2014). The World Health Organization WHO (WHO, 2009), as early as 2009, as well as the US Food and Drug Administration (FDA) in 2014 (FDA, 2014), have warned

that e-cigarettes that include nicotine and those that contain carcinogens and toxic chemicals such as nitrosamines and diethylene glycol can be potentially harmful to humans. It is also recognised that nicotine has been detected in e-cigarette cartridges labelled nicotine-free (WHO, 2009). According to a recent systematic review, the safety of e-cigarettes is not yet confirmed (Pisinger & Døssing, 2014).

Where such data are available, e-cigarettes have been found to have a rapid spread worldwide. In Europe, they seem to be more common among young people in northern and eastern Europe (Vardavas, Filippidis, & Agaku, 2014), with prevalence rates of 17% in Finland in 2013 (Kinnunen et al., 2014) and 62% in Poland in 2013–2014 (Goniewicz, Gawron, Nadolska, Balwicki, & Sobczak, 2014) of ever having used e-cigarettes. Data collected in Korea in 2008 reported that only 0.5% of students had used e-cigarettes (Cho, Shin, & Moon, 2011), but the figure had risen to 9% in another study three years later (Lee, Grana, & Glantz, 2014). Use of e-cigarettes in the United States increased between 2011 and 2014 among middle- and high-school students, and the "have ever used group" rose from 4.7% to 13.4% (Arrazola et al., 2015). It seems that most young people who had tried e-cigarettes had experimented only once or twice (Kinnunen et al., 2014). Self-reports show that adolescents think the popularity of e-cigarettes comes from their availability and ease of use (Peters, Meshack, Lin, Hill, & Abughosh, 2013). E-cigarette users report friends and the internet as primary sources for getting e-cigarettes (Kinnunen et al., 2014).

A Swedish annual report (Englund, 2014) recently reported on e-cigarette use on the basis of a national representative school survey data (n=8771). About 25% of the participating 15–16-year-old boys, and 20% of the girls, said that they had tried e-cigarettes. Corresponding figures for students aged 17–18 years were 26% for boys and 21% for girls.

Tobacco and tobacco-like products in Sweden

Swedish law requires a person to be 18 years old to purchase tobacco products (Swedish Government, 1993). School surveys in Sweden show decreased tobacco consumption among 15–16-year-olds during the 2000s and the 2010s (Englund, 2014). The decrease applies to the more frequent (daily or almost daily) use of cigarettes and snus (moist, smokeless tobacco tucked under the lip, common in Scandinavian countries, and legal for people over 18 years to purchase in Sweden) as well as to those who have tried tobacco. More girls (17%) than boys (11%) are current smokers, but boys are current snus users to a greater extent. No such trend is seen among 17–18-year-old Swedish students; instead their tobacco use has been relatively constant, or has in fact increased among boys during the 2000s. The results show that 28% of the boys and 29% of the girls aged 17–18 are current smokers and that 22% of the boys and 4% of the girls are current snus users. E-cigarettes are not included in the Swedish Tobacco Act (Swedish Government, 1993) but are listed in the Pharmaceutical Act (Swedish Government, 1992). An investigation on e-cigarettes has recently been finished, and the final report was submitted to the Swedish Government in March 2016. No e-cigarettes and filling liquid containing nicotine have been ap-

proved as drugs in Sweden (Swedish Medical Products Agency, 2016).

Risk factors of e-cigarette use

A strong risk factor of adolescent e-cigarette use is smoking conventional cigarettes: most current e-cigarette users reported daily, occasional or previous smoking of conventional cigarettes (e.g. Camenga et al., 2014; Cho et al., 2011; Kinnunen et al., 2014). But the use of e-cigarettes is not limited to conventional cigarette smokers. A notable proportion of young people who have never tried conventional cigarettes have used e-cigarettes (e.g. Bunnell et al., 2014; Camenga et al., 2014; Carroll Chapman & Wu, 2014). Ever having used e-cigarettes was also associated with use of other tobacco products, e.g. water pipe (also called hookah), snus, or with cannabis use (blunt) (Amrock, Zakhar, Zhou, & Weitzman, 2015; Camenga et al., 2014; Dautzenberg, 2013; Kinnunen et al., 2014), and with alcohol consumption (Dautzenberg 2013; Hughes et al., 2015). It has been shown that lifestyle habits tend to cluster (Bunnell et al., 2014; Joffer et al., 2014); therefore it is important to find out their relation to e-cigarette use as well.

Another important risk factor of e-cigarette use is age. Young people in their late teens are more likely to have ever used e-cigarettes than younger adolescents (Amrock et al., 2015; Carroll Chapman & Wu, 2014; Dautzenberg, 2013; Lee et al., 2014). Most studies find that e-cigarettes are more common among boys (e.g., Amrock et al., 2015; Cho et al., 2011). However, in France, until the age of 17 years, more girls than boys had tried e-cigarettes (Dautzenberg, 2013). Other risk factors associated with e-cigarette use is living in urban areas (Goniewicz & Zielinska-Danch, 2012), being in vocational education and having poor school performance (Kinnunen et al., 2014) and lower satisfaction with school (Cho et al., 2011). Kinnunen and colleagues (2014) found that having parents with higher levels of education and in employment, and living in an intact family served as protective factors against e-cigarette use among adolescents.

Because of the increasing awareness, availability and use of e-cigarettes all over the world, and Europe in particular, and the ongoing regulation changes in some countries (cf. Swedish Medical Products Agency, 2016) for selling e-cigarettes and what they may contain, it is important to gain knowledge of prevalence rates and risk factors of using e-cigarettes. There is still not enough knowledge in this area in Sweden, and yet comprehensive understanding is a prerequisite to undertaking effective preventive work among youth. As far as we know, ours is the first study in Sweden to publish prevalence rates and risk factors of e-cigarette use among adolescents. Given that Sweden (as the only EU country) is also allowed to sell another tobacco product, snus, makes the study unique. This study also adds to the lack of knowledge concerning the specific use of e-cigarettes with nicotine compared to ever having tried e-cigarettes. Hence the aim of this study is to assess the prevalence rates and risk factors of e-cigarette use, with special focus on e-cigarettes containing nicotine, among grade 9 students (aged 15–16 years) in four different municipalities in Sweden.

Table 1. Demographics and response rates by municipality[1]

Municipality	City population	Responses (n)	Response rate %[2]	boys/girls %
Western	52 859	422	89	50/50
Southwestern	23 517	58	84	52/48
Southern 1	50 227	72	87	44/56
Southern 2	18 401	113	84	44/56
Total		665 (out of 762)	87	49/51

[1] (Statistics Sweden 2013).
[2] Response rate is defined as students present on the day of the survey divided by all students on the class list.

Methods

Participants and data collection

This paper is part of an ongoing study on "School as a setting for ANDT (Alcohol, Narcotics, Doping, Tobacco) prevention", which examines the effectiveness of a school-based preventive programme run by an NGO in Sweden (Börjesson & Eriksson, 2012; Geidne et al., 2014; Bortes et al., 2015). However, the data used for this paper come from the second cross-sectional follow-up, conducted in 2014, which comprised 665 participants in compulsory school, grade 9 (15–16-year-olds), with a mean response rate of 87% (due to absence on the day of the survey). The question on e-cigarette use was not included in the previous surveys, but students made us aware during the first follow-up that this was an important item. Hence, this study was based solely on one cross-sectional data collection. Self-report questionnaires were collected in four municipalities, two in southern Sweden (5 schools), one in southwestern Sweden (1 school), and one in western Sweden (5 schools) (Table 1). The questionnaire took about 30–40 minutes to complete and comprised five sections about the students and their family; school satisfaction; tobacco, alcohol and narcotics use; crime; and health. Many of

the questions have previously been used in earlier studies (cf. Brunnberg, Lindèn Bostrom, & Berglund, 2008). The questionnaires were administered by two of the authors of this paper.

The study was approved by the regional ethical committee in Uppsala in June 2011 (reg. No. 2011/213).

Variables

The dependent variable "Have you ever smoked e-cigarettes?" had the response options "No", "Yes, with nicotine", "Yes, without nicotine" and "Yes, but I do not know if it contained nicotine". There was a possibility to select more than one type of e-cigarettes. In this study we used two different dependent variables. The first dependent variable was dichotomised into "I have never smoked e-cigarettes" and "I have smoked some type of e-cigarettes". The second dependent variable was dichotomised into those who had used e-cigarettes with nicotine and those who did not know if the e-cigarette contained nicotine (designated as "Yes, with nicotine") against the rest of the participants. If both "Yes, with nicotine" and "Yes, without nicotine" were selected, it was categorised as having used e-cigarettes with nicotine. This was done to test if the group that had

used e-cigarettes with nicotine could be a special risk group, as much as those not being aware if the e-cigarette contained nicotine. (If they do not know whether the e-cigarette contains nicotine they are considered especially risk-taking).

Questions from three blocks were included as independent variables and control variables: demographics, health-related variables and substance use. The demographic variables were gender (boy or girl), student's country of birth (dichotomised into "born in Scandinavia" or "born outside Scandinavia"), parents' country of birth (dichotomised into "both parents born in Scandinavia" and one/both born outside of Scandinavia," books at home (dichotomised into "few", or "many books") intact family (dichotomised into "living with both parents" and "not living with both parents") and having older siblings. The number of books at home has been used earlier as a sociocultural indicator (Mullis, Martin, Foy, & Arora, 2012; Yoshino, 2012).

Two variables concerning the adolescents' self-rated health and school satisfaction were included. The self-rated health question "How are you doing?" was trichotomised into "very well/well", "neither good nor bad" and "pretty/very bad." The school satisfaction question "How do you feel about school?" was trichotomised into "very/pretty good", "neither good nor bad" and "pretty/very bad".

Substance use included four variables. Alcohol use was trichotomised into "never used alcohol", "have tried" and "have used or currently use alcohol". Tobacco use was measured by "smoking [conventional cigarettes]", "using Swedish snus" categorised into "never smoked/used

snus", "do not smoke/use snus, but have tested" or "yes, currently using/have quit using") and smoking water pipe (dichotomised into "yes, have tried" and "no, have not tried").

For all models, we included a dummy for schools participating as a control or an intervention school.

Statistical analysis
Prevalence rates were estimated for each independent variable to reflect ever having used e-cigarettes and ever having used e-cigarettes with nicotine among participants in the current study. The prevalence rates were based on those answering the question and did not include missing answers. The proportions and chi-square tests were used to explore the cross relationships between the dependent and independent variables. We chose to conduct a multi-level model, as our data has a hierarchical structure, which means that observations within schools and municipalities may be correlated. This data is based on four municipalities, 11 schools and 665 students. To account for this data structure, a three-level logistic model is estimated, where the individuals represent level 1, schools level 2 and municipalities level 3 (Diez-Roux, 2000).

Our analysis models have been guided by the literature. We have chosen three different models including variables that tend to cluster to illuminate associations for e-cigarette use among adolescents. In model 1 we included a block of demographic and socioeconomic factors which have been shown to be confounders when analysing the associations for substance use among adolescents (Hanson & Chen, 2007; Hiscock, Bauld, Amos, Fidler, & Mu-

nafò, 2012). In model 2 we adjusted for the demographic and socioeconomic variables and further included self-rated health and enjoyment of school as independent variables in order to see how these were related to e-cigarette use. In model 3 we studied how substance use related to e-cigarette use, still controlling for demographic and socioeconomic factors (but removing the health-related factors).

As for missing data, the external attrition rate was only 13%, which may be considered low in this type of surveys. No specific attrition analysis was made. The internal attrition rate was also very low and was assumed not to affect the results. (The largest model contained 590 observations out of 665.) The data were analysed using STATA version 13.0.

Results

The results show that 26% of the adolescents in this study said that they had smoked e-cigarettes (have ever used), 13% that they had smoked e-cigarettes with nicotine, 10% that they had smoked e-cigarettes without nicotine and 6% that they did not know whether the e-cigarettes they had tried contained nicotine (there was a possibility to select more than one type of e-cigarettes).

Adolescents in the participating schools in southern Sweden smoked e-cigarettes more than their peers in the schools of the other two municipalities, with as many as 50% answering "have used" in Southern 1 against 17% in Western (p<0.001) (Table 2). Boys had smoked e-cigarettes to a greater extent than girls (30% vs 22%, p=0.030). There were no differences in the students' or their parents' country of birth. Moreover, adolescents who did not live

with both parents all the time, or who had older siblings, had smoked e-cigarettes to a greater extent. Few books at home indicated a higher proportion of e-cigarette smokers. A greater proportion of the adolescents who did not enjoy school had used e-cigarettes. A greater proportion of those adolescents who used or had used alcohol, smoked tobacco or used snus, or who had ever smoked a water pipe had also smoked e-cigarettes. The group who had used e-cigarettes with nicotine did not differ in terms of gender or having older siblings. Otherwise the groups were quite similarly distributed.

A significantly larger proportion of the boys had smoked e-cigarettes (table 2), but when controlling for the demographic and socioeconomic factors, gender was no longer a statistical significant risk factor for e-cigarette use (Table 3). Not living with both parents as well as having older siblings indicated higher use of e-cigarettes (model 1 and 2). Also not enjoying school seems to be a risk factor of ever using e-cigarettes (model 2). More books at home indicated less use of e-cigarettes in both model 1 and 2.

Controlling for demographic and socioeconomic variables in model 3 reveals that the strongest substance use risk factor is smoking conventional cigarettes (OR 14.6, CI 5.9–35.4). The following items served as statistically significant risk factors as well: "have tried smoking cigarettes" (OR. 5.6, CI 2.7–11.4), "have tried snus" (OR. 2.4, CI. 1.1–4.3), "use or have used alcohol" (OR. 4.4, CI. 1.5–13.6), as well as "have smoked a water pipe" (OR. 3.2, CI. 1.7–6.1). The estimated intra-class correlations (ICC) were 0.4 for municipality and 0.2 for school (explaining 40% and 20%,

Table 2. Summary statistics for "ever having used e-cigarettes and "ever having used e-cigarettes with nicotine" (chi-square tests).

		N[1]	Have ever used e-cigarettes %	Have ever used e-cigarettes with nicotine %[#]
Municipality	Western (intervention)	422	17.4	11.0
	Southwestern (control)	58	22.4	19.0
	Southern 1 (intervention)	72	50.0	44.4
	Southern 2 (intervention)	113	44.2¤	32.7¤
DEMOGRAPHICS AND SOCIOECO-NOMICS				
Gender	Boys	321	29.9	21.7
	Girls	339	22.4*	16.8
Student's country of birth	Scandinavia	610	25.4	18.3
	Outside Scandinavia	53	32.1	28.3
Parents' country of birth	Both from Scandinavia	559	25.0	18.1
	One/Both from outside Scandinavia	99	32.3	25.3
Family structure	Not living with both parents	196	37.2¤	29.6¤
	Living with both parents all the time	465	21.3	14.6
Having older siblings	None	220	21.5	16.4
	At least one	410	29.4*	21.6
Books at home	Few	181	38.1	28.2
	Many	468	21.2¤	15.2¤
HEALTH-RELATED				
Self-perceived health	Very good/good	516	25.5	18.5
	Neither good nor bad	110	25.7	20.2
	Pretty/very bad	31	32.3	19.4
School satisfaction	Very/pretty much	543	23.1	16.3
	Neither good nor bad	85	31.8	25.9
	Pretty/very bad	33	51.5¤	39.4¤
SUBSTANCE USE				
Smoking	Never smoked	412	6.1	1.7
	Tried	136	44.4	31.1
	Smoke/have quit smoking	113	74.3¤	65.5¤
Swedish snus	No, have never used snus	484	12.0	7.2
	Tried	121	58.3	45.0
	Use snus/have quit using	58	75.9¤	63.8¤
Alcohol	No, have never used alcohol	154	3.2	1.9
	Tried	186	10.3	5.4
	Use or have used alcohol	321	46.3¤	35.3¤
Smoked water pipe	No	509	13.6	9.9
	Yes	154	66.9¤	49.4¤
Total		**665**	**25.5**	**19.0**

Note: Significance level *=p<0.05, ¤=p<0.001, # = including those who do not know if it contained nicotine
[1]The prevalence rates were based on those answering the question and did not include missing answers

Table 3. Multi-level analyses (models 1–3) showing adjusted odds ratios and 95% confidence interval (CI 95%) with ever having used e-cigarettes as the dependent variable.

	Model 1 N=594	Model 2 N=594	Model 3 N=594
INTERVENTION			
Control	1.0	1.0	1.0
Intervention	2.0 (0.3–11.7)	1.8 (0.3–10.9)	2.1 (0.2–19.4)
DEMOGRAPHICS AND SOCIO-ECONOMICS			
Gender			
Boys	1.0	1.0	1.0
Girls	0.7 (0.4–1.0)	0.7 (0.4–1.0)	0.8 (0.4–1.4)
Student's country of birth			
Scandinavia	1.0	1.0	1.0
Outside Scandinavia	1.0 (0.4–2.5)	1.1 (0.4–2.7)	0.8 (0.2–3.1)
Parents' country of birth			
Both from Scandinavia	1.0	1.0	1.0
One/both from outside of Scandinavia	1.6 (0.8–3.1)	1.6 (0.8–3.1)	0.9 (0.4–2.2)
Family structure			
Always living with both parents	1.0	1.0	1.0
Not living with both parents	**2.2 (1.4–3.3)***	**2.2 (1.4–3.3)***	1.1 (0.6–1.9)
Having older siblings			
None	1.0	1.0	1.0
At least one	**1.8 (1.2–2.8)***	**1.7 (1.0–2.7)***	0.9 (0.5–1.7)
Books at home			
Few	1.0	1.0	1.0
Many	**0.6 (0.4–0.9)***	**0.5 (0.3–0.9)***	0.9 (0.5–1.6)
HEALTH-RELATED			
Self-perceived health			
Very good/good		1.0	
Neither good nor bad		0.8 (0.4–1.5)	
Pretty/very bad		1.3 (0.5–3.)	
School satisfaction			
Very good/good		1.0	
Neither good nor bad		1.6(0.8–23.0)	
Pretty bad/very bad		**2.7(1.1–6.2)***	
SUBSTANCE USE			
Smoke			
Never smoked			1.0
Tried			**5.6 (2.7–11.4)¤**
Smoke/have quit			**14.6 (5.9–35.4)¤**
Swedish snus			
Never used snus			1.0
Tried			**2.2 (1.1–4.3)***
Use snus/have quit			2.8 (0.9–8.2)
Alcohol			
Never used alcohol			1.0
Tried			2.4 (0.7–7.9)
Use or have used			**4.4 (1.5–13.5)***
Smoked water pipe			
No			1.0
Yes			**3.2 (1.7–6.1)¤**
Municipality rand.eff (variance)	0.4 (0.1–2.3)	0.4 (0.1–2.3)	0.7 (0.1–3.5)
School rand.eff (variance)	0.2 (0.02–1.2)	0.2 (0.03–1.2)	0.1 (0.01–2.6)

Level of significance = .05, two-sided chi-square test * = p<0.05, ¤ = p<0.001

respectively, of the variance) in model 1 and 2, and 0.7 and 0.1, respectively, in model 3. This means that both municipality and school are statistically significant contextual factors (since the ICC is above 0).

When comparing the group that had used e-cigarettes with nicotine (including those who did not know if the e-cigarettes contained nicotine) with the rest of the students, not living with both parents indicated higher use of e-cigarettes (model 1 and 2). Many books at home indicated less use of e-cigarettes in both model 1 and 2. Controlling for demographic and socio-economic variables in model 3 reveals that the strongest substance use risk factor still was smoking conventional cigarettes (OR. 68.9, CI. 21.1–225.2).

However, the picture changes concerning other substance use, which are here not significant risk factors of e-cigarette use (Table 4).

The estimated intra-class correlations (ICC) are 0.5 for municipality and 0.5 for school (explaining 50%, respectively, of the variance) in model 1, 0.4 and 0.6 in model 2, and 0.8 and 0.2 in model 3. This means that both municipality and school are statistically significant contextual factors, and the school explains more of the variance. Intervention or control did not affect any of the models included in table 3 or 4. Also, analysing boys and girls separately did not show any large deviations from these results.

Discussion
Main results
E-cigarette use is a relatively new phenomenon in Sweden as well as in the rest of the world. This study, which is one of the first of its kind in Sweden, estimates the prevalence of ever having used e-cigarettes in four Swedish municipalities at more than 25% among grade 9 students (aged 15–16 years). The strongest risk factors for using e-cigarettes in the current study was smoking conventional cigarettes, having tried snus, using or having used alcohol, and having smoked a water pipe. In addition, living in one of the southern municipalities was also significantly associated with e-cigarette use. The majority of the students in this study had used e-cigarettes with nicotine or did not know if they contained nicotine. The only significant risk factor for having used e-cigarettes with nicotine was having tried or smoking conventional cigarettes.

Result discussion
In line with recent literature (Camenga et al., 2014; Cho et al., 2011; Kinnunen et al., 2014), we also found the strongest risk factor of adolescent e-cigarette use to be smoking conventional cigarettes, although other tobacco products, as snus, were included, as in the study by Kinnunen and colleagues (2014). We also found alcohol use to be a risk factor, in accordance with Dautzenberg and colleagues (2013) and Hughes and colleagues (2015). Our first analysis with univariate data showed that boys smoked e-cigarettes to a greater extent than girls, but when we adjusted for all independent variables, the difference was statistically non-significant. Most previous studies report that boys are more likely than girls to have ever used e-cigarettes (e.g. Amrock et al., 2015; Cho et al., 2011). However, in Sweden girls smoke conventional cigarettes to a greater extent than boys (Englund 2014).

Table 4. Multi-level analyses (models 1–3) showing adjusted odds ratios and a 95% confidence interval (CI 95%) with ever having used e-cigarettes with nicotine (including those who did not know whether there was nicotine in it or not) as the dependent variable.

	Model 1 n=590	Model 2 n=590	Model 3 n=590
INTERVENTION			
Intervention	1.0	1.0	1.0
Control	1.4 (0.1–14.4)	1.2 (0.1–12.7)	1.0 (0.1–12.8)
DEMOGRAPHICS AND SOCIOECO-NOMICS			
Gender			
Boys	1.0	1.0	1.0
Girls	0.8 (0.5–1.2)	0.8 (0.5–1.3)	0.9 (0.5–2.0)
Student's country of birth			
Scandinavia	1.0	1.0	1.0
Outside Scandinavia	1.5 (0.5–3.9)	1.8 (0.7–4.8)	1.8 (0.4–7.3)
Parents' country of birth			
Both from Scandinavia	1.0	1.0	1.0
One/both from outside of Scandinavia	1.7 (0.8–3.7)	1.7 (0.8–3.7)	0.9 (0.4–2.6)
Family structure			
Always living with both parents	1.0	1.0	1.0
Not living with both parents	**2.7 (1.7–4.54)***	**2.7 (1.6–4.4)***	1.4 (0.7–2.6)
Having older siblings			
None	1.0	1.0	1.0
At least one	1.6 (0.9–2.5)	1.6 (0.9–2.5)	0.7 (0.3–1.)
Books at home			
Few	1.0	1.0	1.0
Many	**0.5 (0.3–0.8)***	**0.5 (0.3–0.8)***	0.9 (0.4–1.7)
HEALTH-RELATED			
Self-perceived health			
Very good/good		1.0	
Neither good nor bad		0.7 (0.2–3.1)	
Pretty/very bad		0.7 (0.4–1.4)	
School satisfaction			
Very/pretty much		1.0	
Neither good nor bad		1.8 (0.9–3.6)	
Pretty/very bad		3.7 (1.4–9.8)	
Smoking			
Never smoked			1.0
Tried			**14.9 (5.3–41.7)¤**
Smoke/have quit smoking			**68.9(21.1–225.2)¤**
Swedish snus			
Never used snus			1.0
Tried			2.1 (0.9–4.7)
Use snus/ have quit using			2.7 (0.9–8.5)
Alcohol			
Never used alcohol			1.0
Tried			1.4 (0.3–6.7)
Use or have used alcohol			2.5 (0.6–10.3)
Smoked water pipe			
No			1.0
Yes			1.5 (0.8–3.0)
Municipality rand.eff (variance)	0.5 (0.1–3.8)	0.4 (0.1–4.0)	0.8 (0.2–4.3)
School rand.eff (variance)	0.5 (0.1–2.2)	0.6 (1.1–2.4)	0.2 (0.02–3.4)

Level of significance = .05, two-sided chi-square test * = p<0.05, ¤ = p<0.005

We found that the unadjusted odds ratio for "have tried snus" was statistically significant, while "currently using snus" or "have quit" was not. One reason for this could be that those who use snus on a daily basis are not interested in exploring other tobacco products (Edvardsson, Troein, Ejlertsson, & Lendahls, 2012), or that adolescents trying snus are a sensation-seeking group who also like exploring different substances. It is nevertheless important to highlight the relatively large confidence interval for these items, indicating few respondents and uncertainty. Joffer and colleagues (2014) discuss that an important health hazard of snus is early introduction of nicotine, which may also be the case of using e-cigarettes with nicotine. Because nearly half of all e-cigarettes contain nicotine, which is addictive, there is concern that young non-smokers who start using e-cigarettes will develop nicotine dependence or eventually take up conventional cigarette smoking. The WHO stated in a report (WHO, 2014) that e-cigarettes with nicotine are inappropriate for children and young people, that there is a risk that e-cigarettes are a gateway to smoking. During adolescence, the developing brain is more sensitive to nicotine, and e-cigarette smoke may contribute to an addiction. Also, Wills and colleagues (2016) conclude that adolescents who use e-cigarettes are more likely to start smoking conventional cigarettes.

We wanted to test whether those who consciously smoke e-cigarettes with nicotine, or do not care whether the device contains nicotine, are a specific risk group. Unfortunately, we could not find any studies that prove such assumptions. When comparing the specific use of e-cigarettes with nicotine compared to ever having tried e-cigarettes, we found relatively small differences in our study. We argue that this is an important aspect to emphasise in future studies with larger samples than ours. However, the majority of the students in this study had smoked e-cigarettes containing nicotine, which also Kinnunen and colleagues (2014) found in their study.

Künzli (2014) suggests that e-cigarettes can have different effects in different countries. In a country with a low proportion of smokers, such as Sweden, e-cigarettes can lead more people to start smoking, while the opposite is the case in other countries. Kalkhoran and Glantz (2016) conclude that e-cigarettes, as currently being used, are associated with significantly less quitting among smokers.

We found that not living with both parents as well as disliking school were significant risk factors for using any e-cigarettes – as well as those with nicotine. Disliking school has elsewhere been found to be a risk factor of ever having used e-cigarettes (Cho et al., 2011), as well as not living with both parents (Kinnunen et al., 2014). These risk factors for e-cigarettes are similar to those for smoking conventional cigarettes (U.S. Department of Health and Human Services, 2012; Wetzels, Kremers, Vitória, & De Vries, 2003). We did not have information concerning parents' education and employment, but we used the number of books at home as a sociocultural indicator (Mullis et al., 2012; Yoshino, 2012) and found that fewer books at home predicted use of e-cigarettes.

Previous studies have identified living in urban areas to be a risk factor associated with e-cigarette use (Goniewicz & Zielinska-Danch 2012), but we could not find any

indication that living in one of the larger municipalities in this study predicted use of e-cigarettes. However, we did see that e-cigarette use was more common in the most southern municipalities and least common in the municipality located in western Sweden. Southern Sweden has a documented higher use of tobacco than the rest of the country (Englund 2014). However, more studies are needed to map the use of e-cigarettes in different parts of Sweden.

WHO (2014) has also stated that e-cigarettes should be banned in otherwise non-smoking environments. Smokers are of course more often in environments where others smoke (U.S. Department of Health and Human Services, 2012). Therefore, one may suspect that even the habit of smoking e-cigarettes can spread among friends; friends were also stated to be one of the primary sources of e-cigarettes among youth (Kinnunen et al., 2014). Smoke-free environments are protective for young people. They prevent young people from starting to smoke and cause those who do smoke to reduce their smoking (Pierce, White, & Emery, 2012; U.S. Department of Health and Human Services, 2012). However, smoking e-cigarettes can give the impression that one is smoking conventional cigarettes, which increases the risk of normalising attitudes to smoking if it is possible to smoke anywhere. If e-cigarettes are allowed in non-smoking environments, it could weaken the important side effects of laws on smoke-free environments.

Methodological considerations
As we only have prevalence data for one cross-sectional sample occasion, we can-

not predict the causal effect of the independent variables analysed in this study. However, the project on which this study builds will collect data on more occasions, which will allow for more refined analyses of causal inferences. The Western and Southern 2 samples included the total population of 15–16-year-old adolescents in each municipality, unlike the Southwestern and Southern 1 samples, which only included one or two schools. In Sweden the national school curriculum prescribes mandatory alcohol and drug preventive work. The different schools in our sample are implementing this in different ways and will therefore succeed to different extents, which of course could affect the results. The ongoing intervention in all schools except the southwestern school can be seen as one specific way to work with prevention and was controlled for showing no statistical differences. This could however be due to the very different success in implementing the intervention in the different municipalities, with the western municipality being the most successful. Also, snus is not very common in our sample, which gives rise to a relatively large confidence interval. Hence the results should in some aspects be interpreted with caution.

One can also discuss whether the second categorisation of the dependent variable (i.e. those reporting using e-cigarettes with nicotine) gives another picture than the first. It might be that the group that has used e-cigarettes with nicotine could be a special risk group, as much as those not being aware if the e-cigarette contained nicotine.

Finally, it is important to notice that the updated EU directive on tobacco products

(EU, 2015) specifying the sale of tobacco and related products was released at about the same time as the survey was conducted. Therefore we can exclude that this directive could have affected the prevalence of e-cigarette use in Sweden.

While our study has some limitations, these results add to the small body of knowledge about e-cigarettes in Sweden and also in an international perspective even if the study is made in a context with another popular tobacco product and also emphasises the specific use of e-cigarettes with nicotine compared to ever having tried e-cigarettes. As our results are in line with previous literature, it is possible to generalise these results to other municipalities in the country. Future studies should study e-cigarette smoking longitudinally in order to establish the causal effect. Cultural differences, too, should be examined in more depth to see what makes adolescents in a specific municipality smoke more e-cigarettes compared to adolescents in another municipality. This would also be interesting from a qualitative perspective.

Conclusions and implications

WHO stresses that one of six elements in a tobacco control strategy is to monitor tobacco use and prevention policies (WHO 2015). As e-cigarettes are a relatively new phenomenon, there is a clear monitoring need. E-cigarettes will not be the last new tobacco product launched, which policy makers and prevention workers need to be aware of.

The most important task is however not to identify individual risk factors and eliminate them, but to keep one step ahead

of them. This suggests that preventive measures directed at young people are vitally important in counteracting multiple risk behaviours. Therefore, schools' tobacco or health policies must take account of the overall environment and people's lifestyle habits (Edvardsson, Lendahls, Andersson, & Ejlertsson, 2012). As research has shown that school-based interventions targeting several risk factors are more effective than those targeting just one single factor, knowledge about e-cigarettes correlates can be important to incorporate into schools' preventive work. Hence, our findings can help policy makers and schools to develop preventive interventions. It seems that e-cigarettes, as well as conventional cigarettes, are commonly used in lower socioeconomic groups (those not living with two parents and have fewer books at home). Therefore targeting adolescents in lower socioeconomic areas would be a priority.

Declaration of Interest None

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