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**ELECTRONIC CIGARETTE USE AMONG ADOLESCENTS IN
THE EUROPEAN AREA**

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Abstract

Electronic cigarettes (e-cigarettes) are devices that allow the release of aerosols by heating a mixture solution which might contain nicotine or other substances at temperatures between 65 and 120°C in order to be inhaled. Over the past few years, e-cigarettes have been promoted by manufacturers as smoking cessation products, but evidence about their safety and efficacy for smoking cessation remains limited, while there are several concerns that they may increase the risk of non-smokers to develop nicotine dependence and of current smokers to maintain their dependence. The aim of this study is to evaluate the status of the research concerning prevalence of e-cigarettes and factors associated with the use of e-cigarettes among European adolescents. The information is based on data available in specific literature such as articles published in journals or international reports. Data from different European countries showed that e-cigarettes are popular products among adolescents. For instance, a study performed in 2013 among Romanian high school students showed that almost 30% of them have experimented with e-cigarettes at least once during lifetime. There are several variations concerning prevalence and factors that influence the use of e-cigarettes between countries as well as within the same country based on socio-demographics characteristics of the groups involved in the study, the year when the survey was performed, or the methodology and instruments for data collection. The results underline the need for future research in this field, as well as for educational and policy measures to face this new public health challenge.

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1. Introduction

Electronic cigarettes (e-cigarettes) appeared for the first time on the Chinese market in 2004 and since then they have been promoted as a safe source of smoking cessation (Greenhill, Dawkins, Notley, Finn, & Turner, 2016). They are devices that allow the release of aerosols by heating a liquid mixture which might contain nicotine as well as other substances at temperatures between 65 and 120°C in order to be inhaled. E-cigarettes are re-usable products composed of a battery, a reservoir for rechargeable cartridges, an atomizer, and a mouthpiece (Schaller et al., 2013). The solutions used to refill the cartridges can contain various amounts of nicotine, but also other substances with possible harmful effects, particularly on the health of young people (Richmond, Pike, Maguire, & Macpherson, 2018). There are many reasons why e-cigarettes are harmful to young people. First, they could contain nicotine that can cause addiction and negative effects on brain development. Second, there is a multitude of potentially carcinogenic chemicals, but they can also have negative pulmonary and cardiovascular effects (Bernat, Gasquet, Wilson, Porter, & Choi, 2018).

2. Problem Statement

In the last years, interest in the use of e-cigarettes by adolescents has increased in most countries around the world. There has been little information on the safety and efficacy of these products (Goniewicz & Zielinska-Danch, 2012), while they have been intensively promoted and in many European countries no regulations or educational programs were in place for prevention of use of these products. Several studies among adolescents showed that e-cigarette users are going to use tobacco-based products in the future (Singh et al., 2016; Westling, Rusby, Crowley, & Light, 2017; Kowitt, Osman, Ranney, Heck, & Goldstein, 2018; East et al., 2018; Tam & Warner, 2018

3. Research Questions

The main questions at the beginning of the present research were: (i) what is the evolution of the prevalence in e-cigarette consumption by European adolescents; (ii) what are the factors that influence the use of e-cigarettes.

4. Purpose of the Study

The aim of this study is to evaluate the status of the research concerning prevalence of e-cigarette use and factors that influence it among European adolescents (age between 11 and 19 years).

5. Research Methods

A narrative review was made based on data available in specific literature such as articles published in journals or international reports from the past 10 years..

6. Findings

6.1. Prevalence of e-cigarettes use

In the past years, around the world, more and more studies have tracked data on the prevalence of the use of e-cigarettes among youth and their behaviour regarding these products. Several studies showed an increase in young peoples' interest in e-cigarettes (Jamal et al., 2017; Perikleous et al., 2018). Table 1 summarizes data regarding the use of e-cigarettes among adolescents and includes three issues: **the ever use** (use of e-cigarettes at least once during lifetime), **of past 30-day use** (use of e-cigarettes at least once in the last 30 days) and **weekly users of e-cigarettes** (those who responded that they use e-cigarettes at least once a week). Most of the studies from the current literature were focused on e-cigarettes prevalence among adolescents, but no distinction has been made between e-cigarettes with and without nicotine. Thus, there is limited information in this sense. One study from Netherlands stated that e-cigarettes without nicotine are more used for e-cigarette experimentation (Treur, Rozema, Mathijssen, van Oers, & Vink, 2018) (Table 1).

It must be mentioned that also, an **intention to use e-cigarettes** could be present in adolescents' mind. Depending on the personality, education, and vulnerability to external factors of each adolescent, there is a risk of those declared never-users of e-cigarettes, that in the future they may become at least ever-users. Few studies included information concerning the intention to experiment with e-cigarettes in the future. For example, 7.4% of the high school students never smokers from Romania declared that they probably/definitely will use e-cigarettes in the next year (Lotrean et al., 2016).

Table 01. Prevalence of e-cigarette use among adolescents in various European countries

Country	Year of study	Sample size	Age (years)	Main findings concerning prevalence (% of use)			Reference
				Ever	Past 30-days	Weekly	
Finland	2013	3 535	12-18	17.4 E-liquids with nicotine were used most often (65.7%)	n.a.	n.a.	(Kinnunen et al., 2015)
France	2013	3151	12-19	17.9	5.6	n.a.	(Dautzenberg et al., 2015)
Germany	2010	2 693	12-13	4.7	n.a.	n.a.	(Hanewinkel & Isensee, 2015)
	2015-2016	4 163	10 th grade students (mean 15.5)	14.3	n.a.	n.a.	(Morgenstern et al., 2018)
Greece	2014	1 320	15	16.6	n.a.	0.5	(Fotiou et al., 2015)
Hungary	2012	2 325	13-15	n.a.	13	n.a.	(Demjén, Tomka, Böti, & Koncz, 2013)
Ireland	2014	821	16-17	24	3.2	n.a.	(Babineau et al., 2015)
Netherlands	2016-2017	6 819	11-17	13.7 (with nicotine) 29.4 (without nicotine)	6.7 (with nicotine) 13.2 (without nicotine)	n.a.	(Treur et al., 2018)
Poland	2010-2011	11 893	15-19	23.5	8.2	n.a.	(Goniewicz & Zielinska-Danch, 2012)

	2013-2014	1 785	16-18	60.7	29.6	n.a.	(Goniewicz et al., 2016)
	2014-2015	3 552	13-19	49.1	27.4	n.a.	(Kaleta, Wojtysiak, & Polańska, 2016)
Romania	2013	342	16-18	28.9	3	n.a.	(Lotrean et al., 2016)
	2014	1 835	5-10 th grade students (mean 14.9)	38.5	n.a.	n.a.	(Nădășan, Pénez, & Urbán, 2017)
Scotland	2013	33 685	13-15	11.6	1.1	n.a.	(Kaufmann & Currie, 2017)
Switzerland	2012	3 067	8 th grade students (mean 14.2)	43	24	n.a.	(Suris et al., 2015)
The United Kingdom	2013	2 062	11-18	4.6	0.9	n.a.	(Eastwood et al., 2015)
	2014	1 952	11-18	8.2	1.7	n.a.	(Eastwood et al., 2015)
	2015	1 943	11-18	13.5	3.3	n.a.	(Eastwood et al., 2017)
	2016	2 019	11-18	11.9	2.6	n.a.	(Eastwood et al., 2017)
	2016	1 152	11-18	11.5	2.1	n.a.	(East et al., 2018)
Wales	2013-2014	9 055	11-16	12.3	1.5	n.a.	(Moore et al., 2015)
Estonia, Latvia, Lithuania, Romania, Bulgaria	2017	21 196	15-17	32.7	n.a.	n.a.	(Kristjansson et al., 2017)

n.a.: not available

6.2. Factors correlated with the experimentation and use of e-cigarette

There are a high variety of factors influencing the use of e-cigarettes.

a. Socio-demographic characteristics

Age is an important factor for using e-cigarettes. Different studies showed that young people aged 15-17 years and those over the age of 18 have a higher prevalence for the use of e-cigarettes compared to those aged between 9-14 years (Bernat et al., 2018; Dai & Hao, 2016; Goniewicz & Zielinska-Danch, 2012).

Gender is another factor that influences the ever use or regular use of e-cigarettes. Males are more likely to use e-cigarettes than females in Europe, the same trend as in United States of America (USA) (Dai & Hao, 2016; Goniewicz & Zielinska-Danch, 2012; Perikleous et al., 2018; Rohde et al., 2018). In a study in five European countries it was shown that boys are three times more likely to use e-cigarettes than girls (Kristjansson et al., 2017).

The level of education can also have a high impact on the decision of adolescents to try and continue use e-cigarettes. Being included in a vocational school or in a disadvantaged school, not attending school, and lower school performance has been demonstrated that are strongly linked with both e-cigarette ever- and daily use (Perikleous et al., 2018). For example, a population-based study from Finland including 12–18-year-old adolescents presented that 46.9% and 51.3% of the adolescents not in school and attending vocational upper secondary, respectively, have ever used e-cigarettes, while the percentage of adolescents attending general, comprehensive, combined general and vocational upper secondary or other types of school, who ever tried e-cigarettes was under 26% (Kinnunen et al., 2015). A similar conclusion was

established in a study in Switzerland, an increased tendency to try e-cigarettes being observed in out-of-school adolescents (only 19.6% of the out-of school adolescents never tried e-cigarettes, compared with 63.7% of the adolescents in high school) (Surís et al., 2015).

The area of living also influences the use of e-cigarettes. Some studies showed that adolescents from rural area are more susceptible to e-cigarette than those from urban area (Eastwood et al., 2015), while in other countries a reverse situation was encountered (Goniewicz & Zielinska-Danch, 2012).

b. Behavioural factors

Several studies underlined that the use of e-cigarettes is more frequent among smokers of traditional tobacco cigarettes, but never smokers of tobacco cigarettes are also sometime using e-cigarettes (Moore et al., 2015; Lotrean et al., 2016; Kaufmann & Currie, 2017). For instance, in a study from Wales the percentage of never smokers reporting having used e-cigarettes was 5.3% at age 10-11 to 8.0% at age 15-16 (Moore et al., 2015). At the same time, several studies showed associations between e-cigarette use and problematic alcohol consumption and illicit drug use (Moore et al., 2015; Kaufmann & Currie, 2017).

On the other hand, there were studies underlining the influence of sensation seeking behaviour (defined as "the search for changing and novel experiences to feel intense sensations again and again") and e-cigarette use (Morgenstern et al., 2018; Nădășan, Pénczes, & Urbán, 2017; Hanewinkel & Isensee, 2015).

c. Believes and curiosity related to e-cigarette use

Believes regarding the benefits and threats posed by e-cigarette use, as well as curiosity to try these novel products play an important role in influencing e-cigarette use (Surís et al., 2015; European Commission, 2017; Byrne et al., 2018). The latest data from the Eurobarometer, showed that for adults the main reasons for trying e-cigarettes was the intention to quit or reduce smoking and the perceive that e-cigarettes are less harmful than other conventional tobacco as cigarettes, smokeless tobacco, and cigars, (European Commission, 2017). On the other hand, adolescents perceive e-cigarettes to have generally lower harm, but they experiment e-cigarettes firstly by curiosity, not guided by the desire to exclude another risk as it is the consumption of tobacco (Byrne et al., 2018). Studies from United Kingdom (UK) and Scotland, Switzerland, Sweden and Romania also reported curiosity as an important factor influencing e-cigarette use (McKeganey, Barnard, & Russell, 2018; Frauenfelder, 2016; Surís et al., 2015, Lotrean et al., 2016).

d. External factors

It is well known that, for adolescents, the behaviour and social norms of the family (parents, grandparents, siblings), school colleagues or friends have a great influence on the short- or long-term habits. This has also been remarked in the habit of using cigarettes and, in past years, e-cigarettes.

A study from in Finland showed that 33.2% of the adolescents with both parents smoking stated that they have ever used e-cigarettes, followed by the adolescents with mother smokers (31.4%) and father smokers (28.4%), while only 18.6% of the adolescents with neither of the parents smoking have ever tried e-cigarettes (Kinnunen et al., 2015). Goniewicz et al., after analyzing the behaviour concerning e-cigarettes among adolescents and young adults (15-24 years) from Poland, observed that the use of e-cigarettes (ever or during the last 30 days) is higher (26.4 and 10%, respectively) if one parent is smoking, comparing with the group of no-smoking parents (16.9 and 4.5%, respectively) (Goniewicz & Zielinska-Danch, 2012).

The influence coming from family and peers with regard to e-cigarettes was also assessed in Romania. More than 60% of the Romanian high school students aged 16-18 affirmed that their friends have tried e-cigarettes, while 45% of them stated that people from the same school year have tried e-cigarettes.

On the other hand, 7% of them declared that their parents use e-cigarettes and around 9% admitted that their siblings do so. Among smokers, e-cigarette experimentation was associated with having parents using e-cigarettes, while ex-smokers and never-smokers were more likely to experiment e-cigarette if they had friends using e-cigarette (Lotrean et al., 2016).

Media and marketing (including television, radio, internet, social groups, newspapers, magazines) are commercial strategies with powerful visual impact, particularly for young people. Beside friends, Internet is an important source of information about e-cigarettes for adolescents (Lotrean et al., 2016; Kinnunen et al., 2015). A Finish study showed that during the previous month, 10.5% of adolescents aged 12 to 18 had seen e-cigarette advertisements; out of these 21.8% had seen them on Facebook, 41.4% on other internet pages, 14.7% in shops, 7.4% in magazines or on television, 4.9% in the street and 7.1% elsewhere (Kinnunen et al., 2015). At the same time, the easy access of adolescents to purchase these products might influence their behaviour, but limited information is available with regard to these issues.

7. Conclusion

There are several variations with regard to prevalence and factors which influence the use of e-cigarettes between countries as well as within the same country based on socio-demographics characteristics of the groups involved in the study as well as the year when the survey was performed, the methodology and instruments for data collection. The results underline the need for future research in this field, as well as for educational and policy measures to face this new public health challenge.

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