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RESEARCH ARTICLE

Knowledge and Attitudes toward Electronic Cigarette Smoking: A Survey of School Male Adolescents in Jordan

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Abstract:

Background:

The prevalence of e-cigarette use among adolescents is on the rise worldwide and in the Arab region as well. Youth are amongst the different age groups who are mostly affected by this practice.

Objective:

The purpose of this study was to assess the knowledge and attitudes of Jordanian adolescent students toward e-cigarettes.

Methods:

A cross-sectional study was conducted using a convenience sample of 500 male school students. A self-reported questionnaire was distributed to the students electronically through social media platforms. T-test was used to identify differences in adolescents' knowledge and attitudes based on their use and non-use of e-cigarettes.

Results and Discussion:

The results revealed that 35% of participants reported trying e-cigarettes and 43% reported trying tobacco cigarettes. The vast majority (97.2%) of the participants had heard about e-cigarettes, while 63% were not aware of their components. The majority of participants agreed that e-cigarette is dangerous (89.2%), is cleaner than tobacco smoking (55.6%), and that use of e-cigarettes can help to quit tobacco smoking (61.4%). Furthermore, the students who used tobacco and e-cigarettes had a significantly higher mean score of knowledge ($p< .001$) and a lower mean score of attitudes toward e-cigarettes ($p< .001$) than those who did not.

Conclusion:

there is still a need to increase accurate knowledge about e-cigarettes among youth, with special emphasis on adolescents. Health awareness campaigns about e-cigarettes, including their composition and side effects, are highly recommended.

Keywords: Electronic cigarettes, Smoking, Attitudes, Knowledge, Adolescents, Tobacco.

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1. INTRODUCTION

Smoking is considered one of principal causes of preventable diseases, disability, and death all over the world [1]. Tobacco contributed to 8 million deaths globally in 2017. Approximately, 80% of these deaths occur in low and middle -income countries [2]. According to the World Health Organization (WHO, 2022), 1.3 billion adults worldwide smoke tobacco, accounting for 22.3% of the global population. 36.7% of the world's men and 7.8% of the world's women smoke tobacco. Although the trend of tobacco smoking is decreasing all over the world, it is still increasing in most countries of the Eastern Mediterranean Region [3]. It was reported that 60% of smokers worldwide want or intend to quit. Many of them believe in electronic cigarettes (e-cigarettes) as

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an efficient method to quit smoking. Nevertheless, there is no strong evidence until now about the role of e-cigarettes in helping to quit smoking, as most people use them with one or more tobacco products [4].

There are many types of smoking products used worldwide by smokers. These types include cigars, pipe smoking, hookah, and e-cigarettes. Currently, there is conflicting evidence comparing those products and their effects on health in terms of mortality and morbidity rates [5]. E-cigarettes consist of a battery, an electrical heater, and an aerosolized liquid for the user to inhale [6]. There are many types of e-cigarettes in use, such as vapes, e-hookahs, vape pens, tank systems, and mods. These types of e-cigarettes are also known as Electronic Nicotine Delivery Systems (ENDS). These ENDS include varying amounts of nicotine and harmful emissions [4].

Most adolescents believe that e-cigarettes, regardless of their flavor, are less harmful than tobacco. However, around one in five adolescents were unsure whether e-cigarettes contain nicotine [7]. Till recently, there is still no solid evidence that e-cigarettes are safer than tobacco cigarettes or whether e-cigarettes help in smoking cessation [8]. Most adolescents declared that they became motivated to use e-cigarettes because of their peer influence. They also believed that e-cigarettes are less harmful than usual tobacco cigarette smoking. However, they also admitted that e-cigarette is not risk-free [9]. There are many risk factors associated with the increased susceptibility to use e-cigarettes among adolescents. Such factors include family influence, substance use, sensation seeking, transition to high school, and exposure to social media [10, 11].

As many adolescents perceive that e-cigarettes are safer than tobacco cigarettes and help in quitting smoking, their prevalence has increased. For example, a repeated cross-sectional online survey was conducted in the United States, Canada, and England between 2017 and 2019 to assess changes in the prevalence of using e-cigarettes among adolescents. Results of the survey revealed that the prevalence increased within all three countries (*i.e.*, from 2.2% to 6.7% in the United States; 1.8% to 5.7% in Canada, and 1.5% to 2.7% in England) [12]. Furthermore, a cross-sectional study was conducted in Italy using the Global Youth Tobacco Survey (GYTS) among male and female adolescents aged between 13 and 15 years. The prevalence of tobacco smoking and e-cigarette smoking was estimated for the years of 2010, 2014, and 2018. The results showed that the prevalence of dual users increased from 20.7% in 2010 to 27.9% in 2018. While current smokers were around 20%, current e-cigarette smokers remarkably increased from 0% in 2010 to 7.4% in 2014, and further increased to 17.5% in 2018. In addition, the current exclusive e-cigarette smokers reported around a 3-fold significant increase from 2.9% in 2014 to 8.2% in 2018 [13].

In the same context but in the Arab world, a cross-sectional study was conducted in Saudi Arabia to assess the prevalence of e-cigarettes compared to tobacco cigarettes. A self-administered online questionnaire was distributed to 3000 students in different medical colleges at three different universities. A sample of 1007 students completed the electronic survey. The results revealed that 14.1% of the participants were tobacco cigarette users and 27.7% were e-cigarette users. Also, 42.7% of e-cigarette users used it as an alternative to quitting smoking [14]. In Jordan, a cross-sectional study targeted 1819 medical students to assess the prevalence and perceptions of e-cigarettes through a self-administered questionnaire. The results showed that most medical students (86%) were aware of the use of e-cigarettes and they reported that their use is less harmful and helpful in quitting smoking. Besides, 9.5% of all students (29% of all smoker students) were using e-cigarettes combined with another type of smoking [15].

In order to change the behavior of adolescents toward e-cigarettes, their level of knowledge and attitudes toward them should be assessed. For this purpose, a cross-sectional study was conducted in the USA among 69 adolescents aged between 14 and 18 years. The result showed that 47% of adolescents were ever-users of e-cigarettes. Compared to never-users, e-cigarette ever-users were significantly less likely to believe that e-cigarettes may lead to adverse health consequences and to believe that e-cigarette use may lead to addiction. Furthermore, participants who had smoked tobacco cigarettes ever were four times more likely to ever use e-cigarettes ($p < 0.05$) [16]. On the other hand, a series of focus group sessions with youths aged 12–17 years in Canada were formulated to assess their knowledge and perception toward e-cigarettes. The result revealed that most of the adolescents were willing to use e-cigarettes under their peer influence. They also perceived e-cigarettes as less harmful and easier to access and use than tobacco cigarettes [9].

In Jordan, the reported rates of e-cigarette smoking have noticeably increased [15]. Therefore, this study was conducted to assess the knowledge and attitudes of Jordanian adolescent students (15–19 years) toward e-cigarette smoking.

The study aims to answer the following research questions:

1. What are the levels of knowledge and attitudes of Jordanian adolescent students (15–19 years) toward e-cigarette smoking?

2. Is there a significant difference between Jordanian adolescent students who smoke (tobacco or e-cigarettes) and those who do not smoke regarding knowledge and attitude toward e-cigarettes?

1.1. Study Significance

The use of e-cigarettes is unsafe for children, teens, and young adults. Most e-cigarettes contain nicotine in the ingredients. Nicotine is highly addictive and can harm smokers by affecting many of their body systems. Additionally, e-cigarettes contain other harmful substances besides nicotine, such as ultrafine particles, volatile organic compounds, cancer-causing chemicals, flavoring chemicals, and heavy metals (*i.e.*, nickel, tin, and lead) [17]. Many researchers have focused on investigating the prevalence of e-cigarette use and the associated factors relevant to its use [12, 13, 15]. However, only a few researchers have investigated the knowledge and attitudes toward e-cigarettes, especially among adolescents.

In Jordan, no studies were found focusing on assessing the knowledge and attitudes of school-aged students toward e-

cigarettes. The results of this study will provide us with important information about the level of knowledge and attitudes of adolescents toward e-cigarettes. Besides, the results will also provide policymakers and healthcare providers with the required data to develop health-promotion strategies and programs through multi-component interventions.

2. METHODS

2.1. Study Design and Setting

A descriptive cross-sectional, correlational design was used. Where the data was collected at one specific point in time. The study was conducted in the schools of 6 different governorates in the North and Center of Jordan (Irbid, Amman, Ajloun, Alzarqaa, Almafraq, and Madaba). In Jordan, there are approximately 7,434 schools with a total number of students of more than 2 million; 52% of them are in public schools [18].

2.2. Population and Sample

The target population was all male adolescent students in Jordan's tenth, eleventh, and twelfth grades. The accessible population was all male adolescent students from tenth to twelfth grades who were available on social media platforms and official online websites of convenient private and public schools in the Northern and Central parts of Jordan.

A convenience sampling method was used to select the study participants. The sample size was calculated using Pass software (2021). Using a conventional power estimate of 0.80, alpha of 0.05, and a small effect size, it was estimated that for the t-test (two sides), with a 20% dropout, a round figure of 484 students needed to be approached. The sample was expanded to 500 students. The inclusion criteria consisted of all Jordanian students who were in the 10th, 11th, or 12th grades, and mentally and physically able to fill out the questionnaire.

2.3. Ethical Considerations

Before starting this research study, ethical approval was obtained by the Institutional Review Board (IRB) of the primary investigator's university. Permission was also obtained from the Ministry of Education to distribute the questionnaire to the teachers and administrators of the selected schools (who, in turn disseminated the link of the questionnaire to their students). The consent form was distributed to the students and included information that assures anonymity, confidentiality, voluntary participation, and the right to withdraw from this study at any time. The students were asked in the consent form to gain approval from their parents before completing the questionnaire. It was also explained on the consent form that if a student answered the questionnaire, it indicated an implicit assent to participate in the study.

2.4. Data Collection

The questionnaire was distributed to the students using several steps. First, the school administrators were approached to explain the study's purpose and gain their approval to disseminate the questionnaire to the students in their schools. Then, the teachers and administrators of the schools were contacted and provided with the link to the study questionnaire that was supposed to be distributed through the online groups that the students used for education at the convenient schools. Additionally, the questionnaire was distributed by the teachers and administrators through social media platforms such as Facebook, Telegram, and WhatsApp Application which included students belonging to the target age group. The time required to fill the questionnaire was approximately 10 minutes, and the email of the researcher was placed on the consent form in case any of the students had any questions or asked for clarifications. The period of data collection was between February and March (2021).

2.5. Instrument

Knowledge and attitudes of adolescent students toward e-cigarettes were assessed using an instrument adopted from the study conducted by Shaikh *et al*. (2017) with some modifications to suit the study objectives [19]. The final version of the instrument after modification contained four parts with a total of 34 questions. The first part of the study questionnaire contained seven questions about the demographic data of the students (age, educational level of the parents, family income, smoking status of the parents, and type of school). The second part of the questionnaire included 9 questions regarding knowledge about e-cigarettes. Out of the 9 questions, 6 questions contained "yes" or "no" answer options, and 3 of the questions were supposed to be answered only if some of the answers were "yes". Examples of the knowledge questions include if the students heard about e-cigarettes, the sources of knowledge regarding e-cigarettes, the ingredients in e-cigarettes, and the level of nicotine in e-cigarettes. The maximum score for the knowledge section was 6 and the minimum was zero.

The third part of this questionnaire included 10 questions assessing the students' attitudes toward e-cigarettes. The attitudes section included questions regarding e-cigarette safety, harm comparison between e-cigarettes and tobacco cigarettes, addiction associated with e-cigarettes, and if e-cigarettes help in quitting smoking. Items of the attitudes were rated from 1 to 5 on a 5-points Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree). Items numbered 3, 8, and 9 were reversed. The scores for this section ranged between 10 and 50. Finally, the fourth part included 8 questions about smoking status and mainly focused on the current or past use of e-cigarettes or tobacco smoking. Current e-cigarette users were described as students who had used e-cigarettes once or more in the past 30 days, and ever-user students who had tried e-cigarettes (even one or two puffs) but not in the past 30 days [19].

Permission to use this instrument was granted by the authors. The instrument was developed in English. Therefore, it was translated to Arabic o and then back-translated to English by a professional translator. The content validity was checked by a panel of experts from the Faculty of Nursing at the primary investigator's university. The Cronbach's Alpha was examined to check internal consistency and it was 0.74 for the entire instrument.

2.6. Data Analysis

Statistical Package for Social Sciences (SPSS version 22) was used to analyze the data. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to analyze the demographic data and describe the main study variables. An independent samples t-test was used to test the difference between adolescent students who smoke (tobacco or e-cigarettes) and those who did not smoke in terms of knowledge and attitude toward e-cigarettes.

3. RESULTS

Around 750 eligible students from the 10^{th} to 12^{th} class in the assigned governorates were available at the time of data collection. Around six hundred questionnaires were distributed. Five hundred questionnaires were returned for those who agreed to participate. There were no missing data as the online questionnaire was designed to reject the incomplete submission. There were no missing data as the Ages of the participants ranged between 15 and 19 years (mean = 16.76, SD = 1.17). Most of the participants were in governmental schools (n=440, 88%) and 12^{th} graders (n = 259; 51.8%). The level of education for mothers and fathers was reported to be more than high school by 45% of the students. Also, 56.6% of the students reported that the monthly income of their families was less than 500 Jordanian Dinar (JD) as shown in Table **1**.

Regarding the smoking status of the participants, results revealed that 43% of the participants tried tobacco smoking and 35% tried e-cigarettes. Also, 14% of the participants were current tobacco smokers, while 7.6% were current e-cigarette users. Among those who smoked e-cigarettes, 4.0% used e-cigarettes for less than one year and 4.4% used e-cigarettes less than five times a day as shown in Table **2**.

Table 1. Socio-demographic characteristics of the study sample (N=500).

Variable	Frequencies (n)	Percentages (%)
Class		
10^{th}	134	26.8%
11^{th}	107	21.4%
12^{th}	259	51.8%
***Income**		
Less than 500 JD	283	56.6%
500-1000 JD	169	33.8%
More than 1000 JD	48	9.6%
Father level of education		
High school or less	275	55.0%
More than high school	225	45.0%
Mother level of education		
High school or less	272	54.4%
More than high school	228	45.6%
Type of school		
Private	60	12.0%
Governmental	440	88.0%

*Note: JD is Jordanian Dinar (1 JD = $ .71).

Table 2. Smoking Status of the Participants (N= 500).

Item	Category	N (%)
1) Are you surrounded by people using e-cigarettes?	Yes No	257 (51.4%) 243 (48.6%)
2) How many smokers in your family?	Zero 1 2 3 or more	138 (27.6%) 179 (35.8%) 109 (21.8%) 74 (14.8%)
3) Have you ever tried tobacco smoking?	Yes No	215 (43.0%) 285 (57.0%)
4) Have you ever tried e-cigarettes?	Yes No	175 (35.0%) 325 (65.0%)
5) Are you currently using tobacco smoking? (Even one or two puffs).	Yes No	70 (14.0%) 430 (86.0%)
6) Are you currently using e-cigarettes? (Smoked in the past 30 days).	Yes No	38 (7.6%) 462 (92.4%)
7) Those who use e-cigarettes, how many times they used it daily?	5 times or less 6-10 times More than 10 times	22 (4.4%) 10 (2.0%) 6 (1.2%)

(Table 2) contd.....

Item	Category	N (%)
8) Those who use e-cigarettes, for how long they use it?	Less than 1 year 2 years More than 3 years	20 (4.0%) 14 (2.8%) 4 (0.8%)

3.1. Knowledge of Participants toward Electronic Cigarettes

The results showed that the mean total knowledge score of study participants was 3.34 out of 6 (SD = 1.36). Most of the participants (97.2%) heard about e-cigarettes (62.6% from friends, 59% from the internet, 30.4% from family, 27.2% from television, 7% from newspapers, and 5.4% from magazines). In addition, 75.4% of the participants viewed advertisements about e-cigarettes on social media (71% on Facebook, 24.8% on Instagram, 5.6% on Snapchat and Twitter, and 19.6% from other social media platforms) by some actors (n = 209, 41.8%). Generally, students had limited knowledge about various ingredients and chemicals present in e-cigarettes, nicotine levels in e-cigarettes, and the amount of nicotine they inhale while smoking e-cigarettes compared to tobacco smoking as shown in Table **3**.

3.2. Attitudes of Participants toward Electronic Cigarettes

The results revealed that the mean total attitude score of study participants was 34.34 out of 50 (SD = 4.99). For example, 89.2% of the study participants agreed/strongly agreed that all tobacco products are dangerous and 38.2% reported that smoking e-cigarettes results in harming smokers. More than half of the participants (55.6%) agreed/ strongly agreed that using e-cigarettes is cleaner than tobacco smoking. The majority of the participants (61%) agreed/strongly agreed that raising taxes on e-cigarettes was a good idea and 69.2% of them agreed/strongly agreed that selling e-cigarettes only to people aged 21 and over should be regulated by government agencies. Furthermore, 61.4% of the participants agreed/ strongly agreed that using e-cigarettes helps people to quit smoking tobacco cigarettes because e-cigarettes are less addictive than tobacco smoking, as reported by 25% of the participants as shown in Table **4**.

3.3. The Relationship between Smoking Status of Participants and their Scores of Knowledge and Attitudes

Results of the independent samples t-test used to identify significant differences between adolescent students who used tobacco cigarettes or e-cigarettes and those who did not in terms of knowledge and attitude toward e-cigarettes showed that the students who used tobacco smoking had a significantly higher mean score of knowledge (mean = 3.67, SD = 1.42) compared to students who did not use tobacco smoking (mean = 3.29, SD = 1.35) (t (496) = 2.004, p = .046). In addition, students who used e-cigarettes had a significantly higher mean score of knowledge (mean = 4.18, SD = 1.31) compared to students who did not use e-cigarettes (mean = 3.27, SD= 1.34) (t (496) = 4.030, $p < .0001$).

Regarding differences in the mean scores of attitudes, the results showed that students who did not use tobacco cigarettes had a significantly higher mean score of attitudes toward e-cigarettes (mean = 34.72, SD = 4.92) compared to the ones who used tobacco cigarettes (mean = 31.97, SD = 4.76) (t (498) = - 4.359, $p < .0001$). In addition, students who did not use e-cigarettes had a significantly higher mean score of attitudes (mean = 34.68, SD = 4.87) toward e-cigarettes compared to those who used e-cigarettes (mean = 30.13, SD = 4.44) (t (498) = - 5.571, p < .0001). See Table **5** for the details.

4. DISCUSSION

This study aimed to assess the knowledge of Jordanian adolescent students about e-cigarette smoking. The results revealed an adequate overall knowledge score about e-cigarettes. For example, over 95% of the study participants heard about e-cigarettes. The sources of e-cigarettes' knowledge varied as well. This finding was congruent with the related research findings of Jordanian studies. Results of related studies in Jordan showed that 75% to 85% of college students heard and knew about e-cigarettes [15, 20]. In terms of sources of knowledge about e-cigarettes, studies carried out in different countries revealed that adolescents knew about e-cigarettes from friends and family [21, 22]. Social media and the internet were also influential in advertising e-cigarettes and it was evident in similar studies [19, 21, 22]. The feasibility of the internet and social media for adolescents in different cities and villages played an important role in advertising e-cigarettes in a way that may exceed the contribution of family and friends in this regard. Besides, social media and internet have unlimited boundaries in influencing adolescents' knowledge and even attitudes because there are no rules governing the content that is shared and disseminated on these platforms.

Table 3. Knowledge of participants toward electronic cigarettes (N=500).

Item	Frequencies (N)		Percentages (%)
1) Did you hear about e-cigarettes?	Yes No	486 14	97.2% 2.8%
2) Did you see any advertisement about e-cigarettes on social media?	Yes No	377 123	75.4% 24.6%
3) Did you see any actor Poromte to use e- cigarettes?	Yes No	209 291	41.8% 58.2%
4) Did you know about the various ingredients and chemicals in e-cigarette?	Yes No	186 314	37.2% 62.8%

(Table 3) contd.....

Item	Frequencies (N)		Percentages (%)
1) Did you hear about e-cigarettes?	Yes No	486 14	97.2% 2.8%
5) Did you know the different levels of nicotine in e-cigarettes?	Yes No	168 332	33.6% 66.4%
6) When using e-cigarettes, you get less nicotine than using tobacco?	Yes No	246 254	49.2% 50.8%

Table 4. Attitudes of participants toward electronic cigarettes (N=500).

Item	Strongly Agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly Disagree N (%)
1) People harm themselves when smoking e-cigarettes	191 38.2%	0 0.0%	121 24.2%	142 28.4%	46 9.2%
2) All tobacco products are dangerous	340 68.0%	106 21.2%	41 8.2%	10 2.0%	3 0.6%
3) Smoking e-cigarettes makes young people ‘fit in’, feel ‘cool’ and more socially acceptable	62 12.4%	87 17.4%	75 15.0%	119 23.8%	157 31.4%
4) Using e-cigarettes feels cleaner than tobacco smoking	133 26.6%	145 29.0%	111 22.2%	65 13.0%	46 9.2%
5) If e-cigarettes are more expensive, they are less likely to be used by teenagers.	164 32.8%	149 29.8%	92 18.4%	61 12.2%	34 6.8%
6) Raising taxes on e-cigarette is a good idea	200 40.0%	105 21.0%	87 17.4%	62 12.4%	46 9.2%
7) It should be regulated by government agencies to sell the e-cigarette only to people aged 21 and over	236 47.2%	110 22.0%	77 15.4%	55 11.0%	22 4.4%
8) E-cigarettes should be allowed in indoor spaces	76 15.2%	69 13.8%	112 22.4%	114 22.8%	129 25.8%
9) E-cigarettes help people to quit smoking tobacco cigarettes	57 11.4%	250 50.0%	0 0.0%	85 17.0%	108 21.6%
10) E-cigarette is less addictive than Tobacco smoking.	124 24.8%	1 0.2%	194 38.8%	0 0.0%	181 36.2%

Table 5. Independent sample t-test between smokers and nonsmokers in terms of the total scores of knowledge and attitudes.

		Mean (SD)	t-test	DF	Mean Difference	P
Knowledge						
Tobacco cigarettes	Use	3.67 (1.42)	2.004	4968	0.351	0.046
	No use	3.29 (1.35)				
E-cigarettes	Use	4.18 (1.31)	4.030	498	0.912	0.0001
	No use	3.27 (1.34)				
Attitudes						
Tobacco cigarettes	Use	31.97 (4.76)	-4.359	498	-2.752	0.0001
	No use	34.72 (4.92)				
E-cigarettes	Use	30.13 (4.44)	-5.571	498	-4.552	0.0001
	No use	34.68 (4.87)				

In the current study, over 60% of the participants reported that they did not know about the various ingredients and chemicals or the different levels of nicotine present in e-cigarettes. These results are in correspondence with the studies carried out in Karachi and India, which revealed that 56% and 62% of adolescents were not aware of the composition of e-cigarettes, respectively [19, 23]. Lack of knowledge regarding the ingredients of e-cigarettes symbolizes the nature of adolescents who pay attention to the context rather than the core of issues. In other words, adolescents are taken by the behavior of e-cigarette smoking as they may feel mature and find their identity through smoking. In the meantime, they do not pay the least amount of attention to the core of that behavior in terms of identifying the ingredients of e-cigarettes and the subsequent risks associated with e-cigarette smoking. The influence of social media and advertising also fosters this point wherein adolescents may imitate idols they follow on social media without paying attention to the details behind

those selected behaviors.

This study also aimed to assess the attitudes of Jordanian adolescent students toward e-cigarette smoking. The results revealed an overall positive attitudes score among the study participants. Over half of the participants agreed that using e-cigarettes is cleaner than tobacco smoking. In this regard, Gorukanti *et al*. (2017) indicated in their study in the USA that approximately 44% of participants believed that e-cigarettes are cleaner and safer than smoking cigarettes [24]. In addition, a study among some adults in Jordan showed that around one-third of the participants who were current e-cigarette users reported that it is a safer alternative to tobacco smoking [21]. Our study also showed that the majority of the participants (over 60%) agreed that raising taxes on e-cigarettes is a good idea and that they should be regulated by government agencies. If e-cigarettes are more expensive, they are less likely to be used by teenagers. This finding may represent a positive attitude for our participants. Their belief that raising taxes would be a good idea may reflect their intention to quit smoking, as raising prices and taxes would trigger it. Gorukanti *et al*. (2017) also found that almost 76% of adolescents believed raising e-cigarette and cigarette taxes was a good idea. Over 60% agreed that the age of buying e-cigarettes and cigarettes should be raised, and if they were more expensive, teenagers would be less likely to use them [24]. Based on the current and previous evidence, it is essential to involve government agencies to regulate the use of e-cigarettes, especially at work, schools, and public places, and raise taxes that may reduce the affordability of e-cigarettes among teenagers and young adults.

Our study results revealed that over 60% of the participants agreed that using e-cigarettes helps people to quit smoking tobacco cigarettes. Similarly, the results of previous studies in Saudi Arabia and Pakistan showed that over 40% of the participants used e-cigarettes as a method to quit tobacco smoking [14, 19]. Using e-cigarettes to quit smoking was justified by the findings of another cross-sectional study conducted among Jordanian medical students. Results of the study showed that smokers and non-smokers perceived e-cigarettes as less harmful than tobacco cigarettes and helpful in quitting smoking [15]. However, this finding should be stressed through smoking cessation interventions where proper and healthy ways to quit smoking are addressed in a scientific and logical way.

It was revealed in the current study that over 40% of the participants tried tobacco smoking and over 30% tried e-cigarettes. However, only 14% of the participants reported being current tobacco smokers and 7.6% reported being current e-cigarette users. Various prevalence rates of tobacco and e-cigarette smoking were revealed by participants of different studies. A study conducted in seven countries in Europe revealed that about 34% of adolescents had tried e-cigarettes and 37% had tried tobacco cigarettes. While 4% reported weekly use of e-cigarettes, 7% reported weekly tobacco smoking [25]. In contrast, a cross-sectional study among Saudi college students revealed that 14.1% were tobacco cigarette smokers, while 27.7% were e-cigarette users (Qanash *et al*., 2019). Also, a study in Jordan among medical students showed that around 10% of all the participants reported using e-cigarettes combined with another type of smoking [15]. The variation in prevalence rates of smoking in these studies might be due to the different cultures and socio-economic statuses in the different regions in addition to the differences between college and school students in terms of age and intellect.

This study aimed to identify differences in adolescents' knowledge and attitudes based on their use and non-use of e-cigarettes. The results of our study showed that the students who reported using tobacco smoking and e-cigarettes had a significantly higher mean score of knowledge, but a lower mean score of attitudes compared to students who did not report using tobacco and e-cigarettes smoking. In this regard, a cross-sectional study in Pakistan among post-graduate medical trainees showed that there was a significant correlation between being a current smoker and possessing a higher amount of knowledge regarding e-cigarettes [26]. However, our results contradicted the ones found by Chudech and Janmaimool (2021) in Thailand wherein they found that the university students who were using e-cigarettes reported less knowledge, but a higher positive attitude toward e-cigarettes than those who were not using them. This contradiction might be due to the reason that university students are more mature than school students and have enough knowledge about the harmful effects of e-cigarettes. Thereafter, they are less likely to use e-cigarettes [27]. These results denote the importance of initiating health education for adolescents regarding all types of smoking early on in schools to enhance their knowledge and attitudes; a strategy that may reduce the chances of being a smoker during adulthood.

4.1. Study Implications and Recommendations

School nurses have a unique and important relationship with the students so that they can play a major role as educators. School health nurses can cooperate with primary care physicians and health professionals to provide educational and health promotion programs for teachers, counselors, parents, and students concerning e-cigarettes in terms of their harmful effects on health, long-term consequences, ingredients, levels of nicotine, addiction properties, and treatment options. The school nurses should also implement early and appropriate intervention for those students who already use e-cigarettes by applying the latest evidence and the most effective methods to quit using e-cigarettes. Finally, a school nurse can also influence the school policies by suggesting strategies suitable for schools to prohibit using e-cigarettes in schools and increase supervision of students [28, 29].

This study added to the body of knowledge about e-cigarettes as this is the first study in Jordan to be conducted among school-aged adolescents. However, there were several limitations associated with this study. First, the study was cross-sectional in nature, so causality cannot be assumed. Second, the study used a questionnaire to measure study variables which may lead to reporting bias. Finally, the current study utilized a convenience sample of Jordanian adolescents, which limits the generalizability of our results. Thus, to enhance the generalizability of the findings, it is preferable to use a different study design, such as a longitudinal cohort study, to investigate whether the association is causal in nature and to use a random sample across the country.

CONCLUSION

This study was among the first to assess the knowledge and attitude of adolescents in schools toward e-cigarettes. The results suggest that participants have an adequate overall level of knowledge and a positive attitude toward e-cigarettes. However, there is still a need for regular health promotion programs targeting school students. Nurses, teachers, health care providers, parents, and policymakers should work together to increase the awareness and knowledge of adolescents about the components of e-cigarettes, their harmful effects, addiction properties, and how to quit all types of smoking.

LIST OF ABBREVIATIONS

WHO	=	World Health Organization
CDC	=	Centers for Disease Control and Prevention
ENDS	=	Electronic Nicotine Delivery Systems
e-cigarettes	=	Electronic Cigarettes

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Institution Review Board (IRB) at Jordan University of Science and Technology (reference #: 217/132/2020).

HUMAN AND ANIMAL RIGHTS

No animals were used that are the basis of this study. All the human procedures were performed in a accordance with Helsinki Declaration.

CONSENT FOR PUBLICATION

The consent form was distributed to the students and included information that assures anonymity, confidentiality, voluntary participation, and the right to withdraw from this study at any time. The students were asked in the consent form to gain approval from their parents before completing the questionnaire. It was also explained on the consent form that if a student answered the questionnaire, it indicated an implicit consent to participate in the study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is not available as it is confidential.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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