Volume 06, Issue 06 (November-December 2023), PP 142-152 **www.ijmsdr.org**
ISSN: 2581-902X

International Journal of Medical Science and Dental Research

The efficacy of electronic cigarettes as a smoking cessation tool among medical students

Ameerah Omar Almutairi, Ghassan Saud Abdulaziz Alsmail, Mohammed Sultan Muathid Alotaibi, Wedad Hamdan Godhaian Alshammari, Ahmed Saed Hazzazy, Muneerah Mubarak Alotaibi, Najwa Saud Alonazi, Reem Miqad Almanie, Ali Ahmed Moied AlWadei, Misfer Ahmed Moied AlWadei, Mohammad Ali Sariei Alqahtani, Majed Ahmed Saad Alqahtani, Abdul Rahman Ibrahim Abdul Rahman Al Faza

Corresponding Author: *Ameerah Omar Almutairi*
Ministry of Health, Saudi Arabia

ABSTRACT: *Background:* Several studies have been conducted to assess the efficacy of E-cigarettes in facilitating smoking cessation and to determine their safety and viability as a substitute for conventional tobacco cigarettes. The evaluation of the product necessitates a substantial investment in research in order to conduct a thorough analysis of its usage prevalence, encompassing both its application as a means of smoking cessation and its adoption as a habitual smoking practice. *Methods:* The present cross-sectional study was carried out in the early months of 2022 at the Faculty of Medicine, King Abdulaziz University. The research encompassed a total of 263 participants, who were students. The researchers in the prior study implemented and verified the use of a standardized and anonymous questionnaire. The idea was evaluated and tested using statistical analysis conducted with "IBM SPSS Statistics version 20.0." *Results:* The research encompassed a sample of 263 pupils, with 60.9% identified as male and 39.1% identified as female. Out of a total of 133 students, it was found that 49 of them were former smokers, while the remaining 86 were now smoking. In terms of the smoking type employed, it was found that 23 individuals (17.3%) utilized tobacco cigarettes, while 90 individuals (67.7%) engaged in the usage of E-cigarettes/vape. Additionally, 20 individuals (15%) reported the use of other forms of tobacco products. A total of 36.1% of individuals who smoke employ electronic cigarettes (e-cigarettes) as a means to cease tobacco consumption. A statistically significant correlation was observed between the regular use of E-cigarettes/vape and the marital status and academic year of the subjects ($P< 0.05$). *Conclusion:* The present study has determined that the utilization of electronic cigarettes (e-cigarettes) or vaping serves as a contributing factor in the cessation of smoking among a cohort of medical students who successfully quit smoking through its implementation. Furthermore, it is regarded as a transitional tool for those seeking to reduce their overall tobacco intake.

Keywords: E-cigarettes, vape, smoking cessation, medical students, smoking

I. INTRODUCTION

Tobacco, a plant belonging to the Nicotiana genus, has been widely utilized Smoking poses a significant risk to one's health. The cardiovascular and respiratory systems are significantly impacted by many diseases, resulting in increased morbidity and death rates (Jayes et al., 2016; Morris et al., 2015). Additionally, other bodily systems

are also affected by these disorders (Khani et al., 2018). According to the World Health Organization (2000), it is estimated that there are approximately 1.1 billion smokers worldwide. The health ramifications of tobacco smoking are widely recognized on an annual basis, with an approximate estimation of 7 million premature deaths attributed to smoking-related illnesses. According to data from the World Health Organization (WHO), the prevalence of smoking among teenagers in the Kingdom of Saudi Arabia in 2016 was reported to be 21.2% among men and 9.1% among females. The prevalence of smoking among adults in Saudi Arabia was found to be 23.7% for males and 1.5% for females. Alkhalaf et al. (2021) reported a prevalence of smoking among medical students at 12.4%, while passive smoking was found to be frequent among the entire medical student population at 39.9%. The study findings indicate that there was a prevalence of active smoking among male medical students at a rate of 18.6%, while female medical students exhibited a lower prevalence of 5.9%. In relation to the variety of tobacco, Alkhalaf et al. (2021) disclosed that 47% of male smokers reported using hookah, whereas the prevalence of hookah use among female smokers was found to be 77.8%.

The electronic cigarette, often known as an e-cigarette or vape, is a tobacco product that does not involve combustion. It typically consists of nicotine, propylene glycol, flavors, and vegetable glycerin (Gotts et al., 2019). The vaping sector has experienced significant growth and is increasingly appealing to individuals who currently smoke, have previously smoked, and young individuals who have never engaged in smoking behavior (Gotts et al., 2019). E-cigarettes were introduced to the market without undergoing comprehensive preclinical toxicity assessments or long-term safety evaluations, which are often mandated for conventional medicines or medical devices (Gotts et al., 2019). The efficacy of e-cigarettes as aids for smoking cessation, their effects on population health, and their safety in comparison to conventional tobacco products such as cigarettes and hookahs remain uncertain (Gotts et al., 2019).

The Polosa et al. (2014) study observed a rise in the prevalence of e-cigarette usage throughout the 2017-2018 period. This increase had an impact on three indicators of cigarette cessation between 2009 and 2018, namely quit attempts, recent cessation, and quit ratio. According to the findings of a clinical experiment conducted by Adriaens et al. (2014) and Polosa et al. (2014), pen-like E-cigarettes demonstrated a significant cessation rate of 36% within a six-month period. A study conducted by Polosa et al. (2015) examined a sample of 71 frequent smokers (44 males, 27 females) who transitioned from conventional cigarettes to electronic cigarettes (e-cigarettes) with the intention of quitting smoking. After a period of 12 months, the results indicated that 40.8% of participants were categorized as successful in achieving smoking cessation, 25.4% were classified as individuals who reduced their smoking habits, and 33.8% were classified as those who did not succeed in quitting smoking. Several studies have been conducted in the existing body of literature to assess the efficacy of E-cigarettes in facilitating smoking cessation. However, no study has been identified that examines the association between E-cigarette use and smoking cessation specifically among medical students at King Abdulaziz University.

Additionally, a noteworthy surge in the utilization of E-cigarettes has been observed among medical students enrolled at King Abdulaziz University. This necessitates a thorough examination of this phenomenon to ascertain whether it serves as a means to quit conventional cigarette smoking or merely as a substitute for it. The major aim of this study was to assess the efficacy of e-cigarettes as a smoking cessation tool. Additionally, the study sought to determine the prevalence of e-cigarette use among medical students at King Abdulaziz University in Jeddah, Saudi Arabia.

II. METHODS

Study design and Study setting

The present cross-sectional study was undertaken in the faculty of medicine of King Abdulaziz University (KAU) between the months of January and November 2022. The study gained ethical approval from the Institutional Review Board (IRB) of KAU, with the assigned number (359-21). The individuals involved in the study were undergraduate medical students now enrolled in faculties of medicine at King Abdulaziz University in Jeddah, Saudi Arabia.

Inclusion and Exclusion criteria

The study encompassed a diverse group of participants, including both male and female students from the second year through the internship year, as well as students from both Saudi and non-Saudi backgrounds. First-year students have been omitted from the study due to the fact that this academic year is considered a general preparatory year for all university students. Additionally, those who have never smoked and those with medical conditions that need them to quit smoking have also been excluded from participation.

Sample size

A cohort of 263 medical students was included in the present study. Of these, 120 students were omitted from the analysis since they reported never having smoked, while an additional 10 students were eliminated due to cessation of smoking resulting from a medical condition. The stratified random sampling strategy was employed in our study. Initially, a cohort of students from each academic year was collectively regarded as a single entity. Subsequently, we extended invitations to all undergraduate medical students who were admitted to medical institutions affiliated with KAU. These students were requested to partake in the research endeavor by completing a questionnaire, which encompassed sections designated for both female and male respondents. The study's necessary sample size was determined to be 265 people, with a 95% confidence interval, a population size of 1000, and a margin of error of 5%. The computation was conducted via the Qualtrics sample size calculator.

Data collection Technique and tools

The researchers in a prior study (Siegel et al., 2011) utilized a standardized and anonymous questionnaire to collect data from participants spanning from their second year through their internship year. The sample included both male and female students, as well as Saudi and Non-Saudi students. The survey is disseminated in the form of an electronic questionnaire utilizing Google forms, comprising six distinct sections. A consent form was acquired from all participants, who were thereafter requested to respond to a series of questions that were categorized into multiple parts.

The initial section of the study focused on gathering demographic information from the participants, including variables such as gender, age, marital status, medical year, residing area, and presence of psychological issues. The second component was evaluating the smoking status of the participants, encompassing several aspects such as the primary form of smoking, smoking history and associated features, degree of tobacco cessation or reduction following the adoption of E-cigarettes/vape, frequency of E-cigarette/vape usage, and the underlying ideas and beliefs driving its use. The Third portion was regarding the pattern of E-cigarettes use and nicotine use of persons who are not smoking for 6-month period.

Pilot test

The questionnaire was provided to a sample of 20 persons, who were then requested to complete it. The purpose of this action was to assess the ease of use of the questionnaire and the practicality of conducting the survey. The data obtained from the pilot project was omitted from the final dataset of the study.

Data analysis

The current study employed statistical analysis utilizing "IBM SPSS statistics ver. 20.0" to assess and examine the hypothesis. The analysis includes the utilization of basic frequency tables, cross tabulations, and percentages. The chi-square test was employed to examine and elucidate the association between two variables that have been grouped. The researchers employed binomial logistic regression to examine the factors that predict the binary outcome variables. A significance level of $P<0.05$ was employed as the threshold value.

III. RESULTS

According to the data presented in Table 1, the research encompassed a total of 263 participants, with 60.9% of the sample being male and 39.1% being female. In the study, it was found that 32.3% of the participants were enrolled in their third academic year, while 21.1% were in their fifth academic year. Additionally, 19.5% of the participants were in their sixth year, and 9.8% were in their second year. The study found that 88.7% of the

participants fell between the age range of 20 to 25 years old. 22.6% of the individuals surveyed were found to be married, while the remaining 77.4% were not married.

Table 1 Socio-demographic characteristics of participants (n=263)

Parameter		No.	%
Gender	Male	81	60.9
	Female	52	39.1
Medical year	Intern year	13	9.8
	2nd year	13	9.8
	3rd year	43	32.3
	4th year	10	7.5
	5th year	28	21.1
	6th year	26	19.5
Age	less than 20	9	6.8
	20- 25	118	88.7
	more than 25	6	4.5
Living Area	Central Jeddah	30	22.6
	East Jeddah	29	21.8
	North Jeddah	41	30.8
	South Jeddah	33	24.8
Marital status	Married	30	22.6
	Single	103	77.4

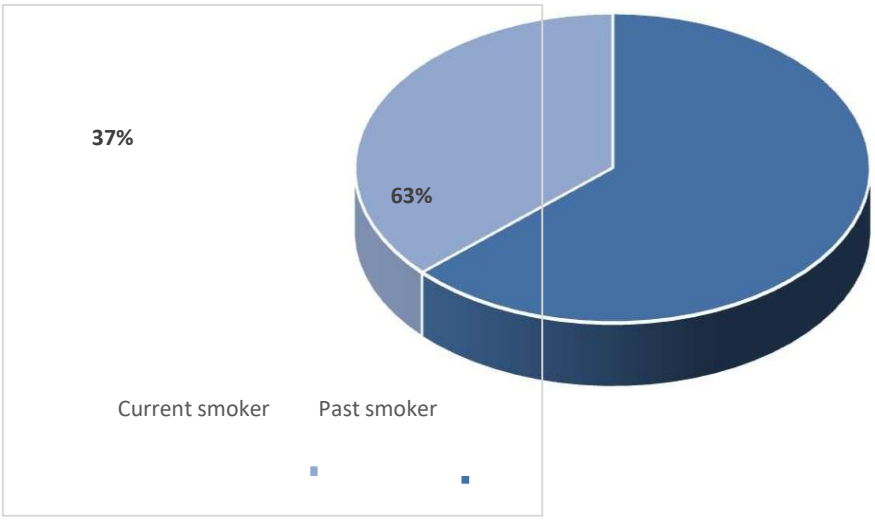

Figure 1 Smoking status among smoking participants

Table 2 presents the distribution of smoking types among the participants. Of the total sample, 23 individuals (17.3%) reported using tobacco cigarettes, while 90 individuals (67.7%) reported using E-cigarettes or vape. Additionally, 20 individuals (15%) reported using other types of tobacco products, such as shisha. In terms of motivation for using E-cigarettes, 48 individuals (36.1%) reported using them as a method of tobacco cessation. Furthermore, 55 individuals (41.4%) reported using E-cigarettes due to their perceived lower after effects

compared to tobacco cigarettes, including factors such as smell, headache, and dry mouth. Lastly, 30 individuals (22.6%) did not provide a clear explanation for their use of E-cigarettes.

Table 2 Smoking status, type and history among smoking participants (n=133)

Parameter		No.	%
Smoking history (yearssmoked)	<1 year	18	13.5
	2-4 years	46	34.6
	5-6 years	19	14.3
	7-8 years	8	6.0
	>8 years	1	.8
	Don't know	41	30.8
Main type of smoking used	E-cigarettes/vape	90	67.7
	Other tobacco products (shisha, etc.)	20	15.0
	Tobacco cigarettes	23	17.3
Presence of psychological problems	Yes	6	4.5
	No	127	95.5
Using or used E- cigarettes/vape regularly	Yes	92	69.2
	No	41	30.8
Reason for using the E-cigarettes	As a way of tobacco cigarette cessation	48	36.1
	Less side effects than tobacco cigarettes (smell, headache, dry mouth, cough, etc.)	55	41.4
	No specific reason	30	22.6

According to the data presented in Table 3, it can be observed that 19.5% of the participants hold the belief that E-cigarettes pose no danger whatsoever. Additionally, 20.3% of the participants perceive E-cigarettes to be equally as bad as tobacco cigarettes, while a majority of 58.6% consider E-cigarettes to be less harmful than its tobacco counterparts. A small proportion of 1.5% of participants believe that E-cigarettes are more harmful than tobacco cigarettes. A total of 36.6% of the participants expressed partial agreement, while 8.3% indicated partial disagreement, and 30.1% strongly agreed with the notion that E-cigarettes serve as an effective method for smoking cessation.

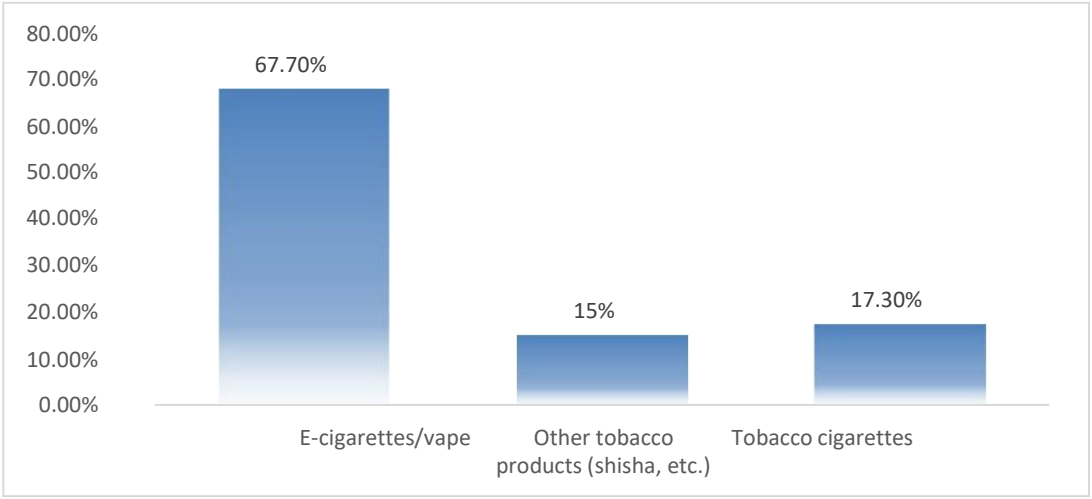

Figure 2 Main type of smoking used among study participants (n=263)

Table 3 Awareness about E-cigarettes among study participants (n=263)

Parameter		No.	%
E-cigarettes compared totobacco cigarettes are	Absolutely Harmless	26	19.5
	Equal harmful as tobacco cigarettes	27	20.3
	Less harmful than tobacco cigarettes	78	58.6
	More harmful than tobacco cigarettes	2	1.5
E-cigarettes are an effective way of smokingcessation	Neither agree nor disagree	28	21.1
	Partially agree	46	34.6
	Partially disagree	11	8.3
	Strongly agree	40	30.1
	Strongly disagree	8	6.0

According to the data shown in Table 4, a significant proportion of persons saw a reduction in their overall nicotine consumption (54.9%) and a decrease in the number of tobacco cigarettes smoked per day (57.1%) subsequent to the utilization of E-cigarettes. In terms of daily frequency, the majority of participants reported smoking between 5 and 10 times per day, accounting for 32 individuals (24.1%). The remaining participants reported smoking less than 5 times per day, between 11 and 15 times per day, or more than 15 times per day. In relation to the utilization of E-cigarettes, it is noteworthy that approximately one third of the subjects reported daily usage, while the remaining individuals reported intermittent usage. Interestingly, among those who had refrained from smoking for an extended duration, 51.1% exclusively utilized E-cigarettes, 10.5% used nicotine-free alternatives, and 7.5% employed nicotine products devoid of tobacco. Table 5 presents a statistically significant correlation between the regular use of E-cigarettes/vape and the marital status and academic year of the individuals ($P< 0.05$).

Table 4 Determinants of use of E-cigarettes among smoking participants (n=133)

Parameter		No.	%
Reduced overall nicotine use after e- cigarette use	Yes	73	54.9
	No	19	14.3
	Don't know	41	30.8
Reduced number of tobacco cigarettes per day after e-cigarette use	Yes	76	57.1
	No	16	12.0
	Don't know	41	30.8
Number of previousquit attempts	0	18	13.5
	1–2	38	28.6
	3–5	21	15.8
	>5	15	11.3
	Don't know	41	30.8
Quit/abstained for a	< 1 week	14	10.5

period of time	1-4 weeks	26	19.5
	1-3 month	16	12.0
	>3 month	22	16.5
	Don't know	55	41.4
Reason for return tosmoking	Craving	28	21.1
	Others	6	4.5
	Stress	24	18.0
	Successfully quit and never returned	22	16.5
	Don't know	53	39.8
Number of times usedper day	0	9	6.8
	<5	16	12.0
	5–10	32	24.1
	11–15	13	9.8
	16–20	11	8.3
	>20	11	8.3
	Don't know	41	30.8
Weekly pattern of e-cigarette use	Everyday use	49	36.8
	No current e-cigarette use	10	7.5
	Only uses some days	33	24.8
	Don't know	41	30.8
Nicotine use of thosewho are not smokingfor 6-month period	Nicotine-free	14	10.5
	Using only E-cigarettes	68	51.1
	Using tobacco-free nicotine products	10	7.5
	Don't know	41	30.8

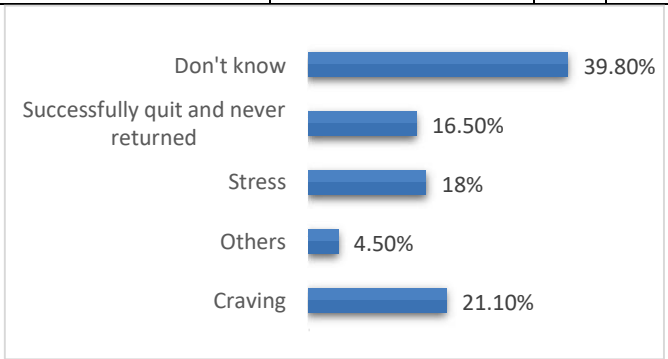

Figure 3 Reason for return to smoking among study participants (n=263)

Table 5 Association between using E-cigarettes regularly with socio-demographic characters of participants

		Using E- cigarettes/ vape regularly		Total (N=133)	P value
		Yes	No		
		26	4	30	

Marital status	Married	28.3%	9.8%	22.6%	0.018
	Single	66	37	103	
		71.7%	90.2%	77.4%	
Gender	Male	54	27	81	0.435
		58.7%	65.9%	60.9%	
	Female	38	14	52	
		41.3%	34.1%	39.1%	
Academic year	Intern year	11	2	13	0.004
		12.0%	4.9%	9.8%	
	2nd year	9	4	13	
		9.8%	9.8%	9.8%	
	3rd year	34	9	43	
		37.0%	22.0%	32.3%	
	4th year	6	4	10	
		6.5%	9.8%	7.5%	
	5th year	11	17	28	
		12.0%	41.5%	21.1%	
	6th year	21	5	26	
		22.8%	12.2%	19.5%	
Age	Less than 20	8	1	9	0.414
		8.7%	2.4%	6.8%	
	20- 25	80	38	118	
		87.0%	92.7%	88.7%	
	More than 25	4	2	6	
		4.3%	4.9%	4.5%	
Living Area	Central Jeddah	21	9	30	0.063
		22.8%	22.0%	22.6%	
	East Jeddah	25	4	29	
		27.2%	9.8%	21.8%	
	North Jeddah	28	13	41	
		30.4%	31.7%	30.8%	
	South Jeddah	18	15	33	
		19.6%	36.6%	24.8%	

IV. DISCUSSION

Electronic cigarettes, also known as E-cigarettes, are nicotine delivery systems that operate on battery power. These devices offer users the experience of nicotine use while replicating the physical actions associated with smoking, such as hand movements and inhaling. Consequently, they may also function as a neurobiologically and psychologically efficacious approach for smoking cessation. According to Vardavas et al. (2015), the use of e-cigarettes may not pose equivalent risks of morbidity and mortality as combustible cigarettes due to the absence of tobacco combustion. This study presents novel findings about the correlation between e-cigarette usage and smoking cessation among medical students at King Abdelaziz University.

Based on the findings of our study, it was observed that 36.1% of individuals who smoke employ E-cigarettes as a means to cease tobacco consumption. Following the utilization of electronic cigarettes (e-cigarettes), a significant proportion of participants, specifically 54.9%, exhibited a reduction in their overall nicotine consumption. Additionally, 57.1% of individuals saw a drop in the quantity of cigarettes they consumed on a daily basis. In a systematic review conducted by Hartmann et al. (2016), the efficacy of E-cigarettes as a smoking cessation aid was compared to that of placebo E-cigarettes and nicotine replacement therapy. The analysis found that the available studies were insufficient in number and often exhibited poor quality, often characterized by small sample sizes. Several other systematic reviews have arrived at comparable findings on the substandard quality of the studies and the limited impact of electronic cigarettes (E-cigarettes) on smoking cessation. One such analysis discovered a general decrease in the likelihood of quitting smoking among those who utilized E-cigarettes (Grabovac et al., 2021). Based on the findings of four systematic reviews, it has been determined that electronic cigarettes (e-cigarettes) exhibit more efficacy compared to a placebo in aiding individuals in smoking cessation (Eidib et al., 2017; Hartmann et al., 2016; Khoudigian et al., 2016; Rahman et al., 2015). In a study conducted by Kalkhoran and Glantz (2016), it was found that those who utilized E-cigarettes had a 28% reduced likelihood of successfully ceasing their tobacco use compared to those who did not engage in such usage. In a study comprising five randomized controlled trials (RCTs), it was observed that the rate of abstinence was 2.6% greater in the group using e-cigarettes compared to the control group.

Several studies (Hajek et al., 2019; Lee et al., 2019; Li et al., 2020; Soneji et al., 2017; Tseng et al., 2016) have suggested that E-cigarettes could potentially be more effective than nicotine replacement therapy (NRT) or a placebo in aiding adult smokers in their cessation efforts. This conclusion is supported by the presence of control groups in these studies.

The accessibility of E-cigarettes as consumer items holds potential significance in considering their efficacy as a smoking cessation therapy. The situation can be likened to the disparities observed between the utilization of legal nicotine replacement therapy (NRT) drugs for the purpose of smoking cessation in non-clinical environments and their efficacy as demonstrated in clinical research. Numerous studies have investigated the correlation between various over-the-counter nicotine products and the act of quitting smoking. The findings derived from the comprehensive population-based California Tobacco Surveys indicate that the utilization of nicotine replacement therapy (NRT) for smoking cessation demonstrated sustained efficacy in the long term when it was exclusively accessible through prescription. However, this positive correlation between NRT and successful smoking cessation was no longer observed once NRT became readily available over the counter (Pierce and Gilpin, 2002). The results derived from a nationally representative survey of people in the United States suggest that the utilization of E-cigarettes for smoking cessation purposes among adults is seldom (Patel et al., 2021). Nevertheless, the literature presents varying findings about the efficacy of e-cigarettes as a tool for smoking cessation. Therefore, the objective of this cross-sectional study conducted in Saudi Arabia is to assess the efficacy of e-cigarettes as a smoking cessation tool.

The motivation to cease smoking tobacco cigarettes is a widely observed incentive for the utilization of electronic cigarettes (e-cigarettes). This inclination can be attributed to the efficacy assertions propagated in e-cigarette marketing campaigns across the United States, United Kingdom, and China. It is noteworthy, nevertheless, that these assertions have not received official validation from regulatory authorities. E-cigarettes are promoted as a means to circumvent smoke-free legislations, and individuals who are addicted to nicotine may employ them for this purpose, even if their original intention is not to quit (Kalkhoran & Glantz, 2016).

The potential effects of regulating electronic cigarettes on marketing strategies and user motives warrant consideration. The implementation of smoke-free rules and the adoption of voluntary smoke-free policies, which encompass E-cigarettes, have the potential to decrease the use of E-cigarettes as a substitute for traditional cigarettes. Additionally, these measures may potentially augment the effectiveness of E-cigarettes as aids in smoking cessation. There exists a disparity between the dissemination of E-cigarettes for cessation inside a closely supervised clinical trial setting and the accessibility of E-cigarettes for utilization by the broader population, owing to their unrestricted availability on the market for unrestricted usage. Hence, a comprehensive examination of the advertising strategies and utilization patterns of E-cigarettes is imperative in order to evaluate their efficacy as a smoking cessation tool and their overall implications for public health (Kalkhoran and Glantz,

2015).

The primary objectives for future research should include the standardization of definitions pertaining to e-cigarette use, examination of the correlation between different levels of use and various devices, as well as smoking cessation outcomes. Additionally, conducting randomized clinical trials that compare e-cigarettes with conventional therapies such as nicotine replacement therapy (NRT) would be valuable. Furthermore, it is important to analyze the influence of e-cigarette use on factors like motivation to quit smoking and to differentiate e-cigarette users based on their motivations for utilizing these products.

Limitations and Recommendations

The research conducted in this study was subject to many limitations. Initially, the study utilized self-reported measures of smoking consumption and quit duration, a method that may introduce recall bias, particularly among those who had ceased smoking. Furthermore, the research was carried out within a cohort of medical students, so limiting the feasibility of employing a more extensive sample size. The objective examination of the present smoking status, as is customary in large-scale population studies, was not conducted. Due to the constraints imposed by the COVID-19 epidemic, data collection on physical files was not feasible. Consequently, an online questionnaire was employed as an alternative method for data acquisition. An additional constraint pertains to the exclusion of 120 out of the total 263 participants due to their lack of smoking history. Regarding medical issues, a majority of the participants, namely 133 out of 143 individuals, or 93%, were found to be medically free. Conversely, a smaller subset of participants, precisely 10 out of 143 individuals, or 7%, were identified as having a diagnosed medical condition that rendered them unable to smoke. The present study did not investigate the phenomenon of nicotine addiction or explore the potential impact of alternative tobacco products on cessation endeavors. The study did not incorporate information regarding the potential impact of various electronic cigarette devices on the effectiveness of smoking cessation. Ultimately, as the use patterns and varieties of e-cigarettes continue to develop, the association between e-cigarettes and the rates of tobacco cessation may undergo changes. Although the notion of smoking cessation is commonly advertised and sometimes used as a justification for e-cigarette usage among smokers, the prevailing consensus derived from existing research indicates a rise in the prevalence of e-cigarette use within the current regulatory framework.

It is strongly advised that further investigation be conducted on extended durations of smoking cessation subsequent to e-cigarette usage. This study should encompass a comprehensive sample size that encompasses the entirety of Saudi Arabia. Additionally, it is essential to examine the potential health risks associated with e-cigarettes in comparison to regular cigarettes.

V. CONCLUSION

The present study has determined that the utilization of E-cigarettes/vape plays a significant role in facilitating smoking cessation among a cohort of medical students who successfully quit smoking through its implementation. Furthermore, it is noteworthy that these devices serve as a transitional tool for individuals seeking to reduce their tobacco consumption, as a considerable proportion of our participants were able to effectively quit smoking by transitioning to E-cigarettes/vape.

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