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EVALUATION OF THE LEVEL OF AWARENESS AMONG MEDICAL STUDENTS ABOUT E-CIGARETTES AND THEIR RELATION TO CANCER IN SAUDI ARABIA

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Abstract

Background: E-cigarette use has become widespread globally, with 8.1 million American young adults aged 18-24 using them. This habit is linked to cancer risk, particularly for head, neck, lung, and bladder cancers, as e-cigarettes contain toxic substances like benzene and carbon monoxide. The inventor of the e-cigarette is Hon Lik from China in 2003. This study aimed to assess medical students' awareness of e-cigarettes and their relationship to cancer in the Kingdom of Saudi Arabia.

Methodology: The cross-sectional study was done in Saudi Arabia during 2023-2024. Those who had cancer prior to using e-cigarettes will be excluded, and medical students will be the inclusion criterion. For this study, 493 participants were the estimated sample size. Additionally, SPSS will perform the statistical analysis.

Results: The total sample size were 493 participants. As regard knowledge and awareness score about e-cigarette smoking and cancer risk among our study participants, there were a significant portion of the participants, specifically 53.5%, possess a moderate level of knowledge regarding e-cigarette smoking. Additionally, 23.7% demonstrated a high level of awareness in this area, while 22.7% exhibited a low level of knowledge. Regarding the relation between awareness level towards e-cigarette smoking and cancer and sociodemographic characteristics, there were a statistically significant relation to the academic level of participants (p value=0.003) and the university (p value=0.001). It also showed statistically insignificant relation to gender, age, and marital status.

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Conclusion: The study showed that a significant proportion of participants had a moderate level of knowledge about e-cigarette smoking, with some demonstrating high awareness while others showed low knowledge levels. The study also found a statistically significant relationship between awareness levels and participants' academic level and university. These findings align with previous research indicating varying levels of awareness among medical students regarding the potential health risks associated with e-cigarette use.

Keywords: e-cigarettes, cancer, community, level of awareness, medical students, educating, carcinogenesis.

Introduction:

Electronic cigarettes, often known as e-cigarettes, are battery-operated gadgets created to deliver nicotine, taste, and other substances, as The United States Food and Drug Administration specified (FDA, 2014). It does not burn tobacco as traditional cigarettes do. Instead, they create vapor from a flavored liquid [1]. The Chinese chemist Lik Hon invented e-cigarettes in Hong Kong in 2003, and at the time, the product was hailed as a "safe" method of quitting smoking or as a smoking substitute. E-cigarettes have gained popularity among smokers who wish to lower their health risks or give up, as well as among teens and non-smokers since they were first introduced to the market [2][3].Nevertheless, recent research has revealed that the vapor from e-cigarettes also contains many toxic chemicals found in traditional cigarettes, such as acetaldehyde, formaldehyde, acetone, acrolein, chromium, N-nitrosamines, and others, in addition to nicotine, even though the levels of carcinogens and toxins are significantly lower in e-cigarette users compared to tobacco smokers [3]. Evidence exists to suggest that using e-cigarettes may raise the chance of developing some cancers. Cells that are exposed to carcinogens in the bodily fluids of e-cigarette users are inevitably susceptible to neoplastic transformation, such as lung cancer, bladder cancer, breast cancer head and neck squamous cell carcinoma [4]. A cross-sectional study was published in 2021 showed that individuals with higher levels of education declared that electronic cigarette use causes lung cancer [5]. A review in 2021 showed that e-cigarettes have been proven to induce DNA harm, reduce DNA repair, and promote carcinogenesis [6]. Other study published in 2021 showed that Carcinogenic materials, which might be connected to bladder most cancers, have been proven to build up in the urine of human e-cigarette consumers [7].

Due to the vast spread of e-cigarettes at the current time and a little number of studies conducted in Saudi Arabia related to our topic. This study aimed to evaluate the awareness level among medical students about e-cigarette and its relation to cancer in the Kingdom of Saudi Arabia.

Materials and Methods:

Study design:

This is a cross-sectional study was performed between November 2023 and June 2024 in Saudi Arabia. The study's population consisted of undergraduate medical students. During 2023-2024, in Saudi Arabia. medical students with cancer before using E-cigarettes was excluded.

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Sample size:

The Rao soft calculator determined the study sample, keeping a response distribution of 50%, a margin of error of 5%, and a confidence level of 95%; our calculated sample size is 400 Participants.

Method for data collection and instrument (Data collection Technique and tools):

A cross- sectional survey study was conducted using electronic questionnaires send among the medical students in Saudi Arabia from November 2023 up to February 2024. Toward the evaluations of the level of awareness among medical students about e-cigarettes and their relation to cancer in Saudi Arabia. The total enumeration method was used for including all medical students who agreed to answer the questionnaires in this study.

Adult individuals in the age group of 18 - 24 years were included in this study. Students with cancer before using E-cigarettes will be excluded. The survey consisted of demographic data, age, academic level, regions, history of smoking, type of smoke, the effects of vaping, relation with cancer.

The survey web link was distributed via social media and our university groups.

Data were analyzed by using SPSS version 23.

Scoring system:

The overall scoring was 26, for most questions we used answers (yes, no, I don't know) so that the right answer will score 1, the wrong answer as well as 'I don't know' will score 0, if the recipient couldn't answer more than 15 question correctly, this indicate a lack of low awareness of the relationship between E-cigarettes and cancer, but if answered more than 20 correct answers, this indicates a high awareness of this relationship, which means that answering between them will indicate moderate awareness.

Analyzes and entry method:

Collected Data was entered on a computer using the Microsoft Excel program (2016) for Windows. Data was transferred to the Statistical Package of Social-Science Software (SPSS) program, version 23. To be statistically analyzed.

Results:

Table (1) displays various demographic parameters of the participants with a total number of 493. In terms of age distribution, it is evident that most participants fall within the 21-22 age bracket, accounting for 40.6% of the total sample, followed closely by those aged less than 21 at 28.4%. Participants aged 23 or above constitute 31% of the cohort. Gender-wise, the distribution is almost evenly split between female (52.7%) and male (47.3%) participants. Regarding marital status, a significant proportion of participants identify as single, comprising 93.3% of the sample, while married individuals make up 5.9%, and divorced individuals represent 0.8%. When considering academic levels, the data shows a varied distribution across different levels, with the highest percentage of participants at the fourth academic level (30.0%), followed by the fifth level (15.6%) and the third level (19.9%). The distribution

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of participants across different universities reveals that most participants are affiliated with other universities (40.2%), followed by King Abdulaziz University (21.5%) and Qassim University (10.8%). This comprehensive breakdown of sociodemographic characteristics provides valuable insights into the composition of the participant pool, which can inform further analysis and interpretation of the study findings.

Table (1): Sociodemographic characteristics of participants (n=493)

Parameter		**No.**	**Percent (%)**
Age	less than 21	140	28.4
	21 or 22	200	40.6
	23 or above	153	31.0
Gender	Female	260	52.7
	Male	233	47.3
Marital status	Single	460	93.3
	Married	29	5.9
	Divorced	4	.8
Academic level	Second	97	19.7
	Third	98	19.9
	Fourth	148	30.0
	Fifth	77	15.6
	Sixth	73	14.8
University	Imam Abdulrahman bin Faisal University	8	1.6
	King Abdulaziz university	106	21.5
	King Faisal university	45	9.1

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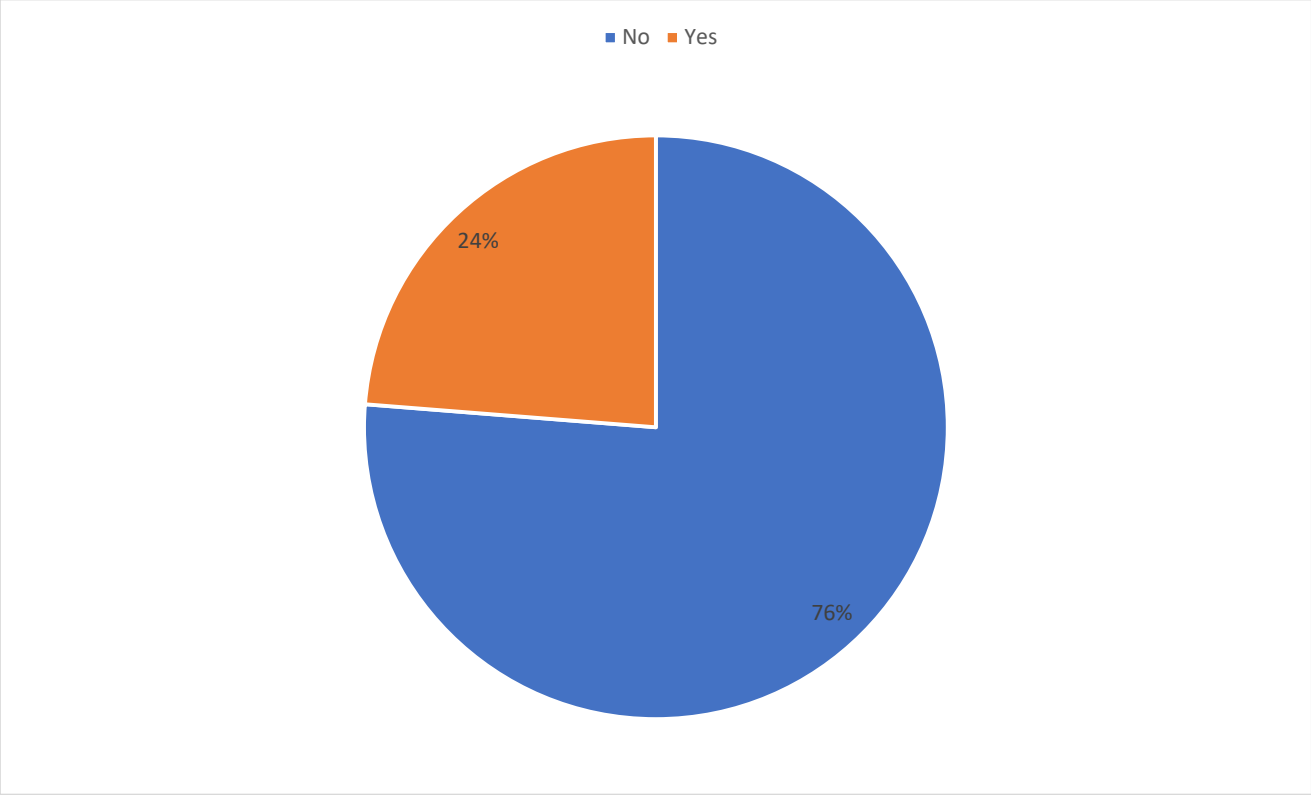
	King Saud University for Health Sciences (KSAU-HS)	31	6.3
	Others	198	40.2
	Qassim University	53	10.8
	Taibah University	52	10.5

Figure (1) shows the responses to the question "Have you ever smoked before?" with corresponding frequencies of "No" at 376 and "Yes" at 117, several observations can be made. The data suggests that a larger proportion of individuals surveyed have not engaged in smoking, as evidenced by the higher count associated with the "No" response category. This disparity in numbers indicates a potential prevalence of non-smokers within the sampled population.

Figure (1): Illustrates if participants had smoked before.



The data presented in Table (2) provides valuable insights into the awareness of the relationship between e-cigarette smoking and cancer among the sample population of 493 individuals. Most respondents,

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accounting for 76.3%, reported never having smoked before, while 23.7% indicated they had smoked at some point. When asked about the duration of their vape usage, a significant proportion (83.2%) stated that they did not vape, with only small percentages reporting varying lengths of use ranging from less than a month to over a year. In terms of the type of smoking, the data reveals that a large majority (80.7%) of respondents do not vape, with a smaller percentage indicating their preference for cigarettes, shisha, or vape. When asked about current vape usage, 79.7% stated they had never used it, while 7.9% reported using it daily. Interestingly, the data also shows that a considerable number of respondents (79.9%) who switched to vaping have stopped smoking traditional cigarettes, hookah, or shisha. This data underscores the importance of understanding individuals' smoking behaviors and the impact of vaping on their smoking habits and awareness of health risks associated with e-cigarette use.

Table (2): Parameters related to awareness of the relationship between e-cigarette smoking and cancer (n=493).

Parameter		**No.**	**Percent (%)**
Have you ever smoked before?	No	376	76.3
	Yes	117	23.7
How long have you been using vape?	I don't vape	410	83.2
	Less than month	24	4.9
	Over 6 months	9	1.8
	Over a year	41	8.3
	Over three months	9	1.8
Which type do you smoke?	Cigarettes	24	4.9
	Hookah	2	.4
	I don't vape	398	80.7
	Shisha	14	2.8
	Vape	55	11.2

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Are you currently smoking vape?	No but I used it in the past	36	7.3
	No, I never used it	393	79.7
	Yes, but not daily	25	5.1
	Yes, I used it daily	39	7.9
Have you stopped smoking the traditional cigarette, hookah, shisha after switching to vape?	I don't vape	394	79.9
	No	50	10.1
	Yes	49	9.9

As shown in figure (2), The data presented in the figure raises an important question regarding the safety of vaping in relation to one's health. The responses provided by the participants indicate a diverse range of opinions on the matter. It is noteworthy that most of the respondents, specifically 244 individuals, expressed a belief that vaping is more dangerous than cigarettes. This viewpoint suggests a prevailing concern among a significant portion of the population regarding the potential health risks associated with vaping. On the other hand, 145 respondents indicated that while they do not consider vaping to be safe, they believe it is less harmful than traditional cigarettes. This nuanced perspective reflects a recognition of the relative risks posed by different forms of smoking. Interestingly, only a small minority of 6 individuals asserted that vaping is safe, a stance that appears to be in the minority based on the distribution of responses.

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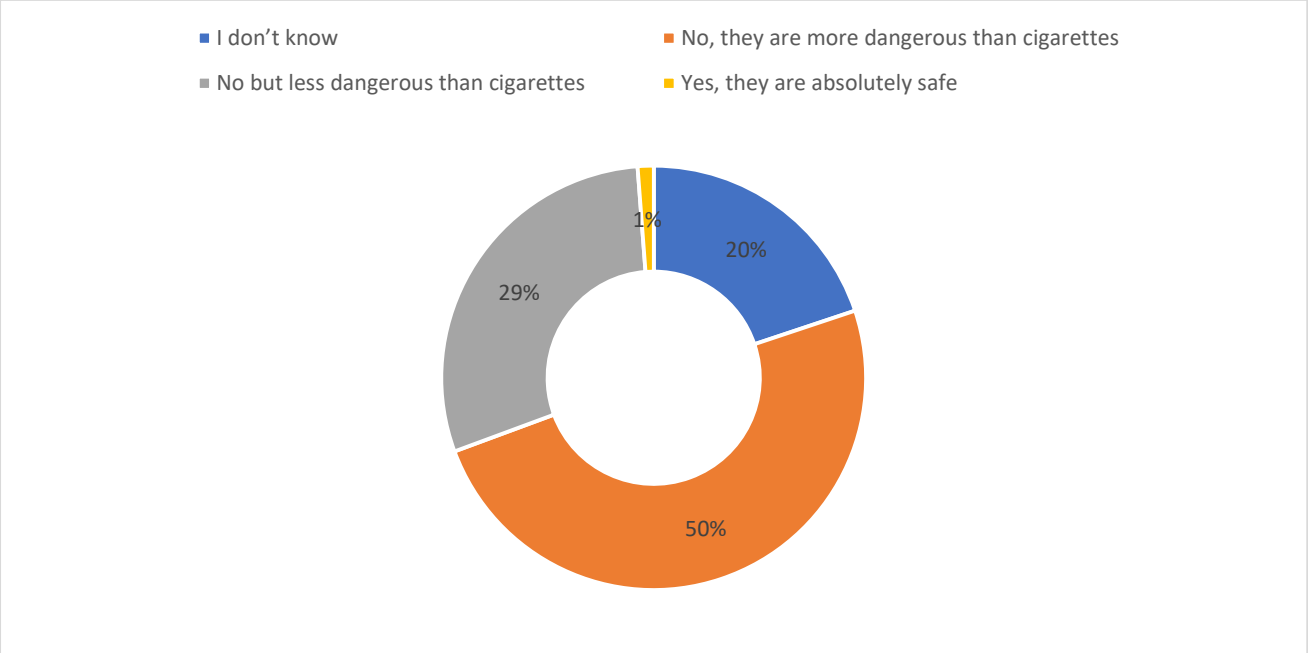
Figure (2): Illustrates what participants think about the safety of e-cigarette smoking.



As illustrated in table (3), It is evident from the responses that a significant portion of the participants have concerns about the safety of vaping for health, with a substantial percentage considering e-cigarettes more dangerous than traditional cigarettes. The perception of the harmful effects of vaping on health, particularly in relation to lung cancer, is prevalent among the respondents. Interestingly, a considerable number of participants believe that vaping is addictive, with a majority considering it as addictive as cigarettes. The data also highlights varying opinions on the suitability of e-cigarettes for different groups, such as pregnant women and children, indicating a need for further education and awareness in this area. Moreover, most participants feel that medical students should receive education about e-cigarettes, underscoring the importance of incorporating this topic into medical school curricula.

Table (3): participants awareness of the relationship between e-cigarette smoking and cancer (n=493).

Parameter		**No.**	**Percent (%)**
Do you think that vaping is safe for your health?	I don't know	98	19.9
	No, they are more dangerous than	244	49.5

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	cigarettes		
	No but less dangerous than cigarettes	145	29.4
	Yes, they are absolutely safe	6	1.2
Regarding the effect of vaping on health, do you think smoking vape can cause which of the following?	Cardiovascular system	67	13.6
	Cerebral stroke	17	3.4
	Impotence	10	2.0
	Lung cancer	346	70.2
	None of the above	53	10.8
Do you think vaping helps in smoking cessation?	I don't know	143	29.0
	No	242	49.1
	Yes	108	21.9
Do you think vape is addictive?	I don't know	81	16.4
	No, they are not addictive	29	5.9
	Yes, as addictive as cigarettes	287	58.2
	Yes, but less addictive than cigarettes	96	19.5
Do you think e-cigarettes associated with lung cancer?	I don't know	91	18.5
	No	23	4.7
	Yes	379	76.9

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Do you think e-cigarettes associated with bladder cancer?	I don't know	215	43.6
	No	96	19.5
	Yes	182	36.9
Do you think it is important for medical students to be educated about E-cigarettes?	I don't know	65	13.2
	No	26	5.3
	Yes	402	81.5
Do you think E-cigarettes are suitable for pregnant woman?	I don't know	63	12.8
	No	408	82.8
	Yes	22	4.5
Do you think E- cigarettes suitable for children?	I don't know	50	10.1
	No	425	86.2
	Yes	18	3.7
Do you feel it is more socially acceptable to smoke E cigarettes, compared to cigarettes?	I don't know	109	22.1
	No	221	44.8
	Yes	163	33.1
Do you think cigarettes help students to concentrate?	I don't know	94	19.1
	No	323	65.5
	Yes	76	15.4
Would you promote or recommend the use of e-cigarettes to other people?	I don't know	71	14.4
	No	394	79.9
	Yes	28	5.7

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Which of the following organs do you think is the most common cancer caused by e-cigarettes?	Bladder cancer	21	4.3
	I don't know	83	16.8
	Liver cancer	10	2.0
	Lung cancer	370	75.1
	None	9	1.8
In your opinion have you received adequate education about e-cigarettes in medical school	No	345	69.9
	Yes	148	30.1

Upon reviewing Table (4) detailing the knowledge and awareness concerning e-cigarette smoking score results, it is evident that the data provides a comprehensive overview of the respondents' understanding of this pertinent issue. The table indicates that a significant portion of the participants, specifically 53.5%, possess a moderate level of knowledge regarding e-cigarette smoking. Additionally, 23.7% of the respondents demonstrate a high level of awareness in this area, while 22.7% exhibit a low level of knowledge. The total number of respondents included in this analysis amounts to 493, representing a diverse sample size for the study. This data offers valuable insights into the current state of awareness surrounding e-cigarette smoking, shedding light on areas that may require further education or intervention.

Table (4): Shows knowledge and awareness about e-cigarette smoking score results.

	Frequency	**Percent**
High level	117	23.7
Moderate level	264	53.5
Low Level	112	22.7
Total	493	100.0

Table (5) shows that the level of awareness of relationships between e-cigarette smoking and cancer has statistically significant relation to the academic level of participants (p value=0.003) and the university (p value=0.001). it also shows statistically insignificant relation to gender, age, and marital status.

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Table (5): Relation between awareness level of the relationship between e-cigarette smoking and cancer and sociodemographic characteristics.

Parameters		**Awareness level**		**Total (N=493)**	**P value***
		High	**Moderate or low**		
Gender	Female	62	198	260	0.95
		53.0%	52.7%	52.7%	
	Male	55	178	233	
		47.0%	47.3%	47.3%	
Age	less than 21	52	148	200	0.057
		44.4%	39.4%	40.6%	
	21 or 22	26	127	153	
		22.2%	33.8%	31.0%	
	23 or above	39	101	140	
		33.3%	26.9%	28.4%	
Marital status	Single	113	347	460	N/A
		96.6%	92.3%	93.3%	
	Married	4	25	29	
		3.4%	6.6%	5.9%	
	Divorced	0	4	4	
		0.0%	1.1%	0.8%	
Academic level	2nd	21	76	97	**0.003**
		17.9%	20.2%	19.7%	

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	3th	38	60	98	
		32.5%	16.0%	19.9%	
	4th	31	117	148	
		26.5%	31.1%	30.0%	
	5th	15	62	77	
		12.8%	16.5%	15.6%	
	6th	12	61	73	
		10.3%	16.2%	14.8%	
University	Imam Abdulrahman bin Faisal University	1	7	8	**0.001**
		0.9%	1.9%	1.6%	
	King Abdulaziz university	33	73	106	
		28.2%	19.4%	21.5%	
	King Faisal university	10	35	45	
		8.5%	9.3%	9.1%	
	King Saud University for Health Sciences (KSAU-HS)	4	27	31	
		3.4%	7.2%	6.3%	

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Qassim University	17	36	53	
	14.5%	9.6%	10.8%	
Taibah University	21	31	52	
	17.9%	8.2%	10.5%	
Others	31	167	198	
	26.5%	44.4%	40.2%	

P value was considered significant if ≤ 0.05.

Discussion:

During the 20th century, the prevalence of cigarette smoking surged globally, leading to a sharp rise in smoking rates, particularly in high- and middle-income nations, resulting in significant health issues and fatalities [8]. Annually, approximately 8 million deaths are linked to tobacco smoking, with substantial economic repercussions due to productivity losses and healthcare expenses. Alongside conventional cigarettes, a range of alternative tobacco products (ATPs) have emerged, with e-cigarettes being the most prevalent among them, experiencing a remarkable surge in global usage. The prevalence of e-cigarette use among adults has more than doubled, with a higher prevalence among current and former smokers compared to never-smokers, especially following their recent introduction to the market [9].

The ongoing debate surrounding the potential cancer risks associated with electronic-cigarette (e-cigarette) use remains a contentious issue. E-cigarettes function by heating a liquid containing nicotine, flavorings, and other substances, with users inhaling an aerosol into their lungs. While e-cigarettes are generally considered less harmful than traditional tobacco products, they still contain potentially harmful chemicals that have the capacity to harm DNA and induce cancer [10]. Thus, we aimed in this study to assess medical students' knowledge and awareness of e-cigarettes and their relationship to cancer in the Kingdom of Saudi Arabia.

As regard knowledge and awareness score about e-cigarette smoking and cancer risk among our study participants, we revealed that a significant portion of the participants, specifically 53.5%, possess a moderate level of knowledge regarding e-cigarette smoking. Additionally, 23.7% of the respondents demonstrate a high level of awareness in this area, while 22.7% exhibit a low level of knowledge. On the other hand, a study conducted by Shatha A. Alduraywish (2023) [11] in Saudi arabia showed

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relatively moderate awareness of the harmful effects of e-cigarette use, and half of the study population thought that e-cigarettes and conventional cigarettes have the same composition. These findings were consistent with other similar studies. King et al. and Hughes et al. reported lower harm perception among e-cigarette smokers in American and British youths [12,13]. Regional studies from Saudi Arabia also showed similar results [14]. Moreover, another study by Almughem et al. (2019) [15] surveyed 300 medical students from different universities in Saudi Arabia and found that only 45% of participants were aware of the potential carcinogenic effects of e-cigarettes. Another study by Alotaibi et al. (2020) [16] examined 200 medical students and reported that 60% of participants believed that e-cigarettes were less harmful than traditional cigarettes in terms of cancer risk. Additionally, a study by Alqahtani et al. (2017) [17] assessed 150 medical students and revealed that 70% of participants were unaware of the potential link between e-cigarette use and lung cancer. In contrast, a study by Patel et al. (2020) [18] conducted among 400 medical students revealed that 70% were aware of the potential cancer risks associated with e-cigarettes. However, a study by Gupta et al. (2017) [19] found that only 30% of medical students had received formal education on the health effects of e-cigarettes.

Regarding the relation between awareness level towards e-cigarette smoking and cancer and sociodemographic characteristics, we have found a statistically significant relation to the academic level of participants (p value=0.003) and the university (p value=0.001). It also showed statistically insignificant relation to gender, age, and marital status. On the other hand, a study by Sreeramareddy et al. (2015) [20] aimed to investigate the awareness level towards e-cigarette smoking and its relation to cancer risk among medical students, the study reported a significant association between awareness level and sociodemographic characteristics, such as age, gender, and educational level, with a p-value of <0.05. Similarly, a study by Singh et al. (2017) [21] examined the awareness level towards e-cigarette smoking and its association with cancer risk among medical students in India. The study found a significant association between awareness level and socioeconomic status and urban/rural residence, with a p-value of <0.01.

Conclusion:

In conclusion, this study aimed to evaluate the awareness level among medical students in the Kingdom of Saudi Arabia regarding e-cigarettes and their association with cancer. The results showed that a significant proportion of participants had a moderate level of knowledge about e-cigarette smoking, with some demonstrating high awareness while others showed low knowledge levels. The study also found a statistically significant relationship between awareness levels and participants' academic level and university. These findings align with previous research indicating varying levels of awareness among medical students regarding the potential health risks associated with e-cigarette use. Continued education and awareness campaigns are essential to ensure that individuals, especially in the medical field, are well-informed about the risks of e-cigarette use and its potential link to cancer.

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We thank the participants who all contributed samples to the study.

Ethical approval

Ethical approval was obtained from the research ethics committee of the King Faisal University in Al-Ahsa with Application number: [KFU-REC-2023-NOV-ETHICS1652]. An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

Funding

The study did not receive any external funding.

Conflict of interests

The authors declare that there are no conflicts of interest.

Informed consent:

Written informed consent was obtained from all individual participants included in the study.

Data and materials availability

All data associated with this study are present in the paper.

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