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AWARENESS AND MISCONCEPTIONS REGARDING VAPE SMOKING AND ITS HEALTH EFFECTS

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Abstract

BACKGROUND:

While significant research has been conducted on e-cigarettes and their influence on teenagers, there is still a shortage of data in specific regions, such as Pakistan, particularly regarding teenagers' perceptions and awareness of these devices. Despite the growing prevalence of e-cigarettes, there remains a significant gap in knowledge and understanding regarding their health risks. Many individuals, particularly in developing regions like Pakistan, perceive e-cigarettes as a safer alternative to traditional smoking, often overlooking the potential for severe health consequences, including respiratory, cardiovascular, and addiction-related issues. , this research is not only timely but also essential in addressing the growing public health concern posed by vaping. By shedding light on the awareness and misconceptions held by university students in Peshawar, this study aims to contribute to broader efforts to protect public health, promote informed decision-making, and prevent the potential health crises associated with vaping.

METHODS AND MATERIALS:

A cross-sectional study was conducted among 384 students from the University of Peshawar aged 15 to 40 years.The participants were evaluated for the prevalence of vape smoking and other related beliefs as well as their relationship with different demographic variables,smoking behaviors, and health outcomes.For statistical analysis chi-square tests were used for categorical variables and binary logistic regression was used to find the association between adverse effects and physiological changes with the use of nicotine-containing versus nicotine-free e-liquids.

RESULTS:

Out of 436 study participants, 77.1% had ever heard of e-cigarettes while 36% used them with 21.8% being e-cigarette-only users and 14.2% being dual users. Among e-cigarette users, there were significantly younger (<0.05). The pattern of e-cigarette use differed significantly between dual and e-cigarette-only users as the former had been using e-cigarettes more frequently, for longer duration, and with marked differences in the characteristics of e-liquids.22.2%-87.8% of all respondents answered correctly to knowledge questions with most of them being non-smokers. Among smokers, e-cigarette-only users significantly provided the most

correct answers. The most commonly reported adverse effect by e-cigarette users was headache (49.7%) while the least reported one was chest pain (10.2%).Dual users were more likely to report adverse effects and the result was significant for all adverse effects except nose bleeding (p=0.085) and sleepiness(0.056). Although the majority(36.3%-66.9%) of all e-cigarette users.
reported "no change" in physiological functions since e-cigarette use, a small proportion (20.4%-36.9%) reported improvement as well and dual users were more likely to report it than e-cigarette only users but the results were significant only for memory(p=0.013).

INTRODUCTION

The act of vaping, which involves inhaling and exhaling aerosol produced by electronic cigarettes (e-cigarettes) or similar devices, has seen a rapid rise in popularity over the past decade [1]. This trend is noticeable globally, including in Pakistan, where the use of e-cigarettes is growing across different age groups, particularly among the youth . E-cigarettes are battery-operated devices that deliver nicotine via a vaporized liquid composed of propylene glycol, glycerol, and nicotine [2].

The development of e-cigarettes was largely motivated by the idea of providing a solution for quitting traditional cigarette smoking and managing nicotine addiction.Because of their appealing looks, convenient features ,less unpleasant smoking experiences ,alluring flavors , and ability to be used discreetly, modern e-cigarettes are more socially acceptable among teenagers and young adults than traditional cigarettes. These devices, which produce nicotine-laden vapor, mimic the sensation of smoking conventional cigarettes [2]. The e-liquid is available in a variety of flavors ,with widely varying nicotine doses based on the brand and flavor selection [3]. Over 8000 flavors are currently available from about 450 vape brands , a number that almost doubled in only three years [4]. While significant research has been conducted on e-cigarettes and their influence on teenagers, there is still a shortage of data in specific regions, such as Pakistan, particularly regarding teenagers' perceptions and awareness of these devices.

Globally, there are numerous misconceptions about the safety of e-cigarettes. For instance, a review found that in the Americas, the lifetime prevalence of e-cigarette use was around 24%, while in Europe, Asia, and Oceania, it was 26%, 16%, and 25%, respectively. The current usage rates were 10% in the Americas, 14% in Europe, 11% in Asia, and 6% in Oceania [5]. According to the review of data commissioned by WHO on the prevalence and trends of ENDS/ENNDS use among people of 20 years of age or less identified a total of 27 studies that used probability sampling from very few countries. The age range of respondents varied across studies,as did the prevalence of ENDS/ENNDS use reported across jurisdictions.From 2013 to 2015 , current use among non-smokers is around 2%, although in jurisdictions like Florida, USA and Poland it was 13% and 19%, respectively. While its current use among smokers is around 17%, with Florida (44.8% in the 11–14age range and 51.7% in the 15–18 age range) and Poland (57.4%) showing much higher prevalence[6]. Moreover, a study in the United States indicated that e-cigarettes (68.8% of current e-cigarette users) were the most commonly used tobacco product among high school students, with 27.5%(4.1million) of them reporting usage, alongside 10.5%(1.2million) of middle school students [7].

In South-East Asia, where tobacco use remains a significant public health challenge, the introduction of e-cigarettes has further complicated efforts to reduce smoking rates. Many people in this region perceive vaping as a safer alternative to smoking, even though there is limited awareness of the potential health risks . For example, a study conducted in Malaysia revealed that 73% of adult smokers believed that vaping was a safer option compared to traditional smoking, despite evidence indicating that e-cigarettes contain harmful substances [8]. Another study conducted on 3,652 respondents aged 18 to 24 years by Aghar et al. in Indonesia ,showed that more than 50% of

respondents had a positive attitude or supported the use of e-cigarettes while 63.3% of respondents had low or less knowledge of the use of e-cigarettes . In 2019 ,the overall prevalence of e-cigarette use among students in grades 7–12 was 3.7% (5.9% for male, and 1.3% for female students); among youth aged 14–16 years, the prevalence of e-cigarette use was 6.4%[9]. Similarly, studies in other South-East Asian countries, have shown that while awareness of e-cigarettes is high, knowledge about their associated health risks is often lacking .

According to the study conducted in 2016 among medical students in Pakistan revealed that over 65.6 % students had knowledge of E-cigarettes , with 6.2 % reporting E-cigarette usage, out of which 1.2 % were daily users [10].Another study conducted in 2020 among university students found that approximately 70% of the respondents were aware of e-cigarettes, but only 30% knew about their potential health risks. Furthermore, 50% of the respondents believed that e-cigarettes could help quit smoking, despite the lack of evidence supporting this claim[11] .According to another study conducted in Karachi,E-cigarettes were perceived as less harmful than tobacco cigarettes by 175(45.3%) respondents, helpful in quitting smoking by 138(35.6%), associated with chronic diseases by 158(40.9%), addictive 142(36.7%), and not safe during pregnancy by 197(50.8%) participants[12].

A research conducted in Karachi showed that majority of participants knew what e-cigarettes were (n=277, 68.7%) but did not know about their contents (n=225, 55.8%) and had learned about them from either friends or the internet (n=245, 60.%). Almost half of them (n=190, 47.2%) believed that the reason for e-cigarette use was either peer pressure or to quit smoking conventional cigarettes. An overwhelming majority also stated that; it was either easy or very easy to obtain e-cigarettes (n=277, 68.7%), they would not try smoking e-cigarettes even if a good friend of theirs recommended them (n=287, 71.2%), they were not current e-cigarette smokers (n=370, 91.8%) and they would never promote e-cigarette use (n=371, 92.1%). Statistically significant differences were found with males knowing more about e-cigarettes (p=0.006) and being more common to either have smoked (p <0.001) or be current e-cigarette smokers (p <0.001). Furthermore, middle school students were more likely to have negative attitudes towards e-cigarettes believing they were more harmful (p=0.003) and more addictive (p <0.001) than conventional cigarettes[13].

E-cigarettes have often been marketed as a safer alternative to traditional cigarettes; however, emerging evidence suggests they carry significant health risks. Additionally, a recent study involving nearly 40,000 participants in the Health eHeart Study revealed that e-cigarette use was linked to higher self-reported levels of shortness of breath and increased incidences of COPD and asthma. [14]. Another study published in the American Journal of Preventive Medicine revealed that e-cigarette users had a 56% higher risk of myocardial infarction compared to non-users, underscoring the cardiovascular dangers of vaping [15]. These findings are particularly concerning in light of the recent outbreak of e-cigarette or vaping-associated lung injury (EVALI), which led to thousands of hospitalizations and several deaths in the United States . The Centers for Disease Control and Prevention (CDC) reported that EVALI was strongly linked to the use of e-cigarettes, particularly those containing THC, although the precise mechanisms remain under investigation [16].In addition to physical health risks, there is growing evidence that e-cigarettes may have adverse effects on mental health. A longitudinal study published in JAMA Pediatrics found that young people who used e-cigarettes were more likely to develop symptoms of depression compared to those who did not use these devices [17].

Despite the growing prevalence of e-cigarettes, there remains a significant gap in knowledge and understanding regarding their health risks. Many individuals, particularly in developing regions like Pakistan, perceive e-cigarettes as a safer alternative to traditional smoking, often overlooking the potential for severe health consequences, including respiratory, cardiovascular, and addiction-related issues . The lack of comprehensive education and public awareness about the contents and dangers of e-cigarettes has led to widespread misconceptions. These misconceptions are further exacerbated by aggressive marketing, peer influence, and the

relative novelty of vaping, which has limited the availability of long-term research on its health impacts . This situation is particularly concerning in Pakistan, where tobacco use is already a major public health challenge and where regulatory frameworks around vaping are still underdeveloped . In summary, this research is not only timely but also essential in addressing the growing public health concern posed by vaping. By shedding light on the awareness and misconceptions held by university students in Peshawar, this study aims to contribute to broader efforts to protect public health, promote informed decision-making, and prevent the potential health crises associated with vaping

Methodology

Study Design and Instrument:

The study utilized a cross-sectional quantitative design to investigate awareness and misconceptions regarding vape smoking and its health effects among university students. A modified version of a questionnaire, originally developed for a similar study titled, "Perceived health effects of vaping among Hungarian adult e-cigarette-only and dual users: a cross-sectional internet survey", published on PubMed, was used to collect data. This adaptation ensured that the instrument aligned with the specific objectives of this research. The quantitative approach facilitated a comprehensive statistical analysis, enabling the identification of patterns and potential risk factors associated with vape smoking, particularly within the Pakistani context. The cross-sectional nature of the study was appropriate for assessing the prevalence of vape smoking and related beliefs at a single point in time, allowing for an examination of relationships between demographic variables, smoking behaviors, and health outcomes.

The questionnaire was structured into five main sections. The socio-demographics section collected information on participants' gender, age, type of settlement (urban or rural), level of education, and family income, providing essential background characteristics for the sample. The smoking status section inquired about participants' awareness of e-cigarettes, their current smoking status—whether they used combustible cigarettes, e-cigarettes, both, or none—and details about the duration and frequency of e-cigarette use, as well as the nicotine content in their e-cigarette refills. The awareness and misconceptions section assessed participants' knowledge and beliefs regarding the health effects of vaping compared to traditional smoking, using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Responses were later categorized into two groups: those who were aware and those who were not. The reasons for vaping section explored participants' motivations for initiating e-cigarette use, including,reducing smoking, protecting family members from secondhand smoke exposure, avoiding a smoking ban in public places, economic reasons,and enjoying different flavors. Another section assessed any adverse effects experienced by participants since they began using e-cigarettes, such as sore throat, headaches, and breathing difficulties. And last section sought to identify physiological changes potentially attributable to vaping.And they included smell, taste, and breathing among many others.

The questionnaire was pilot-tested on a small group of students to ensure clarity and ease of understanding. Based on feedback from the pilot test, minor adjustments were made to improve the instrument.

Study Population:

The study population consisted of students currently enrolled at the University of Peshawar, with a total of 436 students participating. This sample represented a diverse cross-section of the university's demographic profile. Participants were selected through convenience sampling, which, while non-random, was effective in accessing a large number of respondents within a relatively short timeframe. The sample included 296 males and 140 females, enabling gender-based analysis of vaping behaviors and misconceptions. Participants were categorized into two age groups—under 22 years and 23 years or older—to facilitate the analysis of age-related differences in awareness and smoking habits. The educational levels of participants, including undergraduate, postgraduate, and diploma holders, were recorded to explore the impact of education on awareness and misconceptions about vaping. Family income was categorized into four brackets: less than Rs. 50,000, Rs. 50,000 to 100,000, Rs.

100,000 to 200,000, and more than Rs. 200,000, to assess whether socioeconomic status influenced vaping behavior and health perceptions.

Inclusion criteria required participants to be active students at the university, aged 18 years or older, and willing to participate voluntarily. Exclusion criteria ruled out non-students, individuals under 18 years of age, and those who declined to give consent.

Study Procedure:

Data collection occurred over six months, from March 2023 to August 2023, with all four authors participating in the process. Students were approached in various locations on the university campus, including classrooms, libraries, hostels, and common areas. In addition to printed questionnaires, data were also collected online through Google Forms, which were distributed via various university groups. Participants were informed about the study's purpose, and informed consent was obtained before they completed the questionnaire.

Statistical Analysis:

The sample size was determined using the Cochran formula, with a 5% margin of error and a 95% confidence interval, resulting in a target sample size of 384. To account for potential non-responses, an additional 10% (40 participants) was added, making the final sample size 424. Ultimately, 436 responses were collected.

The data were initially entered into Google Sheets for cleaning, during which incomplete or inconsistent responses were removed. The cleaned data were then analyzed using IBM SPSS Statistics software, version 27 (release 27.0.1.0). Descriptive statistics were calculated to summarize demographic characteristics and the frequency of responses to each questionnaire item. Given the categorical nature of the variables, frequencies, and percentages were used to assess the prevalence and patterns of vaping.

Chi-square tests were employed to explore the relationships between categorical variables, such as gender, age groups, educational level, financial status, and vaping status. This analysis identified significant associations between demographic factors and participants' awareness or misconceptions about vaping. To examine the association between adverse effects and physiological changes with the use of nicotine-containing versus nicotine-free e-liquids, binary logistic regression analysis was performed. The Independent variable was nicotine content in e-cigarettes, while the dependent variables included reported adverse effects and physiological changes. The analysis provided odds ratios (OR) and 95% confidence intervals (CI) for each dependent variable, offering insights into the likelihood of health outcomes based on nicotine content.

A significance level of $p < 0.05$ was set for all statistical tests to ensure the reliability of the findings. Results were presented in tables and graphs to facilitate the interpretation of complex statistical information, making the findings accessible to a broader audience.

This study was conducted with strict adherence to ethical guidelines. Ethical approval was granted by the Institutional Research and Ethical Board (IREB) of Khyber Medical College, under approval number 183/DME/KMC. Informed consent was obtained from all participants, who were assured of the voluntary nature of their participation and the confidentiality of their responses. To protect participants' privacy, data were securely stored and accessible only to the research team, ensuring compliance with ethical standards throughout the research process.

RESULTS:

Demographics:

This research was conducted on a total of 436 students from university of Peshawar. Majority of respondents were male (67.9%,n=296),less than 22 yearsof age (71.1%, n=310),undergraduate students (82.34%,n=359),residing in city(74.3%,n=324) and with a monthly family income between Rs. 1-2 lacs/ month (30.0% ,n=131).

Smoking status:

77.1%(n=336) of the total respondents had ever heard about e-cigarettes and those who were undergraduates and residing in city were significantly more likely to answer “yes” to thequestion “have you ever heard of e-cigarettes ?” .More details are displayed in Table 1.

Table 1: Analysis of various demographics if they have heard about E-cigarettes.

		HaveyoueverheardofE-cigarettes?			
		No	Yes	Total	p-value
Gender	Male	63	233	296	
	Female	37	103	140	0.233
Age	Under22	77	233	310	
	23and above	23	103	126	0.138
SettlementType	City	63	261	324	
	Village	37	75	112	0.003
Education	Undergraduate	95	264	359	
	Postgraduate	4	27	31	0.001
	Diploma	0	17	17	
	Other	1	28	29	0.001
Income	LessthanRs.50,000	21	57	78	
	Rs.50,000to100,000	28	102	130	0.242
	Rs.100,000to200,000	35	96	131	
	MorethanRs.200,000	16	81	97	0.242

Out of a total of 436 participants,60.3% (n=263) were non smokers while remaining 39.7% (n=173) were smokers in the following proportion ; The results of chi square test showed significant association of smoking status with gender, age , type of settlement and level of education. Exact figures with p-values are displayed in Table 2

There were significantly more male, undergraduateand under 22 years of age students (p<0.05 for each) in all the categories (non-smokers , combustible cigarette only users, e-cigarette only users and dual users).Difference was seen in type of settlement where majority of combustible cigarette only users (62.5%,n=10) resided in villages while rest of all resided majorly in city(p<0.001).There was no significant association between smoking status and monthly family income (p=0.233)

3.7%(n=16) used combustible cigarettes only,21.8%(n=95) used e-cigarettes only while 14.2%(n=62) used both combustible and e- cigarettes.

Table 2: Prevalence and Pattern of Vape Smoking Among Different Demographics

	Total	CombustibleCigarettesOnly	ECigarettesOnly	Both	None	P-value
Gender						
Male	296	16(100.0%)	79(83.2%)	54(87.1%)	147(55.9%)	<0.001
Female	140	0(0.0%)	16(16.8%)	8(12.9%)	116(44.1%)	
AgeGroups						
Under 22	310	10(62.5%)	61(64.2%)	39(62.9%)	200(76.0%)	0.048
23andAbove	126	6(37.5%)	34(35.8%)	23(37.1%)	63(24.0%)	
TypeofSettlement						
City	324	6(37.5%)	80(84.2%)	41(66.1%)	197(74.9%)	<0.001
Village	112	10(62.5%)	15(15.8%)	21(33.9%)	66(25.1%)	
HighestLevelofEducation						
Undergraduate	359	14(87.5%)	64(67.4%)	34(54.8%)	247(93.9%)	
Postgraduate	31	0(0.0%)	10(10.5%)	11(17.7%)	10(3.8%)	<0.001
Diploma	17	2(12.5%)	6(6.3%)	9(14.5%)	0(0.0%)	
Other	29	0(0.0%)	15(15.8%)	8(12.9%)	6(2.3%)	
FamilyMonthlyIncome						

LessthanRs.50,000	78	4(25.0%)	22(23.2%)	13(21.0%)	39(14.8%)	
Rs.50,000to100,000	130	7(43.8%)	29(30.5%)	22(35.5%)	72(27.4%)	
Rs.100,000to200,000	131	3(18.8%)	24(25.3%)	13(21.0%)	91(34.6%)	0.233
MorethanRs.200,000	97	2(12.5%)	20(21.1%)	14(22.6%)	61(23.2%)	

Prevalence and pattern of e-cigaretteuse:

Total prevalence of e-cigarette use among our sample was 36%(n=157) with 21.8%(n=95) being e-cigarette only users while 14.2%(n=62)being dual users.

Table 3 shows pattern of e-cigarette use by the participants. Majority of the e-cigarette users (exclusive+dual) were non-dailyusers(61.1%,n=96)whohad started usingthem <6 months ago (51.6%,n=81).Most of them used nicotine free(36.9%,n=58), fruit flavored (67.5%,n=106), ready-to-use e-liquid (46.5%,n=73) with both propylene glycol (PG) and vegetable glycerine (VG) as additives (38.9%,n=61).Exclusive e-cigarette users followed exactly the same pattern while dual users differed significantly from e-cigarette only users in all these characteristics as majority of them had started using e-cigarettes 1-2 years ago with a frequency of 1-10 times a day. Most of them used tobacco flavored e-liquid containing 1-18mg/ml of nicotine with vegetable glycerin as additive (p<0.05 for each).

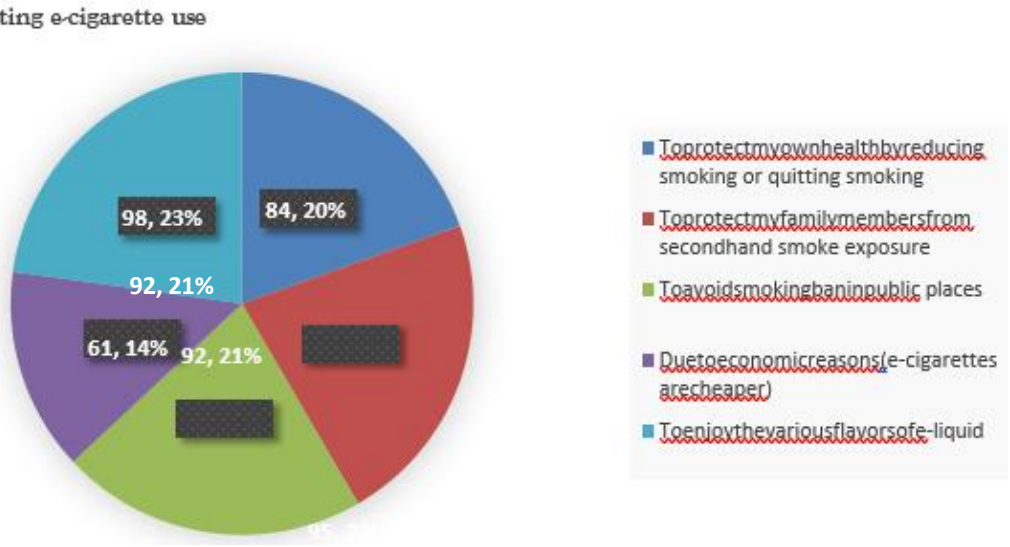
Table 3

E-cigarettes use and Tobacco smoking practice by participants

	Total Participants	E-Cigarettes Only	Bothof Them	p-value
3.Howlonghaveyoubeenusingane-cigarette?	157			
Lessthan6months ago	81	58(71.6%)	23(28.4%)	
6–12months ago	31	19(61.3%)	12(38.7%)	
1–2yearsago	29	11(37.9%)	18(62.1%)	0.007
Morethan2yearsago	16	7(43.8%)	9(56.3%)	
4.Howoftendoyouuseane-cigarette?	157			
Non-daily	96	73(76.0%)	23(24.0%)	
1–10timesaday	36	11(30.6%)	25(69.4%)	
11–19timesaday	13	4(30.8%)	9(69.2%)	<0.001
≥20timesaday	12	7(58.3%)	5(41.7%)	
5.Howmanymg/mlofnicotinecontainsthee-cigaretterefille-liquidyouarecurrently using?	157			0.003
Nicotine-free	58	42(72.4%)	16(27.6%)	
1–18mg/ml	45	18(40.0%)	27(60.0%)	
Morethan18mg/ml	54	35(64.8%)	19(35.2%)	
6.Whatkindofe-cigaretterefille-liquiddoyou use?	157			
Prefilledcartomizers	41	21(51.2%)	20(48.8%)	
Ready-to-usee-liquid	73	47(64.4%)	26(35.6%)	0.362
Do-it-yourselfe-liquid	43	27(62.8%)	16(37.2%)	
7.Whatflavorede-liquiddoyouuse?(Youcanchoosemore)	157			
Tobaccoflavored	22	7(31.8%)	15(68.2%)	
Fruitflavored	106	70(66.0%)	36(34.0%)	0.011
Dessertflavored	29	18(62.1%)	11(37.9%)	
8.Whichadditivecontainsthee-liquidusedforyoure-cigarette?	157			
PG-propyleneglycol	52	35(67.3%)	17(32.7%)	
VG-vegetableglycerin	44	18(40.9%)	26(59.1%)	0.007

PG-propyleneglycolandVG-vegetableglycerin	61	42(68.9%)	19(31.1%)	

Figure 1



Knowledge about e-cigarettes:

Respondents who correctly answered the knowledge questions ranged from 22.2%-87.8% andare presented in Figure 2.

Majority (87.8%,n=383) of the total respondents knew that tobacco smoking is harmful forhealth and environment while 2/3rdof them (66.7%,n=291) mono-oxide than combustible cigarettes (22.2%,n=97) and that e-cigarettes are not less harmful than combustible cigarettes (26.6%,n=116).

Overall , non-smokers were the ones who provided most correct answers to all the knowledge questions whereas among smokers, e-cigarette users provided the most correct answers as they mostly correctly knew that e-cigarettes are harmful to health and environment. More than 1/3rd of the respondents (36%,n=157) reported that e- cigarettes are not a safer way of nicotine intake whereas nearly 1/4thof them reported that use of e-cigarettedoesn'treducepassivesmoking(25.9%,n=113), e-cigarettesdonotemitlesscarbon

responded to the questions tobacco smoking is harmful for health and environment(22.2%),e-cigarettes are harmful to health and environment (17.9%) and e-cigarette is not a safer way for nicotine intake(12.7%) and all these were significant with p<0.05 for each. See Table 4for more details.

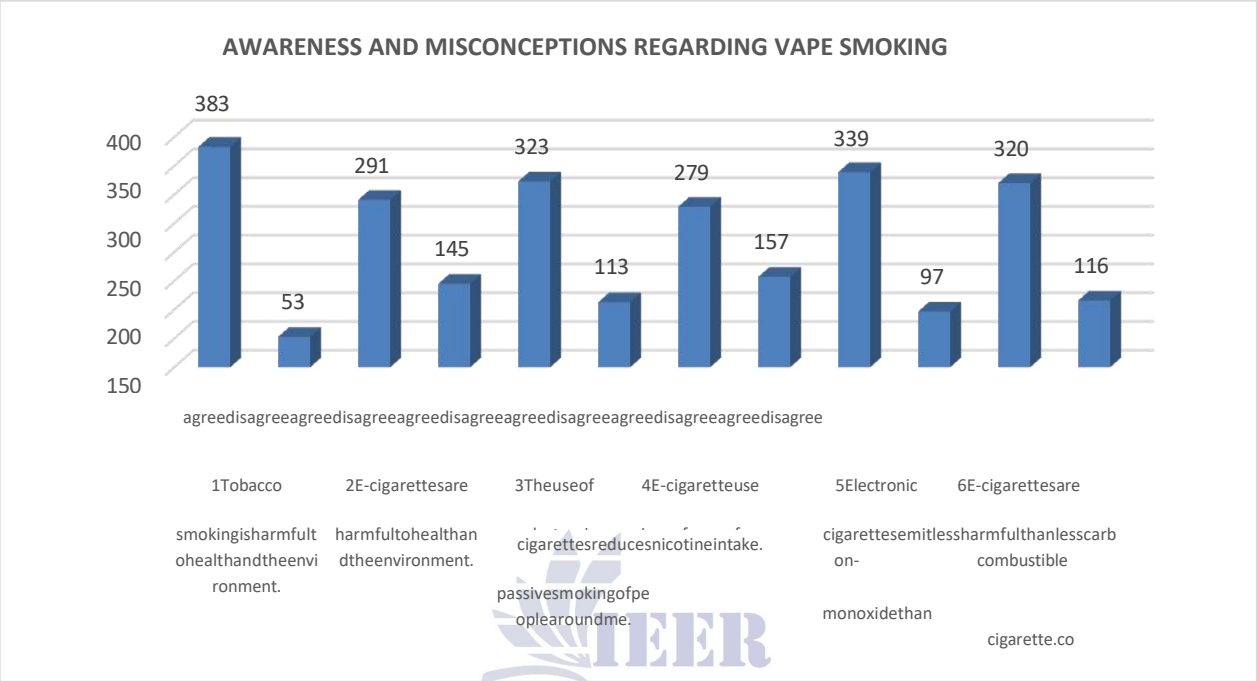
Table 4

.AWARENESSANDMISCONCEPTIONSRDINGVAPESMOKING REGA

	Total Participants	Combustible CigarettesOnly	E-Cigarettes Only	Bothof Them	Noneof Them	p- value
Tobacco smoking is harmful to health and the environment.	383	11(2.9%)	85(22.2%)	42(11.0%)	245 (64.0%)	<0.001
E-cigarettes are harmful to health and the environment.	291	9(3.1%)	52(17.9%)	22(7.6%)	208 (71.5%)	<0.001
The use of electronic cigarettes reduces passive smoking of People around me.	113	7(6.2%)	15(13.3%)	17(15.0%)	74 (65.5%)	0.037
E-cigarette use is a safer way for nicotine intake.	157	9(5.7%)	20(12.7%)	13(8.3%)	115 (73.2%)	<0.001

Electronic cigarettes emit less carbon-monoxide than Combustible cigarettes.	97	6(6.2%)	18(18.6%)	16(16.5%)	57 (58.8%)	0.354
E-cigarettes are less harmful than combustible cigarette.	116	6(5.2%)	15(12.9%)	16(13.8%)	79 (68.1%)	0.041

Figure2



Vaping related self-reported adverse effects: Table 5 shows the adverse effects reported by e-cigarette users. Out of a total of 157 e-cigarette users ,20(12.7%) reported no adverse effects with dual users significantly more likelyto report it than e-cigarette only users (21% vs 7.4%, p=0.012). Overall, the self reported adverse effects ranged from a minimum of 10.2% for those who reported chest pain to a maximum of 49.7% for those who reported headache .Surprisingly, not a single e-cigarette user among our sample reported sore or dry mouth and throat. All the adverse effects were reported more by the dual userscomparedtoe-cigaretteonlyusersandthisdifferencewassignificantforalladverseeffects except for nose bleeding (p=0.085) and sleepiness (p=0.056).The five most frequently reported complaints by e-cigarette only users were headache, dizziness, mouth or tongue sores, black tongue and nose bleeding .Dual users also followed the same pattern with the exception of gingivitis/ gum bleeding which was second most frequent adverse effect in dual users but 7th most frequent in e-cigarette only users (p<0.001).On the other hand, least reported adverseeffects among e-cigarette only users were chest pain and heart palpitations (6.3%, n=6 for both) whereas for dual users , it was chest pain only (16.1%, n=10).

Table 5

VAPING-RELATED ADVERSE EFFECTS				
Adverse Effect	**E-CigarettesOnly**	**BothofThem**	**Total**	**p-value**
SoreorDryMouthand Throat	0(0.0%)	0(0.0%)	0(0.0%)	-
Headache	36(37.9%)	42(67.7%)	78(49.7%)	<0.001
Gingivitis/GumBleeding	12(12.6%)	29(46.8%)	41(26.1%)	<0.001
MouthorTongueSores/Inflammation	16(16.8%)	23(37.1%)	39(24.8%)	0.004
BlackTongue	15(15.8%)	23(37.1%)	38(24.2%)	0.002
NoseBleeding	14(14.7%)	16(25.8%)	30(19.1%)	0.085
Cough	9(9.5%)	15(24.2%)	24(15.3%)	0.012
Dizziness	23(24.2%)	26(41.9%)	49(31.2%)	0.019
Sleepiness	13(13.7%)	16(25.8%)	29(18.5%)	0.056
Sleeplessness	8(8.4%)	14(22.6%)	22(14.0%)	0.012
HeartPalpitations	6(6.3%)	14(22.6%)	20(12.7%)	0.003
BreathingDifficulties	8(8.4%)	15(24.2%)	23(14.6%)	0.006
Allergy	9(9.5%)	15(24.2%)	24(15.3%)	0.012
ChestPain	6(6.3%)	10(16.1%)	16(10.2%)	0.047
NoSideEffect	7(7.4%)	13(21.0%)	20(12.7%)	0.012

Table 6

Adverse effects compared by nicotine-free and nicotine-containinge-liquid use.

AdverseEvent	**OddsRatio(OR)**	**95%CIforOR**	**p-value**
Soreordrymouthandthroat	N/A	N/A	N/A
Headache	**0.372**	**0.190-0.729**	**0.004**
Gingivitis/gumbleeding	0.457	0.205-1.020	0.056
Mouthortonguesores/inflammation	0.811	0.378-1.739	0.59
Blacktongue	0.994	0.466-2.120	0.988
Nosebleeding	0.56	0.231-1.356	0.199
Cough	0.83	0.331-2.079	0.689
Dizziness	0.762	0.374-1.552	0.451
Sleepiness	**0.295**	**0.106-0.822**	**0.011**
Sleeplessness	**0.141**	**0.032-0.628**	**0.001**
HeartPalpitations	0.384	0.122-1.211	0.08
Breathingdifficulties	**0.312**	**0.101-0.968**	**0.044**
Allergy	0.662	0.257-1.707	0.393
Chest pain	0.537	0.165-1.750	0.302
Nosideeffect	1.16	0.444-3.029	0.762

N/A:Calculation of odds ratios(OR) and 95%CI was not possiblebe cause the dependent variable had less than two non-missing values,which is required for logistic regression analysis.

We conducted binary logistic regression analysis to find out association of reporting these adverse effects with using nicotine containing vs nicotine free e-liquid , the results of which are displayed in Table 6. Those who used nicotine containing e-liquid were 1.6 times more likely to experience “no side effects” compared to those using nicotine free e-liquid but the result was insignificant (p=0.762, 95% CI=0.444-3.029).Moreover, users of nicotine containing e-liquids were less likely to experience adverse effects but the results were significant only for headache , sleepiness, sleeplessness and breathing difficulties (p<0.05 for each).

Perceived changes in physiological functions:
Overall, majority (36.3%-66.9%) of all e-cigarette users reported "no change" in their physiological functions since theinitiation ofe-cigaretteuse with e-cigaretteonlyusersreporting itmorefrequently(41.1%-73.7%)thandualusers(29%-56.5%)."Improvement"wasreportedby 20.4%-36.9% of all e-cigarette users but this time dual users reported it more oftenly (24.2%- 46.8%) than e-cigarette only users (17.9%-35.8%) though the results were significant only for memory(p=0.013).More details are displayed in Table 7. Physiological functions which were improvedin30%andmoreofalle-cigaretteusersweremood,senseofsmell,senseoftaste, .

memory,qualityofsleepandstaminaandleastreportedwereappetiteandsexualperformance

Both e-cigarette only and dual users followed nearly the same pattern with the major difference displayed by memory which was the most improved function for dual users (46.8%, p=0.013)but third least improved for e-cigarette only users. The results of binary logistic regression analysis carried out to find association between the use of nicotine containing vs. nicotine free e- liquid and reporting improvement in physiological functions are displayed in Table 8. Users who consumed nicotine containing e-liquids were "less likely" to report improvement than those who used nicotine free e-liquids except for breathing which displayed opposite trendbut the results were significant only for physical status in general and sense of smell (p<0.05 for both).

Table 7

Physiological Functions	Response	E-cigarettes only	Both	Total	p-value
1.Physicalstatusingeneral	Worsened	20.0%(19)	22.6%(14)	21.0%(33)	0.738
	Nochange	54.7%(52)	48.4%(30)	52.2%(82)	
	Improved	25.3%(24)	29.0%(18)	26.8%(42)	
2.Smell	Worsened	20.0%(19)	25.8%(16)	22.3%(35)	0.45
	Nochange	45.3%(43)	35.5%(22)	41.4%(65)	
	Improved	34.7%(33)	38.7%(24)	36.3%(57)	
3.Taste	Worsened	22.1%(21)	25.8%(16)	23.6%(37)	0.332
	Nochange	47.4%(45)	35.5%(22)	42.7%(67)	
	Improved	30.5%(29)	38.7%(24)	33.8%(53)	
4.Breathing	Worsened	27.4%(26)	29.0%(18)	28.0%(44)	0.699
	Nochange	48.4%(46)	41.9%(26)	45.9%(72)	
	Improved	24.2%(23)	29.0%(18)	26.1%(41)	
5.Appetite	Worsened	25.3%(24)	24.2%(15)	24.8%(39)	0.648
	Nochange	53.7%(51)	48.4%(30)	51.6%(81)	
	Improved	21.1%(20)	27.4%(17)	23.6%(37)	
6.Sexualperformance	Worsened	8.4% (8)	19.4%(12)	12.7%(20)	0.052
	Nochange	73.7%(70)	56.5%(35)	66.9%(105)	
	Improved	17.9%(17)	24.2%(15)	20.4%(32)	
7.Mood	Worsened	21.1%(20)	21.0%(13)	21.0%(33)	0.924
	Nochange	43.2%(41)	40.3%(25)	42.0%(66)	
	Improved	35.8%(34)	38.7%(24)	36.9%(58)	
8.Memory	Worsened	25.3%(24)	16.1%(10)	21.7%(34)	0.013
	Nochange	50.5%(48)	37.1%(23)	45.2%(71)	
	Improved	24.2%(23)	46.8%(29)	33.1%(52)	
	Worsened	27.4%(26)	27.4%(17)	27.4%(43)	

9.Qualityofsleep	Nochange	41.1%(39)	40.3%(25)	40.8%(64)	0.995
	Improved	31.6%(30)	32.3%(20)	31.8%(50)	
	Worsened	33.7%(32)	33.9%(21)	33.8%(53)	
10.Stamina	Nochange	41.1%(39)	29.0%(18)	36.3%(57)	0.197
	Improved	25.3%(24)	37.1%(23)	29.9%(47)	

Table 8: Physiological Functions compared by nicotine-free and nicotine-containinge-liquid use.

PhysiologicalFunctions	OR	95% CI Lower	95% CI Upper	P-Value
PhysicalStatus	**0.306**	**0.13**	**0.718**	**0.007**
Smell	**0.539**	**0.267**	**1.086**	**0.084**
Taste	0.726	0.361	1.458	0.368
Breathing	1.296	0.625	2.685	0.486
Appetite	0.657	0.297	1.455	0.3
SexualPerformance	0.607	0.259	1.42	0.25
Mood	0.664	0.334	1.318	0.242
Memory	0.667	0.329	1.351	0.261
Qualityof Sleep	0.728	0.358	1.481	0.381
Stamina	0.636	0.306	1.324	0.226

DISCUSSION:

To the best of our knowledge, this is the first study to investigate the prevalence, usage patterns, knowledge, and health outcomes of e-cigarette use among university students in Peshawar, the capital of Khyber Pakhtunkhwa province in Pakistan. Our findings revealed a high prevalence of e-cigarette use and distinct usage patterns within the sample population. Moreover, there were significant misconceptions regarding the health effects of e-cigarettes. Interestingly, individuals who used both traditional and e-cigarettes reported more adverse effects but also perceived greater improvements in their physiological functions compared to those who exclusively used ecigarettes. This suggests a complex relationship between dual use and health outcomes. These results carry important implications for public health policies and educational interventions, highlighting the need to address both the misconceptions and the health risks associated with ecigarette use. The prevalence of e-cigarette use in our sample (36%) was less than that reported in university students of Karachi(50.4%)[18] that can be due to the reason that their sample was comprised mainly of private university students, hence having higher socio-economic status, compared to our sample of a public university. When compared to the other parts of the world, our sample's prevalence was more than that reported in the undergraduates of U.S.(24.8%) [19] and (34.3%) [20], New Zealand (6.1%) [21], Malaysia (28.1%) [22], Saudi Arabia (11.7%) [23], UAE(3.7%) [24]and Qatar(14%) [25], but it was less than that reported in Australia (61.9%) [26]. Higher prevalence of vaping in our sample may be attributed to un-regulated vaping market in Pakistan and is a call for action before it takes the shape of an epidemic [27]. Our study found a notable 14.2% dual use rate, which was unexpectedly lower than exclusive e- cigarette use (21.8%), contradicting previous studies [28–32]. This difference may indicate that our population has unique traits, such as stronger preference for e-cigarettes or a greater motivation to quit combustible cigarettes, or that there is a shift in vaping behaviors, potentially driven by changing attitudes, marketing or regulations. Further research should investigate this difference more thoroughly so as to find out the exact reasons for more popularity of e-cigarettes among our population and hence develop targeted interventions accordingly. We found distinct patterns of electronic cigarette usage among dual and exclusive e-cigarette users. The majority of users, especially e-cigarette only users, were non-daily consumers, reporting a preference for fruit-flavored and nicotine-free products, suggesting inclination towards more enjoyable and less harmful option. These results align with some previous researches [33–35] but contradicts the findings of a research[36]

in which e-cigarette only users consumed higher levels of nicotine in e-juice compared to dual users. In contrast, dual users exhibited more frequent usage patterns and a preference for nicotine-containing, tobaccoflavored e-liquids, which may suggest nicotine dependence or a desire to maintain smoking like experience. Although a study conducted on dual users in Chicago, a city of United States, contradicted the above finding [37], yet many other studies [35,38,39] reported similar results as well. In addition to the above findings, our study reported that e-cigarette only users were more recent adopters of e-cigarettes compared to dual users who had comparatively a prolonged duration of use. This disparity may again reinforce the fact that dual users, having already been used to nicotine through traditional cigarettes, were more likely to adopt e-cigarettes earlier as a mean to complement or reduce their smoking habits [40,41]. In contrast, more recent adoption of e-cigarettes by e-cigarette only users can be linked to increased marketing of e-cigarettes by social media platforms which portray e-cigarettes as a modern, flavorful and relatively safe alternative, hiding their health warnings, hence compelling the youth to initiate e-cigarette use [42–45]. Approximately 23%, 22% and 21% of e-cigarette users in our sample used e-cigarettes to enjoy various flavors, protect family from second hand smoke exposure and to avoid smoking ban in public places respectively. Somewhat similar percentages were found in some other studies [46–48]. This finding further support the fact that users want an enjoyable and socially acceptable product which will reduce the harm to others, and e-cigarettes are perceived to have above all qualities, hence they prefer e-cigarettes. The reasons mostly cited as important by participants from other studies include curiosity and because friends were using it suggesting a significant role of social factors in e-cigarette adoption[49–52]. Most of the researches conducted previously found un-satisfactory or average knowledge and awareness about health risks of e-cigarettes [53–56]. In our sample, we got a knowledge range of 22.2%-87.8% which was comparable to a multinational study conducted among dental students [46]. While a majority (87.8%) of the participants recognized tobacco smoking as harmful to health and environment, only 66.7% considered similar risk with e-cigarettes, indicating a knowledge gap of 21.1%. Proportion of participants who knew that e-cigarettes are harmful was high in previous studies [46,55] compared to ours. In our study, more than onethird of the respondents denied that e-cigarettes are a safer way of nicotine intake and nearly onefourth denied them to be less harmful than combustible cigarettes. Other studies assessing knowledge about relative dangers of combustible and electronic cigarettes found that 23.1% [55], 41.8% [23], 41.9% [25] and 53.5% [57] of the respondents considered e-cigarettes as less harmful than combustible ones. This widespread misconception may persist due to several factors. One contributing element is the marketing of electronic cigarettes as smoking cessation aids, potentially fostering a false perception of reduced harm. Furthermore, the diverse array of appealing e-liquid flavors might diminish the perceived dangers, particularly among younger consumers who may be more attracted to the novelty of these flavors than concerned about potential health risks. The perceptions about passive smoke associated with e-cigarettes have been different. 19.7% of the undergraduates in Thailand believed that e-cigarettes do not produce second hand smoke [58]. In contrast, 21.1% of Saudi undergraduates perceived them to produce second hand smoke, but, with lesser risks compared to tobacco products [55]. Also, 25.9% of our participants believed that e-cigarettes do not reduce passive smoking and this proportion was lesser than that reported among dental students (35.8%) [46]. This suggests a knowledge gap regarding the harmful chemicals that e-cigarettes release and how they differ from secondhand smoke from traditional cigarettes in their ability to affect nearby people. This false belief may have an impact on public health since it could normalize vaping in public places or among people who don't smoke. Hence, there is a need for awareness programs that can increase knowledge about dangers of e-cigarettes among our population, one such example being the implementation of VKT curriculum among students [59]. Our finding that non-smokers were overall most knowledgeable about e-cigarettes is in line with another study[46], while the one that among smokers, e-cigarette users possessed the maximum knowledge, is supported by a study [60] while contradicted by another [46]. This

trend of ecigarette users being more knowledgeable in our study could mean that people who use ecigarettes are more aware of the products they use, either because they want to justify their behavior or they actively look for harm-reduction information. However, knowing these risks doesn't always lead to quitting, suggesting a difference between what they know and how they act. The adverse effects of e-cigarette use on health have been well documented [61–65]. In our study, the most frequent adverse effects reported by e-cigarette only users were headache and dizziness concurrent with the findings of Alhajj et al.[66], while that in dual users were headache followed by gingivitis which is again supported by previous studies that found gum related problems to be more common among combustible cigarette users than e-cigarette users [67,68]. However, our study found no reports of sore/dry mouth and throat, which is a well documented adverse effect in other studies [69–72]. This could be due to the specific e-liquid compositions or device types used by our participants, possibly involving newer devices designed to minimize throat irritation. It is also possible that our participants had adjusted to vaping over time and no longer experienced these symptoms. Overall, dual users significantly experienced more adverse effects than exclusive e-cigarette users. This finding is in line with previous studies that reported more adverse effects with dual use [72–74], but it is in contrast to the finding of Pénzes at al. [71] that exclusive e-cigarette users experienced more adverse effects, though their result was not significant. Individuals using both conventional and electronic cigarettes are exposed to harmful substances from both like cigarette combustion products, electronic cigarette aerosols, and combined nicotine from the two and hence, it may be the reason that they were more likely to report adverse effects in our study. These results that simultaneous usage of e-cigarettes may exacerbate rather than improve health outcomes hence emphasize the need for caution while using them as a smoking cessation aid. In our study, we were unable to identify a significant association between dual or exclusive ecigarette use and any change in most of the physiological functions. Still, our data indicates that a majority, particularly exclusive e- cigarette users, reported no change in their functions since initiating e-cigarette use. Even among those few participants who perceived improvement, there were more dual users compared to e-cigarette only users. This finding contrasts with most of the previous studies wherein exclusive e-cigarette users perceived more improvement in their health compared to dual users [66,71,72] but, it should be interpreted with caution as the improvements were in context of switching from traditional cigarettes to exclusive e-cigarette use [72,73]. So, it may suggest that whether improvement is perceived or not depends on the intent of initiating e-cigarette use as stated in a study [71] that those whose reason of e-cigarette initiation was smoking reduction or cessation were more likely to have perceived any improvement. Also, that any perceived improvement among e-cigarette users may be more closely related to cigarette reduction rather than the benefits of vaping itself. Hence, exclusive ecigarette users in our study may have experienced no change because they might not be transitioning from more harmful traditional cigarettes and, the finding that dual users experienced more improvement could be attributed to those who would have reduced combustible cigarette smoking after e-cigarette initiation. But again, as these findings were not significant, future studies are needed that should investigate this difference more thoroughly since knowing exactly what is causing these improvements could help develop more effective smoking cessation strategies and harm reduction approaches.

CONCLUSION:

The study conducted at Peshawar University sheds light on the prevalent awareness, usage patterns, and perceptions surrounding electronic cigarettes (e-cigarettes) among undergraduate students. The findings revealed a notable level of awareness among participants regarding e-cigarettes, with a considerable percentage actively using these devices. It's crucial to underscore that a majority of participants abstained from using either e-cigarettes or combustible cigarettes.

The demographic analysis underscored a balanced gender distribution among participants, predominantly residing in urban settings and possessing undergraduate degrees. Additionally,

varying family income distributions and age ranges provided a comprehensive overview of the cohort.

Noteworthy trends emerged regarding e-cigarette usage, with a significant portion of users initiating usage within the last six months, preferring non-daily usage, and displaying preferences for nicotine-free and fruit-flavored e-liquids. Motivations for e-cigarette use encompassed health considerations, avoidance of secondhand smoke, adherence to smoking bans in public areas, and economic factors.

Regarding attitudes, a substantial percentage expressed strong beliefs regarding the harmful nature of both tobacco smoking and e-cigarettes. However, divergent opinions emerged concerning the safety comparison between e-cigarettes and traditional combustible cigarettes.

An intriguing aspect was the low combustible cigarette usage among participants, with a majority not having a history of smoking before transitioning to e-cigarettes. This suggests a shift or initiation toward e-cigarette usage without prior combustible cigarette exposure among a significant proportion of users.

The study's comprehensive approach, encompassing awareness levels, usage patterns, attitudes, and demographics, provides a nuanced understanding of the landscape surrounding e-cigarette use among Peshawar University undergraduates. The insights gleaned from this research serve as a critical foundation for further investigations into the health effects and public health implications of e-cigarette usage, especially within the context of Pakistani youth.

Given the rising popularity of e-cigarettes and the lack of extensive studies in this domain in Pakistan, this research serves as a significant contribution to understanding the nuances of e-cigarette usage among the youth, aiding in the formulation of targeted interventions and policies to address potential health concerns and misinformation surrounding these devices

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