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Emerging Nicotine and Tobacco Products among Medical Students and Physicians at Ain Shams University: Knowledge, Attitude, and Practice

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ABSTRACT

Background: Emerging nicotine and tobacco products such as Electronic Nicotine Delivery Systems (ENDS) and Heated Tobacco Products (HTPs) have become popular worldwide. **Objective:** To measure the knowledge, attitude, and practice of medical students and physicians at Ain Shams University (ASU) toward ENDS and HTPs and to identify the factors associated with their use. **Method:** A cross-sectional study was conducted among 407 undergraduate medical students and 111 physicians at ASU. The data were collected using an electronic questionnaire including socio-demographic characteristics, knowledge, attitude, and practice of participants toward ENDS and HTPs, and factors associated with their use. **Results:** The mean age of participants was 22.7±5.39 years, 63.5% were females, and 7.3% were current smokers. Approximately 84.4% and 19.5% of the participants had previously heard about ENDS and HTPs, respectively. Friends were the most reported source of information about ENDS (61.6%) and HTPs (63.4%). More than half of the participants agreed that ENDS and HTPs encourage smoking initiation in those who have never smoked. 4.6% and 11.9% of participants who had previously heard of ENDS and HTPs (respectively) had used them. Physicians were more knowledgeable about ENDS than medical students (p=0.008). **Conclusion:** Most participants had a negative attitude toward ENDS and HTPs. As all ENDS smokers were medical students rather than physicians who were more knowledgeable about ENDS and HTPs, health education programs should mainly target medical students. Counseling should be specifically started for ENDS and HTPs users.

INTRODUCTION

The tobacco epidemic is one of the biggest public health threats the world has ever faced, killing more than 8 million people a year around the world. Nowadays, there are novel and emerging nicotine and tobacco products like Electronic Nicotine Delivery Systems (ENDS) and Heated Tobacco Products (HTPs).[1] ENDS use an e-liquid that may contain nicotine, glycerin, propylene glycol, flavorings, and other ingredients; the device has an electric source that heats the e-liquid to create an aerosol that the user inhales.[2] On the other side, HTPs consist of a heating source and tobacco; the tobacco is heated to a lower temperature than a combusted cigarette to create an aerosol that the user inhales.[3] According to FDA (2020), there is no safe tobacco product. Non-combusted cigarettes may help reduce the risk of tobacco use for adult smokers who switch completely from combusted cigarettes, but all tobacco products can lead to nicotine addiction. Also, they contain toxic and cancer-causing chemicals that can cause serious health problems. So, ENDS and HTPs are not FDA-approved method for quitting smoking.[3]

In 2019, there was an outbreak of lung injury associated with the use of electronic cigarettes, or vaping products (EVALI) in the United States resulting in around 2800 hospitalized EVALI cases and 68 deaths. Laboratory data showed that an

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additive in some electronic cigarettes was strongly linked to the EVALI outbreak.[4] Public health organizations and medical experts around the world are raising concerns that those who smoke ENDS or HTPs may be at higher risk for COVID-19 infection susceptibility, severity, and adverse outcomes.[5,6]

Recently, the prevalence of ENDS and HTPs has increased among medical students. In USA, a study conducted in Minnesota in 2018 showed that (14.7%) of medical students had ever used e-cigarettes.[7] In Saudi Arabia, 15.9% of medical students at Taibah University used ENDS.[8] While at Umm Al-Qura University, 31.8 % of the surveyed medical students confirmed using ENDS regularly.[9] In Egypt, a study conducted at Governmental and Private Universities showed that 8.8% of students used e-cigarettes ≥2 times. ENDS were more common among men, older students, those belonging to higher economic classes, students of the theoretical faculties, those attending private universities, and smokers.[10] Moreover, a study showed that 71% of Physicians from Ain-Shams University Hospital have heard of ENDS and media advertisements were the main source of their knowledge.[11]

Young adults are the main target group for ENDS and HTPs companies because they are trendy, mobile, and flavorful, making them popular among young people. They have different reasons for using ENDS than older adults; like experimenting new tools, varied flavors, and quitting traditional smoking.[12] The socio-demographic characteristics of the Egyptian population have shown variations resulting in changes in their smoking pattern.[13] Although the number of ENDS and HTPs users is increasing, there is a scarcity of knowledge about their use among Egyptian medical students and Physicians. So the objectives of the study were to measure the knowledge, attitude, and practice of medical students and physicians at Ain Shams University (ASU) toward ENDS and HTPs and to identify the factors associated with their use.

METHOD

A cross-sectional study was carried out from April 2022 to September 2022 in the Faculty of Medicine, ASU, in Cairo, Egypt.

Using Epi Info 7 Program for sample size calculation, setting a confidence interval at 95%, it is estimated that a sample size of 385 medical students will be enough to detect an expected prevalence of good knowledge among medical students toward ENDS and HTPs of about 50% ± 5%. And regarding physicians, a sample size of 100 Physicians will be needed to detect an expected prevalence of good knowledge among Physicians toward ENDS and HTPs of about 50% ± 10%.[14]

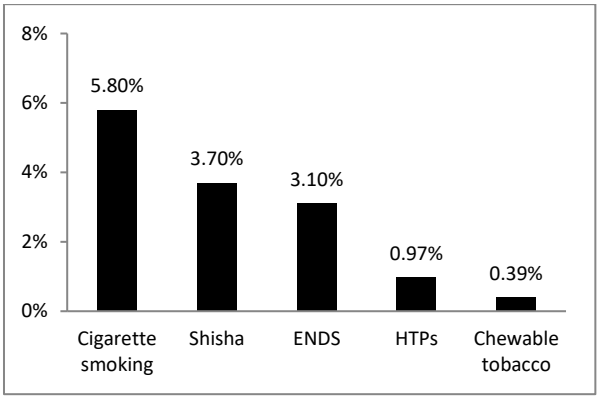

Figure 1: Types of used tobacco products among the studied sample.

A convenience sample of medical students from Faculty of Medicine and physicians from the internal medicine and chest departments at ASU Hospital was recruited. A total 407 undergraduate medical students and 111 physicians at ASU were included.

Operational definitions: E-cigarette users: Participants who used ENDS twice or more. Current smokers: Participants, who reported smoking at least 100 cigarettes during their lifetime and who, at the time they participated in a survey, reported smoking every day or some days."

Data Collection Tool: An internet-based questionnaire was conducted among medical students and physicians in ASU Hospitals. Data collection was fulfilled with the aid of junior doctors to disseminate the Google form and motivate participants to fill it. The questionnaire was distributed in English form. Knowledge, practice, and reasons for smoking were adapted from World Health Organization's Global Adult Tobacco Survey (GATS), 2020[15], and the Attitude section was adapted from Dwedar et al., 2019[11].

The final questionnaire consisted of four sections: *Section I* included socio-demographic and lifestyle characteristics such as age (in years), gender, nationality, grade, residence, working status, hobbies, practicing sports, personal monthly expenditure, previous and current smoking (cigarette, shisha, ENDS, and HTPs). *Section II* included knowledge of the participants about ENDs

Table 1: Knowledge of the study participants about ENDS and HTPs

	ENDS N. (%)	HTPs N. (%)
Previously heard about ENDS or HTPs	437 (84.4)	101(19.5)
Source of knowledge		
Media advertisement	236 (54)	41 (40.6)
Newspaper	30 (6.9)	19 (18.8)
Roadside poster	24 (5.5)	13 (12.9)
Friends	269 (61.6)	64 (63.4)
Patients	18 (4.1)	8 (7.9)
Professional source	27 (6.1)	7 (6.9)
Others*	13 (3)	1 (1)
They cause lung cancer	287 (65.7)	83 (82.2)
They cause cardiovascular problems	282 (64.5)	86 (85.1)
They cause cerebral stroke	215 (49.2)	76 (75.2)
They contain carcinogenic ingredients	259 (59.3)	84 (83.2)
They are addictive	254 (58.1)	82 (81.2)
They are less harmful to health compared to traditional cigarettes	199 (45.5)	39 (38.6)
They prevent person from smoking traditional cigarettes	159 (36.4)	24 (23.8)

** Family members used it, people in public places used it, or don't know a specific source*

Table 2: Attitude of the studied sample toward ENDS and HTPs

	ENDS N. (%)	HTPS N. (%)
They are safer to use than regular cigarettes	144 (33)	28 (27.7)
They are helpful aids for smoking cessation	121 (27.7)	37 (36.6)
They encourage smoking initiation in those who have never smoked	299 (68.4)	55 (54.5)
They encourage smoking continuation among smokers who might have quit otherwise	275 (62.5)	59 (58.4)
They contain some chemicals that may cause long-term health effects	319 (73.0)	81 (80.2)
Their smoking is a public health concern	286 (65.4)	64 (63.4)
Their smoking should be regulated in public areas	273 (62.5)	57 (56.4)
They can lower cancer risk compared to traditional cigarettes	126 (28.8)	28 (27.7)
They can be a gate way for smoking other tobacco products later	297 (68.0)	69 (68.3)
They can increase the risk of COVID19 infection	215 (49.2)	60 (59.4)

and HTPs. They were asked if they have ever heard of ENDs and HTPs; those who have not ever heard of them were asked to end the questionnaire at this point. Participants who have heard of them were further asked about how they first learned about them and their knowledge regarding the influence of ENDs and HTPs on health, for example, lung cancer, cardiovascular problems, and cerebral stroke.[15] *Section III* included attitude of the participants toward ENDS and HTPs. Answers were on a 3-point Likert scale (Agree, Neutral, and Disagree). They were asked whether they thought ENDS and HTPs are safe aid for smoking cessation, encourage smoking initiation and continuation, and can cause long-term health effects. They also asked if ENDS and HTPs are a public health concern, should be avoided in public areas, can lower cancer risk than traditional cigarettes, whether they recommend the use of them and the effect of their smoking on COVID-19 infection.[11] *Section IV* included practice of the participants toward ENDS and HTPs; it included questions about their use among the participants, timing of their use, and reasons behind ENDS and HTPs use.[15]

Validation: A pilot test included 20 subjects (10 medical students and 10 physicians) to test accuracy and the language of the questionnaire. Pilot test results were not included, and no correction was conducted in the wording of the questionnaire. All students indicated that the questions were clear and easy to be understood.

Data analysis: Collected data were revised for completeness then coded and finally entered to a personal computer to be analyzed using computer

Table 3: ENDS and HTPs smoking among the participants.

	ENDS N. (%)	HTPs N. (%)
Previous smoking	20 (4.6)	12 (11.9)
Causes of smoking		
• Trying it out of curiosity	9 (45)	4 (33.3)
• Due to their appealing flavours	10 (50)	3 (25)
• To quit smoking traditional tobacco products	5 (25)	2 (16.7)
• To reduce the number of smoked traditional tobacco products	3 (15)	3 (25)
• They are less harmful than other traditional tobacco products	5 (25)	5 (41.7)
• I feel less embarrassed than using other types of smoking	1 (5)	1 (8.3)
• To cope with friend's atmosphere	3 (15)	2 (16.7)
• They can be used in non-smoking area	2 (1)	3 (25)

program SPSS version 22. Data were presented and suitable analysis was done according to the type of data obtained for each parameter (mean, standard deviation, range, ANOVA for quantitative data and frequency, percentage, and chi-square for qualitative data). A value of $p \leq 0.05$ was considered significant.

A knowledge score for ENDS was calculated by summing the number of correct answers for all knowledge items. The knowledge score for each of them ranged from 0 to 7 depending on the number of correct answers the participant had on the 7 knowledge questions. For each item, a correct answer was given a value of 1, and an "incorrect" or "don't know" answer was given a 0 value.[16] Reliability of ENDS' knowledge score was applied on the pilot sample and the Cronbach's Alpha was 0.73.

RESULTS

The study was conducted among 407 (78.6%) of ASU medical students and 111 (21.4%) physicians. The mean age of the recruited participants was 22.7±5.39 years, 63.5% of them were females, 83% were Egyptian, and 93.1% single. Also, 86.7% live in urban areas, 80.7% live with family, and 69.9% had a hobby. On the other hand, 62.7% of them didn't practice sports and 29.3% of them had 500-999 EGP as a monthly expenditure. Furthermore, 7.3% of the study participants were current smokers. Figure 1 shows the most used tobacco products was cigarette smoking.Table (1) shows that 84.4% and 19.5% of the participants had previously heard of ENDS and HTPs respectively. Friends were the most reported source of information about ENDS (61.6%) and HTPs (63.4%). More than half of whole participants reported that ENDS and HTPs can cause lung cancer, cardiovascular problems, contain carcinogenic materials, and that they are addictive.

Table (2) shows that more than half of the whole participants agreed that ENDS and HTPs encourage smoking initiation in those who have never smoked, they encourage smoking continuation among smokers who might have quit otherwise, their smoking is a public health concern, their smoking should be regulated in public areas and they can be a gateway for smoking other tobacco products later. More than two-thirds of the participants believed that ENDs and HTPs contain some chemicals that may cause long-term health effects.

Table (3) shows that 4.6% and 11.9% of the participants who heard of ENDS and HTPs respectively have previously used them, respectively. Also, 50% and 41.7% of them reported that they smoke ENDS and HTPs, respectively, on occasions and gatherings. Approximately 55% and 66.7% of ENDS and HTPs users (respectively) evaluate their health as same as before. Also, 65% of ENDS smokers use nicotine liquid and 60% of them use fruity flavors. The most frequently reported causes of ENDS smoking among users were appealing flavors (50%) and trying it out of curiosity (45%). For HTPs smoking, being less harmful compared to other traditional tobacco products is the most common cause (41.7%).

Table (4) shows that being male, non-Egyptian, a medical student, not living with family, practicing sports, and having personal monthly expenditure ≥ 3000 EGP are factors associated with ENDS smoking. Table (5) shows that ENDS knowledge score was significantly higher among participants who have 25 years or more, being physicians, whose personal monthly expenditure of 2000-2999 EGP and among current smokers. Regarding HTPs, age ≥ 25 years and being male are factors associated with their use. Also, HTPs knowledge score was significantly more among males and participants

Table 4: Factors affecting ENDS smoking among participants

	ENDS Smoking		Statistical test	P-value
	Yes	No	(χ^2)	
Age				
< 25 years	18 (4.9%)	350 (95.1%)	0.47	0.56
≥ 25 years	2 (2.9%)	67 (97.1%)		
Gender				
Male	18 (11.2%)	143 (88.8%)	25.45	< 0.001*
Female	2 (0.7%)	274 (99.3%)		
Nationality				
Egyptian	5 (1.4%)	364 (98.6%)	65.36	< 0.001*
Non-Egyptian	15 (22.1%)	53 (77.9%)		
Current Job				
Physician	0 (0%)	94 (100%)	5.7	0.017*
Medical student	20 (5.8%)	323 (94.2%)		
Residence				
Urban	18 (4.7%)	367 (95.3%)	0.07	0.79
Rural	2 (3.8%)	50 (96.2%)		
Living with Family				
Yes	6 (1.7%)	347 (98.3%)	34.8	< 0.001*
No	14 (16.7%)	70 (83.3%)		
Practicing sport				
Yes	12 (7.6%)	145 (92.4%)	5.3	0.022*
No	8 (2.9%)	272 (97.1%)		
Having a hobby				
Yes	12 (3.9%)	297 (96.1%)	1.2	0.28
No	8 (6.3%)	120 (93.8%)		
Personal monthly expenditure (EGP)				
< 500	1 (1.5%)	65 (98.5%)	Fisher exact	0.034*
500-999	5 (3.7%)	129 (96.3%)		
1000-1999	3 (2.9%)	101 (97.1%)		
2000-2999	1 (2.1%)	46 (97.9%)		
≥ 3000	10 (11.6%)	76 (88.4%)		

** Statistically significant at p- value <0.05*

who didn't smoke, but these results were not shown in tables due to the small number of HTPs users (12 participants). After applying logistic regression model, Table (6) shows that the variables affecting ENDS use were male gender (OR=9.15) and non-Egyptian nationality (OR= 12.13).

DISCUSSION

Emerging nicotine and tobacco products such as ENDS and HTPs become popular worldwide, especially among adolescents and young adults.[17] Moreover, these products have driven the total youth tobacco use to rates unseen in decades.[18] The present study showed that the mean age of the recruited participants was 22.7±5.39 years as more than three-fourths of participants were medical students. It was found that 7.3% of the study participants were current smokers and the most commonly used tobacco product was cigarette smoking (5.8%). But according to Dwedar et al. (2019), only 2.4% of healthcare providers in ASU were smokers to traditional cigarettes.[11] On the other hand, this proportion was much higher among the medical students in Qatar which was 25.6% and the most used tobacco product was shisha smoking.[16] In 2019, 71% of the surveyed healthcare providers in ASU heard of ENDS.[11] But, this proportion was increased in the present study to be 84.4% - indicating the increase in ENDS popularity - versus only 19.5% of them heard of HTPs, reflecting that ENDS are more known than HTPs.

The most reported source of knowledge about ENDS and HTPs was friends; 61.6% and 63.4% respectively, followed by media advertisement 54% and 40.6%, respectively. Another study reported that media advertisements were the main source of getting knowledge about ENDS for the first time (50.4%), followed by friends (33.2%).[11]Thus, the difference explains the important role of peer influence. Besides, one of the most efficient methods to deliver information to the public about smoking is

Table 5: Factors affecting ENDS knowledge score among the participants.

	ENDS Knowledge Score		Statistical test (*t*)	P-value
	Mean	± SD		
Age				
< 25 years	3.6	1.96	1.99	0.048*
≥ 25 years	4.1	1.92		
Gender				
Male	3.8	1.94	0.74	0.46
Female	3.7	1.97		
Nationality				
Egyptian	3.7	2	0.84	0.4
Non-Egyptian	3.9	1.7		
Current Job				
Physician	4.19	1.94	2.67	0.008*
Medical student	3.59	1.95		
Residence				
Urban	3.75	1.96	1.07	0.28
Rural	3.44	1.96		
Personal monthly expenditure (EGP)* **				
< 500	3.06	2.1	3.2**	0.013*
500-999	3.7	1.87		
1000-1999	3.9	2.02		
2000-2999	4.3	1.7		
≥ 3000	3.7	1.9		
Current smoking				
Yes	4.4	1.7	2.2	0.032*
No	3.7	1.97		
E- cigarette use				
Yes	4	2	0.66	0.51
No	3.7	1.96		

*ENDS Knowledge Score out of 7. Mean ± SD was 3.7±1.96; * Statistically significant at p- value <0.05; ** Kruskal Wallis test; ***Post Hoc test: < 500 EGP Vs 2000-2999 EGP (significant).*

through mass media with its different platforms reaching a wide range of population.

The present study revealed that 65.7% and 82.2% of participants reported that ENDS and HTPs can respectively cause lung cancer. Also, 64.5% and 85.1% mentioned that they can respectively cause cardiovascular problems. Moreover, 49.2% and 75.2% of respondents reported that ENDS and HTPs can respectively cause a cerebral stroke. The ENDS' proportions in the present study were comparable to Kurdi et al. (2021), who reported that 58.3% of respondents agreed that they may cause lung cancer, 57.8% mentioned that they can cause cardiovascular problems, and 47.7% agreed that they can cause a cerebral stroke.[16] Furthermore, 59.3% and 83.2% of participants reported that ENDS and HTPs contain carcinogenic materials, respectively. Although ENDS and HTPs generally contain fewer harmful chemicals than the smoke from burned tobacco products, they contain cancer-causing chemicals and tiny particles that reach deep into the lungs.[19, 20]

Approximately 58.1% and 81.2% of participants mentioned that ENDS and HTPs respectively are addictive. This result was comparable to Alshanberi et al. (2021), who reported that 59.5% of users in Saudi Arabia believed that ENDS can cause addiction similar to tobacco cigarettes in Saudi Arabia.[9] It is worth noting that nicotine is highly addictive, and non-smokers who used ENDS may become addicted to nicotine and find it difficult to stop using it or become addicted to conventional tobacco products.[21]

Around half of participants reported that ENDS are less harmful to health compared to traditional cigarettes versus 38.6% of them toward HTPs. This proportion was near to Kurdi et al. (2021) who reported 41.9%.[16] Both ENDS and HTPs pose risks to health and the safest approach is not to use either.[20,21]

Table 6: Logistic regression model for the factors affecting ENDS use among participants.

Item	B	S.E.	Sig.	Odds Ratio	95% C.I.	
					Lower	Upper
Gender	2.214	.776	.004	9.154	2.001	41.874
Nationality	2.495	.554	.000	12.127	4.091	35.945
Constant	-5.537	.766	.000	.004		

More than one-third of participants reported that ENDS can prevent person from smoking traditional cigarettes versus one-fourth of them toward HTPs. Evidence-based research revealed that ENDS and HTPs are a gateway to smoking, and data show that people who smoke ENDS are five times more likely to become regular cigarette smokers.[22]

The present study revealed that more participants reported that HTPs can cause lung cancer, cardiovascular problems, cerebral stroke, and addiction than ENDS. This may be explained by awareness of the participants with the presence of tobacco products in HTPs rather than ENDS.[23]

Regarding attitude of the participants toward ENDS and HTPs, the current study showed that one-third of participants agreed that ENDS are safer to use than regular cigarettes versus more than a quarter of them to HTPs. In 2019, only 11.2% of healthcare providers in ASU Hospital agreed that ENDS were safe[11], also CDC (2021) stated that ENDS are not safe for youth and adults who do not currently use tobacco products.[24]

More than one-fourth of participants agreed that ENDS are helpful aids for smoking cessation versus more than one-third of them to HTPs. But, in Saudi Arabia, only 14.7% think that ENDS are medically approved methods for smoking cessation.[9] In addition, while some adults have used ENDS to switch completely from combustible cigarettes, the FDA has not approved any ENDS or HTPs as a cessation intervention.[19, 20]

Around two-thirds of participants agreed that ENDS encourage smoking initiation in those who have never smoked and encourage smoking continuation among smokers who might have quit otherwise versus more than half of them to HTPs. This result was comparable to Dwedar et al. (2019)[11]. Also, Two-thirds of participants agreed that ENDS and HTPs can be a gateway for smoking other tobacco products later. Around three-fourths of participants agreed that ENDS and HTPs contain some chemicals that may cause long-term health effects. Also, around one-fourth of participants agreed that ENDS and HTPs can lower cancer risk compared to traditional cigarettes, but additional research can help understand ENDS and HTPs long-term health effects.[23, 24]

Around two-thirds of participants agreed that smoking ENDS and HTPs is a public health concern, and their smoking should be regulated in public areas. ENDS are currently regulated as consumer, pharmaceutical and tobacco products[21], but because of the diversity of these products, their design features and characteristics, it is difficult for countries to regulate them and monitor their use in the population.[17]Around half of participants agreed that ENDS and HTPs can increase the risk of COVID-19 infection. But Jose et al. (2021) revealed that although ENDS have a well-documented potential for harm, they do not appear to increase susceptibility to COVID19 infection.[25] Also, Young-Wolff et al. (2022) reported that no evidence that current versus never e-cigarette use was associated with risk of COVID-19.[26]

Regarding ENDS and HTPs smoking among participants, 4.6% and 11.9% of the participants who heard of ENDS and HTPs have previously used ENDS and HTPs, respectively. The prevalence was much higher (10.6%) in Kabbash et al. (2022) among university students from 4 Egyptian faculties.[27] In USA, the prevalence of current ENDS use was 4.4% in 2017, which increased to 5.5% in 2018 and decreased slightly to 5.1% in 2020.[28] On the contrary, ENDS smoking in Qatar was 14% in 2021.[16] In Saudi Arabia, the prevalence of ENDS usage ranged from 10.6% to 27.7% among medical students.[29] This large difference reflects the relatively low prevalence of ENDS among Egyptian medical students. On the other hand, the prevalence of ever HTP use among Korean adolescents was 2.9%[30] and 6·5% of participants in Europe had ever used an HTP.[31]

Around half of participants (50% and 41.7%) of them reported that they smoke ENDS and HTPs respectively in occasions and gatherings. This agrees with Kurdi et al. (2021) that revealed that 53.6% tended to use ENDS and other electronic vapor

products during stressful situations and on social occasions (50%).[16]

The most frequent causes for smoking ENDS among participants were the appealing flavors (50%), trying it out of curiosity (45%), followed by quitting smoking traditional tobacco products (25%), and because it is less harmful than other traditional tobacco products (25%). This study agrees with Kabbash et al. (2022), who reported that most frequent reasons for smoking ENDS was keeping with fashion (33.7%) followed by the influence of peers (27.7%).[27] Also, Kurdi et al. (2021) revealed the most common reason for using them were absence of smell (85.7%) followed by the belief that ENDS were less harmful to the smoker than traditional cigarettes (75%).[16] On the other side, the most frequent causes for HTPs smoking among participants; being less harmful than other traditional tobacco products was the most reported cause (41.7%), which agreed with Laverty et al. (2021).[31] But, there is insufficient evidence for this claim as while HTPs may expose users to lower levels of some toxicants than conventional cigarettes, they also expose their users to higher levels of other toxicants.[23]

The current study showed that there is no statistically significant difference between ENDS smokers less than 25 years and 25 years or more reflecting its spread between different age groups. Regarding gender, 11.2% of males versus 0.7% of females were ENDS smokers and this difference was statistically significant. This agreed with Patil et al. (2022)[29], but disagreed with kurdi et al. (2021) who revealed that the prevalence of ENDS use was 16.2% and 12.8% among males and females, respectively, with no significant difference as females there were more likely to use ENDS, because they don't smell[16], this difference may be attributed to different population culture. Regarding nationality, only 1.4% of Egyptian participants were ENDS smokers versus 22.1% of non-Egyptians, which was statistically significant, reflecting that ENDS use is still low among Egyptian medical students compared with the non-Egyptian ones which may be explained by different cultures. Moreover, only 1.7% of ENDS smokers live with their family versus 16.7% of them who don't live with their family, reflecting the important role of the family. Furthermore, the monthly expenditure of most ENDS smokers was 3000 L.E. or more, which agreed with Atwa et al. (2019).[10] It may be explained by higher socio-economic status being associated with greater recent advertising exposure, which, in turn, is associated with greater frequency of ENDS use.[32]

The present study showed that ENDS knowledge score was statistically higher among who aged 25 years or more, which was agreed with Abo-Elkheir and Sobh (2016).[33] This may be explained by the positive correlation between age and knowledge score. Furthermore, the knowledge score was statistically higher among physicians than medical students reflecting the more experience of physicians, and this may explain why none of the physicians use ENDS as all ENDS smokers were medical students. Regarding personal monthly expenditure, the knowledge score was statistically higher among the participants who had income of 2000-2999 EGP which may be attributed to greater recent advertising exposure. ENDS knowledge score was statistically higher among current smoking than non-smokers and it was not affected by gender, nationality, residence, and ENDS use.

***Study Limitations*:** This research was limited to faculty of medicine at ASU and convenient sampling was used. Therefore, obtained results cannot be generalized to all students and physicians at ASU and other Egyptian universities, because every university has its specific characteristics. Moreover, since HTPs users were few in this study, they cannot be compared to other studies. So, further studies with a broader scale have to be conducted.

CONCLUSION

Most participants had a negative attitude toward ENDS and HTPs. As all ENDS smokers were medical students rather than physicians who were more knowledgeable about ENDS and HTPs, health education programs should be provided to medical students in general. Counseling should be specifically started for ENDS and HTPs users.

Ethical Considerations: Approval of the Research Ethical Committee of the Faculty of Medicine, ASU was obtained (FWA 00017585) (FMASU P06 / 2022). Informed consent by participants was also obtained as they were provided with information at the start of the questionnaire about the aim of the study and confirmed that their sharing is not obligatory at all then they were asked if they wanted to participate in the study or not.

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***Author contributions*:** Shaimaa S. Yousef: literature search, methodology, statistical analysis, and writing the original draft; Nayera S. Mostafa: conceptualization, project administration, methodology, and critical review & editing; Wagida A. Anwar: conceptualization, funding acquisition, project administration and critical review & editing. All authors have read and agreed to the published version of the manuscript.

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