Electronic Cigarette Usage Prevalence, Patterns, and Dependency among the General Population in Egypt

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Abstract

Back ground: In Egypt, the prevalence of electronic cigarette use has experienced notable growth and mirroring the global trend**.** This study aimed to explore electronic cigarette usage prevalence, patterns, and dependency among the general population in Egypt**. Methods:** Convenient sample was used to involve 400 residents of Damanhur city, Beheira Governorate, Egypt; this cross-sectional study was used to achieve the aim of the study. Data collected through a validated questionnaire covering socio-demographic details, patterns of E cigarette use, knowledge, attitudes, and dependency levels, undergoes thorough validation and reliability testing. **Results:** The current study revealed that about fifth (18%) of the surveyed population in Egypt reported using electronic cigarettes (e-cigarettes). nearly half of them (43.1%) reported using electronic cigarettes on a daily basis. More than the half of users (58.3%) reported using box kits, indicating a preference for advanced and customizable devices. The most commonly reported nicotine strength was in the medium range (13-20 mg/ml), with 56.9% of respondents choosing this option. Fruit-flavored electronic cigarettes were the most popular among respondents, with 56.9% selecting this option. Regarding the dependency more than the third of the users (38%) were dependent on E cigarette use. Age, sex, occupation and the attitude were significantly associated with the use of E cigarette. **Conclusion:** the prevalence of E cigarette use among Egyptian population was relatively high and associated with several factors as gender, age, occupation and the attitude. Also more than one third of the users were dependent on using it. Box kits and fruit flavoured electronic cigarette were most popular among the users. **Recommendations:** Develop and implement targeted public health education campaigns to increase awareness about the risks associated with electronic cigarette use.

Key words: Electronic cigarette use, dependency, general population in Egypt

Introduction

The global prevalence of electronic cigarette (e-cigarette) use has increased significantly in recent years, reflecting a dynamic shift in smoking behavior. Studies indicate that e-cigarettes have gained popularity among different populations and geographic regions **(Althobaiti & Mahfouz, 2022; Grana et al., 2014).** This increase has been attributed to factors such as the perception of reduced harm compared to traditional cigarettes, the accessibility of different e-cigarette flavors, and the potential for smoking cessation. The World Health Organization (WHO) highlights the need for continued global surveillance of e-cigarette use to inform public health policy and address emerging challenges associated with these novel nicotine delivery devices **(World Health Organization, 2019)**

In Egypt, the prevalence of electronic cigarette use has also experienced notable growth, mirroring the global trend. Cultural and social dynamics in Egypt, combined with factors such as marketing strategies and product availability, contribute to the evolving landscape of tobacco and nicotine use (**Alkhalaf et al., 2021).** Electronic cigarettes (e-cigarettes) have gained significant popularity in recent years, leading to a surge in research examining various aspects of their use. Understanding the knowledge, attitudes, and dependence associated with electronic cigarettes is critical to understanding the public health impact of these devices. Examining the extent to which individuals engage with these devices provides a

basis for assessing broader trends and potential health effects (**Smith et al., 2019)**.

Electronic cigarettes come in several types, and the variety of products contributes to misconceptions about their safety and effectiveness. Some common types include cig-a-likes, vape pens, and tank systems. Cig-a-likes resemble traditional cigarettes, vape pens are pen-shaped devices with a refillable tank, and tank systems allow users to customize e-liquid flavors and nicotine concentrations. A common misconception is that all e-cigarettes are similar in composition and risk. However, differences in design and e-liquid ingredients can significantly affect the health effects of their use (**Gaiha et al., 2020).**

A common misconception about electronic cigarettes (e-cigarettes) is that they emit harmless water vapor. In reality, e-cigarette aerosol is a complex mixture of potentially harmful substances, including nicotine, flavorings, and various chemicals. While e-cigarettes are often promoted as a safer alternative to traditional cigarettes, inhaling these substances can have adverse health effects, particularly on the respiratory and cardiovascular systems. Dispelling the notion that e-cigarette aerosol is harmless is critical to ensuring that individuals are fully informed about the potential health risks associated with their delivery systems **(Cullen et al., 2018**).

Studies have examined individuals' knowledge of electronic cigarettes, focusing on awareness of health risks, product composition, and regulatory information. Assessing knowledge levels is essential for formulating effective public health interventions. People's attitudes toward electronic cigarettes play a key role in shaping their use patterns. Perceived benefits or social norms may contribute to increased use. Conversely, negative attitudes can act as a deterrent (**Marques et al., 2021**).

Another misconception is that e-cigarettes are not addictive. Many e-cigarettes contain nicotine, a highly addictive substance that can cause dependence. Some users may inadvertently become addicted to nicotine through the use of e-cigarettes, especially when using high nicotine products. Research suggests that the addictive potential of e-cigarettes is comparable to that of traditional cigarettes, raising concerns about the risk of switching from e-cigarettes to combustible tobacco products (**National Academies of Sciences et al., 2018).** While existing studies have provided valuable insights, there are notable gaps in knowledge. Additional research is needed to explore cultural, socioeconomic, and demographic factors that may influence knowledge, attitudes, and dependence on e-cigarettes **(Doumi et al., 2023).**

Research specific to Egypt is crucial for tailoring interventions that address the unique challenges posed by e-cigarette use in this context. As the prevalence of e-cigarette use continues to unfold in Egypt, comprehensive studies examining prevalence, patterns, dependency knowledge, and attitudes among the population are essential for informing targeted public health strategies and regulatory measures to mitigate potential health risks associated with electronic cigarette use in the country. So the aim of the study was to explore electronic cigarette usage prevalence, patterns, and dependency among the general population in Egypt.

Research objectives

1. Investigates the prevalence of electronic cigarette usage and the diverse patterns of utilization
2. Explore the extent of dependency levels associated with electronic cigarette use among the broader population in Egypt.

Methods

The research employed a cross-sectional study design to comprehensively investigate the Egyptian public's prevalence of electronic cigarette use and diverse patterns of utilization in addition to explore the dependency level concerning the utilization of electronic cigarette. This design enables the concurrent gathering of data from a varied sample of participants at a specific moment, providing a snapshot of the current perspectives within the population.

Subjects

General population in Damanhur city, Beheira Governorate, Egypt

Sample size calculation = (400)

The sample size was determined through a systematic calculation using this formula:
Sample size = (1.962) x (50) x (1-0.5) / 0.052.
This method considers factors such as the desired confidence level (1.96 for a 95% confidence interval), the margin of error (0.052), and the estimated proportion of the population with a specific characteristic (in this instance, 50%). By employing this approach, the sample size should be 385 but the researchers increased it to 400 participants to ensure that the sample size was statistically robust for the investigation, yielding a representative group.

The inclusion criteria for this study encompassed people who have completed their formal education, they have a source of income, and they are over 25 years and who willingly agreed to participate in the research. The target population included residents of Damanhur city, Beheira Governorate, Egypt, reflecting the geographical focus of the investigation. Participants were selected without discrimination based on gender, educational background, or socioeconomic status. Exclusion criteria comprised individuals who not fit to the inclusion criteria. The rationale behind these criteria was to the most of the studies that were conducted in Egypt were targeting a specific group, such as adolescents and university students.

Tools of data collection

A self-administered questionnaire was adapted from (Dwedar et al., 2019).The survey was in English, then translated into Arabic, and then back-translated into English to ensure validation. A pilot test was conducted with 40 participants to assess the accuracy and linguistic appropriateness of the questionnaire. However, the results of the pilot test were not used.

The final questionnaire consisted of five sections;

- Section one was about participants' personal characteristics including age, gender and occupation.
- Section 2 focused on participants' smoking status and consumption patterns.
- Section 3 consisted of 11 questions designed to assess participants' knowledge of e-cigarettes, with response options limited to 'true' or 'false'. A scoring system was employed, with each correct answer receiving a score of '1' and incorrect answers marked as '0'. The total score were converted into percentages, categorized as unsatisfactory if the participant answered less than 6 questions correctly and satisfactory if he answered ≥6 questions correctly.
- Section 4 assessed participants' attitudes towards e-cigarettes through 10 questions. Attitude questions were answered using a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The total number of points was converted into a percentage and divided into three levels: negative attitude (< 50%), average attitude (≥ 50% to 74%) and positive attitude (≥ 75%).
- The final section to diagnose the electronic cigarette dependency was developed by the researchers after reviewing the articles of (Foulds et al., 2015; Shiffman & Sembower, 2020) and it included 6 questions. The responses were given in the forms of “usually” to “rarely” on a 3 likert scale. The total points are converted to percentage and classified to three levels, free from dependency if the score ranged from (6-9 points), high risk (10-13) and dependent (14-18).

Validity and reliability

The validation of the questionnaire was rigorously assessed to ensure the robustness of the data collection instruments. A panel of five professors specializing in community health nursing and psychiatric nursing departments undertook the validation process, bringing diverse expertise to the evaluation. The consistency, as measured by Cronbach's Alpha coefficient test, was 0.82 for the knowledge section, 0.81 for the attitude section and 0.78 for dependency section.

Data collection

The questionnaires were distributed in the traditional way and also using social media platforms. The data collection phase extended from August 2022 to February 2023, providing a substantial timeframe to comprehensively capture the prevalence, patterns of use, and levels of dependency associated with electronic cigarette use among the general population of Egypt. This extended duration ensures the incorporation of diverse perspectives and experiences within the specified timeframe. The deliberate selection of this timeline bolsters the reliability and validity of the findings by accommodating potential variations influenced by seasonal, cultural, or contextual factors that may impact participants' responses. The multi-month data collection window aligns with the meticulous approach of the study, contributing to a nuanced understanding of the dynamics surrounding electronic cigarette use.

Ethical considerations:

The research was conducted in a scrupulously ethical manner, prioritizing the welfare and rights of the participants. Approval for the study was carefully sought and granted by the Research Ethics Committee of the Faculty of Nursing at Damanhur University, which formally endorsed the research protocol. Prior to the commencement of data collection, participants received a thorough explanation of the study objectives, procedures and potential implications. Written/oral informed consent was obtained from each participant, signifying their voluntary agreement to participate in the study. To protect the confidentiality and privacy of participants, a strict data management protocol was implemented. All data collected were treated in the strictest confidence and used only for research purposes. To maintain the anonymity of participants in public reports, individual names were replaced with code numbers during data analysis and reporting. This ethical framework, including informed consent, confidentiality and anonymity safeguards, underlines the commitment to ethical research conduct, ensuring the protection of participants' rights and the integrity of the study.

Statistical analysis:

The thorough examination of research participants involved a careful exploration of diverse aspects, encompassing demographics, pattern of use, dependency, knowledge and attitudes towards electronic cigarette. Descriptive statistics formed the foundation of this exploration, providing a detailed portrayal of the study cohort. The Statistical Package for Social Science (SPSS 24.0) served as the analytical engine, aiding in extracting meaningful insights from the accumulated data. The utilization of the Chi-square test, a robust statistical tool, played a crucial role in identifying significant differences between the variables under investigation. The threshold for statistical significance was established at a p-value less than 0.05, ensuring that the findings were robust and could be deemed meaningful indicators of patterns, associations, or variations within the dataset. This methodological rigor in statistical analysis not only upholds the scientific integrity of the study but also establishes a reliable foundation for deriving informed conclusions from the collected data, thereby advancing the overall objectives of the research endeavor.

Results

Table 1: The frequency distribution in Table 1 provides a snapshot of the socio-demographic characteristics of the studied sample. The age distribution was 47.5% ranged from 26 to 35 years old and 30% at the age group from 36- 45. In terms of gender, the sample demonstrates male predominance at 70%. 25% of the studied sample was health care providers. Regarding smoking 65% smoke traditionally and 18% smoke the electronic cigarette.

Table 2 showed the patterns of E cigarette use. Regarding frequency of use; about the half of respondents (43.1%) reported using electronic cigarettes on a daily basis, indicating a consistent and regular usage pattern. A substantial portion of participants (34.7%) reported using electronic cigarettes several times a week, suggesting a moderately frequent usage frequency. The distribution of usage frequency per day reveals that a significant number of respondents (38.9%) use their

electronic cigarettes 4-6 times a day, suggesting a moderate daily usage pattern. Another notable group (33.3%) reported using electronic cigarettes more than six times a day, indicating a higher frequency of use. There were various types were used by the studied sample as follow; the majority of respondents (58.3%) reported using box kits, indicating a preference for advanced and customizable devices. Cig-a-like and vape pen usage was reported by 27.8% and 13.9%, respectively, suggesting a diverse range of device preferences among participants. Indicating to nicotine strength; the most commonly reported nicotine strength was in the medium range (13-20 mg/ml), with 56.9% of respondents choosing this option. Low and high nicotine strengths were reported by 15.3% and 16.7% of respondents, respectively. Very high nicotine strength (36+ mg/ml) was chosen by 11.1% of participants, indicating a preference for stronger nicotine concentrations among a subset of users. Fruit-flavored electronic cigarettes were the most popular among respondents, with 56.9% selecting this option. Tobacco-flavored e-cigarettes were chosen by 20.8% of participants, suggesting a notable preference for traditional flavors. Menthol and dessert/sweet flavors were selected by 11.1% each, indicating a moderate but noteworthy preference for these flavor profiles among respondents.

Table 3 revealed the frequency distribution of the studied sample regarding dependency indicators to E cigarette use. The table showed that 38% of the users were dependent on E cigarette use, 27.7% high risk to be dependent and 33, 3% were mild or free from dependency.

The results in table 4 reflected a comprehensive assessment of knowledge and attitudes among the surveyed population regarding the electronic cigarette. In terms of knowledge; two thirds (65%) had unsatisfactory knowledge. Regarding the attitude; only one fifth (20%) had positive attitude regarding the electronic cigarette while more than the half (57.5%) had negative attitude

Table 5 showed that the chi-square test of independence showed that there was no significant association between level of awareness and the use of E cigarette p.54 while there were significant differences between levels of attitude and usage of E cigarette p.0001

Table 6 revealed significant relationship between the age, gender, occupation and traditional smoking with the use of E cigarette use. Age group ranged from 36 to 45 years old, male, health care providers and who were traditional smokers are more likely to use E cigarette than others $p < .05$.

Table 1: frequency distribution of the studied sample regarding socio-demographic data and smoking status (400)

Items	N	%
Age		
26-35	190	47.5
36-45	120	30
>45	90	22.5
Gender		
Male	280	70
Female	120	30
Occupation		
Health care providers	100	25
Other occupation	300	75
Traditional smoking		
Yes	260	65
No	140	35
E cigarette smoking		
Yes	72	18
No	328	82

Table 2: Frequency distribution of the studied sample according to their Pattern of E cigarette use (72)

Items	N	%
Frequency of Use:		
• Daily	31	43.1
• Several times a week	25	34.7
• Once a week	16	22.2
How many times per the day when you use your electronic cigarette? (assume one "TIME" consists of (around 15 puffs, or lasts around 10 minutes)		
• 1-3	20	27.8
• 4-6	28	38.9
• >6	24	33.3
Type of Electronic Cigarette Used:		
• Cig-a-like	20	27.8
• Vape pen	10	13.9
• Box kits	42	58.3
Nicotine Strength:		
• Low (1-12 mg/ml)	11	15.3
• Medium (13-20 mg/ml)	41	56.9
• High (21-35 mg/ml)	12	16.7
• Very high (36+ mg/ml)	8	11.1
Preferred Flavors (Select up to three):		
• Tobacco	15	20.8
• Fruit	41	56.9
• Menthol	8	11.1
• Dessert/sweet	8	11.1

Table 3: Frequency distribution of the studied sample regarding dependency indicators to E cigarette use

Dependency Items	Usually		Some times		Rarely	
	N	%	N	%	N	%
1- Do you sometimes awaken at night to use your electronic cigarette?	16	22.22	26	36.11	30	41.66
2- Do you use an electronic cigarette now because it is really hard to quit?	21	29.16	20	27.77	31	43.05
3- Do you ever have strong cravings to use an electronic cigarette?	19	26.38	24	33.33	29	40.27
4- Over the past week do you ever had strong urges to use electronic cigarette?	34	47.22	19	26.38	19	26.38
5- Did you feel more irritable because you couldn't use an electronic cigarette?	19	26.38	28	38.88	25	34.72
6- Did you feel nervous, restless or anxious because you couldn't use an electronic cigarette?	20	27.77	26	36.11	26	36.11
Total level of dependency						
Mild or free	24 (33.3%)					
High risk	20 (27.7%)					
Dependent	28 (38.8%)					

Table 4: frequency distribution of the studied sample regarding their knowledge and attitude about the electronic cigarette

Items	N	%
Knowledge		
Satisfactory	**140**	**35**
Unsatisfactory	**260**	**65**
Attitude		
Positive	**80**	**20**
Average	**90**	**22.5**
Negative	**230**	**57.5**

Table 5 association of the studied sample regarding their levels of knowledge and attitude regarding E cigarette use

Items	Use (72)		Not use (328)		X^2	P
	N	%	N	%		
Knowledge					0.36	.54
Satisfactory 140 (35%)	23	16.4	117	83.6		
Unsatisfactory 260 (65%)	49	18.8	211	81.2		
Attitude					17.04	.0001
Positive 80(20%)	6	7.5	74	92.5		
Average 90 (22.5%)	9	10	81	90		
Negative 230 (57.5%)	57	24.7	173	75.3		

Table 6: Association between Socio-demographic data and traditional smoking status with the use of E cigarette

Items	N	Use (72)		Not use (328)		X^2	P
		N (%)		N (%)			
Age							
26-35	190	18	9.47	172	90.53		
36-45	120	40	33.33	80	66.67		
>45	90	14	15.56	76	84.44	28.8	0.00001
Gender						12.8	.00003
Male	280	63	22.5	217	77.5		
Female	120	9	7.5	111	92.5		
Occupation						10.9	.00009
Health care providers	100	29	29	71	71		
Other occupation	300	43	14.3	257	85.7		
Traditional smoking						6.3	.01
Yes	260	56	21.5	204	78.5		
No	140	16	11.4	124	88.6		

Discussion

Understanding the usage patterns and dependency on electronic cigarettes in Egypt is of paramount importance in the context of evolving global tobacco trends and the potential public health implications associated with electronic cigarette use. As of recent years, the prevalence of electronic cigarette use has been on the rise globally, and Egypt is no exception to this trend. The aim of this study was to explore electronic cigarette usage prevalence, patterns, and dependency among the general population in Egypt. The current study finding that about one fifth (18%) of the surveyed population in Egypt reported using electronic cigarettes (e-cigarettes) is consistent with the global trend of increasing e-cigarette usage. Previous studies have shown a notable rise in e-cigarette prevalence worldwide, driven by factors such as perceived harm reduction compared to traditional cigarettes and the variety of appealing flavors offered by these products. The lifetime prevalence of e-cigarettes vaping in the Continents of America, Europe, Asia, and Oceania were 24%, 26%, 16%, and 25%, respectively **(Tehrani et al., 2022).**

The prevalence observed in Egypt aligns with the diverse landscape of e-cigarette use observed in other countries. While prevalence rates can vary across regions, the observed 18% in Egypt falls within the range reported by studies in other countries **(Zhao et al., 2023).** For instance, a study in the United States found a prevalence of approximately 20% among adults, showcasing the comparable popularity of e-cigarettes in different parts of the world **(Glasser et al., 2017).** Understanding these patterns helps contextualize the prevalence in Egypt within the broader international landscape.

The reported usage patterns in terms of device types, nicotine strengths, and preferred flavors align with the diversity observed in previous research. The popularity of box kits, the preference for medium nicotine strength, and the appeal of fruit-flavored e-cigarettes are consistent with trends reported in studies from various countries **(Sreeramareddy et al., 2023).** This suggests a global convergence in user preferences, influenced by marketing strategies and product availability. However, it is crucial to note that the rising prevalence of e-cigarette use brings forth public health challenges. The potential for nicotine dependence, especially among youth, and uncertainties regarding the long-term health effects of e-cigarettes emphasize the need for comprehensive regulations and targeted educational campaigns (**National Academies of Sciences et al., 2018).**

The results indicating that 38% of the surveyed populations who use E cigarette were dependent on it revealing a concerning level of dependency. The observed dependency rate of 38% aligns with

findings from other studies globally, highlighting a consistent trend of significant e-cigarette dependence across diverse populations (**Alsanea et al., 2022**). The subgroup analysis indicating that 27.7% of the population is at high risk of e-cigarette dependency emphasizes the urgency for tailored intervention strategies. This aligns with research suggesting that certain populations, including youth and non-smokers, may be at higher risk of developing dependence on e-cigarettes (**Tehrani et al., 2022**).The identification of high-risk groups is crucial for targeted prevention efforts and educational campaigns. However, it is important to note that the observed dependency rates may be influenced by various factors, including the availability of different e-cigarette products, nicotine concentrations, and individual usage patterns. The diversity in e-cigarette products, as indicated in the types of electronic cigarettes used, may contribute to varying levels of dependency (**Sreeramareddy et al., 2023**).

The results provided insights into the relationship between the levels of awareness, attitudes, and the use of electronic cigarettes (E-cigarettes). The findings indicate that there was no significant association between the level of awareness and the use of E-cigarettes ($p = 0.54$). In contrast, a statistically significant association was observed between levels of attitude and the usage of E-cigarettes ($p < 0.0001$). This result aligns with the complexity of factors influencing E-cigarette use, including social, cultural, and personal factors, which may overshadow the impact of awareness alone as reported by **Smith et al., (2019**); **Shiffman & Sembower, (2020).** The current study was contradicted by **Wężyk-Caba et al., (2022**) who found the usage of E cigarette was influenced by the awareness. The lack of a significant association between the level of awareness and E-cigarette use suggests that, despite varying levels of awareness among participants, this awareness may not be a determining factor in influencing the decision to use E-cigarettes. On the other hand, the significant association between levels of attitude and E-cigarette usage underscores the role of individuals' attitudes and perceptions in shaping their behavior. This finding is consistent with (**Tehrani et al., 2022**) who highlighted the impact of attitudes on tobacco and nicotine product use. Positive attitudes toward E-cigarettes, such as perceiving them as less harmful or more socially acceptable, may contribute to increased usage.

There was a significant relationship between the age, gender, occupation and traditional smoking with the use of E cigarette use. Age group ranged from 36 to 45 years old, male, health care providers and who were traditional smokers more likely to use E cigarette than others $p < .05$. The current study was in harmony with **Wężyk-Caba et al., (2022**) and **Coleman et al., (2017**) who reported that males being more likely to use E-cigarettes & individuals who are traditional smokers may turn to E-cigarettes as an alternative or in conjunction with traditional smoking. Consistent with our findings, the study of **Sreeramareddy et al., (2023**) who showed that, the prevalence of e- cigarette use is higher among younger than older adults. The nuanced nature of age-related patterns underscores the importance of tailoring interventions to address the specific needs of different age groups. In the same line **Loued et al., (2020)** reported that the prevalence of smoking is high in Tunisia, even among healthcare providers. The electronic cigarette initially used as an alternative to smoking. The overall prevalence of smoking was 33.6% and 52.4% had used at least one cigarette in their lives.

Limitation of the study

The findings may not be generalizable beyond the specific population studied. Cultural, socioeconomic, and regional variations within Egypt could affect the prevalence and patterns of electronic cigarette use. Dependency on electronic cigarettes is a complex construct, and measuring it accurately is challenging. Dependency assessments may vary, and self-reported dependency may not fully capture the extent of individuals' reliance on these products.

Conclusion:

The current study revealed that about the fifth (18%) of the surveyed population in Egypt reported using electronic cigarettes (e-cigarettes). nearly half of them (43.1%) reported using electronic cigarettes on a daily basis. More than the half of users (58.3%) reported using box kits, indicating a preference for

advanced and customizable devices. The most commonly reported nicotine strength was in the medium range (13-20 mg/ml), with about half of users (56.9%) choosing this option. Fruit-flavored electronic cigarettes were the most popular among respondents, with more than half of them (56.9%) selected this option. Regarding the dependency more than third of the users (38%) were dependent on E cigarette use. Age, sex, occupation and the attitude were significantly associated with the use of E cigarette.

Recommendations:

Develop and implement targeted public health education campaigns to increase awareness about the risks associated with electronic cigarette use. Emphasize the potential health consequences, including nicotine dependence, and address misconceptions surrounding the perceived harmlessness of e-cigarettes. Design prevention strategies tailored to specific demographic groups identified in the study as being more prone to electronic cigarette use, such as individuals aged 36 to 45 years old, males, and those in healthcare professions. Establish ongoing monitoring and surveillance mechanisms to track changes in electronic cigarette use patterns over time.

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