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Age and Gender effect on Traditional *vs* E-Cigarettes Smoking Pattern and Smoke Cessation in The Eastern Region, Saudi Arabia, a cross-sectional, survey-based study

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Abstract

Background. The increasing e-cigarette (EC) usage has significantly transformed smoking behaviors worldwide, especially among younger individuals. In Saudi Arabia, smoking continues to pose a serious public health issue, with notable demographic differences in smoking practices. However, there is a lack of comprehensive data examining the impact of age and gender on the patterns of traditional cigarette (TC) and EC usage in the Eastern Region of Saudi Arabia.

Aims. This study aims to evaluate the prevalence of TC *vs* EC consumption and the characteristics of each type users, investigate the effects of age and gender on smoking behaviors, and assess the efficacy of EC as a tool for smoking cessation.

Methods. An online cross-sectional survey was conducted from January to March 2022, targeting respondents aged 18 to 70 years who speak either English or Arabic in the Eastern Region of Saudi Arabia. A total of 1,140 participants completed the survey, which collected demographic data, smoking behaviors, and any previous attempts to smoke cessation. Statistical analyses were carried out using SPSS to identify significant differences among various groups.

Results. The results indicated that 39% of the participants reported using EC, while 29% reported using TC, and 32% reported using both products. TC users tended to be older (27 *vs* 23 years, $P < 0.001$) and predominantly male individuals (89% *vs* 85%, $P = 0.008$), whereas EC users were more likely to be single (82% *vs* 66%, $P < 0.001$). Notably, only 7% of individuals who attempted to quit smoking using EC were successful, in contrast to 46% of individuals who used therapeutic methods were successful.

Conclusion. The increasing popularity of EC among younger individuals raises concerns regarding nicotine addiction and the potential shift to TC. The observed gender and age differences emphasize the need for customized cessation programs. Public health strategies should address both TC and EC usage, prioritizing education and effective cessation methods to reduce health risks across various demographic groups.
Keywords. E-cigarettes, Traditional Cigarettes, Smoking Pattern, Smoke cessation.

Introduction

The rising prevalence of E-cigarette (EC) smoking has significantly transformed smoking behaviors worldwide, especially among young adults and adolescents (1, 2). ECs are often promoted as a safe alternative to traditional cigarettes (TC), which has contributed to the growing interest among smokers towards utilizing them over TC (3). This phenomenon presents substantial public health challenges, as the use of EC may result in nicotine dependence and potentially act as a precursor to TC smoking (4).

In Saudi Arabia, smoking continues to pose a major public health issue, with increased tobacco use across diverse demographic segments (5, 6). The Eastern Region is noted for its cultural variety which could be presented as different social attitudes towards smoking. Prior research has highlighted significant variations in smoking habits based on age and gender, with men generally having a higher prevalence of smoking compared to females (7-9). Nevertheless, the complicated relationships between these demographic variables and EC smoking have yet to be thoroughly investigated.

Therefore, this study aims to investigate the smoking patterns associated with TC and EC in the Eastern Region of Saudi Arabia. This study objectives are; to determine the prevalence of TC *vs* EC smoking, assess the current pattern of TC and EC smoking, investigate the effect of gender and age on TC and EC smoking pattern and to evaluate how EC smoking was effective to smoke cessation. The findings of this research are particularly significant which may explore risk to increased nicotine dependency and potential transitions to TC smoking (1).

1. Methods

1.1. Study Design

A descriptive, cross-sectional online survey was conducted during January to March 2022 throughout the Eastern Region in Saudi Arabia.

1.2. Study population and sample size calculation

The study population consisted of English or Arabic-speaking individuals who were living in the Eastern Region of Saudi Arabia. A convenient sampling method (simple question, short time to answer) was used in this survey to attract respondents from a large geographical area and facilitate the recruitment of a large sample. Participants were selected to be from the Eastern Region in Saudi Arabia, as this region is known for its robust, diverse community which can be an image impose of the country's diversity.

The inclusion criteria were individuals who are TCs or ECs smokers or ex-smokers, located in the Eastern Region of Saudi Arabia and aged between 18 to 70 years old. Conversely, the exclusion criteria included those who never smoked, located outside the Eastern Region of Saudi Arabia, and aged younger than 18 years and older than 70 years. By excluding these individuals, we aimed to ensure the homogeneity of our study sample and maintain the relevance of the findings to the specific context under investigation.

Determining the exact number of individuals who smoke in the Eastern Region was a challenging task due to the lack of a centralized and comprehensive database. While we do not have access to the precise number, sampling measures were considered to ensure the selection of a representative sample that captures the diversity of the community within the Eastern Region. The sample size for our study was calculated based on a previous study which investigated the prevalence of ECs smoking (10). The referenced study found a mean difference of 3.5% with a standard deviation of 3%. By using G-Power

software, these parameters (80% power and 5% significance level) were utilized, and we calculated that 842 participants are required for this study. Predicting that there will be a 20% drop rate, the total sample required for this study will be 1010 participants.

1.3. Survey distribution and return

An internet-based survey was developed and distributed to participants anonymously through an internet-based survey site (Google forms). Informed consent was collected from each participant prior to participation. The consent form was a separate page, an introductory page to the online survey page, outlined the purpose of the study, the data collection process, the rights of the participants, and any potential risks and benefits associated with their participation. Participants were able to access and complete the survey once they agreed with the informed consent. Confidentiality of participants was maintained throughout the entire research, and participation was voluntary throughout the study.

1.4. Participant identification and recruitment

An invitation e-mail was sent by the researchers through their university e-mail network to potential participants. The e-mail contained an introductory statement about the study with a hyperlink to the web-based survey. The e-mail offered transformation of the URLs into direct links to the survey website. WhatsApp® messages were also sent to different official groups across the Eastern Region of Saudi Arabia (i.e., administrative, clinical, or academic sectors), to increase the number of responses. Distribution of the survey link to as many colleagues and friends as possible was requested from other colleagues. The link was sent to different groups to ensure equal distribution among the targeted population.

Moreover, the survey was distributed in a smoking cessation booth at King Fahad university hospital in Al-Khobar and the 8th Saudi Society for Respiratory Care scientific conference which was held at Imam Abdulrahman bin Faisal University in Dammam via a QR code. Finally, the survey link was distributed via a QR code throughout different EC markets.

1.5. Survey development

An anonymous, self-administered research survey was prepared to achieve the study objectives. A validated questionnaire was adapted from previous studies published in this regard (10-12). The study questionnaire included demographic details of the respondents such as age, sex, educational level, and city they live in. The participants were asked questions about the type of cigarettes they use, the frequency they smoke per day and the duration of their smoking habit. Finally, we asked the participants for any previous smoking cessation attempt, the approach which was used and how successful it was. As part of the survey design, a mandatory response to all questions was required.

1.6. Questionnaire validation

A pilot study was conducted before proceeding with the original study with a sample of ten randomly selected participants. The pilot study ensured that the target population can clearly understand each question being asked, as well as what each response means. The research team reviewed and discussed ideas presented by the participants in the pilot study to make the survey easier for the study participants. According to the results of the pilot study, no modifications were implemented to the research questionnaires as the participants in the pilot study reported that the questions were clear and understandable. The reliability of the questionnaire was assessed with Cronbach's alpha coefficient of 0.7. The Arabic version was validated by asking experts in English/Arabic language to re-check the translated questionnaire and their comments were addressed in the final Arabic version. Then, a sample of five randomly selected participants were asked to evaluate and ensure full understanding of the Arabic version.

1.7. Data management and analysis

Once the survey was closed, data was collected and extracted into Microsoft Excel to be coded for statistical analysis. The final Microsoft Excel sheet was entered into the Statistical Package for the Social Sciences (SPSS, version 26) for statistical analysis. GraphPad Prism was used to prepare figures from produced results. The accuracy of the gathered data was assessed by visual inspection.

Demographic variables were reported using mean and standard deviation (SD) for continuous parametric variables and number/frequency for binary variables. Respondents were categorized based on the type of smoked cigarettes into EC smokers and TC smokers. To test the differences, student t- test, analysis of variance (ANOVA) test and Chi-square test were employed and a p value < 0.05 was set as determinant of difference.

1.8. Ethical approval

This study was approved by the Institutional Review Board (IRB) at Mohammed Al Mana College for Medical Science (Reference Number SR/RP/175, Approval Date, 18/08/2024).

2. Result

2.1. Characteristics of The Respondents

A total of 1140 responses were collected for this study. The average respondents age was 24 (± SD = 7) years, whereas male individuals were the dominant respondents (88%). 29% of the total respondents reported living alone or away from their family (Table 1). Table 1 represents that 29% of the respondents reported smoking TC, 39% smoking EC, and 32% smoking both types. Our analysis shows that TC smokers were older compared to EC smokers or those reported smoking both types (27 *vs* 23 *vs* 22 years, respectively (P < 0.001)). Interestingly, TC smokers were more likely to be male individuals (89% *vs* 85%, P = 0.008) compared to EC smokers. In terms of social status, Table 1 presented that most of the respondents were either single (79%) or married (19%). The analysis revealed that EC smokers were more likely to be single (82% *vs* 66%, P < 0.001) but less common to be married (17% *vs* 32%, P < 0.001) compared to TC smokers (Table 1). Table 1 shows that 63% of the respondents were students and 30% were employed. EC smokers were more likely to be students (71% *vs* 45%, P < 0.001), but less often to be employed (24% *vs* 43%, P < 0.001) compared to TC smokers (Table 1).

Table 1: Characteristics of respondents classified by the type of cigarettes they smoke

	Whole participants	**Traditional cigarettes Smoker**	**E-cigarettes smokers**	**Both type smokers**	**p - Values**
	n = 1140	n = 333	n = 445	n = 362	
Age, mean (± SD)	24 (7)	27 (10)	23 (6)	22 (5)	< 0.001
Gender (M), n (%)	1007 (88)	296 (89)	378 (85)	333 (92)	0.008
Living alone, n (%)	334 (29)	98 (29)	131 (29)	105 (29)	0.9
Social status					< 0.001
Single, n (%)	903 (79)	222 (66)	367 (82)	314 (86.5)	
Married, n (%)	225 (20)	106 (32)	74 (17)	45 (12)	
Divorced, n (%)	9 (1)	3 (1)	4 (1)	2 (1)	
Widow, n (%)	3 (0.5)	2 (1)	0	1 (0.5)	
Educational level					0.1
Primary school, n (%)	3 (0.5)	3 (1)	0	0	
Intermediate school, n (%)	21 (2)	8 (2.5)	9 (2)	4 (1)	
High school, n (%)	321 (28)	97 (29)	114 (25.5)	110 (30.5)	
Graduate study, n (%)	775 (68)	217 (65)	315 (70.5)	243 (67)	
Post-graduate study, n (%)	20 (1.5)	8 (2.5)	7 (2)	5 (1.5)	
Employment status					< 0.001
Student, n (%)	724 (63)	150 (45)	316 (71)	258 (71)	
Employee, n (%)	338 (30)	143 (43)	109 (24)	86 (24)	
Unemployed, n (%)	78 (7)	40 (12)	20 (5)	18 (5)	

SD: standard deviation, M: Male, p-value was generated from analysis of variance (ANOVA) test.

2.2. Traditional Cigarettes Smokers

A total of 695 respondents reported TC smoking: 48% of them were known as only TC smokers and 52% known as both types smokers (Figure 1). The analysis revealed that 87% of TC smokers had

reported a usage period of > 12 months compared to 76% of both types smokers ($P = 0.001$) (Figure 1). Conversely, Figure 1 presents that 14% of both types smokers had a usage period of < 6 months compared to 7% of TC smokers ($P = 0.001$). Interestingly, 34% of the respondents reported smoking 1 – 5 cigarettes per day, followed by 22% who smoke 6 – 10 cigarettes per day (Figure 1). The analysis showed that both types smokers reported smoking 1 – 5 cigarettes per day (40% *vs* 29%, $P = 0.003$) and 6 – 10 cigarettes per day (24% *vs* 20%, $P = 0.003$) more often compared to TC smokers, whereas TC smokers reported smoking 11 – 15 cigarettes per day (19% *vs* 13%, $P = 0.003$) and 16 – 20 cigarettes per day (19% *vs* 16%, $P = 0.003$) more likely compared to both types smokers (Figure 1).

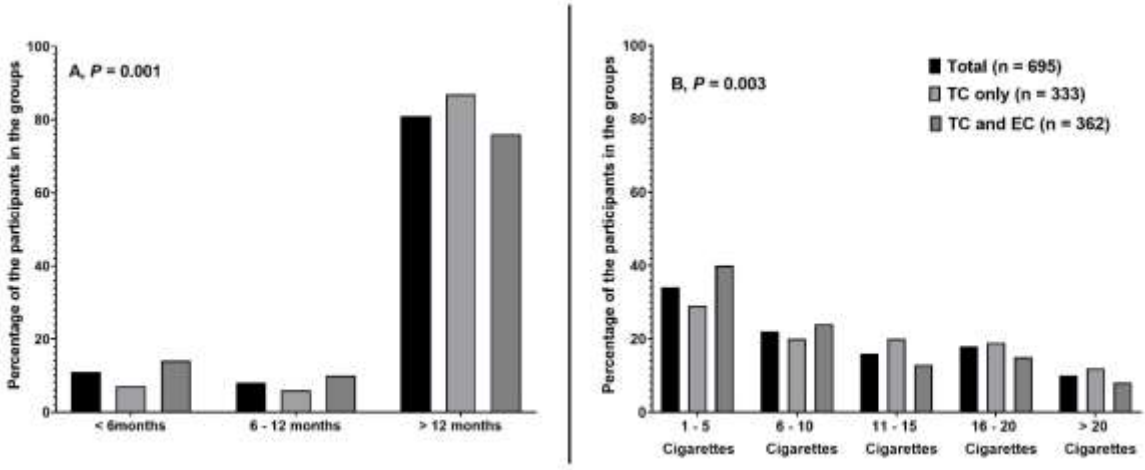

Figure 1: Pattern of traditional cigarettes smoking based on; A: Duration of use, B: Number of cigarettes per day. TC: Traditional cigarette only, TC and EC: Traditional cigarettes and E-cigarettes.

The analysis showed that male individuals were most likely to report a longer duration of TC smoking compared to female individuals (82% *vs* 68%, $P = 0.009$), whereas female individuals reported a usage period of < 6 months and 6 – 12 months more often compared to male individuals (21% *vs* 10%, 11% *vs* 8%, $P = 0.009$ respectively) (Figure 2). In terms of the total amount of smoked cigarettes per day, Figure 2 presents that among female individuals who reported TC smoking, 70% reported smoking 1 – 5 cigarettes per day followed by 20% reported smoking 6 – 10 cigarettes per day. Conversely, 23% of male individuals who were TC smokers reported smoking 6 – 10 cigarettes followed by 10% reported smoking 16 – 20 cigarettes as the two highest patterns among them (Figure 2).

Interestingly, the analysis revealed that increasing age was correlated with increasing the period of TC smoking (Figure 2). Figure 2 shows that those who reported a TC smoking duration of < 6 months were younger than those who reported a TC smoking duration of > 12 months. A similar pattern was identified as those reported smoking 1 – 5 cigarettes per day were younger than those reported smoking > 20 cigarettes per day (Figure 2).

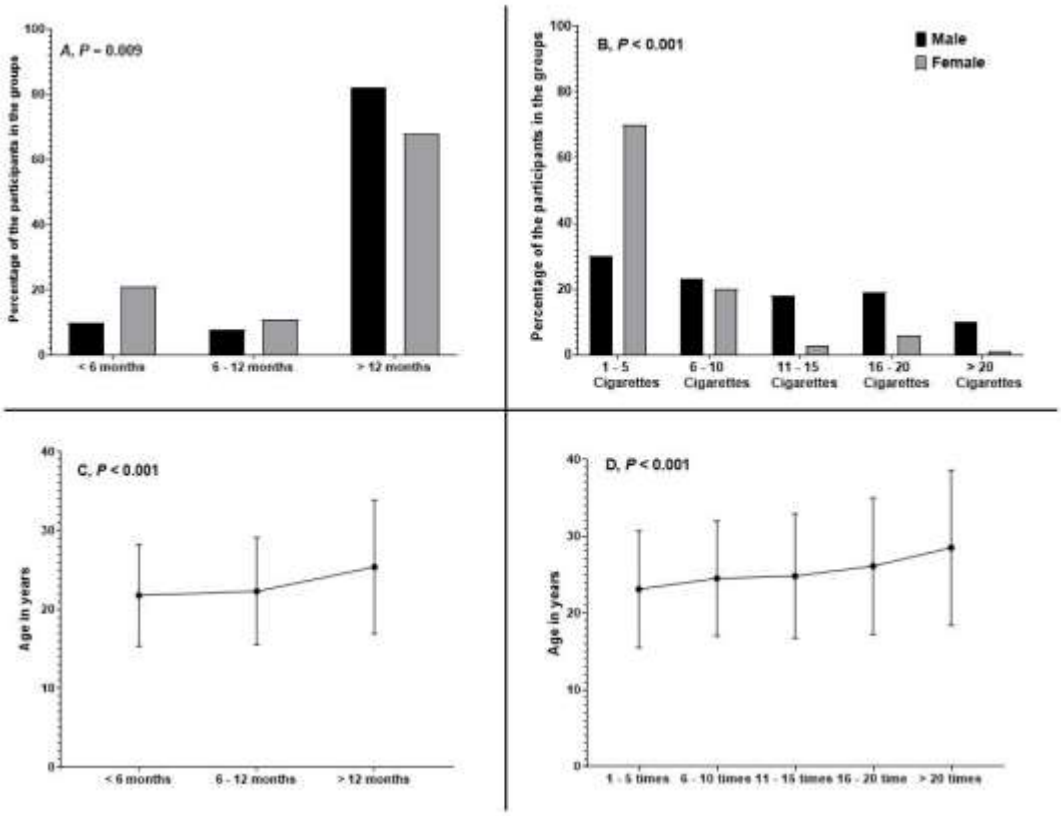

Figure 2: Pattern of Traditional cigarettes Smoking among the respondents, A: Gender differences based on the duration of use, B: Gender differences based on total amount of smoked cigarettes, C: Age differences based on the duration of use, D: Age differences based on total amount of smoked cigarettes.

2.3. E-Cigarettes Smoking

A total of 807 respondents reported EC smoking; 55% of them reported EC smoking and 45% reported both types smoking (Figure 3). Respondents who used both types reported a shorter period of use (< 6 months) (37% *vs* 32%, $P = 0.01$) compared to EC smokers (Figure 3). On the contrary, Figure 3 presents that EC smokers reported a longer period of use (> 12 months) compared to both type users (49% *vs* 39%, $p = 0.01$). In terms of the pattern of use, Figure 3 shows that 37% of the respondents reported a usage pattern of 1 – 5 times per day, whereas 32% of them reported a pattern of > 15 times per day. Interestingly, the analysis demonstrated that EC smokers were more likely to report a usage pattern of 1 – 5 times per day (44% *vs* 28%, $P < 0.001$) but less often to report a pattern of > 15 times per day (27% *vs* 37%, $P < 0.001$) compared to both type smokers (Figure 3).

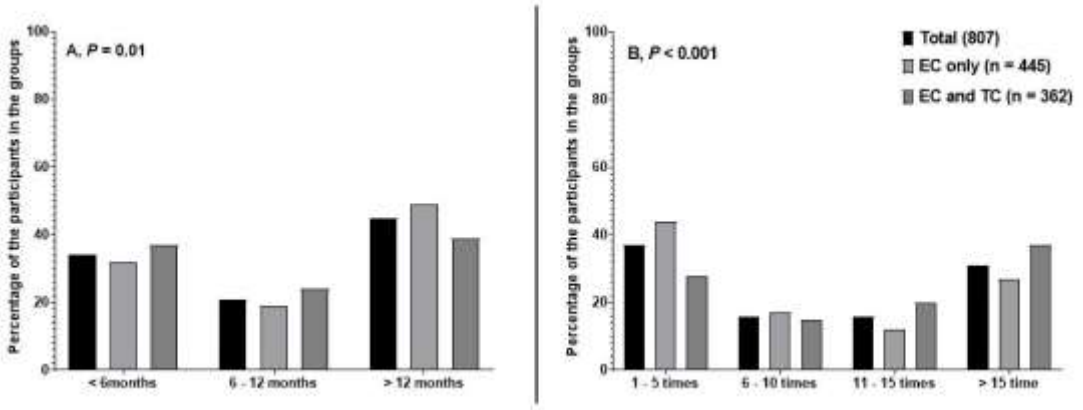

Figure 3: Pattern of E-cigarettes smoking based on; A: Duration of use, B: Number of cigarettes per day. Further analysis showed that respondents who reported a period of use < 6 months were more likely to be female individuals, whereas those reported a period of use > 12 months were male individuals more often (Figure 4). Figure 4 represents a similar pattern as respondents who reported a usage pattern of 1 – 5 times per day were more likely to be female individuals, whereas those reported a pattern of > 15 times per day were male individuals more often. No difference in age was observed among respondents in terms of EC smoking duration of use. However, respondents reported a usage pattern of 6 – 10 times per day were older compared to others who reported a pattern of > 20 times per day (Figure 4).

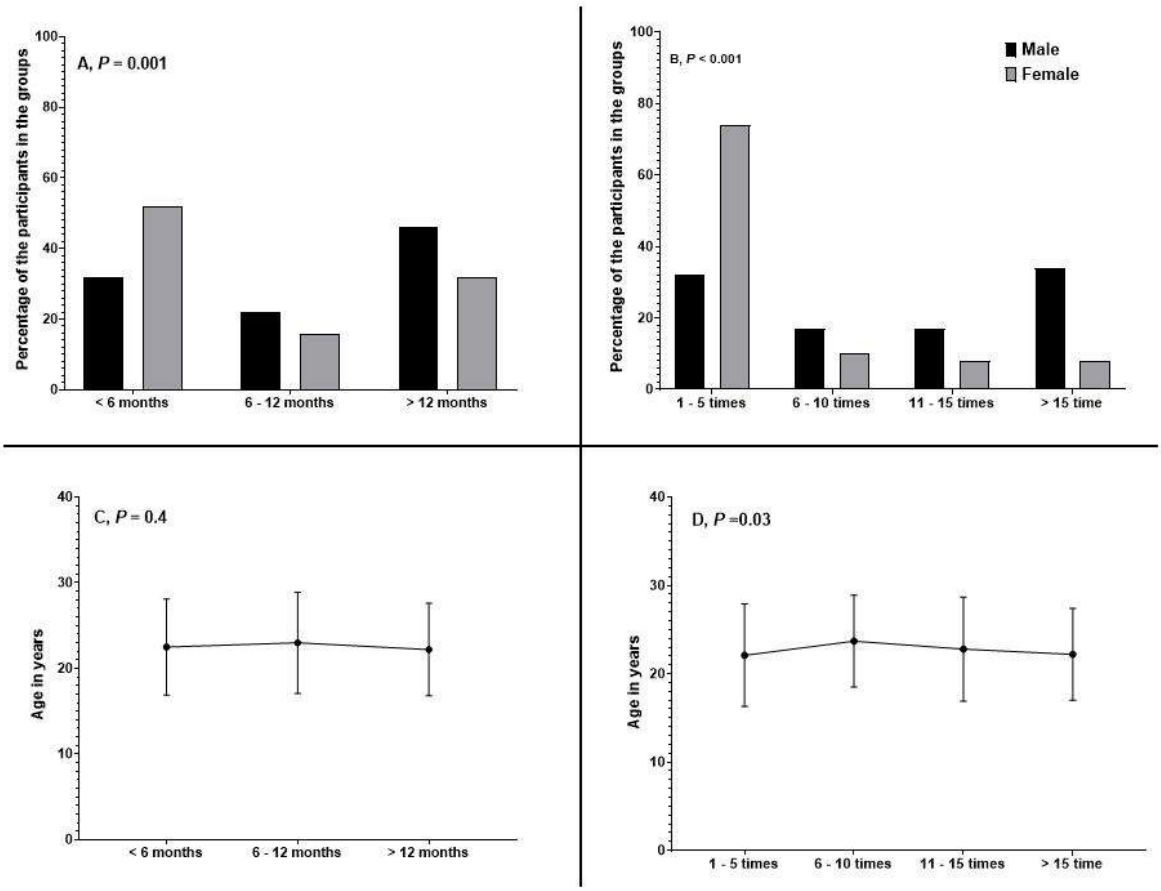

Figure 4: Pattern of E-cigarettes Smoking among the respondents, A: Gender differences based on the duration of use, B: Gender differences based on total amount of smoked cigarettes, C: Age differences based on the duration of use, D: Age differences based on total amount of smoked cigarettes.

2.4. Willingness to Quit Smoking

When asking the respondents if they have tried quitting smoking, 418 (37%) had confirmed a previous attempt (Figure 5). Of those who tried quitting smoking, 315 reported initiating EC as an approach to quit TC smoking and 113 participants reported trying a therapeutic approach (Figure 5). Interestingly, Figure 5 shows that 46% of those who tried the therapeutic approach had succeeded in quite smoking, whereas only 7% had succeeded with the EC approach.

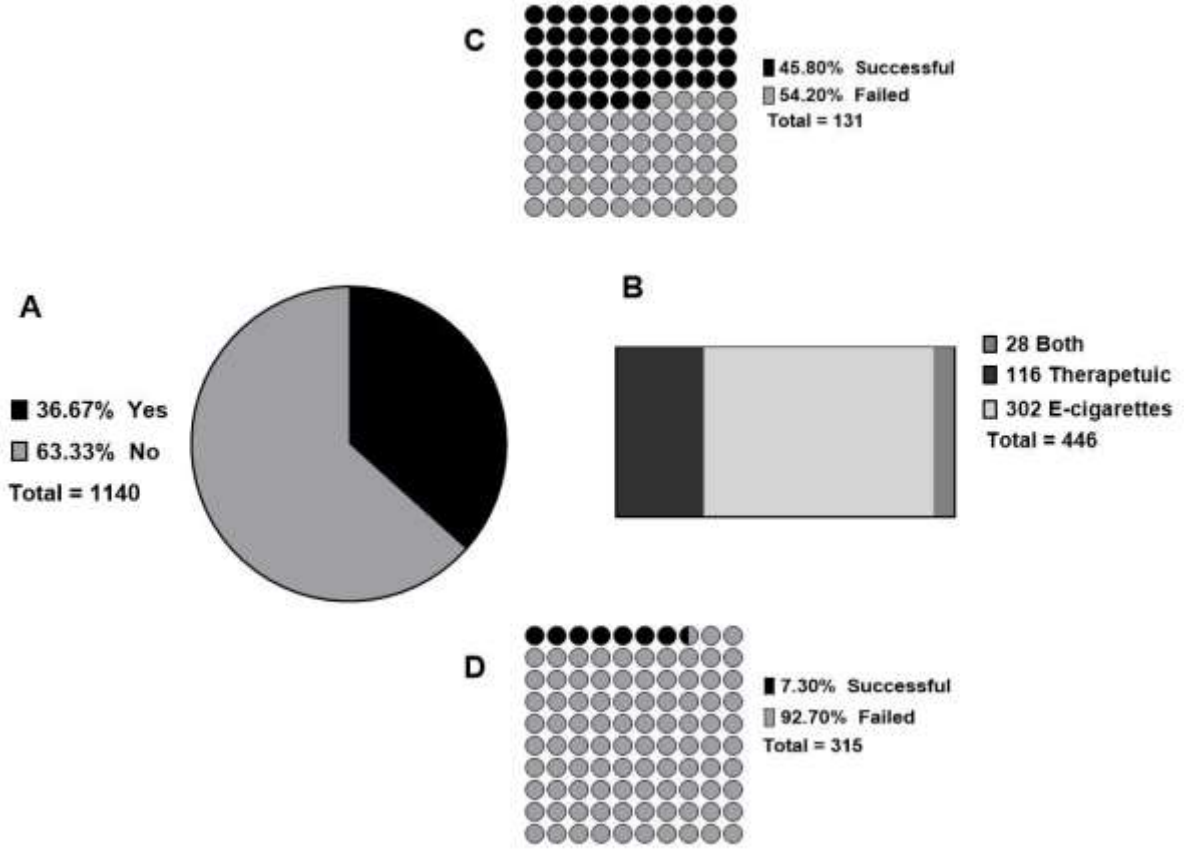

Figure 5: Prevalence of smoke cessation attempts and successful rates among those used e-cigarettes or therapeutic approaches. A: Prevalence of smoke cessation attempt, B: Pattern of smoke cessation approaches reported by respondents, C: Successful rate of quitting smoking among e-cigarettes smokers, D: Successful rate of quitting smoking among therapeutic approach users.

3. Discussion

This is the first study to investigate the smoking patterns associated with TC and EC among a substantial cohort of respondents from the Eastern Region in Saudi Arabia. This study reveals critical insights into demographic variations, usage patterns, and cessation efforts. The current study revealed that 39% of the respondents reported EC smoking, compared to 29% who were TC smokers, while 32% were smoking both types. This trend is consistent with a previously published study which reported an increase in EC use, particularly among younger populations (13). The appeal of EC as a potentially less harmful alternative to TC may partially explain the rise in their usage (14). However, this finding raises concerns regarding the long-term implications of smoking EC, as it may lead to nicotine addiction and subsequent transitions to smoking TC (5). Therefore, public health strategies must adapt to these

emerging trends, emphasizing the necessity of educating the population on the risks associated with both smoking types.

The second significant finding from the current study is gender differences in smoking patterns. This study reported that male individuals were more likely to smoke TC and exhibit longer usage durations compared to female individuals. These findings align with existing literature which presents a higher tobacco consumption rate, as TC, among men (15). Conversely, the higher prevalence of EC smoking among female individuals, who reported shorter durations and lower consumption levels, suggests a need for gender-specific cessation programs. Research has demonstrated that women often face unique social pressures and motivations regarding smoking, which are crucial to consider in designing effective interventions (16).

The third important finding from the current study is that younger respondents were more likely to smoke EC, while older individuals predominantly smoke TC. This age-related preference reflects a concerning trend where EC are increasingly attractive to younger populations due to perceived reduced harm and social acceptance (1). The propensity for younger individuals to initiate EC smoking raises critical public health concerns about the long-term risks of nicotine addiction and the potential for transitioning to TC as discussed above. Public health initiatives must prioritize education about the risks of EC use and provide resources for cessation, particularly targeting younger populations (17).

The fourth important finding from the current study is the low success rate of EC as cessation aids, with only 7% of respondents who attempted to quit using EC reported success. In contrast, therapeutic approaches presented a higher success rate (46%). This discrepancy highlights the need for caution in promoting EC as effective cessation tools (18). Previous studies suggested that while EC may assist some smokers in reducing tobacco consumption, their overall efficacy as a standalone cessation method remains questionable (18, 19). Consequently, healthcare providers should prioritize evidence-based therapeutic methods that demonstrate higher efficacy in achieving long-term quit rates. Integrating cessation support services into clinical practice is crucial for maximizing the effectiveness of smoking cessation efforts.

Having a substantial sample size of 1,140 participants is one strength of the current study, which enhances the reliability and generalizability of the findings. The use of a cross-sectional survey allows for the collection of diverse demographic data and smoking behaviors, providing valuable insights into the smoking patterns among different age and gender groups.

However, this study has several limitations that should be acknowledged. The reliance on self-reported data may introduce bias due to underreporting or overreporting of smoking behaviors. The convenience sampling method may not adequately capture the full diversity of the population, potentially limiting the representativeness of the sample. Furthermore, the study's cross-sectional design restricts the ability to draw causal inferences about the relationship between demographic factors and smoking behaviors. Lastly, the low success rate of EC as a cessation tool raises questions about their effectiveness, indicating a need for further longitudinal studies to evaluate long-term outcomes.

The findings of this study emphasize the need for comprehensive public health strategies that address both TC and EC use. Given the high prevalence of EC consumption and the varying patterns among demographic groups, targeted interventions are essential. Public health campaigns should aim to inform the population about the risks associated with both smoking types and promote the available cessation resources.

Moreover, policymakers should consider implementing regulations that limit the marketing of EC, particularly to younger populations, to prevent the normalization of vaping behavior (2, 20). Stricter age verification measures and smoke-free environment policies can further contribute to reducing the overall prevalence of tobacco products. Additionally, increased funding for cessation programs, especially those tailored to meet the unique needs of different demographic groups, is essential for improving public health outcomes.

4. Conclusion

This study provides important information about the pattern of TC and EC smoking among users from the Eastern Region of Saudi Arabia. The findings revealed significant gender and age differences that must be considered in public health initiatives. In addition, the limited effectiveness of EC as cessation tools raises important questions regarding their role in tobacco harm reduction strategies. As tobacco use continues to progress among different communities, ongoing research and adaptive public health policies will be vital in mitigating the health impacts of smoking and promoting healthier communities.

5. Acknowledgement

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5.1. Conflict of interest

The authors have no potential conflicts of interest that might be relevant to the contents of this manuscript.

5.2. Funding

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5.3. Ethical approval and informed consent

This study was approved by the Institutional Review Board (IRB) at Mohammed Al Mana College for Medical Science (Reference Number SR/RP/175, Approval Date, 18/08/2024). All participants were deidentified.

5.4. Data availability

The datasets analysed during the current study will be made available on reasonable request. Data will be made available for scientific purposes for researchers whose proposed use of the data has been approved by the research team.

5.5. Authors' contributions

Mustafa Almahdi and Ali Albahrani: Data collection and coding and preparing data for analysis, data analysis, writing first draft and approving final version

Hassan Althabet, Ridha Algargoush, Hassan Alali and Jaffar Almustafa: Support in writing the first draft of the introduction, methods, results, and discussion, interpreted the data, and edited and approve the final manuscript.

Dr. Aymen A. AlQurain: Coding and preparing data for analysis, data analysis, writing first draft, evaluating and modify and approving final manuscript and Project supervisor.

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