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Association between e-cigarette smoking and different lifestyle patterns among young adults in Saudi Arabia

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Abstract
Background: E-cigarette use has been linked with multiple morbidities and changes in health behavior. This study investigates e-cigarette use with sleep patterns, stress levels, and physical activity behavior and compare it with nonsmokers.
Methods: A standardized electronic questionnaire for sleep, stress, and physical activity assessment was used on 372 students enrolled in a large university. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 23.0.
Results: The mean age of the study population was around 20 years, with e-cigarette use higher in males. The mean age of smoking initiation was 17 years. The intention to play sports and physical activity differed between smokers and nonsmokers. E-cigarette users practiced sports to remain fit while nonsmokers intended to play sports for enjoyment; however, no significant difference in the level of fitness was found. Sleep behavior and stress levels were similar across the two groups.
Conclusion: No difference in lifestyle patterns between e-cigarette users and nonsmokers may be due to lesser smoking duration since initiation. Longitudinal studies with diverse populations and a longer duration of e-cigarette use are recommended to explore the effects of e-cigarette smoking on lifestyle behavior.

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Introduction

Electronic nicotine dispensing systems (ENDSs), also known as electronic cigarettes or in simpler terms referred to as e-cigarettes, are designed to mimic the traditional cigarettes by dispensing nicotine as e-liquid without the tobacco intoxicants. It was invented in 2003 by Chinese pharmacist Hon Lik as a replacement to the conventional cigarette smoking; it was introduced to the European and American markets in 2006.[1] Since then, the use of e-cigarettes increased exponentially among young adults, despite controversies and safety concerns.[2] The age of initiation of e-cigarette use is generally in high school. Survey suggests that 3.3% and 14.1% of middle and high school students in the United States were reported to have started the use of e-cigarettes, which corresponds to 2.55 million school students in 2022.[3]

Considered as less harmful than the conventional tobacco-containing products, e-cigarettes are marketed as replacement to traditional smoking or as an adjunct to quit conventional cigarette smoking. However, research has generated conflicting evidence on the efficacy of e-cigarettes in smoking cessation. Some studies have shown decreased use of conventional cigarettes upon introducing e-cigarettes while some other reports have shown increased probability of being dual users.[4] Risk factors associated with dual use in adolescents include being a male, urban environment, increased stress, alcohol or substance use, and weekly allowance.[5]

A recent survey in 2022, which assessed the estimated e-cigarette use, enumerated 18.3 million adult users in 14 countries, with the highest prevalence in Russia and the least in India.[6] Male gender, 15–24 years of age, urban dwellers, high socioeconomic status, and higher education were associated with the increased use of first-time users. Of the total users, an overwhelming 85% preferred using flavored e-cigarettes.[6]

Saudi Arabia has the higher burden of illness from traditional cigarette smoking, because higher prevalence rates have constantly been reported in this region. Earlier studies have documented varied prevalence of tobacco smoking among different age groups: 16.5% in school students, 13.5% among university students, 22.6% among adults, and 25% in the elderly people.[7] In recent years, in view of reducing the traditional cigarette consumption, the population began the use of e-cigarettes to either quit smoking or to reduce nicotine exposure owing to its less harmful perception. Prevalence of e-cigarette use in Saudi Arabia has shown diverse results. Higher prevalence is seen in the western region (27.7%), while central and eastern provinces report 12.2% and 10.6% among university students.[8] Among the many reasons for the use of e-cigarettes in Saudi Arabia, the most common is to quit traditional cigarette smoking or reduce tobacco use, followed by peer influence and curiosity to use the new product.[9]

Many studies have suggested a link between e-cigarette use and mental health status. In addition to substance abuse and other psychiatric complaints, longitudinal data have demonstrated higher PHQ-9 depression scores and increased odds of depression in e-smokers compared to nonsmokers.[10-12] Furthermore, e-cigarette users have reported poor sleep quality and difficulty in sleeping with reliance on sleep medication.[13,14] Studies on physical activity behavior showed contradictory results—some studies demonstrated increased physical activity pattern while some reported abstinence from moderate to severe physical activity.[15,16]

Recognizing the inconclusive evidence of harm associated with e-cigarettes, it is important to understand the pattern and associated factors of e-cigarette use in society. Therefore, this study was conducted to determine the pattern of e-cigarette use and its association with lifestyle-related factors like stress levels, sleep quality, and physical activity.

Methods

Study population

A cross-sectional study design was adopted to address the research objectives, and was conducted in a large University with current enrolled students as the study subjects.

Students diagnosed with psychological conditions such as depression or anxiety, those having sleep disorders, handicapped subjects who are unable to perform physical activity, and traditional cigarette smokers were excluded from the study.

The required ethical approval was obtained from the institutional review board of King Saud University. Informed consent was obtained from the participants, and the confidentiality of the information and privacy of the participants were protected.

Sample size estimation

The sample size of 372 participants was calculated using the two proportions formula. Since there are three different outcomes, the largest sample size was considered with 95% confidence interval and the margin of error was 5%.

Study variables

The study variables include sociodemographic variables (age, gender, monthly income, area of residence), history of chronic illnesses, history and pattern of smoking including e-cigarettes smoking, level of stress, physical activity and sleep quality. The main exposure is e-cigarettes smoking, associating with level of stress, physical activity and sleep quality between non-smokers and e-cigarettes smokers.

Measures

The data was collected online using an e-questionnaire that included the sociodemographic status, smoking status, physical activity level, sleep quality, and stress level. The development of questionnaire survey was based on the Pittsburgh Sleep Quality Index (PSQI) and Perceived Stress Scale. The Perceived Stress Scale score is obtained by

summing the points awarded to the 10 items ranging from 0 to 40; they were graded as: 0–13 low stress, 14–26 moderate stress, and 27–40 high perceived stress.

Statistical analysis

The data was analyzed using the IBM Statistical software for Windows version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequencies, percentages, mean and standard deviation) were used to describe the categorical and quantitative variables. Bivariate analysis was done using student's *t*-test for independent samples, and a *P*-value of < 0.05 was considered significant.

Results

Of the total 372 participants, 195 (52.4%) were men. Around 88.4% were never smokers and 11.6% ever smokers. Most had an income greater than SAR 15,000 per month. The age at smoking initiation was 17 years for current e-cigarette smokers. Most of the e-cigarette smokers used one type of tobacco and almost 84% smoked daily. The mean age of the study population was 20 ± 1.5 years. The distribution of sociodemographic characteristics according to smoking status and type is shown in Table 1.

Most of the participants specified either good or average level of fitness while at least 82 (24.8%) of the nonsmokers reported poor health. Frequency of playing sports was similar across the groups, while the most common reason for playing sports was for enjoyment in the nonsmoking (32.3%) group and intention to stay fit among the e-smokers (33.3%). The distribution of physical activity specifications was similar across the groups and none of the parameters reached the level of statistical significance. The physical activity and the smoking status are presented in Table 2.

The sleep quality characteristics of current and past e-cigarette smokers are presented in Table 3. The average bedtime and time taken to fall asleep was similar across the three groups. The current smokers showed slightly longer sleep time with early bedtime, and on average woke up few minutes later than the other two groups. They also seemed to have less disturbed sleep and did not wake up in the middle of the night. The other characteristics of sleep quality are described in Table 3.

Table 1 Distribution of sociodemographic and diabetic characteristics of study participants (N = 372).

	Nonsmoker = 329 N (%)	Current e-smoker = 33 N (%)	Past e-smoker = 10 N (%)
Age in years, (mean ± SD)	19.8 ± 1.86	20.9 ± 1.73	19.4 ± 1.17
Gender:			
Male	160 (49.2)	30 (90.9)	5 (50)
Female	169 (51.4)	3 (9.1)	5 (50)
University year:			
Preparatory year	126 (38.9)	3 (9.09)	4 (40)
First year	68 (20.7)	6 (18.18)	2 (20)
Second year	29 (8.8)	4 (12.12)	2 (20)
Third year	58 (17.6)	9 (27.27)	1 (10)
Fourth year	37 (11.2)	8 (24.24)	1 (10)
Fifth year	11 (3.3)	3 (9.09)	0
Average monthly family income (in Saudi Riyals):			
< 5000	58 (17.6)	2 (6.06)	1 (10)
5000 to < 10,000	76 (23.1)	5 (15.15)	4 (40)
10,000 to < 15,000	62 (18.73)	7 (21.21)	2 (20)
> = 15,000	133 (40.79)	19 (57.57)	3 (30)
History of chronic illness:			
No	302 (91.84)	30 (90.91)	10 (100)
Yes	27 (8.16)	3 (9.09)	0
Area of residency in Saudi Arabia:			
Central	214 (64.65)	25 (75.75)	5 (50)
Western	36 (10.88)	2 (6.06)	0
Eastern	11 (3.32)	3 (9.09)	1 (10)
Southern	51 (16.01)	3 (9.09)	4 (40)
Northern	17 (5.14)	0	0
Area of residence if living in Riyadh:			
Central	23 (12.23)	3 (12.5)	0
West	37 (19.68)	3 (12.5)	0
East	55 (29.26)	6 (25)	4 (80)
South	15 (7.98)	3 (12.5)	0
North	58 (30.85)	9 (37.5)	1 (20)

Table 2 Distribution of physical activity characteristics of study subjects in relation to the smoking status (n = 372).

	Nonsmoker = 329 N (%)	Current e-smoker = 33 N (%)	Past e-smoker = 10 N (%)	*P*-value
Level of fitness:				0.58
Perfect	29 (8.8)	2 (6)	1 (10)	
Good	82 (25.4)	12 (36.3)	2 (20)	
Average	125 (37.7)	11 (33.3)	3 (30)	
Poor	82 (24.8)	5 (15.1)	3 (30)	
Unfit	11 (3.3)	3 (9)	1 (10)	
Times for playing sports:				0.99
Every day	49 (15.1)	4 (12.1)	2 (20)	
Once per week	66 (19.9)	7 (21.2)	2 (20)	
Several times per month	130 (39.3)	13 (39.4)	3 (30)	
Every other day	84 (25.7)	9 (27.7)	3 (30)	
The reason for practicing sports:				-
It is part of my job and I make my living doing it	12 (3.6%)	1 (3)	0	
I enjoy it	106 (32.3)	5 (15.1)	0	
I want to lose weight	90 (27.2)	10 (30.3)	0	
I want to keep fit	91 (27.8)	11 (33.3)	0	
Other	30 (9.1)	6 (18.2)	10 (100)	
Exercise plan:				0.80
No	259 (75.8)	26 (78.8)	7 (70)	
Yes	70 (24.2)	7 (21.2)	3 (30)	
The state of doing your regular exercise:				0.36
Alone	278 (84.4)	25 (75.9)	8 (80)	
In a pair	26 (8.1)	5 (15.1)	2 (20)	
As group	25 (7.5)	3 (9)	0	
Conditions preventing you from exercise:				-
No	309 (93.3)	33 (100)	10 (100)	
Yes	22 (6.7)	0	0	
Changes in activity or physic (body) in the last few months:				0.26
No	147 (44.4)	11 (33.4)	4 (40)	
Changes to better	145 (44.4)	15 (45.4)	3 (30)	
Changes to worse	37 (11.2)	7 (21.2)	3 (30)	

Additionally, the Perceived Stress Scale score was obtained by summing the points awarded to the 10 items ranging from 0 to 40. The mean (SD) stress score of nonsmokers was 11.3 (6.1), current e-cigarette smokers scored 11.2 (5.7), and past e-cigarettes smokers scored 12.7 (8.6). The mean scores did not show significant difference between the groups (f = 0.243; P = 0.784).

Discussion

This study investigated e-cigarette smoking and its relationship with sleep quality, stress levels, and physical activity status. The age of e-cigarette initiation was 17 years, and frequent use was found among men and higher income status. No associations were found between e-cigarette use and stress, sleep quality, and physical activity levels. Lack of statistically significant results between both comparison groups—nonsmokers and current e-smokers—might be related to heterogeneity between the groups and the low number of e-cigarette users compared to nonsmoker participants.

Relation between stress levels and e-cigarette use is a largely underexplored subject, and its use has increased among adolescents and young adults in general and among the stressed in particular.[17,18] Many studies have demonstrated a positive link between increasing stress levels and vaping; however, the initiation stage of e-cigarette has not been proven to be associated with stress while progressive use has been linked to stress, anxiety, and depression.[19,20] This study demonstrated no significant difference between Perceived Stress Scores and e-cigarette use. Some of the probable reasons could be related to the relatively younger age of the study sample and lesser mean duration of smoking history. However, longitudinal data are needed to establish the association between e-cigarette use and stress levels.

Furthermore, this study did not find a significant association between physical activity and e-cigarette use. The levels of physical activity were similar across ever smokers and never smokers. Research has generated conflicting evidence between physical activity among e-smokers. A Canadian youth study reported e-cigarette users' increased

Table 3 Distribution of sleep quality characteristics of study subjects in relation to their smoking status.

	Nonsmoker = 329 N (%)	Current e-smoker = 33 N (%)	Past e-smoker = 10 N (%)
During the past month, what time have you usually gone to bed at night? (mean ± SD):	11:52 pm ± 2.5	11 pm ± 3.0	11:30 pm ± 7.5
During the past month, how long (in minutes) has it usually taken you to fall asleep each night? (mean ± SD):	37 min ± 30	36.5 min ± 40	25 min ± 16.9
During the past month, what time have you usually gotten up in the morning? (mean ± SD):	7.55 am ± 3.5	8:13 am ± 2.8	7:17 am ± 2.5
During the past month, have you had trouble sleeping because you cannot get to sleep within 30 minutes:			
Not during the past month	114 (34.5)	10 (30.3)	1 (10)
Less than once a week	65 (19.7)	6 (18.2)	2 (20)
Once or twice a week	55 (16.7)	4(12.1)	2 (20)
Three or more times a week	95 (29.0)	13 (39.4)	5 (50)
Wake up in the middle of the night or early morning:			
Not during the past month	114 (34.8)	17 (51.5)	3 (30)
Less than once a week	43 (13.0)	4 (12.1)	0 (0)
Once or twice a week	67 (20.3)	6 (18.2)	2 (20)
Three or more times a week	104 (31.8)	6 (18.2)	5 (50)
Have to get up to use the bathroom:			
Not during the past month	154 (46.6)	17 (51.5)	3 (30)
Less than once a week	90 (27.6)	8 (24.2)	4 (40)
Once or twice a week	40 (12.1)	2 (6.1)	2 (20)
Three or more times a week	45 (13.6)	6 (18.2)	1 (10)
Cannot breathe comfortably:			
Not during the past month	232 (70.3)	23 (69.7)	4 (40)
Less than once a week	38 (11.8)	7 (21.2)	3 (30)
Once or twice a week	31 (9.4)	2 (6.1)	2 (20)
Three or more times a week	28 (8.5)	1 (3.0)	1 (10)
Cough or snore loudly:			
Not during the past month	259 (78.5)	25 (75.7)	8 (80)
Less than once a week	35 (10.9)	7 (21.2)	2 (20)
Once or twice a week	12 (3.6)	0 (0)	0 (0)
Three or more times a week	23 (6.9)	1 (3.0)	0 (0)
Feel too cold:			
Not during the past month	175 (53.0)	20 (60.6)	6 (60)
Less than once a week	73 (22.4)	5 (15.2)	2 (20)
Once or twice a week	46 (13.9)	5 (15.2)	1 (10)
Three or more times a week	35 (10.6)	3 (9.1)	1 (10)
Feel too hot:			
Not during the past month	179 (54.2)	18 (54.5)	3 (30)
Less than once a week	71 (21.8)	7 (21.2)	3 (30)
Once or twice a week	50 (15.1)	3 (9.1)	3 (30)
Three or more times a week	29 (8.8)	5 (15.2)	1 (10)
Have pain when you are sleeping:			
Not during the past month	248 (75.1)	26 (78.8)	7 (70)
Less than once a week	34 (10.6)	6 (18.2)	1 (10)
Once or twice a week	21 (6.36)	1 (3.0)	1 (10)
Three or more times a week	26 (7.9)	0 (0)	1 (10)
During the past month, took medicine to help you sleep (prescribed or "over-the-counter"):			
Not during the past month	277 (83.9)	27 (81.8)27	7 (70)
Less than once a week	26 (8.1)	4 (12.1)4	0 (0)
Once or twice a week	10 (3.0)	1 (3.0)	0 (0)
Three or more times a week	16 (4.8)	1 (3.0)	3 (30)

(*continues*)

Table 3 Distribution of sleep quality characteristics of study subjects in relation to their smoking status.

	Nonsmoker = 329 N (%)	Current e-smoker = 33 N (%)	Past e-smoker = 10 N (%)
During the past month, you had trouble staying awake while driving, eating meals, or engaging in social activity:			
Not during the past month	202 (61.2)	22 (66.7)	7 (70)
Less than once a week	52 (16.0)	7 (21.2)	1 (10)
Once or twice a week	41 (12.4)	3 (9.1)	1 (10)
Three or more times a week	34 (10.3)	1 (3.0)	1 (10)
Have room partner:			
No	180 (54.5)	20 (60.6)	5 (50)
Yes	49 (45.5)	13 (39.4)	5 (50)
If you have a roommate or bed partner, ask him/her how often you snored loudly in the past month:			
Not during the past month	105 (32.4)	7 (21.2)	5 (50)
Less than once a week	12 (3.6)	2 (6.1)	0 (0)
Once or twice a week	10 (3.0)	1 (3.0)	0 (0)
Three or more times a week	14 (4.2)	3 (9.1)	0 (0)
Long pauses between breaths while asleep:			
Not during the past month	113 (34.8)	9 (27.3)	3 (30)
Less than once a week	15 (4.5)	3 (9.1)	1 (10)
Once or twice a week	3 (0.9)	1 (3.0)	1 (10)
Three or more times a week	7 (2.1)	0 (0)	0 (0)
Episodes of disorientation or confusion during sleep:			
Not during the past month	106 (32.7)	10 (30.3)	3 (30)
Less than once a week	19 (5.7)	1 (3.0)	1 (10)
Once or twice a week	8 (2.4)	0 (0)	0 (0)
Three or more times a week	7 (2.1)	2 (6.1)	1 (10)

likelihood of getting involved in sports compared to non-users,[21] whereas a study from the United States reported diminished activity among ever users.[22] A recent study also enumerated similar reports suggesting an inverse relationship between physical activity and e-cigarette use. More research is needed in this direction to ascertain the relation between physical activity and e-cigarette use.

Moreover, this study showed some differences in quality of sleep and pattern between e-smokers and nonsmokers. Although the significance level was not achieved, e-smokers exhibited better quality, undisturbed, and longer duration of sleep. These findings are in stark contradiction with other studies. A study by Brett et al. from the US demonstrated sleep difficulties and poor sleep health among e-cigarette users in college students (mean score = 7.17) compared to traditional smokers (6.73) and nonsmokers (5.45; P = 0.022), thus showing negative impact of smoking on sleep.[14] Another similar study done in a large sample of about 85,000 university students also enumerated sleep impediments among smokers.[23] Population Assessment of Tobacco and Health study (PATH) reported greater odds of sleep disturbances in current and ever users compared to never users.[13] Hence, we suggest more studies to determine the association in the direction of causation among ever and never users.

Study limitations

This study contains numerous limitations. Data from cross-sectional design are not accurate for this subject and further research using longitudinal studies is highly recommended. The sample size and single center data is not representative of the population. Self-administered questionnaire contains a degree of response bias that might affect the results. The authors suspect that the prevalence of e-cigarette smoking has been largely underrepresented due to the sensitive nature of the topic, even though anonymity was maintained. Furthermore, confounders of stress and sleep were not assessed and causal associations cannot be established; however, the study provides preliminary data for future longitudinal research.

Conclusion

This study did not find any differences in quality of sleep, stress, and physical activity between e-smokers and nonsmokers. Given the rising prevalence of e-cigarettes in the global population, larger well-designed studies are highly recommended to determine the association.

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Author Contributions

All authors contributed equally to this article.

Conflicts of Interest

The authors declare no conflicts of interest.

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