

ORIGINAL ARTICLE

Physical and Mental Health Outcomes in Electronic Cigarette Users: A Cross-Sectional Study

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Main Points

- E-cigarette use is exponentially increasing in youth and young adults.
- The available evidence does not confirm the use of e-cigarettes as an effective strategy for supporting traditional cigarette smoking.
- The components constituents of e-cigarettes may adversely impact health.

Abstract

This cross-sectional study examined the physical and mental health outcomes of individuals who use electronic cigarettes. Data were collected using an online survey incorporating the Personal Information Form, CES-Depression Scale, and SF-12 Quality of Life Scale. SPSS 25.0 software was used to evaluate the data and produce descriptive statistics. An independent sample *t*-test, one-way ANOVA, and logistic regression analysis were applied to the analysis. The mean age of the participants was 38.85 ± 13.82 while 56.7% used only e-cigarettes. The physical quality of life scores of those using e-cigarettes 20 times a day or more were significantly higher, while the depression scores of those using e-cigarettes 1 – 10 times a day were significantly higher ($p < .05$). Regarding physical problems, the participants most frequently reported painful dry mouth and throat (35%), cough (30.8%), and/or headache (28.3%). Regarding physiological functions, the participants mostly reported poor taste (9.2%), sleep quality (9.2%), and mood (8.3%). Nicotine concentrations of 13 mg and above were associated with poorer taste ($p = .044$), general physical condition ($p = .008$), mood ($p = .004$), sleep quality ($p = .044$), and appetite ($p = .041$). The findings indicate that the public needs greater awareness about the health hazards of e-cigarettes.

Keywords: Effects on health, electronic cigarette, health, liquid, tobacco

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Introduction

One of the important problems threatening public health is smoking addiction, with over 8 million people dying globally every year due to smoking. Furthermore, over than 1 million of these deaths occur when non-smokers are exposed to cigarette smoke (World Health Organization [WHO], 2020). Yet, although this harm is preventable, addiction caused by nicotine intake makes it difficult to break the habit of smoking. In Türkiye, for example, 28% of individuals aged 15 years and over use tobacco every day (TÜİK, 2020).

Electronic cigarettes (e-cigarettes) have become an increasingly popular type of cigarette. The idea of e-cigarettes dates back to 1963 when Herbert A. Gilbert registered a patent on “smokeless tobacco-free cigarettes.” The product was first put on the market in 2004 by the Ruyan Group (Dragonite) in China with the aim of providing a safe method of smoking by replacing burning tobacco with heated, moist, flavored air (Dawkins et al., 2013; Rom et al., 2015). E-cigarettes are also marketed as smoking cessation aids. The belief among smokers that e-cigarettes are less harmful provides producers with an important sales strategy.

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However, while some experts argue that e-cigarettes offer a pathway to reducing or quitting tobacco use, others see them as a dangerous product that could undermine efforts to denormalize smoking (Fairchild, 2014). In Türkiye, for example, a significant portion of e-cigarette sales are made online, while 91% of websites related to e-cigarettes have no warning about the minimum age limit (18 years old). Furthermore, 51% of sites claimed they are safe, 56% claim they help users to quit smoking, 26% have slogans stating that they “Make you quit smoking” or have other advantages such as “They are very economical,” “They have no harmful or chemical content,” or “They do not make your teeth yellow” (Dağlı, 2016). Companies also attract consumers through varied designs and scented or flavored varieties. Thus, contradicting global efforts to reduce the use of tobacco products, the tobacco industry is marketing e-cigarettes as potential reduced exposure products (PREPs), whose content is “less toxic” (Vansickel et al., 2010).

Consequently, e-cigarette use has increased rapidly from 750,000 in 2010 to 2.5 million in 2011 and 3.5 million in 2012, with more than 100 different brands (Dawkins et al., 2013). E-cigarettes, offered by cigarette companies by changing the format, have become an important public health problem. Despite widespread claims that e-cigarettes can help tobacco users quit smoking and reduce the harm of smoking, there is no convincing evidence of either claim. On the contrary, there is growing evidence that e-cigarettes may be harmful.

The long-term health risks of e-cigarettes are not yet fully known. The National Academies Press (NAP) 2018 report stated that, unlike combustible tobacco cigarettes, e-cigarettes “do not burn” and do not contain many of the estimated 7000 chemical components found in tobacco smoke, so e-cigarettes are generally believed to be “safer” than combustible tobacco cigarettes, although exposure to nicotine and various other potentially harmful components still occurs. The same report states that harm can also occur if young people who start using “tobacco” with e-cigarettes later switch to combustible tobacco cigarettes, or if adult smokers use e-cigarettes to supplement their cigarettes instead of quitting combustible tobacco cigarettes altogether (NAP, 2018). In August 2019, the US Centers for Disease Control and Prevention (CDC) declared a nationwide outbreak of e-cigarette or vaping product-associated lung injury (EVALI), reporting that 82% of hospitalized patients used e-cigarette products containing tetrahydrocannabinol (THC) (Krishnasamy et al., 2020). E-cigarette or vaping product-associated lung injury has now been defined under ICD-10-CM Diagnosis Code U07.0 (icd-10data.com). Sussan et al. (2015) examined the effects of e-cigarettes containing flavored e-liquid on both mouse and human lung cells, reporting various adverse effects on both cell types including toxicity, oxidation, and inflammation. The amount of nicotine in e-cigarette liquid can vary from 0 to 36 mg, so users also use high-nicotine intermediate dilutions obtained by mixing these e-liquids in e-cigarette cartridges, resulting in poisoning (Göney, 2018). Given their potential acute pulmonary toxicity, vaping products may worsen respiratory illnesses caused by SARS-CoV-2 (Javelle, 2020).

In addition to these physical health problems, e-cigarette use may also put the mental health of individuals at risk if they become

addicted to them while trying to quit smoking, having believed that they are harmless and nonaddictive. Currently, neither the U.S. Food and Drug Administration (FDA), WHO, nor the European Respiratory Society recommend e-cigarette use as a way to overcome smoking addiction (Alver, 2021). Hefner et al. (2018) determined that e-cigarette users in the USA have higher rates of anxiety and depression than the general population. In particular, e-cigarette use was more common among individuals with psychiatric and substance use disorders.

In short, e-cigarette use can have negative effects on individuals’ physical and mental health. Given that the rate of e-cigarette smoking in Türkiye is not fully known and few studies have investigated this area, the present study was conducted to determine the physical and mental health outcomes in individuals using e-cigarettes. The study addressed the following two research questions:

1. Is e-cigarette use associated with lower physical health in individuals?
2. Is e-cigarette use associated with negatively affecting the mental health of individuals?

Material and Methods

Sample Profile

This cross-sectional study was conducted between June 2022 and January 2023. The population of the study consisted of individuals over the age of 18 who used e-cigarettes, while the sample consisted of 120 individuals who met the inclusion criteria and agreed to participate. In the power analysis performed after the study to examine the sample’s power, it was determined that the sample had 95% power with an effect size of 0.66 at the 95% CI. The inclusion criteria were as follows: individuals who can read and understand Turkish, are over the age of 18, use e-cigarettes, use the internet and social media, and voluntarily agree to participate.

Data Collection

The data were collected by the online survey method using three parts: “Personal Information Form,” the “CES-Depression Scale,” and the “SF-12 Quality of Life Scale.” The first part of the online survey provided detailed information about the research, followed by an option for potential participants to indicate whether they wanted to participate. Those who selected the option “I want to participate in the research” were considered to have given consent.

Personal Information Form

The Personal Information Form had 33 questions divided into three sections. The first part measured basic characteristics, the second part collected e-cigarette stories, and the third part asked about physical problems and physiological functions.

CES-Depression Scale

This scale, which was adapted into Turkish by Tatar and Saltukoğlu (2010), who also analyzed its psychometric properties, has 20 items. The internal consistency coefficient of the scale was 0.75 – 0.90. Participants respond using a 4-point scale. “Never – Rarely (less than 1 day)” is scored as 0, “A Little – Several Times (1 – 2 days)” as 1, “Occasionally – Sometimes (3 – 4 days)” as

2, and “Often – Most of the Time (5 – 7 days)” as 3. Items 4, 8, 12, and 16 were reverse scored. Thus, the total score can range between 0 and 60.

SF-12 Quality of Life Scale

This scale, which was adapted into Turkish by Soylu and Kütük (2020), who also analyzed its reliability and validity, has 12 items. The internal consistency coefficient of the scale was 0.73 for FIM-12 and 0.72 for MBS-12. Scoring: It is scored as “Excellent (1),” “Very good (2),” “Good (3),” “Not bad (4),” and “Bad (5).” The answers in the scale are scored as “Yes (1)” and “No (2),” “Yes, it restricts a lot (1),” “Yes, it restricts a little (2),” and “No, it does not restrict at all (3).” Finally, it is scored as “Always (1),” “Most of the time (2),” “Quite often (3),” “Occasionally (4),” “Very rarely (5),” and “Never (6).”

Data Evaluation

SPSS 25.0 (IBM SPSS Corp.; Armonk, NY, USA) was used to evaluate the data. The skewness and kurtosis values of the numerical variables were checked for normality (+1.5, -1.5). Because the numerical variables were normally distributed ($p > .05$), independent groups *t*-test, one-way ANOVA, and logistic regression analysis were used for the analyses. A type 1 error level of less than 5% was considered to be statistically significant.

Ethics of Study

Ethical approval was obtained from the Akdeniz University University Clinical Research Ethics Committee (KA EK-378, 25.05.2022). Permission to use the scales was obtained from the researchers who performed the validity and reliability studies. At the beginning of the survey, the participants were informed about the research, and their written consent was obtained.

Results

Table 1 presents the participants’ sociodemographic characteristics. The mean age was 38.85 ± 13.82 , the majority were male (70%), nearly half were university graduates (46.7%), and over half were married (54.2%). Regarding e-cigarette use, 56.7% of the participants use only e-cigarettes, while 43.3% use combustible cigarettes and e-cigarettes together. The majority have been using e-cigarettes for more than 2 years (45.8%) and use 20 times a day or more (37.5%). About half (47.5%) reported using more than one packet of combustible cigarettes per day before starting e-cigarettes, while 55.8% reported using a nicotine concentration of 1–6 mg in their e-cigarettes.

Regarding physical problems, the most commonly reported were painful dry mouth and throat (35%), cough (30.8%), and headache (28.3%). Regarding physiological functions, the participants most frequently reported poor taste (9.2%), sleep quality (9.2%), and mood (8.3%) (Table 2).

Table 3 presents the mean SF-12 and CES scores in terms of the participants’ patterns and frequency of e-cigarette use. The physical quality of life scores of only e-cigarette users were significantly higher ($p < .05$). The physical quality of life scores of those who used e-cigarettes 20 times a day or more were significantly higher ($p < .05$). Finally, the depression scores of participants who used e-cigarettes 1–10 times a day were significantly higher ($p < .05$).

Table 1.
Distribution of Sociodemographic and e-Cigarette Use Data of Participants (n = 120)

Features	Number	%
Gender		
Women	36	30.0
Male	84	70.0
Educational status		
Primary school	4	3.3
Secondary school	4	3.3
High school	41	34.2
University	56	46.7
Postgraduate	15	12.5
Vocational		
Civil servant	26	21.7
Worker	16	13.3
Self-employment	18	15.0
Executive	10	8.3
Retired/housewife	17	14.2
Other	33	27.5
Marital status		
Married	65	54.2
Single	55	45.8
Use of e-cigarettes		
E-cigarettes only	68	56.7
Together with combustible cigarettes	52	43.3
Time to start smoking e-cigarettes		
Less than 6 months ago	31	25.8
6–12 months	17	14.2
1–2 years	17	14.2
More than 2 years ago	55	45.8
Frequency of e-cigarette use		
Not every day	32	26.7
1–10 times a day	38	31.7
11–19 times a day	5	4.2
20 times a day and more	45	37.5
Daily use of combustible cigarettes before starting e-cigarettes		
10 and less per day	39	32.5
11–19 per day	24	20.0
20 combustible cigarettes and more per day	57	47.5
Nicotine concentration in the e-cigarette used		
0 mg	15	12.5
1–6 mg	67	55.8
7–12 mg	29	24.2
13 mg and above	9	7.5

Note: Average age (minimum–maximum) 38.85 ± 13.82 (17–69).

A multivariate logistic regression analysis was conducted to examine the relationship between the three aspects of e-cigarette use and physical symptoms (Table 4). E-cigarette use alone was associated with cough (OR = 2.20, $p = .050$), shortness of breath (OR = 3.18, $p = .013$), sleepiness (OR = 2.91, $p = .012$); e-cigarette use 11 – 19 times daily was associated with cough (OR = 0.05, $p = .000$), shortness of breath (OR = 0.15, $p = .023$), painful dry mouth/throat (OR = 0.26, $p = .009$), headache (OR = 0.07,

Table 2.*Distribution of Physical Problems and Physiological Functions of the Participants (n = 120)*

	Yes	No	
Physical Problems	Number (%)		
Painful/dry mouth and throat	42 (35.0)	78 (65.0)	
Cough	37 (30.8)	83 (69.2)	
Sores/inflammation in the mouth and tongue	17 (14.2)	103 (85.8)	
Gingivitis/gingival bleeding	26 (21.7)	94 (78.3)	
Headache	34 (28.3)	86 (71.7)	
Dizziness	28 (23.3)	92 (76.7)	
Heart palpitations	22 (18.3)	98 (81.7)	
Shortness of breath	26 (21.7)	94 (78.3)	
Chest pain	20 (16.7)	100 (83.3)	
Sleepiness	32 (26.7)	88 (73.3)	
Allergy	9 (7.5)	111 (92.5)	
Nose bleeding	6 (5.0)	114 (95.0)	
Physiological Functions	Good	Medium	Poor
	Number (%)		
Respiration	73 (60.8)	41 (34.2)	6 (5.0)
Smell	78 (65.0)	34 (28.3)	8 (6.7)
Taste	78 (65.0)	31 (25.8)	11 (9.2)
Durability	68 (56.7)	43 (35.8)	9 (7.5)
General physical condition	76 (63.3)	38 (31.7)	6 (5.0)
Mood	73 (60.8)	37 (30.8)	10 (8.3)
Sleep quality	58 (48.3)	51 (42.5)	11 (9.2)
Appetite	79 (65.8)	36 (30.0)	5 (4.2)
Sexual performance	74 (61.7)	38 (31.7)	8 (6.7)
Memory	78 (65.0)	33 (27.5)	9 (7.5)

$p = .000$), dizziness ($OR = 0.16$, $p = .004$), and heart palpitations ($OR = 0.23$, $p = .024$); e-cigarette use 20 times or more daily was associated with cough ($OR = 0.01$, $p = .001$), painful dry mouth/throat ($OR = 0.14$, $p = .015$), and headache ($OR = 0.04$, $p = .005$); finally, 13 mg and higher nicotine concentration e-cigarette use was found to be associated with painful dry mouth/throat ($OR = 6.28$, $p = .027$).

A logistic regression analysis was then conducted to examine the relationship between e-cigarette use and physiological functions (Table 5). The results showed that 13 mg or more nicotine concentration was associated with poorer taste ($OR = 2.21$, $p = .044$), general physical condition ($OR = 4.34$, $p = .008$), mood ($OR = 3.52$, $p = .004$), sleep quality ($OR = 2.21$, $p = .044$), and appetite ($OR = 3.18$, $p = .041$).

Discussion

This study examined physical and mental health outcomes in individuals living in Türkiye who use e-cigarettes. Nearly half (47.5%) of the participants stated that they smoked 20 or more combustible cigarettes a day before they started using e-cigarettes, while approximately half reported using e-cigarettes for more than 2 years. Over half of the participants use only e-cigarettes, while about half use both combustible cigarettes and e-cigarettes, preferring e-cigarettes containing nicotine (1–6 mg). Similarly Caraballo et al. (2017) found that many

Table 3.*Comparison of SF-12 and CES Score Averages of Participants According to e-Cigarette Use Data*

e-Cigarette Usage Data	SF-12 (Physical Health Component)*	SF-12 (Mental Health Component)	CES**
	X (S.S)		
e-Cigarette use status			
e-Cigarettes only	53.58 (7.05)	47.01 (7.98)	16.88 (10.16)
Together with combustible cigarettes	49.27 (7.56)	47.28 (9.70)	18.53 (9.85)
Test significance***	$t = 3.213$ $p = .002$	$t = -0.167$ $p = .868$	$t = -0.896$ $p = .372$
Frequency of e-cigarette use			
Not every day ^a	51.05 (8.61)	46.17 (10.28)	16.40 (8.74)
1–10 times a day ^b	48.83 (7.90)	48.13 (9.0)	21.31 (8.83)
11–19 times a day ^c	51.51 (4.25)	44.86 (4.91)	20.60 (12.85)
20 times a day and more ^d	54.65 (5.63)	47.21 (7.70)	14.97 (10.77)
Test significance***	$F = 4.560$ $p = .005$ $d > a, b, c$	$F = -0.167$ $p = -.868$	$F = 3.242$ $p = .025$ $b > a, c, d$

Note: t , independent groups t -test; F , one-way ANOVA.

*Tamhane's T^2 test.

**LSD test.

*** $p < .05$.

adults use e-cigarettes to quit smoking, although most do not quit smoking but instead continue to use both products. Furthermore, e-cigarette usage may increase the use of combustible cigarettes (Yeşilay, 2021). In 2019, the CDC reported that 36.9% of current adult e-cigarette users in the USA are current smokers, 39.5% previously used combustible cigarettes, and 23.6% have never smoked.

There is considerable debate as to whether e-cigarettes help smokers or generate new addicts. Sonerji et al. (2017) conducted a comprehensive systematic review of 17,389 adolescents and young adults, including e-cigarette use with later initiation of smoking and cigarette use within the past 30 days. They found that e-cigarettes were not effective for quitting smoking but may instead encourage individuals to use combustible cigarettes. On the other hand, Hartmann-Boyce et al. (2022) reported evidence that e-cigarettes with nicotine can help adults quit smoking better in the long term than placebo (nicotine-free) e-cigarettes. Mendelsohn and Hall (2020) concluded that e-cigarettes are much less harmful than tobacco products. Nevertheless, WHO has cautioned that these products should not be promoted as cessation aids until sufficient evidence is available and the public health community reaches a consensus on their effectiveness in smoking cessation (WHO, 2022).

Table 4.*Logistic Regression Analysis on the Relationship between e-Cigarette Use and Physical Problems*

Variables	Odds Ratio (95% GA)			<i>p</i> *
	e-Cigarette Ue Only	Frequency of Daily e-Cigarette Use	e-Cigarette Nicotine Concentration	
Cough	2.20 (1.00 – 4.84) ^x	0.05 (0.01 – 0.22) ^a 0.01 (0.00 – 0.21) ^b		.050 ^x .000 ^a .001 ^b
Shortness of breath	3.18 (1.28 – 7.90) ^x	0.15 (0.04 – 0.50) ^a		.013 ^x .023 ^a
Sleepiness	2.91 (1.26 – 6.73)			.012
Painful dry mouth/throat		0.26 (0.09 – 0.72) ^a 0.14 (0.02 – 1.00) ^b	6.28 (1.23 – 31.95) ^c	.009 ^a .015 ^b .027 ^c
Headache		0.07 (0.01 – 0.27) ^a 0.04 (0.00 – 0.40) ^b		.000 ^a .005 ^b
Dizziness		0.16 (0.04 – 0.56) ^a		.004 ^a
Heart palpitations		0.23 (0.06 – 0.83) ^a		.024 ^a

Note: **p* < .05.^a11 – 19 times.^b20 times and more.^c13 mg and above.^xYes.

Nicotine is associated with many health problems, such as gastrointestinal symptoms, headache, palpitations, local irritation of the skin or oral cavity irritation, decreased blood flow in tissues with its vasoconstriction, causes microvascular occlusion and tissue ischemia, and chronic diseases (Alver, 2021). In the present study, we found that e-cigarette use 20 times or more daily was associated with cough, painful dry mouth/throat, and headaches, while e-cigarette use with a nicotine concentration of 13 mg or more was associated with painful dry mouth/throat. Similarly, Dağlı et al. (2017) reported symptoms of dry mouth (14.5%), dry throat (24.9%), and cough (29.4%) among 966 e-cigarette users. Lim and Kim (2014) reported that nicotine-containing e-cigarette liquid caused respiratory tract inflammation, while Hajek et al. (2015) observed that nicotine can pass into the lung alveoli at higher temperatures before rapidly mixing into the bloodstream. Hence, serum nicotine levels can increase within just 5 minutes to begin harming health.

We also found that e-cigarette use alone was associated with cough, shortness of breath, drowsiness, headache, dizziness, painful dry mouth/throat, and heart palpitations, indicating that e-cigarette use has adverse health effects without using combustible cigarettes. Alzahrani et al. (2018) showed that e-cigarettes nearly double the risk of heart attack, while the risk is four times higher if the person also smokes. Similarly, Alhajj et al. (2022) reported a higher frequency of dry mouth, black tongue, and heart palpitations for e-cigarette users than non-smokers. In their meta-analysis involving 483,948 participants, Li et al. (2022) showed that e-cigarette use was associated with a significantly higher likelihood of asthma. Cao et al. (2021) related the damage of e-cigarettes to the respiratory system to upper respiratory tract irritation, nausea, vomiting, cough, bronchitis, and emphysema. They also claimed an increased risk of heart disease. Thus, in line with our findings, we can conclude that e-cigarette use poses risks for both the respiratory and cardiovascular systems.

Table 5.*Logistic Regression Analysis on the Relationship of e-Cigarette Use with Physiological Functions*

Variables*	Odds Ratio (95% GA)	
	e-Cigarette Nicotine Concentration**	<i>p</i> ***
Taste	2.21 (1.02 – 4.78)	.044
General physical condition	4.34 (1.46 – 12.87)	.008
Mood	3.52 (1.50 – 8.23)	.004
Sleep quality	2.21 (1.02 – 4.78)	.044
Appetite	3.18 (1.04 – 9.70)	.041

Note: *Poor.

**13 mg and above.

****p* < .05.

Although nicotine is primarily held responsible in the literature due to its addictive and damaging effects on the human body, another important issue is that e-cigarettes may contain many other harmful substances, added in varying types and doses. Because we do not know the types of e-cigarettes used by the participants in this study, we have no idea how much of which substances (other than nicotine) they use. Nevertheless, WHO (2015) reports that e-cigarettes contain other chemicals that are considered toxic, which may explain why e-cigarette use was associated in our study with painful/dry mouth and throat, mouth and tongue sores/inflammation, gingivitis/gingivitis bleeding, and taste. Dağlı (2017) examined health complaints reported on an e-cigarette social media forum with 40,599 members. Users reported various complaints, such as aphthae, dry mouth metallic taste in the mouth, inability to taste, bad breath, and dry lips. Yang et al.'s (2020) systematic review indicated that although the

transition to e-cigarette use may alleviate oral symptomatology for traditional smokers, a wide range of oral health sequelae may be associated with e-cigarette use, with e-cigarette explosions causing extensive dental damage. Hence, we can conclude that e-cigarettes negatively affect oral health.

Because nicotine concentrations in the emissions of each e-cigarette designed to deliver nicotine to users vary, daily nicotine doses also differ between individuals. However, the number of e-cigarette puffs individuals take daily also has important health consequences. For example, Margham et al. (2016) found that nicotine distribution per puff increases with power, such that a dose with a power of 4.6 W provides 0.032 mg of nicotine per puff. Although we do not know the number of puffs taken daily by participants in our study, we demonstrated a statistically significant relationship between daily e-cigarette use frequency and e-cigarette nicotine concentration and the participants' physical problems (cough, shortness of breath, sleepiness, painful dry mouth/throat, headache, dizziness, and health palpitations).

We found that nicotine concentrations of 13 mg or more were negatively associated with general physical condition, mood, sleep quality, and appetite. Similarly, in a study on adolescents, Ogeil and Phillips (2015) reported that nicotine dependence was associated with poorer sleep quality, higher use of sleeping pills, and sleep disorders. Thus, e-cigarettes containing nicotine reduce sleep quality. Morean et al. (2020) reported that 13.8% of high-school adolescents used flavored e-liquids for appetite control, while 9.3% used flavored e-liquids for weight loss. Similarly, Napolitano et al. (2018) reported that 15% of e-cigarette users also used e-cigarettes to control appetite. Combined with our findings, we can conclude that e-cigarettes can negatively affect appetite, with some even using vaping to control weight. Contrary to the negative effects of e-cigarettes on general physical condition and mood in our study, Napolitano et al. (2018) reported that e-cigarettes may be used as a stress management tool. On the other hand, Lechner et al. (2017) found that long-term e-cigarette use was associated with higher depressive symptoms. Overall, these results suggest that there may be a bidirectional relationship between depression/poor mood and e-cigarette use and that inconsistent findings in the literature may be related to the particular samples.

Limitations and Suggestions for Future Research

The results of the present study are limited to the sample group and cannot be generalized to the wider population. In addition, participation was limited by factors like the difficulty of reaching e-cigarette users and their unwillingness to participate in the survey due to a ban on e-cigarette sales in Türkiye.

Nevertheless, it can be stated that e-cigarette use is an increasingly common public health problem. In line with this, our findings indicate that e-cigarette users experience oral health problems, respiratory and cardiovascular problems, mood-appetite, and sleep problems. Given these findings, society should be informed about the health hazards of e-cigarettes, and e-cigarettes should be included in all health education initiatives regarding the harms of combustible cigarettes. Finally, detailed studies are needed to investigate the negative health impacts of e-cigarettes by clearly identifying their contents.

Ethics Committee Approval: This study was approved by the Ethics Committee of Akdeniz University (approval number: KAEK-378; date: 25.05.2022).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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References

- Alhaji, M. N., Al-Maweri, S. A., Folayan, M. O., Halboub, E., Khader, Y., Omar, R., Amran, A. G., Al-Batayneh, O. B., Celebić, A., Persic, S., Kocaelli, H., Suleyman, F., Alkheraif, A. A., Divakar, D. D., Mufadhal, A. A., Al-Wesabi, M. A., Alhaji, W. A., Aldumaini, M. A., Khan, S., Al-Dhelai, T. A., et al. (2022). Oral Health practices and self-reported adverse effects of E-cigarette use among dental students in 11 countries: An online survey. *BMC Oral Health*, 22(1), 18. [\[CrossRef\]](#)
- Alver, İ. (2021). Elektronik sigara (e-sigara) likit ve aerosollerinin halk sağlığı üzerine etkileri [The effects of liquids and aerosols of electronic cigarette (e-cigarette) on public health]. *Journal of Tepecik Education and Research Hospital*, 31(1), 9 – 15. [\[CrossRef\]](#)
- Alzahrani, T., Pena, I., Temesgen, N., & Glantz, S. A. (2018). Association between electronic cigarette use and myocardial infarction. *American Journal of Preventive Medicine*, 55(4), 455 – 461. [\[CrossRef\]](#)
- Cao, Y., Wu, D., Ma, Y., Ma, X., Wang, S., Li, F., Li, M., & Zhang, T. (2021). Toxicity of electronic cigarettes: A general review of the origins, health hazards, and toxicity mechanisms. *Science of the Total Environment*, 772, 145475. [\[CrossRef\]](#)
- Caraballo, R. S., Shafer, P. R., Patel, D., Davis, K. C., & McAfee, T. A. (2017). Peer reviewed: Quit methods used by US adult cigarette smokers, 2014 – 2016. *Preventing Chronic Disease*, 14, E32. [\[CrossRef\]](#)
- Centers for Disease Control and Prevention (U.S.). (2022). About electronic cigarettes (E-Cigarettes). https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html
- Dağlı, E. (2016). Yeni nesil tütün ve Nikotin ürünleri [New generation tobacco and nicotine products]. *Journal of Continuing Medical Education*, 25, 2 – 6.
- Dağlı, E., Sönmez, Ü. P., & Güner, M. (2017). Elektronik sigara: Türkiye’de ve dünyada durum analizi: Electronic cigarette: Situation analysis in Turkey and in the world. *Journal of Continuing Medical Education*, 26, 12 – 17.
- Dawkins, L., Turner, J., Roberts, A., & Soar, K. (2013). ‘Vaping’ profiles and preferences: An online survey of electronic cigarette users. *Addiction*, 108(6), 1115 – 1125. [\[CrossRef\]](#)
- Etter, J. F., & Bullen, C. A. (2014). A Longitudinal study of electronic cigarette users. *Addictive Behaviors*, 39(2), 491 – 494. [\[CrossRef\]](#)
- Fairchild, A. L., Bayer, R., & Colgrove, J. (2014). The renormalization of smoking? E-cigarettes and the tobacco “endgame”. *New England Journal of Medicine*, 370(4), 293 – 295. [\[CrossRef\]](#)
- Göney, G. (2018). Elektronik sigara (E-sigara) kullanımına bağlı zehirlenmeler [Poisoning due to the use of electronic cigarette (E-Cigarette)]. *Journal of Dependence*, 19(2), 40 – 44.

- Hajek, P., Corbin, L., Ladmore, D., & Spearing, E. (2015). Adding e-cigarettes to specialist stop-smoking treatment: City of London pilot Project. *Journal of Addiction Research and Therapy*, 6(3), 1000244.
- Hartmann-Boyce, J., Lindson, N., Butler, A. R., McRobbie, H., Bullen, C., Begh, R., Theodoulou, A., Notley, C., Rigotti, N. A., Turner, T., Fanshawe, T. R., & Hajek, P. (2022). Can electronic cigarettes help people stop smoking, and do they have any unwanted effects when used for this purpose? *Cochrane Database of Systematic Reviews*, 11(11), CD010216. [\[CrossRef\]](#)
- Hefner, K. R., Sollazzo, A., Mullaney, S., Coker, K. L., & Sofuoglu, M. (2019). E-cigarettes, alcohol use, and mental health: Use and perceptions of e-cigarettes among college students, by alcohol use and mental health status. *Addictive Behaviors*, 91, 12 – 20. [\[CrossRef\]](#)
- Hezer, H., & Karalezli, A. (2019). Sigara psikolojik bağımliliğin sigara içme arzusu ve Nikotin yoksunluk semptomlarına etkisi. *Ankara Medical Journal*, 4, 700-7, 651955. [\[CrossRef\]](#)
- Javelle, E. Electronic cigarette and vaping should be discouraged during the new coronavirus SARS-CoV-2 pandemic (2020). *Archives of Toxicology*, 94(6), 2261 – 2262. [\[CrossRef\]](#)
- Krishnasamy, V. P., Hallowell, B. D., Ko, J. Y., Board, A., Hartnett, K. P., Salvatore, P. P., Danielson, M., Kite-Powell, A., Twentymann, E., Kim, L., Cyrus, A., Wallace, M., Melstrom, P., Haag, B., King, B. A., Briss, P., Jones, C. M., Pollack, L. A., & Ellington, S. (2020). Update: Characteristics of a nationwide outbreak of e-cigarette, or vaping, product use – Associated Lung Injury - United States, August 2019 – January 2020. *MMWR. Morbidity and Mortality Weekly Report*, 69, 90 – 94. [\[CrossRef\]](#)
- Lechner, W. V., Janssen, T., Kahler, C. W., Audrain-McGovern, J., & Leventhal, A. M. (2017). Bi-directional associations of electronic and combustible cigarette use onset patterns with depressive symptoms in adolescents. *Preventive Medicine*, 96, 73 – 78. [\[CrossRef\]](#)
- Li, X., Zhang, Y., Zhang, R., Chen, F., Shao, L., & Zhang, L. (2022). Association between e-cigarettes and asthma in adolescents: A systematic review and meta-analysis. *American Journal of Preventive Medicine*, 62(6), 953 – 960. [\[CrossRef\]](#)
- Lim, L. H., & Kim, S. H. (2014). Inhalation of e-cigarette cartridge solution aggravates allergen-induced airway inflammation and hyper-responsiveness in mice. *Toxicology Research*, 30, 13 – 18.
- Margham, J., McAdam, K., Forster, M., Liu, C., Wright, C., Mariner, D., & Proctor, C. (2016). Chemical composition of aerosol from an e-cigarette: A quantitative comparison with cigarette smoke. *Chemical Research in Toxicology*, 29(10), 1662 – 1678. [\[CrossRef\]](#)
- Mendelsohn, C. P., & Hall, W. (2020). Vaping nicotine is far less harmful than smoking tobacco. *Chest*, 158(2), 835 – 836. [\[CrossRef\]](#)
- Morean, M. E., Bold, K. W., Kong, G., Camenga, D. R., Simon, P., Jackson, A., Cavallo, D. A., & Krishnan-Sarin, S. (2020). High school students' use of flavored e-cigarette e-liquids for appetite control and weight loss. *Addictive Behaviors*, 102, 106139. [\[CrossRef\]](#)
- Napolitano, M. A., Lynch, S. B., & Stanton, C. A. (2018). Young adult e-cigarette users: Perceptions of stress, body image, and weight control. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity*, 25, 487 – 495.
- National Academies Press [NAP]. (2018). Public health consequences of E-cigarettes. <https://www.nap.edu/read/24952/chapter/1>
- Ogeil, R. P., & Phillips, J. G. (2015). Commonly used stimulants: Sleep problems, dependence, and psychological distress. *Drug and Alcohol Dependence*, 153, 145 – 151. [\[CrossRef\]](#)
- Rom, O., Pecorelli, A., Valacchi, G., & Reznick, A. Z. (2015). Are E-cigarettes a safe and good alternative to cigarette smoking? *Annals of the New York Academy of Sciences*, 1340, 65 – 74. [\[CrossRef\]](#)
- Soneji, S., Barrington-Trimis, J. L., Wills, T. A., Leventhal, A. M., Unger, J. B., Gibson, L. A., Yang, J., Primack, B. A., Andrews, J. A., Miech, R. A., Spindle, T. R., Dick, D. M., Eissenberg, T., Hornik, R. C., Dang, R., & Sargent, J. D. (2017). Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Pediatrics*, 171(8), 788 – 797. [\[CrossRef\]](#)
- Sussan, T. E., Gajghate, S., Thimmulappa, R. K., Ma, J., Kim, J. H., Sudini, K., Consolini, N., Cormier, S. A., Lomnicki, S., Hasan, F., Pekosz, A., & Biswal, S. (2015). Exposure to electronic cigarettes impairs pulmonary anti-bacterial and anti-viral defenses in a mouse model. *PLoS One*, 10(2), e0116861. [\[CrossRef\]](#)
- Vansickel, A. R., Cobb, C. O., Weaver, M. F., & Eissenberg, T. E. (2010). A clinical laboratory model for evaluating the acute effects of electronic “cigarettes”: Nicotine delivery profile and cardiovascular and subjective effects. *Cancer Epidemiology, Biomarkers and Prevention*, 19(8), 1945 – 1953. [\[CrossRef\]](#)
- World Health Organization. (2015). Electronic cigarettes (e-cigarettes) or electronic nicotine delivery systems. [https://www.who.int/news/item/30-03-2015-electronic-cigarettes-\(e-cigarettes\)-or-electronic-nicotine-delivery-systems](https://www.who.int/news/item/30-03-2015-electronic-cigarettes-(e-cigarettes)-or-electronic-nicotine-delivery-systems)
- World Health Organization. (2020). World no tobacco day. <https://www.who.int/campaigns/world-no-tobacco-day/world-no-tobacco-day-2020/key-messages>.
- World Health Organization. (2022). Tobacco. <https://www.who.int/news-room/fact-sheets/detail/tobacco>
- Yang, I., Sandeep, S., & Rodriguez, J. (2020). The oral health impact of electronic cigarette use: A systematic review. *Critical Reviews in Toxicology*, 50(2), 97 – 127. [\[CrossRef\]](#)
- Yeşilay (2021). Elektronik sigara da, sigara kadar zararlı. <https://www.yesilay.org.tr/tr/makaleler/e-sigara-da-sigara-kadar-zararli>.