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# The degree of nicotine dependence among users of different tobacco and nicotine products in Madinah City, Saudi Arabia

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## Abstract:

**BACKGROUND:** Nicotine addiction has many consequences. The World Health Organization has classified nicotine dependence as a disorder of substance use. This study aimed to assess the dependence in users of different tobacco and/or nicotine-containing products (TNPs).

**MATERIALS AND METHODS:** This analytical, cross-sectional study involved 211 TNP users in Madinah, Saudi Arabia. The data was collected using a self-administered questionnaire that consisted of two main sections. The first section included sociodemographic domain, TNP status domain, and the Stages of Change model domain. The second section of the instrument included the ABOUT dependence construct comprising 12 items. Independent *t*-test, analysis of variance, and correlation analysis were used to assess the relationship between the study variables.

**RESULTS:** Most users of TNPs exclusively used tobacco cigarettes (53.1%). Total dependence score was significantly associated with gender, marital status, age group, monthly income, nicotine concentration in electronic cigarettes (e-cigarettes) liquid, and the number of cigarettes smoked per day ( $P < 0.05$ ). Total dependence score was correlated with the duration of TNP usage ( $r = 0.24$ ,  $P < 0.001$ ), Switching attempts to another TNP ( $r = 0.16$ ,  $P = 0.020$ ), attempts of quitting TNPs ( $r = 0.25$ ,  $P < 0.001$ ), and willingness to quit ( $r = -0.37$ ,  $P < 0.001$ ).

**CONCLUSION:** Dependence was associated with gender, marital status, age group, monthly income, nicotine concentration in e-cigarette liquid, and the number of cigarettes smoked per day. It was also associated with duration of TNP usage, Switching attempts to another TNP, attempts of quitting TNPs and the willingness to quit.

## Keywords:

Electronic cigarettes, nicotine dependence, smoking, tobacco

## Introduction

Saudi Arabia has been going through a major development in tobacco control programs. However, nicotine addiction and its harmful consequences still affect individuals, and more than 7000 Saudis die of tobacco-related diseases every year.<sup>[1]</sup>

Nicotine is the active substance of the tobacco plant (*Nicotiana tabacum*) and is responsible for dependence-producing effects. It is the third most used psychoactive substance worldwide after caffeine and alcohol.<sup>[2-4]</sup>

Nicotine or tobacco use disorder or dependence is the most used criterion for assessing nicotine addiction. According to

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the World Health Organization's (WHO) International Classification of Diseases, nicotine dependence was classified as a disorder of substance use.<sup>[5]</sup>

Inhalation by "smoking cigarettes" is the most common method for nicotine consumption, followed by electronic cigarettes (e-cigarettes), pipe smoking, tobacco chewing (smokeless tobacco), and inhalation of snuff.<sup>[4]</sup>

A strong internal urge to use nicotine is the characteristic feature of nicotine dependence, manifested by the inability to control or prioritize the use of tobacco or nicotine products over other activities.<sup>[6]</sup> These feelings are usually accompanied by a craving to use nicotine products. The physiological features of dependence include tolerance to the effects of nicotine (i.e., increasing or decreasing the amount of tobacco used to achieve the desired effect), withdrawal symptoms following cessation or a reduction in nicotine use, or the repeated use of nicotine to prevent or alleviate withdrawal symptoms.<sup>[6]</sup> It was reported that the signs and symptoms of nicotine dependence usually appear over at least 3–12 months.<sup>[6]</sup>

According to the WHO, high nicotine dependence is associated with a lower motivation to quit, difficulty in quitting, and failure to quit.<sup>[7]</sup> In addition, high dependency is correlated with an increase in the number of nicotine receptors.<sup>[8]</sup>

There are several scales for subjectively measuring nicotine dependence such as the Assessment of Behavioral Outcomes related to Tobacco and nicotine products instrument (ABOUT Dependence), which was developed to provide a subjective measure of the psychological dependence associated with the use of various TNPs including exclusive and multiple users.<sup>[9–11]</sup>

The stages of change model are frequently used in smoking cessation clinics to assess change in behavior and the readiness of users to quit TNPs. Multiple steps are involved in this model, starting from precontemplation, contemplation, preparation, action, maintenance, and relapse. This model is the most commonly applied theoretical and clinical framework in a broad spectrum of behavior that includes smoking.<sup>[12]</sup>

Nicotine dependence is an important determinant in the cessation of tobacco use. There is a dearth of studies on TNPs dependence in Saudi Arabia.<sup>[13]</sup> Therefore, the current study aimed to assess nicotine dependence in different users of TNPs in Saudi Arabia.

## Materials and Methods

This cross-sectional study recruited different TNP users in Madinah city. We prepared a self-administered survey using a Microsoft form through WhatsApp and Telegram applications and distributed the QR code to different tobacconists and coffee shops in the city. A physical paper form was also distributed to those who had no access to the electronic form. Ethical approval was obtained from the institutional review board vide letter number IRB 185–2021 dated 21/11/2021 and informed written consent was taken from all participants. Participants were approached in the period from December 2021 to January 2022.

Tobacco and/or nicotine-containing products (TNPs) in this study were classified into five groups: e-cigarettes, tobacco cigarettes, smokeless tobacco, heated tobacco products, and multiproduct (two or more products).<sup>[14,15]</sup>

The estimated sample size was based on previous literature as follows:  $N = (Z [1 - \alpha] + Z [1 - \beta])^2 (p_1 [1 - p_1] + p_2 [1 - p_2]) / (p_1 - p_2)^2$ , where  $n$ : calculated sample size;  $Z$ : the z-value for the selected level of confidence ( $1 - \alpha$ ) = 1.96;  $P_1$ : estimated prevalence of exclusive current electronic cigarette users = 0.38;  $P_2$  exclusive current smoker = 0.18." The calculated minimum sample size was, therefore, 77 participants for each group. With the five groups, the total sample size was 385 participants.<sup>[16]</sup>

This study excluded those who were not current users, aged <18 years, former smokers, those whose questionnaires were incomplete, and those who were in the "action/maintenance" of the Stage of Change model.

The study instruments consisted of two main sections. The first section included the following: (a) sociodemographic domain, such as age, gender, marital status, and income; (b) TNP status domain, such as the type of tobacco and nicotine product, willingness to quit, average number of cigarettes consumed per day, attempts at quitting, and nicotine concentration in e-cigarettes liquid; and (c) the Stages of Change model domain to assess the current status of TNP users. It consisted of several stages, namely precontemplation (not knowing, unaware, and unwilling to change behavior), contemplation (being aware of a problem but doing nothing), preparation (making plans to change behavior), action (making changes), maintenance (sustaining changes), and relapse (relapsing into old behaviors).<sup>[17,18]</sup> The instrument comprised some items on the experience of the past 7 days.

E-cigarette liquid in Saudi Arabia comes in two kinds of nicotine concentration: salt nicotine (nicotine juice containing  $\geq 20$  mg of nicotine per liquid) and freebase nicotine (nicotine juice containing  $\leq 12$  mg of

nicotine/liquid). The second section of the instrument included the ABOUT dependence construct.<sup>[11]</sup> This instrument assessed the dependence through three domains comprising 12 items. The first domain consisted of two items: the time interval between the first use of the product on waking up and the time interval from when the product is last used before going to bed. Each item was scored as follows: 0 = "more than 3 h;" 1 = ">1 h to 3 h;" 2 = "31–60 min;" 3 = "16–30 min;" 4 = "6–15 min;" and 5 = "0–5 min." The total score ranged from 0 to 10. The second domain included five items that assessed the feelings and experiences of the signs and symptoms of perceived dependence that gave a total score of 0–20. The third domain included five items that measured the behavioral aspects of perceived dependence and its impact on daily activities, with a total score of 0–20. Each item was scored on a five-point Likert scale: 0 = "not at all" or "never, and 4 = "extremely" or "all the time." The total score of the three domains ranged from 0 to 50. A higher score indicated a higher level of severity (for the extent of use domain) or a higher level of perceived dependence (for the remaining domains). There were no cutoff values for that domain. Using a standard "forward-backward" translation procedure, the English language version of the ABOUT was translated into Arabic language. It was then reviewed by clinicians and proofread by the authors.

Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 22. Frequencies and percentages were obtained for the categorical variables while mean, standard deviation (SD), and median were calculated for the scale variables. Independent *t*-test, analysis of variance, and correlation analysis were used to assess the relationship between the study variables.  $P < 0.05$  was considered statistically significant.

## Results

A total of 211 subjects participated in the study with a response rate of 55%. The majority were men (78.9%), aged <30 years (54%), employed (73%), and with a university degree (61.1%) [Table 1].

Most TNP users exclusively used tobacco cigarettes (53.1%), followed by e-cigarettes (20.4%) and smokeless tobacco (4.7%) [Table 2]. The median interquartile range TNPs Quitting attempts was 2 (1–4). The mean (SD) age at which TNPs were first used was 19.7 (4.1) years, and the mean (SD) duration of TNP usage was 11.7 (9.1) years. The mean (SD) total score of TNPs dependence was 25.9 (9.3) [Table 3].

Table 4 shows the relationship between study variables and the dependence domains. The extent of use score

**Table 1: Sociodemographic characteristics of the tobacco and/or nicotine containing products users (n=211)**

Variables	N (%)
Age (years)	
≥30	97 (45.9)
<30	114 (54.0)
Sex	
Male	166 (78.7)
Female	45 (21.3)
Marital status	
Married	105 (49.8)
Unmarried	106 (50.2)
Nationality	
Saudi	193 (91.5)
Non-Saudi	18 (8.5)
Employment status	
Student	35 (16.6)
Working	154 (73)
Does not work	22 (10.4)
Income (SAR)	
<5000	84 (39.8)
5000-11,000	47 (22.3)
>11,000	80 (37.9)
Level of education	
School	46 (21.8)
University	129 (61.1)
Postgraduate	36 (17.1)

**Table 2: The type, age at first use, and duration of tobacco and/or nicotine containing products used among the study participants (n=211)**

Variables	N (%)
Type of nicotine products used	
Tobacco cigarettes	112 (53.1)
Electronic cigarettes	43 (20.4)
Smokeless tobacco	10 (4.7)
Heated tobacco products	7 (3.3)
Multiproduct	39 (18.5)
Switching attempts from one TNP to another	
None	31 (14.7)
One	30 (14.2)
Two	46 (21.8)
Three	43 (20.4)
Four	25 (11.8)
Five or more	36 (17.1)
Quitting attempts TNP, median (IQR)	2 (1-4)
Age of first usage for TNP, mean (SD)	19.7 (4.1)
Duration of TNP usage (year), mean (SD)	11.7 (9.1)
Current willingness to quit, mean (SD)	5.9 (2.8)

TNP=Tobacco and/or nicotine-containing products, IQR=Interquartile range, SD=Standard deviation

was significantly associated with gender, age group, nicotine concentration in e-cigarettes liquid, and the number of cigarettes consumed per day ( $P < 0.05$ ). The signs and symptoms of perceived dependence score were

**Table 3: Level of nicotine dependence among tobacco and/or nicotine products users**

Dependent variables (instrument)	Mean (SD)	Range
The extent of use score	5.4 (2.9)	0-10
The behavioral impact of perceived dependence on daily activities	11.7 (4.3)	0-20
Signs and symptoms of perceived dependence score	8.8 (3.8)	0-20
Total ABOUT dependence score	25.9 (9.3)	2-48

ABOUT=Assessment of Behavioral Outcomes related to Tobacco and nicotine products, SD=Standard deviation

significantly association with gender, marital status, age group, the number of cigarettes consumed per day, and nicotine concentration in e-cigarettes liquid ( $P < 0.05$ ). The behavioral impact of perceived dependence on daily activities score was significantly associated with gender, marital status, and the number of cigarettes smoked per day ( $P < 0.05$ ). Total dependence score was significantly associated with gender, marital status, age group, monthly income, nicotine concentration in e-cigarette liquid, and the number of cigarettes smoked per day ( $P < 0.05$ ).

Table 5 shows the correlation between nicotine dependence and quantitative variables. The extent of use was correlated positively with the duration of usage ( $r = 0.24$ ,  $P < 0.001$ ), and negatively with willingness to quit ( $r = -0.32$ ,  $P < 0.001$ ). The signs and symptoms of perceived dependence was correlated positively with the duration of TNP usage ( $r = 0.22$ ,  $P = 0.002$ ), Switching attempts from certain TNP to another ( $r = 0.14$ ,  $P = 0.040$ ), and number of quit attempts ( $r = 0.27$ ,  $P < 0.001$ ). A negative correlation was found with the willingness to quit ( $r = -0.39$ ,  $P < 0.001$ ). Total dependence score was correlated positively with the duration of TNP usage ( $r = 0.24$ ,  $P < 0.001$ ), Switching attempts to another TNP ( $r = 0.16$ ,  $P = 0.02$ ), and attempts of quitting ( $r = 0.25$ ,  $P < 0.001$ ), as well as negatively with the willingness to quit ( $r = -0.37$ ,  $P < 0.001$ ).

## Discussion

This study found that e-cigarette users who consumed  $\geq 20$  mg of salt nicotine demonstrated a higher score in the dependence construct, timing of use, and signs and symptoms compared to freebase nicotine users. This finding could be attributed to the fact that salt nicotine has high nicotine concentrations, greater attractiveness, smoothness, and less burning sensation in the throat.<sup>[19-21]</sup> In addition, most types of salt nicotine of higher concentrations (ranging from 20 mg to 50 mg) are present on the market. It was found that in higher concentrations of nicotine, the freebase produces a burning sensation and discomfort.<sup>[19-21]</sup>

Regarding tobacco cigarette users, participants who consumed 21–25 cigarettes/day displayed higher score

of dependence in comparison to those who consumed 1–5 cigarettes/day. In this study, women demonstrated lower dependence than men in most of the subscales. Previous studies supported this finding.<sup>[22,23]</sup> Women perhaps tend to display lower nicotine dependence because they consume fewer cigarettes per day.<sup>[24]</sup> Furthermore, previous studies have demonstrated an association between fluctuations in the levels of reproductive hormones and TNP usage; high progesterone levels reduce the tendency in women to smoke.<sup>[25-27]</sup>

According to this study, married participants displayed higher dependence and a greater behavioral impact on the daily activities score. A previous study supported this finding.<sup>[28]</sup> However, another study reported that being married is a substantial factor in successful smoking cessation.<sup>[29]</sup> Higher behavioral impact could provide a comprehensive idea, which is helpful during consultation.

This study showed that increasing years of TNP usage shortens the time interval between waking up and the first use as well as the time between the last use and sleep. This study found that participants aged  $\geq 30$  years displayed a higher score in the extent of use domain (the timing of use). Moreover, this study demonstrated that the dependence score, extent of use score, the signs and symptoms score, and behavioral impact of perceived dependence on daily activities score increased as the duration of TNP use increased.

In this study, there was a positive correlation between the number of changes from one particular TNP to another and the signs and symptoms score. This is because if the desired sense of pleasure is not attained by the use of a particular product, another with higher nicotine concentrations may be tried.<sup>[30,31]</sup> It was reported that e-cigarettes, hookahs, noncombusted cigarettes, and smokeless tobacco are associated with the initiation of cigarette smoking.<sup>[32]</sup> However, the extent of exposure to the ingredients of a TNP and behavioral aspects may play a role in the multiple use of TNPs.<sup>[30]</sup>

In this study, those who had a high “willingness to quit” had a lower score in all domains and the dependence construct. Most participants in this study had attempted to quit at least once. The dependence construct and signs and symptoms of perceived dependence increased with increasing quitting attempts. Previous studies demonstrated that self-efficacy and the removal of urge factors were essential in successful quitting.<sup>[31,33]</sup> Chaiton *et al.*, reported that for many smokers, it may take 30 or more attempts before quitting is successful.<sup>[34]</sup>

The cross-sectional design of this study was not appropriate for the assessment of the temporality

**Table 4: Association between dependence and sociodemographic variables and tobacco and/or nicotine-containing products status**

Variables	Extent of use (the timing of use)		Signs and symptoms of perceived dependence		Behavioral impact of perceived dependence on daily activities		Total about dependence	
	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value
Sex								
Male	5.7 (2.8)	0.002	12.2 (4.3)	0.002	9.2 (3.8)	0.002	27.1 (9.1)	<0.001
Female	4.2 (2.7)		10 (4.1)		7.2 (3.6)		21.3 (8.7)	
Marital status								
Married	5.6 (2.7)	0.243	12.4 (4.3)	0.021	9.6 (4.1)	0.002	27.6 (9.4)	0.001
Unmarried	5.1 (3)		11.1 (4.2)		7.9 (3.3)		24.1 (8.9)	
Age (years)								
<30	4.7 (3)	0.003	11 (4.3)	0.030	8.3 (3.5)	0.104	24.1 (9.2)	0.009
≥30	5.9 (2.7)		12.3 (4.3)		9.2 (4.02)		27.4 (9.1)	
Nationality								
Saudi	5.3 (2.9)	0.902	11.7 (4.4)	0.764	8.7 (3.8)	0.561	25.8 (9.3)	0.643
Not Saudi	5.4 (3)		12 (3.8)		9.4 (3.8)		26.8 (9)	
Employment status								
Working	5.5 (2.8)	0.218	12.1 (4.3)	0.125	9.02 (3.8)	0.250	26.6 (9.1)	0.094
Not working	5.4 (3.1)		11.7 (4.1)		8.4 (4.03)		25.4 (9.2)	
Student	4.6 (3.2)		10.4 (4.5)		7.9 (3.8)		22.9 (10)	
Level of education								
School	5.5 (3)	0.315	11.5 (4.4)	0.790	7.9 (3.4)	0.441	25.1 (9.97)	0.833
University	5.5 (2.8)		11.7 (4.2)		8.4 (3.6)		26.0 (8.9)	
Postgraduate	4.6 (2.9)		12.1 (4.6)		9.8 (5.8)		26.2 (10.1)	
Income (SAR)								
<5000	4.9 (3.1)	0.143	10.99 (4.3)	0.110	7.9 (3.7)	0.019	23.8 (9.4)	0.026
5000-11,000	5.9 (2.7)		12.23 (4)		9.4 (3.3)		27.6 (7.997)	
>11,000	5.4 (2.7)		12.3 (4.5)		9.3 (4.1)		27.1 (9.531)	
TNPs								
Tobacco cigarettes	4.9 (2.8)	0.128	11.4 (4.4)	0.091	8.8 (3.8)	0.211	25.1 (9.4)	0.120
Electronic cigarettes	5.3 (3.0)		10.7 (4.6)		7.5 (3.6)		23.5 (10.2)	
Heated tobacco	4.1 (2.9)		9.3 (4.6)		7.3 (3.1)		20.6 (9.6)	
Smokeless tobacco	5.5 (3.4)		13 (4.7)		9.3 (5.6)		27.7 (12.3)	
Multiproduct	6.4 (2.8)		13 (4.1)		9.2 (4.3)		28.6 (8.9)	
Nicotine (mg) per liquid for electronic cigarettes								
≤ 12 mg of "freebase nicotine"	4.7 (2.9)	0.003	10.2 (4)	0.005	7.6 (3.9)	0.102	22.5 (9.3)	0.004
≥ 20 mg of "salt nicotine"	6.7 (2.7)		13.02 (4.3)		9.1 (3.8)		28.9 (9)	
Number of cigarettes consumed		<0.001		<0.001		<0.001		<0.001
1-5 (reference group)	2.7 (2.7)		7.2 (2.8)		5.8 (2.7)		15.8 (5.9)	
6-10	3.5 (2.1)	0.778	10.9 (3.7)	0.010	8.6 (2.8)	0.055	22.9 (6.8)	0.009
11-15	5.6 (2.4)	0.001	11.3 (3.1)	0.004	9.5 (3.9)	0.007	26.4 (7.2)	<0.001
16-20	5.9 (2.1)	<0.001	13.8 (3.9)	<0.001	9.8 (3.2)	0.002	29.4 (6.9)	<0.001
21-25	7.1 (2.2)	<0.001	14.1 (3.5)	<0.001	11.1 (3.4)	<0.001	32.4 (7.4)	<0.001

ABOUT=Assessment of Behavioral Outcomes related to Tobacco and nicotine products, TNPs=Tobacco and/or nicotine-containing products

**Table 5: Correlation between nicotine dependence and quantitative variables**

Correlation coefficients	Extent of use domain		Signs and symptoms domain		Behavioral impact domain		Dependence	
	r	P-value	r	P-value	r	P-value	r	P-value
The age at first use	-0.09	0.181	-0.10	0.110	-0.05	0.567	-0.10	0.156
The duration of usage	0.24	<0.001	0.22	0.002	0.17	0.013	0.24	<0.001
Switching attempts to another TNP	0.05	0.565	0.14	0.043	0.12	0.086	0.16	0.022
Quitting attempts TNPs	0.13	0.077	0.27	<0.001	0.23	<0.001	0.25	<0.001
Willingness to quit	-0.32	<0.001	-0.39	<0.001	-0.21	0.002	-0.37	<0.001

TNPs=Tobacco and/or nicotine products

between variables. The nonprobability sampling technique in this study limits its generalizability to the target population of Medina city. A limitation of this study is that it was conducted in one city in Saudi Arabia, which limits its generalizability to cover Saudi Arabia in its entirety. Our study depended only on subjective instruments and no biofeedback, such as a carbon monoxide monitor. The response rate in this study (55%) may affect the power of the study.

## Conclusion

Our findings revealed an association between dependence and concentration of nicotine in the liquid of e-cigarettes and the number of cigarettes smoked per day. Consuming salt nicotine was associated with higher nicotine dependence. Men in general and married men in particular displayed a higher dependence than their counterparts. As the duration of TNP usage increased, the score of the extent of use, as well as the score of signs and symptoms of perceived dependence increased. The number of attempts made to quit TNPs was associated with increased nicotine dependence. It is essential to implement health promotion programs to prevent TNP use by the youth because the duration of use is associated with increased annual dependence. Further larger and representative studies are recommended.

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## Conflicts of interest

There are no conflicts of interest.

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