

Original Article

# Psychological and Behavioral Traits in Smokers and Their Relationship with Nicotine Dependence Level

Mehrnaz Rezvanfard MD<sup>1</sup>, Hamed Ekhtiari MD<sup>1</sup>, Azarakhsh Mokri MD<sup>2</sup>, Gholamreza Esmaeeli Djavid MD<sup>1</sup>, Hossein Kaviani PhD<sup>3</sup>

## Abstract:

**Background:** Although several studies have been performed to evaluate the personality differences amongst smokers with different dependency levels, they do not use constant criteria for patients selection. The inconsistencies between some of these findings suggest the need for using solid criteria such as the modified Fagerström Tolerance Questionnaire (mFTQ) score to evaluate the relation between personality traits and impulsivity differences and the severity of nicotine dependency.

**Materials and Methods:** In this study, 22 heavily dependent, 37 lightly dependent and 30 non-smokers were recruited using the mFTQ score, a widely used test of nicotine dependence. All participants completed the Beck Depression Inventory, Cattle Anxiety Scale, Temperament, and Character Inventory and three other personality questionnaires intended to measure impulsivity: the Barratt's Impulsiveness Scale, Eysenck Impulsiveness Questionnaire, and Zuckerman's Sensation Seeking Scale. Participants also had to perform a behavioral choice task, the Delay Discounting Choice, which is designed to assess impulsivity.

**Results:** Although heavily dependent smokers scored higher than non-smokers and lightly dependents on the Beck depression Inventory and most of the impulsivity subscales; lightly dependent smokers scored higher than non-smokers only on a few subscales of the impulsivity scores.

**Conclusions:** The mFTQ scores correlated significantly with many scores of the impulsivity subscales. These results would be helpful to design more specific questionnaires for the psychological assessment of smokers according to nicotine dependence level and to adopt more etiologic oriented treatment approaches in the future.

**Keywords:** delay discounting, impulsivity, nicotine dependency, personality traits, risk taking behavior, tobacco smoking

## Introduction

Although most smokers are aware of the enormous threat of smoking cigarettes to one's health<sup>1</sup>, only 20 to 60 percent claim that they are ready to quit smoking within the foreseeable future, specifically within the next six months.<sup>2</sup> Thus, the question arises as to why so many smokers are reluctant to give up smoking, especially in view of the fact that many of the adverse health effects

and health risks of smoking are reversible when people quit.<sup>3</sup>

Tobacco dependence and the difficulty of quitting are assumed to be the result of nicotine's huge psychopharmacological effects, genetic influences and environmental factors.<sup>4</sup> It also has been suggested that the effect these variables have on the subsequent likelihood of smoking are mediated by personal factors such as intelligence, socioeconomic status, and personality traits.<sup>5,6</sup> According to the personality factors, two theoretical models of tobacco use are proposed for young adults: the self-medication and the orbitofrontal dysfunction models.

The self-medication theory places emphasis on the addictive and reinforcement properties of nicotine. Investigators speculate that a significant number of smokers are self-medicating, since nicotine possesses mood-elevating and pleasure-giving properties.<sup>7</sup> Thus tobacco use and/or dependence is associated with several psychiatric conditions, including depression, anxiety, bipolar disorder, antisocial per-

**Authors' affiliations:** <sup>1</sup>Psychological Assessment Laboratory, Iranian National Center for Addiction Studies (INCAS), Medical Sciences, University of Tehran, <sup>2</sup>Psychiatric Department, School of Medical Sciences, University of Tehran, Roozbeh Hospital, <sup>3</sup>Psychiatric and Psychological Research Center, School of Medical Sciences, University of Tehran, Roozbeh Hospital, Tehran, Iran

•**Corresponding author and reprints:** Hamed Ekhtiari MD, Psychological Assessment Laboratory, Iranian National Center for Addiction Studies, No.669, South Kargar Ave., Tehran, Iran. Tel: +98-215-542-177, Fax: +98-215-542-1166

E-mail: h.ekhtiari@gmail.com; h\_ekhtiari@razi.tums.ac.ir

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sonality disorder (APD), schizophrenia, borderline, and schizotypal personality traits.<sup>5,8-11</sup>

The orbitofrontal system plays a significant role in the processing of emotional information, particularly sensitivity to reward and punishment.<sup>12,13</sup> The orbitofrontal dysfunction model indicates that tobacco use is associated with several related personality traits including extraversion,<sup>14</sup> impulsivity,<sup>15-17</sup> risk taking,<sup>18,19</sup> sensation seeking, monotony avoidance,<sup>2,19</sup> and novelty seeking.<sup>20</sup>

Impulsivity is considered a complex trait with many varieties. In a comprehensive definition, a high level of impulsivity comes with the desire for immediate gratification, risky actions, seeking new feelings, easy self-gratification, as well as the inability to persistently follow a task and shorter reaction times.<sup>21</sup> Because nicotine has stimulating properties,<sup>22</sup> it could have a particular appeal to sensation seekers for whom increase in arousal bears a hedonic value, and who tend to prefer stimulant drugs.<sup>23</sup> Impulsivity could also be explained in terms of “delayed discounting” or “the tendency to choose smaller, relatively immediate rewards over larger but more delayed rewards”.<sup>24</sup> This behavioral definition suggests that drug consumption and impulsivity may be linked. The rationale for the link between impulsivity and smoking is that individuals, who choose to smoke cigarettes, are essentially choosing the immediate reinforcing effects of cigarettes over a healthier, wealthier future life.<sup>25,26</sup>

Although several studies have evaluated the personality differences amongst those with different smoking statuses, they have not followed any consistent criteria on choosing study participants. The inconsistencies found in some of these findings suggest the use of consistent criteria, such as the modified Fagerström Tolerance Questionnaire (mFTQ) score to evaluate personality traits and impulsivity differences in relation to the severity of nicotine dependency. Thus, it would be possible to design more specific questionnaires for the psychological assessment of smokers and develop etiologic oriented treatments, specifically for smokers who are heavily dependent and where cigarette abstinence therapy has been proven ineffective. Using these questionnaires, identifying persons who are at risk for beginning smoking or becoming heavily dependent smokers and predicting the vulnerability to drug dependence as a function of these impulsivity traits

seems feasible in the near future.

## Materials and Methods

### Participants

Participants were recruited from amongst students of school of medical sciences, Tehran University of Medical Sciences through a public board notice. Male students who were regular smokers (defined as smoking at least one cigarette daily within the past six months) or non-smokers (had not smoked at all) were selected. Medications taken at the time were taken into consideration, as well as the psychological conditions of the participants. A total of 102 students responded to our notice, of which 11 subjects did not meet the inclusion criteria and 2 were excluded due to diagnosed psychiatric/psychological disorders. The final participants were 89 medical students between 18 and 26 years of age. There were 59 regular smokers and 30 non-smokers who reported having never smoked.

Participants reported to the Psychological Assessment Laboratory (Psycholab) of the National Iranian Center for Addiction Studies for assessment with a group of psychological questionnaires and a behavioral task.

### Procedure

Participants were seated individually in a small, quiet room at a table in front of the research assistant. They first signed an informed consent which was approved by the Ethics Community of Tehran University of Medical Sciences and were ensured that no one except the chief researcher would have access to their profile.

Regular smokers were required to complete the mFTQ for nicotine dependency. For further assessment, they were divided into two categories based upon their scores: lightly dependent (n=37) and heavily dependent (n=22). Lightly dependent smokers were participants who scored below 7 (mFTQ<7) and heavily dependent smokers scored greater than or equal to 7 on the mFTQ.

Subjects were then asked to complete subsequent questionnaires and, after a break period, they were directed to solitary cabins with desktop computers to perform the computer programmed task, Delay Discounting Choice Task (DDT). Total participation time for each of the participants was approximately

80 minutes and to acknowledge their co-operation, participants received 50000 rials (about US \$5) following completion of the experiment.

### Measures

The specific personality questionnaires were selected because they had previously been used with success by researchers to classify people as more or less impulsive and also to evaluate impulsivity in smokers.

The Persian version of these questionnaires was used. Three questionnaires, the Beck Depression Inventory II (BDI-II), Kattle Anxiety Scale, and Temperament and Character Inventory have been validated and previously used in many experiments, whereas the Barratt Impulsiveness Scale, Eysenck Impulsiveness Questionnaire, and Zuckerman's Sensation Seeking Scale have recently been validated for psychological assessments.<sup>27</sup>

#### *mFTQ*<sup>28</sup>

This questionnaire is a seven item self-reporting questionnaire that allows physicians to classify smokers according to their level of nicotine dependency. A score of seven points or greater indicates a high level of nicotine dependency, while scores below seven are considered to be lightly dependent on nicotine.

#### *Socio-Environmental Determinants Questionnaire*

This self-reporting questionnaire was designed by the authors to evaluate the role of socio-environmental determinants on the smoking status of individuals. It has several criteria, such as: demographic variables, family income, age at onset of smoking, number of smoking family members, percentage of friends who smoke, history of other drug use, and degree of religious beliefs. These items were successfully used by prior studies to evaluate the differences between smokers and non-smokers.

#### *BDI-II*<sup>29</sup>

This inventory is a self-reporting instrument that measures the intensity of depressive symptoms. It is a widely used instrument with excellent psychometric properties. The Persian version of BDI was used in this study.<sup>30</sup>

#### *Cattle Anxiety Scale*<sup>31</sup>

This scale is probably the most efficient assessment tool for the scoring of anxiety provided in a short self-reporting questionnaire. The Persian version of this test was used in this study.<sup>30</sup>

#### *Barratt Impulsiveness Scale (BIS-11)*<sup>32</sup>

This scale is a self-reporting scale of 30 items which measures three types of impulsivity: motor, cognitive, and non-planning. The Persian version was used in this study.

#### *Eysenck Impulsiveness Questionnaire (I-7)*<sup>33</sup>

This 54 item questionnaire is a forced-choice instrument. Participants were asked to indicate whether they agree or disagree with a series of statements related to three behavioral dimensions: impulsiveness, venturesomeness, and empathy. The Persian version of this questionnaire was used for the assessment of these behavioral dimensions.

#### *Zuckerman's Sensation Seeking Scale*<sup>34</sup>

This 40 item forced choice questionnaire yields four subscales and one total score. Its subscales are: thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility. The Persian version was used in the evaluation of these scales.

#### *Temperament and Character Inventory (TCI)*<sup>35</sup>

This inventory is a self-reporting measurement of four temperaments (novelty seeking, harm avoidance, reward dependence, and persistence) and three characteristics (cooperativeness, self-directiveness, and self-transcendence). The Persian version was used in this study.<sup>36</sup>

#### *Delay Discounting Choice Task*<sup>24</sup>

This consisted of a computer program developed to study choice behavior, which was used for measuring delay discount. The Persian version of the task was applied to determine indifference points for eight different delay intervals: 6 hours, 1 day, 1 week, 1 month, 6 months, 1 year, 5 years, and 25 years.<sup>37</sup> The program presented a series of questions that asked the participant to decide between the equivalent of \$100 in Iranian currency to be received after one of the different delay periods or a smaller amount of money (e.g. \$20) that could be received immediately. The participants were informed

that no money would be paid and they should consider all gains as speculative. The smaller amount of immediate money was adjusted up or down by the program depending on the responses of participants to previous questions. Adjustments in the amount of immediate money were made in a manner as to narrow the range of values on successive choice trials until an indifference point was arrived at for each of the delay intervals. The indifference points for all eight delay periods were used to calculate delay discount curves.

#### Data analytic strategy

Comparisons took place between these groups: heavily dependent (n=22), lightly dependent (n=37), and non-smokers (n=30) and no values were excluded from the analysis.

#### Demographic data and questionnaire scores

Using the Kolmogorov-Smirnov Test, normally distributed data for demographic and questionnaire scores were analyzed with a one-way analysis of variance (ANOVA). Pairwise comparisons were conducted via the Post Hoc Tukey Test and Dunnett's test. Scores, which were not normally distributed, were analyzed with the Kruskal-Wallis one way ANOVA. Planned pair-wise comparisons were conducted by the Mann-Whitney U Test and Bonferroni correction was used to reduce the risk of Type 1 error. The "age at onset" and "number of previous attempts to quit" were compared with the Independent Samples T Test between heavily dependent and lightly dependent smokers.

**Table 1.** Demographic data and descriptive statistics of samples based on smoking status

Participants	Heavily dependent (n=22)	Lightly dependent (n=37)	Non-smokers (n=30)	P-value
Age	23.95±3.06	24.22± 2.17	24.84±3.23	0.28
Marital status				0.34
Single	19 (86.40%)	28 (80.00%)	24 (85.70%)	
Married	3 (13.60%)	7 (20.00%)	4 (14.30%)	
Family income (monthly)				0.50
< \$500	2 (9.50%)	7 (20.60%)	5 (19.20%)	
\$500-\$1000	8 (38.10%)	15 (44.10%)	10 (38.50%)	
>\$1000	11 (52.40%)	12 (35.30%)	11 (42.30%)	
Education (years)	17.29 (2.97)	18.60 (2.43)	18.59 (2.31)	0.17
m-FTQ score	9.13 ±1.95*	4.37± 1.33	—	0.00
Cigarettes /day	15.68±5.84*	7.27±4.60	—	0.00
Age at onset of smoking	17.81±2.03*	20.32±2.67	—	0.00
Number of previous quit attempts	2.00 (1.52)	3.06 (4.83)	—	0.31
Number of smoking family members	1.47±0.67	1.57±0.60	1.48± 0.58	0.1
Percentage of friends who smoke				0.02
<50%	15 (50%)*	18 (62.10%)	20 (87%)	
>50%	15 (50%)*	11 (37.90%)	3 (13%)	
History of other drug use				0.00
Yes	17 (81%)*	13 (43%)*	1 (5%)	
No†	4 (19%)*	17 (57%)*	29 (95%)	
Religious beliefs				0.08
Yes	4 (17.00%)	15 (42.90%)	14 (53.80%)	
Somehow	10(47.67%)	11 (31.40%)	10 (38.50%)	
No	7(33.33%)	9 (25.70%)	2 (7.70%)	
Data are presented as mean±SD or n (%); *=heavily dependent vs. non-smokers (P<0.05); +=heavily dependent vs. lightly dependents (P<0.05)				

### Delay Discounting Choice Task

A hyperbolic equation was assigned to each participants switch point data<sup>38</sup> using the curve-fitting tool of MATLAB 7.4 in order to assess the discount rate:

$$V = \frac{M}{1 + K.X} \quad \text{Equation 1}$$

V represents the discounted value of a delayed reward (i.e. the indifference point), M is the amount of the delayed reward, K is the fitted parameter indexing the discount rate and X is the appropriate independent variable. In the delay task, X represents the length of delay. Because distributions of K were skewed, the one-tailed Mann-Whitney U Test was used to assess whether heavily dependent, lightly dependent and non-smokers discounted delays at different rates rather than each other.

Finally Pearson's correlation coefficients were used to examine whether these personality and impulsivity subscales correlated with the mFTQ score.

## Results

### Demographic data and socio-environmental determinants

Heavily dependent, lightly dependent and non-smoker participants all shared the same demographic characteristics of age, education, income and marital status (Table 1). Because all participants were medical students; we assumed that the IQ differences between these three groups would be insignificant.

As seen in Table 1, heavily dependent smokers were younger at the initiation of smoking than lightly dependent smokers ( $P < 0.001$ ). Heavily dependent smokers have been related with higher percentages of smoking friends than non-smokers ( $P < 0.05$ ) but lightly dependent and non-smokers did not differ significantly on this measure.

Heavily dependent smokers also mentioned a higher percentage of positive history of other drug use compared to both non-smokers ( $P < 0.01$ ) and lightly dependent smokers ( $P < 0.05$ ). Lightly dependent smok-

**Table 2.** Personality questionnaires and computerized tasks scores for heavily dependent, lightly dependent and non-smoker samples (SD)

Participants	Heavy dependent	Light dependent	Non-smokers	P-value
<b>Questionnaires</b>				
Beck Depression Inventory Score	13.14 (9.01)*+	9.08 (8.44)	*6.32 (7.27)	<0.001
Cattle Anxiety Score	34.22 (10.34)	32.52 (9.34)	29.60 (10.54)	0.10
<b>Barratt Impulsiveness Scale (BIS )</b>				
Total score	67.13 (9.73)*	60.32 (15.70)	57.96 (12.93)	0.02
Motor impulsivity	26.13 (3.62)*	24.62 (5.30)	23.06 (4.10)	0.01
Cognitive impulsivity	16.00 (4.07)	14.20 (4.53)	14.45 (7.30)	0.26
Non-planning impulsivity	25.00 (4.61)	24.48 (9.69)	22.64 (4.07)	0.07
<b>Eysenck Impulsivity Questionnaire (I-7)</b>				
Venturesomeness	11.00 (3.11)*	9.37 (3.56)†	7.12 (2.93)	<0.001
Impulsivity	8.45 (4.14)*	6.41 (4.18)	5.09 (4.05)	0.02
Empathy	7.95 (3.15)	7.38 (3.15)	7.59 (4.37)	1.29
<b>Zuckerman's Sensation Seeking Scale (SSS)</b>				
Total score	24.04 (4.99)*	18.16 (5.01)	15.13 (6.43)	<0.001
Thrill and adventure seeking	7.86 (2.55)*	6.64 (2.49)	5.81 (2.74)	0.01
Experience seeking	5.77 (2.04)*	4.58 (3.15)	3.46 (1.60)	<0.001
Disinhibition	6.13 (1.98)*+	3.97 (2.43)	3.06 (1.58)	<0.001
Boredom susceptibility	4.27 (1.51)	3.58 (1.14)	3.93 (3.72)	0.61
<b>Temperament and Character Inventory (TCI)</b>				
Novelty seeking	12.13 (3.87)*	9.23 (3.25)	7.89 (3.34)	0.01
Harm avoidance	5.72 (3.96)	7.23 (4.67)	6.55 (4.63)	0.74
Reward dependence	8.09 (3.29)	8.17 (2.66)	8.34 (2.88)	0.57
Self-directiveness	12.31 (5.72)*	15.97 (4.75)	17.44 (4.97)	<0.001
Cooperativeness	15.04 (4.86)*+	17.29 (3.93)	16.75 (4.90)	<0.001
Self-transcendence	7.59 (3.66)	8.26 (3.52)	7.96 (3.39)	0.96
Persistence	1.90 (1.44)	3.08 (1.54)	2.58 (1.47)	0.39
<b>Behavioral task</b>				
<b>Delay Discounting Task</b>				
Median k #	0.003171**	0.002434	0.002420	<0.05
* =heavily dependent vs. non-smokers ( $P < 0.05$ ); + =heavily dependent vs. lightly dependent ( $P < 0.05$ ); † =lightly dependent vs. non-smokers ( $P < 0.05$ ); #: Median >				

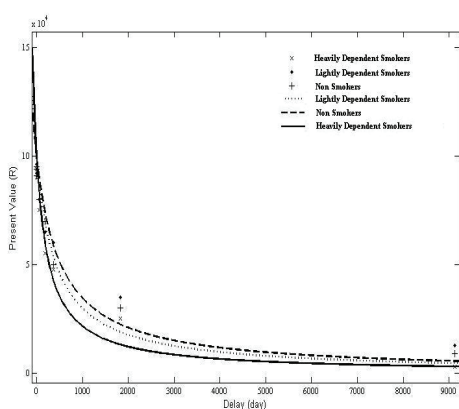
ers also differed significantly from non-smokers on this subscale ( $P<0.01$ ).

### Psychological questionnaires

All personality questionnaire scores for heavily dependent, lightly dependent and non-smoking subjects and subsequent planned pairwise comparisons in significant variables have been reported in Table 2. Heavily dependent smokers differed significantly from non-smokers on 12 out of 21 personality subscales; meanwhile, they also differed significantly from lightly dependent smokers on 4 of these subscales (all  $P$ -values  $<0.05$  or better). Lightly dependent smokers and non-smokers were only significantly different on one of these personality subscales.

### Delay discounting choice task

Figure 1 shows the median indifference points for the monetary delay discount assessment for heavily dependent, lightly dependent and non-smokers, at eight different delay intervals. The functions show the estimated value of the immediate reward at the point of subjective equality after a particular delay. The hyperbolic functions were matched with the median indifference points. The subjective value decreased more rapidly for heavily dependent smokers than for non-smokers and lightly dependent smokers. These differences were assessed by comparing the estimated discounting parameter ( $K$ ), which was obtained by fitting the hyperbolic function to data from each individual within each group. The analyses revealed a significant overall effect upon the group on a monetary discount parameter ( $P<0.05$ ).



**Figure 1.** Delay discount functions for money for heavily dependent, lightly dependent and non-smokers (Points show median indifference points for money as a function of delay, curves represent the best-fit discount functions, see equation 1).

All correlations between the nicotine dependency score (mFTQ) and other personality and impulsivity subscales can be found in Table 3. A total of 14 out of 24 correlation coefficients were significantly greater than zero at  $P<0.05$  or better.

**Table 3.** Pearson's correlation coefficients for the nicotine dependency scale (mFTQ) and other personality and impulsivity subscales. ( $P<0.05$ ,  $**P<0.01$ )

	m FTQ score
Age at onset	-.42**
Percentage of smoking friends	.42**
BDI score	.33**
Cattle score	.12
Total score	.25*
Barratt	
Motor impulsivity	.26*
Cognitive impulsivity	.11
Non-planning impulsivity	.15
Esenck	
Venturesomeness	.48**
Impulsivity	.28**
Empathy	.00
Total score	.50**
Zuckerman	
Thrill and adventure seeking	.32**
Experience seeking	.42**
Disinhibition	.46**
Boredom susceptibility	.03
Cloninger	
Novelty seeking	.42**
Harm avoidance	-.04
Reward dependence	-.09
Self-directiveness	-.35**
Cooperativeness	-.21
Self-transcendence	.01
Persistence	.11
DDT- Median K	.25*

## Discussion

The smoking status variables showed that heavily dependent smokers start smoking at an earlier age than lightly dependent and non-smokers. Heavily dependent smokers also had a higher percentage of friends who smoked than non-smokers. This latest finding supported previous results, in which peer influence was shown to be the strongest contributing factor in determining how and when smoking begins among young people.<sup>39,40</sup> Brook et al. indicated that peer influence could significantly impact nicotine dependence<sup>41</sup> and studies have consistently found that adolescents who associate with smoking peers are less successful with quitting.<sup>42</sup>

Regarding our results, use of other drugs occurs more in heavily dependent and lightly dependent smokers than non-smokers. Studies examining the origins of alcohol and other drug use problems con-

stantly confirm that cigarette smoking is closely related with other drug use,<sup>43</sup> and findings to date suggest that adolescents with a history of drug use may benefit more from relatively intensive multi-component programs rather than brief treatments for quitting smoking.<sup>44</sup>

As previous studies have revealed, annual income was not associated significantly with nicotine dependency in the Fagerstrom Test for Nicotine Dependence (FTND) score.<sup>45</sup> In the current study, no significant relationship between income and smoking status was seen.

Heavily dependent smokers achieved higher scores on the BDI-II score than lightly dependent smokers and non-smokers. Taking into account the previous results, the present data was consistent with the view that people smoking cigarettes had a significantly higher level of depression symptoms than controls<sup>46</sup> and depressed smokers scored higher than controls on nicotine dependence.<sup>47</sup> The BDI-II score has also been able to predict quitting smoking.<sup>48,49</sup> In contrast to the present study, Dinn et al. did not report any significant difference in the BDI score between smoking and non-smoking groups.<sup>7</sup> They defined smoker as “someone who smoked regularly within a six month period”, therefore the lower frequency and intensity of smoking in those subjects could probably justify these differences.

Chiming to previous results,<sup>7</sup> the current study also did not find a relationship between anxiety and smoking.

Findings have indicated that heavily dependent smokers are more impulsive than lightly dependent smokers and non-smokers.

Regarding the BIS-11 questionnaire, heavily dependent smokers scored significantly higher in the total score and the motor impulsivity subscales. Skinner et al. used the French version of the BIS-10 and reported that heavy smokers scored significantly higher on motor impulsivity than non-smokers and medium smokers; and higher than all other smoking levels on non-planning. However, taking age into account as a covariant factor, heavy smokers only scored higher on the motor impulsivity subscale than medium smokers; meanwhile the same pattern was maintained on the non-planning subscale.<sup>16</sup> These results show similarity to the current study, to an extent, but the inconsistency could be due to differences in the characteristics of the partici-

pants such as the wide variety in age (18 – 73) and academic level in the Skinner study, as well as the different criteria used to categorize smokers. Skinner has only considered the number of cigarettes smoked daily as criteria to categorize smokers into three groups (light smokers: <15, medium: 15 to 25, and heavy smokers: >25). Mitchell, using the BIS-11 questionnaire, has also discovered that smokers (persons who smoke more than 15 cigarettes per day) scored higher in motor impulsivity but they were also higher in the non-planning subscale than non-smokers.<sup>15</sup> Our participants did not differ on the non-planning subscale. This may somewhat be due to the high academic level of the participants who were medical students.

Heavily dependent smokers scored significantly higher on the venturesomeness and impulsivity subscales of the I-7 when compared to non-smokers. Similar to our result, Dinn et al. have also reported that smokers achieved higher scores on the impulsivity subscale compared to non-smokers,<sup>7</sup> but no significant difference regarding venturesomeness was found in their study. Although all participants in Dinn’s study were students, they were predominantly females. In their study, student smokers reported that they smoked an average of 5.8 cigarettes per day. Clearly this does not represent “heavy tobacco use”. These two important factors might have an impact on the difference in the result.

Consistent with our findings, Mitchell also reported that smokers gained higher scores on the three subscales of the Zuckerman’s sensation seeking scale (SSS): thrill and adventure, disinhibition, and experience seeking.<sup>15</sup> Harmsen et al. have revealed significant differences only on the experience seeking subscale.<sup>2</sup> Again, one possible reason for the discrepancy may be the degree to which the participants engaged in smoking. Smokers in Mitchell’s study consumed as few as one cigarette per day.

Using the TCI questionnaire has revealed that heavily dependent smokers score higher on the novelty seeking subscale than non-smokers and lower in self-directiveness and cooperativeness when compared to non-smokers. Both Dinn et al. and Mitchell in their studies, have reported similar differences in the novelty seeking subscale between smokers and non-smokers through the use of the tridimensional personality questionnaire (TPQ), which measures three neurobehavioral dimensions: harm avoidance,

novelty seeking and reward dependence.<sup>7,15</sup> Gurpegui et al. also determined that the temperamental dimension of novelty seeking was associated with both smoking and heavy smoking.<sup>50</sup> Impulsivity has also been shown to be a predictive factor of smoking which was mediated by self-directiveness.<sup>51</sup> Effective antidepressant drugs improved and normalized a lower score of self-directiveness.<sup>52</sup> Since heavily dependent smokers had a higher BDI score in our study; thus, the difference in self-directiveness may be due to depression.

Similar to the previous studies,<sup>15,17,53,54</sup> heavily dependent smokers showed greater discounting of delayed money on the delay task (larger *k* values) than non-smokers, which meant that heavily dependent smokers had relatively stronger preferences for smaller, more immediate rewards rather than larger, more delayed rewards. Lightly dependent smokers did not discount delayed monetary rewards more rapidly than non-smokers.

Although several studies have been performed on evaluating personality differences and smoking status, they have not followed any solid criteria on choosing participants. There is wide verity in definition of smoking, thus it is not unexpected to achieve varied results as well. Thus, having solid categorization for future studies, such as the m-FTQ which has been used for the current study, would be helpful in order to design more specific questionnaires that identify persons at risk for beginning smoking or becoming heavily dependent smokers.

This study does not allow us to draw solid conclusions, nor does it determine whether impulsivity is a cause or a consequence of smoking. Therefore, it is not certain how higher scores on impulsivity measures relate to smoking. That is, the scores may reflect some intrinsic differences that simultaneously manifest themselves in cigarette smoking and impulsivity, or may reflect neuropsychopharmacological changes caused by nicotine that result in an increase in impulsivity measures. Some studies have reported that the level of chronic nicotine exposure is associated with impulsive behavior in discounting delayed monetary gains<sup>55</sup> and is also known to associate with strong neuroadaptation, predominantly in the reward-processing brain regions.<sup>56</sup> It may also be argued that these group differences reflect the direct effect of nicotine rather than trait differences between the groups. Psychopharmacologists are in-

terested both in whether impulsive people are more likely to use drugs and whether a drug increases a person's level of impulsivity. However, whether the differences in impulsivity are trait or state related does not make them less interesting. Further research is necessary to determine the correctness of each of these possibilities. Besides, lightly dependent smokers and non-smokers differed in only the venturesomeness subscale. The level of nicotine exposure in lightly dependent smokers might not be strong enough to affect impulsivity, so venturesomeness could be considered more to be a cause of cigarette smoking instead of an effect of nicotine exposure. The effect of acute and chronic nicotine consumption on behavioral and personality characteristics should be evaluated further. Additional longitudinal studies, especially on ex-smokers, would more show any impulsivity changes after smoking cessation and could help explain this hypothesis.

As seen in Table 3, 14 subscales are positively associated with nicotine dependency levels (m FTQ score). Available evidence also indicates that, as with adults, it is more difficult for youth with higher levels of nicotine dependency to quit smoking.<sup>57</sup> Therefore, it would be beneficial to evaluate the highly correlated subscales such as the total score of Zuckerman's SSS, venturesomeness, disinhibition, novelty seeking, and the percentage of smoking friends; particularly for those smokers who are heavily dependent smokers and unsuccessful with cigarette cessation therapy. With the aim of these results, the design of more abstract and specific questionnaires on the psychological assessment of smokers seems feasible. Developing etiologic oriented treatment programs emphasizing planning, goal setting and controlling present impulses for a later benefit would be facilitated for the near future.

Whereas it has been confirmed in several studies that personality and impulsivity differences in smokers may be influenced by many factors such as age,<sup>2</sup> gender, educational level, income,<sup>54</sup> and race.<sup>58</sup> Although we avoid this bias by selecting matched participants amongst medical students, it should be noted that these findings could not be generated to non-student groups and general population. More comprehensive studies are undoubtedly needed on larger samples of both smoker and non-smoker subjects by using more specific questionnaires to determine these relationships more definitively among



different clinical populations.

However, there are limitations to our present study: first, we did not restrict the participants' access to nicotine prior to the experiment. It is improbable that the time of the last cigarette prior to participating in the experiment significantly affected the results. However, one previous study<sup>59</sup> has shown that even a 24 hour nicotine deprivation did not change the discounting behavior of monetary outcomes. It is also possible that the differences in impulsivity measures between the groups were attributed to other drug use such as alcohol or caffeine. Controlled studies would be required to investigate the direction of causality and the role of particular drug use profiles on impulsivity measures.

Secondly, we did not assess CO breath levels or urine cotinine levels, so some prospective participants may have inflated their daily cigarette intake number during screening to be included in the study. The same problem may also exist with the participants of the non-smoker group in underestimating their cigarette intake to participate in the study. But it is, however, noteworthy that a number of studies<sup>60-62</sup> have shown a significant correlation between self-reported smoking status and actual nicotine intake. Nevertheless, it would be preferable for future studies to assess biological markers of nicotine exposure such as plasma cotinine levels and CSF (cerebrospinal fluid) nicotine levels.

Additionally, our group samples were not matched on the BDI-II score. The probable effect of the confounding role of depression should be regarded more in future studies.

In conclusion, further research should focus on designing more specific questionnaires on the assessment of smoking and etiologic oriented treatment approaches regarding all the above-mentioned limitations.

The results would be helpful to design more specific questionnaires for psychological assessments of smokers in terms of their nicotine dependency levels and to adopt further etiologic oriented treatment approaches in the future.

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