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Original Article

The Effect of Individual Time Preferences on Smoking Behavior: Insights from Behavioral Economics

Moslem SOOFI [1,2], ****Ali AKBARI SARI*** [1], ***Farid NAJAFI*** [3]

1. *Department of Health Management and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
2. *Social Development and Health Promotion Research Center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran*
3. *Research Center for Environmental Determinants of Health, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran*

***Corresponding Author:** Email: akbarisari@tums.ac.ir

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Abstract

Background: We aimed to explore the correlation between the time and risk preferences and the smoking behavior of adult population in western Iran.

Methods: Overall, 792 individuals with the age of 35 to 65 yr participating in an ongoing national cohort study (Persian Cohort) were approached to complete a pre-structured questionnaire in 2017. Time preferences were measured using a standard choice-based method. The individuals' discount rates were identified by questions that offered binary monetary choices on immediate future and distant future, by making trade-offs between them. Probit regression model was used to investigate the relationship between time preferences and smoking when controlling for demographic and socioeconomic variables.

Results: Time and risk preferences had statistically significant direct correlations with smoking. A unit increase in discount rate was associated with a 4.4% percentage point increase in the likelihood of being smoker. A present-biased individual had 5.7% percentage points lower likelihood of being smoker. Moreover, a unit increase in willingness to take the risk increased the likelihood of being a smoker by 1.5% percentage points.

Conclusion: Time and risk preferences are important determinants of smoking behavior. These factors should be considered in designing effective prevention and control programs. Policies that increase the immediate costs of cigarette smoking or the immediate benefits of smoking cessation are likely to have a greater impact on reducing the prevalence of cigarette smoking.

Keywords: Smoking; Time preferences; Discount rate; Present bias; Behavioral economics

Introduction

Risky health behaviors such as smoking, alcohol consumption, addiction, inadequate physical activity and unhealthy diet are the main risk factors for non-communicable diseases (NCDs) and the leading causes of preventable deaths across the world (1). Smoking is the main cause of NCDs, disabilities, premature deaths and a large drain on healthcare resources in low, middle and high income countries (2, 3). There are significant arguments about why people have suboptimal health-related behaviors; while they are aware of the negative consequences of these behaviors. Recently, the emerging and growing field of behavioral economics has focused on health-related behaviors and why individuals choose suboptimal choices in their decision making (4). Behavioral economics tries to explain how individuals behave in the real-world e.g. why people make decisions in the short run, that are often not in line with their long-term benefits; and why peo-

ple's behavior sometimes deviates from the rational choice model (5, 6).

In the economics literature, the explanation of sub-optimal behaviors is based on the theories and models of inter-temporal choices and time preferences. Inter-temporal choices refer to decisions that their costs and benefits occur at different points in time. Time preference is the rate at which people trade current utility for future one. It determines how people make trade-offs between different outcomes over time (7). This concept is commonly used in economics to explain investment behaviors. Investing money is a common example; where we normally ignore the pleasure of spending it today (current cost) to receive its future interest (future benefits).

The decision about many health-related behaviors is often a trade-off between outcomes over time. In the Grossman model of demand for health, health behaviors have been modeled as an investment in health (8).We can invest in our long-term health by quitting smoking and therefore give up the current gratification of smoking (today cost) to obtain potential future benefits such as a reduction in mortality and morbidity (future benefits) (9). Time Preferences indicate the degree of people's impatience. Having a high time preference rate means higher willingness for present utility compared to future utility, so that a person prefers current satisfaction to future satisfaction and therefore, she/he discounts future more intensely (10, 11). The economic theories of cigarette consumption have predicted that people with a high discount rate place more weight on immediate benefits of smoking than its future negative consequences. Consequently, they are more likely to consume cigarettes (12, 13). In summary, considering that investment in health has current costs and future benefits, people with a high rate of time preference tend to be less willing to invest in healthy and optimal behaviors (6, 9).In addition to the time preferences, that is an important factor in inter-temporal choices, uncertainty is another important feature of these models because future health outcomes are uncertain. For instance, a person does not know with certainty whether quitting smoking can improve future health status (7). Therefore, people's attitude to uncertainty or risk may influence their inter-temporal decisions (7, 14).

To develop and design effective preventive interventions, a better understanding of the main factors that affect smoking is crucial. This study uses economic theories and models to explain smoking behavior and examines whether differences in the rate of time preferences can explain the differences in smoking behavior.Many studies have examined the correlation between time preferences and smoking in developed countries, but this topic has not been well explored in developing countries including Iran.

We aimed to investigate the correlation between time and risk preferences and smoking in a sample of Iranian adult population.

Methods

Data and sample

Overall, 792 individuals with the age of 35 to 65 yr were randomly selected from people that participated in Ravansar Non-Communicable Diseases (RaNCD) cohort study in Iran Kermanshah Province; and were asked to complete a pre-structured questionnaire between Jul and Nov 2017.

All individuals gave informed consent to participate in our study. Ethics Committee of Tehran University of Medical Sciences (TUMS), Tehran, Iran approved the study protocol with ethical approval code: IR.TUMS.VCR.REC.1396.2671.

The questionnaire had three sections: demographic and socioeconomic characteristics, health-related behaviors (e.g. smoking), and time preferences. The validity of the time preferences questionnaire was confirmed qualitatively using expert opinion. In order to minimize potential bias and to ensure that participants fully understood the questions, the questionnaire was pre-tested in a small sample of 65 individuals. The Ravansar's cohort study is part of an ongoing Prospective Epidemiological Research Study in Iran (PERSIAN), PERSIAN Cohort, in Kermanshah Province. The PERSIAN Cohort has start-

ed in ten geographical regions in Iran since 2014 and has now expanded to 17 regional centers. These regional centers have been selected based on exposure to specific risk factors, diseases pattern, causes of mortality and morbidity, local capacity, etc. (15).

Dependent variable

A binary variable for cigarette smoking was defined as the dependent variable. It was equal to one for current smokers and zero for never- and ex-smoker.

Measuring time preferences

Time preferences were measured using a standard choice-based method. The choice-based approach is a series of binary-choice questions, containing smaller sooner and larger later amount of money. The participants were asked to compare choices and choose between them according to their preferences. To elicit individual discount rates, we used questions that offer binary monetary choices on immediate future and distant future trade-offs. The indifference points were determined and converted to the discount rate. The time horizons used in this study were based on the Kang and Ikeda study (16). For the near future, participants were asked to choose between (i) receiving a smaller hypothetical amount of money immediately or (ii) receiving a larger later amount of money a week later. For distant future, the binary choices were (i) receiving a smaller hypothetical amount of money one year later or (ii) receiving a larger later amount of money one year and one week later. The smaller immediate amount was constant at 3.000.000 IR Rials in two horizons, and the larger later money amounts ranged from 3.150.000 IR Rials to 10.500.000 IR Rials. We used the staircase method to frame the choices. The hyperbolic discount function was used to calculate the individual discount rate. The hyperbolic model fits the data fairly well, and most recent studies have used the hyperbolic function to quantify the individual discount rate (17).

$$V = \frac{A}{1 + (kD)}$$

Where V is the smaller sooner amount of money,
A is the amount of the delayed money,
D is the delay, and k is the discount rate.

Present-biased preferences (hyperbolic discounting)

A binary variable for present bias as another behavioral feature of time preferences entered into the model which equals one if: Near Future Discount Rate > Distant Future Discount Rate, and zero otherwise (18).

Measuring risk preferences

People's investment behaviors are likely to be affected by their tendency to take the risk. The future outcomes of investment are inherently uncertain, and therefore people's attitude to uncertainty or risk may affect their investment decisions (14). Risk preferences were measured using a general risk question. We asked the participants to show their willingness to take risks on a 10-point scale (1: unwilling to take risk, 10: complete willingness to take risks).

Other covariates

Other explanatory variables were gender, age group (35-44, 45-54, and 55-66), marital status (married and divorced/widowed/single), education level (illiterate/elementary, secondary/high school and university), economic status (low, middle and high) and job status (employee, self-employed and others).

Econometric model

The maximum likelihood probit regressions model was used to estimate the relationship between time preferences and smoking behavior. This model can be derived from a latent variable model. If y* shows the latent or unobservable variable such that:

$y^* = \beta_0 + \sum_{j=1}^{k} \beta x + \varepsilon$, Where, $\varepsilon i \sim$ Normal (0, 1) and y = $1\ if y^* > 0$, y=$0\ if y^* < 0$

Then the probability of being smoker, y, is obtained by

$$P(y = 1 \mid x) = P(y^* > 0 \mid x) = \Phi\ (\beta_0 + \sum_{j=1}^{k} \beta x)$$

Φ shows the cumulative distribution function. For better interpretation, estimated coefficients were converted to average marginal effects, an average marginal effect is interpreted as an effect of one-unit change of the explanatory variable on the change of probability of outcome variable (19). The smoking behavior was modeled as a function of individual discount rate, present-biased preferences, risk preferences and a set of covariates (socio-demographic and socioeconomic characteristics).

$$smokingbehavior = \beta_1 + \beta_2 DR + \beta_2 \mathrm{PB} + \beta_3 \mathrm{RP} + \beta_4 C + \varepsilon$$

Results

Overall, 792 individuals aged 35 to 65 yr, completed the questionnaire (mean age 43.7, SD ±6.33) (response rate 99%). 61.1% of participants belonged to the age group of 35-44 yr, 78.2% of participants were married, and 47% of them had tertiary education. The prevalence of smoking in the study sample was 25.76%. The average discount rates for the immediate and distant future were .15531 (±.1827SD) and .00365 (±.00716SD), respectively. Moreover, the present-biased subjects accounted for 40.91% of the sample in the study. The average willingness to take risks was 5.87 (±2.2SD) (Table 1).

Table 1: Characteristics of the study sample

Variable	*N*	*%*
Smoking behavior		
Smoker	204	25.76
Nonsmoker	588	74.24
Time preferences		
Near future Discount rate (mean (SD))	.15531 (±.1827SD)	
Distant future Discount rate (mean (SD))	.00365 (±.00716SD)	
Risk preferences		
Willingness to take risk	5.87 (±2.2SD)	
Hyperbolic discounting		
Present-biased	324	40.91
Non present-biased	468	59.09
Sex		
Male	619	78.16
Female	173	21.84
Age group (yr)		
35-44	484	61.11
45-54	257	32.45
55-65	51	6.44
Marital status		
Married	744	93.94
Single /divorced/ Widowed	48	6.06
Education		
Primary	110	13.89
Intermediate	305	38.51
Academic	377	47.60
Employment status		
Employed	368	46.46
Self-employer	361	45.58
Other	63	7.95
Wealth status		
Low	317	40.03
Middle	317	40.03
High	158	19.95

Table 2 shows the marginal effects of discount rate, present bias, risk preferences and other covariates on the probability of being smoker. There was a statistically significant association between the amount of discount rate and the probability of being a smoker. A unit increase in the individual discount rate was associated with a 4.4% point increase in the probability of being a smoker. There was also a direct significant association between the present bias and probability of being smoker. A present-biased individual had 5.7% percentage points lower probability of being smoker. A unit increase in the willingness to take a risk was associated with a 1.5% point increase in the probability of being smoker. There was also a statistically significant correlation between the probability of being smoker and the level of education, age and being employed.

Table 2: Probit regression results of the role oftime and risk preferences on smoking

Variable	*Marginal effects*	*Std. Err.*	*P>/z/*
Time preferences			
Discount rate	.04471	.01171	0.011
Hyperbolic discounting (Present bias)	.05710	.02880	0.047
Risk preferences			
Willingness to take risk	.01569	.00620	0.030
Sex			
Male	.06385	.10079	0.000
Age group (yr)			
45-54	.08399	.02866	0.003
55-65	.19066	.05057	0.000
Marital status			
Married	.18584	.14409	0.197
Education			
Intermediate	-.25401	.04409	0.000
Academic	-.35737	.04925	0.000
Employment status			
Employed	.14209	.06516	0.029
Self-employer	.11795	.05949	0.047
Wealth status			
Middle	.02908	.03339	0.384
High	.01285	.04530	0.777

Obs. 792, Log likelihood = -344.1490, Prob> chi2= 0.0000, Pseudo R2=0.2605

Discussion

This study explored the relationship between time preferences and smoking in a sample of Iranian adult population. There are several methods for eliciting time preferences. The two most frequently used methods are choice-based and matching methods. If the goal is to predict the real-world behaviors (such as smoking), a choice-based method should be used to elicit time preferences. As per their suggestion, we used the choice-based method to elicit time preferences (17). This approach is easier to implement and understand (20). In addition, the staircase method was used for framing the scenarios. The advantages of this approach are that binary choices are dynamically selected, which reduces the number of questions that need to be asked from the

participants, and the indifference points are estimated more accurately (17).

As expected, we found that the time preferences were positively correlated with the probability of being smoker. A unit increase in the discount rate increased the likelihood of being smoker by 4.4% percentage points. This finding is consistent with several studies (5, 17, 21, 22). People with a high discount rate and a high degree of impatience were more likely to smoke. Therefore, a lower degree of time preferences rate seems to be a protective factor against smoking. Time preferences have been associated with other health-related behaviors, both high-risk behaviors and preventive and promoting behaviors. For example, discount rate is a good predictor of body mass index (BMI) and physical activity (23). A significant association was shown between time preferences and the frequency of fast food consumption in US adults (24). Findings from outside health research have shown that time preferences are correlated with job, retirement, and investment behaviors (25, 26).

Present bias was positively and significantly associated with smoking. Similarly, the current bias was significantly related to smoking (16). Present-biased individuals were more likely to use cigarettes (27). Present-biased preferences also are related to other health behaviors. For example, present bias is related to obesity and suggested it as a strong predictor of BMI (28).

We found that willingness to take the risk was correlated with smoking behavior. This result is in line with another finding indicating that the overall willingness to take the risk has a strong positive impact on cigarette smoking (29).A study of 1094 adults, showed that smokers are significantly less risk-averse than non-smokers (30). Sutter et al. found no statistically significant relationship between risk aversion and smoking. On the other hand, the risk aversion had a strong correlation with body mass index, so that risk-averse individuals had lower BMI (31). Risk preferences are usually measured via lotteries. Since the lotteries and probabilistic choices may be difficult for people to understand and relatively time-consuming, we used a general risk question to elicit risk preferences. The general risk question is a valid and reliable measure for measuring individuals' risk preferences and is also easy to use and implement (29).

Studies that investigate the role of time preference in health behaviors (such as cigarette smoking) have important policy implications for public health. Current evidence suggests that individuals' preferences follows the hyperbolic discounting model (32). In this model, the discount rate, in contrast to the standard discounted utility model that assumes the discount rate constant, is a decreasing function of time. The discount rate for the short horizon is considerably higher than the discount rate for long-horizon (33). Hyperbolic discounting leads to present-biased preferences (34). The present bias is a tendency to place more weight on short-term's costs and benefits than long-term's costs and benefits (35). People are more affected by the present and less future-oriented. Therefore, compared to the long-term choices, people are more impatient for immediate and sooner choices. Present-biased preferences can be an explanation for why people often procrastinate and do not pursue their behavior change program. For example, smokers repeatedly plan to quit smoking next month but when next month arrives they place extra weight on gratification of smoking at that point of time and as a result, they procrastinate the smoking quitting again. Present bias leads people to value the utility of smoking much more than the disutility due to the quitting and its potential negative consequences (34, 35).

The policy implication of these preferences is that health behavior interventions can affect smoking behavior by highlighting the short term outcomes. Because emphasis on long-term outcomes, as most health policies focus on, are likely to be less effective, especially for those who have present-biased preferences (36, 37). Hence, policies that increase the current cost of smoking can be effective in reducing the prevalence of smoking. For example, behavioral economics models reinforce policy-making towards taxation on health-harming goods. These models suggest that, in addition to the negative externalities of

smoking (the costs that smokers impose on society), offered in classical economies, taxes should include internalities (costs that smokers impose on themselves). This can be helpful in overcoming self-control problem and present bias in people who know that smoking is not their best choice and is not in line with their long-term interests. Therefore, this policy can help individuals to pursue their long-term preferences. The optimal tax rate for this purpose can be investigated in future studies. Interventions that design to educating individuals to be more future-oriented and making them more aware of the link between current actions and future outcomes may help them to quit smoking (7, 38).

Moreover, using commitment devices (constraints or costs by which individuals can influence their future choices to increase their well-being) may be helpful for people with high rate of time preferences and those who have present-biased preferences (38). The reason that commitment devices are effective in reducing health-harming behaviors like smoking is that they reduce the utility of a particular behavior. In an experimental study, commitment contracts lead to a higher rate of smoking cessation than traditional health education interventions (39). Weight loss programs had been more successful in those obese individuals that used a contract commitment (40, 41).

Identifying and designing the type of rewards or costs that encourage people to quit smoking are important topics for future investigations. Future studies can also explore innovative and potential behavioral economics methods and interventions to change health-related behaviors. Behavioral economics suggests interventions and policies that encourage people to engage in healthy behaviors and lifestyles to reduce negative future consequences (42, 43). For example, the concept of "nudge" in behavioral economics has been introduced by Thaler, the Noble Prize winner for economics in 2017, which leads people toward optimal decisions and behaviors by changing the environment in which people make decisions (choice architecture) (42). In recent years, behavior change policies have been directed toward nudges (44). Most nudges include simple policy interventions and, at a low cost, have high success rates in behavior change programs (42). For example, the "default option", a type of nudge, has been very effective in donation policies. The rate of donation is much higher in countries that have used the opt-out policy as the default option than countries that have used the opt-in policy (4).

This study has some limitations. First, the data used in this study was self-reported and may have been subjected to response bias and a measurement error in the variables under study. Specifically, questions about time preference are somewhat difficult and people might not have been familiar with this type of tradeoffs. Second, this study used a cross-sectional study to investigate the relationship between time preferences and smoking, and therefore the causal relationship is not inferred. Longitudinal studies are needed to determine the causal relationship as well as the effect of preferences changes on smoking behavior. Finally, this study focuses geographically on the West of Iran and is not a representative sample of the whole country.

Conclusion

The time preference was an important determinant of smoking behavior. There was a statistically significant correlation between the probability of being a smoker and the rate of time preferences, present bias, and the level of willingness to take the risk. These factors should be considered in designing interventions and planning policies for the prevention and control of smoking. Policies that increase the immediate costs or benefits of smoking are likely to have a greater impact on reducing the prevalence of smoking. Moreover, policies that help individuals to overcome their self-control problem and present bias (e.g. commitment devices and nudges) can be helpful.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or fal-

sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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