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# Development and validation of a questionnaire based on the protection motivation theory to predict cigarette smoking preventive behavior in the Iranian university students

Salime Zare Abdollahi, Seyed Saeed Mazloomi Mahmoodabad, Mohammad Hasan Lotfi<sup>1</sup>, Seyed Mojtaba Yassini Ardakani<sup>2</sup>

## Abstract:

**BACKGROUND:** Prevention of smoking is very important at a young age and during the student period. Because of the lack of a questionnaire based on the prevention of smoking behavior, this study was conducted to design and standardize a tool according to the protection motivation theory (PMT).

**MATERIALS AND METHODS:** This was an analytical cross-sectional study where information and opinions of experts and then designing tools and assessing the face validity in the first phase and content validity, construct validity, test-retest reliability, and internal consistency of questions in the second phase were examined. The initial themes and structures were determined based on the literature Review and the opinion of experts. Three hundred students of Yazd Universities were selected by cluster sampling and included in the study. All analyses were performed in SPSS and AMOS software version 24 with a significance level of less than 5%.

**RESULTS:** The final version of the scale had 39 questions in eight dimensions. The overall Cronbach's alpha value was 0.89, and for each dimension, it was more than 0.7. The content validity ratio and content validity index for the whole tool were 0.87 and 0.94, respectively. The results of confirmatory factor analysis showed that the latent construct model had good fit ( $X^2/df = 4.31$ ;  $RMSEA = 0.07$ ;  $CFI = 0.94$ ;  $NFI = 0.92$ ;  $TLI = 0.91$ ,  $P < 0.001$ ).

**CONCLUSION:** In this study, a valid and reliable tool based on PMT to predict smoking behavior in students was introduced. This tool can be used in interventional and etiological studies. It also has questions related to the coronavirus disease 2019 (Covid 19) virus and can be used in the coronavirus pandemic.

## Keywords:

Protection motivation theory, psychometric, questionnaire, smoking behaviors, student, Yazd

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## Introduction

Although the advancement of science has increased the quality of life and longevity, there has always been a range of factors that threaten human health and shorten life expectancy; one of these factors is smoking cigarette (SC).<sup>[1,2]</sup> Every year, 7 million people

worldwide die of serious illnesses because of SC.<sup>[3]</sup> Previous studies have shown that SC contributes significantly to the mortality of diseases such as lung cancer,<sup>[4]</sup> cardiovascular and pulmonary diseases,<sup>[5]</sup> and coronavirus,<sup>[6]</sup> and in some cases, smoking-related deaths are higher than the total mortality of some non-communicable diseases.<sup>[7]</sup>

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Starting SC at the age of 20 has been the experience of many addicts, so the World Health Organization has repeatedly expressed concern about the onset of high-risk smoking-related behaviors in adolescence and young adulthood.<sup>[8]</sup> Despite the efforts of countries and the fight against narcotic drugs, high-risk smoking behavior because of family structures and cultures, hanging with wrong crowd and miscommunications, social networks, and interest in gaining experience is still common. Today, about 20 percent of the world's population is smoking;<sup>[9]</sup> although smoking is declining in developed countries, it is on the rise in developing countries.<sup>[10]</sup> In Iran, as a developing country, according to the statistics of 2018, the prevalence of smoking at the age of 15 years and above in men, in women, and in general was equal to 24.6%, 1.3%, and 14%, respectively.<sup>[11]</sup> Ehsani-Chimeh *et al.*<sup>[12]</sup> 2020, in their meta-analysis about current and former smoking in Iran, showed that the prevalence of current and former smoking was 9% and 24%, respectively.

One of the theories and models that can explain why people engage in unhealthy behaviors and make suggestions for people to change that unhealthy behavior is protection motivation theory (PMT).<sup>[13]</sup> In this theory, it is suggested that people protect themselves based on threat and coping appraisal; the first one is about evaluating the situation, and the second is about how to provide an appropriate response to the situation.<sup>[14]</sup> In general, the theory of protection motivation consists of seven main components, of which four components – perceived severity, perceived susceptibility/vulnerability, intrinsic reward, and extrinsic reward – are in threat appraisal factor and three components including response efficacy, self-efficacy, and response cost are in coping appraisal factor.<sup>[13]</sup> Previous studies have shown that both factors that make up the theory with high power are able to predict a person's intentions and behavior; especially, the coping appraisal factor and the self-efficacy component provide a strong prediction of a person's behavior.<sup>[1,15]</sup> PMT has been used in various studies to prevent a behavior, for example, to prevent risky behaviors such as acquired immunodeficiency syndrome (AIDS),<sup>[16]</sup> cardiovascular disease,<sup>[17-19]</sup> Ebola infection,<sup>[20]</sup> corona virus,<sup>[21]</sup> coronavirus vaccination.<sup>[13]</sup>

Greening *et al.*<sup>[22]</sup> 1997, in their study on the smoking behaviors of 690 high-school students, stated that PMT predicts smoking behavior well, and perceived severity, perceived vulnerability, and reward were the most important components. Thrul 2013, in a longitudinal study on smoking-related behaviors which were studied in 494 individuals aged 11–16 years using PMT theory, showed that the coping appraisal factor, and in particular self-efficacy, was a strong predictor of smoking-related behavior.<sup>[23]</sup>

To the best of our knowledge, no tool has been developed based on PMT to examine university students' smoking behavior. Therefore, the present study was conducted to design and validate a questionnaire on smoking behaviors based on PMT and to evaluate the psychometric properties of the instrument among the students of Yazd Universities, the central part of Iran, 2020.

## Materials and Methods

**Study design and setting** This study was an analytical cross-sectional study where information and opinions of experts and then designing tools and assessing the face validity in the first phase and content validity, construct validity, test-retest reliability, and internal consistency of questions in the second phase were examined.

### Ethical consideration

Ethical approval for this study has been obtained by the ethics committee affiliated with Shahid Sadoughi University of Medical Sciences, Yazd, Iran (IR.SSU.SPH.REC.1399.174).

### Scale development procedure

The development of the tool was performed in two general steps as follows:

#### Initial phase

The phase of our study was conducted in four stages. In the first stage, to generate questions, a detailed and complete search and literature review on online databases such as PubMed, Scopus, Google scholar, SID, Web of science (ISI) by using the keywords of use of cigarettes, smoking behavior, youth, and the theory of protection motivation were performed.

In order to extract the necessary items for the development of the questionnaire, while observing the ethical considerations, all the abstracts of the searched articles were reviewed by two independent groups and the unrelated articles were removed without prejudice and bias, after which the related articles were studied in depth and the required items were extracted from them. Our initial search found 413 articles, of which 25 were related to the present study, so about 75 items were extracted from them.

In the second step to generate the items, we formed a focus group discussion. The group consisted of eight people including two physicians, a sociologist, two health education specialists, a statistician with a mastery of questionnaire design, and two researchers in the field of addiction and social factors affecting health. A total of 32 items were obtained from the review of previous studies, and 12 items were obtained from the

focus group discussion. After collecting the items, they were classified according to their relevance to the areas of protection motivation theory. Also, two dimensions called fear and protective motivation were added to the questionnaire. The answer option was the Likert 5-point scale. The researcher-made questionnaire had two general dimensions, with one dimension of demographic information and the other dimension related to nine areas derived from the theory of protection motivation. In the demographic information section, age, gender, marital status, father's education, mother's education, smoking cigarette, and parental smoking were asked.

The created questionnaire was given to 15 students and six experts of the focus group to check the face validity. Based on the opinions collected in face validity, two questions were removed from the questionnaire and 39 questions were approved.

### Second phase

At this stage, in order to check the content validity, a questionnaire was given to ten experts, and based on their opinion, content validity index (CVI) and content validity ratio (CVR) were calculated.

The ten experts included seven specialists in the field of health education, two specialists in the field of addiction, and one statistician in the field of questionnaire design.

For CVR calculation, the opinions of experts in the field of test content are used, and first, the objectives of the questionnaire design for experts are explained and operational definitions related to the content of the questions are stated. Then, they are then asked to indicate the necessity of each question based on the following three Likert sections: 1) The item is necessary, 2) the item is useful but not necessary, and 3) the item is not necessary. After gathering the views of experts, CVR could be calculated using the following equation (eq. 1)<sup>[24]</sup>:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} \quad (\text{eq. 1})$$

N = Total number of experts;  $n_e$  = number of experts who chose the item is necessary.

According to the table, the minimum acceptable value for CVR with ten experts is 0.62.

To calculate the CVI of each question, experts are asked to indicate how relevant each item is to the following four-part range: 1) irrelevant, 2) need a major overhaul, 3) related but need review, 4) and totally related. If the number of experts who have selected options 3 and 4 is

divided by the total number of experts, the value of CVI is obtained. If the CVI was greater than 0.79, the question remains in the questionnaire.

A sample of 30 students was used to complete the questionnaires and calculate the internal consistency of the questions. Internal consistency is determined by calculating the Cronbach's alpha coefficient for the dimensions and also for the whole questionnaire. Values above 0.7 indicate good internal consistency of the dimensions as well as the whole questionnaire.

To evaluate the test-retest reliability, the questionnaires were completed again after 2 weeks in a group of 30 people and then the correlation between the scores was calculated. The construct validity of the questionnaire was also assessed through exploratory and confirmatory factor analysis at the end step.

### Participants and sampling

Three hundred students of Yazd Universities were selected by cluster sampling and included in the study.

### Statistical analysis

Frequency, frequency percentage, mean, and standard deviation were used to describe the variables. To check for internal consistency, the Cronbach's alpha coefficient was calculated; a value greater than 0.7 indicates good internal consistency.<sup>[24]</sup> To evaluate the reliability of the stability, in addition to calculating the Pearson correlation coefficient, the intra-cluster correlation coefficient was also calculated. Exploratory and confirmatory factor analyses were used to evaluate the construct validity. In exploratory factor analysis, Bartlett's test of sphericity (p-value <0.05 is good and shows factorability of variable) and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (>0.5 is acceptable) were performed. Promax rotation was also used to rotate the factors. In confirmatory factor analysis, model fit indices including Chi-square/degree of freedom and comparative fit index (CFI) (values greater than 0.90 mean good fit), and so on were calculated. Root mean square error (RMSEA) (values under 0.08 mean good fit), Tucker Lewis Index (TLI), and normed fit index (NFI) (values greater than 0.90 mean good fit) were used.<sup>[24]</sup>

All analyses were performed in SPSS and AMOS software version 24 with a significance level of 5%.

## Results

### Sample characteristics

A total of 300 students with a mean (standard deviation) age of 21.17 (3.45) participated in the study. 57% of the students (171) were male, 94.67% (284) were single, more than 36% of the students declared that their parents had

a bachelor’s degree, 38.67% (116 people) were smokers, and 15% (45 people) of the students reported that their parents were smokers [Table 1].

**Reliability and validity**

The face validity of the questionnaire was confirmed by minor corrections. Both content validity indices had acceptable values (overall CVI = 0.94, CVR = 0.87), so content validity was also confirmed.

The CVI value for susceptibility, severity rewards, response cost, response efficacy, self-efficacy, fear, and protection motivation dimensions was equal to 0.92, 0.93, 0.93, 0.97, 0.92, 0.95, 0.96, and 1, respectively. Also, the lowest value of CVI was in the response cost dimension with a value of 0.92, and the highest value was in the protection motivation dimension with a value of 1.

The CVR value for susceptibility, severity rewards, response cost, response efficacy, self-efficacy, fear, and protection motivation dimensions was equal to 0.85, 0.98, 0.92, 0.87, 0.73, 0.80, 0.84, and 1, respectively. Also, the lowest value of CVR was in the self-efficacy dimension with a value of 0.73, and the highest value was in the protection motivation dimension with a value of 1.

The Cronbach’s alpha value was calculated separately by dimensions, and in general, and its values were acceptable (Overall cronbach’s alpha = 0.89), so the internal consistency of the questionnaire was also confirmed. The correlation coefficient between two times of measurements of the questionnaire (2 weeks interval) also showed acceptable stability validity (Overall r = 0.89). The intra-class correlation coefficient also provided acceptable values [ICC (95% CI) = 0.825 (0.786-0.859)] [Table 2].

In the results of exploratory factor analysis, the KMO value was 0.703, and the Bartlett test was significant. According to the scree plot [Figure 1], eight factors were extracted by explaining the total variance of 81.44% [Table 3].

The results of confirmatory factor analysis showed that the 39-item questionnaire with eight dimensions was approved. The goodness-of-fit indicators of the model all had acceptable values ( $\chi^2/df = 4.31$ ; RMSEA = 0.07; CFI = 0.94; NFI = 0.92; TLI = 0.91) [Table 4].

The correlation between the latent constructs (dimensions of the questionnaire) was calculated by the confirmatory factor analysis model and is presented in Table 5. According to the table, there were weak and significant correlations between the latent constructs [Table 5].

**Table 1: Characteristics of students who participated in this study (n=300)**

| Variables          | Levels                  | n   | %     | Mean  | SD   |
|--------------------|-------------------------|-----|-------|-------|------|
| Age                | -                       | -   | -     | 21.17 | 3.45 |
| Gender             | Male                    | 171 | 57    | -     | -    |
|                    | Female                  | 129 | 43    | -     | -    |
| Marital status     | Single                  | 284 | 94.67 | -     | -    |
|                    | Married                 | 16  | 5.33  | -     | -    |
| Father education   | Illiterate              | 7   | 2.33  | -     | -    |
|                    | 1-5 years of education  | 22  | 7.33  | -     | -    |
|                    | 5-8 years of education  | 22  | 7.33  | -     | -    |
|                    | 8-12 years of education | 85  | 28.33 | -     | -    |
| Mother’s education | Bachelor                | 109 | 36.33 | -     | -    |
|                    | MSc and PhD             | 55  | 18.33 | -     | -    |
|                    | Illiterate              | 13  | 4.33  | -     | -    |
|                    | 1-5 years               | 40  | 13.33 | -     | -    |
| Smoking cigarette  | 5-8 years               | 24  | 8.00  | -     | -    |
|                    | 8-12 years              | 67  | 22.33 | -     | -    |
|                    | Bachelor                | 116 | 38.67 | -     | -    |
| Parental smoking   | MSc and PhD             | 40  | 13.33 | -     | -    |
|                    | Yes                     | 116 | 38.67 | -     | -    |
|                    | No                      | 184 | 61.33 | -     | -    |
|                    | Yes                     | 45  | 15.00 | -     | -    |
|                    | No                      | 255 | 85.00 | -     | -    |

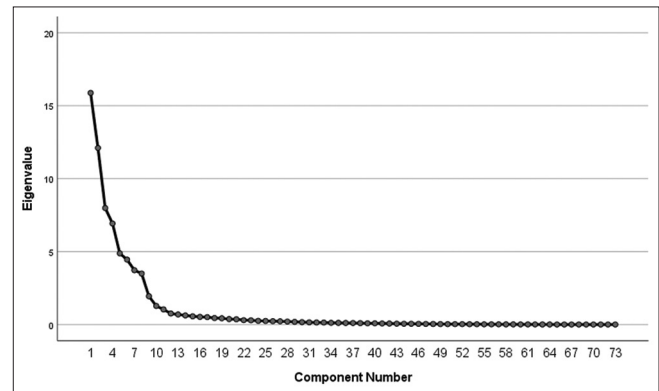


Figure 1: Scree plot for determining the number of components

**Discussion**

PMT is one of the theories that can explain why people engage in unhealthy behaviors and make suggestions for people to change that unhealthy behavior.<sup>[13]</sup> Actually, it suggested that people protect themselves based on threat and coping appraisal.<sup>[14]</sup> In general, the theory of protection motivation consists of seven main components, of which four components – perceived severity, perceived susceptibility/vulnerability, intrinsic reward, and extrinsic reward – are in threat appraisal factor and three components including response efficacy, self-efficacy, and response cost are in coping appraisal factor.<sup>[13]</sup> In this study, we developed a scale based on PMT to predict student-related smoking behaviors.

**Table 2: Results of content validity, test-retest reliability, and internal consistency**

| Dimensions            | No. Items | CVI  | CVR  | Cronbach's alpha | Test-retest correlation | ICC (95% CI)        |
|-----------------------|-----------|------|------|------------------|-------------------------|---------------------|
| Susceptibility        | 6         | 0.92 | 0.85 | 0.87             | 0.86                    | 0.929 (0.911-0.943) |
| Severity              | 4         | 0.93 | 0.98 | 0.91             | 0.91                    | 0.986 (0.983-0.989) |
| Rewards               | 5         | 0.93 | 0.92 | 0.87             | 0.86                    | 0.907 (0.877-0.929) |
| Response efficacy     | 5         | 0.97 | 0.87 | 0.93             | 0.86                    | 0.937 (0.922-0.950) |
| Self-efficacy         | 5         | 0.92 | 0.73 | 0.88             | 0.83                    | 0.981 (0.969-0.993) |
| Response cost         | 4         | 0.95 | 0.80 | 0.90             | 0.98                    | 0.826 (0.780-0.863) |
| Fear                  | 5         | 0.96 | 0.84 | 0.87             | 0.85                    | 0.965 (0.956-0.973) |
| Protection motivation | 5         | 1    | 1    | 0.89             | 0.87                    | 0.697 (0.598-0.781) |
| Overall scale         | 39        | 0.94 | 0.87 | 0.89             | 0.88                    | 0.825 (0.786-0.859) |

**Table 3: Results of exploratory factor analysis- Extraction Method: Principal Component Analysis**

| Items                             | Components    |                |                   |          |         |       |               |                       |
|-----------------------------------|---------------|----------------|-------------------|----------|---------|-------|---------------|-----------------------|
|                                   | Self-efficacy | Susceptibility | Response efficacy | Severity | Rewards | Fear  | Response cost | Protection Motivation |
| Q1                                | 0.985         |                |                   |          |         |       |               |                       |
| Q2                                | 0.983         |                |                   |          |         |       |               |                       |
| Q3                                | 0.981         |                |                   |          |         |       |               |                       |
| Q4                                | 0.978         |                |                   |          |         |       |               |                       |
| Q5                                | 0.974         |                |                   |          |         |       |               |                       |
| Q6                                |               | 0.907          |                   |          |         |       |               |                       |
| Q7                                |               | 0.898          |                   |          |         |       |               |                       |
| Q8                                |               | 0.885          |                   |          |         |       |               |                       |
| Q9                                |               | 0.866          |                   |          |         |       |               |                       |
| Q10                               |               | 0.858          |                   |          |         |       |               |                       |
| Q11                               |               | 0.858          |                   |          |         |       |               |                       |
| Q12                               |               |                | 0.943             |          |         |       |               |                       |
| Q13                               |               |                | 0.942             |          |         |       |               |                       |
| Q14                               |               |                | 0.941             |          |         |       |               |                       |
| Q15                               |               |                | 0.935             |          |         |       |               |                       |
| Q16                               |               |                | 0.934             |          |         |       |               |                       |
| Q17                               |               |                |                   | 0.956    |         |       |               |                       |
| Q18                               |               |                |                   | 0.955    |         |       |               |                       |
| Q19                               |               |                |                   | 0.953    |         |       |               |                       |
| Q20                               |               |                |                   | 0.951    |         |       |               |                       |
| Q21                               |               |                |                   |          | 0.944   |       |               |                       |
| Q22                               |               |                |                   |          | 0.941   |       |               |                       |
| Q23                               |               |                |                   |          | 0.933   |       |               |                       |
| Q24                               |               |                |                   |          | 0.931   |       |               |                       |
| Q25                               |               |                |                   |          | 0.923   |       |               |                       |
| Q26                               |               |                |                   |          |         | 0.962 |               |                       |
| Q27                               |               |                |                   |          |         | 0.951 |               |                       |
| Q28                               |               |                |                   |          |         | 0.945 |               |                       |
| Q29                               |               |                |                   |          |         | 0.943 |               |                       |
| Q30                               |               |                |                   |          |         | 0.934 |               |                       |
| Q31                               |               |                |                   |          |         |       | 0.854         |                       |
| Q32                               |               |                |                   |          |         |       | 0.845         |                       |
| Q33                               |               |                |                   |          |         |       | 0.820         |                       |
| Q34                               |               |                |                   |          |         |       | 0.798         |                       |
| Q35                               |               |                |                   |          |         |       |               | 0.893                 |
| Q36                               |               |                |                   |          |         |       |               | 0.892                 |
| Q37                               |               |                |                   |          |         |       |               | 0.864                 |
| Q38                               |               |                |                   |          |         |       |               | 0.856                 |
| Q39                               |               |                |                   |          |         |       |               | 0.844                 |
| Variance explained (%)            | 21.74         | 16.58          | 10.94             | 9.49     | 6.68    | 6.09  | 5.10          | 4.79                  |
| Cumulative variance explained (%) | 21.74         | 38.33          | 49.28             | 58.77    | 65.45   | 71.55 | 76.65         | 81.44                 |

Rotation Method: Promax with Kaiser Normalization

**Table 4: Confirmatory factor analysis result**

| Observed variables  | Latent construct      | Standardized parameter estimates | P     |
|---|-----------------------|----------------------------------|-------|
| SC is bad for your health.  | Susceptibility        | 0.52                             | 0.008 |
| The harm and addiction of SC are as much as narcotic drugs.   |                       | 0.61                             | 0.012 |
| There is no harm in social SC.  |                       | 0.73                             | 0.001 |
| There are no side effects to SC expensive cigarettes.   |                       | 0.52                             | 0.020 |
| All smokers are at risk for SC-related diseases.  |                       | 0.57                             | 0.015 |
| Cigarette smoke can cause teeth to become black and dull.   | Severity              | 0.54                             | 0.001 |
| SC can kill or shorten life.  |                       | 0.91                             | 0.001 |
| SC can cause heart attacks and strokes.   |                       | 0.83                             | 0.031 |
| SC can cause lung diseases such as asthma and allergies.  |                       | 0.71                             | 0.027 |
| SC can cause coronavirus infection.   |                       | 0.36                             | 0.022 |
| SC can reduce a person's social and economic efficiency.  | Rewards               | 0.42                             | 0.013 |
| SC is fun and enjoyable for people.   |                       | 0.48                             | 0.001 |
| SC reduces discomfort and stress.   |                       | 0.53                             | 0.005 |
| SC is a great way to fill your free time and entertainment.   |                       | 0.68                             | 0.028 |
| SC is a sign of growing up.   |                       | 0.49                             | 0.018 |
| SC makes more friends.  | Response cost         | 0.38                             | 0.001 |
| Because a person does not have information about the dangers of smoking, he/she cannot take action to prevent SC. |                       | 0.60                             | 0.003 |
| It is difficult not to smoke or quit SC.  |                       | 0.54                             | 0.001 |
| Now with the COVID-19 pandemic, if I do SC, it will protect me against the corona virus.                          |                       | 0.36                             | 0.021 |
| If a person does not do SC, he/she loses his/her friends  |                       | 0.77                             | 0.015 |
| If I do not do SC, I have a healthier body and fresher skin.  | Response efficacy     | 0.76                             | 0.001 |
| If I do not do SC, I fill my free time with activities such as exercise and reading.                              |                       | 0.59                             | 0.001 |
| If I do not do SC, I will not have a heart attack or stroke.  |                       | 0.49                             | 0.027 |
| If I do not do SC, I will not suffer from respiratory diseases such as asthma and allergies.                      |                       | 0.88                             | 0.018 |
| If I do not do SC, I will not have problems with the coronavirus.   |                       | 0.64                             | 0.018 |
| If I do not do SC, I will be more successful in doing things in life.   | Self-efficacy         | 0.45                             | 0.016 |
| I am sure that I can resist the temptation to SC.   |                       | 0.58                             | 0.022 |
| I am sure that I can say no to the urge to SC.  |                       | 0.52                             | 0.008 |
| I am sure that I can quit SC while I am tired and bored.  |                       | 0.47                             | 0.001 |
| I am sure that I can stay away from the environment in which they do SC.  |                       | 0.87                             | 0.001 |
| I am sure that I can refuse my friends' compliments for smoking.  | Fear                  | 0.87                             | 0.015 |
| I am afraid to get addicted to smoking.   |                       | 0.65                             | 0.013 |
| I am afraid of having a heart attack and smoking by smoking.  |                       | 0.70                             | 0.018 |
| I am afraid of getting asthma and allergies from smoking.   |                       | 0.91                             | 0.015 |
| I am afraid of getting the coronavirus by smoking.  |                       | 0.58                             | 0.022 |
| I am afraid of being rejected by the society for smoking.   | Protection motivation | 0.57                             | 0.008 |
| I have decided to pay more attention to the educational messages about smoking.                                   |                       | 0.86                             | 0.001 |
| I decide not to do SC when I am tired and bored.  |                       | 0.60                             | 0.001 |
| I have decided to replace smoking with positive activities such as exercise and reading.                          |                       | 0.83                             | 0.018 |
| I decide not to say no to encouraging friends to SC.  |                       | 0.51                             | 0.006 |
| I have decided to quit SC to prevent the coronavirus.   |                       | 0.74                             | 0.012 |

Fit indices:  $\chi^2/df=4.31$ ; RMSEA=0.07; CFI=0.94; NFI=0.92; TLI=0.91. SC=Smoking cigarette

The fight against smoking has long been the focus of health activists and policymakers. Adolescents and young people have always been the main victims of smoking. There have been a few studies on the application of PMT to protect adolescents and young people from the dangers of smoking. Greening *et al.* 1997, in their study on the smoking behaviors of 690 high-school students, stated that PMT predicts smoking behavior well, and perceived severity, perceived vulnerability, and reward were the most important components.<sup>[22]</sup> Thrul 2013, in a longitudinal study

on smoking-related behaviors which were studied in 494 individuals aged 11–16 years using PMT, showed that the coping appraisal factor, and in particular self-efficacy, was a strong predictor of smoking-related behavior.<sup>[21]</sup> In the present study, according to the identified and influential dimensions in the studies of Greening *et al.*<sup>[22]</sup> and Thrul,<sup>[23]</sup> 20 questions from the scale were assigned to these important dimensions; for example, in our scale, the dimensions of reward, self-efficacy, severity, and susceptibility had 5, 5, 4, and 6 questions, respectively.

**Table 5: Correlation coefficients among latent constructs in CFA**

| Latent construct      | Susceptibility | Severity | Rewards | Response cost | Response efficacy | Self-efficacy | Fear    | Protection motivation |
|-----------------------|----------------|----------|---------|---------------|-------------------|---------------|---------|-----------------------|
| Susceptibility        | 1              |          |         |               |                   |               |         |                       |
| Severity              | 0.574**        | 1        |         |               |                   |               |         |                       |
| Rewards               | 0.267**        | 0.486**  | 1       |               |                   |               |         |                       |
| Response cost         | 0.185**        | 0.281**  | 0.340** | 1             |                   |               |         |                       |
| Response efficacy     | 0.160**        | 0.434**  | 0.384** | 0.290**       | 1                 |               |         |                       |
| Self-efficacy         | 0.242**        | 0.487**  | 0.519** | 0.378**       | 0.573**           | 1             |         |                       |
| Fear                  | 0.101          | 0.276**  | 0.170** | -0.036        | 0.352**           | 0.180**       | 1       |                       |
| Protection motivation | 0.350**        | 0.432**  | 0.417** | 0.244**       | 0.533**           | 0.518**       | 0.285** | 1                     |

\*\*Correlation is significant at the 0.01 level (2-tailed)

In the present study, the scale design was performed according to the standards in the questionnaire design instructions;<sup>[24]</sup> for instance, the basic information was collected through literature review by searching all scientific databases and reading previous articles; by making focus groups with specialized team members, the best items were selected for the scale.

In our study, according to the existing instructions for face validity evaluation,<sup>[24]</sup> both experts' opinions and the opinions of sample members (students) were used to calculate face validity. Finally, the face validity of the questionnaire was confirmed by both groups. Another validity investigated in the present study was the content validity. In the present study, ten experts were used to calculate content validity. According to the standard value suggested by Lawshe 1975, when ten experts are used to calculate the content validity, its value should be more than 0.62.<sup>[24]</sup> In this study, the value of CVR in all dimensions was more than 0.85, so content validity was also confirmed.

Internal consistency examines how questions designed to measure a concept really and confidently do it.<sup>[24]</sup> The most well-known indicator used to assess internal consistency is the Cronbach's alpha coefficient. Ghanbari *et al.*,<sup>[25]</sup> in their study, declared the acceptable value for Cronbach's alpha coefficient to be more than 0.7. In the present study, the Cronbach's alpha values in all dimensions were greater than 0.7, so the internal consistency of the designed scale was acceptable.

Another method of validity testing is stability validity.<sup>[24]</sup> To evaluate the validity of stability, it is necessary to calculate the correlation between two scale measurements at two consecutive weeks and also to calculate the ICC. Taherzadeh *et al.*<sup>[26]</sup> considered the ICC suitable for checking the stability validity needed to be calculated through the two-way mixed model and the agreement type. Therefore, in the present study, this type of ICC was used to evaluate the stability validity. A value above 0.6 was an acceptable value, which in all dimensions of our scale values were above 0.6.

The recommended value for KMO measure is greater than 0.6.<sup>[27]</sup> Our results showed that in performing exploratory factor analysis, Bartlett's test of sphericity was significant and shows factorability of variable, and the KMO measure of sampling adequacy value was 0.73, so it confirmed adequacy of our sample. According to a significant correlation among factors, Promax rotation was used to rotate the factors. The results of exploratory factor analysis showed that having eight dimensions explained more than 80% variance, which was consistent with the result of the visual method of the scree plot. According to what was recommended in the guidelines,<sup>[26,28-30]</sup> the results of factor extraction were consistent with the results of the scree plot.

The results of confirmatory factor analysis (CFA) showed that the 39-item instrument is a reliable tool based on PMT that can be used to predict smoking-related behaviors. The goodness-of-fit indicators of the model confirmed the good fit of the model to the data, which is consistent with other studies that used a similar theory, such as the 2016 Xiao study, which also developed an 18-item tool based on design PMT. Finally, a good fit was obtained in the factor analysis model.<sup>[31]</sup>

The results of CFA results showed that there is a significant correlation between the latent constructs (dimensions of the instrument) so that the dimensions had a positive correlation with protection motivation, and this is in accordance with the theoretical models of PMT.<sup>[32]</sup> For example severity, susceptibility, response efficacy, and self-efficacy had a positive correlation with protection motivation with values of 0.432, 0.350, 0.533, and 0.518, respectively [Table 5]. Among all dimensions, the highest correlation with protection motivation belonged to the dimensions of response efficiency and self-efficiency. Therefore, if the present questionnaire is used in the intervention study, special attention should be paid to response efficiency and self-efficiency dimensions for the effectiveness of the intervention. Various studies have pointed to the key role of self-efficacy in SC.<sup>[22,27]</sup>

In a nutshell, our results showed that this new scale was valid and reliable and could be used in studies of SC and

related behaviors in the future. Some of the questions in the scale address the issue of smoking during the corona virus pandemic, which has improved the usability of the tool in the current situation.

The novelty of this study was that until now, there was no comprehensive scale to predict cigarette smoking preventive behavior in the Iranian University students. Therefore, designing and measuring the psychometric properties of this questionnaire is an important step to predict and control smoking-related behaviors in students. Another strength of this study was the uniqueness of the work. The present study is one of the first studies that have designed a tool to predict students' smoking-related behaviors based on the theory of protection motivation. This standard scale can be used in interventional and etiological studies among university students in Iran and the world. Also, this scale included questions that cover smoking issues during the COVID-19 pandemic in the world so that in different dimensions of the tool, questions about smoking during the outbreak of the coronavirus have been designed.

One of the limitations of this study is the study population of students in Yazd. It may be impossible to generalize to all students in Iran, so it is necessary to conduct other studies in other provinces of Iran in the future. Another limitation of this study was that no videos or films were made of students, which would later be reviewed by body language experts to see if everyone responded honestly or if they may have refused to tell the truth. Therefore, the questionnaire designed based on the model of PMT has been concluded only on the basis of students' self-declaration, so if they were not honest in filling out the questionnaire, the results will change completely.

## Conclusion

The psychometric properties and the validity and reliability of the instruments designed in this study were confirmed. Therefore, this 39-item scale with eight dimensions according to the theory of protection motivation is proposed as a tool to measure and predict smoking-related behaviors in university students. By measuring smoking-related behaviors in students, policymakers can replace healthy behaviors with destructive ones through regular planning.

## Abbreviations

SC: Smoking cigarette  
 PMT: Protection motivation theory  
 AIDS: Acquired immunodeficiency syndrome  
 CVI: Content validity index  
 CVR: Content validity ratio  
 KMO: Kaiser–Meyer–Olkin test

CFI: Comparative fit index  
 RMSEA: Root mean square error  
 TLI: Tucker Lewis index  
 NFI: Normed fit index.

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## Conflicts of interest

There are no conflicts of interest.

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