

Predicting Psychological Factors Affecting COVID-19 Preventive Measures in Dentists: Application of Theory of Planned Behavior

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Abstract

Dentists are more susceptible to respiratory infections such as COVID-19 due to close contact with patients, as well as exposure to droplets and aerosols diffused from their oral cavity. Effective interventions to prevent the spread of COVID-19 in high-risk occupations are highly dependent on accurate identification of the most important factors influencing the adoption of COVID-19 preventive measures. Therefore, the purpose of the present study was to assess the psychological factors affecting the adoption of COVID-19 preventive measures in Iranian dentists using the theory of planned behavior (TPB). This cross-sectional study was conducted from April to July 2020, with the participation of 138 dentists working in governmental clinics affiliated to Qazvin, Gilan, Mazandaran, and Golestan Universities of Medical Sciences, North of Iran. Data collection tools included a demographic information questionnaire, knowledge scale (15 items), TPB-related scales comprising the attitude scale (12 items), perceived behavioral control ([PBC], 8 items), subjective norms ([SN], 6 items), intention (3 items), and actual performance regarding COVID-19 preventive measures (15 items). Chi-square, independent t-test, ANOVA, and correlation coefficient were applied to analyze the data. Moreover, path analysis and the Maximum Likelihood estimation approach using LISREL 8.80 were utilized to describe the causal relationships between the latent variables. The findings showed that all TPB constructs had a significant positive correlation with actual performance ($P < 0.05$).

The strongest correlation coefficient was observed between attitude and PBC ($r = 0.47$, $P < 0.01$). The path coefficients between PBC, SN, and attitude with intention were significant, which altogether described 43% of the variance of intention. Furthermore, the attitude was the most potent predictor of intention to perform COVID-19 preventive measures ($\beta = 0.40$, $P < 0.01$). Additionally, intention ($\beta = 0.36$, $P = 0.01$) and PBC ($\beta = 0.13$, $P < 0.01$) were found to be the direct predictors of actual performance for implementation of COVID-19 preventive measures, which described 29% of the variance of preventive behaviors. Overall, the results supported the application of the TPB framework to explain the factors affecting COVID-19 preventive measures in dentists. Providing up-to-date training based on receiving frequent feedback, along with presenting adequate Personal Protective Equipment (PPE), verbal encouragement, as well as significant organizational support can enhance dentists' commitment for performing COVID-19 preventive measures via strengthening positive attitudes and increasing self-efficacy.

Keywords: COVID-19; Preventive Measures; Self-efficacy; Attitude; Dentist

Introduction

On January 8, 2020, the China Centers for Disease Control and Prevention officially announced a new coronavirus as the causative agent of COVID-19. The new coronavirus (COVID-19) spread worldwide in less than a month, and the World Health Organization (WHO) declared it a pandemic disease on March 11, 2020 [1]. Due to the acute respiratory syndrome caused by COVID-19, the WHO immediately announced such pandemic as a public health emergency [2]. COVID-19 can potentially cause severe acute respiratory infections in infected individuals. Common routes of transmitting the virus include droplets, aerosols, and physical contact [3,4]. In addition, the average incubation period of COVID-19 is between 4 and 14 days, with upper respiratory tract infection, high fever, dry cough, and dyspnea being its' common symptoms [5,6].

To date, no vaccine or antiviral treatment is available to combat the disease, and therefore, adopting preventive behaviors such as avoiding close contact could be an essential intervention to control COVID-19 [7-9]. In addition to voluntary individual quarantine, many countries have restricted or suspended educational activities, meetings, sports activities, events, banking, as well as airports and transportation system activities to control the infection. Furthermore, health care facilities are an undeniable necessity in any society, which are rarely stopped in such a pandemic situation. Hence, health care workers (HCWs) are at greater risk with respect to direct contact and provision of medical care to patients in these conditions [10]. Evidence from previous infectious diseases such as SARS and Ebola has shown that HCWs are at the front line in terms of risk of infection and death [11,12]. Similarly, statistics emphasize the high rate of infection and mortality in nurses, physicians and other HCWs due to COVID-19 since the beginning of the pandemic [13]. Meanwhile, the findings of Schwartz, et al. [11] study revealed that regarding face-to-face contact with patients, dentists are more prone to COVID-19 transmission than other HCWs. For this reason, dentistry is regarded as one of the most dangerous occupations in terms of the risk of developing COVID-19 [14,15]. In Iran, statistics indicate a worrying prevalence of COVID-19 in the general population, HCWs, as well as dentists. Sarkarat, et al. [16] found that 2.2% of dentists had a medical diagnosis of COVID-19, where the highest incidence was reported in ceramists (50%) and dental students (3.19%), respectively [16].

Asymptomatic infected people with very mild symptoms may seek dental treatment. Moreover, many dental clinics around the world have returned to normal status for a variety of economic, cultural, psychological reasons a few months after the COVID-19 outbreak. Additionally, insufficient knowledge and limited awareness, lack of access to protocols and laboratory tests related to COVID-19 detection, unavailability, and improper utilization of PPE may reduce the patients' and dentists' safety level, which ultimately could increase the prevalence of infection in the community [17].

Successful control of COVID-19 requires multiple strategies such as nationwide shutdowns, tracking infected and suspected cases, maintaining social distance, and changing behaviors that are influenced by the knowledge and beliefs of high-risk groups [18]. In this regard, implementing preventive behaviors by dentists would be one of the most effective approaches to prevent COVID-19 [19]. Despite the emphasis on dentists' vulnerability and the importance of following standard protocols, many dentists do not perform the recommended preventive behaviors [12]. Understanding the factors influencing health behaviors is the first step in designing behavioral change interventions [20]. Moreover, applying behavior change models to determine the factors affecting the motivation of people to adopt preventive behaviors is recognized as a rational and economical approach. The primary constructs in TPB, developed by Ajzen and Fishbein (1980) to study the psychological factors affecting health behaviors, are intended to perform a particular action. Intention involves the process of thinking and deciding about the probability of conducting behavior, which is influenced by three other constructs: (1) attitudes toward behavior; (2) SN (subjective norms); and (3) PBC (perceived behavioral control). The type of behavior and social, cultural and psychological characteristics of the audience determine the impact of these constructs [21,22].

As one of the economic and concise models, TPB has good predictive power in a wide range of health behaviors such as smoking [23], high-risk sexual behaviors [24], and chronic diseases preventive behaviors [25], dietary behaviors [26], weight loss [27], exclusive breastfeeding [28], alcohol consumption [29], sun protection [30], physical activity [31], pedestrian safety [32] and SARS preventive behaviors [33]. Further, reviewing studies that used the TPB to describe the factors influencing SARS-preventing behaviors suggests that individuals may engage in such behaviors if they consider that taking preventative behaviors would lead to positive consequences. They may also participate in SARS-preventative behaviors if they expect their reference groups to approve of these behaviors and if there is a strong motivation to follow the demands of the reference group [33,34]. At a glance, the need to design cognitive-behavioral interventions to raise awareness, change attitudes, create sensitivity to disease, as well as encourage dentists to adopt COVID-19 preventive behaviors is felt more than ever in the current situation. Moreover, the application of behavior change models such as TPB is a reasonable approach to identify psychological variables affecting the adoption of COVID-19 preventive behaviors. Therefore, the aim of this study was to evaluate the psychological factors affecting the adoption of COVID-19 preventive behaviors in Iranian dentists. This study appraised the following hypotheses:

H_{1a}: Attitude toward behavior has a positive effect on dentists' intention to perform COVID-19 preventive measures.

H_{1b}: SN has a positive effect on dentists' intention to perform COVID-19 preventive measures.

H_{1c}: PBC has a positive effect on dentists' intention to perform COVID-19-preventive measures.

H_{2a}: PBC has a positive effect on the performance of COVID-19 preventive measures by dentists.

H_{2b}: Intention has a positive effect on the performance of COVID-19 preventive measures by dentists.

Methods

Study Design

The present study was a questionnaire-based cross-sectional study conducted from April 10 to July 20, 2020. This study aimed to determine the psychological factors relevant to dentists' practice towards COVID-19 preventive measures using the TPB framework.

Study Population and Participants

All dentists employed by governmental clinics affiliated with Qazvin, Gilan, Mazandaran, and Golestan Universities of Medical Sciences, with more than a year of professional experience were invited to participate in the study. These universities are located in four Northern provinces of Iran and are geographically and culturally similar to each other. The inclusion criteria included being a doctor of dental science, at least one year of professional experience as a dentist not retired, and full-time or part-time employment in one of the universities of Qazvin, Gilan, Mazandaran, and Golestan.

From a total of 286 distributed questionnaires, 138 were returned (48.25% response rate). A designated contact person was responsible for distributing and collecting questionnaires in each province. Each participant was given a questionnaire instruction and an information sheet that included the research objectives, the way of answering questions, information about researchers, and the benefits and risks of partaking in the investigation. The participants were also informed of the anonymity of the questionnaires and their right to leave the study whenever they wished. After completing the inquiry forms, they were handed over to a designated contact person and placed in a special box prepared for this purpose. Participants who returned the closed questionnaire were considered to have given informed consent. The present study was designed according to the Helsinki Declaration and approved by the Ethics Committee of Qazvin University of Medical Sciences (IR.QUMS.REC.1399.241).

Measures

Four self-administered questionnaires were utilized to collect data in the present study as follows:

Demographic Characteristics

The demographic variables assessed in the current study included age, gender, marital status, professional experience years, contract type, shift, specialization, and history of participation in training courses regarding COVID-19.

TPB Scales

The questionnaire section to measure TPB related constructs was developed in several stages as follows:

Focus Group and Elicitation of Silent Beliefs

According to Ajzen's recommendation for developing TPB scales [34], a focus group was conducted with 14 dentists to extract silent belief. Therefore, salient beliefs related to COVID-19 preventive behaviors amongst Iranian dentists were removed in the first step of the TPB scales design. Item production for the pilot questionnaire was based on the open-ended questionnaire, where the sentences were formulated according to the silent beliefs extracted in the focus group. Then, 6 to 8 items were generated for each of the constructs of TPB. A pilot questionnaire was sent to 8 dentists for assessment, with some items being modified, removed, or added based on their comments.

The face and content validity of the TPB scales were evaluated by quantitative and qualitative methods. To this end, an eight-member expert panel assessed the face validity of the questionnaires, qualitatively. The expert panel members included three general dentists, one psychologist, 2 Ph.D. in health education, and one orthodontist. The expert panel was asked to appraise the level of difficulty, the amount of appropriateness, ambiguity of phrases, and semantic incompatibility of the items related to TPB scales. Thus, the face validity of the TPB scales was confirmed qualitatively by making minor revisions according to the comments of the expert panel.

In the next step, the impact score of each question was calculated to determine the face validity quantitatively. First, a 2-part Likert scale was considered for all questions related to the TPB related scale model such as "Completely disagree (1), disagree (2), no idea (3), agree (4) and completely agree (5)". Second, the scales were given to 10 participants in order to measure the quantitative validity. Finally, quantitative face validity was calculated using the formula of the item impact method as follows: "Impact score = frequency (%) × Importance". In the following, two general dentists and four senior dental students were requested to assess issues comprising grammatical compliance, the usage of appropriate words, the importance of items, proper placement of words and phrases, etc. The purpose of this stage was to characterize the content validity of the TPB scales qualitatively.

Based on the suggestions presented in this step, minor changes were made in the context of the questions, and then the Content Validity Ratio (CVR), and Content Validity Index (CVI) were calculated to determine the content validity quantitatively. The value of these two indicators (CVI and CVR) was reported to be higher than 7 for the TPB scales, which confirmed the content validity. Finally, the validated version of the scales was completed in two weeks by ten general dentists. Thereupon, the test-retest coefficient was applied to appraise the reliability and Cronbach's alpha coefficient for determining the internal consistency of the TPB scales. To determine the psychometric properties of the TPB scales, all participants of the pilot study were chosen from dentists working in public clinics affiliated to Qazvin University of Medical Sciences. Moreover, all the dentists who engaged in the pilot study were excluded from participating in the primary research. Thus, the final TPB scale included the following:

Attitude

A 12-item scale was used for the measurement of attitudes toward COVID-19 preventive behaviors in dentists. Participants were

asked to respond to items using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). “Adherence to standard health protocols is sufficient to prevent Covid-19 in dentistry” was the example of an item related to the attitude scale. Item scores were summed, and the final score ranged from 12 to 60. A higher attitude score indicated a greater tendency to evaluate the effectiveness of Covid-19 preventive behaviors as having more benefits and fewer barriers, as well as a greater likelihood of the benefits occurring. Cronbach’s alpha ($\alpha = 0.78$) and test-retest coefficient ($r = 0.80$) confirmed the internal consistency and reliability of the items on this scale, respectively. Other psychometric properties of the scale are presented in Table 1.

Constructs	items	range	Cronbach's α	r (Test-Retest)	CVR	CVI	ICC
Attitude	12	12-60	0.77	0.80	0.81	0.85	0.76
Subjective Norms	6	6-30	0.85	0.83	0.86	0.88	0.79
PBC	8	8-40	0.82	0.90	0.87	0.80	0.82
Intention	3	3-15	0.92	0.96	0.88	0.86	0.90

Table 1: Psychometric properties of TPB related constructs

PBC

Regarding the adherence to preventive behaviors of COVID-19, eight items were used to assess the dentists’ perceptions. Responses were recorded on a 5-point range of 1 (strongly disagree) to 5 (strongly disagree). An example of a question on this scale was “Regularly disinfecting surfaces, tools and equipment in a dental clinic is easy”. A composite score was created by summing the ratings for all of the items. PBC scores ranged from 8 to 40 where the higher the scores, the higher the self-efficacy and perceived ability of dentists to overcome perceived or real barriers to adherence preventive behaviors. The results of the pilot study revealed that this scale has good internal consistency and reliability. Other psychometric properties of this scale are presented in Table 1.

Subjective Norms

To appraise the influence of important people (senior dentists, colleagues, experts, family, spouses, and friends) on dentists’ beliefs about adherence to COVID-19 Preventive Behaviors, six items were utilized. Sample question of this scale were as follows: “I am motivated to adopt the COVID-19 preventive behaviors according to what my colleagues think”. Participants were requested to display the extent of their agreement with the items of a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A composite score was created by summing the ratings for all of the items and ranged from 6 to 30. A higher SN score demonstrated the perception of more significant social pressure to perform COVID-19 preventive behaviors. The outcomes of the pilot study disclosed that this scale had good internal agreement and reliability ($\alpha = 0.85$, $r = 0.83$). Table 1 lists other psychometric properties relevant to the SN.

Intention to Perform COVID-19 Preventive Behaviors

The scale consisted of 3 items, in which participants were asked to reply to items using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). An Example of items related to this scale was: “I plan to perform Covid-19 prevention behaviors on a regular basis in the next month”. Scores of each item were summed, and responses ranged from 3 to 15. A higher score showed a stronger intention to follow COVID-19 preventive behaviors and vice versa. Cronbach’s alpha and test-retest coefficient confirmed the internal consistency and reliability of the scale, respectively ($\alpha = 0.82$, $r = 0.87$).

Actual Performance towards COVID-19 Preventive Measures

A 15-item scale was used to measure the actual performance of COVID-19 preventive measures in dentists. Participants were demanded to rate the frequency of each preventive behavior in the past week using a 5-point scale ranging from 0 (never) to 4 (every day). A composite score was created by summing the ratings of all the items. Actual performance score ranged from 0 to 60. A higher score indicated better performance in terms of the number and frequency of COVID-19 preventive measures. The face and content validity of this scale “actual performance COVID -19 Preventive Measures scale” was confirmed by an experts panel (CVI = 0.79, CVR = 0.82).

Knowledge Scale

According to previous studies [36,37] and based on the guideline of CDC (the Centers for Disease Control and Prevention), a 15-item questionnaire was used to evaluate dentists’ awareness and knowledge regarding COVID-19. The main content of the questions consisted of items about common symptoms, mode of transmission, access to vaccines, various prevention measures, details of preventive behaviors, etc. Infectious disease specialists confirmed the content validity of the questionnaire. In addition, the results of the pre-test study confirmed the reliability of the questionnaire ($r = 0.83$). The total knowledge score was calculated based on the response of each subject. Each positive answer was given a score of “1” and the negative response as “zero”. The total score of each subject was calculated by adding the sum of responses, and the final scores ranged from 1 to 15. The final score was classified into three levels: low (0-5), medium (6-10), and high (11-15). The time to complete the knowledge scale was approximately 10 minutes.

Statistical Analysis

Statistical analysis was performed using SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) and LISREL (LISREL 8.80 for Windows, developed by Scientific Software International Inc. in Skokie, Illinois). Descriptive statistics, independent t-test, one-way ANOVA, and Chi-square test were computed to test participant's characteristics and all variables under study. A two-sample T-test was used to compare continuous variables (if the data distribution was not normal, the Mann-Whitney U test was used). Also, a Chi-square test and Fischer test were used to compare qualitative variables. Moreover, one-way ANOVA was applied to examine the differences in mean values between more than two groups. Pearson correlation coefficients were also calculated to examine the linear relationships between the main TPB constructs (attitude, SN, PBC, and intention) and COVID-19 preventive behaviors.

Path analysis and the Maximum Likelihood estimation approach using LISREL were applied to describe the causal relationships between the latent variables. With regard to some previous studies, six fit indices were used to assess the fit of the model: the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), normed fit index (NFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). According to Hair (2010) [37], for GFI, AGFI, NFI, and CFI, a value greater than 0.90 indicates a good model fit. Moreover, for RMSEA, an amount of less than 0.08 is an indication of a good model fit. The level of statistical significance was set at 0.05 in the current study.

Data availability Statement

All data generated or analyzed during this study are included in this published article. Data would be, however, available from the authors upon reasonable request and following current privacy policy as well as after the permission of all site investigators.

Results

General Characteristics

The average age of participants was 40.2 ± 11.7 years, and 60.14% of them were men. Roughly, 70% of the participants were married, and 83.33 % were general dentists. The professional experience of 62.32% of the dentists participating in this study was between 2 and 10 years. Moreover, approximately 40% of the participants had full-time contracts, and the same amount was morning shifts. Also, 63.04% of dentists took part in no COVID-19 related training. Other demographic information is presented in Table 2.

Variable	N (%) or M \pm SD
Age	40.2 \pm 11.7
Gender	
male	83 (60.14)
female	55 (39.86)
Marital Status	
married	94 (68.12)
single	39 (28.26)
divorced	5 (3.62)
Professional Experience	
Less than 2 years	19 (13.77)
2-5 years	39 (28.26)
5-10 years	47 (34.06)
More than 10 years	33 (23.91)
Contact Type	
full time	56 (40.58)
part time	40 (28.99)
temporary	18 (13.04)
others	24 (17.39)
Shift	
morning shift	59 (42.75)
afternoon shift	20 (14.49)
night shift	10 (7.25)
rotation	49 (35.51)

Variable	N (%) or M ± SD
Specialization	
General Dentistry	115 (83.33)
Orthodontics	3 (2.17)
Surgery and Implantology	4 (2.90)
Prosthetics	1 (0.72)
Periodontology	5 (3.62)
Conservative endodontics	4 (2.90)
Pedodontics	6 (4.34)
Did you participate in a training course related to COVID-19 prevention?	
yes	51 (36.96)
no	87 (63.04)

Table 2: Demographic characteristics of dentists participating in the study (n = 138)

Table 3 compares the mean and standard deviation scores of TPB constructs. The results of the independent t-test revealed that the mean attitude score was statistically different between male (37.4 ± 12.6) and female (45.2 ± 14.7) dentists ($P < 0.05$). In other words, the mean attitude score of female dentists was higher than male. Moreover, the results indicated that the mean score of actual behavior in female dentists (42.9 ± 17.7) is significantly higher than males' (38.3 ± 15.2) ($P < 0.05$). Furthermore, no significant difference was observed between male and female dentists in terms of knowledge, SN, and PBC variables.

TPB constructs	Male dentists	Female dentists	P value
	Mean ± SD	Mean ± SD	
knowledge of COVID-19	11.87 ± 4.23	12.15 ± 4.06	0.334
Attitude	37.42 ± 12.60	45.21 ± 14.71	$P < 0.05$
Subjective norms	14.63 ± 7.39	15.10 ± 6.75	0.195
PBC	19.35 ± 9.72	18.62 ± 10.24	0.108
Intention	11.48 ± 3.55	11.64 ± 3.70	0.274
Actual performance	38.26 ± 15.20	42.93 ± 17.65	$P < 0.05$

Table 3: Comparison of mean and standard deviation of TPB constructs among dentists participating in the study by gender (n=138)

The correlation coefficients between the variables are given in Table 4. Except for knowledge, all the TPB constructs had a significant positive correlation with actual performance. Dentist's knowledge about COVID-19, attitudes, SN, and PBC was significantly positively correlated with their intentions to implement COVID-19 preventive behaviors. Also, correlations amongst the TPB primary constructs were positive. The weakest correlation coefficients were reported between intention and knowledge ($r = 0.127$, $P < 0.05$), as well as knowledge and attitude ($r = 0.173$, $P < 0.05$), while the strongest correlation coefficients were between PBC and attitude ($r = 0.472$, $P < 0.01$), intention and attitude ($r = 0.447$, $P < 0.01$), and intention and PBC ($r = 0.413$, $P < 0.01$), respectively. The findings did not display a significant correlation between SN with actual performance and knowledge.

Variables	1	2	3	4	5	6
1. Knowledge	1					
2. Attitude	0.173*	1				
3. Subjective norms	0.081	0.286*	1			
4. PBC	0.215**	0.472**	0.310*	1		
5. Intention	0.127*	0.447**	0.235**	0.413*	1	
6. Actual performance	0.092	0.331**	0.134	0.268**	0.372**	1

* $P < 0.05$, ** $P < 0.01$

Table 4: Pearson correlation coefficients of study variables)

Table 5 shows the results of one-way ANOVA to compare the mean of TPB constructs between participants according to different levels of knowledge. With respect to the results, 52.90%, 31.15%, and 15.95% of the participants had high, medium, and poor knowledge scores, respectively. The findings also demonstrated that the mean of attitude scores between the three groups of dentists in terms of the level of knowledge (high, medium, and low) were statistically different ($F = 16.957$, $df = 2$, $P < 0.001$). In other words, dentists with greater knowledge levels had higher mean attitude scores (39.8 ± 12.3) than those with medium (35.4 ± 11.8) and low knowledge levels (30.6 ± 10.3). Moreover, the mean score of PBC in dentists with a low rank of knowledge was statistically dissimilar to the other groups ($F = 7.814$, $df = 2$, $P < 0.001$). Our results also showed that the mean score of intention in dentists with lower knowledge level was significantly lower than dentists with a medium and high level of knowledge ($F = 5.537$, $df = 2$, $P < 0.005$). Moreover, the mean score of actual performance toward COVID-19 preventive measures at various levels of

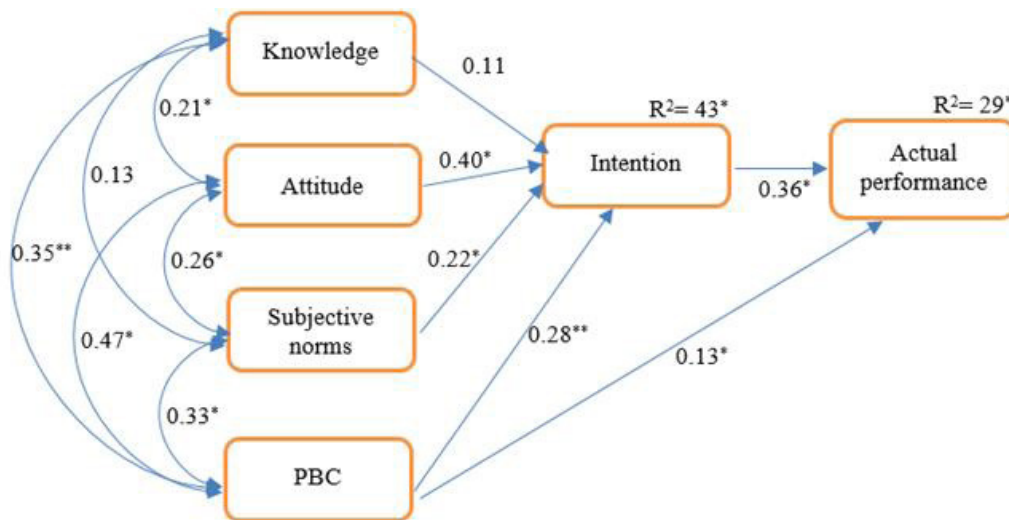
knowledge was statistically significant. In other words, the mean score of actual behavior in dentists who had greater knowledge was significantly higher than the other two groups ($F = 9.656, df = 2, P < 0.001$). Finally, the mean score of SN showed no significant differences between dentists regarding diverse levels of knowledge.

TPB constructs P value	Knowledge level			P value
	Low (n=22) (Mean±SD)	Medium (n =73) (Mean±SD)	High (n=63) (Mean±SD)	
Attitude	30.57 ± 10.33 ^a	35.41 ± 11.76 ^b	39.82 ± 12.25 ^c	F=16.957, df =2, P<0.001
Subjective Norms	13.82 ± 7.44 ^a	15.38 ± 8.33 ^a	15.43 ± 8.15 ^a	F=0.533, df =2, P=0.588
Perceived Behavioral Control	17.63 ± 9.48 ^a	22.85 ± 11.42 ^b	23.19 ± 11.83 ^b	F=7.814, df =2, P<0.001
Intention	9.31 ± 3.12 ^a	11.30 ± 3.85 ^b	12.29 ± 3.88 ^b	F=5.537, df =2, P=0.005
Actual Performance	31.45 ± 11.27 ^a	37.56 ± 14.75 ^b	40.53 ± 15.63 ^c	F=9.565, df =2, P<0.001

a to c indicate a significant difference between the means

Table 5: Comparison of the mean of TPB constructs in relation to the COVID-19 preventive behaviors in dentists according to different levels of knowledge

Figure 1 displays the path coefficients between the TPB constructs and actual performance to implement COVID-19 preventive measures in the participated dentists of the current study. The path coefficients between the three primary constructs of TPB, namely perceived behavioral control, SN, and attitude with intention were significant. The attitude was the strongest predictor of intention to perform COVID-19 preventive behaviors ($\beta = 0.40, P < 0.01$). Additionally, intention ($\beta = 0.36, P = 0.01$) and perceived behavioral control ($\beta = 0.13, P < 0.01$) were found to be the direct predictors of actual performance to implement COVID-19 preventive behaviors, which were able to describe 29% of the variance of actual performance to perform such preventive measures. The knowledge also had no significant path toward the intention. Totally, the TPB constructs were capable of predicting a 43% variance of intention toward COVID-19 preventive behaviors.



* P<0.01, **P<0.05

($\chi^2/df = 1.34, CFI = 0.97, GFI = 0.98, AGFI = 0.96, NFI = 0.99, RMSEA = 0.028$)

Figure 1: Path Analysis Model of Dentists' Intention and actual Performance to Perform COVID-19 Preventive Behaviors Based on Theory of planned behavior (n=138)

Discussion

The recent COVID-19 outbreak has had a salient impact not only on public health and healthcare facilities but also on HCWs, especially dentists. This study aimed to determine the factors affecting COVID-19 prevention behaviors in Iranian dentists using the TPB framework. The participants in this study included dentists working in governmental clinics affiliated to Qazvin, Gilan, Mazandaran, and Golestan universities of medical sciences. In general, the findings confirmed the hypotheses $H_{1a}, H_{1b},$ and $H_{1c},$ which showed that attitudes, SN, and PBC have a positive effect on dentists' intention to perform COVID -19 preventive behaviors. Moreover, the H_{2a} and H_{2b} hypotheses were also proven, and it was shown that PBC and intention have a positive and significant effect on the implementation of COVID -19 preventive behaviors in dentists.

The results of the present study can be discussed in several sections. According to the current study, it was revealed that there was a significant correlation between knowledge and intention to perform COVID-19 preventive behaviors in dentists, whereas

the knowledge did not directly affect intention. In accordance with our findings, Tang and Wang (2005) reported that being knowledgeable about SARS is was a significant factor in encouraging the elderly to implement preventive behaviors [39]. Therefore, it is clear that knowledge alone is not enough to predict different preventative behaviors.

Despite the lack of direct impact, knowledge indirectly affected intention through proxy constructs such as attitude, SN and, PBC. This finding was parallel to previous ones that reported an association between the level of knowledge of HCWs and their attitudes toward COVID-19 preventive behaviors [40-42]. Studies have also emphasized that higher levels of knowledge are linked with a positive attitude toward preventive behaviors [43,44]. It is well known that the knowledge of HCWs is a fundamental prerequisite for preventative ideas, positive attitudes, and promoting the positive practice [45,46]. Adequate knowledge and comprehension of transmission methods, symptoms, and procedures to hinder COVID-19 play a central role in performing real preventive behaviors.

In addition, our results revealed that 84% of the participants had high knowledge score, which was consistent with the results of the Putrino, *et al.* [47]. The great amount of knowledge in dentists could be due to the continuous and systematic training which has been provided through the health care system since the beginning of the COVID-19 outbreak. Moreover, dentists, similar to other members of the community, seem to be committed to gaining the necessary knowledge about the COVID-19 via various means comprising television, news, and mass media to protect themselves and their families. The attitude of dentists towards performing COVID-19 preventive behaviors had a significant correlation with actual performance ($r = 0.331$, $P < 0.01$). The findings of this study were consistent with those of previous research in terms of the positive effect of attitude on intention ($\beta = 0.40$, $P < 0.01$). In this regard, after integrating constructs of protection motivation theory (PMT) and the extended TPB to identify the factors influencing the perceived effectiveness of COVID-19 preventive measures in the Philippines during quarantine, Prasetyo, *et al.* [48] concluded that attitude directly affects the perceived effectiveness of COVID-19 preventive measures [48].

In other words, given the high level of knowledge of dentists as front-line HCWs who deal directly with patients, we expect them to have a clear comprehension of the benefits and advantages of following COVID-19 preventive measures. Moreover, it should be noted that despite the high level of knowledge of dentists, most of them are afraid and feel more susceptible to COVID-19 infection [40,49]. In this regard, the findings of previous studies demonstrated that 85% and 92% of HCWs were afraid of contracting the disease and transmitting it to their families, respectively [40,50]. Accordingly, determining the risk perceived by dentists is considered an essential tool to change attitudes and create a healthier and safer workplace [51,52]. Most studies have shown that people obey rules and regulations when they have a positive attitude [53-55]. Furthermore, people would find themselves vulnerable to the disease when being highly knowledgeable about COVID-19 and regularly witnessing the implementation of preventive behaviors by others. Hence, it could be mentioned that perceived susceptibility has a significant impact on attitude [56]. Dentists' correct understanding of the number of patients with COVID-19 will strengthen their belief in vulnerability to the disease similar to other people. Given the results of previous studies, understanding individual susceptibility to disease is a silent determinant of participation in health screening programs and preventative behaviors [57,58].

The next important finding of the current study was the significant correlation between SN and intention ($r = 0.235$, $P < 0.01$) and its direct effect on intention ($\beta = 0.22$, $P < 0.05$), which was in line with the results of previous studies [59,34]. SN are defined as normative rewards, values, and interests to adhere to a particular action, which is primarily influenced by observing the behaviors of others [34,60]. Dentists are more likely to follow these guidelines when other dentists and HCWs pursue the instructions relevant to COVID-19. In line with our study, a strong association between SN and adherence in the organization has been proven in most studies [61-63].

Moreover, the findings of the current study revealed that SN were the weakest predictor of intention to follow COVID-19 preventive behaviors. Previous studies have also concluded that the number of behaviors being under normative control is way lower than those under attitude control. Furthermore, it can be deduced that the social effects of co-workers play a substantial role in the following of preventive behaviors and SN addressed dentist's perceptions of how COVID-19 preventive measures were prioritized and implemented by the other dentists. Dentists think that significant others expect them to pursue preventive measures, and when they do not follow these actions, they would be surprised and blamed by significant others (those individuals would be surprised and blame them.). Therefore, it appears that dentists have identified themselves as crucial decision-makers in following preventive measures [46,64], which is similar to what reported in a study conducted by Via-Clavero, *et al.* [65]. Hence, a low perception of disapproval could be considered as a barrier to following the recent guideline recommendations to diminish the risk of COVID-19 [66]. Accordingly, two conditions have to be met in the development of strategies related to the avoidance of COVID-19 in dentists: first, administrative supervision to ensure dentists' commitment to following health protocols, and subsequently strengthening social support from significant others. Second, elevating the network of communication between dentists with each other and with managers to reflect on problems, share new knowledge and experience, and ameliorate problem-solving skills.

The significant correlation coefficients between PBC and behavioral intention ($r = 0.413$, $P < 0.05$) as well as PBC and actual behavior ($r = 0.268$, $P < 0.01$) was another finding of the current study, which was in accordance with those of previous studies [33,34,66]. Furthermore, Tang and Wong (2005) indicated that self-efficacy was significantly associated with the intention to perform SARS-preventive behaviors [39]. The results of a path analysis revealed that PBC had a significant effect on intention ($\beta = 0.28$, $P < 0.01$) and actual performance ($\beta = 0.13$, $P < 0.05$), which was in parallel with a research of Prasetyo, *et al.* [48]. PBC has been identified as one of the momentous predictors of people's willingness to follow suggested recommendations [67]. In this regard, our findings

were in line with those of Bandura (1977) who emphasized the role of PBC as an essential predictor of many health behaviors [68], and Ajzen (1991) who argued that the more realistic or accurate people's perception of behavioral control, the greater the predictive power of this variable [47]. However, the accuracy of PBC is limited by two factors: the amount of information about behavior and the availability of resources [47].

Since knowledge can also be considered as a source, therefore, the predictive power of PBC would be reduced as a result of lack of knowledge and information about behavior, and vice versa. Similarly, Chan, *et al.* [69] indicated that certain social situations or personal beliefs could facilitate the motivation for autonomy [69]. Additionally, Kortteisto, *et al.* [66] emphasized that low perceptions of disapproval of significant others, along with inadequate self-efficacy, could be regarded as obstacles to following common recommendations [66]. Therefore, holding video conferences or using web-based training to identify potential barriers to the implementation of health protocols along with the practice of the COVID-19 related prevention methods in clinics such as disinfection of equipment and tools can eventually lead to an enhancement in the level of preventive behavior by boosting PBC.

Conclusion

Findings of the study supported the use of TPB to explain the factors affecting the COVID-19 related preventive behaviors in dentists. The results revealed that positive attitude, perceived social support, and PBC was significantly influential on dentists' intention to perform COVID-19 preventive behaviors. Moreover, with respect to the path analysis outcomes, knowledge was not a significant predictor of intention or COVID-19 relevant preventive behavior. Nevertheless, the role of sufficient knowledge should not be overlooked in elevating self-efficacy, and understanding the reasons for COVID-19 related preventive behaviors. Thus, the current results could be applied by health officials to develop an intervention to promote preventative behaviors and to further adhere to COVID-19 related protocols as follow: First, equipping dental clinics with adequate PPE, along with regular training related to COVID-19 control measures that would be helpful for enhancing dentists' self-efficacy in self-care and disrupting the virus transmission cycle.

Second, raising a positive attitude is far better than increasing dentists' knowledge regarding COVID-19 control measures lonely; Expressing verbal approval or motivational persuasions such as awarding a commendation plaque, certificate of competence to provide dental care in full compliance with preventive protocols, as well as organizational and financial support, are examples of strategies to strengthen attitude. Third, regular receipt of feedback from dentists by health officials and providing appropriate responses to their concerns about the likelihood of exposure to patients with COVID-19 with special emphasis on dentists' participation in designing routine retraining courses can significantly reduce dentists' fears. In general, presenting regular and up-to-date training on the basis of receiving frequent feedback along with providing adequate PPE, verbal encouragement, and remarkable organizational and financial support can boost dentists' commitment to performing COVID-19 preventive behaviors via amplification of positive attitudes and improving self-efficacy.

Limitations

The major weakness of this study was that other important variables influencing COVID-19 related preventive behaviors in dentists might not have been included in the TPB. As with all health behaviors, the agents impacting COVID-19 associated preventive behaviors in dentists seemed to be very complicated and influenced by the novelty of the disease and the diversity of cultural, social, and personality factors affecting behavior. Measurement of psychological characteristics and preventive behaviors using the TPB framework was crude and without contextual information. Moreover, since motivational factors and other cognitive-behavioral variables affecting COVID-19 related preventive behaviors (e.g. perceived barriers, normative pressures, and guidelines for action) do not exist in TPB, further studies with qualitative methods to discover the various factors influencing such behaviors in dentists may be necessary. Second, the dentists were selected from public dental clinics under the auspices of four adjacent universities of medical sciences (geographically), which probably could not represent the entire Iranian dental community. And as they were chosen from the public (governmental) clinics, due to administrative constraints, it was not possible to involve dentists being only employed in the private sector.

To better compare the agents affecting the adoption of COVID-19 preventive behaviors, it is suggested that samples be picked out from both public and private clinics. Third, the response rate in this study was 48%, and the factors affecting the involuntary participation of some dentists were not identified, which reduced the generalizability of the findings. Fourth, data were collected using a self-administered questionnaire (retrospective self-reports of participants) and without external verifications. Accordingly, the results may be impressed by the recall and social desirability bias. Finally, with regard to the nature of this investigation being a cross-sectional survey, it could not detect cause-and-effect relationships. Furthermore, the correct judgment of the stability of preventive behaviors over time-based on the research results won't be possible.

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