Gender differences in concerns, stress levels and behavior changes in dental academics in Iran during the COVID-19 pandemic: A cross-sectional study

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Abstract

Background. Coronavirus disease 2019 (COVID-19) has placed a significant psychological burden on the healthcare personnel. Dental academics play a crucial role in the promotion of public oral health and the education of dental students.

Objectives. The aim of the study was to assess COVID-19-related concerns, stress and behavior changes in Iranian dental academics, determine the associated factors, and assess the potential gender differences.

Material and methods. In this cross-sectional study, we shared a researcher-developed questionnaire with Iranian dental academics through social media and e-mail. The questionnaire contained 4 sections: Background (8 items and additional 6 knowledge questions); Concerns (18 items); Stress (based on the 15-item Impact of Event Scale (IES)); and Behavior Change (5 items). We divided the concerns by means of the principal component analysis (PCA) into 3 various components of the fear of infection, concerns over professional responsibilities and concerns over restrictions. The backward stepwise multilevel linear and logistic regression analyses served to discover the association of other factors with stress and behavior changes.

Results. Out of 274 respondents, 66% were female, and 78% were 45 years old or younger. Approximately half of the respondents demonstrated moderate to severe stress and the median (*Me*) for behavior change was 46.5 out of 50. The greatest concern expressed by the participants referred to the fear of becoming infected by their patients and spreading the virus to their loved ones. Being female, living with parents and not having any administrative role, along with greater fear of infection, concerns over restrictions and academic experience were associated with higher levels of COVID-19-related stress. Being female and having an administrative role, along with greater fear of infection and knowledge, and more daily patient visits were associated with desirable COVID-19-related behavior changes.

Conclusions. The COVID-19 pandemic has significantly affected dental academics' psychological state, leading to various levels of concern, stress and behavior change. Supportive and educational programs must target those with high fear and stress levels to prevent undesirable behaviors.

Keywords: health behavior, psychological stress, fear, COVID-19, dental faculty

Introduction

Coronavirus disease 2019 (COVID-19) emerged in China in December 2019[1] and quickly developed into a pandemic by March 2020.[2] Until November 2021, about 250 million cases and 5.1 million deaths had occurred worldwide due to the pandemic.[3]

Many countries have imposed restrictions to control the spread of the infection.[4] Under such circumstances, the number of people with mental health issues tends to exceed the number of people directly affected by the infection.[5] The COVID-19 pandemic has exacerbated anxiety, depression, fear, stress, and sleep problems among the public.[6] The highly contagious nature of the disease and its fatal consequences have also led to lifestyle changes, such as avoiding crowds, social distancing, more frequent handwashing, and wearing masks.[7]

Due to close contact with patients, healthcare professionals are at high risk of contracting the disease.[8,9] This causes psychological problems, such as the fear of spreading the disease to their family or loved ones, and possibly post-traumatic stress disorder (PTSD).[10] This psychological distress was also apparent among healthcare workers (HCWs) during the severe acute respiratory syndrome (SARS) outbreak, with an elevated risk for those more exposed,[11] and was associated with the fear of contagion[12] and concern about family.[11]

Among HCWs, dentists are the highest-risk group to contract COVID-19[13] due to exposure to droplets and aerosols, which are the main transmission routes for the virus.[8,14] In a situation like this, even standard protective measures are relatively ineffective in preventing the transmission of the disease,[8] thus making dentists susceptible to severe distress.[15]

Researchers and academics are also dealing with the psychological impact of the COVID-19 pandemic due to the challenges faced by dental and medical schools.[16] The adoption of e-learning, the suspension of several research projects and the threat of unemployment may have created new additional stressors.[17]

A dental academic is a clinician and a researcher at the same time, and also trains students in an educational clinic, along with teaching them theoretical courses. Therefore, in the pandemic situation, dental academics need to protect themselves, their loved ones, patients, students, and the public. However, the psychological impact of the pandemic on productivity, well-being and quality of life may push people into panic and making mistakes that lead to irrational decisions and behavior.[18] Mental illnesses can also negatively affect the decision-making ability of the medical staff, including dentists, leading to the suboptimal treatment of patients as well as burnout.[19,20]

Identifying the specific sources of stress and undesirable behavior is essential for developing effective approaches to tackle these problems. It should be the primary focus of supportive efforts,[21] along with targeting attention at those who are in a greater need of help.

There are plenty of studies on the psychological impact of the COVID-19 pandemic among dental students and dentists; however, very few have assessed psychological outcomes in dental academics. Therefore, we aimed to assess COVID-19-related concerns, stress and behavior changes in Iranian dental academics, determine the associated factors, and assess the potential gender differences.

Material and methods

Study design

This online survey-based cross-sectional study was part of a multinational study conducted in Alexandria University, Egypt,[22] and it was performed in Tehran University of Medical Sciences, Egypt, in April 2020. The research was approved by the institutional ethics committee (approval ID: IR.TUMS.DENTISTRY.REC.1399.001).

Study population and sampling

The study population consisted of all the 1,826 officially registered dental academics employed in Iran.[23] By considering the elevated distress among dental professionals to be 11.5%[24] and the confidence level to be 95%, we needed at least 145 participants to obtain a margin of error less than 5%.[25]

We used convenient sampling and shared the survey link together with a brief explanation of the study with Iranian dental academics through e-mail and social media (Telegram, WhatsApp, Instagram) – privately, and also through social media groups and channels exclusive to dental academics. We also sent reminders 1 week after sending the invitation for response rate maximization. Additionally, we used the snowball method and asked the receivers to share the invitation with their fellow dental academics. The survey was available from April 8 to April 21, 2020, and an estimate of 700 dental academics received the invitation. A total of 274 dental academics participated in the study (response rate: 39%).

Questionnaire

An international team[22] designed a questionnaire containing 4 sections (the questionnaire is available from the corresponding author on reasonable request). The 1st section referred to background information, and contained 8 questions about the respondent's gender, age, living status, and academic experience,

the number of courses coordinated per semester, the number of students dealt with per semester, the number of daily patient visits, and the respondent's administrative role (having an extra responsibility of managing a department or a certain affair beside the academic role). This section also contained 6 questions on COVID-19-related knowledge with a total of 29 true-or-false statements.[26] The 2nd section was about concerns and it contained 18 items; the respondent had to indicate on a 10-point scale how much the particular issue concerned them during the COVID-19 pandemic – from 1 (not worried at all) to 10 (extremely worried). The 3rd section was related to the evaluation of stress and was based on the 15-item Impact of Event Scale (IES).[27,28] It measured the psychological impact of the COVID-19 pandemic with the 4-point Likert scale response alternatives: 0 – not at all; 1 – rarely; 3 – sometimes; and 5 – often. The sum of points for all the items depicted the stress level of each participant, later categorized as follows: 0–8 – subclinical stress; 9–25 – mild stress; 26–43 – moderate stress; and ≥44 – severe stress.[28] The 4th section was devoted to changes in behavior and it contained 5 statements the respondent had to refer to, indicating to what degree the particular change occurred in their life during the COVID-19 pandemic – from 1 (extremely low) to 10 (extremely high). The sum of scores for the 5 statements made up the total behavior change score, and the median (*Me*) of this score served as the cut-off between desirable and undesirable behavior changes.

Two English experts translated the questionnaire into Persian, and then back-translated it into English in order to make sure of an accurate translation. The face and content validity of the stress section had been ensured previously.[27] However, 5 dental academics who were not involved in the study rated the necessity, relevancy, clarity, and simplicity of items in sections 3 and 4, and recommended some improvements; as a result, the revised version of the questionnaire was developed. We also ran a pilot study on 10 dental academics who were excluded from the study; the questionnaire was administered twice at a 2-week interval to assess its face and content validity as well as reliability, and to make sure of an acceptable agreement. Cronbach's alpha for sections 2–4 after completing the main study was 0.893, 0.793 and 0.866 respectively, all values showing desirable internal consistency.

We uploaded the survey on Google Forms, which is a platform for creating and sharing online surveys. On the 1st page, we explained the study's objectives, and assured the respondents of the voluntary nature of the study participation and data confidentiality. The respondents provided their consent on the 1st page of the questionnaire. The participants could select only 1 option per item and answering all the questions was necessary for submission; therefore, there was no missing data.

Statistical analysis

The IBM SPSS Statistics Windows software, v. 21.0 (IBM Corp., Armonk, USA), was used for data analysis. Absolute and relative frequencies (*n* (%)), along with means and standard deviations (*M* ±*SD*) for normally distributed data, and medians and quartiles (*Me* (Q_1–Q_3)) as well as ranges for not normally distributed data served as descriptive statistics. The percentage of correct responses with regard to the overall 29 COVID-19-related knowledge statements was considered as the knowledge score for each respondent.

The principal component analysis (PCA) was conducted for the section regarding concerns after checking the prerequisites; the number of participants was more than 100,[29] the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.843 (above the desired value of 0.6) and Bartlett's test of sphericity was statistically significant ($p < 0.001$).[30] The number of extracted components was primarily based on eigenvalues >1, but then we also fixed the analysis with 1 factor more or less to find out whether a more reasonable division of items is attainable. We used the rotated component matrix, applying the varimax rotation method with Kaiser normalization to display the result of PCA.

The backward stepwise multilevel linear regression analysis was used to discover the association of background data, concern components and knowledge with the stress level. In addition, we used the backward stepwise multilevel logistic regression analysis to find the association of background data, concern components, knowledge, and the stress score with the behavior change level. The significance level was set at 5%.

Results

Background information, stress and behavior changes

The majority of the respondents were female (66.4%) and the mean age was 39.44 ±8.89 years. Besides, the mean COVID-19-related knowledge score was 74.30 ±9.63. The fully detailed background information about the participants is presented in Table 1.

Table 1 also demonstrates the mean COVID-19-related stress scores, the percentages of the stress level with regard to the IES categories and the percentages of the undesirable/desirable behavior change level in dental academics according to background variables. The percentage of participants with moderate to severe stress was 50.4%. Since the behavior change data was not normally distributed, the *Me*, interquartile range (*IQR*) and range values for this section are presented in Table 2. The least behavior change due to the COVID-19 pandemic was observed in 'changing life habits' (*Me* = 8; *IQR* = 3), which was the only item with *Me* < 10. The total behavior change *Me* was 46.5 (*IQR* = 8).

Table 1. Iranian dental academics' ($N = 274$) COVID-19-related stress and behavior change levels according to background variables

Variable		*n* (%)	Stress level† *M* ±*SD*	Stress level‡				Behavior change level	
				subclinical %	mild %	moderate %	severe %	undesirable %	desirable %
Gender	male	92 (33.6)	23.39 ±11.47	7.6	48.9	38.0	5.4	60.9	39.1
	female	182 (66.4)	27.10 ±12.38	5.5	40.7	44.0	9.9	44.5	55.5
Age [years]	25–35	107 (39.1)	25.60 ±10.12	0.9	46.7	49.5	2.8	47.7	52.3
	36–45	106 (38.7)	26.61 ±12.84	9.4	39.6	40.6	10.4	50.0	50.0
	≥46	61 (22.3)	24.98 ±14.29	9.8	44.3	31.1	14.8	54.1	45.9
Living status	parents	42 (15.3)	27.90 ±12.44	7.1	31.0	57.1	4.8	42.9	57.1
	partner/spouse	198 (72.3)	25.27 ±11.76	6.1	46.0	39.9	8.1	50.5	49.5
	other	34 (12.4)	26.74 ±14.21	5.9	44.1	35.3	14.7	55.9	44.1
Academic experience [years]	<5	113 (41.2)	25.18 ±10.49	2.7	45.1	49.6	2.7	46.9	53.1
	5–10	91 (33.2)	26.64 ±12.53	7.7	40.7	40.7	11.0	56.0	44.0
	11–20	41 (15.0)	26.00 ±14.32	9.8	48.8	26.8	14.6	48.8	51.2
	≥21	29 (10.6)	25.83 ±14.38	10.3	37.9	37.9	13.8	44.8	55.2
Number of courses coordinated per semester	0–1	22 (8.0)	26.41 ±11.79	4.5	36.4	54.5	4.5	50.0	50.0
	2	51 (18.6)	23.98 ±12.25	7.8	54.9	27.5	9.8	60.8	39.2
	3	55 (20.1)	24.76 ±11.94	9.1	40.0	41.8	9.1	54.5	45.5
	4	47 (17.2)	26.96 ±10.79	4.3	38.3	53.2	4.3	48.9	51.1
	≥5	99 (36.1)	26.78 ±13.05	5.1	43.4	41.4	10.1	42.4	57.6
Number of students dealt with per semester	0–49	57 (20.8)	26.81 ±12.32	1.8	49.1	35.1	14.0	54.4	45.6
	50–100	122 (44.5)	25.86 ±11.60	6.6	40.2	45.9	7.4	52.5	47.5
	101–200	59 (21.5)	24.86 ±13.16	10.2	47.5	35.6	6.8	44.1	55.9
	≥201	36 (13.1)	25.94 ±12.65	5.6	38.9	50.0	5.6	44.4	55.6
Number of daily patient visits	0	56 (20.4)	23.95 ±13.28	12.5	42.9	33.9	10.7	44.6	55.4
	1–10	142 (51.8)	26.50 ±12.40	4.9	42.3	45.1	7.7	59.9	40.1
	11–20	48 (17.5)	25.75 ±10.66	4.2	45.8	43.8	6.3	35.4	64.6
	≥21	28 (10.2)	26.57 ±11.47	3.6	46.4	39.3	10.7	35.7	64.3
Administrative role	yes	124 (45.3)	24.97 ±12.55	9.7	46.0	35.5	8.9	46.0	54.0
	no	150 (54.7)	26.59 ±11.87	3.3	41.3	47.3	8.0	53.3	46.7
Total		274 (100.0)	25.85 (12.19)	6.2	43.4	42.0	8.4	50.0	50.0

COVID-19 – coronavirus disease 2019; *M* – mean; *SD* – standard deviation; † based on the Impact of Event Scale (IES); ‡ based on the IES categories.

Table 2. Behavior changes in Iranian dental academics ($N = 274$) after the onset of the COVID-19 pandemic

Behavior change†	*Me* (Q_1–Q_3)	Range
Changing life habits	8.00 (7.00–10.00)	1.00–10.00
More frequent handwashing	10.00 (8.00–10.00)	1.00–10.00
Avoiding crowded places	10.00 (9.00–10.00)	1.00–10.00
Cancelling social events	10.00 (9.00–10.00)	1.00–10.00
Cancelling travel plans	10.00 (10.00–10.00)	1.00–10.00
Total behavior change‡	46.50 (42.00–50.00)	5.00–50.00

Me – median; Q_1 – 1st quartile; Q_3 – 3rd quartile; † out of 10 for each item; ‡ out of 50.

Dental academics' concerns regarding COVID-19

Table 3 presents COVID-19-related concern items and the rotated component matrix of PCA with loadings between 0.627 and 0.845 in 3 components. The greatest and the least 'fear of infection' scores for the participants were respectively 'loved ones getting infected with COVID-19 because of me' (8.96 ±1.87) and 'catching the COVID-19 infection from a student' (6.42 ±2.74), while the mean total score for this component was 53.51 ±11.89 out of 70. The greatest and the least 'concerns over professional responsibilities' scores for the participants were respectively 'supporting students psychologically in the difficult times of the COVID-19 outbreak' (6.62 ±2.45) and 'finishing open courses satisfactorily during the COVID-19 outbreak' (6.36 ±2.84), while the mean total score for this component was 32.70 ±10.78 out of 50. The greatest and the least 'concerns over restrictions' scores for the participants were respectively 'economic impact caused by the COVID-19-related lockdown' (7.99 ±2.27) and 'missing scientific events important to my career because of the COVID-19 outbreak' (5.31 ±2.91), while the mean total score for this component was 37.37 ±12.38 out of 60.

Table 3. Principal component analysis (PCA) for the COVID-19-related concerns of Iranian dental academics ($N = 274$)

Concerns	Score† *M* ±*SD*	Components		
		fear of infection	concerns over professional responsibilities	concerns over restrictions
Catching the COVID-19 infection from a colleague at work	6.56 ±2.60	0.730	–	–
Catching the COVID-19 infection from a patient during treatment	8.49 ±2.02	0.726	–	–
Catching the COVID-19 infection from a student	6.42 ±2.74	0.715	–	–
Catching the COVID-19 infection from a source not related to work	6.73 ±2.53	0.678	–	–
Loved ones getting infected with COVID-19 because of me	8.96 ±1.87	0.689	–	–
Loved ones getting infected with COVID-19 because of another source	8.44 ±1.95	0.678	–	–
Patients getting infected with COVID-19	7.92 ±2.32	0.682	–	–
Finishing open courses satisfactorily during the COVID-19 outbreak	6.36 ±2.84	–	0.820	–
Teaching students the required material during the COVID-19 outbreak	6.56 ±2.65	–	0.845	–
Supporting students psychologically in the difficult times of the COVID-19 outbreak	6.62 ±2.45	–	0.641	–
Managing the extra load of online lecturing during the COVID-19 outbreak	6.60 ±2.68	–	0.760	–
Finishing the required reports, assignments and duties before deadlines during the COVID-19 outbreak	6.56 ±2.59	–	0.800	–
Restricted mobility from one place to another in my country because of the COVID-19 outbreak	6.07 ±3.10	–	–	0.715
Restricted mobility from and to my country because of the COVID-19 outbreak	5.52 ±3.18	–	–	0.736
COVID-19-related restrictions affecting my sports and social activities	6.63 ±2.61	–	–	0.646
Missing scientific events important to my career because of the COVID-19 outbreak	5.31 ±2.91	–	–	0.699
Short supplies for personal and/or household use because of the COVID-19 outbreak	5.85 ±2.88	–	–	0.714
Economic impact caused by the COVID-19-related lockdown	7.99 ±2.27	–	–	0.627

Rotated component matrix with the use of the varimax rotation method with Kaiser normalization. † out of 10 for each item.

Factors associated with stress and behavior changes

Table 4 and Table 5 demonstrate the factors associated with the COVID-19-related stress and behavior change levels, respectively. As there were interactions between gender and other associated factors in both regression models, we considered gender as an effect modifier, and analyzed male and female dental academics separately after ensuring an adequate statistical power with the use of the Power Analysis and Sample Size (PASS) software, v. 15 (NCSS, Kaysville, USA). As for the gender itself, women demonstrated more stress (mean difference (*MD*): 3.708; 95% confidence interval (*CI*): 0.665–6.750; $p = 0.017$, according to the independent samples *t* test) and more desirable behavior (odds ratio (*OR*): 1.940; 95% *CI*: 1.164–3.232; $p = 0.011$, according to the χ^2 test).

Table 4. Factors associated with Iranian dental academics' COVID-19-related stress level (based on the Impact of Event Scale (IES)) according to gender

Variable#			Coefficient	95% *CI*	*p*-value
Men *n* = 92	living status	partner/spouse	ref.	–	–
		parents	12.215	4.125–20.306	0.004*
		other	2.858	–3.466–9.181	0.372
	fear of infection		0.193	0.006–0.381	0.044*
	concerns over restrictions		0.238	0.047–0.429	0.015*
Women *n* = 182	academic experience [years]	<5	ref.	–	–
		5–10	4.188	0.356–8.021	0.032*
		≥11	7.221	2.464–11.978	0.003*
	administrative role	yes	ref.	–	–
		no	4.573	1.083–8.063	0.011*
	fear of infection		0.252	0.084–0.420	0.004*
	concerns over restrictions		0.228	0.074–0.382	0.004*

Backward stepwise multilevel linear regression analysis. Power analysis: $\rho 0^2 = 0$; the saturated model's R^2 values of 0.323 (men) and 0.246 (women); a power of 99% (men) and 100% (women).
CI – confidence interval; ref. – reference category which other categories of a particular variable were compared with in the regression model; # only the significantly associated variables which remained in the final regression model for each gender are presented in the table; * statistically significant.

Table 5. Factors associated with Iranian dental academics' COVID-19-related behavior change level according to gender

Variable[#]			*OR*	95% *CI*	*p*-value
Men *n* = 92	administrative role	no	ref.	–	–
		yes	3.079	1.156–8.200	0.024*
	fear of infection		1.096	1.045–1.150	<0.001*
Women *n* = 182	number of daily patient visits	0	2.010	0.915–4.414	0.082
		1–10	ref.	–	–
		≥11	3.638	1.633–8.107	0.002*
	fear of infection		1.063	1.030–1.097	<0.001*
	knowledge		1.051	1.008–1.095	0.019*

Backward stepwise multilevel logistic regression analysis (category 0 – undesirable level of behavior change; category 1 – desirable level of behavior change). Power analysis: $\rho 0^2 = 0$; the saturated model's pseudo R^2 values of 0.323 (men) and 0.174 (women); a power of 99% (men) and 99% (women).
OR – odds ratio; ref. – reference category which other categories of a particular variable were compared with in the regression model; [#] only the significantly associated variables which remained in the final regression model for each gender are presented in the table; * statistically significant.

Greater fear of infection and concerns over restrictions were associated with more stress in both men ($p = 0.044$ and $p = 0.015$, respectively) and women ($p = 0.004$ and $p = 0.004$, respectively). Furthermore, men living with their parents demonstrated more stress due to the COVID-19 pandemic than those living with their partner/spouse ($p = 0.004$). Regarding women, those with less than 5 years of academic experience demonstrated less stress as compared to those with 5–10 years ($p = 0.032$) and 11 or more years ($p = 0.003$) of academic experience, much like administrators, who demonstrated less stress than those without any administrative role ($p = 0.011$) (Table 4).

In both men and women, a greater fear of infection was associated with desirable behavior changes due to the COVID-19 pandemic ($p < 0.001$ in both cases). In addition, desirable behavior changes were more evident in men with administrative roles ($p = 0.024$) and more knowledgeable women ($p = 0.019$), while undesirable behavior changes were more apparent in female dental academics visiting 1–10 patients daily as compared to those visiting 11 or more patients per day ($p = 0.002$) (Table 5).

Discussion

The repercussions of the rapid spread of COVID-19, ranging from isolation and quarantine to disease contraction and death, have resulted in undeniable psychological fear and stress. Healthcare workers, particularly dentists, who continuously treat patients, are at higher risk of contracting infectious diseases, which increases the possibility of distress even further.[5,15] Dental academics are additionally affected by the closure of dental schools.[16] The World Health Organization (WHO) has recommended lifestyle changes, such as crowd avoidance, more frequent handwashing, and the cancelation of travel plans and events to control the infection.[31] It is important that dental academics adhere to these recommendations, as they practice in a high-risk environment, and also serve as profession and community role models. However, psychological distress can cause irrational behavior, along with physical and mental health problems.[32] We aimed to provide insight into the early impact of the COVID-19 pandemic on dental academics' psychological state and behavior, and distributed an online questionnaire focusing on concerns, stress and behavior changes during the COVID-19 pandemic for this purpose.

We divided dental academics' COVID-19-related concerns into 3 different components with the use of PCA: the fear of infection; concerns over professional responsibilities; and concerns over restrictions. The greatest concern expressed by the participants referred to the fear of becoming infected by their patients and spreading the virus to their loved ones, which is in line with other studies.[24,33–35] Similar to our study, Shacham et al. reported that dentists were more concerned about themselves as compared to their patients regarding disease contraction.[24] Ahmed et al. suggested that meticulous adherence to the recommendations of regulatory authorities could reduce dentists' fear of infection.[33] The least concerns of our study participants were the ones about the restrictions regarding mobility and events; however, the respondents were concerned about the economic impact of the lockdown, much like Mishra et al.'s study participants.[35] Dentists have been one of the most economically affected categories of health professionals during the pandemic.[36] On the other hand, similar to our study, Martina et al. reported that concerns over the economic loss and quarantine were of less importance to dentists than the fear of infecting family members.[37]

In the regression models, we analyzed men and women separately, as gender interacted with some other important factors; however, we did not compare concern between genders. Interestingly, Gasparro et al. reported that higher levels of COVID-19-related fear and concern were evident in female dentists.[38]

More than 90% of our participants were experiencing psychological distress, similar to dentists in a study by Ranka and Ranka,[39] which highlights a vital need for

supportive efforts. Furthermore, 8.4% of our study respondents demonstrated severe stress. Similar studies reported the percentage of severe stress, anxiety or depression to be 9.9% among dental academics from 28 countries,[22] 8.7%, 6.4% and 5.4% in Italian dentists (3 studies),[34,37,40] 22% and 17.9% in Indian dentists (2 studies),[35,41] 5.2–8% in German dentists,[42] and 2% in Indian medicine, dentistry, nursing, and physical therapy academics.[43] Other studies also reported 11.5–25.7% of dental professionals experiencing elevated psychological impact.[24,44] Differences in percentages are probably due to different measurement scales and country conditions. Although these proportions are small, extensive psychological attention is of great importance to these groups. Interestingly, dentistry and physical therapy academics demonstrated higher levels of stress as compared to medicine and nursing academics.[43]

Women in the present study demonstrated a worse COVID-19-related psychological outcome, similar to other studies among dentists.[38,41,42] Previous studies claimed that women experienced higher levels of depression and anxiety as compared to men during the COVID-19 pandemic in the general population,[45] which may have originated from the overall gender differences already reported for anxiety and depressive symptoms.[46] However, some studies reported no difference between male and female academics[43] and dental professionals[24,47] regarding COVID-19-related distress, and attributed their results to the governmental support for women. Therefore, the need for additional support systems for female dentists is undeniable in Iran.

In the present study, stress among women was less evident in administrators, probably due to being more in charge, and also less experienced ones, possibly due to the lesser fear of death. The underlying medical conditions, which are more evident in older dentists, have also been associated with more distress during the COVID-19 pandemic.[24,42] In contrast, younger and less experienced academics and dental professionals from several other countries demonstrated higher levels of psychological impact[35,38,42–44] due to the added responsibility of balancing the family life and finances, less developed coping skills, and more mobility and time spent on social media.[48] Those studies mostly did not control for other factors, whereas we used a regression model to control for other variables. Greater subjective overload and financial concerns, which are more evident in younger dentists, have also been associated with a greater psychological impact.[24,41,42] Conversely, Shacham et al. reported that there were no association between age and COVID-19-related distress.[24] These contradictions probably originate from different scales for the psychological impact measurement and different conditions in different countries.

In the present study, men who lived with their parents were significantly more stressed as compared to those living with their partner/spouse. A possible solution is to leave parents and live on their own; still, a longitudinal study should back up this solution with evidence. Our result is in line with the findings of Shacham et al., who reported that dental professionals who were in a committed relationship demonstrated less distress.[24] This is probably due to a greater risk of COVID-19 in older parents, against the great emotional support of the partner and their buffering effect.[49] In contrast, no differences in terms of psychological outcomes existed between various marital statuses in Mekhemar et al.'s study.[42]

Concerns over infection and restrictions were positively associated with stress in the participants of the present study. Similarly, other studies introduced the fear of contracting and spreading COVID-19 to close persons[22,24,34,38,41] as well as restrictions during the pandemic[22] as stressors and depressors to dental professionals. Ammar et al. also highlighted the association of worries about the professional responsibilities related to teaching and research with stress during the COVID-19 pandemic,[22] as the lack of fulfillment at work can negatively affect mental health.[50] On the other hand, such associations did not exist in our study. Another interesting finding of the present study is that the association between the fear of infection and stress was much stronger in women than men.

Dental academics in the present study demonstrated overall acceptable behavior change due to the COVID-19 pandemic. The participants reported that they definitely washed their hands more frequently, avoided crowded places, and canceled social events and travel plans after the onset of the COVID-19 pandemic; however, they were fairly hesitant in changing their life habits. On the other hand, 12.8% of American dental hygienists attended large public events during the pandemic.[44] Professionals should not only avoid crowded places and social events themselves, but also encourage the public to do so.

The present study has 2 distinct features with regard to the behavior change section which distinguish it from similar studies. Firstly, it focuses on general protective behaviors, not the preventive measures used in dental practice. Secondly, it measures the amount of change in protective behaviors due to COVID-19 rather than the behaviors during the pandemic themselves, therefore omitting the effect of difference in individuals' protective behaviors before the pandemic.

The behavior change of male dental academics in our study was less desirable as compared to females; however, male administrators' behavior change was more desirable as compared to non-administrators. This may be due to their attitude as a role model for other academics. Furthermore, women visiting more patients daily had changed their behavior more desirably as compared to those whose offices were open, but who visited fewer patients. In addition, the fear of infection had a positive association with desirable behavior change in all responders, contrary to knowledge, which showed such a positive association only in women. This brings the idea

of increasing COVID-19-related knowledge to induce better behaviors; however, this hypothesis must be evaluated in a randomized study. Similarly, negative emotions, such as fear, worry and anxiety, and also higher fatality rates of the country have proved to be positively associated with the COVID-19-preventive behaviors of dentists, such as handwashing and social distancing.[22] The promotion of preventive behaviors could help those with undesirable behavior change.

One of the strengths of the present study is its psychometric quality, which shows high internal consistency of the questionnaire, reliable scales and high statistical power due to the large sample size from among Iranian dental academics. Another strength is the robust methodological approach of the study, which contained PCA and effect modification. The present study portrayed the psychological impact of the COVID-19 pandemic at its early stages; therefore, it can be useful in case of similar pandemics in the future. This study may also help policymakers to make better decisions and enhance the resiliency and preventive behaviors of dental academics during the COVID-19 pandemic.

Limitations

The present study also has some inevitable limitations, such as a fairly low response rate due to the online nature of the study. Furthermore, female and young dental academics made up the majority of our respondents, which may be due to more time spent online by them. Therefore, the possibility of self-selection bias exists; however, we used various routes and platforms for sending the invitation to diminish the errors of convenient sampling. Our study's fairly large sample could represent almost all Iranian dental academics. However, one should keep in mind that dental academics and specialists have proved to experience less stress during the pandemic than other dentists do.[35] Generalizing the results to all dental academics in the world is not possible, as the amount of fear and distress due to COVID-19 as well as the level of associations differ in each country.[47] In addition, the cross-sectional nature of the study resulted in overlooking changes in psychological impact through time and the elimination of the cause–effect relationship.

Conclusions

The present study demonstrated the great psychological impact of the COVID-19 pandemic on Iranian dental academics, with moderate to severe stress being apparent in about half of them. However, most of the participants had effectively changed their behavior during the pandemic. The fear of getting infected and spreading the virus to the loved ones was a major concern, which had a positive association with stress and behavior change. Concerns over mobility and other restrictions was less of an issue for the respondents; however, they were positively associated with stress. Female dental academics were more stressed, but presented more desirable behavior change. This study identified more vulnerable dental academics, who must be the target of psychological and behavioral, supportive and educational programs. We recommend conducting similar studies on dental students, as they are having a hard time studying and socializing. It is also reasonable to conduct prospective or randomized studies to investigate different methods of stress reduction and desirable behavior promotion among HCWs.

Ethics approval and consent to participate

The research was approved by the institutional ethics committee (approval ID: IR.TUMS.DENTISTRY.REC.1399.001) at Tehran University of Medical Sciences, Egypt. Informed written consent was obtained from the participants before filling in the questionnaire.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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