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COVID 19—Depression and Neurosurgeons

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■ **OBJECTIVE:** The goal of this survey was to determine factors associated with anxiety/depression among neurosurgeons during the coronavirus disease 2019 (COVID-19) pandemic.

■ **METHODS:** An online survey was performed of neurosurgeons worldwide, conducted over 3 weeks. Depression in neurosurgeons was assessed by Self-Reporting Questionnaire—20.

■ **RESULTS:** A total of 375 responses were received from 52 countries. Among all neurosurgeons, 34% felt tense, 32.5% were unhappy, 25% experienced insomnia, almost 20% had headaches, and 5% had suicidal ideation during the pandemic. Of participants, 14% had a score on Self-Reporting Questionnaire—20 consistent with depression. The likelihood of depression was significantly higher among those who did not receive guidance about self-protection from their institutions (odds ratio [OR], 2.47), those who did not feel safe with provided personal protective equipments (OR, 3.13), and those whose families considered their workplace unsafe (OR, 2.29). Depression was less likely in neurosurgeons who had minor concerns, compared with those with significant health concerns for their families (OR, 0.36). In multivariate analysis after controlling for effects of other covariates, odds of

depression were significantly higher among neurosurgeons who did not feel safe with the provided personal protective equipment (OR, 2.43) and who were exposed to a COVID-19—positive colleague (OR, 2.54). Participants who had moderate concerns for their families had lesser odds of anxiety/depression than did those with significant concerns (OR, 0.28).

■ **CONCLUSIONS:** Based on the modifiable risk factors of depression in this study, it is recommended that the safety of neurosurgeons be ensured by providing appropriate safety measures for them to regain their confidence and hence reduce the incidence of depression.

INTRODUCTION

The novel coronavirus initially originated in China and has rapidly spread globally. The increasing pandemic of severe acute respiratory syndrome coronavirus 2 diseases (coronavirus disease 2019 [COVID-19]) has become a significant public health liability worldwide. The COVID-19 pandemic has become one of the central health crises of a generation. It has affected people irrespective of nation, race, caste, and socioeconomic

Key words

- COVID-19
- Depression/anxiety
- Depression in neurosurgeons
- Depression in surgeons
- Depression scale
- Global neurosurgery
- Health care workers
- Pandemic
- PPE
- Safety
- Social media

Abbreviations and Acronyms

- CI:** Confidence interval
COVID-19: Coronavirus disease 2019
OR: Odds ratio
PPE: Personal protective equipment
SRQ-20: Self-Reporting Questionnaire—20

WHO: World Health Organization

WSCS: World Spinal Column Society

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groups. On January 30, 2020, the World Health Organization (WHO) announced the emergence of the novel coronavirus. It declared a PHEIC (Public Health Emergency of International Concern), which is the sixth PHEIC under the International Health Regulations. The rapid increase in cases and evolving guidelines regarding protection and prevention of the spread of pandemic, with no confirmed treatment or approved vaccine, have caused apprehension and anxiety among health care workers. Unpredictability in the biological behavior of the virus, erratic changing instructions from WHO, and variable guidelines regarding quarantine and management of the pandemic have increased the uncertainty.

As of the first week of May 2020, 2,227,191 COVID-positive patients with 258,356 confirmed deaths had been reported worldwide and 212 countries were affected by the pandemic.¹ More than 42,600 health care providers have been infected with COVID-19 in China, and more than 124 doctors have died in Italy.^{2,3} In the United States, approximately 9300 nurses, doctors, and other frontline health care workers have been infected by the disease, and dozens have died.⁴ Across Western Europe, nearly 14% of patients with confirmed coronavirus are medical professionals, which is the highest number of cases reported among doctors and nurses.⁵ Moreover according to the report on April 3, 2020, at least 35 doctors have died, and more than 4200 health workers have self-isolated in countries across the Asia and Pacific region, Therefore, concerns among health care professionals are well founded.⁶ The pandemic is serious and disruptive,⁷ yet, despite its widespread infectivity and higher mortality than the common influenza virus, little is known regarding management of critical cases, prevention, and optimal measures to reduce its spread. Scarce resources and an often inadequate availability of personal protective equipment (PPE) and lack of knowledge about their optimal use can further lead to apprehension, distress, panic, and anxiety in health care workers.⁸ The COVID-associated health crisis has disrupted working of all medical communities worldwide, including delivery of essential medical and neurosurgical services. The rapidly increasing number of COVID-positive patients not only presents a public health challenge but also has significant medical and ethical implications for the care of neurosurgical patients. There is a paucity of literature guiding neurosurgery practice. Neurosurgical societies have developed and reported guidelines to promote best practices for their patients. However, implementation of these guidelines is a challenge in many parts of the world where health care systems are not well established, but adjustments during an event such as the COVID-19 pandemic have been made. The crisis may provoke even more distress and depression within the neurosurgical fraternity.⁹

Objective

A survey was developed to assess the stressors affecting neurosurgeons as a result of the pandemic. The goal of this survey was to determine the prevalence and factors associated with anxiety and depression among neurosurgeons during the COVID-19 pandemic.

Although the full impact of the pandemic remains to be seen, this survey aimed to determine the frequency of depression among neurosurgeons during the pandemic and explore any modifiable factors that could be addressed to reduce the incidence of distress and mental illness among neurosurgeons.

METHODS

Study Design

This was a cross-sectional study design conducted through an anonymous online questionnaire with information only about the city and no contact information to address ethical implications of the survey. The study duration was 3 weeks (until the requisite sample size was achieved). The questionnaire was modified based on suggestions from World Spinal Column Society (WSCS) executive board members. Most members of the WSCS are neurosurgeons, who also perform spinal surgery. The survey was designed on Google Forms and sent to neurosurgeons who were members of scientific societies globally through the WSCS Executive Committee. The survey was circulated to members of WSCS on their social media, WhatsApp groups, and e-mails and through a snowballing technique locally and internationally. The neurosurgeons identified through these media were asked to forward the survey to other neurosurgeons in their professional circle and so on. Of 800 neurosurgeons who were approached, 375 responded. A recent Chinese study⁹ showed a 40.77% (201/493) prevalence of mild to moderate depression among physicians during the COVID pandemic.

Depression was assessed through a WHO validated questionnaire (Self-Reporting Questionnaire-20 [SRQ-20]).¹⁰ A cutoff score ≥ 8 was considered as positive for depression.

Study Variables

The dependent variable was depression graded on WHO SRQ -20 with a cutoff score ≥ 8 for a positive case of anxiety/depression.

Independent variables were age (years), country, continent, consultant/resident self-rating of COVID-19 knowledge, level of practice, experience, size of the department, number of consultants/staff, number of trainees, level of awareness regarding self-protection provided by current workplace, provision of adequate PPE at the workplace, training courses conducted for PPE use, safe practice with the provided PPE by institution, presence of COVID-positive colleagues, redeployment to COVID-affected area, perception about redeployment, concerns regarding the health of the family, and perception of the family regarding work place safety.

Data Analysis

All study variables were categorical including age, designation, departmental size, number of trainees, self-rating of knowledge, feeling safe with provided PPE, family concerns, deployment in different areas, perception of family about workplace safety, enough knowledge to deal if deployed, presence of COVID-positive colleagues, and SRQ-20 questions expressed as frequencies and percentages. A χ^2 test was applied to compare study variables among depressed and nondepressed individuals. A McNemar test was applied to see the difference in proportions of neurosurgeons performing elective surgeries before and after the COVID-19 pandemic.

Univariate binary logistic regression was applied to determine association of each independent variable with the outcome (anxiety/depression). Multivariate logistic regression was used to measure the association of multiple independent variables with the outcome (anxiety/depression) by computing adjusted odds

ratios (ORs) and their 95% confidence intervals (CIs). Variables with a P value <0.25 in univariate analysis were subsequently included in the multivariate logistic regression model. Statistical significance was assumed for $P < 0.05$ in the multivariate model.

Ethical Consideration

Consent was obtained from all those who filled the online questionnaire. The participant's identity and name of the institution were not disclosed. All data were kept confidential in a password-protected computer. There was no financial compensation for participation or any penalty for not participating.

RESULTS

Sociodemographic Distribution of Participants

A total of 375 neurosurgery trainees and consultants from 52 countries and 5 continents participated in the survey (Figure 1). Most respondents were from Asia ($n = 181$, 48.5%) (Figure 1). Table 1 shows the distribution of sociodemographic factors among participants. Most participants were consultants (79%) from low to middle-income countries (66%). More than half were younger than 40 years. Among all participants, 84% worked in departments with ≥ 4 staff (83%), and more than half of the respondents reported having <10 trainees in their departments (53.3%).

Responses Regarding COVID-19 Pandemic

Table 2 shows the distribution of responses regarding the COVID-19 pandemic. Almost 69% reported basic to moderate knowledge about the pandemic. Sources of information are shown in Figure 2. The most common source of information was scientific publications, and almost half also used social media as a source for information. Most of the participants (74%) believed that it would take more than 2 months for the pandemic to end (Figure 3).

Most participants (68%) said that enough information had been provided by their institutions regarding the COVID pandemic. Of respondents, 31% reported that they had not been provided with PPE by their hospital, although more than half had attended training courses arranged by their institutions. Among consultants and trainees, 45.6% reported that they did not feel safe during the pandemic. Most (72%) had severe concerns regarding the safety of their families at home. Of respondents, 21% reported that they had been exposed to a COVID-positive colleague. Of these respondents, 85% had been quarantined or self-isolated themselves and 8.8% were admitted for quarantine. Surprisingly, 5% continued work, whereas 1.3% took no action at all on being exposed. Of the respondents, 41.6% reported that their primary concern during this pandemic was the inadequate provision of PPE.

Most ($n = 328$; 87.5%) of the neurosurgeons said that as a routine, their weekly surgery volumes were >10 cases. In comparison, during the pandemic, 270 (72%) said that they were performing <10 surgeries/week ($P < 0.001$). Similarly, most ($n = 336$, 89.6%) reported performing $>75\%$ elective surgeries before the pandemic, whereas 272 (72.5%) said that the number of elective surgeries during the COVID-19 pandemic had reduced to 25% or less ($P < 0.001$).

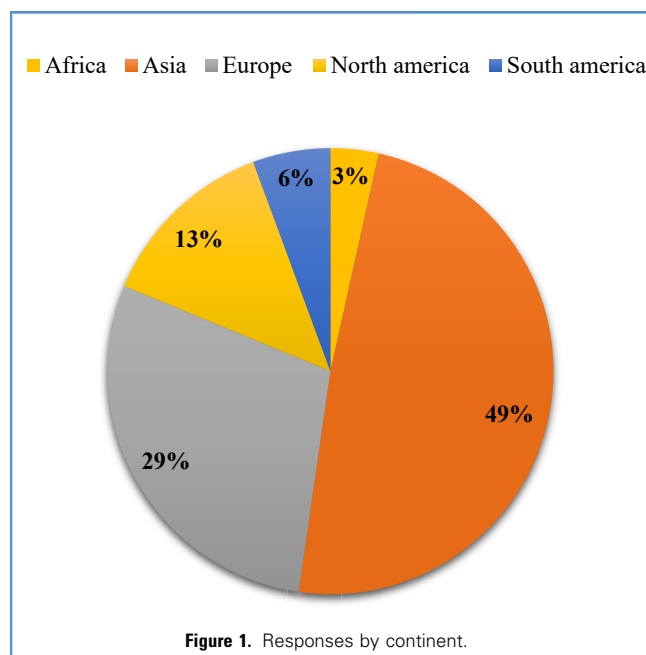


Figure 1. Responses by continent.

Families of 67% of neurosurgeons did not feel it was safe for them to go to work. About a quarter (28%) of the participants were redeployed to a COVID-affected area for work during the pandemic, and most (60%) believed that redeployment would not be useful considering their knowledge and expertise.

Depression and Anxiety Among Participants and the Distribution of Factors

A 13.9% prevalence of anxiety/depression was found among neurosurgery trainees and consultants in this study. Among all participants, 34% felt tense; 32.5% were unhappy; 25% experienced insomnia; almost 20% had headaches, were easily fatigued or tired, and believed that they were unable to play a useful part in their life; 10% had difficulty in decision making, 5% cried more than usual; and 5% had suicidal ideation during the pandemic (Table 3).

Table 4 shows the univariate and multivariate analysis for the association of different factors with anxiety and depression among neurosurgical trainees and consultants. The likelihood of depression was higher among those who did not receive information or self-protection from their institutions to combat the situation than in those who received it (OR, 2.47; 95% CI, 1.37–4.48). Those who reported that they did not feel safe with provided PPE were also at a higher risk of depression (OR, 3.13; 95% CI, 1.67–5.88). Anxiety and depression were less likely among those who had minor ($n = 4$; 10%) and moderate concerns ($n = 3$; 4.7%) for the health of their families compared with participants who were more concerned for their families during the current pandemic situation ($n = 45$; 16.6%). Univariate ORs showed that the likelihood of depression was significantly lower in neurosurgeons who had minor concerns compared with those with significant health concerns for their families (OR, 0.36; 95% CI, 0.16–0.83). The prevalence of depression was also significantly

Table 1. Responses Distribution and Participants Characteristics

Variables	Groups	Frequency	%
Age	<40 years	202	55.0
	≥40 years	165	45.0
	Missing	8	2.1
Designation	Resident	77	20.7
	Consultant	295	79.3
Number of staff/consultants in department	<4	58	15.5
	≥4	314	83.7
	Missing	3	0.8
Number of trainees	<10	200	53.3
	≥10	172	45.9
	Missing	3	0.8
Practice area	Both private and government	87	24.3
	Private setup	60	16.8
	University hospital	143	39.9
	Government	68	19.0
	Missing	17	4.5
Self-rating of knowledge about COVID-19	Basic	116	30.9
	Moderate	209	55.7
	Extensive	50	13.3
Is your hospital providing enough information and guidance for your protection?	No	119	31.7
	Yes	256	68.3
Provision of PPE by hospital	No	117	31.2
	Yes	258	68.8
Did you get training (courses)?	No	171	45.6
	Yes	204	54.4
Do you feel safe to practice with the provided PPE by your hospital?	No	171	45.6
	Yes	204	54.4
Do you have concerns regarding the health of your family?	Minor	40	10.7
	Moderate	64	17.1
	Major	271	72.3
Do you have colleagues in your department that are COVID-19 positive?	No	295	78.7
	Yes	80	21.3
When exposed, what was the action taken?	Self-isolation	46	57.5
	Quarantine	22	27.5
	Admitted	7	8.8
	Continue work	4	5.0
	No action	1	1.3

Continues

Table 1. Continued

Variables	Groups	Frequency	%
What is your biggest concern(s) regarding the COVID-19 and your safe practice?	Lack of enough information	48	12.8
	Lack of adequate organization at your workplace	79	21.1
	Lack of adequate PPE	156	41.6
	Lack of adequate training for PPE usage	56	14.9
	Other	36	9.6
Average no. of surgeries/week in your department before COVID-19	≤10	47	12.5
	>10	328	87.5
Average no. of surgeries/week in your department after COVID-19	≤10	317	84.5
	>10	58	15.5
Elective surgeries before COVID-19	<75% elective surgeries (NO)	39	10.4
	≥75% elective surgeries (YES)	336	89.6
Elective surgeries after COVID-19	<25% elective surgeries (YES)	303	80.8
	≥25% elective surgeries (NO)	72	19.2
Does your family feel safe for you to go to work?	No	251	66.9
	Yes	124	33.1
Have you been asked a redeployment to COVID-19 affected area?	No	270	72.0
	Yes	105	28.0
Do you think your knowledge and expertise would be useful and your work meaningful if you are redeployed out of your specialty?	No	223	59.5
	Yes	152	40.5
In your opinion, when will this pandemic end?	Within 2 months	64	17.1
	>2 months or not sure	311	82.9
Depression score in categories	<8	323	86.1
	≥8	52	13.9

PPE, personal protective equipment.

higher in participants whose families considered their workplace unsafe (OR, 2.29; 95% CI, 1.11–4.73).

In multivariate analysis (Table 4), effects of the following variables were controlled; age, self-rating of COVID-19 knowledge, information regarding protection provided by hospital, feeling safe with provided protective equipment, degree of concern for family health, presence of COVID-19–positive colleagues, and families considering the workplace safe. After controlling for the effects of other covariates, the odds of depression were significantly higher in individuals who did not

Table 2. Comparison of Participants' Characteristics and Perception Among Depression Groups

	Depressed Frequency (%)	Nondepressed Frequency (%)	Total Frequency (%)	P Value
Age				
<40 years	33 (16.3)	169 (83.7)	202 (100)	0.188
≥40 years	19 (11.5)	146 (88.5)	165 (100)	
Socioeconomic status of countries				
Middle/low	35 (14.2)	211 (85.8)	246 (100)	0.664
High income	16 (12.6)	111 (87.4)	127 (100)	
Continents				
Africa	2 (15.4)	11 (84.6)	13 (100)	0.679
Asia	27 (14.8)	155 (85.2)	182 (100)	
Europe	11 (10.2)	97 (89.8)	108 (100)	
North America	7 (14.3)	42 (85.7)	49 (100)	
South America	4 (19)	17 (81)	21 (100)	
Designation				
Trainee	10 (13)	67 (87)	77 (100)	0.778
Consultant	42 (14.2)	253 (85.8)	295 (100)	
Department size				
<40 beds	16 (12)	117 (88)	133 (100)	0.446
>40 beds	36 (14.9)	206 (85.1)	242 (100)	
Number of staff/consultants in the department				
<4	8 (13.8)	50 (86.2)	58 (100)	0.965
≥4	44 (14)	270 (86)	314 (100)	
Number of trainees				
<10	30 (15)	170 (85)	200 (100)	0.540
≥10	22 (12.8)	150 (87.2)	172 (100)	
Area of practice				
Combined	15 (17.2)	72 (82.8)	87 (100)	0.594
Private	6 (10)	54 (90)	60 (100)	
University hospital	21 (14.7)	122 (85.3)	143 (100)	
Government	8 (11.8)	60 (88.2)	68 (100)	
Rating of self-knowledge				
Basic	20 (17.2)	96 (82.8)	116 (100)	0.206
Moderate/extensive	32 (12.4)	227 (87.6)	259 (100)	
Is your hospital providing enough information and guidance for your protection?				
No	26 (21.8)	93 (78.2)	119 (100)	*0.002
Yes	26 (10.2)	230 (89.8)	256 (100)	
Are you provided with PPE by your hospital?				
No	19 (16.2)	98 (83.8)	117 (100)	0.371
Yes	33 (12.8)	225 (87.2)	258 (100)	
Did you get training (courses)?				
PPE, personal protective equipment. *Significant at $P < 0.05$.				Continues

Table 2. Continued

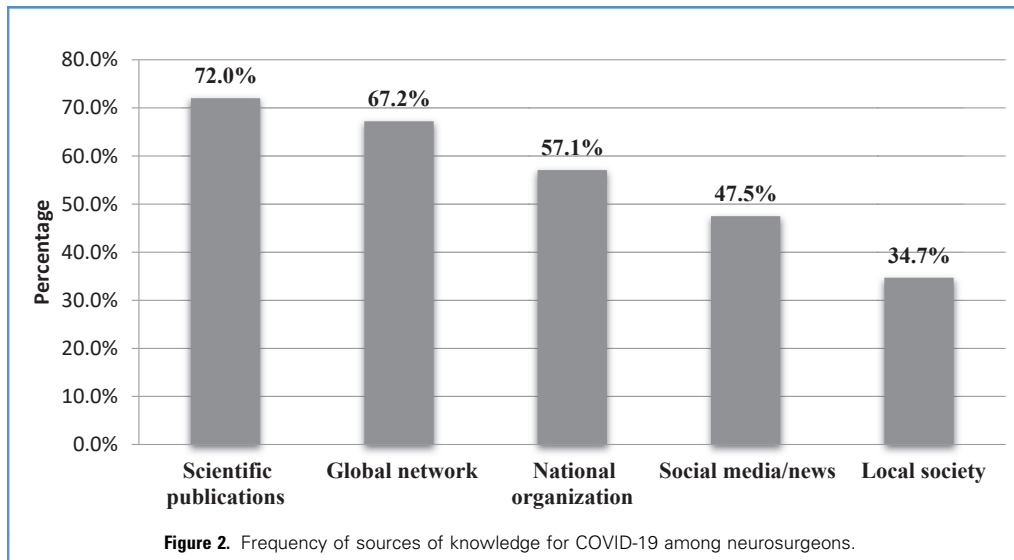
	Depressed Frequency (%)	Nondepressed Frequency (%)	Total Frequency (%)	P Value
No	25 (14.6)	146 (85.4)	171 (100)	0.699
Yes	27 (13.2)	177 (86.8)	204 (100)	
Do you feel safe to practice with the provided PPE by your hospital?				
No	36 (21.1)	135 (78.9)	171 (100)	* <0.001
Yes	16 (7.8)	188 (92.2)	204 (100)	
Concerns regarding the health of your family				
Minor	4 (10.0)	36 (90.0)	40 (100)	* 0.035
Moderate	3 (4.7)	61 (95.3)	64 (100)	
Major	45 (16.6)	226 (83.4)	271 (100)	
Do you have colleagues in your department that are COVID-19 positive?				
No	36 (12.2)	259 (87.8)	295 (100)	0.074
Yes	16 (20)	64 (80)	80 (100)	
Average no. of surgeries/week in your department before COVID-19				
≤10	6 (12.8)	41 (87.2)	47 (100)	0.815
>10	46 (14.0)	282 (86.0)	328 (100)	
Average no. of surgeries/week in your department after COVID-19				
≤10	41 (12.9)	276 (87.1)	317 (100)	0.222
>10	11 (19.0)	47 (81.0)	58 (100)	
Elective surgeries before COVID-19				
<75% elective surgeries	5 (12.8)	34 (87.2)	39 (100)	0.842
>75% elective surgeries	47 (14)	289 (86)	336 (100)	
Elective surgeries after COVID-19				
<25% elective surgeries	39 (12.9)	264 (87.1)	303 (100)	0.253
>25% elective surgeries	13 (18.1)	59 (81.9)	72 (100)	
Does your family feel safe for you to go to work?				
No	42 (16.7)	209 (83.3)	251 (100)	* 0.022
Yes	10 (8.1)	114 (91.9)	124 (100)	
Have you been asked redeployment to COVID-19 affected area?				
No	37 (13.7)	233 (86.3)	270 (100)	0.884
Yes	15 (14.3)	90 (85.7)	105 (100)	
Do you think your knowledge and expertise would be useful and your work meaningful if you are redeployed out of your specialty?				
No	32 (14.3)	191 (85.7)	223 (100)	0.743
Yes	20 (13.2)	132 (86.8)	152 (100)	
Opinion regarding the end of the pandemic				
<2 months	5 (7.8)	59 (92.2)	64 (100)	0.124
>2 months or not sure	47 (15.1)	264 (84.9)	311 (100)	

PPE, personal protective equipment.

*Significant at $P < 0.05$.

feel safe with the PPE provided to them than in those who were satisfied with provided PPE (OR, 2.43; 95% CI, 1.13–5.22). Participants who had moderate concerns for their families had lesser

odds of anxiety and depression than did those with significant concerns (OR, 0.28; 95% CI, 0.08–0.99). Being exposed to a COVID-19–positive colleague significantly increased the



likelihood of anxiety/depression, even after adjusting for other covariates (OR, 2.54; 95% CI, 1.24–5.19).

DISCUSSION

The COVID-19 pandemic is spreading across the globe at an exponential rate, creating apprehension and distress among all health care professionals.⁸ Neurosurgeons, who are an essential part of the health care community, are also affected in a major way. Belonging to a fundamental surgical specialty, tackling emergencies and performing complex operations requiring significant dexterity, hypothetically enables them to deal with stressful situations, making them less prone to develop anxiety and depression.¹¹ This may only be an assumption because we did not find any study to determine the frequency of anxiety/depression among this specialty before the pandemic. This is the first time that depression has been found among 14% of

neurosurgeons. It cannot be said with conviction if this frequency is higher than that before the pandemic but a study performed in 2003 among surgeons¹² showed an increase in prevalence of depression after the severe acute respiratory syndrome outbreak, with a 30% increase in suicide. Poor mental health is a social stigma¹³; moreover, a fear of being judged may explain why neurosurgeons have a lower depression score, as found in another study assessing level of stress among surgeons.¹¹ This may be one of the reasons that despite mental health problems and psychosocial issues among health care workers, most do not often seek mental health care.¹⁴

Most participants were consultants (79%), and almost half were 40 years old and older. The senior neurosurgeons were less likely to be anxious and depressed, although the results were not statistically significant. In relation to this finding, a recent United Kingdom National Health Service survey also indicated that 70% of young physicians had mental health issues, whereas retired physicians and surgeons were more enthusiastic to volunteer for COVID duties.^{15,16}

There was no difference in the frequency of depression among neurosurgeons working in private or government/university hospitals. Although a significant decrease in workload may be a potential risk factor leading to psychological distress, a non-differential change between workload of private and public sector explains our finding, as confirmed by a recent survey by Jean.¹⁷

The COVID-19 pandemic has a global impact, irrespective of race, caste, color, or creed, with widespread xenophobia especially among the medical fraternity regarding their families' and their own health (unpublished data). Despite trying times, this survey showed no difference in depression among the neurosurgeons, whether they belonged to high-income (12.6%) or middle-/lower-income countries (14.2%) or European (10.4%) or non-European (15%) countries. However, a recent Chinese study¹⁶ reported a higher prevalence of depression (50.4%), anxiety (44.6%), and insomnia (34%) among frontline health care workers. This finding shows that more than the income, specialty, or region,

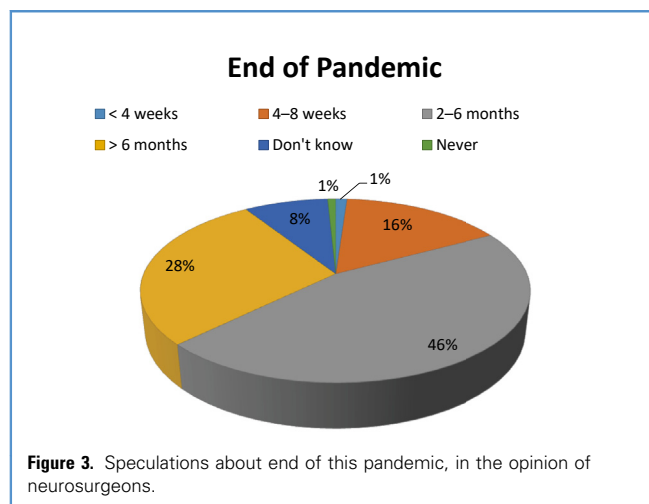


Table 3. Distribution of Different Symptoms Among Participants During the COVID Pandemic

Self-Reporting Questionnaire-20 Items	Responses	Frequency	%
Often have headaches?	No	300	80.0
	Yes	75	20.0
Is your appetite poor?	No	349	93.1
	Yes	26	6.9
Do you sleep badly?	No	282	75.2
	Yes	93	24.8
Do your hands shake?	No	352	93.9
	Yes	23	6.1
Are you easily fatigued?	No	303	80.8
	Yes	72	19.2
Do you feel nervous, tense, or worried?	No	248	66.1
	Yes	127	33.9
Is your digestion poor?	No	340	90.7
	Yes	35	9.3
Do you have trouble thinking clearly?	No	335	89.3
	Yes	40	10.7
Do you feel unhappy?	No	253	67.5
	Yes	122	32.5
Do you cry more than usual?	No	356	94.9
	Yes	19	5.1
Difficult to enjoy daily activities?	No	258	68.8
	Yes	117	31.2
Difficulty in decision making?	No	341	90.9
	Yes	34	9.1
Is your daily work suffering?	No	254	67.7
	Yes	121	32.3
Are you unable to play a useful part in life?	No	296	78.9
	Yes	79	21.1
Have you lost interest in things?	No	316	84.3
	Yes	59	15.7
Do you feel you are a worthless person?	No	353	94.1
	Yes	22	5.9
Has the thought of ending your life been on your mind?	No	356	94.9
	Yes	19	5.1
Do you have uncomfortable feeling in the stomach?	No	323	86.1
	Yes	52	13.9

Continues

Table 3. Continued

Self-Reporting Questionnaire-20 Items	Responses	Frequency	%
Do you feel tired all the time?	No	322	85.9
	Yes	53	14.1
Are you easily tired?	No	298	79.5
	Yes	77	20.5

the area of practice influences mental health, predisposing to an increased sense of insecurity and hence psychological distress.

The requirement for quarantine, social distancing, and shelter-in-place orders has led to an abrupt change in lifestyles and may be causing increased apprehension among families, especially of health care workers. Not only families of neurosurgeons believed that it was unsafe for them to go to work, but the surgeons themselves reported concerns for the safety of their families at home. Therefore, a feeling of self-protection with provided PPE had a significant negative association with anxiety/depression whereas a COVID-positive colleague increased the likelihood of depression among neurosurgeons. A recent survey in United Kingdom reported that half of health workers had stress because of inadequate availability of PPE.¹⁵

This pandemic has disturbed functioning of all medical and surgical specialties. Selected emergency neurosurgery cases are being performed in special circumstances only such as trauma, severe acute functional impairment, and tumors causing impending disability. Neurosurgical approaches through the nose and sinuses are being postponed because of the high risk of viral transmission and updated neurosurgical guidelines for the treatment of COVID-positive patients or patients with suspected COVID have been circulated.⁸ The COVID crisis has hence led to a considerable decrease in elective cases ($P < 0.001$). Jean also reported a decrease of >50% operative volume during the present pandemic.¹⁷ Although our study did not find a significant association between this decrease in elective cases and anxiety/depression among neurosurgeons, if this status quo is further extended, it may lead to depression, because one third of our participants were unhappy, felt tensed, experienced insomnia and headaches, or and felt fatigued and tired. Moreover, 1 in 20 respondents cried more than usual and had suicidal ideation. This hypothesis is confirmed by another study conducted at Liaquat National Hospital on frontline physicians (unpublished data), which found that there was more depression in physicians who were working <20 hours a week compared with those who were working >20 hours during the pandemic.

Although the potential shortage of ventilators and intensive care unit beds necessary to care for the surge of critically ill patients has been well described, additional supplies and beds will not be helpful unless there is an adequate workforce. According to our data, about 28% of the participants were redeployed to a COVID-affected area during the pandemic. Nevertheless, 60% of

Table 4. Univariate and Multivariate Analysis for Crude and Adjusted Odds Ratios for Depression

	Univariate		Multivariate	
	OR (95% CI)	P Value	Adjusted OR (95% CI)	P Value
Age				
<40 years	1.50 (0.82–2.75)	0.190	1.23 (0.63–2.41)	0.543
≥40 years	Reference		Reference	
Rating of self-knowledge				
Basic	1.48 (0.81–2.71)	0.208	1.48 (0.78–2.84)	0.232
Moderate/extensive	Reference		Reference	
Is your hospital providing enough information and guidance for your protection?				
No	2.47 (1.37–4.48)	*0.003	1.44 (0.71–2.92)	0.314
Yes	Reference		Reference	
Do you feel safe to practice with the provided PPE by your hospital?				
No	3.13 (1.67–5.88)	*<0.001	2.43 (1.13–5.22)	*0.023
Yes	Reference		Reference	
Concerns regarding the health of family				
Minor	0.56 (0.19–1.65)	0.290	0.83 (0.25–2.76)	0.764
Moderate	0.25 (0.07–0.82)	*0.023	0.28 (0.08–0.99)	*0.048
Major	Reference		Reference	
Do you have colleagues in your department that are COVID positive?				
No	Reference		Reference	
Yes	1.80 (0.94–3.44)	0.076	2.54 (1.24–5.19)	*0.011
Does your family feel safe for you to go to work?				
No	2.29 (1.11–4.73)	*0.025	1.27 (0.54–2.98)	0.588
Yes	Reference		—	

OR, odds ratio; CI, confidence interval; PPE, personal protective equipment.
*Significant at $P < 0.05$.

neurosurgeons believed that their knowledge and expertise in an unknown environment would not be useful, and their work will not be meaningful if redeployed out of their specialty.

Limitations of the Study

To our knowledge, this is the first study to determine the frequency and factors associated with anxiety and depression among 375 neurosurgeons from 52 countries. The prevalence of depression and anxiety among neurosurgeons was found to be lower than the frequency reported among other frontline workers during the COVID pandemic. Yet, it is difficult to conclude the magnitude of the problem attributable to the pandemic, because there is a paucity of data regarding mental illness among neurosurgeons before the catastrophe. In a recent survey among neurosurgery residents, the risk of burnout was found to be 20.7% and higher working hours was one of the drivers for burnout, whereas another survey found a 56.7% burnout among neurosurgeons. Because both these surveys did not explore depression or anxiety, results of

our study are not comparable, yet, because working hours during the pandemic have considerably reduced, it can be extrapolated that the frequency of burnout would be consequentially less.^{17,18}

Mental illness is a social stigma worldwide, which may be more of an issue among fraternities who are considered resilient such as the neurosurgical specialty, hence leading to an underreporting of symptoms. Only 1 scale (SRQ-20) was used to screen for anxiety/depression, because asking too many questions on an online survey was inconvenient and would have led to missing data. Moreover, in online surveys, there is always a high probability of participation bias because the participants, based on their state of mind at the time of the study, may or may not choose to participate in the study. However, this situation may lead to non-differential participation bias. With the evolving pandemic, the situation is still dynamic in various countries worldwide. Circumstances have varied from day to day, and hence, the response of participants may be different according to their changing situation. Therefore, the survey being completed readily by

participants having more concerns regarding the ongoing pandemic may have introduced a bias. Although we tried to control for confounders during recruitment as well as during analysis through multivariate analysis, there is a possibility that we may have missed potential confounders, which may have exaggerated or masked the associations. Yet, the factors associated with anxiety/depression among neurosurgeons in the multivariate analysis are all biologically plausible.

CONCLUSIONS

The world is going through an unprecedented crisis, which has caused turmoil in all the countries worldwide. The health system has not dealt with such a disaster in decades. Neurosurgeons, like all other specialties, are affected and experiencing challenges in their work and daily living. Colleagues becoming infected, feelings of being unprotected, and concerns for the health of their families were factors found to be associated with anxiety/depression. We therefore recommend that the safety of health care workers is ensured by providing standard PPE and having optimum safety

measures for them to regain confidence and hence reduce the incidence of mental ailments.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Salman Sharif: Writing - original draft, Writing - review & editing. **Faridah Amin:** Writing - original draft, Writing - review & editing. **Mehak Hafiz:** Writing - original draft, Writing - review & editing. **Edward Benzel:** Conceptualization, Data curation, Writing - review & editing. **Nikolay Peev:** Conceptualization, Data curation, Writing - review & editing. **Rully Hanafi Dahlan:** Conceptualization, Data curation, Writing - review & editing. **Yavor Enchev:** Conceptualization, Data curation, Writing - review & editing. **Paulo Pereira:** Conceptualization, Data curation, Writing - review & editing. **Sandeep Vaishya:** Conceptualization, Data curation, Writing - review & editing.

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