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Burnout, Discrimination, Abuse, and Mistreatment in Latin America Neurosurgical Training During the Coronavirus Disease 2019 Pandemic

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■ **BACKGROUND:** Discrimination, abuse, and mistreatment are prevailing problems reported in neurosurgical training programs globally. Moreover, the current coronavirus disease 2019 (COVID-19) pandemic may also show a negative impact on burnout levels in neurosurgery residents. This study aims to evaluate burnout, discrimination, and mistreatment in neurosurgical residents training in Latin America during the severe acute respiratory syndrome coronavirus 2 era.

■ **METHODS:** A 33-item electronic survey was sent to neurosurgery residents from Latin America from May 10 to 25, 2021. Statistical analysis was performed using SPSS version 25.

■ **RESULTS:** A total of 111 neurosurgery residents responded to the survey. Mean age was 29.39 ± 2.37 years; 22.5% were female and 36% were training in Mexico. Residents who reported experiencing discrimination for testing positive to COVID-19 had the highest levels of depersonalization (66.7%; $P = 0.043$) and emotional exhaustion (75%; $P = 0.023$). Female respondents reported higher rates of gender discrimination (80% vs. 1.2%; $P = 0.001$), abuse (84% vs. 58.1%; $P < 0.005$), and sexual harassment (24% vs. 0%; $P < 0.001$) than did male respondents. Residents training in Mexico reported lower rates

of emotional or verbal abuse (59.2% vs. 32.5%; $P = 0.007$) and bullying ($P < 0.005$) than did those in other countries in Latin America. Older age was a protective factor for high depersonalization scores (odds ratio [OR], 0.133; 95% confidence interval [CI], 0.035–0.500). Experiencing discrimination represented a risk factor for presenting high emotional exhaustion scores (OR, 3.019; 95% CI, 1.057–8.629). High levels of depersonalization were associated with a 7-fold increased risk of suicidal ideation (OR, 7.869; 95% CI, 1.266–48.88).

■ **CONCLUSIONS:** The COVID-19 pandemic has been a significant burden on several aspects of health care workers' lives. Our results provide a broad overview of its impact on burnout, discrimination, and mistreatment as experienced by neurosurgery residents training in Latin America, laying the groundwork for future studies and potential interventions.

INTRODUCTION

The negative impact of the current coronavirus disease 2019 (COVID-19) pandemic on the training of neurosurgery residents in Latin America has been previously reported,

Key words

- Burnout
- Coronavirus
- Latin America
- Mistreatment
- Neurosurgery

Abbreviations and Acronyms

CI: Confidence interval

COVID-19: Coronavirus disease 2019

FLANC: Federación Latinoamericana de Neurocirugía [Latin American Federation of Neurosurgical Societies]

OR: Odds ratio

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including its effects on physical and emotional health, increased workload, and the need for developing different academic strategies to make up for less on-site experience.¹ A high demand for health care providers in COVID-19 designated areas, decreased time in the operating room, and fewer surgical procedures, along with the loss of close colleagues and family members, have discouraged most health care workers and created uncertainty, especially in neurosurgery.^{1,2}

Residents are constantly faced with mistreatment, abuse, and discrimination during their training. Neurosurgery residents are not the exception, with 10%–50% of them reporting bullying or abuse.^{3,4} Sexual harassment,^{5,6} gender discrimination, race discrimination,^{7–11} disadvantages experienced by foreign residents,^{12,13} and other types of harassment inflicted by fellow residents or professors¹⁴ are other factors that have been studied globally and that have contributed to an increase in burnout and suicidal ideation in neurosurgery residents.^{3,4}

Burnout is defined as a state of emotional, physical, and mental exhaustion caused by excessive and prolonged stress. Risk factors include long working hours, high levels of stress, and lack of sleep.¹⁵ Burnout is associated with a higher rate of substance abuse, poor interpersonal relations and occupational performance, and a lower perceived job satisfaction.¹⁶ Burnout is highly prevalent among surgery residents, with rates of up to 76% being reported in some studies.^{17,18} Moreover, burnout has recently become a public health problem, because it seems to increase the risk of depression,^{19,20} anxiety,²⁰ and suicidal behavior.^{19,20}

Burnout represents a global health problem and has been specifically evaluated in neurosurgery residents.²¹ However, even although the negative impact of COVID-19 on the training of neurosurgery residents in Latin America has been studied,¹ we do not know to what extent it may contribute to the development of burnout. The present study aims at evaluating burnout, abuse, and mistreatment in neurosurgery residents training in Latin America going through the COVID-19 pandemic. A better understanding of the status of these issues may lay the groundwork for potential alternatives to treat or prevent this health problem constantly faced by residents.

METHODS

A 33-question survey was developed based on previous surveys in available literature focused on mistreatment, discrimination, and burnout in residents with surgical training^{1–6} (see [Appendix 1](#)). It was created and distributed using Google Forms Survey (Google LLC, Mountain View, California, USA). Questions were divided into 4 main sections:

- 1) Demographics: this section consisted of 12 questions, describing the characteristics of the respondent residents (age, sex, year of neurosurgical training, country of origin, and country of training) and their training centers.
- 2) Technological and academic resources of the neurosurgical center: this section consisted of 6 questions: number of major surgeries performed, number of monthly admissions, number of exclusive operating rooms, work hours per week, and subspecialty and intraoperative adjuncts availability.
- 3) Discrimination, abuse and mistreatment: section of 5 questions regarding discrimination on different grounds (e.g., gender, place of origin, and testing positive for COVID-19), different types of abuse (e.g., verbal, emotional, and physical); and the position of the offenders (e.g., bosses, managers, and fellow residents). The residents' main concerns and uncertainties, as well as the aspects of their training most affected by the COVID-19 pandemic, were also queried in this section.
- 4) Burnout: in this section, the level of burnout was evaluated applying the Maslach Burnout Inventory (Abbreviated), in which 3 main dimensions were evaluated: emotional exhaustion, depersonalization, and personal accomplishment.²² In addition, we inquired about any suicidal thoughts or behaviors that the residents may have experienced.

Survey links were distributed via e-mail to different training programs in Latin American countries between May 10 and 25, 2021. The survey was distributed to neurosurgery residents registered in the Latin American Reference Centers accredited by FLANC (*Federación Latinoamericana de Neurocirugía* [Latin American Federation of Neurosurgical Societies]) in 2020–2022 (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Uruguay, El Salvador, Guatemala, and Venezuela). According to the records of the FLANC 2020–2022 secretariat, approximately 1498 residents were training in 182 registered centers in Latin America in 2021. Project collaborators included neurosurgeon members of FLANC, who assisted with the distribution of the survey among certified neurosurgical programs. Because of the sensitive nature of the study, the survey was conducted anonymously, with the objectives and the confidential handling of the provided information clearly established at the beginning of the survey. All results were collected in a Google Forms database.

Statistical Analysis

Statistical analysis was performed using SPSS version 25 (IBM Corp., Armonk, New York, USA). In this cross-sectional study, reported outcomes (discrimination, harassment, abuse, bullying, and burnout) were compared among different groups in a univariate analysis using a χ^2 test: country of training (Mexico vs. other countries in Latin America); gender, and academic training year (junior residents, PGY 1–3 vs. senior residents, PGY 4–6 or more). Yates correction for continuity (or Yates χ^2 test) was used when 0 cell (0.0%), or 1 cell (25.0%) or 2 cells (50%) had expected count <5. For multivariate analysis, linear regression was used to analyze the impact of certain variables on burnout.

RESULTS

Survey Responses

A total of 123 responses were obtained. After excluding surveys from nonresident physicians and from specialties other than neurosurgery, 111 surveys were included in the analysis, achieving a response rate of 7.4% (111 of 1498). Mean age was 29.39 ± 2.37 years (range, 25–38); 70 respondents (63%) were junior residents (PGY 1–3) and 25 (22.5%) were female. More than 50% of the residents reported being single and approximately 90% reported

not having any children (Table 1). Most of the respondents were carrying out their training in Mexico (36%), Argentina (17.1%), Brazil (16.2%), and Colombia (11.7%) (Figure 1).

Characteristics of the Residents and Their Training Centers

Most residents reported undertaking their neurosurgical training at specialty hospitals (58.1%) followed by general hospitals (33.3%). Approximately 92% of the centers became hybrid hospitals, caring for patients with COVID-19 along with neurosurgical patients during the severe acute respiratory syndrome coronavirus 2 pandemic, regardless of the country. Of the neurosurgery residents in Mexico, 80% referred to training in specialty hospitals, a higher proportion than in other Latin American countries, where neurosurgical training was carried out in specialty hospitals in 46.5% and in general hospitals in 46.5% ($P < 0.001$). Most of the respondents (73%) mentioned that their training centers had only 1 exclusive operating theater for neurosurgical procedures. On the other hand, 41.4% of residents reported performing 10–30 major neurologic surgeries monthly, and 36% reported a monthly admission rate of 50–100 neurosurgical patients during the pandemic. Despite this situation, most residents reported a persistently high workload during the pandemic (68.5%) (Supplementary Table 1).

Of residents in Mexico, 40% reported having >1 exclusive operating theater in their training centers, compared with 20% of residents in other Latin American countries ($P = 0.021$; Yates χ^2 $P = 0.037$). However, the number of major neurologic surgeries performed and monthly hospital admissions, as well as the perceived workload, did not show any significant difference among countries.

Female residents reported a higher rate of noncompliance with maximum working hours compared with men (76% vs. 51.2%; $P = 0.027$; Yates χ^2 $P = 0.048$). Of senior residents (PGY 4–6), 44% reported performing >30 major surgeries per month compared with 17% of junior residents ($P = 0.002$). However, junior residents reported a higher workload than did senior residents (75.7% vs. 56.1%; $P = 0.032$; Yates χ^2 $P = 0.053$) mainly because of longer working hours (>60 hours per week). The rest of the variables were not significantly different among academic training years (Supplementary Table 2).

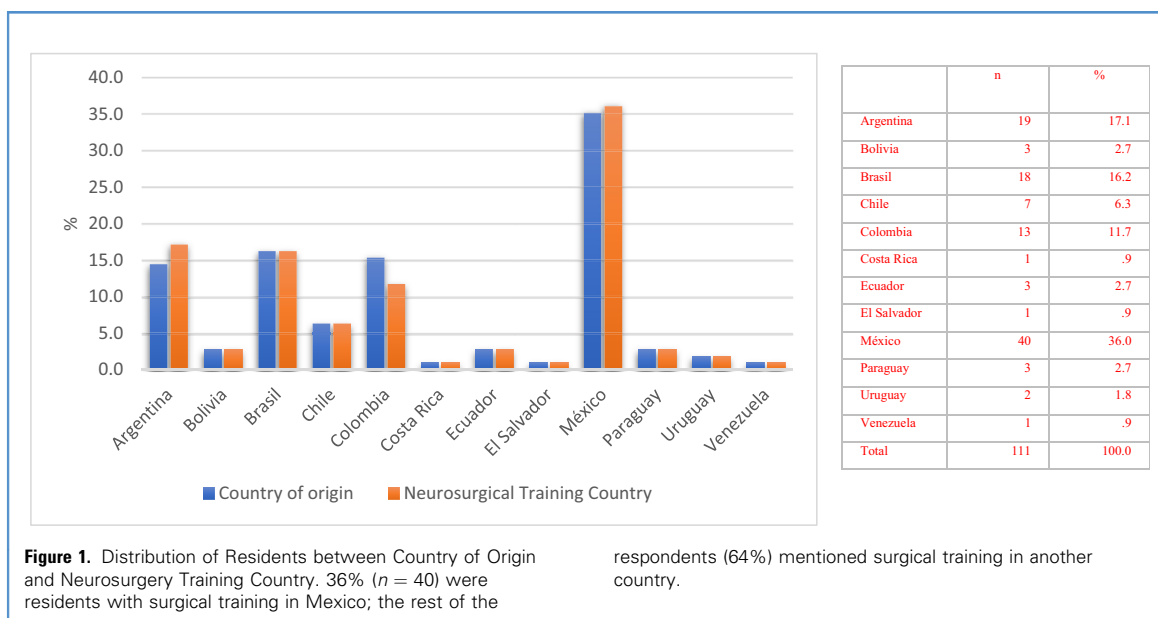
Neurosurgical training centers with >1 exclusive operating room reported a significantly higher availability of technological and subspecialty resources compared with centers with only 1 operating room: neuronavigation systems (73.3% vs. 37%; $P = 0.001$), vascular surgery and bypass (70% vs. 24.7%; $P < 0.001$), endoscopic skull base surgery (73.3% vs. 50%; $P = 0.032$), endoscopic brain surgery (100% vs. 69.1%; $P = 0.001$), intraoperative neurophysiologic monitoring (73.3% vs. 42%; $P = 0.003$), intraoperative brain mapping (63.3 vs. 22.2%; $P < 0.001$), epilepsy and functional surgery (80% vs. 37%; $P < 0.001$), neuroanesthesiology (77% vs. 48%; $P = 0.007$), neuropsychology (67% vs. 21%; $P < 0.001$), functional magnetic resonance imaging and blood-oxygenation-level-dependent imaging (60% vs. 32.1%; $P = 0.008$), nuclear medicine (single-photon emission computed tomography and brain positron emission tomography) (53% vs. 26%; $P = 0.007$), and microsurgical laboratory (50% vs. 22%; $P = 0.004$) (Supplementary Figure 1).

Table 1. Sociodemographic Information

Characteristics	Value
Total number of residents	111
Number of residents per center, mean \pm SD (range)	11.14 \pm 7.99 (1–37)
Age (years), mean \pm SD (range)	29.39 \pm 2.37 (25–38)
Gender	
Female	25 (22.5)
Male	86 (77.5)
Relationship status	
In partnership	55 (49.5)
Single	56 (50.5)
Have children	
Yes	14 (12.6)
No	97 (87.4)
Postgraduate year, mean \pm SD (range)	3.09 \pm 1.339 (1–6)
1	17 (15.3)
2	19 (17.1)
3	34 (30.6)
4	21 (18.9)
5	18 (16.2)
≥ 6	2 (1.8)
Neurosurgery training country	
Mexico	40 (36)
Other	71 (64)
Type of center	
Exclusive hospital for neurologic diseases	9 (8.1)
Medical specialty hospital that includes neurosurgery department	65 (58.1)
General hospital that includes neurosurgery department	37 (33.3)
COVID hospital	
Exclusive COVID hospital	1 (0.9)
Hybrid hospital	102 (91.9)
The hospital does not receive COVID patients	8 (7.2)
Values are number (%) except where indicated otherwise. SD, standard deviation; COVID, coronavirus disease.	

Discrimination, Harassment, and Bullying

Discrimination. Discrimination was reported on several grounds, mainly based on gender (19%), caring for patients with COVID-19 (13.5%), and testing positive for COVID-19 (11%). Of foreign residents, 10% experienced discrimination at their training program. Nevertheless, 60% of all residents reported not having been victims of any type of discrimination (Figure 2).



Compared with male residents, female residents were more often victims of gender discrimination (80% vs. 1.2%; $P < 0.001$; Yates $\chi^2 P < 0.001$) and discrimination for testing positive for COVID-19 (24% vs. 7%; $P = 0.016$; Yates $\chi^2 P = 0.041$). On the other hand, two thirds of male residents reported not experiencing any type of discrimination (62% vs. 16%; $P < 0.001$; Yates $\chi^2 P < 0.001$) (Table 2). Two thirds of all surveyed residents were victims of abuse, mainly verbal and emotional (approximately 50% each). However, 23% of the residents reported not being victims of any type of abuse or mistreatment (Figure 3).

Harassment and Bullying. Bullying was reported by most residents and was mainly inflicted by other residents (42%), followed by patients and their relatives (28%), and managers and bosses (23%). These proportions were slightly different for non-Mexican residents, who reported that the main sources of bullying were their managers or bosses (29.6% vs. 12.5%; $P = 0.041$; Yates χ^2

$P = 0.071$) followed by patients and their relatives (38% vs. 10%; $P = 0.002$; Yates $\chi^2 P = 0.003$). However, 25% of the surveyed residents reported not having been victims of bullying (Figure 4).

Residents undergoing neurosurgical training in Mexico reported a lower rate of abuse (32.5% vs. 59.2%; $P = 0.007$; Yates $\chi^2 P = 0.012$) than did those training in other countries, who also reported higher rates of harassment and bullying (Table 2).

Female residents reported higher rates of any type of abuse (84% vs. 58%; $P = 0.018$; Yates $\chi^2 P = 0.033$), verbal or emotional abuse (80% vs. 40%; $P = 0.001$; Yates $\chi^2 P = 0.001$), physical abuse (8% vs. 0%; $P = 0.008$; Yates $\chi^2 P = 0.073$), and sexual harassment (24% vs. 0%; $P < 0.001$; Yates $\chi^2 P < 0.001$) than did males. A higher proportion of male residents denied having experienced any type of abuse or harassment (29% vs. 4%; $P = 0.009$; Yates $\chi^2 P = 0.019$). Bullying was more frequently inflicted on female than on male residents by professors (44% vs. 15%; $P = 0.002$; Yates $\chi^2 P = 0.005$) and managers or bosses (40% vs. 19%;

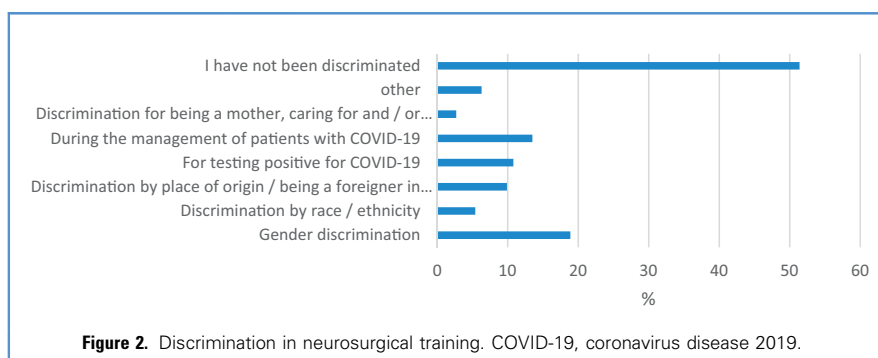


Table 2. Discrimination, Bullying, Abuse, and Harassment: Analysis by Neurosurgical Training Country, Gender, and Academic Training Year

Characteristics	Country			Continuity Correction*	Gender			Continuity Correction*	Training Year			Continuity Correction*
	Mexico, n (%)	Other, n (%)	P		Male, n (%)	Female, n (%)	P		PGY Junior (1–3) n (%)	PGY Senior (4–6) n (%)	P	
Discrimination												
Gender discrimination	5 (12.5)	16 (22.5)	0.195		1 (1.2)	20 (80)	<0.001*	<0.001†	9 (12.9)	12 (29.3)	0.033†	0.060
Discrimination by race/ethnicity	1 (2.5)	5 (7)	0.310		5 (5.8)	1 (4)	0.724		3 (4.3)	3 (7.3)	0.495	
Discrimination for being a foreigner	3 (7.5)	8 (11.3)	0.524		7 (8.1)	4 (16)	0.247		7 (10)	4 (9.8)	0.967	
Discrimination for being positive for COVID	5 (12.5)	7 (9.9)	0.667		6 (7)	6 (24)	0.016†	0.041†	5 (7.1)	7 (17.1)	0.104	
Discrimination for handling patients with COVID	7 (17.5)	8 (11.3)	0.356		13 (15.1)	2 (8)	0.360		9 (12.9)	6 (14.6)	0.792	
Discrimination for being a father or mother	1 (2.5)	2 (2.8)	0.921		2 (2.3)	1 (4)	0.650		1 (1.4)	2 (4.9)	0.279	
I was not discriminated against	23 (57.5)	34 (47.9)	0.331		53 (61.6)	4 (16)	<0.001†	<0.001†	40 (57.1)	17 (41.5)	0.111	
Harassment and abuse												
Sexual harassment	4 (10)	2 (2.8)	0.108		0 (0)	6 (24)	<0.001†	<0.001†	3 (4.3)	3 (7.3)	0.495	
Verbal or emotional abuse	13 (32.5)	42 (59.2)	0.007†	0.012†	35 (40.7)	20 (80)	0.001	0.001†	31 (44.3)	24 (58.5)	0.147	
Physical abuse	2 (5)	0 (0)	0.057		0 (0)	2 (8.0)	0.008†	0.073	2 (2.9)	0 (0)	0.275	
Any exposure to abuse	26 (65)	45 (63.4)	0.865		50 (58.1)	21 (84)	0.018†	0.033†	44 (62.9)	27 (65.9)	0.751	
I did not receive harassment or abuse	13 (32.5)	13 (18.3)	0.090		25 (29.1)	1 (4)	0.009†	0.019†	16 (22.9)	10 (24.4)	0.854	
Bullying												
Bullying by managers or bosses	5 (12.5)	21 (29.6)	0.041†	0.071	16 (18.6)	10 (40)	0.026†	0.051	14 (20)	12 (29.3)	0.266	
Bullying by direct teachers	7 (17.5)	17 (23.9)	0.429		13 (15.1)	11 (44)	0.002†	0.005†	12 (17.1)	12 (29.3)	0.134	
Bullying by other residents	21 (52.5)	26 (36.6)	0.104		33 (38.4)	14 (56)	0.116		28 (40)	19 (46.3)	0.514	
Bullying by nursing staff	3 (7.5)	14 (19.7)	0.086		11 (12.8)	6 (24)	0.171		8 (11.4)	9 (22)	0.137	
Bullying by patients and their families	4 (10)	27 (38)	0.002†	0.003†	21 (24.4)	10 (40)	0.126		17 (24.3)	14 (34.1)	0.264	
I did not receive bullying	15 (37.5)	13 (18.3)	0.025†	0.045†	26 (30.2)	2 (8)	0.024†	0.046†	20 (28.6)	8 (19.5)	0.289	

PGY, postgraduate year; COVID, coronavirus disease.

*Yates χ^2 test was applied.†P value obtained by Pearson χ^2 .

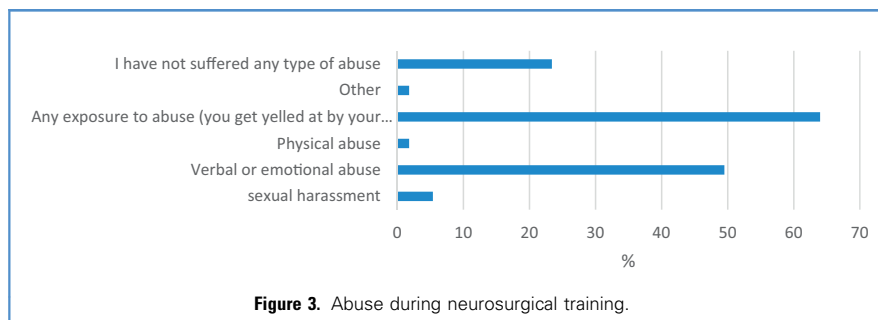


Figure 3. Abuse during neurosurgical training.

$P = 0.026$; Yates $\chi^2 P = 0.051$). A higher proportion of men denied having been a victim of bullying ($P = 0.024$; Yates $\chi^2 P = 0.046$) (Table 2).

Burnout

Of those surveyed, 44% reported high levels of emotional exhaustion, whereas 68.5% of the respondents reported low levels of burnout regarding personal accomplishment and 48.6% reported low levels of depersonalization (Table 3). Of the residents, 46.2% experienced some degree of emotional exhaustion and 21.9% had symptoms of depersonalization on a weekly or daily basis. Contrary to this finding, 85.9% of the residents reported daily or weekly feelings of personal accomplishment (Supplementary Figures 4-7).

High levels of burnout because of depersonalization were seen less frequently in Mexico than in other Latin American countries (31.8% vs. 68.2%; $P = 0.026$). On the other hand, younger residents (≤ 30 years) reported burnout because of depersonalization more frequently than did older residents (84.1% vs. 15.9%; $P = 0.004$). Male residents reported higher rates of burnout because of

emotional exhaustion than did female residents (69.4% vs. 30.6%; $P = 0.030$) (Table 4).

A higher rate of suicidal ideation was found in neurosurgery residents training in countries other than Mexico (18.3% vs. 2.5%; $P = 0.016$; Yates $\chi^2 P = 0.035$) and in female residents (28% vs. 8.1%; $P = 0.008$; Yates $\chi^2 P = 0.022$) (Table 4). Obtaining a high level of burnout in any of the 3 dimensions was significantly associated with the presence of suicidal ideation (Figure 5).

The main concerns that residents raised regarding the COVID-19 pandemic were uncertainty regarding the future because of the current status of the pandemic (56%), its impact on their professional (49%) and personal (37%) lives, and the decrease in working hours (34%) (Supplementary Figure 2). The factors that were perceived as affecting the usual neurosurgical practice the most were insufficient time/fewer hours in the operating room (67%), inadequate teaching time (55%), and uncertainty regarding health care policies (43%) (Supplementary Figures 2 and 3).

Statistical analysis showed that verbal or emotional abuse and bullying by patients or their relatives were significantly associated

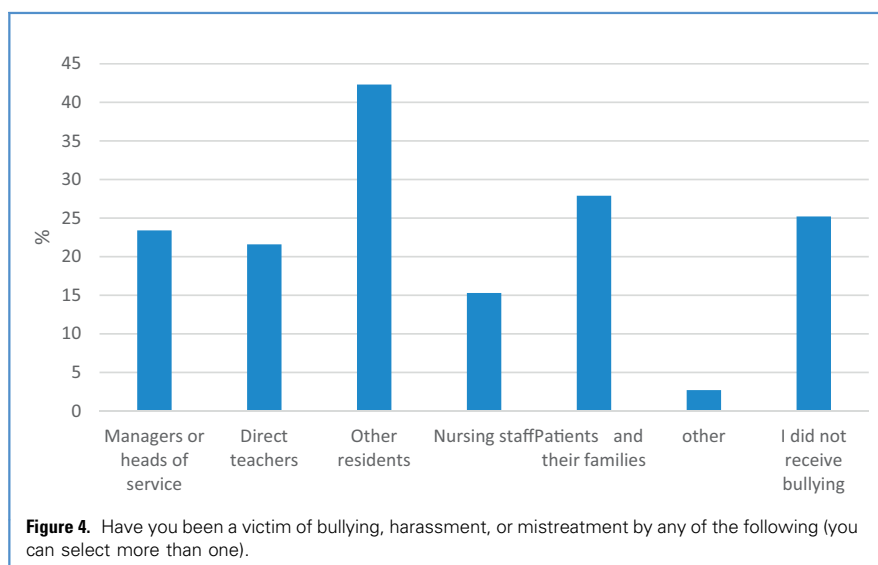


Figure 4. Have you been a victim of bullying, harassment, or mistreatment by any of the following (you can select more than one).

Table 3. Results of the Maslach Burnout Inventory (Abbreviated)

Level of Burnout	Personal Accomplishment, n (%)	Depersonalization, n (%)	Emotional Exhaustion, n (%)
Low	76 (68.5)	54 (48.6)	32 (28.8)
Moderate	17 (15.3)	13 (11.7)	30 (27.0)
High	18 (16.2)	44 (39.6)	49 (44.1)

Values in bold express the highest Burnout scores presented by Depersonalization and Emotional Exhaustion.

with lower scores of personal accomplishment ($P < 0.05$). Younger residents and those who experienced discrimination because of a positive COVID-19 test reported higher levels of depersonalization ($P < 0.05$). Moreover, residents who experienced any type of discrimination, as well as those who were victims of any type of abuse, reported higher levels of burnout in the emotional exhaustion dimension ($P < 0.05$) (**Supplementary Table 3**).

The number of major surgeries and monthly admissions, type of hospital, number of operating rooms, working hours, noncompliance with work schedules, and marital or childcare status were not associated with any level of burnout (results not shown).

Multivariate analysis showed that older age (odds ratio [OR], 0.198; 95% confidence interval [CI], 0.041–0.954; $P = 0.043$) and having been a victim of bullying (OR, 0.037; 95% CI, 0.004–0.389; $P = 0.006$) were less frequently associated with high scores in personal accomplishment. On the other hand, older age was a protective factor for high depersonalization scores (OR, 0.133; 95% CI, 0.035–0.500; $P = 0.003$), whereas being discriminated against represented a risk factor for high emotional exhaustion scores (OR, 3.019; 95% CI, 1.057–8.629; $P = 0.039$) (**Supplementary Table 4**). High levels of depersonalization were associated with a 7-fold increased risk of suicidal ideation (OR, 7.869; 95% CI, 1.266–48.88; $P = 0.027$) (**Supplementary Table 5**).

DISCUSSION

Discrimination, mistreatment, and abuse are problems that detrimentally affect the training of neurosurgery residents worldwide. Recently, the severe acute respiratory syndrome coronavirus 2 pandemic has significantly contributed to the burden experienced in neurosurgery residency programs,¹ resulting in higher burnout scores and suicidal ideation, which represent a global health problem that must be promptly addressed.

These issues still represent a taboo because of the great demands laid upon residents and the major adjustments that are often expected from them during training. We can even recognize a lack of interest reflected in the very low response rates obtained in previous surveys intended to assess these problems (8.9% and 12.2% in surveys applied to members of the Congress of Neurological Surgeons²³ and residents belonging to the American Association of Neurological Surgeons, respectively).² A survey in

France reported a response rate of 100%.²⁴ Our study achieved a response rate of approximately 7.4% of Latin American residents, including 15% ($n = 40$) of all neurosurgery residents training in Mexico (264 residents were registered in 2020 according to the records of the Mexican Society of Neurological Surgery (*Sociedad Mexicana de Cirugía Neurológica*).²⁵ However, the exact number of residents who undergo neurosurgical training in Latin America is difficult to gather because of different recording systems.

Discrimination, Abuse, and Bullying

Discrimination. The response rate of female residents was 22.5% ($n = 25$), similar to that reported by other investigators.²³ Gender discrimination represents 1 of the main types of discrimination. In our study, a higher proportion of female respondents reported discrimination by gender, and for testing positive to COVID-19 than did male respondents (80% vs. 1.2%, $P < 0.001$, Yates χ^2 $P < 0.001$ and 24% vs. 7%, $P = 0.016$, Yates χ^2 $P = 0.041$, respectively), which is an issue of major concern given the status of the pandemic. Other investigators report that 47.9% of their respondents were victims of some form of discrimination, with female respondents (90.2% vs. 13%; $P < 0.001$) and residents (54.2% vs. 25%; $P < 0.001$) being the population experiencing most gender discrimination.²³

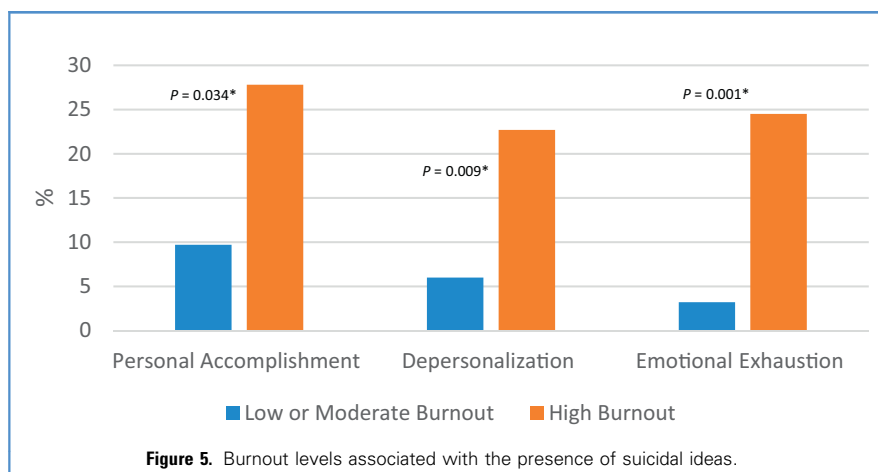
Abuse and Mistreatment. Our results show a rate of 64% of any form of abuse, similar to that reported by another study (61.4%),²³ in which verbal and emotional abuse were also the most prevalent forms,²³ mainly inflicted by other neurosurgeons.²³ Moreover, in that study, female respondents (63.1%) and residents (37.3%) were most frequently victims of sexual harassment.²³ Similarly, in our study, female respondents were victims of sexual harassment more frequently than were male respondents (24% vs. 0%; $P < 0.001$, Yates χ^2 $P < 0.001$). Furthermore, female residents were victims of bullying more frequently than were male residents, mainly by professors (44% vs. 15%; $P = 0.002$; Yates χ^2 $P = 0.005$) and managers or bosses (40% vs. 19%; $P = 0.026$; Yates χ^2 $P = 0.051$). Overall, male residents experienced lower rates of discrimination, abuse, and bullying than did female residents ($P < 0.05$). In this regard, male residents reported not being victims of any type of discrimination (61.6% vs. 16%; $P < 0.001$; Yates χ^2 $P < 0.001$) or bullying (30.2% vs. 8%; $P = 0.024$; Yates χ^2 $P = 0.046$) 4 times more frequently; and not being victims of any form of abuse or harassment 7 times more frequently than did female residents (29.1% vs. 4%; $P = 0.009$; Yates χ^2 $P = 0.019$). This finding contrasts with the rate of victims reporting these issues, as shown by Gadjaradj et al., who showed that male respondents were 3 times more likely to complain than were female respondents (77.2% vs. 22.8%; $P = 0.01$).²³

Verbal or emotional abuse and bullying seem to be less prevalent in Mexico compared with other countries in Latin America ($P < 0.05$). More specifically, neurosurgery residents training in countries other than Mexico reported higher rates of bullying by bosses and managers ($P = 0.041$; Yates χ^2 $P = 0.071$) and by patients and their relatives (38% vs. 10%; $P = 0.002$; Yates χ^2 $P = 0.003$), suggesting a background cultural basis.

Table 4. Burnout: Analysis by Neurosurgical Training Country, Gender, and Academic Training Year

Characteristics of Burnout	Country			Continuity Correction*	Gender			Continuity Correction*	Training Year			Age			Continuity Correction*
	Mexico, n (%)	Other, n (%)	P		Male, n (%)	Female, n (%)	P		PGY Junior (1–3) n (%)	PGY Senior (4–6) n (%)	P	≤30 years, n (%)	>30 years, n (%)	P	
	Personal accomplishment														
Low	31 (40.8)	45 (59.2)	0.159		62 (81.6)	14 (18.4)	0.301		47 (61.8)	29 (38.2)	0.407	49 (64.5)	27 (35.5)	0.246	
Moderate	6 (35.3)	11 (64.7)			12 (70.6)	5 (29.4)			13 (76.5)	4 (23.5)		14 (82.4)	3 (17.6)		
High	3 (16.7)	15 (83.3)			12 (66.7)	6 (33.3)			10 (55.6)	8 (44.4)		14 (77.8)	4 (22.2)		
Depersonalization															
Low	25 (46.3)	29 (53.7)	0.026†	N/A	43 (79.6)	11 (20.4)	0.861		36 (66.7)	18 (33.3)	0.535	35 (64.8)	19 (35.2)	0.004†	
Moderate	1 (7.7)	12 (92.3)			10 (76.9)	3 (23.1)			9 (69.2)	4 (30.8)		5 (38.5)	8 (61.5)		
High	14 (31.8)	30 (68.2)			33 (75)	11 (25)			25 (56.8)	19 (43.2)		37 (84.1)	7 (15.9)		
Emotional exhaustion															
Low	14 (43.8)	18 (56.3)	0.483		30 (93.8)	2 (6.3)	0.030†	N/A	17 (53.1)	15 (46.9)	0.353	21 (65.6)	11 (34.3)	0.224	
Moderate	11 (36.7)	19 (63.3)			22 (73.3)	8 (26.7)			21 (70)	9 (30)		18 (60)	12 (40)		
High	15 (30.6)	34 (69.4)			34 (69.4)	15 (30.6)			32 (65.3)	17 (34.7)		38 (77.6)	11 (22.4)		
Suicidal ideas	1 (2.5)	13 (18.3)	0.016†	0.035	7 (8.1)	7 (28)	0.008†	0.022	9 (12.9)	5 (12.2)	0.919	9 (64.3)	5 (35.7)	0.659	

PGY, postgraduate year; N/A, not applicable.
 *Yates χ^2 test was applied.
 †P value obtained by Pearson χ^2 .



Burnout

Multiple personal, demographic, and institutional factors contribute to the risk of burnout in neurosurgery residents. Jean et al.²¹ observed that increased workload is associated with a higher risk of burnout in neurosurgery residents worldwide, including Latin America. In their study, responses were obtained from 93 countries, 13.8% (n = 109) of which were from Latin America, with 39 responses from Mexico. Burnout risk rate was 20.7%, with the lowest rates reported for the United States and Canada (11.2%), and the highest for Europe (26.9%).²¹ Even although Latin American residents worked greater hours and covered more on-call shifts, their burnout risk rate (16.2%) was similar to that in other countries.²¹ Nevertheless, we found a high burnout rate among our residents (>40% of surveyed residents), probably reflecting certain buildup from the COVID-19 pandemic.

Moreover, while many surgeries may represent a risk factor for burnout in residents training in the United States and Canada (OR, 3.808; 95% CI, 1.107–13.104; P = 0.034), it could also be a protective factor for European residents (OR, 0.392; 95% CI, 0.196–0.738; P = 0.008).²¹ Thus, the reduced caseload and time in the operating room associated with the COVID-19 pandemic could contribute to burnout in some scenarios. However, the number of major surgeries, monthly admissions, and weekly workload was not found to be significantly associated with high levels of burnout in our study.

Despite the high burnout rates reported in neurosurgery residents (26.1%–52.02%),^{2,22,23,26} personal satisfaction rates have also been found to be high (74%).² In this regard, even although >40% of the residents in our study reported high levels of burnout, 68.5% also reported high rates of personal satisfaction. This finding might contrast with the results of a recent meta-analysis,²⁶ which reported personal accomplishment to be the most influential factor for the development of burnout in neurosurgery residents (51.56%).

Our results showed that high levels of depersonalization were associated with a 7-fold increased risk of suicidal ideation (OR, 7.869; 95% CI, 1.266–48.88; P = 0.027). In contrast, a survey applied in France documented that although drug abuse and consultation with a psychiatrist were significantly associated with

burnout, burnout itself was not associated with suicidal ideation.²⁴ Nonetheless, the potential interaction between both entities deserves more attention and should be further examined in future studies.

Other studies carried out in several training institutions in the United States have also reported risk factors for high levels of burnout, including being victims of abuse,²³ being a younger resident,²⁷ major social or personal stressors, clinical rotations, lack of children,²⁸ inadequate exposure to the operating room, and hostile faculty.²⁹ Postgraduate year 2 residents seem to be most susceptible to developing burnout, probably because of increased responsibilities.²⁷ In our study, older age (OR, 0.198; 95% CI, 0.041–0.954; P = 0.043) and having been a victim of bullying (OR, 0.037; 95% CI, 0.004–0.389; P = 0.006) were less frequently associated with high scores in personal accomplishment. In contrast, older age was a protective factor for high depersonalization scores (OR, 0.133; 95% CI, 0.035–0.500; P = 0.003). As may be expected, experiencing discrimination represented a risk factor for presenting high emotional exhaustion scores (OR, 3.019; 95% CI, 1.057–8.629; P = 0.039). Burnout levels were not associated with marital status, childcare status, or type of hospital in our study.

Concerns and Uncertainty Surrounding COVID-19

Uncertainty regarding the future because of the current COVID-19 pandemic (56%), its impact on professional (49%) and personal (37%) life, and its associated decrease in working hours (34%) were the most prevalent concerns within the surveyed residents in our study. The factors related to the COVID-19 pandemic that most affected usual neurosurgical practice were insufficient time/fewer hours in the operating room (67%), inadequate teaching time (55%), and uncertainty about health care policies (43%). A study by Khalafallah et al.² also identified commonly perceived uncertainties, such as regarding future health care reform (79.3%) and future income (45.9%) because of the pandemic. In their study, some of the most frequently expressed concerns were experiencing fewer weekly working hours (74.8%), inability to meet minimum operative cases

requirements (67.6%), altered rotation or work schedules (66.7%), and the potential of COVID-19 interfering with their achievement of surgical milestones (65.8%). Thus, the uncertainty surrounding the future course of the pandemic and its impact on the professional and personal lives of neurosurgery residents are undeniable and contribute to a negative perception of their training performance.

Strengths and Limitations

This study focused on evaluating the rates and associated factors of discrimination, abuse and mistreatment experienced by neurosurgery residents training in Latin America, as well as their impact on burnout and suicidal ideation amid the pandemic. One of the limitations of our study was not evaluating optimism,³⁰ social and work stress, or the presence of depression³¹ in the surveyed residents.³² Furthermore, the influence of other factors on burnout or suicidal ideation, such as reward reestablishment,²⁷ resident attrition,³³ substance abuse, personality traits, and grit and resilience were not evaluated.^{24,28} However, as more evidence surrounding these issues is produced, their multifactorial nature may be expected to become more apparent.

In a previous study, we reported a rate of 66.2% of residents perceiving a negative impact of the COVID-19 pandemic on their training and their physical and mental health.¹ The present study may serve as a complement to our previous findings. Overall, it seems that gender and country of training have a strong influence on the prevalence of sexual harassment, abuse, mistreatment, and discrimination as experienced by residents, consequently increasing their levels of burnout and suicidal ideation. Furthermore, the lower proportion of female residents (22.5%) accounting for most cases of sexual harassment and gender discrimination underscores the importance of addressing the underlying social inequality. Given that the relatively low response rate (only 7.4% of the residents) may be explained by residents who have experienced more burnout and discrimination and were more inclined to answer the questionnaire, these findings must be interpreted with caution. Nonetheless, our results aim to shed light on a major global

health problem recently aggravated by the current pandemic and demanding prompt action.

CONCLUSIONS

The negative impact of the COVID-19 pandemic on health care workers extends well beyond initial estimates. The high rates of discrimination, abuse, and mistreatment experienced by neurosurgical residents, recently aggravated by the pandemic, have a major influence in the rate and severity of burnout and suicidal ideation. Our study represents an effort to better understand these issues and to increase awareness among neurosurgeons regarding the crisis that afflicts our residents, to take action against this global health problem and improve the training conditions of neurosurgery residents in Latin America and worldwide.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

María F. De la Cerda-Vargas: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – review & editing. **Martin N. Stienen:** Methodology, Formal analysis, Data curation, Writing – review & editing. **Alvaro Campero:** Methodology, Investigation. **Armando F. Pérez-Castell:** Formal analysis, Data curation, Writing – review & editing. **José A. Soriano-Sánchez:** Methodology, Investigation. **Barbara Nettel-Rueda:** Investigation. **Luis A.B. Borba:** Investigation. **Carlos Castillo-Rangel:** Methodology, Investigation. **Pedro Navarro-Domínguez:** Formal analysis, Data curation, Writing – review & editing. **Melisa A. Muñoz-Hernández:** Formal analysis, Data curation, Writing – review & editing. **Fany K. Segura-López:** Formal analysis, Data curation, Writing – review & editing. **Gerardo Y. Guinto-Nishimura:** Writing – original draft, Writing – review & editing. **Bayron Alexander Sandoval-Bonilla:** Methodology, Investigation, Formal analysis, Data curation, Writing – review & editing.

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APPENDIX 1

SURVEY

BURNOUT ON THE TRAINING OF NEUROSURGERY RESIDENTS IN LATIN AMERICA: IMPACT DURING THE SARS-CoV-2 PANDEMIC

INTRODUCTION

The objectives of this survey are:

- 1) Collect the number of neurosurgical procedures, hours of work, as well as know the academic and technological resources for treatment and diagnosis in each neurosurgical training center.
- 2) Know the conditions of burnout, mistreatment and discrimination experienced by residents in each training center.

Please note that all data will be collected and analyzed anonymously. The name of the participant will not be displayed and, in particular, individual data will not be displayed.

Instructions: Please read the questions below carefully. Respond as you consider relevant to the situation that arises.

Section 1: Demographic information.

E-mail address:

1. Are you a resident in neurosurgery? Yes. No.
2. How many residents work in your Neurosurgery department? (just answer with a number).
3. What is your gender? Female. Male.
4. Age (in years):
5. Marital Status: In Relationship. Single:
6. Do you have children: Yes. No:
7. What is your country of origin? (Place of birth):
 - Argentina
 - Bolivia
 - Brazil
 - Chile
 - Colombia
 - Costa Rica
 - Cuba
 - Ecuador
 - El Salvador
 - Guatemala
 - Honduras
 - Mexico
 - Nicaragua
 - Panama
 - Paraguay

- Peru
- Puerto Rico
- Republica Dominicana
- Uruguay
- Venezuela

8. In which country are you doing your residency program in neurosurgery?

- Argentina
- Bolivia
- Brazil
- Chile
- Colombia
- Costa Rica
- Cuba
- Ecuador
- El Salvador
- Guatemala
- Honduras
- Mexico
- Niragua
- Panama
- Paraguay
- Peru
- Republica Dominicana
- Uruguay
- Venezuela

9. What year are you currently studying in the neurosurgery residency? (not counting years of previous general surgery)

- PGY 1
- PGY 2
- PGY 3
- PGY 4
- PGY 5
- PGY 6 or more

10. What is the name of your hospital or neurosurgical training center:

11. The hospital where you currently reside is:
 - Exclusive Center for Neurological Diseases
 - Hospital of Medical Specialties that includes Neurosurgery
 - General hospital including neurosurgery
 - Other

12. Does your current residency hospital hospitalize COVID-19 patients?

- Yes, COVID-exclusive Hospital
- Yes, hybrid COVID hospital (admits positive and negative COVID patients)
- No, the hospital does not receive COVID patients

Section 2: Technological and academic resources by hospital center

1. How many major surgeries (craniotomies, complete spine surgeries, skull base, etc.) did you perform per month in the last 6 months?

- less than 10
- 10 to 30
- 30 to 50
- more than 50

2. How many monthly admissions did your training center have in the last 6 months?

- Less than 50
- 50 to 100
- 100 to 150
- more than 150

3. How many operating rooms in your hospital are exclusive to neurosurgery?

- 1
- 2
- 3
- 4 or more

4. How many hours of work per week did you spend at the hospital in the last 6 months?

- less than 10
- 10 to 30
- 30 to 60
- More than 60

5. Has your work schedule been breached in the last 6 months due to causes external to COVID?

- Every day
- Once a week
- Once a month
- Never

6. Select which of the following resources your training center or hospital has (you can select more than one):

- Fluorescein filter microscope

- Fluoroscope

- Craniotome and milling system

- Brain and/or spinal neuronavigator

- Endovascular therapy

- Brain bypass and vascular surgery

- Endoscopic skull base surgery

- Endoscopic brain and/or ventricular surgery

- Endoscopic spine surgery

- Ultrasonic vacuum cleaner

- Neurophysiological monitoring

- Intraoperative brain mapping

- Functional surgery, epilepsy and stereothaxia

- Neuroanesthesiology

- Neuropsychologist

- Functional MRI and BOLD

- Nuclear medicine (PET or brain SPECT)

- Histological and molecular diagnosis

- Microsurgery laboratory

- Other

Section 3: Discrimination, abuse and impact of COVID-19 during neurosurgical training

1. Have you ever felt discriminated against for any of the following causes (you can select more than one):

- Gender discrimination

- Discrimination by race/ethnicity

- Discrimination by place of origin/being a foreigner in the country of training

- For testing positive for COVID-19

- During the management of patients with COVID-19

- Discrimination for being a mother, caring for and/or having children

- Other

2. Have you ever suffered any of the following forms of abuse during your neurosurgical training (you can select more than one):

- Sexual harassment

- Verbal or emotional abuse

- Physical abuse

- Any exposure to abuse (you get yelled at by your superiors, exclusion, hostility)

- Other

3. You have been a victim of bullying, harassment or mistreatment by any of the following (you can select more than one):
- Managers or heads of service
 - Direct teachers
 - Other residents
 - Nursing staff
 - Patients and their families
 - Other
4. Have you had any of the following concerns or uncertainties during the COVID-19 pandemic (you can select more than one)
- Uncertainty about future changes in healthcare due to COVID-19
 - Weekly work hours decrease due to COVID-19
 - Altered holiday schedule due to COVID-19
 - Uncertainty about future earnings due to COVID-19
 - Professional life will get worse due to COVID-19
 - Personal life will get worse due to COVID-19
 - I'm not sure or would not do neurosurgery again
5. Mention if any of the following factors you consider that most affect the practice due to COVID-19:
- Very few cases
 - Uncertainty about future income or health care reform
 - Low salary/income
 - Hostile or difficult work environment
 - Very little vacation time
 - Too many guards in COVID
 - Loss of coworker/teachers
 - Inadequate teaching time
 - Complications related to surgery
 - Inadequate investigation time
 - Insufficient time/hours in the operating room
- Section 4: Burnout During COVID-19
Instructions: Complete the abbreviated Maslach Inventory. For each statement, check the box that most accurately reflects your answer.
1. I deal very effectively with my patients' problems.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
2. I feel that I treat some patients as if they were impersonal objects.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
3. I feel emotionally exhausted from my work.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
4. I feel fatigued when I get up in the morning and have to face another day at work.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
5. I have become more insensitive to people since I accepted this job.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
6. I feel that I am positively influencing the lives of other people through my work.
- Never
 - Few times a year or less

- Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
7. Working with people all day is really a strain for me.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
8. I really don't care what happens to some patients:
- Never
 - Few times a year or less
- Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
9. I feel exhilarated after working closely with my patients.
- Never
 - Few times a year or less
 - Once a month or less
 - Few times a month
 - Once a week
 - Few times a week
 - Every day
10. Have you had suicidal thoughts in the last year: Yes. No.

Supplementary Table 1. Number of Major Surgeries and Monthly Admissions, Number of Operating Rooms, and Work Hours per Week

Major Surgeries, n (%)	Admissions, n (%)	Operating Rooms, n (%)	Work hours (%)
<10 (31.5)	<50 (32.4)	1 (73.0)	10–30 (9.0)
10–30 (41.4)	50–100 (36.0)	2 (12.6)	30–60 (22.5)
31–50 (15.3)	100–150 (12.6)	3 (5.4)	>60 (68.5)
>50 (11.7)	>150 (18.9)	≥4 (9.0)	

Supplementary Table 2. Characteristics of the Residents and Their Neurosurgical Training Centers: Analysis by Country, Gender, and Academic Training Year

Characteristics	Country			Continuity Correction*	Gender			Continuity Correction*	Academic Training Year			Continuity Correction*
	Mexico, n (%)	Other, n (%)	P		Male, n (%)	Female, n (%)	P		PGY Junior (1–3), n (%)	PGY Senior (4–6), n (%)	P	
PGY junior (1–3)	27 (67.5)	43 (60.6)	0.467		57 (66.3)	13 (52)	0.193		—	—	—	
PGY senior (4–6)	13 (32.5)	28 (39.4)			29 (33.7)	12 (48)			—	—	—	
Relationship status												
Single	22 (55)	34 (47.9)	0.472		42 (48.8)	14 (56)	0.528		36 (51.4)	20 (40.8)	0.788	
In relationship	18 (45)	37 (52.1)			44 (51.2)	11 (44)			34 (48.6)	21 (51.2)		
Have children												
No	38 (95)	59 (83.1)	0.070		75 (87.2)	11 (12.8)	0.917		64 (91.4)	33 (80.5)	0.094	
Yes	2 (5)	12 (16.9)			11 (12.8)	3 (12)			6 (8.6)	8 (19.5)		
Type of center												
Exclusive hospital for neurologic diseases	4 (10)	5 (7)	<0.001†	Not applicable	8 (9.3)	1 (4)	0.653		5 (7.1)	4 (9.8)	0.739	
Medical specialty hospital that includes neurosurgery department	32 (80)	33 (46.5)			49 (57)	16 (64)			40 (57.1)	25 (61)		
General hospital that includes neurosurgery department	4 (10)	33 (46.5)			29 (33.7)	32 (37)			25 (35.7)	12 (19.3)		
COVID hospital												
The hospital does not receive patients with COVID	4 (10)	4 (5.6)	0.275		8 (9.3)	0 (0)	0.241		5 (7.1)	3 (7.3)	0.744	
Exclusive COVID hospital	1 (2.5)	0 (0)			1 (1.2)	0 (0)			1 (1.4)	0 (0)		
Hybrid hospital	35 (87.5)	67 (94.4)			77 (89.5)	25 (100)			64 (91.4)	38 (92.7)		
Major surgeries (>30 per month)	11 (27.5)	19 (26.8)	0.933		23 (26.7)	7 (28)	0.901		12 (17.1)	18 (43.9)	0.002†	0.004†
Hospital admissions (>100 per month)	15 (37.5)	20 (28.2)	0.310		30 (34.9)	5 (20)	0.159		21 (30)	14 (34.1)	0.650	
Operating rooms (>1)	16 (40)	14 (19.7)	0.021†	0.037†	26 (30.2)	4 (16)	0.158		21 (30)	9 (22)	0.357	
Hours of work (>60 per week)	25 (62.5)	51 (71.8)	0.310		59 (68.6)	17 (68)	0.954		53 (75.7)	23 (56.1)	0.032†	0.053
Unfulfilled work schedule	23 (57.5)	40 (56.3)	0.906		44 (51.2)	19 (76)	0.027†	0.048†	35 (50)	28 (68.3)	0.060	

PGY, postgraduate year; COVID, coronavirus disease.
 *Yates χ^2 test was applied.
 †P value obtained by Pearson χ^2 .

Supplementary Table 3. Association of Burnout Levels with Demographic Characteristics, Discrimination, Abuse, and Bullying

Variables	Personal Accomplishment			Depersonalization			Emotional Exhaustion					
	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*
Age												
≤30 years	63 (81.8)	14 (18.2)	0.398		40 (51.9)	37 (48.1)	0.006†	0.012†	39 (50.6)	38 (49.4)	0.096	
>30 years	30 (88.1)	4 (11.8)			27 (79.4)	7 (20.6)			23 (67.6)	11 (32.4)		
Gender												
Male	74 (86)	12 (14)	0.230		53 (61.6)	33 (38.4)	0.613		52 (60.5)	34 (39.5)	0.070	
Female	19 (76)	6 (24)			14 (56)	11 (44)			10 (40)	15 (60)		
Relationship status												
Single	47 (83.9)	9 (16.1)	0.967		31 (55.4)	25 (44.6)	0.277		31 (55.4)	25 (44.6)	0.915	
In couple	46 (83.6)	9 (16.4)			36 (65.5)	19 (34.5)			31 (56.4)	24 (43.6)		
Have children												
No	82 (84.5)	15 (15.5)	0.571		59 (60.8)	39 (39.2)	0.792		54 (55.7)	43 (44.3)	0.917	
Yes	11 (78.6)	3 (21.4)			8 (57.1)	6 (42.9)			8 (57.1)	6 (42.9)		
Academic training year												
Junior resident (PGY 1–3)	60 (85.7)	10 (14.3)	0.471		45 (64.3)	25 (35.7)	0.269		38 (54.3)	32 (45.7)	0.663	
Senior resident (PGY 4–6)	33 (80.5)	8 (19.5)			22 (53.7)	19 (46.3)			24 (58.5)	17 (41.5)		
Neurosurgery training country												
Other	56 (78.9)	15 (21.1)	0.061		41 (57.7)	30 (42.3)	0.453		37 (52.1)	34 (47.9)	0.290	
Mexico	37 (92.5)	3 (7.5)			26 (65)	14 (35)			25 (65.2)	15 (35.7)		
Gender discrimination												
Discrimination by race/ethnicity	16 (76.2)	5 (23.8)	0.294		12 (57.1)	9 (42.9)	0.738		8 (38.1)	13 (61.9)	0.069	
Discrimination for being a foreigner	3 (50)	3 (50)	0.210		3 (50)	3 (50)	0.594		3 (50)	3 (50)	0.766	
Discrimination for having a COVID + test	10 (90.9)	1 (9.1)	0.499		7 (63.6)	4 (36.4)	0.815		7 (63.6)	4 (36.4)	0.584	
Discrimination during the management of patients with COVID	9 (75)	3 (25)	0.382		4 (33.3)	8 (66.7)	0.043†	0.086	3 (25)	9 (75)	0.023†	0.049†
Discrimination being mother/father	10 (66.7)	5 (33.3)	0.053		7 (46.7)	8 (53.3)	0.244		5 (33.3)	10 (66.7)	0.059	
I was not discriminated against	2 (66.7)	1 (33.3)	0.415		1 (33.3)	2 (66.7)	0.332		1 (33.3)	2 (66.7)	0.426	
	50 (87.7)	7 (12.3)	0.248		37 (64.9)	20 (35.1)	0.314		40 (70.2)	17 (29.8)	0.002†	0.003†

PGY, postgraduate year; COVID, coronavirus disease.

*Yates χ^2 test was applied.

†P value obtained by Pearson χ^2 .

Continues

Supplementary Table 3. Continued

Variables	Personal Accomplishment				Depersonalization				Emotional Exhaustion			
	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*	Low or Moderated Burnout, n (%)	High Burnout, n (%)	P	Continuity Correction*
Sexual harassment	6 (100)	0 (0)	0.268		3 (50)	3 (50)	0.594		3 (50)	3 (50)	0.766	
Verbal or emotional abuse	42 (76.4)	13 (23.6)	0.036†	0.065	29 (52.7)	26 (47.3)	0.103		26 (47.3)	29 (52.7)	0.071	
Physical abuse	2 (100)	0 (0)	0.530		2 (100)	0 (0)	0.247		0 (0)	2 (100)	0.108	
Exposure to any type of abuse	58 (81.7)	13 (18.3)	0.425		40 (56.3)	31 (43.7)	0.248		36 (50.7)	35 (49.3)	0.145	
I received no abuse	23 (88.5)	3 (11.5)	0.460		19 (73.1)	7 (26.9)	0.130		19 (73.1)	7 (26.9)	0.043†	0.073
Bullying by managers or bosses	22 (84.6)	4 (15.4)	0.895		12 (46.2)	14 (53.8)	0.091		9 (34.6)	17 (65.4)	0.013†	0.023†
Bullying by direct teachers	21 (87.5)	3 (12.5)	0.577		15 (62.5)	9 (37.5)	0.809		11 (45.8)	13 (54.2)	0.264	
Bullying by other residents	38 (80.9)	9 (19.1)	0.473		25 (53.2)	22 (46.8)	0.186		22 (46.8)	25 (53.2)	0.100	
Bullying by nursing staff	13 (76.5)	4 (23.5)	0.374		8 (47.1)	9 (52.9)	0.223		5 (29.4)	12 (70.6)	0.017†	0.034†
Bullying by patients and their families	22 (71)	9 (29)	0.023†	0.046†	17 (54.8)	14 (45.2)	0.459		12 (38.7)	19 (61.3)	0.024†	0.040†
I did not receive bullying	22 (78.6)	6 (21.4)	0.387		21 (75)	7 (25)	0.067		22 (78.6)	6 (21.4)	0.005†	0.010†
I have suicidal ideas	9 (64.3)	5 (35.7)	0.034†	0.084	4 (28.6)	10 (71.4)	0.009†	0.021†	2 (14.3)	12 (85.7)	0.001†	0.002†

PGY, postgraduate year; COVID, coronavirus disease.
 *Yates χ^2 test was applied.
 †P value obtained by Pearson χ^2 .

Supplementary Table 4. High Levels of Burnout, Multivariate Analysis

	Personal Accomplishment (High Levels)				Depersonalization (High Levels)			Emotional Exhaustion (High Levels)				
	OR	95% CI	P		OR	95% CI	P	OR	95% CI	P		
Age (>30 years)	0.198	0.041	0.954	0.043*	0.133	0.035	0.500	0.003*	0.360	0.121	1.069	0.066
Gender (male)	0.792	0.192	30.256	0.746	0.936	0.295	2.973	0.911	1.153	0.387	3.434	0.798
Marital status (in couple)	1.196	0.348	4.107	0.776	0.497	0.193	1.277	0.146	0.918	0.374	2.249	0.851
You have children (yes)	2.207	0.325	14.977	0.418	2.685	0.526	13.710	0.235	1.155	0.258	5.182	0.851
Junior resident (postgraduate year 1–3)	1.682	0.407	6.950	0.472	3.043	1.058	8.754	0.039	0.696	0.255	1.903	0.480
Mexican	0.223	0.043	1.172	0.076	0.557	0.204	1.525	0.255	0.729	0.277	1.921	0.523
>30 major surgeries per month	1.866	0.334	10.428	0.477	0.967	0.307	3.044	0.954	1.714	0.549	5.350	0.353
>100 monthly admissions	0.599	0.141	2.547	0.488	10.432	0.528	3.885	0.481	0.539	0.193	1.499	0.236
>1 operating room	3.514	0.580	21.272	0.171	0.563	0.199	1.594	0.279	1.399	0.490	3.999	0.531
>60 hours of work per week	1.087	0.249	4.742	0.911	1.994	0.688	5.783	0.204	1.255	0.461	3.420	0.657
Noncompliance with the departure time	1.287	0.348	4.765	0.705	0.731	0.273	1.958	0.533	0.987	0.385	2.530	0.979
Discrimination	4.817	0.795	29.186	0.087	1.035	0.353	3.030	0.950	3.019	1.057	8.629	0.039*
Abuse and mistreatment	5.123	0.616	42.645	0.131	2.443	0.553	10.781	0.238	1.112	0.268	4.616	0.883
Bullying	0.037	0.004	0.389	0.006*	1.392	0.298	6.503	0.674	1.935	0.439	8.519	0.383

*Statistically significant values.
OR, odds ratio; CI, confidence interval.

Supplementary Table 5. Risk of Suicidal Ideas and High Burnout Scores

	Odds Ratio	95% Confidence Interval	P	
Suicidal ideas				
Age (>30 years)	6.438	0.897	46.199	0.064
Gender (male)	3.471	0.680	17.729	0.135
Junior resident (PGY 1–3)	0.190	0.031	1.172	0.074
Mexican	0.107	0.009	1.337	0.083
Discrimination	4.760	0.619	36.639	0.134
Abuse and mistreatment	1.950	0.134	28.329	0.625
Bullying	0.723	0.038	13.659	0.829
Burnout				
Personal accomplishment (high level)	2.745	0.436	17.271	0.282
Depersonalization (high level)	7.869	1.266	48.888	0.027*
Emotional exhaustion (high level)	7.398	0.957	57.162	0.055

*Statistically significant values.

