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Pandemic impact on training and mental health of medical residents: an Italian multicentre prospective study

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Abstract

Objective. To describe the mental health of Italian medical residents during COVID-19 pandemic and explore the impact of personal and work-related changes on their mental health.

Methods. A multicentre prospective study was conducted on a sample of Italian residents across five timepoints (February-October 2021). Mental health outcomes (symptoms of post-traumatic stress disorder, PTSD, depression, anxiety, poor sleep quality) were assessed. Regressions analysed the association between pandemic-related personal and professional changes and the mental health outcomes.

Results. Participants were 451. From February to October 2021, the prevalence of symptoms ranged from 21.6% to 12.7% (PTSD), 29.8% to 16.2% (depression), 36.2% to 28.8% (anxiety), 15.2% to 5.7% (sleep). Several work-related changes were significantly associated with symptoms, e.g. a perceived negative training change was associated with all outcomes; increased working hours with PTSD, depression, and anxiety; reallocation to tasks far from expertise area with PTSD.

Conclusions. Residents reported a relevant frequency of mental issues. Many work-related changes were associated with poor mental health.

Key words

- education, medical, graduate
- internship and residency
- COVID-19
- mental health

INTRODUCTION

The COVID-19 pandemic caused a public health crisis that seriously affected medical and surgical practice [1-3]. Most countries reported the disruption of at least one essential health service [4, 5]. If on the one hand the pandemic reduced many services, on the other it generated a high demand for healthcare assistance. The impossibility of working in proper conditions, with increased workloads, organizational unpreparedness, and lack of resources caused healthcare professionals (HCPs) to feel scared, anxious, and even burnout [6]. Many physicians and residents were reallocated from their activities to emergency departments or COVID-19 wards due to a shortage of personnel [7].

HCPs were exposed to psychological distress, especially those who worked with COVID-19 patients [2, 8-10]. High risk of contagion, inadequate protection, lack of experience, negative feedback from patients, social stigma, and isolation were all factors potentially influencing mental health. Working in such conditions could cause depression, anxiety, post-traumatic stress disorder (PTSD), insomnia, and fear, affecting HCP well-being and their effectiveness at work [2, 8-10].

Medical residents are particularly at risk, as they are physicians or surgeons in a formation process, and both younger age and less experience are important distress risk factors [7]. Already before the pandemic, this population reported poor mental health outcomes, both considering their previous path as medical students [11, 12] and their residency training, which is well-known to be very stressful as residents are often burdened by long working hours, high workloads, and personal time inadequacy [13]. Although without considering clinical diagnoses, many studies evaluated the pandemic impact

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on the mental health of residents [1, 14-16], mostly considering stress, anxiety, and depression symptoms and showing results consistent with other HCPs [2, 8-10]. For instance, a study on French urology residents revealed that over 90% of respondents felt more stressed during the pandemic, with senior residents particularly affected by the crisis's impact on work quality [1]. In South Korea, orthopaedic residents reported that their quality of life scores dropped significantly during the pandemic [14]. In the UK, 64% of cardiothoracic surgical trainees expressed concerns about their mental health, with significant reductions in clinical training opportunities and fears about personal protective equipment provision [15]. A US study found that nearly half of the otolaryngology residents experienced anxiety or distress, with residents reporting higher burnout rates compared to attendings [16]. Most of the data are cross-sectional and focus on specific subpopulations of residents, limiting the ability to provide a comprehensive picture of residents' mental health across different pandemic phases. As far as we know, few studies have been conducted in Italy, where the healthcare system has been widely disrupted by the pandemic [17].

Therefore, the primary aim of this prospective multicentre study was to assess the mental health of Italian residents across different pandemic periods, exploring whether pandemic-related changes in personal and working life might influence mental health symptoms. Secondarily, this work aimed to provide a glimpse of the changes in the training and work of residents during this unprecedented situation.

MATERIALS AND METHODS

Study design

A multicentre prospective study was conducted amongst a convenience sample of medical residents. The centres were 4 universities selected by convenience in different Italian regions, from North to South. The study was approved by the Ethics Committee of the University of Turin (Piedmont), which was the leading centre. First-year residents were excluded since they began their residency in November 2020, thus they worked as residents only a few months before the study began.

Residents were recruited via email thanks to university administrative offices. Informed consent was obtained. Participation was voluntary and participants received no compensation. Individuals were asked to create a nickname according to rules decided by the researchers to match data across timepoints. The researchers did not know the respondents' identity.

In 2021, the survey was repeated every two months: February (T0), April (T1), June (T2), August (T3), and October (T4). At each timepoint, the survey could be completed within two weeks.

The questionnaire

Four sections of the questionnaire were developed by the researchers after a study of literature on residents and mental health during the pandemic. The following topics were identified as relevant: economic situation [2, 18], living conditions [19], worries about the health of family and loved ones [14, 20], having a loved one belonging to a vulnerable group for COVID-19 [21], personal medical history [1], having contracted SARS-CoV-2 [21], year of residency [1, 20], worries about residency training and education [18, 21], perception of availability of personal protective equipment (PPE) [21, 22], changes in working tasks [21], treating COVID-19 positive patients [1, 2]. The fifth section included 4 validated tools to assess the outcomes.

Two versions of the questionnaire were created. A long one for T0 and a shorter one for the remaining timepoints.

The T0 questionnaire included a first section with sociodemographic and residency-related items. Items about living conditions were repeated at each timepoint. Most items from the second to the fourth section referred both to the period of the first lockdown (between March and May 2020) and to the period when the survey was conducted (considering the last two months). Items concerning the lockdown were explored only at T0. The second section investigated the pandemic impact on the private life of the residents and the third part the impact on the professional life. The fourth section explored work-related exposure to COVID-19 and the perception of PPE availability at work. In the last section, mental health was assessed. The English translation of the questionnaire developed by the Authors is *available online as Supplementary Material.*

PTSD symptoms were evaluated with the primary care (PC) PTSD screen for DSM-5 (PC-PTSD-5), adapted to ask about pandemic-related events over the last month. If participants answered "Yes" at least to 3 items the test was above the cut-off for PTSD [23]. The Patient Health Questionnaire-2 (PHQ-2) explores symptoms over the last two weeks and a score of 3 or higher represents a higher probability of having a depressive disorder [24]. The Generalized Anxiety Disorder-2 (GAD-2) assesses symptoms over the same period and a score of 3 or higher represents a higher probability of having an anxiety disorder [25]. The Single-Item Sleep Quality Scale (SQS) is one item that evaluates the quality of sleep during the last 7 days: a score of 3 or lower represents a poor/terrible quality of sleep [26].

Statistical analysis

Participants who completed only one questionnaire were excluded. To analyse possible differences in the outcomes at T0 between participants who completed only T0 and participants who completed at least another questionnaire, chi-squared tests were used. The same analysis was repeated between participants who completed only T0 and participants who completed all timepoints. To further evaluate missing outcome data, the scores of the outcomes at each timepoint were tested with the Little's missing completely at random (MCAR) test.

The main analyses were conducted on a sample composed of residents who completed at least two questionnaires. Questionnaires completed by the same resident were matched through nicknames. Each timepoint was not necessarily composed of the same participants.

Descriptive analyses were done for all variables at each timepoint. Age had a non-normal distribution

(Shapiro-Wilk test) and was described as the median and interquartile range (IQR). To compare the proportion of each variable across the timepoints, chi-squared tests were executed. To explore the variables associated with mental health outcomes, multilevel mixed-effect multiple logistic regression models were run (levels: university; participant). Overall, models were adjusted by gender and covariates were selected based on *p*-values at univariable analyses. Results were expressed as adjusted odds ratio (adjOR) and 95% confidence interval (CI).

To explore if the results were confirmed considering only participants who completed all the timepoints, a sensitivity analysis was performed in such longitudinal subsample. Descriptive analyses were repeated. The overall sample and the longitudinal subsample characteristics at T0 were compared through chi-squared tests. To compare the subsample characteristics across timepoints the related-samples Cochran's Q test was performed. The same multilevel multiple regression models were re-run on this subsample.

The analyses were executed with STATA v16 and SPSS v26 software. Significance was set at *p*-value<0.050.

RESULTS

Characteristics of the sample

A total of 451 residents completed at least two questionnaires and were analysed (Little's MCAR test *p*-value=0.778). Considering the outcomes at T0, participants who completed only T0 and participants who completed at least another questionnaire were not different (PC-PTSD-5: p=0.452; PHQ-2: p=0.803; GAD-2: p=0.228; SQS: p=0.517). A total of 97 participants completed all timepoints. Also in this case, these participants were not different from the ones who completed only T0 (PC-PTSD-5: p=0.601; PHQ-2: p=0.908; GAD-2: p=0.702; SQS: p=0.752).

Table 1 shows time-invariant variables explored at T0. The median age was 30 years (IQR=29-32). The most frequent changes during the lockdown were reallocation to tasks (very different from the usual ones but within their expertise area) and changes in working hours. *Table S1 available online as Supplementary Material* shows the descriptive analysis for the same variables in the longitudinal subsample; no significant differences between the overall sample and this subsample were revealed.

Table 2 shows time-varying variables reporting the changes related to the pandemic impact on personal, academic, and working life. The location of the university was not differently distributed across timepoints (p=0.834). Some variables significantly changed, e.g. perceived negative impact of the pandemic on training, reallocation, increased working hours, and working with COVID-19 patients were more frequent during the first timepoints. *Table S2 available online as Supplementary Material* shows time-varying variables for the longitudinal subsample. Also for these variables, no significant differences between the overall sample and this subsample at T0 were reported. Similarly to relationships reported for the overall sample, the related-samples Cochran's Q tests showed that the distribution across timepoints was significantly different for some work-related variables, e.g. holding a pandemic-related contract, reallocation of tasks, working with COVID-19 patients, having been isolated or tested positive, and having received COVID-19 vaccine.

Mental health outcomes

PTSD was present in 21.6% (T0), 24.2% (T1), 15.4% (T2), 12.0% (T3), and 12.7% (T4) of participants (p<0.001). Considering depressive symptoms, participants above the cut-off were 29.8% (T0), 29.2% (T1), 23.2% (T2), 17.5% (T3), and 16.2% (T4) of the sample (p<0.001). Anxiety was likely in 36.2% (T0), 34.5% (T1), 31.2% (T2), 22.6% (T3), and 28.8% of residents (T4) (p<0.007). Poor sleep was reported by 15.2% (T0), 13.7% (T1), 13.1% (T2), 10.6% (T3), and 5.7% of participants (T4) (p<0.009). *Table S3 available online as Supplementary Material* shows the outcomes in the longitudinal subsample (no significant differences at T0 with the overall sample). Related-samples Cochran's Q test confirmed similar relationships as reported for the overall sample considering PTSD, depressive symptoms, and sleep.

The multivariable models (*Table 3*) reported many significant relationships. Some locations of universities showed differences from the leading university for PTSD, depressive, and anxiety symptoms. Overall, participants who completed the questionnaire during the last 3 timepoints had a lower likelihood of poor mental health. Specifically, compared with T0, at T2 participants had a lower likelihood of reporting PTSD (adjOR=0.42, 95% CI 0.22-0.82) and depressive symptoms (adjOR=0.55, 95% CI 0.32-0.93). At T3, participants had a lower likelihood of reporting PTSD (adjOR=0.45, 95% CI 0.21-0.99), depressive symptoms (adjOR=0.35, 95% CI 0.19-0.67), and anxiety symptoms (adjOR=0.39, 95% CI 0.22-0.69). At T4, participants had a lower likelihood of reporting depressive symptoms (adjOR=0.38, 95% CI 0.20-0.72) and poor sleep quality (adjOR=0.23, 95% CI 0.08-0.61). Women had higher odds of PTSD (adjOR=2.38, 95% CI 1.12-5.06), depressive symptoms (adjOR=2.18, 95% CI 1.16-4.09), and anxiety (adjOR=2.58, 95% CI 1.41-4.70). Other socio-demographic characteristics were associated with worse mental outcomes, both non-COVID-19-related and COVID-19-related. Specifically, the following variables significantly increased the likelihood of reporting symptoms: worsening of the economic situation due to the pandemic (depressive symptoms: adjOR=2.87, 95% CI 1.29-6.37), loved ones suffering from COVID-19 (PTSD: adjOR=5.91, 95% CI 2.76-12.65), and having children (poor sleep quality: adjOR=5.48, 95% CI 1.46-20.45). Several specialization-related variables revealed significant associations, with higher odds of reporting symptoms: reallocations to tasks far from the area of expertise (PTSD: adjOR=3.12, 95% CI 1.2-8.09) or within the area of expertise (depressive symptoms: adjOR=1.82, 95% CI 1.04-3.20), increased working hours (PTSD: adjOR=2.59, 95% CI 1.41-4.76; depressive symptoms: adjOR=2.26, 95% CI 1.34-3.78; anxiety symptoms: adjOR=2.57, 95% CI 1.59-4.15), positive change in training due to the pandemic (PTSD: adjOR=4.77, 95% CI 1.83-12.43), and negative change

Table 1
Descriptive analysis of time invariant variables at T0

Characteristic		Sample at T0 (n=356)	
		N	%
Gender	Male	124	34.83
	Female	229	64.33
	Non-binary	3	0.84
Area of specialization	Medical area	178	50.00
	Surgical area	58	16.29
	Clinical services area	120	33.71
Specialization related to Emergency-Urgency area	No	290	81.50
	Yes	66	18.50
Location of University	Piedmont	169	47.47
	Friuli-Venezia Giulia	77	21.63
	Emilia Romagna	67	18.82
	Sicily	43	12.08
Year of specialization	2	122	34.27
	3	104	29.21
	4	85	23.88
	5	45	12.64
Nationality	Italian	354	99.44
	Other	2	0.56
Having children	No	326	91.57
	Yes	30	8.43
Belonging to a risk group for COVID-19 complications	No	348	97.75
	Yes	8	2.25
Loved ones belonging to a risk group for COVID-19 complications	No	130	36.52
	Yes	226	63.48
Change of living condition during the first lockdown due to the pandemic (e.g., to not share the house with frail individuals)	No	299	83.99
	Yes, less than one month	18	5.06
	Yes. more than one month	39	10.96
Psychological/psychopharmacological support during lockdown (not needed before the pandemic)	No	336	94.38
	Yes	20	5.62
Reallocation to tasks that, according to the participant, are too far from his/her area of expertise (during the lockdown)	No	321	90.17
	Yes	35	9.83
Reallocation to tasks that are very different from the usual ones but still within their area of expertise (during lockdown)	No	266	74.72
	Yes	90	25.28
Working hours substantially modified due to the pandemic (during lockdown)	No	127	35.67
	Reduced	119	33.43
	Increased	110	30.90
Working from home for most of the working hours (during lockdown)	No	318	89.33
	Yes	38	10.67
In the department where he/she worked, COVID-19 patients were treated (during lockdown)	No	183	51.40
	Yes	173	48.60
The department where he/she worked was entirely dedicated to the treatment of COVID-19 patients (during lockdown)	No	282	79.21
	Yes	74	20.79
The participant personally treated COVID-19 patients (during lockdown)	No	228	64.04
	Yes	128	35.96
The participant felt that the available PPE at work was enough to keep him/her safe (during lockdown)	No	203	57.02
	Yes	153	42.98

n=sample size; figures are expressed as number (N) and column percentages (%); PPE: personal protective equipment.

Table 2
Descriptive analysis of time varying variables across timepoints

Characteristic		T0 n=356 N (%)	T1 n=380 N (%)	T2 n=298 N (%)	T3 n=217 N (%)	T4 n=229 N (%)	*p*-value
Living condition	Alone	103 (28.93)	108 (28.42)	82 (27.52)	65 (29.95)	59 (25.76)	0.879
	Flatmates	42 (11.8)	42 (11.05)	27 (9.06)	24 (11.06)	25 (10.92)	
	Family	41 (11.52)	32 (8.42)	29 (9.73)	19 (8.76)	24 (10.48)	
	Partner w/wo children	169 (47.47)	195 (51.32)	160 (53.69)	109 (50.23)	120 (52.4)	
	Other	1 (0.28)	3 (0.79)	0 (0)	0 (0)	1 (0.44)	
Change of living condition	No	324 (91.01)	331 (87.11)	272 (91.28)	202 (93.09)	213 (93.01)	0.131
	Yes, less than one month	12 (3.37)	26 (6.84)	12 (4.03)	8 (3.69)	5 (2.18)	
	Yes. more than one month	20 (5.62)	23 (6.05)	14 (4.7)	7 (3.23)	11 (4.8)	
The pandemic is causing a substantial change of the economic situation of the participant's family	No	281 (78.93)	295 (77.63)	225 (75.5)	170 (78.34)	184 (80.35)	0.593
	Yes, it improved	48 (13.48)	60 (15.79)	49 (16.44)	37 (17.05)	35 (15.28)	
	Yes, it worsened	27 (7.58)	25 (6.58)	24 (8.05)	10 (4.61)	10 (4.37)	
Psychological/ psychopharmacological support (not needed before the pandemic)	No	325 (91.29)	337 (88.68)	268 (89.93)	197 (90.78)	204 (89.08)	0.784
	Yes	31 (8.71)	43 (11.32)	30 (10.07)	20 (9.22)	25 (10.92)	
Fear of personally contracting COVID-19 in relation to potential consequences on one's own health	None	43 (12.08)	60 (15.79)	53 (17.79)	40 (18.43)	30 (13.1)	0.080
	Little	165 (46.35)	194 (51.05)	147 (49.33)	108 (49.77)	134 (58.52)	
	Moderate	131 (36.8)	114 (30)	87 (29.19)	61 (28.11)	56 (24.45)	
	A lot	17 (4.78)	12 (3.16)	11 (3.69)	8 (3.69)	9 (3.93)	
Fear of personally contracting COVID-19 in relation to potential consequences on the health of one's loved ones	None	3 (0.84)	6 (1.58)	8 (2.68)	4 (1.84)	7 (3.06)	**<0.001**
	Little	17 (4.78)[b]	29 (7.63)[b]	35 (11.74)	37 (17.05)	45 (19.65)	
	Moderate	118 (33.15)[b]	158 (41.58)	140 (46.98)	104 (47.93)[a]	105 (45.85)[a]	
	A lot	218 (61.24)[a]	187 (49.21)[a]	115 (38.59)[b]	72 (33.18)[b]	72 (31.44)[b]	
A loved one has suffered serious health damage after COVID-19	No	324 (91.01)	323 (85)[b]	262 (87.92)	189 (87.1)	214 (93.45)[a]	**0.012**
	Yes	32 (8.99)	57 (15)[a]	36 (12.08)	28 (12.9)	15 (6.55)[b]	
Holder of a contract entered into following urgent provisions for the pandemic	No	296 (83.15)[a]	233 (61.32)[b]	206 (69.13)	158 (72.81)	182 (79.48)[a]	**<0.001[c]**
	Yes	60 (16.85)[b]	147 (38.68)[a]	92 (30.87)	59 (27.19)	47 (20.52)[b]	
Reallocation to tasks that, according to the participant, are too far from his/her area of expertise	No	338 (94.94)	352 (92.63)	283 (94.97)	208 (95.85)	219 (95.63)	0.382
	Yes	18 (5.06)	28 (7.37)	15 (5.03)	9 (4.15)	10 (4.37)	
Reallocation to tasks that are very different from the usual ones but still within their area of expertise	No	296 (83.15)	296 (77.89)[b]	234 (78.52)	184 (84.79)	203 (88.65)[a]	**0.005[c]**
	Yes	60 (16.85)	84 (22.11)[a]	64 (21.48)	33 (15.21)	26 (11.35)[b]	
Working hours substantially modified due to the pandemic	No	230 (64.61)	212 (55.79)[b]	195 (65.44)	147 (67.74)	164 (71.62)[a]	**0.003**
	Reduced	15 (4.21)[b]	35 (9.21)[a]	22 (7.38)	13 (5.99)	12 (5.24)	
	Increased	111 (31.18)	133 (35)[a]	81 (27.18)	57 (26.27)	53 (23.14)[b]	
Working from home for most of the working hours	No	352 (98.88)	377 (99.21)	293 (98.32)	216 (99.54)	229 (100)	0.294
	Yes	4 (1.12)	3 (0.79)	5 (1.68)	1 (0.46)	0 (0)	
Believing that the pandemic is substantially changing one's specialization training	No	81 (22.75)[b]	100 (26.32)[b]	112 (37.58)	96 (44.24)[a]	112 (48.91)[a]	**<0.001**
	Yes, positively	54 (15.17)	51 (13.42)	42 (14.09)	33 (15.21)	24 (10.48)	
	Yes, negatively	221 (62.08)[a]	229 (60.26)[a]	144 (48.32)	88 (40.55)[b]	93 (40.61)[b]	
In the department where he/she worked, COVID-19 patients were treated	No	159 (44.66)	152 (40)[b]	124 (41.61)	111 (51.15)	134 (58.52)[a]	**<0.001[c]**
	Yes	197 (55.34)	228 (60)[a]	174 (58.39)	106 (48.85)	95 (41.48)[b]	

Continues

Table 2
Continued

Characteristic		T0 n=356 N (%)	T1 n=380 N (%)	T2 n=298 N (%)	T3 n=217 N (%)	T4 n=229 N (%)	*p*-value
The department where he/she worked was entirely dedicated to the treatment of COVID-19 patients	No	279 (78.37)	280 (73.68)[b]	227 (76.17)	179 (82.49)	200 (87.34)[a]	**0.001**[c]
	Yes	77 (21.63)	100 (26.32)[a]	71 (23.83)	38 (17.51)	29 (12.66)[b]	
The participant personally treated COVID-19 patients	No	208 (58.43)	186 (48.95)[b]	159 (53.36)	126 (58.06)	154 (67.25)[a]	**<0.001**[c]
	Yes	148 (41.57)	194 (51.05)[a]	139 (46.64)	91 (41.94)	75 (32.75)[b]	
Having been in isolation due to suspicion or diagnosis of COVID-19	No	217 (60.96)[b]	284 (74.74)	251 (84.23)[a]	190 (87.56)[a]	204 (89.08)[a]	**<0.001**[c]
	Yes	139 (39.04)[a]	96 (25.26)	47 (15.77)[b]	27 (12.44)[b]	25 (10.92)[b]	
Having tested positive for COVID-19 through a swab test	No	308 (86.52)[b]	338 (88.95)	280 (93.96)	207 (95.39)[a]	218 (95.2)[a]	**<0.001**[c]
	Yes	48 (13.48)[a]	42 (11.05)	18 (6.04)	10 (4.61)[b]	11 (4.8)[b]	
The participant felt that the available PPE at work was enough to keep him/her safe	No	37 (10.39)	63 (16.58)[a]	50 (16.78)[a]	22 (10.14)	21 (9.17)	**0.005**
	Yes	319 (89.61)	317 (83.42)[b]	248 (83.22)[b]	195 (89.86)	208 (90.83)	
Having already received anti-COVID-19 vaccine	No	36 (10.11)[a]	13 (3.42)	4 (1.34)[b]	3 (1.38)[b]	2 (0.87)[b]	**<0.001**[c]
	Yes	320 (89.89)[b]	367 (96.58)	294 (98.66)[a]	214 (98.62)[a]	227 (99.13)[a]	

P-values are presented in bold for results with $p < 0.050$. All variables refer to the last two months; n=sample size; figures are expressed as number (N) and column percentages (%); *p*-value obtained via chi-squared test; [a]adjusted residual >1.96; [b]adjusted residual <-1.96; [c]significant relationships confirmed via the Cochran Q test for paired samples within the longitudinal subsample of 97 participants; PPE: personal protective equipment; w/wo with or without.

in training due to the pandemic (PTSD: adjOR=3.6, 95% CI 1.73-7.53; depressive symptoms: adjOR=3.20, 95% CI 1.86-5.48; anxiety symptoms: adjOR=2.89, 95% CI 1.78-4.70; poor sleep quality: adjOR=2.33, 95% CI 1.07-5.08). Attending the 3rd year of specialization compared with the 2nd was associated with a lower probability of reporting PTSD (adjOR=0.37, 95% CI 0.15-0.91). Unadjusted regressions are reported in *Table S4* and *Table S5 available online as Supplementary Material*.

The sensitivity analysis based on the longitudinal subsample confirmed many of the above-mentioned relationships (*Table* S6 and S7 *available online as Supplementary Material*). Considering PTSD, associations with gender, serious health damage of a loved one, and negative change of training were confirmed. Furthermore, participants who changed their living conditions due to the pandemic had a higher likelihood of PTSD. Regarding depression and anxiety, the relationships with T3 and negative change of training were confirmed. Concerning poor sleep quality, the association with T4 was confirmed and participants who treated COVID-19 patients were more likely to report this outcome.

DISCUSSION

This study primarily aimed to analyse medical residents' mental health from 4 Italian universities from February to October 2021, exploring the influence of working and personal life changes due to COVID-19. Second, it aimed to provide insights into residents' training changes across the pandemic.

Across all timepoints, the outcomes' prevalence was always at least above 12%, except for poor sleep quality, showing a substantial burden of mental health symptoms. Indeed, for instance, one of the major surveillance systems in Italy, the Passi surveillance, reported – using the PHQ-2 – a prevalence of depressive symptoms of 6.7% among young people aged 18 to 34 during the period 2020-2021 (https://www.epicentro.iss.it/passi/dati/depressione#dati). In addition, Italian pre-pandemic data from the World Health Organization (WHO) World Mental Health Surveys showed a 12-month prevalence of anxiety disorders and PTSD among trauma-exposed individuals of 6.5% and 1.3%, respectively [27, 28].

Our findings were consistent with data about residents from other countries during the pandemic [29-33]. PTSD symptoms prevalence rose in April 2021 and decreased successively. Similarly, depressive symptoms were higher in February and April, then decreased; as well as poor sleep quality decreased from February to October. Anxiety showed similar patterns but with a rise in October. Interestingly, in the longitudinal subsample anxiety symptoms were not significantly reduced in the last study phases. Consistently with descriptive analysis, regression models generally confirmed lower levels of symptoms during June, August, or October, compared with February. Overall, the outcomes' trends reflected the pandemic curve in Italy. The number of new daily confirmed cases in February and April ranged from 10,000 to 20,000 cases, while it ranged from 1,000 to 6,000 cases in summer and autumn [34]. It is possible residents benefited from the decline in cases since it led to fewer COVID-19 hospitalizations [34]. We hypothesise that the increased anxiety in October might be related to the expected rise in cases in autumn 2021. Speaking of the pandemic curve, it could only partially explain differences in outcomes found among university locations, e.g., Piedmont, which was the reference in multivariable models, had better epidemiological situations mostly in the latest phases (https://mappe.protezionecivile.gov.it/it/mappe-e-dashboards-emer-

Table 3
Multivariable logistic regression models

	PTSD		Depressive symptoms		Anxiety symptoms		Poor sleep quality	
	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*
Timepoint: T0	Ref.		Ref.		Ref.		Ref.	
T1	1.04 (0.6-1.79)	0.893	0.87 (0.55-1.39)	0.577	0.87 (0.56-1.34)	0.528	0.75 (0.41-1.36)	0.350
T2	0.42 (0.22-0.82)	**0.011**	0.55 (0.32-0.93)	**0.026**	0.70 (0.43-1.14	0.156	0.67 (0.34-1.33)	0.258
T3	0.45 (0.21-0.99)	**0.046**	0.35 (0.19-0.67)	**0.001**	0.39 (0.22-0.69)	**0.001**	0.84 (0.36-1.85)	0.667
T4	0.58 (0.27-1.23)	0.157	0.38 (0.20-0.72)	**0.003**	0.88 (0.52-1.49)	0.647	0.23 (0.08-0.61)	**0.003**
Gender: Male	Ref.		Ref.		Ref.		Ref.	
Female	2.38 (1.12-5.06)	**0.024**	2.18 (1.16-4.09)	**0.015**	2.58 (1.41-4.70)	**0.002**	1.29 (0.55-3.06)	0.549
Non-binary[a]	-	-	-		-	-	-	-
Specialization related to Emergency-Urgency area	2.42 (0.98-5.97)	0.055						
Location of University: Piedmont	Ref.		Ref.		Ref.		Ref.	
Friuli-Venezia Giulia	1.51 (0.6-3.79)	0.385	2.14 (1.02-4.46)	**0.043**	1.58 (0.79-3.18)	0.192	1.11 (0.39-3.18)	0.834
Emilia Romagna	5.17 (2.12-12.64)	**<0.001**	3.89 (1.84-8.23)	**<0.001**	4.02 (1.96-8.23)	**<0.001**	2.18 (0.77-6.19)	0.141
Sicily	7.7 (2.55-23.26)	**<0.001**	3.06 (1.14-8.21)	**0.026**	1.30 (0.50-3.41)	0.585	1.53 (0.42-5.51)	0.508
Year of specialization: 2	Ref.							
3	0.37 (0.15-0.91)	**0.030**						
4	0.75 (0.3-1.87)	0.533						
5	0.36 (0.11-1.18)	0.091						
Change of living condition: No	Ref.							
Yes, less than one month	1.39 (0.46-4.15)	0.559						
Yes. more than one month	0.61 (0.19-1.99)	0.416						
The pandemic is causing a substantial change of the economic situation of the participant's family: No	Ref.		Ref.					
Yes, it improved	1.46 (0.65-3.29)	0.361	1.71 (0.88-3.33)	0.109				
Yes, it worsened	0.99 (0.34-2.87)	0.980	2.87 (1.29-6.37)	**0.009**				
A loved one has suffered serious health damage after COVID-19	5.91 (2.76-12.65)	**<0.001**					1.92 (0.80-4.60)	0.141
Reallocation to tasks that, according to the participant, are too far from his/her area of expertise	3.12 (1.2-8.09)	**0.020**						
Reallocation to tasks that are very different from the usual ones but still within their area of expertise	0.94 (0.48-1.85)	0.862	1.82 (1.04-3.20)	**0.035**	1.24 (0.73-2.12)	0.414		
Working hours substantially modified due to the pandemic: No	Ref.		Ref.		Ref.			
Reduced	1.13 (0.36-3.53)	0.838	1.86 (0.79-4.37)	0.152	0.86 (0.38-1.95)	0.722		
Increased	2.59 (1.41-4.76)	**0.002**	2.26 (1.34-3.78)	**0.002**	2.57 (1.59-4.15)	**<0.001**		
Believing that the pandemic is substantially changing one's specialization training: No	Ref.		Ref.		Ref.		Ref.	
Yes, positively	4.77 (1.83-12.43)	**0.001**	0.61 (0.26-1.42)	0.260	1.43 (0.69-2.93)	0.330	1.73 (0.62-4.78)	0.290
Yes, negatively	3.6 (1.73-7.53)	**0.001**	3.20 (1.86-5.48)	**<0.001**	2.89 (1.78-4.70)	**<0.001**	2.33 (1.07-5.08)	**0.033**

Continues

Table 3
Continued

	PTSD		Depressive symptoms		Anxiety symptoms		Poor sleep quality	
	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*	adjOR (95% CI)	*p*
The participant personally treated COVID-19 patients	1.8 (0.98-3.31)	0.059	1.40 (0.88-2.24)	0.152	1.37 (0.89-2.12)	0.147	1.72 (0.90-3.26)	0.095
Having been in isolation due to suspicion or diagnosis of COVID-19	1.26 (0.68-2.32)	0.460	1.07(0.64-1.77)	0.787				
The participant felt that the available PPE at work was enough to keep him/her safe					0.59 (0.33-1.08)	0.091		
Age							1.05 (0.92-1.19)	0.463
Having children							5.48 (1.46-20.45)	**0.011**
Loved ones belonging to a risk group for COVID-19 complications							2.02 (0.85-4.82)	0.110

P-values are presented in bold for results with $p < 0.050$; [a]omitted for low sample size; PTSD: post-traumatic stress disorder; adjOR: adjusted odds ratio; CI: confidence intervals; Ref.: reference; PPE: personal protective equipment; empty cells indicate variables that were not selected for inclusion in that specific regression model.

genze/dashboards-coronavirus/situazione-desktop/). Probably, other circumstances were involved, e.g. hospitalization rate and availability of material and human resources in the workplaces. Moreover, a selection bias could not be excluded.

From our results, women were more at risk for PTSD, depression, and anxiety, in line with previous research regarding HCPs [35, 36]. Although certain mental disorders are typically more prevalent among women than men, the impact of pandemic-related changes on women's work-life balance should also be taken into account [36]. Women may not have had the needed support in balancing work and family demands [36]. Furthermore, having children without care support has been acknowledged to be a risk factor for depression [36]. Additionally, we found that having children was linked to poor sleep quality, but it is not clear whether this result is due to the pandemic or is independent.

Concern about loved ones' health was associated with PTSD. This is not surprising: similar results were found regarding medical staff with families, who were more worried about their own risk of getting infected and of getting their families infected, if compared with their single colleagues [35].

Financial pandemic-related challenges were associated with depressive symptoms. Low-income status or economic concerns are well known for influencing depression [37, 38].

Considering pandemic-related changes in work life, long working hours were associated with PTSD, anxiety, and depressive symptoms. Long working hours are known to be a risk factor for such conditions, especially in extreme working environments, like COVID-19 wards [32, 35]. Additionally, redeployment was a risk factor for PTSD and depression. This result could be explained as residents were placed in an unfamiliar environment, without the specific experience for critical situations [39-41]. Indeed, during the pandemic, many HCPs, including residents, were reassigned to different departments or roles to meet urgent demands. This sudden shift may have placed them in new environments, exposing them to high-stress situations and responsibilities they were not accustomed to handling. It is also important to note that experiences may have varied significantly across different regions of Italy and different hospital departments. The impact of redeployment may have differed between departments; for instance, the transition from a non-critical specialty to a COVID-19 ward was vastly different compared to transitions within critical care specialties. Due to these variations, our observations can only be generalized to a certain extent.

Being in training during this situation meant that not only job activities were disrupted, but also formation was affected. Perceived negative training modifications were associated with all the outcomes. Concerns regarding formation have been linked with increased levels of stress, anxiety, and burnout [1, 15]. With exams and training courses being cancelled, not being able to progress in the training process and concerns about career progression could be very frustrating [42]. Also, academic pressure may have had a role in the worsening of mental health [43]. Interestingly, participants who perceived a positive impact on their training had a higher likelihood of PTSD symptoms too. This suggests that the higher workload and the numerous challenges might have represented an opportunity to learn but were still a stressful event. Furthermore, third-year residents had less odds of PTSD compared with second-year participants. Senior residents might be more capable of coping with the whole situation, being more experienced. These relationships should be further investigated.

The longitudinal subsample analyses confirmed the relevance of the perceived negative impact on training. They also suggested further pandemic-related changes that could influence residents' mental status, e.g., modifications in living conditions and treating COVID-19 patients. Remarkably, time was not signifi-

cant for PTSD, potentially due to the need for a longer follow-up.

Lastly, the findings shed light on the lockdown's impact on the working conditions and experiences of Italian residents. It is worth noting that many working changes that resulted associated with poor mental outcomes involved more than a quarter of participants, indicating a substantial proportion of residents experienced negative triggers for their health. The reduction of most of these issues during the last timepoints suggests that healthcare systems may have adapted to better manage the pandemic challenges.

Existing literature highlights several strategies for improving mental health among HCPs during health crisis. For instance, mindfulness-based interventions have shown effectiveness in reducing stress and improving mindfulness and mental well-being, though their impact on burnout, anxiety, and depression is less conclusive [44]. Group psychological therapies, including cognitive behavioral programs and acceptance and commitment therapy, also show promise in reducing distress symptoms, but studies often suffer from methodological limitations [45]. Multi-component prevention programs, which include staffing adjustments and psychological support, appear beneficial but need more robust evaluation [46]. Psychotherapy, psychoeducation, and mind-body interventions demonstrated efficacy in reducing anxiety, burnout, depression, and PTSD, with psychoeducation enhancing resilience and mind-body interventions improving quality of life [47]. Future research should focus on more rigorous methodologies and active involvement of healthcare workers in intervention design to enhance the effectiveness and applicability of these programs.

This study had several limitations. The sample size limited the representativeness. The survey was repeated during the summer when many potential respondents were on vacation. Additionally, there may have been survey fatigue, as respondents were involved in multiple questionnaires. Convenience sampling of both centres and participants could have biased sample selection. The self-reported questionnaire could represent itself a limitation in terms of data quality. However, this work represented one of the first prospective Italian studies about the pandemic impact on the training and mental health of residents, a population that is often overlooked, laying the foundation for further investigations. Few studies addressed PTSD in this population, so these data can be relevant to provide insights into this possible pandemic consequence.

CONCLUSIONS

Our study found medical residents' levels of PTSD, depression, anxiety symptoms, and poor quality of sleep that should not be underestimated. Many pandemic-related changes, like redeployment, increased working hours, and disrupted training, increased the odds of such mental health outcomes. Monitoring the long-lasting effects of the pressure many HCPs underwent will be crucial to provide support and prevent worst-case scenarios.

To plan strategies to address mental health issues among residents, it is important to note that there is growing evidence for interventions aimed at improving mental health among healthcare workers. Indeed, many approaches have shown promising benefits in reducing mental health symptoms, e.g., mindfulness-based interventions, psychological therapies, prevention programs that integrate psychological support with systemic changes, mind-body practices, and psychoeducation [44-47]. Future research should focus on rigorous evaluation of these interventions and encourage the involvement of healthcare workers in their design to improve both efficacy and relevance.

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Conflict of interest statement

The Authors have no conflicts of interest to declare.

Ethical approval and consent to participate

All procedures performed were in accordance with the 1964 Helsinki declaration and its later amendments. The study was approved by the Ethics Committee of the University of Turin (Prot. n. 492587, 4 December 2020). Written informed consent was obtained from all individual participants included in the study.

Availability of data and material

All relevant data are within the paper. Dataset is available upon reasonable request to the corresponding Author.

Authors' contributions

Conceptualization: GLM, GS, PL, FB, RS; data curation: GLM, GG, LFB; formal analysis: GLM, GG; investigation: GLM, GG, CAM, DA, LB, SB, MEF, WM; methodology: GLM, GS, PL, FB, RS; project administration: GLM; GG; resources: FB, RS, CAM, DA, LB, SB, MEF, WM; supervision: GS, PL, FB, RS; visualization: GLM, GG, LFB; writing-original draft: GLM, GG; writing-review and editing: PL, FB, RS, CAM, DA, LB, SB, MEF, WM.

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REFERENCES

1. Abdessater M, Rouprêt M, Misrai V, et al. COVID-19 pandemic impacts on anxiety of French urologist in training: Outcomes from a national survey. Prog Urol. 2020;30(8-9):448-55. doi: 10.1016/j.purol.2020.04.015
2. Que J, Shi L, Deng J, et al. Psychological impact of the COVID-19 pandemic on healthcare work-

ers: a cross-sectional study in China. Gen Psychiatr. 2020;33(3):e100259. doi: 10.1136/gpsych-2020-100259
3. Giacomini G, Elhadidy HSMA, Paladini G, et al. Eating disorders in hospitalized school-aged children and adolescents during the COVID-19 pandemic: a cross-sectional study of discharge records in developmental ages in Italy. Int J Environ Res Public Health. 2022;19(20):12988. doi: 10.3390/ijerph192012988
4. World Health Organization (WHO). Essential health services face continued disruption during COVID-19 pandemic. Geneva: WHO; 2022. Available from: https://www.who.int/news/item/07-02-2022-essential-health-services-face-continued-disruption-during-covid-19-pandemic.
5. World Health Organization (WHO). Third round of the global pulse survey on continuity of essential health services during the COVID-19 pandemic. Geneva: WHO; 2022. Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-EHS_continuity-survey-2022.1.
6. Shah K, Chaudhari G, Kamrai D, Lail A, Patel RS. How essential is to focus on physician's health and burnout in coronavirus (COVID-19) pandemic? Cureus. 2020;12(4):e7538. doi: 10.7759/cureus.7538
7. Steil A, Pereira Tokeshi AB, Bernardo LS, et al. Medical residents' mental distress in the COVID-19 pandemic: An urgent need for mental health care. PLoS One. 2022;17(3):e0266228. doi: 10.1371/journal.pone.0266228
8. Kisely S, Warren N, McMahon L, Dalais C, Henry I, Siskind D. Occurrence, prevention, and management of the psychological effects of emerging virus outbreaks on healthcare workers: rapid review and meta-analysis. BMJ. 2020;369:m1642. doi: 10.1136/bmj.m1642
9. Lee BEC, Ling M, Boyd L, Olsson C, Sheen J. The prevalence of probable mental health disorders among hospital healthcare workers during COVID-19: A systematic review and meta-analysis. J Affect Disord. 2023;330:329-45. doi: 10.1016/j.jad.2023.03.012
10. Ghahramani S, Kasraei H, Hayati R, Tabrizi R, Marzaleh MA. Health care workers' mental health in the face of COVID-19: a systematic review and meta-analysis. Int J Psychiatry Clin Pract. 2023;27(2):208-17. doi: 10.1080/13651501.2022.2101927
11. Leombruni P, Corradi A, Lo Moro G, et al. Stress in medical students: PRIMES, an Italian, multicenter cross-sectional study. Int J Environ Res Public Health. 2022;19(9):5010. doi: 10.3390/IJERPH19095010
12. Rotenstein LS, Ramos MA, Torre M, et al. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students a systematic review and meta-analysis. JAMA. 2016;316(21):2214-36. doi: 10.1001/jama.2016.17324
13. Mata DA, Ramos MA, Bansal N, et al. Prevalence of depression and depressive symptoms among resident physicians: a systematic review and meta-analysis. JAMA. 2015;314(22):2373-83. doi: 10.1001/jama.2015.15845
14. Chang DG, Park JB, Baek GH, et al. The impact of COVID-19 pandemic on orthopaedic resident education: a nationwide survey study in South Korea. Int Orthop. 2020;44(11):2203-10. doi: 10.1007/s00264-020-04714-7
15. Caruana EJ, Patel A, Kendall S, Rathinam S. Impact of coronavirus 2019 (COVID-19) on training and well-being in subspecialty surgery: A national survey of cardiothoracic trainees in the United Kingdom. J Thorac Cardiovasc Surg. 2020;160(4):980-7. doi: 10.1016/j.jtcvs.2020.05.052
16. Civantos AM, Byrnes Y, Chang C, et al. Mental health among otolaryngology resident and attending physicians during the COVID-19 pandemic: national study. Head Neck. 2020;42(7):1597-609. doi: 10.1002/hed.26292
17. Gruppo Italiano per la Medicina Basata sulle Evidenze (GIMBE). Report Osservatorio GIMBE 1/2021. Impatto della pandemia COVID-19 sull'erogazione di prestazioni sanitarie; 2021.
18. Khanna R, Honavar S, Metla A, Bhattacharya A, Maulik P. Psychological impact of COVID-19 on ophthalmologists-in-training and practising ophthalmologists in India. Indian J Ophthalmol. 2020;68(6):994. doi: 10.4103/ijo.IJO_1458_20
19. Chew QH, Chia FLA, Ng WK, et al. Perceived stress, stigma, traumatic stress levels and coping responses amongst residents in training across multiple specialties during COVID-19 pandemic – A longitudinal study. Int J Environ Res Public Health. 2020;17(18):6572. doi: 10.3390/ijerph17186572
20. Collins C, Mahuron K, Bongiovanni T, Lancaster E, Sosa JA, Wick E. Stress and the surgical resident in the COVID-19 Pandemic. J Surg Educ. 2021;78(2):422-30. doi: 10.1016/j.jsurg.2020.07.031
21. Khusid JA, Weinstein CS, Becerra AZ, et al. Well-being and education of urology residents during the COVID-19 pandemic: results of an American national survey. Int J Clin Pract. 2020;74(9):e13559. doi: 10.1111/ijcp.13559
22. Rana T, Hackett C, Quezada T, et al. Medicine and surgery residents' perspectives on the impact of COVID-19 on graduate medical education. Med Educ Online. 2020;25(1):1818439. doi: 10.1080/10872981.2020.1818439
23. Prins A, Bovin MJ, Smolenski DJ, et al. The primary care PTSD screen for DSM-5 (PC-PTSD-5): development and evaluation within a veteran primary care sample. J Gen Intern Med. 2016;31(10):1206-11. doi: 10.1007/s11606-016-3703-5
24. Kroenke K, Spitzer RL, Williams JBW. The patient health questionnaire-2: Validity of a two-item depression screener. Med Care. 2003;41(11):1284-92. doi: 10.1097/01.MLR.0000093487.78664.3C
25. Kroenke K, Spitzer RL, Williams JBW, Monahan PO, Löwe B. Anxiety disorders in primary care: Prevalence, impairment, comorbidity, and detection. Ann Intern Med. 2007;146(5):317-25. doi: 10.7326/0003-4819-146-5-200703060-00004
26. Snyder E, Cai B, DeMuro C, Morrison MF, Ball W. A new single-item sleep quality scale: results of psychometric evaluation in patients with chronic primary insomnia and depression. Journal of Clinical Sleep Medicine. 2018;14(11):1849-57. doi: 10.5664/jcsm.7478
27. Koenen KC, Ratanatharathorn A, Ng L, McLaughlin KA, et al. Posttraumatic stress disorder in the world mental health surveys. Psychol Med. 2017;47(13):2260-74. doi: 10.1017/S0033291717000708
28. 28. Alonso J, Liu Z, Evans-Lacko S, et al. Treatment gap for anxiety disorders is global: results of the world mental health surveys in 21 countries. Depress Anxiety. 2018;35(3):195-208. doi: 10.1002/da.22711
29. Emre N, Edirne T, Ozsahin A, Kulceler MF. Assessment on risk and stress of resident doctors during the COVID-19 pandemic. J Infect Dev Ctries. 2021;15(08):1080-5. doi: 10.3855/jidc.14877
30. Chang J, Ray J, Joseph D, Evans L, Joseph M. Burnout and post-traumatic stress disorder symptoms among emergency medicine resident physicians during the COVID-19 Pandemic. West J Emerg Med. 2022;23(2):251-7. doi: 10.5811/westjem.2021.11.53186
31. Blekas A, Voitsidis P, Athanasiadou M, et al. COVID-19: PTSD symptoms in Greek health care professionals. Psy-

chol Trauma. 2020;12(7):812-9. doi: 10.1037/tra0000914
32. Sahebi A, Nejati-Zarnaqi B, Moayedi S, Yousefi K, Torres M, Golitaleb M. The prevalence of anxiety and depression among healthcare workers during the COVID-19 pandemic: An umbrella review of meta-analyses. Prog Neuropsychopharmacol Biol Psychiatry. 2021;107:110247. doi: 10.1016/j.pnpbp.2021.110247
33. Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, et al. Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res. 2021;295:113599. doi: 10.1016/j.psychres.2020.113599
34. Mathieu E, Ritchie H, Rodés-Guirao L, et al. Coronavirus pandemic (COVID-19); 2020. Available from: https://ourworldindata.org/coronavirus.
35. Qi G, Yuan P, Qi M, Hu X, Shi S, Shi X. Influencing factors of high PTSD among medical staff during COVID-19: evidences from both meta-analysis and subgroup analysis. Saf Health Work. 2022;13(3):269-78. doi: 10.1016/j.shaw.2022.06.003
36. León Rojas D, Castorena Torres F, Garza Ornelas B, Rodríguez-de-Ita J. Mental health outcomes and risk factors among female physicians during the COVID-19 pandemic. Heliyon. 2022;8(5):e09325. doi: 10.1016/j.heliyon.2022.e09325
37. Blake H, Mahmood I, Dushi G, Yildirim M, Gay E. Psychological impacts of COVID-19 on healthcare trainees and perceptions towards a digital wellbeing support package. Int J Environ Res Public Health. 2021;18(20):10647. doi: 10.3390/ijerph182010647
38. Zare H, Meyerson NS, Nwankwo CA, Thorpe RJ. How income and income inequality drive depressive symptoms in US adults, does sex matter: 2005-2016. Int J Environ Res Public Health. 2022;19(10):6227. doi: 10.3390/ijerph19106227
39. Robbins JB, England E, Patel MD, et al. COVID-19 impact on well-being and education in radiology residencies: a survey of the association of program directors in radiology. Acad Radiol. 2020;27(8):1162-72. doi: 10.1016/j.acra.2020.06.002
40. Alhasan AS, Alahmadi SM, Altayeb YA, Daqqaq TS. Impact of COVID-19 pandemic on training and well-being in radiology residency: a national survey of diagnostic radiology trainees in Saudi Arabia. Acad Radiol. 2021;28(7):1002-9. doi: 10.1016/j.acra.2021.03.019
41. England E, Kanfi A, Flink C, et al. Radiology residency program management in the COVID era – Strategy and reality. Acad Radiol. 2020;27(8):1140-6. doi: 10.1016/j.acra.2020.05.001
42. Faderani R, Monks M, Peprah D, et al. Improving well-being among UK doctors redeployed during the COVID-19 pandemic. Future Healthc J. 2020;7(3):e71-e76. doi: 10.7861/fhj.2020-0111
43. Scarpis E, Del Pin M, Ruscio E, Tullio A, Brusaferro S, Brunelli L. Symptoms of anxiety and depression within the UNiversity community: the cross-sectional UNSAD study. BMC Public Health. 2022;22(1):1479. doi: 10.1186/s12889-022-13876-5
44. Benavides-Gil G, Martínez-Zaragoza F, Fernández-Castro J, Sánchez-Pérez A, García-Sierra R. Mindfulness-based interventions for improving mental health of frontline healthcare professionals during the COVID-19 pandemic: a systematic review. Syst Rev. 2024;13(1):160. doi: 10.1186/s13643-024-02574-5
45. Sanz S, Valiente C, Espinosa R, Trucharte A. Psychological group interventions for reducing distress symptoms in healthcare workers: a systematic review. Clin Psychol Psychother. 2024;31(3):e2980. doi: 10.1002/cpp.2980
46. Nicolakakis N, Lafantaisie M, Letellier MC, et al. Are organizational interventions effective in protecting healthcare worker mental health during epidemics/pandemics? A systematic literature review. Int J Environ Res Public Health. 2022;19(15):9653. doi: 10.3390/ijerph19159653
47. Neil-Sztramko SE, Belita E, Hopkins S, et al. What are effective strategies to respond to the psychological impacts of working on the frontlines of a public health emergency? Front Public Health. 2023;11:1282296. doi: 10.3389/fpubh.2023.1282296