Sleep disorders, stress coping strategies and neurobehavioral aspects: an outlook on the impact of covid-19 in first-year resident physicians

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Abstract. The COVID-19 pandemic had a profound impact on the physical and mental health of healthcare professionals. The present study explored the relationship between sleep disorders, stress, coping strategies and neurobehavioral aspects among young physicians during the second wave of the COVID-19 pandemic. Through a multi-assessment approach, this cross-sectional study collected sociodemographic and occupational data from first-year resident doctors in southern Italy. Subjective sleep quality, chronotype, work-related stress, coping approach and mood state were assessed by administering validated questionnaires during face-to-face interviews. Among the 258 resident physicians enrolled in the study, ~25% complained of poor sleep quality, mainly male subjects [odds ratio (OR), 2.52]. Alcohol consumption resulted as a risk factor for poor sleep quality (OR, 1.97). None of the participants reported work-related stress showing, on the contrary, a high score for the vigor factor in the profile of mood state, in particular in subjects with previous working experience with COVID patients and prevention ($P<0.040$ and $P<0.035$, respectively). Women were more likely to adopt coping strategies that involved the search for social support, confirming their tendency to manage stressful situations through emotion-focused mechanisms. The set of these results represents a sight on the attitude of young physicians in their approach to facing the COVID-19 pandemic, in its second wave. The pandemic has turned the spotlight on the importance of prevention and early diagnosis of physical health and mental well-being. Further studies are performed to monitor long-term consequences on health status.

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Introduction

Sleep disorders, stress and neurobehavioral features, referring to the cognitive, emotional and behavioral functions, are interconnected in a bidirectional loop, where each factor influences and exacerbates the others. This intricate and mutual interplay can have significant implications for overall well-being and mental health. Chronic accumulation of sleep debt impairs cognitive function, emotional regulation and coping mechanisms, creating a vicious cycle between sleep disturbances and stress (1).

Stress is a complex biological state resulting from the cerebral processing of the individual interaction with the environment. When prolonged and uncontrolled, it can precipitate various cardiovascular, digestive, metabolic and musculoskeletal diseases, as well as mental disorders such as anxiety and depression. From an occupational perspective, the response occurring when work demands do not correspond to the worker's skills and/or exceed his/her ability to cope, defines work-related stress. The risk of stress and related psychosomatic disorders would occur when the effort is not compensated by reward factors, such as salary, recognition, career advancement, or job security. In the long run, if chronic work-related stress reaches emotional exhaustion and depersonalization, the risk of burnout may occur (2).

Stress, anxiety and depressive symptoms are reported in healthcare workers, particularly in training physicians (3,4).

During training years, resident physicians are required to have the same workload as full-time hospital physicians (5). Their working context is characterized by high job demand, patient care responsibilities, uncertainties in the clinical decision-making process, competitive work environments, long working hours, night shifts, sleep deprivation, financial issues, and imbalance between professional and personal life (6). Work contents present a variability depending on several factors, including geographical area, institution, stage of training and field of specialization. Literature data demonstrate high levels of perceived stress in anesthesia trainees (7,8), psychiatry

residents (9) and surgical branches (10). Excessive levels of stress can also affect skills such as teamwork, communication, empathy and judgment, risking compromising patient safety (11).

Other studies suggested that resident physicians are more prone to high levels of stress at the beginning of their training, i.e. at the transition from a student stage to the responsibilities and new lifestyle of a work environment; but over the years, they learn to cope with difficult events and acquire confidence and expertise, to reduce stress levels (6,12).

Healthcare workers involved in night shifts have acute and chronic sleep deprivation and poor sleep quality (13-15). The consequences can be not only on the health of the young doctors but also on their attention and skills in the workplace (16,17). Sleep constraints can impair daytime vigilance, mood and neurobehavioral aspects, including awareness, cognitive processing, reaction time and executive functions (18-20), with a dose-dependent and accumulative trend (21,22).

In this already complex working environment, the last three years have been characterized by the COVID-19 pandemic. Medical treatment facilities had to redefine the whole organization for COVID-19 patient management, especially through the extraordinary recruitment of medical doctors, including residents, as additional personnel (14). Healthcare professionals worked with a high risk of contracting SARS-CoV-2, initially due to the shortage of reliable personal protective equipment and lack of specific Coronavirus protocols (23,24).

The most common physical symptoms reported were fatigue, breathlessness pain, reduced physical capacity and declines in daily activities. Anxiety, depression, cognitive impairment and post-traumatic stress disorder were reported as mental health outcomes (25,26).

According to the ongoing epidemiological situation, public health measures have been continuously updated. This high degree of uncertainty, along with a lack of experience in managing stressors, as well as in problem-solving and decision-making skills, had a detrimental effect on the work-life balance and psychological well-being (27) of healthcare workers, particularly in young training physicians, causing physical exhaustion, emotional stress and insomnia (28,29). Moreover, the training program of resident physicians has been inevitably disrupted by the pandemic, but there are still little literature data on trainee medical doctors who started specialization courses in a profoundly different background than in the past.

In this scenario, the adoption of appropriate coping strategies, depending on external factors (such as culture and workplace context) and subjective components (including emotions and mood status), helps individuals deal with stress productively without being overwhelmed, maintaining their psychological well-being (30). Medical doctors are known to be at risk for negative coping mechanisms that may exacerbate stress, such as substance use, venting and denial (31). Early assessment of a coping approach with a validated tool and recognition of maladaptive reactions to stress, especially during challenging periods, might be useful to identify healthcare workers who may suffer from psychological discomfort, to implement adequate supporting measures.

Under these conditions, the present investigation aimed to assess work-related stress, coping strategies and neurobehavioral aspects along with the prevalence of sleep disorders in a population of resident physicians at the beginning of their training courses. Additionally, the occurrence of social, demographic and work-related factors as possible predictors of the considered outcomes was searched, to identify more susceptible residents to which preventive interventions and suggestions should be directed.

Materials and methods

Study design and population. The present cross-sectional study was conducted between November 1, 2021 and February 28, 2022, at the University Hospital 'G. Martino' in Messina (Italy). It is important to highlight that study was conducted during the second wave of COVID-19 pandemic.

Participants were first-year resident physicians at the very beginning of the training courses, working 38 h/week. The sample was divided into two groups according to sex. In accordance with the current Italian legislation, residents are involved in a compulsory medical surveillance program. They underwent a medical examination at the Occupational Medicine Unit, including past medical history, physical examination, blood tests and electrocardiogram. During that occasion, they were requested to participate in the study without any reward. The present study was approved (approval no. 40/19; date: September 27, 2019) by the University Hospital 'G. Martino' Ethical Committee (Messina, Italy) and it was carried out in accordance with the 1964 Declaration of Helsinki's ethical standards. Written informed consent was provided by all respondents who accepted to participate in the survey.

Measures. Data including sociodemographic characteristics were collected: age, sex and marital status; health and lifestyle factors included body mass index (BMI), glycemia, systolic and diastolic blood pressure (SBP and DBP, respectively), heart rate (HR), QT interval [extrapolated by the electrocardiogram and corrected according to Bazett's formula QTc (ms)=QT measured/$\sqrt{RR}$, where RR is the RR interval] (32), diseases, use of medications, smoking habit, alcohol intake, coffee consumption and frequency of sports activities. Work-related factors consisted of current night shifts, previous night shifts, and previous working experiences (with COVID patients, in COVID prevention departments, and others). Subjects were enrolled as involved in night shifts when they were scheduled in ≥4-night shifts per month; otherwise, residents involved in <4-night shifts/month were enrolled in the group 'No current night shifts'. Previous experiences with COVID patients included employment in continuity assistance special units, in particular carrying out nasopharyngeal swabs for COVID detection or temporary assignments at COVID wards in hospital settings; duties in COVID prevention departments included vaccination or contact tracing activities; other experiences included territory care services that did not concern COVID.

Before the medical examination, a psycho-diagnostic protocol including five standardized questionnaires was administered: Pittsburgh Sleep Quality Index (PSQI), Morning Evening Questionnaire (MEQ), Effort Reward Imbalance (ERI), Brief-COPE and Profile of Mood States (POMS).

The assessment of sleep was performed by PSQI and MEQ. PSQI is composed of 10 items (each one scoring from 0 to 3) and provides a subjective measure of sleep quality. A score >5

is considered suggestive of the presence of poor sleep quality. Instead, MEQ (19 items) concerns habitual bed and waking hours, time intervals predilections in performing physical and mental activities. According to scores, subjects are divided into five groups: Absolutely morning type (70-86), moderately morning type (59-69), intermediate type (42-58), moderately evening type (31-41) and absolutely evening type (16-30).

The evaluation of work-related stress was conducted through the administration of the short Italian version ERI (16 items). The tool is composed of three subscales regarding Effort (E), Reward (R) and Over-commitment (O), respectively measured by three, seven and six items. Possible answers to each question are proposed according to a 4-point Likert scale (strongly disagree, disagree, agree, strongly agree). The Siegrist algorithm permits to compute the E/R ratio. The ERI indicates the level of occupational distress: ERI values >1 are suggestive of distress (33,34).

The 'situational-actual' version of the Brief-COPE was used to assess the adoption of different coping strategies, to evaluate the stress reaction in a recent period. The tool reveals 14 strategies, which include the following: Emotional support, instrumental support, venting, religion, active, planning, disengagement, self-blame, self-distraction, denial, substance use, positive reframing, acceptance and humor. Furthermore, according to literature data and to allow a critical approach coping strategies were grouped into 4 dimensions: Seeking social support (emotional support, instrumental support, venting and religion), problem-solving (active and planning), avoidance (disengagement, self-blame, self-distraction, denial and substance use), positive thinking (positive reframing, acceptance and humor). Social support comprises seeking understanding, support and information from others; problem-solving includes those strategies oriented in finding resolutive approaches to problems; subjects who adopt avoidance tend to reject and not pay interest in stressful situations; positive thinking is the tendency to positively reinterpret and accept circumstances.

The POMS questionnaire comprises 58 items, defining six mood binary factors: Tension-anxiety (T), depression-dejection (D), anger-hostility (A), vigor-activity (V), fatigue-inertia (F) and confusion-bewilderment (C). Each question is scored according to a 5-point Likert scale, ranging from 0 (not at all) to 4 (extremely). Every factor is made up of a variable number of items, whose scores are summed to calculate each factor's raw score. Finally, the raw scores are computed into standard T scores based on Gaussian distribution data originating from the reference Italian population.

Statistical analysis. Descriptive statistics were conducted for all variables; categorical data were expressed as frequency and proportion, and continuous variables as the mean and standard deviation. Differences between groups in categorical variables were assessed through Chi-square tests and Fisher's exact tests, as appropriate. The application of the Kolmogorov-Smirnov test revealed that all continuous variables followed a non-Gaussian distribution. Differences between groups were thus estimated using the Mann-Whitney U test. After the dichotomization of the PSQI, in accordance with the previously cited score (>5), a binary logistic regression was used to identify risk factors for poor sleep quality. Generalized linear models were used to identify possible predictors for MEQ, for E/R ratio, for each one of the 4 dimensions of Brief-COPE, and for each one of the mood binary factors composing POMS T standard scores. $P<0.05$ was considered to indicate a statistically significant difference. Statistical analysis was performed using IBM SPSS Statistics 23 software (IBM Corp.).

Results

Social, demographic, health, lifestyle and occupational characteristics of the study population. A total of 258 subjects (152 women and 106 men) completed the survey over 292 residents undergoing medical surveillance. A detailed description of sociodemographic characteristics, health status, life habits and work-related factors is reported in Table I. The mean age was 28.4 years both in women and men; the majority of the sample was married or lived with a partner. Statistically relevant differences were found between women and men; in particular, female group was characterized by lower BMI, SBP, DBP and glycemia, higher HR and QTc interval. Moreover, women were more likely to complain about diseases (23 vs. 13.2%) and take medications (17.1 vs. 8.5%, $P<0.05$) than men. Most of the participants did not smoke (76%), did not drink alcohol (52%), and drank regularly coffee (74%), without significant differences between women and men. A higher proportion of male subjects (46%) declared to regularly practice sports activities while 61% of women stated to rarely exercise. Furthermore, all participants demonstrated overlapping work-related factors: 23.6 and 58.5% of respondents performed night shifts at the moment and previously the interview, respectively; a high rate of subjects (83.3%) had previous working experience, in particular 43.4% with COVID patients, 15.9% in COVID prevention departments and 51.6% in other healthcare settings (for example, primary care).

Psychodiagnostic protocol. The results of the standardized questionnaires are reported in Table II. Overall, ~25% of the sample (24.4%) reported poor sleep quality; both men (29.2%) and women (21.1%) complained of sleep disturbances, but this difference was not statistically relevant. The comprehensive and detailed outcomes of the PSQI questionnaire are available for consultation in Table SI. Notwithstanding, the binary logistic regression (Table III) revealed that men had over a double risk [odds ratio (OR), 2.52; $P=0.022$] to experience poor sleep, as well as alcohol consumption represented a risk in favoring sleep disturbances (OR, 1.97; $P=0.039$).

The majority of subjects showed an intermediate chronotype (68.2%), but women exhibited a slight tendency to be more frequently classified as a relative morning chronotype (Table II). The generalized linear model (Table III) identified that using medications and regularly practicing sports activities were associated with a morning chronotype according to the MEQ questionnaire, while regular coffee intake and previous working experiences not concerning the COVID-19 pandemic were associated with an evening chronotype.

Regarding work-related stress, none of the participants reported an E/R ratio >1, therefore work efforts were not considered undue compared with rewards (Table II); notably, women demonstrated higher values than men in the over-commitment subscale (14.0 and 13.3, respectively). Despite the globally low

Table I. Sample description of sociodemographic characteristics, health status, life habits and work-related factors.

Characteristics	Whole sample, n (%)	Women, n (%)	Men, n (%)	P-value
Total number	258 (100)	152 (58.9)	106 (41.1)	
Age, years (Mean ± SD)	28.44±3.58	28.47±3.72	28.41±3.39	0.720
Marital status				0.137
Single	110 (42.6)	59 (38.8)	51 (48.1)	
Married/cohabitant	148 (57.4)	93 (61.2)	55 (51.9)	
Body mass index (Mean ± SD)	22.94±3.86	21.73±3.52	24.68±3.66	<0.001
Systolic blood pressure (Mean ± SD)	115.21±11.50	111.71±11.36	120.22±9.75	<0.001
Diastolic blood pressure (Mean ± SD)	74.45±8.93	72.14±9.09	77.75±7.60	<0.001
Heart rate (Mean ± SD)	74.00±12.32	75.42±12.35	71.95±12.05	0.018
Glycemia (Mean ± SD)	84.49±9.99	83.96±9.31	87.69±10.57	<0.001
QTc interval (Mean ± SD)	406.08±24.73	414.56±23.01	393.2±21.95	<0.001
Diseases				0.048
No	209 (81.0)	117 (77.0)	92 (86.8)	
Yes	49 (19.0)	35 (23.0)	14 (13.2)	
Medications				0.047
No	223 (86.4)	126 (82.9)	97 (91.5)	
Yes	35 (13.6)	26 (17.1)	9 (8.5)	
Smoking habit				0.180
No	196 (76.0)	120 (78.9)	76 (71.7)	
Yes	62 (24.0)	32 (21.1)	30 (28.3)	
Alcohol consumption				0.380
No	135 (52.3)	83 (54.6)	52 (49.1)	
Yes	123 (47.7)	69 (45.4)	54 (50.9)	
[a]Mean ± SD	1.62±0.96	1.54±0.93	1.72±1.38	0.738
Coffee consumption				0.585
No	66 (25.6)	37 (24.3)	29 (27.4)	
Yes	192 (74.4)	115 (75.7)	77 (72.6)	
[b]Mean ± SD	2.30±0.96	2.24±0.92	2.38±1.02	0.455
Sport activities				0.007
Never	28 (10.9)	17 (11.2)	11 (10.4)	
Rarely	139 (53.9)	93 (61.2)	46 (43.4)	
Regularly	91 (35.3)	42 (27.6)	49 (46.2)	
Current night shifts				0.780
No	197 (76.4)	117 (77.0)	80 (75.5)	
Yes	61 (23.6)	35 (23.0)	26 (24.5)	
Previous night shifts				0.309
No	107 (41.5)	67 (44.1)	40 (37.7)	
Yes	151 (58.5)	85 (55.9)	66 (62.3)	
Previous working experiences				0.571
No	43 (16.7)	27 (17.8)	16 (15.1)	
Yes	215 (83.3)	125 (82.2)	90 (84.9)	
Previous working experiences with COVID patients				0.309
No	146 (56.6)	90 (59.2)	56 (52.8)	
Yes	112 (43.4)	62 (40.8)	50 (47.2)	
Previous working experience in COVID prevention departments				0.770
No	217 (84.1)	127 (83.6)	90 (84.9)	
Yes	41 (15.9)	25 (16.4)	16 (15.1)	
Other working experiences				0.551
No	125 (48.4)	76 (50.0)	49 (46.2)	
Yes	133 (51.6)	76 (50.0)	57 (53.8)	

[a]Alcohol unit/week; [b]Coffee serving/day.

Table II. Results of the standardized questionnaires.

	Whole sample, n (%)	Women, n (%)	Men, n (%)	P-value
Pittsburg sleep quality index (Mean ± SD)	4.35±2.02	4.21±1.90	4.55±2.18	0.462
≤5	195 (75.6)	120 (78.9)	75 (70.8)	0.132
>5	63 (24.4)	32 (21.1)	31 (29.2)	
Morning evening questionnaire				0.181
Absolute evening type (16-30)	1 (0.4)	1 (0.7)	0 (0.0)	
Moderate evening type (31-41)	15 (5.8)	10 (6.6)	5 (4.7)	
Intermediate type (42-58)	176 (68.2)	95 (62.5)	81 (76.4)	
Moderate morning type (59-69)	61 (23.6)	42 (27.6)	19 (17.9)	
Absolute morning type (70-86)	5 (1.9)	4 (2.6)	1 (0.9)	
Effort reward imbalance				
Effort	7.07±1.71	7.02±1.80	7.13±1.57	0.953
Reward	20.67±2.80	20.90±2.82	20.34±2.76	0.113
Over-commitment	13.72±3.11	14.02±3.12	13.29±3.07	0.038
Effort/reward ratio	0.15±0.05	0.14±0.05	0.15±0.05	0.423
Brief-COPE				
[a]Emotional Support	5.00±1.62	5.24±1.66	4.64±1.51	0.002
[a]Instrumental Support	5.49±1.59	5.55±1.63	5.40±1.54	0.421
[a]Venting	4.70±1.52	4.95±1.54	4.34±1.44	0.004
[a]Religion	3.56±1.81	3.69±1.78	3.38±1.86	0.050
[b]Active	6.93±1.13	7.00±1.07	6.84±1.20	0.343
[b]Planning	6.87±1.17	6.80±1.22	6.97±1.08	0.321
[c]Disengagement	2.72±1.12	2.66±1.11	2.81±1.15	0.195
[c]Self-blame	5.94±1.28	5.99±1.32	5.87±1.23	0.411
[c]Self-distraction	5.24±1.55	5.39±1.49	5.02±1.62	0.070
[c]Denial	2.68±1.03	2.75±1.08	2.58±0.96	0.159
[c]Substance use	2.20±0.71	2.14±0.59	2.29±0.85	0.149
[d]Positive reframing	5.66± 1.61	5.83±1.61	5.42±1.59	0.058
[d]Acceptance	5.90 ± 1.27	5.93±1.30	5.86±1.25	0.549
[d]Humor	4.10 ± 1.38	3.88±1.34	4.42±1.39	0.003
Brief-COPE 4-factor model				
[a]Seeking social support	18.74±4.59	19.43±4.64	17.75±4.34	0.004
[b]Problem solving	13.81±1.96	13.8±1.95	13.81±1.99	0.904
[c]Avoidance	18.79±3.33	18.93±3.43	18.58±3.31	0.534
[d]Positive thinking	15.66 ± 3.06	15.64±3.25	15.69±2.79	0.933
POMS				
Tension	9.81±6.47	10.0±6.52	9.52±6.41	0.467
Depression	7.69±9.40	7.6±10.00	7.80±8.50	0.372
Anger	7.24±8.04	6.61±7.83	8.16±8.27	0.096
Vigor	18.88±5.81	19.1±5.95	19.93±5.46	0.016
Fatigue	6.78±4.73	6.74±4.83	6.82±4.60	0.789
Confusion	7.51±5.06	7.41±4.98	7.66±5.20	0.793
POMS score T standard				
Tension	50.53±10.68	50.86±10.75	50.0±10.61	0.467
Depression	48.66 ± 10.60	48.07±11.30	49.51±9.49	0.210
Anger	49.74±10.87	48.87±10.61	50.98±11.18	0.096
Vigor	54.45±13.25	54.00±13.73	55.08±12.58	0.442
Fatigue	51.73±10.47	51.67±10.68	51.81±10.19	0.789
Confusion	48.73 ± 11.19	48.52±10.99	49.03±11.51	0.793

[a]Coping strategies included in Seeking social support factor; [b]Coping strategies included in Problem solving factor; [c]Coping strategies included in Avoidance factor; [d]Coping strategies included in Positive thinking factor. POMS, Profile of Mood States.

Table III. Binary logistic regression of Pittsburgh sleep quality index. Generalized linear models of morning evening questionnaire and E/R ratio.

	Pittsburg sleep quality index		Morning evening questionnaire		E/R ratio	
Independent variables	OR	P	B	P	B	P
Sex (Male)	2.52	0.022	-0.03	0.978	0.01	0.504
Age	1.01	0.773	0.18	0.208	-0.01	0.268
Marital status (married/cohabitant)	1.13	0.707	0.58	0.542	0.01	0.464
Body mass index	0.96	0.403	-0.06	0.655	0.01	0.788
Systolic blood pressure	0.98	0.305	-0.02	0.767	0.01	0.395
Diastolic blood pressure	1.02	0.461	0.01	0.861	0.01	0.802
Heart rate	0.99	0.376	-0.02	0.597	0.01	0.510
Glycemia	0.99	0.791	0.01	0.909	0.01	0.701
QTc interval	1.01	0.393	0.02	0.306	0.01	0.431
Diseases (Y)	1.55	0.346	-2.59	0.070	-0.01	0.590
Medications (Y)	1.82	0.247	3.99	0.014	0.01	0.285
Smoking habit (Y)	1.23	0.583	-1.17	0.300	0.02	0.037
Alcohol consumption (Y)	1.97	0.039	-0.81	0.394	-0.01	0.795
Coffee consumption (Y)	0.73	0.399	-2.32	0.038	-0.01	0.480
Sport activities (Regularly)	0.79	0.399	1.73	0.024	-0.01	0.316
Current night shifts (Y)	0.63	0.258	-0.57	0.606	0.01	0.085
Previous night shifts (Y)	0.94	0.879	2.04	0.122	-0.01	0.594
Previous working experiences	1.70	0.429	-0.78	0.682	0.01	0.882
Working experience with COVID patients (Y)	0.79	0.563	-0.90	0.444	0.02	0.038
Working experience in COVID prevention (Y)	1.64	0.359	0.52	0.756	0.01	0.604
Other working experience (Y)	0.80	0.639	-3.87	0.006	0.02	0.063

E/R, effort/reward; Y, year.

scores of the E/R ratio, higher values were positively associated with smoking habits and a previous working experience with COVID patients (Table III).

Considering coping strategies, the most frequently adopted were active, planning, self-blame and acceptance in both groups (Table II). Statistically relevant differences were highlighted in emotional support, venting and religion in which women reported higher values than men, while male subjects were more likely to adopt humor than female ones. The 4-factor model of Brief-COPE showed how women reported higher scores in the seeking social support dimension, with a statistically relevant difference. The generalized linear models showed female sex as a predictive variable of Seeking Social Support (Table IV, part A). Avoidance dimension was associated with a higher BMI, having diseases, not using medications, and regularly exercising, while positive thinking was positively associated with age (Table IV, part B).

The analysis of mood states, assessed by the POMS questionnaire, revealed a peak in the vigor factor with an increase also in fatigue, while the other factors were slightly below the T-50 standard score (Table II). The generalized linear models did not reveal any independent variable as a predictor of tension, depression and anger (Table V, part A). Vigor was associated with previous working experiences both with COVID patients and COVID prevention departments; fatigue was associated with low glycemia and performing night shifts; confusion was associated with never practicing sports activities (Table V, part B).

Discussion

The current investigation assessed sleep disorders, stress coping strategies and neuro-behavioral aspects in a population of resident physicians at the beginning of their training course. Furthermore, sociodemographic characteristics and work-related factors were investigated to identify those subjects more vulnerable to possible psychological discomfort, aiming to suggest preventive strategies.

Sociodemographic characteristics demonstrated that the majority of the sample population lived with their partner and adopted a healthy lifestyle: They did not smoke, did not use alcoholic beverages, and only 20% suffered from chronic diseases. Considering that the survey was conducted during the second wave of the COVID-19 pandemic, due to the extraordinary recruitment of medical personnel, ~83% of subjects had previous work experience (43% with COVID patients).

A total of ~25% of participants complained of poor sleep quality, mainly male subjects. Shift work and night shifts have been shown to have an impact on both psychological and physiological spheres, and are considered as a primary cause of

Table IV. Generalized linear models of Brief-COPE.

A, generalized linear models of Brief-COPE (seeking social support, problem-solving)

	Seeking social support		Problem-solving	
Independent variables	B	P	B	P
Sex (Male)	-1.49	0.033	-0.04	0.900
Age	0.07	0.384	0.07	0.058
Marital status (married/cohabitant)	0.77	0.176	0.03	0.908
Body mass index	0.03	0.741	0.03	0.414
Systolic blood pressure	0.02	0.557	-0.01	0.571
Diastolic blood pressure	-0.02	0.640	-0.01	0.497
Heart rate	0.02	0.462	0.01	0.829
Glycemia	-0.02	0.405	0.01	0.310
QTc interval	0.01	0.601	-0.01	0.592
Diseases (Y)	-0.25	0.774	-0.06	0.869
Medications (Y)	-0.88	0.366	0.25	0.561
Smoking habit (Y)	-0.27	0.693	-0.16	0.592
Alcohol consumption (Y)	-0.62	0.274	0.02	0.939
Coffee consumption (Y)	-0.48	0.474	0.05	0.879
Sports activities (Regularly)	0.53	0.250	0.13	0.518
Current night shifts (Y)	0.5	0.703	-0.10	0.743
Previous night shifts (Y)	-1.45	0.069	-0.09	0.805
Previous working experiences	-1.27	0.267	-0.75	0.135
Working experience with COVID patients (Y)	0.02	0.973	0.43	0.159
Working experience in COVID prevention (Y)	0.12	0.904	-0.40	0.364
Other working experience (Y)	0.27	0.743	0.45	0.226

B, generalized linear models of Brief-COPE (avoidance, positive thinking)

	Avoidance		Positive thinking	
Independent variables	B	P	B	P
Sex (Male)	-0.90	0.072	-0.14	0.769
Age	0.03	0.655	0.13	0.020
Marital status (married/cohabitant)	-0.57	0.162	-0.09	0.812
Body mass index	0.18	0.002	0.01	0.953
Systolic blood pressure	0.03	0.157	0.03	0.201
Diastolic blood pressure	-0.03	0.246	-0.04	0.189
Heart rate	0.04	0.062	0.01	0.873
Glycemia	-0.04	0.087	0.03	0.128
QTc interval	0.01	0.915	-0.01	0.892
Diseases (Y)	1.40	0.021	-0.61	0.291
Medications (Y)	-1.52	0.028	0.64	0.329
Smoking habit (Y)	-0.19	0.689	0.17	0.705
Alcohol consumption (Y)	0.72	0.076	0.33	0.384
Coffee consumption (Y)	-0.73	0.129	-0.23	0.620
Sports activities (Regularly)	0.72	0.029	-0.15	0.633
Current night shifts (Y)	0.13	0.782	-0.62	0.164
Previous night shifts (Y)	0.14	0.802	-0.30	0.577
Previous working experiences	-0.74	0.363	-1.05	0.175
Working experience with COVID patients (Y)	-0.19	0.710	0.26	0.581
Working experience in COVID prevention (Y)	-0.21	0.771	-0.32	0.637
Other working experience (Y)	-0.84	0.160	0.61	0.282

Y, year.

Table V. Generalized linear models for POMS T standard score.

A, generalized linear models for POMS T standard score (tension, depression, anger)

	Tension		Depression		Anger	
Independent variables	B	P	B	P	B	P
Sex (Male)	-1.15	0.492	1.63	0.319	2.05	0.228
Age	-0.29	0.151	-0.30	0.136	-0.32	0.120
Marital status (married/cohabitant)	0.12	0.931	-0.05	0.969	-0.07	0.958
Body mass index	0.10	0.636	0.02	0.938	0.17	0.392
Systolic blood pressure	0.04	0.605	0.08	0.289	0.04	0.669
Diastolic blood pressure	0.04	0.696	0.04	0.712	-0.04	0.712
Heart rate	0.11	0.077	0.04	0.522	-0.01	0.912
Glycemia	-0.10	0.174	-0.06	0.386	-0.10	0.148
QTc interval	-0.04	0.243	0.01	0.764	-0.01	0.845
Diseases (Y)	2.58	0.208	2.16	0.283	0.48	0.819
Medications (Y)	-0.09	0.969	2.90	0.204	1.89	0.423
Smoking habit (Y)	-0.66	0.684	-2.44	0.125	-0.28	0.863
Alcohol consumption (Y)	0.78	0.566	-1.72	0.196	-0.47	0.731
Coffee consumption (Y)	0.91	0.572	0.24	0.879	0.51	0.753
Sports activities (Regularly)	-1.32	0.232	0.09	0.937	-1.34	0.232
Current night shifts (Y)	2.29	0.148	1.009	0.482	2.60	0.107
Previous night shifts (Y)	-2.67	0.159	-2.07	0.266	-1.71	0.375
Previous working experiences	-0.08	0.978	2.23	0.407	0.59	0.831
Working experience with COVID patients (Y)	1.43	0.395	1.66	0.318	2.28	0.183
Working experience in COVID prevention (Y)	-0.51	0.832	1.62	0.490	0.06	0.979
Other working experience (Y)	1.03	0.611	2.37	0.233	2.76	0.178

B, generalized linear models for POMS T standard score (vigor, fatigue, confusion)

Sex (Male)	-0.45	0.828	-0.11	0.945	1.93	0.271
Age	-0.14	0.577	-0.28	0.142	-0.33	0.121
Marital status (married/cohabitant)	1.61	0.339	0.36	0.783	-0.30	0.833
Body mass index	-0.01	0.988	0.18	0.337	-0.10	0.650
Systolic blood pressure	0.01	0.965	0.06	0.454	0.05	0.526
Diastolic blood pressure	0.06	0.610	-0.03	0.770	-0.04	0.674
Heart rate	-0.13	0.092	-0.01	0.909	0.01	0.982
Glycemia	0.06	0.501	-0.16	0.019	-0.13	0.080
QTc interval	0.01	0.918	-0.01	0.735	0.01	0.688
Diseases (Y)	-0.74	0.770	0.05	0.979	0.44	0.838
Medications (Y)	-1.29	0.653	0.85	0.702	1.24	0.948
Smoking habit (Y)	2.40	0.232	-0.34	0.826	-2.09	0.221
Alcohol consumption (Y)	1.97	0.241	0.48	0.714	-0.66	0.641
Coffee consumption (Y)	-1.64	0.411	1.02	0.508	1.24	0.463
Sports activities (Regularly)	-0.24	0.863	-1.99	0.062	-2.50	0.031
Current night shifts (Y)	-1.84	0.349	3.90	0.010	-0.41	0.805
Previous night shifts (Y)	3.70	0.115	-1.86	0.306	-0.24	0.906
Previous working experiences	-5.92	0.080	2.36	0.368	2.95	0.305
Working experience with COVID patients (Y)	4.29	0.040	2.25	0.165	0.84	0.636
Working experience in COVID prevention (Y)	6.24	0.035	-1.23	0.592	-0.90	0.720
Other working experience (Y)	0.13	0.960	1.66	0.391	-0.33	0.878

Y, year.

sleep disorders. The shift work sleep disorder is defined by the International Classification of Sleep Disorders as 'consisting of symptoms of insomnia or excessive sleepiness that occur as transient phenomena concerning work schedules' (35).

In the authors' previous investigations, conducted on similar populations (in terms of risk profile, job tasks and age) of resident physicians through the administration of the ESS and PSQI questionnaires, sleep disturbances in 2019 before the COVID-19 pandemic were not found (5), while in 2020 (during the first wave of the pandemic) over a third of subjects reported poor sleep quality and 10% a very poor sleep quality (15). Thereafter, a web-based survey conducted by other authors in 2021, amid the second wave in Italy, explored the self-reported effects of the COVID-19 pandemic on healthcare workers: 58.3% of participants reported the onset or worsening in the last 6 months of insomnia or sleep disorders, which were the most frequent physical symptoms, particularly between young residents compared with specialists; these findings suggested a generalized physical and psychological exhaustion (36).

After this increasing trend, the lower incidence of sleep disorders observed in the present study population is coherent with the findings of another Italian survey conducted in the first months of 2022 on a similar study sample (37).

Sleep disruption observed at the beginning of the pandemic could be referred to the stress caused mainly by anxiety to be infected, lack of diagnostic and therapeutic tools with inadequate protection, and excessive workload. But the apparently decreasing trend in sleep disorders observed may seem to suggest a progressive adaptation, as healthcare workers may have progressively managed to regain control over their profession, along with improved sleep quality.

This could be attributed to the different study design, i.e. the application of validated assessment instruments, timing, sampling and place.

Sex stratification revealed that male residents had a higher risk of suffering from sleep disorders (OR, 2.52). Though men had a less pronounced diurnal preference, there were no significant sex differences in chronotype. Contrariwise, the literature suggests that women are more prone to suffer from sleep disorders due to their family role (38). It can be hypothesized that female residents, young women with lighter familial duties at the early stage of their career, also had a different 'cognitive-motivational pattern' initially acting as a protective component against negative health outcomes, including sleep impairment, as suggested by the higher score (P=0.038) in over-commitment subscale (39).

Furthermore, alcohol consumption resulted as a risk factor for poor sleep quality (OR, 1.97). It is well established that alcohol is frequently assumed for its sleep-promoting consequences, but it is also true that alcohol consumption, also at low doses, disturbs sleep, contributing to alterations of the sleep/awake cycle and shorter sleep duration (40).

Notably, residents more involved in night shifts were more likely to be stressed (Table III, P=0.085). Literature suggests that residents represent a high-risk population for burnout and stress; a systematic review and meta-analysis including 36,266 trainee physicians concluded that they present a high risk of burnout and stress due to poor mental or physical health, but as much as a 3-fold risk due to work demands (4). Moreover, trainees who had in charge COVID patients had a risk to experience burnout which increased along with the number of patients under their care (41). Although literature data show a high prevalence of work-related stress in similar populations (42-44), in the present study none of the resident physicians demonstrated occupational stress, suggesting an ideal balance between work demands and personal resources. The current findings, according to the theoretical model of ERI suggested by Siegrist and Li (30), can be explained with the extrinsic components of stress, i.e. by adequate rewards, as they had recently reached important goals: The successful completion of a public competition (mandatory to be admitted to residency courses), the enthusiasm of starting a new job, the perspective of suitable economic income and career progression. To be remarked, subjects with previous work experience with COVID patients tended to report higher values in the E/R ratio, confirming the literature data (36,45). This was not observed in residents with other previous work experiences, including COVID prevention: A sudden increase in workload, problematic interaction with patients, the daily challenge in patient management, loss of colleagues, and personal experience of being a COVID patient have characterized the entry in the professional scenario of these young and inexperienced doctors.

On this basis, the intrinsic component of the ERI model gained particular relevance: Over-commitment, defined as a specific coping pattern characterized by excessive engagement and need for control (30), which resulted significantly higher in female residents; this finding may represent the potential role of O as a moderator the relation between E and R. Nevertheless, in the long run O, may play a maladaptive role in the escalation of emotional exhaustion characterizing burnout (3). The complex relation between ERI and O is particularly relevant also because people who are highly over-committed to their work are more likely to experience work-related stress and to suffer from adverse health conditions typical of a chronically aroused sympathetic-adrenergic system, as cardiovascular risk factors, increased pro-inflammatory and reduced immune activity, fatigue and insomnia (30,46).

In the pandemic context, to prevent the negative effects of occupational stress on health, resident physicians implemented appropriate coping strategies. At the onset of new stressors, subjects usually seek social support and avoid stressful stimuli, by easing emotions, as primary coping mechanisms tending to reduce eventual negative effects on mental health (47). Unfortunately, maladaptive strategies such as 'disengagement', 'denial' and 'self-blame', which have been associated with cases of depression, suicidal ideation and drug use, have been identified among young doctors in their early years of training courses (48). Whereas the most frequently adopted coping strategies in the population examined in the present study were active, planning, self-blame and acceptance, showing a higher tendency to problem-solving and avoidance approaches. In other terms, although physicians are reported to commonly adopt negative coping mechanisms, in the current investigation resident physicians recurred to a problem-solving approach, which helps subjects deal with stress productively (31). Conversely, the attitude of avoidance can be positively adopted as a self-protective mechanism (49), which has been demonstrated to be helpful at the beginning of stressful circumstances (50); in the long run, the consequences

of this self-defensive style may become detrimental, leading to depressive symptoms and burnout (51). To be remarked, female residents relied more often on social support, which is essential in buffering emotions, with positive results in managing stressful situations (14,52).

Emotional involvement, assessed by the POMS questionnaire, showed borderline values in all residents, approximating the T score of 50 for all factors; differently from other research, revealing an increase in depression (D factor) and anxiety (T factor) levels in trainee physicians (53,54). Notably, in the authors' previous experience with a similar population before the COVID pandemic (5), D factor sub-score levels were found sensibly lower.

Residents tend to report higher vigor/activity (V) sub-score levels, in particular in subjects with previous working experience with COVID patients and prevention ($P<0.040$ and $P<0.035$, respectively). According to some studies, higher vigor with lower levels of tension, depression, anger and confusion is a pattern associated with optimal professional outcome (5); it can be hypothesized that the previous work experience, giving a personal contribution to the management of the pandemic, acted as a motivational lever with a consequent increase in the levels of perceived vigor.

As a theoretical model, vigor represents a multifaceted affective state including individual feelings of physical strength, emotional energy and cognitive liveliness, which may have a positive impact on perceived stress, anxiety, fatigue and sleep quality (55). On this basis, the high V score reported in this population of young medical doctors may contribute to explaining the low levels of stress and sleep disorders.

Residents performing night shifts reported significantly higher levels of fatigue, resulting slightly above the standard T score both in men and women; importantly, this is a work-related factor that negatively impacts not only physicians' health but also patients' safety: In fact, fatigue induces emotional alteration mostly affecting perceived effort in task performance. There is evidence that work fatigue, in the long run, is associated with increased stress leading to burnout (56).

The set of these results represents a sight on the attitude of young physicians in their approach to facing the COVID-19 pandemic, in its second wave. Notwithstanding the critical issues brought on by this difficult period, this population of residents succeeded in containing stress and sleep disorders, the most distinctive outcomes in this unprecedented scenario.

All the results emerging from this survey were shared with participants and their tutors, to identify both individually tailored interventions to improve coping strategies and an organizational approach aiming to reduce stress levels, prevent burnout and ensure overall well-being in the work environment.

These measures, implemented also through the expertise of the occupational physician, can include actions on work timesheets such as the introduction of flexible scheduling and adequate rest and breaks; providing workers with proper safety protocols and protective equipment; fostering bidirectional communication, inviting prompt feedback from personnel for timely intervention; acknowledging the efforts and results to boost motivation; offering training tools on stress management for personnel empowerment to effective navigation of demanding situations; being the purpose of this intervention merely preventive and not therapeutic, basic sleep hygiene rules as suggested by World Sleep Society and Italian Association of Sleep Medicine were included in safety training and refresher courses for residents/healthcare personnel held by occupational physicians (57,58). Last but not least, planning mental health support programs including mentorship, counseling services and peer support groups to cope with emotional challenges, specifically targeting the more vulnerable young healthcare professionals.

The principal strength of the present study relies on the use of a multi-assessment approach to assess sleep disorders, stress levels, depression, anxiety and other neurobehavioral aspects through validated tools administered face to face; this approach allows to lower the risk of underestimating mental disorders. An additional strength is to suggest specific interventions aimed at maintaining mental well-being, contributing to the improvement of work organization. Another peculiarity is the enrollment of a population composed of first-year resident doctors, representing a snapshot of their attitude during the second wave of the Covid-19 pandemic in Italy. However, it should be observed that the lack of a control group recruited in last year's residents or the general population, as well as the cross-sectional design of the study, do not provide information on the evolution of the results over time. The pandemic has turned the spotlight on the importance of prevention and early diagnosis of physical health and mental well-being. It is thus fundamental that further studies are performed to monitor the long-term consequences of the Covid-19 pandemic on health status.

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Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to privacy concerns but are available from the corresponding author on reasonable request.

Authors' contributions

CC, CF and FG contributed to the conception of the study. SI, FG and MT were responsible for writing the original draft, reviewing and editing the manuscript. SI and MT were responsible for acquisition, analysis and interpretation of data. SI and FG confirm the authenticity of all the raw data. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

The present study was approved (approval no. 40/19; date: September 27, 2019) by the University Hospital 'G. Martino' Ethical Committee (Messina, Italy) and conducted according to the ethical standards of the 1964 Declaration of Helsinki

and its later amendments; The analysis used anonymous clinical data; written informed consent was provided by all participants.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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