



Special article

Work stress and resident burnout, before and during the COVID-19 pandemic: An up-date[☆]Estrés laboral y *burnout* en los médicos residentes, antes y durante la pandemia por COVID-19: una puesta al díaRicard Navinés^{b,c}, Victoria Olivé^{b,d}, Francina Fonseca^{c,e}, Rocío Martín-Santos^{a,b,c,*}^a Grupo de Investigación en Vulnerabilidad, Psicopatología y Género, Servicio de Psiquiatría y Psicología, Programa de Atención al Personal Sanitario, Hospital Clínic, IDIBAPS, CIBERSAM, Barcelona, Spain^b Unidad Funcional de Psiquiatría, Departamento de Medicina, Instituto de Neurociencias, Universidad de Barcelona (UB), Barcelona, Spain^c Societat Catalana de Psiquiatria i Salut Mental (SCPISM), Barcelona, Spain^d Servicio de Prevención de Riesgos Laborales, Hospital Clínic, Barcelona, Spain^e Grupo de Investigación en Adicciones, Instituto de Investigación Médica Hospital del Mar (IMIM), Universidad Autònoma de Barcelona, Instituto de Neuropsiquiatria y Adicciones (INAD), Red de Trastornos Adictivos (RediTA), Barcelona, Spain

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Introduction

In recent years there has been an extensive national and international debate on whether residency years constitute a risk to the mental health of the resident physician.¹ The specialty training period involves a level of general activation and coping with new situations that most residents find stimulating and rewarding. However, for others it may mean an increase in the body's response to stress, which, when prolonged in time and intensity, does not allow adequate adaptation, and leads to *psychobiological exhaustion* or *burnout*.²

Stress is a term used to refer to the state of anti-homeostatic biological activation that occurs when the body fails in its attempts to adapt to the demands of its immediate environment.³ This biological activation is accompanied by unpleasant emotions (anxiety, sadness, irritation) and by physiological modifications of the adaptive subsystems (autonomic and neuroendocrine activation and immune and behavioural inhibition) that decrease the capacities to maintain homeostasis when interacting with the environment. Therefore, stress is a complex biological state that results

from the cerebral processing of the subject's interaction with the environment,³ which is specific to each person, and which will also depend on the threatening stimulus (e.g., more intense in social threats than in physical ones).³ Uncontrollable stress is a biological state of transition to disease³ and can precipitate various cardiovascular, digestive, musculoskeletal diseases, as well as mental disorders such as anxiety and depression.^{3,4}

Work stress can be defined as the response that occurs when work demands, and pressures do not correspond to the knowledge and skills of the worker and exceed his/her ability to cope.² All workers experience pressure at work, but when the individual perceives that the demands are beyond his or her resources to cope, work stress and the risk of *burnout*² may occur. On the other hand, and according to the effort-reward model at work,³ the risk of stress and psychosomatic disorders would occur when effort is not compensated by reward factors, such as salary, recognition, career advancement or job security.

Although the weight of the work environment is key in *burnout*, chronic work-related stress affects the biological functioning of the body. The feeling of lack of control in the face of the multiple stressors faced by doctors on a daily basis can in some cases lead to a state of uncontrollable stress, affecting brain functioning. From a neurobiological perspective, there is increasing evidence to support the biological substrate of the syndrome,⁴ whereby a prefrontal cortex dysfunction exerts a *top-down* regulatory effect on cognition, behaviour, and mood. The prefrontal cortex is involved in many cognitive functions essential to the medical profession, such

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as abstract reasoning, decision-making, working memory, *insight* and empathy.⁴ Chronic uncontrollable work stress can lead to a decrease in motivation, concentration, impaired working memory, organisational skills, decision-making, insight and empathy, characteristic of the worker with burnout.

The current COVID-19 pandemic situation carries a high degree of uncertainty, causing a significant impact on the mental wellbeing of healthcare workers, especially those who work on the frontline or who have been exposed to extreme and continuous pressure, causing physical exhaustion, emotional stress, stigmatisation and insomnia.⁵ Before the COVID-19 pandemic, health professions were already considered as *highly stressful*.⁵ Research on stress in medical residents has shown that this group of professionals is particularly vulnerable and has a high proportion of *burnout*.⁶ Obviously, not all doctors are equally vulnerable, and a number of risk factors have been identified related to the individual (e.g. socio-demographic variables or personality traits), to the healthcare profession itself (e.g. dealing with serious illnesses or long working hours) and to the organisation of care (e.g. excessive workload or lack of oversight).^{2,6} In general, professionals can function with high levels of stress if their work gives them positive feedback, which will depend on the degree of resilience and the presence of protective factors.⁷

Traditionally, the *burnout syndrome* has been clinically diagnosed using Maslach's *burnout scale* (Maslach Burnout Inventory [MBI]), which assesses the 3 main dimensions of the syndrome: emotional exhaustion, depersonalization and personal accomplishment.⁸ *Emotional exhaustion* refers to the experience of being emotionally exhausted by the demands of work. *Depersonalization* assesses the degree to which each one recognizes attitudes of unfeeling and impersonal response from the recipients of their care. Finally, the *personal accomplishment* dimension assesses feelings of self-efficacy and accomplishment at work.⁸

The American Psychiatric Association's classification of mental disorders, the DSM-5 (2013), does not include *burnout syndrome* as a specific disease, but rather it is included in other problems that can be the object of medical care, in this case related to employment. However, in 2019 the World Health Organisation has officially recognised *burnout* as an occupational phenomenon following the ratification of the eleventh revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-11), which is due to come into force on 1 January 2022.⁹ Thus, the *burnout syndrome* has been identified as one of the main mental health problems and the prelude to many mental disorders resulting from this syndrome's poor control and lack of primary prevention. This already challenging situation will be exacerbated by the high stress that caring for COVID-19 patients places on many health care workers, including resident doctors. Resident doctors have had their current clinical care work and training programme disrupted and are experiencing particularly stressful situations.

In this context, the aim of this paper has been to provide an update through a literature review of the main evidence on *burnout* in medical residents, its prevalence, risk, and protective factors, before and during the COVID-19 pandemic.

Methodology

A review was made of publications in English or Spanish on *burnout* in residents in PubMed databases for the last 5 years (2016–2020), as well as publications referring to the first wave of the COVID-19 pandemic. The keywords *burnout*; *resident training*; *prevalence*; *risk factors*; *Maslach Burnout Inventory*; *Ölidenburg Burnout Inventory* and *COVID-19* and the Boolean operators AND and OR were used. Studies with samples smaller than 50 subjects and non-observational studies have been ruled out. Literature reference lists have been used to identify additional studies. Finally, a

subgroup of studies with a higher degree of evidence was selected, with a preference for systematic reviews with or without meta-analysis for data on *prevalence* and longitudinal studies regarding *risk factors* and *protection of burnout* in residents.

Stress and burnout during residency

A total of 210 studies published in these years were found in the literature search. Thirteen were excluded due to duplication, 77 due to being studies in other samples (e.g., medical students), 8 due to sample size, 13 due to being non-observational studies (e.g., clinical trials) or not relevant to the study subject. Two systematic reviews and a longitudinal article were included from the literature review. Of the total of the selected studies (N = 98), 5 were systematic reviews with and without meta-analysis, 9 longitudinal studies and the rest were cross-sectional studies (N = 84), 7 during the pandemic. Table 1 shows the results of *burnout prevalence* data from systematic reviews and Table 2 shows the results of risk factors in longitudinal studies. Finally, Table 3 shows the results of cross-sectional studies of prevalence and risk factors associated with *burnout* in residents during the first wave of the COVID-19 pandemic.

Epidemiological data

The results of the systematic reviews carried out in recent years show a high prevalence of *burnout syndrome in resident physicians*, ranging between 30 and 50%.^{10–14} A systematic review with meta-analysis, which included 47 cross-sectional and cohort observational studies with more than 22,000 residents from different specialties and from various countries in Europe, Asia, and America, found a 51.0% *mean prevalence of burnout* using Maslach's questionnaire (95% CI: 45.0%–57.0%).¹³ This prevalence was higher than that found in a previous meta-analysis that included 26 cross-sectional studies from different countries, with almost 5000 residents of medical and surgical specialties assessed with the same questionnaire, 35.7% (95% CI: 26.8%–43.5%)¹⁴ (Table 1).

Since the onset of the COVID-19 pandemic several studies have investigated its impact on the occurrence of *burnout* in medical residents showing a wide range of prevalence, between 26% and 76%.^{15,16} This may be due to the heterogeneity of the studies conducted, for example, using different *burnout*^{17,18} assessment scales. Some of the studies found higher prevalence depending on the number of COVID-19 patients seen.^{19,20} Others found prevalence lower than those obtained before the pandemic with the same assessment tools²¹ (Table 3).

Individual and psychosocial factors related to the occurrence of stress and burnout syndrome during residency

Sociodemographic variables

There are a wide variety of individual and work factors that can affect *burnout* rates in resident physicians.

First, sociodemographic variables have been analysed. Regarding *gender*, the results are contradictory. In a systematic review by Low et al. (2019),¹³ male gender was a risk factor, as was being older, while in Rodrigues et al. (2018) it was being a woman and being young.¹⁴ However, the results of longitudinal studies seem to confirm an increased risk for women^{22–24} (Tables 2 and 3).

With respect to the *burnout dimensions*, it seems that there could be sociodemographic differences. Thus, there are studies that show that women score more in emotional exhaustion and men in depersonalization.²² In relation to *marital status*, being married or

Table 1Systematic reviews on the prevalence and risk factors of the *burnout* syndrome in residents published in the last 5 years in PubMed (using the Maslach or Oldenburg burnout scales).

Authors and year	N	Countries	Specialty	Questionnaires <i>burnout</i> /others	<i>Burnout</i> %	Risk factors	Protective factors	Comments
Verougstraete and Idrissi, 2020 ¹⁰	4 articles ^a 685 subjects 2008–2018	Iran, Jamaica, USA, China	Emergency Medicine	MBI ↑ EE, ↑ D or ↓ PA	55.6%–77.9%			PRISMA criteria High quality of included studies (20.7/22) Includes cross-sectional studies
Galaiya et al., 2020 ¹¹	62 articles 68.977 subjects 2008–2018	Saudi Arabia, Australia, China, USA, France, Fiji, Great Britain, Ireland, Italy, Lithuania, Switzerland, Pakistan	Surgical specialties	MBI ↑ EE or ↑ D ↑ EE, ↑ D or ↓ PA	22.2%–85.1%	Young age Female gender Single Workload Peer and patient conflicts <i>Neuroticism</i> Depression/substance use	Having children Work environment support Supervisor Physical activity Emotional intelligence/strength of character/ <i>mindfulness</i> <i>Extraversion</i> , <i>kindness</i> , <i>conscientiousness</i> Academic work Absence of economic concern	PRISMA criteria Includes cross-sectional and longitudinal studies (N = 7, 11%) 24% studies with less than 50 cases Diagnostic criteria heterogeneity
Chan et al., 2019 ¹²	22 articles 883 subjects 2000–2019	Canada, Korea, USA, France, Japan, Italy, Lebanon, Holland, New Zealand	Psychiatry	MBI ↑ EE, ↑ D or ↓ PA OLBI Utrecht Burn-Out Scale	33.7% ^b 27.9%–87%, 32%–40%, 4.4%–33%	Not having a partner First year of residency Not being the priority specialty No supervision Workload Insufficient rest Other stressors Anxiety or depression symptoms Low empathy Few coping strategies Self-medication Use of Mental Health services		PRISMA criteria Includes observational and experimental studies Differences in response rate Cut-off point differences even on the same <i>burnout</i> scale Participation bias

Table 1 (Continued)

Authors and year	N	Countries	Specialty	Questionnaires burnout /others	Burnout %	Risk factors	Protective factors	Comments
Low et al., 2019 ¹³	47 articles 22,778 subjects 1974–2018 Meta-analysis	Saudi Arabia Australia, Brazil Canada, USA, Egypt, Spain France, Pakistan, Turkey	All	MBI	All specialties 51.0% (95% CI: 45.0–57.0) Surgical > medical 53.27% (95% CI: 46.27–60.15) Asian Countries > Ameri- can > European 57.18% (95% CI: 45.80–67.85) 51.64% (95% CI: 46.96–56.28) 27.72% (95% CI: 17.40–41.11) Psychiatry <50% 42.05% (95% CI: 33.09–51.58) Radiology > 70% 77.16% (95% CI: 5.99–99.45)	Older Male gender Geographic location Specialty type: Radiology, Neurology and General Surgery		PRISMA criteria 50% studies with N < 100 subjects > Surgical specialties > USA than other countries Response rate on potential participants decreased <50% in many cases No publication bias Meta-analysis
Rodrigues et al., 2018 ¹⁴	26 articles 4664 subjects 1974– 2018 Meta-analysis	Argentina, Australia, Saudi Arabia Brazil, Canada USA, Spain, France, Greece Hungary, Iran Pakistan, Turkey	All (does not include Psychiatry)	MBI ↑ EE, ↑ D or PA ↓	All specialties 35.7% (95% CI: 26.8–43.5) EE: 43.6% (95% CI: 38.4–48.9) D: 38.9% (95% CI: 31.8–46.0) PA: 34.3% (95% CI: 21.3–47.2) Surgical/emergency > medical	Lack of confidence in acquiring medical knowledge Difficulty reconciling family/work life Poor workplace relations Female gender Young age To be single Excessive workload		PRISMA criteria: > 50% studies with N < 100 subjects Study response <i>ratio</i> not specified Global heterogeneity: I ² 87.6–98.6% No publication bias Meta-analysis

MBI: Maslach burnout inventory and its dimensions (EE: emotional exhaustion, D: depersonalization and PA: personal accomplishment); OLB: Oldenburg burnout inventory.

^a This systematic review also included studies in emergency medicine's attending physicians which are not shown on this table.

^b Of the 22 studies, 13% used a categorical definition and percentage of *burnout*.

Table 2Longitudinal studies of *burnout* syndrome in residents published in the last 5 years in PubMed (using Maslach's or Oldenburg's *burnout* inventories).

Authors and year	N (% response) Evaluation times Year of completion	Country	Specialty	Questionnaires <i>burnout</i>	Type of study	<i>Burnout</i> %/mean (SD)	Risk factors	Protective factors
<i>National</i> Kemper et al., 2020 ²⁷	1664 (61%) A 20162153 (66%) B 20172 241 (61%) C 2018 2016–2018	USA	Paediatrics	MBI ↑ EE, ↑ D	Survey national, prospective, <i>on-line</i>	56% A 54% B 54% C	Stress < Hours of sleep > Medical errors Family/work life dissatisfaction	Empathy Self-pity Quality of life Confidence in being able to provide compassionate care
Kocalevent et al., 2020 ²²	1011 (48%) R1, R2, R3, R4, R5 2009–2016	Germany	All	MBI ↑ EE, ↑ D or ↓ PA	Multicenter survey, prospective, <i>on-line</i>	Significant increase in EE and D and PA from R1 to R5	Female gender (>EE) Male gender (>D) Work/family reconciliation Effort/reward imbalance	
Dyrbye et al., 2018 ^{2,3}	3574 (81.2%) Baseline (graduation) and R2 2010–2014	USA	All	Adapted MBI ↑ EE, ↑ D	Survey national, prospective, <i>on-line</i>	45.2% symptoms R2	Female gender Urology, Neurology, Emergency medicine, Ophthalmology, General Surgery > Internal Medicine University-stage anxiety Specialty regret >Workload <Control over work <Support of supervisors	High levels of empathy in the university stage
Galatea Foundation, 2018 ³⁰	478 (57.5%) B 290 (34.9%) R1 216 (26.0%) R4 2014–2015	Catalonia (Spain)	All	OLB	Prospective, multicenter survey, <i>on-line</i>	18.4 (2.99): R1 19.2 (3.02): R4		
O'Connor et al., 2017 ²⁸	172 (28.6%) 3 and 12 months (R1) 2015–2016	Ireland	Medicine	MBI ↑ EE, ↑ D	National survey, prospective, <i>on-line</i>	60.3% 3 months 72.6% 12 months	Making mistakes	

Table 2 (Continued)

Authors and year	N (% response) Evaluation times Year of completion	Country	Specialty	Questionnaires <i>burnout</i>	Type of study	<i>Burnout</i> %/mean (SD)	Risk factors	Protective factors
Cubero et al., 2016 ²⁹	54 (100%) B, 6 months, 1 year 2010–2011	Brazil	Oncology	MBI ↑ EE, ↑ D	Survey prospective multicenter, <i>on-line</i>	76% baseline 88% per year of R	Work overload (No. patients and No. h)	
<i>Local</i> Cortez et al., 2020 ²⁵	55 (93.3%) 2015–2017	USA	General Surgery	MBI ↑ EE, ↑ D or ↓ PA	Survey single centre, prospective, <i>on-line</i>	11.8% (R1) 25.0% (R2) 50% (R3) OR = 11.7 (p = 0.03)	Low strength of character scores	
Gleason et al., 2020 ²⁶	236 (81%) 2015–2019	USA	General Surgery	MBI ↑ EE, ↑ D	Single-center survey, prospective, <i>on-line</i>	117 (58.5) 68% (2015) 53% (2019)	> Year of residency: R5 (64%) and R1 (38%) Suffering disruptive behaviour (being taken advantage of, being humiliated)	Emotional intelligence Sense of wellness Professional career development
Lindeman et al., 2017 ²⁴	88 (61.5%) A 64 (44.8%) B 69 (48.3%) C	USA	General Surgery	MBI ↑ EE	Multicenter survey, prospective, <i>on-line</i>	24% A 17% B 32% C	Female gender (EE) Beginning and end of residency	High emotional intelligence Emotional stability, kindness Positive work experiences

B: baseline; MBI: Maslach burnout inventory and its dimensions (EE: emotional exhaustion, D: depersonalization and PA: personal accomplishment); OLBI: Oldenburg burnout inventory; R1: first year of residency; R4: fourth year of residency.

Table 3Studies on *burnout* syndrome in residents during the first wave of the COVID-19 pandemic in 2020.

Authors	N/% responders	Country	Specialty	Burnout questionnaire	Type of study	Burnout Mean (SD)/%	Risk factors
Degraeve et al., 2020 ¹⁵	126 50%	Belgium	Urology	CBI subscales: CBIP, CBIPPro and CBIR	National, cross-sectional survey <i>on-line</i>	CBIP: 47% reduction CBIPPro: 48% reduction CBIR: 32% reduction	First line: 66% Other departments: 86%
Dimitriu et al., 2020 ¹⁶	100	Romania	First line 50% Other departments 50%	MBI	National, cross-sectional survey <i>on-line</i>	76%	
Osama et al., 2020 ¹⁷	112	Pakistan	Surgery	MBIm score	National, cross-sectional survey <i>on-line</i>	72% score reduction <i>burnout</i>	<Workload <Clinical and surgical work
Civantos et al., 2020 ¹⁸	165	USA	Otolaryngology	Mini-Z Burnout Assessment	National, cross-sectional survey <i>on-line</i>	29.7% <i>burnout</i> symptoms	No. patients with COVID-19 seen: ≥60: quadrupled risk 31–59: tripled risk 1–30: risk almost doubled Female Direct care for COVID-19 patients Unavailability of rest areas Rotation/holidays changes In case of choice, change of specialty < Older residents
Cravero et al., 2020 ¹⁹	1420 doctors in training 73% residents	USA, China, Saudi Arabia, Taiwan	All	MBI	International, cross-sectional survey <i>on-line</i>	High <i>burnout</i> % in those exposed to COVID-19 patients	
Coleman et al., 2021 ^{twenty}	465	USA	Surgery	MBIa subscales	Cross-sectional survey, <i>on-line</i>	EE: 55% D: 39% PA: 45%	
Khalafallah et al., 2020 ²¹	1.374 12.2%	USA	Neurosurgery	MBI	<i>On-line</i> , cross-sectional, national survey	26.1%	

CBI: Copenhagen Burnout Inventory (*burnout subscales*: CBIP: personal; CBIPPro: professional; CBIR: relational); MBI: Maslach burnout scale and dimensions (EE: emotional exhaustion, D: depersonalization, and PA: personal accomplishment); MBIa: abbreviated Maslach burnout inventory; Mini Z-Burnout assessment: consists of a single burnout assessment item.

with a partner appears to be a protective factor,^{1,12} as does responsibility for *childcare*, contrary to what might be assumed.¹¹

As to *cultural differences*, the review by Low et al. (2019),¹³ which includes studies from several Asian countries, found a higher *burnout* syndrome prevalence in Asia, close to 60%, compared to 30% in European residents, without reaching statistical significance (Table 1).

During the pandemic, several studies found that the *female gender* is a risk factor for *burnout*.²⁰ This greater vulnerability in women may be related to the already known propensity to develop anxiety and depression (Table 3).

Personality traits

Neurotic and introverted personalities have been associated with a higher risk of *burnout*, with *extroversion* being a protective factor.¹¹ As well as emotional stability, kindness²⁴ and strength of character.²⁵ On the other hand, several studies have found that *emotional intelligence* and *empathy* are strong predictors of well-being during residency and are protective against *burnout*.^{23,24,26,27} In terms of coping styles, those based on emotional reactions (self-blame, anger, irritation, self-concern) seem to be a risk factor for developing *burnout*.¹²

The relationship between personality factors and the occurrence of stress or *burnout* in residents has not yet been studied in this pandemic period.

Type of specialty and year of residency

Another debated issue is the possible difference in terms of the chosen specialty. In a systematic review by Low et al. (2019),¹³ Radiology, Neurology and General surgery were the specialties with the highest prevalence of *burnout* syndrome in its residents (>60%), followed by Internal Medicine, Traumatology, Dermatology, Gynaecology and Neurosurgery (50%), and those of Medical Oncology and Family Medicine (40%). The studies that included Psychiatry residents (N = 245) showed a prevalence of 43%.^{12,13} Data from Rodrigues et al. (2018)¹⁴ show that prevalence was higher in surgical and emergency specialties (40%) compared to medical specialties (25%). In relation to other factors, it has been described that both the first year and the last year of residency,²⁴ other recent stressful events^{15,28} and dissatisfaction with the chosen specialty^{12,23} constitute risk factors for *burnout* (tables 1 and 2).

Most of the studies on *burnout* among resident physicians during the COVID-19 pandemic that we have found were cross-sectional and conducted in *surgical specialties*^{15,17,20,21}. This group has had to move on many occasions to other units, such as Intensive Care Units or specific care wards for COVID-19 patients, which is an added stress factor.²¹ During the pandemic, being a *first-year resident* was also a risk factor for *burnout*.²¹ This fact reflects the need not to neglect the mentoring of especially younger residents at this time (Table 3) (Fig. 1).

Working conditions

A *high workload* with excessive working hours, a *hostile work environment* and generally *poor workplace conditions* have been reported as risk factors for the occurrence of stress and *burnout*.^{8,12,22,29,30} among residents. *Poor oversight* and support, not having an identifiable manager, poor relationships with superiors and *diminished perception of peer support* are other risk factors that may contribute to poor adaptation and have been associated with the development of stress and *burnout* in residents.^{12,22,26,30} (Fig. 1). There are many differences in practice depending on the type of hospital. General, university hospitals may generate more tension due to high internal competition, although they tend to have a

higher number of residents per year and from different specialties, which favours a peer support network. Smaller hospitals create more cohesive work groups, with a more familiar *environment* that can mitigate the effects of stress.³⁰

During the pandemic, the large hospitals with the greatest number of Intensive Care Unit beds have been the hospitals that have treated the greatest number of COVID-19 patients, which, on the one hand, has led to a high number of residents being in the front line of action, generating a situation of uncertainty and insecurity and great added work stress.¹⁸ However, the existence of clear protocols, practical trainings with staff on protective measures, access and proper use of protective equipment have acted as *protective factors for burnout*.^{16,19,20} (Tables 3 and 4).

An important aspect of residency training is *emergency* and on-call training. For some residents it is a stimulating activity, while for others it is a source of high anticipatory anxiety, extreme professional difficulty, and fear of making mistakes.^{27,28,30} Studies have shown that on-call duty is one of the most stressful situations for residents.¹⁰ This is compounded by many factors, inexperience, situations of poor oversight, the risk of making mistakes, dealing with potentially life-threatening situations and the regular disruption of circadian rhythms. Objectively, the study of the hypothalamic-pituitary-adrenal axis during an on-call period shows that the plasma cortisol concentration curve over the course of an on-call day is significantly higher than that of a day without an on-call period, regardless of the year of residency.³¹

During the pandemic, the emergency department has been a frontline site of care for patients with COVID-19, overloading an already high-stress activity for residents¹⁶ (Table 4).

Protective stress factors and burnout during residency

Hours and quality of sleep

One of the factors that can contribute to and even predict the occurrence of stress and *burnout* is the *decrease in sleep hours* (< 6 h) and *alteration of the circadian rhythm*. This relationship holds even when considering other variables, such as *work demand* or *work pressure* or *thoughts about work during leisure time*.³² Poor quality of sleep and decreased hours of sleep have been observed as specific risk factors for *burnout* in residents of different specialties.^{12,27} The longitudinal survey of residents from all over Catalonia in 2018 showed that before starting the residency only 10% of residents slept less than 6 h a day, a year into the residency this was the case for 50% of them and at the end of the residency it reached 60%. The *decrease in sleeping hours* was related to the increase in the number of working hours.³⁰ Sleep deprivation and fatigue are known to produce metabolic and physiological abnormalities that lead to cognitive deficits.⁴ Therefore, paying attention to this aspect could be a relatively easy way to decrease the risk of *burnout* in residents also, to the extent possible, in a crisis situation such as the current pandemic (Fig. 1).

Physical exercise and diet

Regular *physical exercise* and relaxation techniques such as *mindfulness* have been shown to be protective against *burnout* in residents. Regular exercise was the only *burnout*-protective activity in a study of nearly 5000 American obstetrics and gynaecology residents.³² However, several studies show that residents reduce *physical activity* during the training period from 60% at the beginning to 40% in the final year.³⁰ These data are in line with the results of a sample of 2623 doctors, nurses, and residents from 5 European countries which found that *insufficient exercise* and increased consumption of *fast food* were associated with the occurrence of

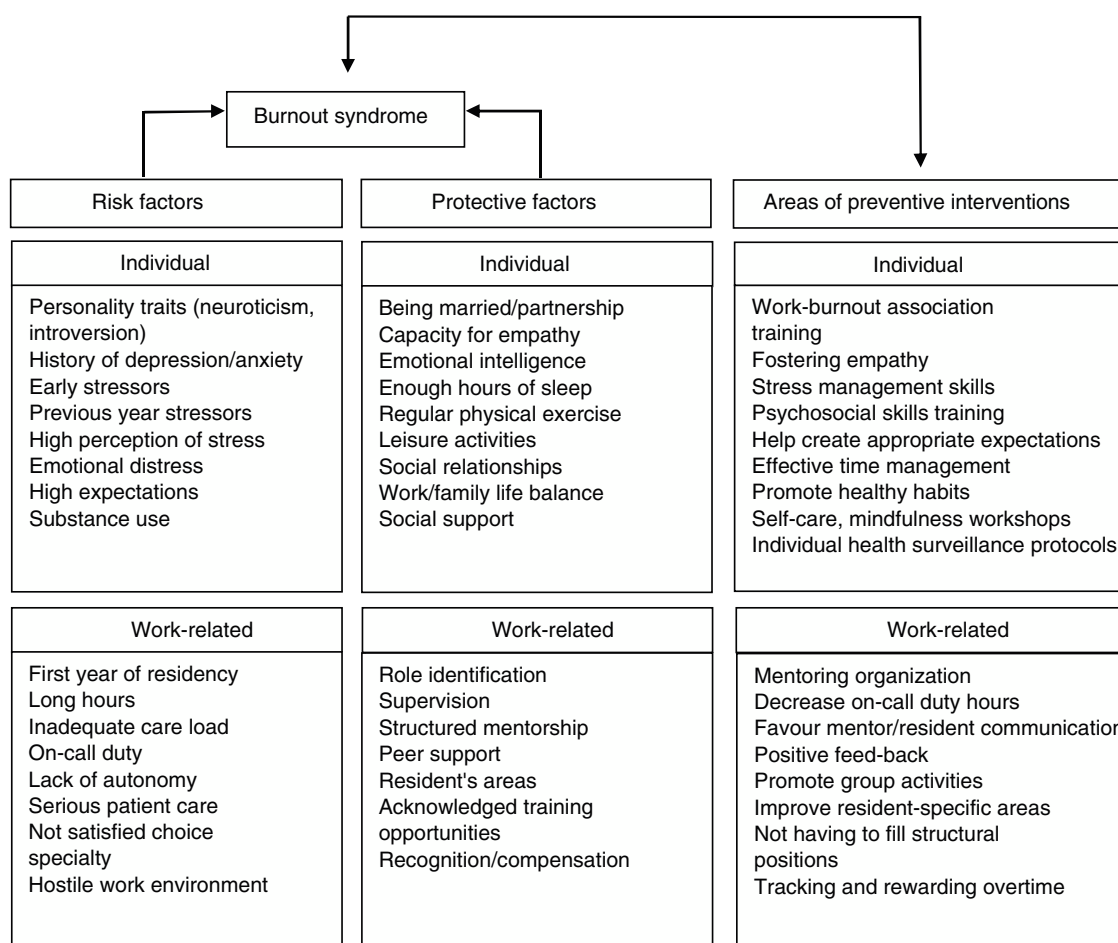


Fig. 1. Risk and protective factors for *burnout* syndrome in residents and possible areas of preventive action.

Table 4

Impact of the COVID-19 pandemic on resident doctors in the following dimensions: healthcare, training and personal.

Healthcare aspects	Training aspects	Personal aspects/risk perception
Timetable change/elective rotation/holidays Relocation to other departments or shift grouping Elimination/reduction of work in outpatient clinics, or change to telehealth participation Elimination/reduction of elective/emergency surgery Restrictions due to lack of sufficient protective equipment or maintenance of safety measures Negative impact on clinical or surgical experience Negative impact on meeting the minimum number of visits/interventions required in the training plan Concern to improve or maintain the skills of the specialty	Training plan reorganization. Elimination of rotas/training stays Less direct contact with attending/mentors Less contact with peers Implementation of innovative training and capacity building solutions Adaptation of the educational programmes of the institution or scientific societies to other formats (videoconferences, recordings, etc.). Increased availability for study/research Increased participation time in e-learning conferences	Impact on mental health in vulnerable residents (women, first year in residence, infected colleagues, previous mental illness, number of infected patients cared for) Fear of becoming infected or potentially infecting family members and close people Residency development concern Little recognition effort made Search alternative residency avoid infecting Mobility difficulties outside the area Decreased social support Risk of loss of healthy habits

burnout.³³ Exercise and a healthy diet meet the high energy needs for proper brain function, particularly that of the prefrontal cortex. Maintaining both of these healthy habits despite the stressful work situation should be considered a priority in order to support proper functioning.⁴

During the pandemic, *restrictions* put in place by governments have limited access to gyms or the possibility of practicing sports. We did not find data on this particular aspect in our review, but it is

likely that this situation limited access to a *protective stress factor* in residents. Finally, the *consumption of alcohol and other psychoactive substances* has also been linked to *burnout*.^{32,33} Those residents who consume alcohol on 4 or more occasions per week during residency have a 3.3 increased risk (*odds*) of developing *burnout syndrome*.³² Alcohol consumption, although it may initially produce a sense of stress relief, worsens brain physiology in the long term, promoting emotional distress and depression.⁴

Social and leisure activities

Adequate *social support*, being involved in *social activities* and a suitable *work-life balance* have been reported as *burnout protectors* in residents^{22,26,30} (Fig. 1). The 'within work' activities that residents associated with *relaxation* were the possibility of having time to review clinical notes, talk to patients and to be able to assess articles and study. Also, having areas where they could relax (*office*) and having a chance to hold informal conversations or discuss patients improved the stress of the professionals. Unfortunately, there is an increasing tendency to eliminate this type of areas in the workplace.

In general, during the pandemic, institutions have prioritised the physical safety of their workers, with less emphasis on measures to *support the emotional well-being*. A shortage of wellness spaces at work has been reported as a risk factor for *burnout* in residents during this pandemic.²⁰ These results underline the importance of implementing wellness programmes in institutions and maintaining them during times of health crisis such as formal counselling space, relaxation spaces or relaxation and meditation programmes.²⁰ Despite the social restrictions imposed by the pandemic, residents reported in several studies that during this period they had more time to spend on study activities or pursuing a *hobby* at home, and this was rated positively by them²¹ (Table 4).

Limitations

The literature review carried out has the limitation of not being systematic. However, it highlights the lack of consensus on the most widely used validated instrument, the MBI, due to the use of different cut-off points, different criteria for the subscales (emotional exhaustion, depersonalisation, personal accomplishment) needed to make the diagnosis and different versions of the inventory (Tables 1–3). This represents a challenge in understanding the prevalence of *burnout* syndrome in the resident physician population with greater accuracy. Most of the studies reviewed have a cross-sectional design and few studies have a longitudinal design that allows an analysis of incidence and risk/protective factors. In the case of resident *burnout* during COVID-19, a longitudinal follow-up will be of great interest in order to observe what happens throughout the different stages of the pandemic. On the other hand, the samples do not always include all specialties or study the same risk or protective factors. As all studies were conducted through *on-line surveys*, it was not possible to study any biological variables associated with the presence of *burnout*. Another limitation is the sample size and response rate of some of the surveys.

Conclusions

The average prevalence of *burnout* in residents observed in the systematic reviews examined, mostly cross-sectional studies, is around 50%. *Burnout* syndrome seems to increase over time throughout residency in the longitudinal studies reviewed. The most commonly observed risk factors for *burnout* during residency were confirmed by those found in the cross-sectional studies; they were female gender (greater emotional exhaustion), male gender (greater depersonalisation), surgical specialties, making mistakes, little sleep, difficulty in reconciling family/work life and work overload. The protective factors were emotional intelligence, empathy and being able to develop a professional career.

Due to the heterogeneity of the studies, the prevalence of *burnout* in residents during the first wave of the COVID-19 pandemic in the cross-sectional studies reviewed was found to encompass a very wide range (26%–76%). The most important associated risk factor was the number of COVID-19 patients cared for directly by the resident. Caring for 1–30 patients almost doubled

the risk and the risk quadrupled in those who cared for 60 or more patients.

The management and prevention of *burnout syndrome* during residency remains a pending issue, which should consider not only the psychosocial aspects of the work environment, but also the underlying biological changes in the person experiencing it. The COVID-19 pandemic has underlined the importance of being aware of this problem among professionals in training because of the enormous impact it can have both on the individual and on adequate patient care.

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Conflict of interests

All authors declare that they have no conflict of interest. The funding sources had no participation in the design, development, or publication of the study.

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