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DOI: 10.4103/jfcm.jfcm_304_23

# Cognitive function and work resilience of healthcare professionals: A comparative cross-sectional study

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## Abstract:

**BACKGROUND:** Healthcare professionals (HCPs) face a variety of work-related stressors that have impact on their mental health and cognitive performance. Work resilience is a psychological resource that helps workers cope with stress and prevents unfavorable psychological impact. The aim of this study was to assess the associations between working as HCPs and cognitive function as well as work resilience.

**MATERIALS AND METHODS:** This was a comparative cross-sectional study conducted among HCPs at Suez Canal University Hospital in Ismailia Governorate, Egypt, during April 2023 to August 2023. Two hundred and thirty-five HCPs and 107 administrative employees (Admins) were invited to participate in this study. A self-administered questionnaire was used to obtain sociodemographic and other relevant data. Cognitive function was assessed with the Mini-Mental State Examination test; work resilience was assessed with the Brief Resilience Scale; and psychological distress was measured with the Depression, Anxiety, and Stress Scale - 21-items (DASS-21) scale. Statistical significance was determined by Mann Whitney U-test for continuous variables, and Chi-square test or Fisher's exact, as appropriate, for categorical variables. Multiple logistic regression models were employed to determine associations between the main outcomes (cognitive impairment and low resilience) and the main covariate (working as HCPs vs. Admins), adjusting for all potential confounders.

**RESULTS:** HCPs showed a significantly greater cognitive impairment, less resilience, and DASS-21 than the Admins. The odds of impaired cognitive function in HCPs were significantly higher than the Admins (odds ratio [OR]: 4.45, 95% confidence interval [CI]: 1.27–15.67,  $P = 0.020$ ), adjusted for all potential covariates. Similarly, the odds of low resilience in HCPs were significantly higher than Admins (OR: 5.81, 95% CI: 2.72–12.44,  $P < 0.001$ ), adjusted for all potential covariates. However, the adjusted association between impaired cognitive function and low resilience was not statistically significant (OR: 0.55, 95% CI: 0.23–1.33,  $P = 0.185$ ).

**CONCLUSION:** HCPs had significantly impaired cognitive function and low work resilience. Workplace policies and interventions to control depression, stress, and anxiety are required as it is the encouragement of physical activity. Programs that combine positive coping skills training (e.g., relaxation training, positive thinking, and problem solving) with resilience-building interventions (e.g., taking a proactive approach to solving problems, being flexible and adaptive) should be developed, with special attention to HCPs who have a higher sense of self-efficacy.

## Keywords:

Cognitive function, healthcare professionals, resilience, work

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Received: 31-10-2023

Revised: 03-02-2024

Accepted: 26-02-2024

Published: 15-04-2024

## Introduction

Healthcare professionals (HCPs) are at greater risk of greater mental

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health issues.<sup>[1]</sup> Some factors thought to be challenging working conditions that frequently result in burnout are work overload, shift work, inadequate resources, exposure to stressful emotional situations,

**How to cite this article:** Amer SA, Fouad AM, El-Samahy M, Anan M, Saati AA, Sarhan AA, *et al.* Cognitive function and work resilience of healthcare professionals: A comparative cross-sectional study. *J Fam Community Med* 2024;31:153-9.

risk of exposure to infectious diseases and injuries, financial strain, and so on. Poor mental health has been linked to lower efficiency and productivity of healthcare workers (HCWs).<sup>[2]</sup> Owing to the overwhelming workload and responsibilities as well as the lack of experience, residency is a very stressful phase in a physician's career.<sup>[3]</sup> Studies on stress in medical residents indicate that a significant percentage of this group of professionals suffer from burnout.<sup>[4]</sup> As a result of the widespread negative effects on the prefrontal cortex, the part of the brain responsible for organizing brain functions and offering top-down control over emotion, thought, and intelligent behavior regulation (action), cognitive impairment is regarded as a prominent feature of job burnout.<sup>[5,6]</sup> The PFC is regarded as the mental toolbox of the physician, where numerous crucial cognitive functions are carried out.<sup>[7]</sup>

Research done during the coronavirus disease 2019 (COVID-19) epidemic showed that cognitive abilities of HCPs were compromised.<sup>[8,9]</sup> While the pandemic has drawn attention to the need for researchers and medical organizations to prioritize the protection of HCP mental health, it may be unrealistic to expect that these recommendations will receive priority, particularly in low- and middle-income nations where health authorities have difficulty in meeting the ever-increasing health needs of most of the population.

Given that HCPs are the first responders to this crisis, cognitive problems of HCWs are an important area for future investigation. HCPs are expected to have a higher risk of infection because of their close interaction with infected patients, particularly those whose infections are either undetected or subclinical. According to a recently published meta-analysis, HCPs are exposed to a range of long-term psychological stressors such as anxiety (37%), depression (36%), and insomnia (32%), which could have an adverse effect on their quality of life.<sup>[10]</sup>

Psychological resilience is a protective element that functions as a kind of "magical medication" in reducing the adverse effects of trying circumstances, avoiding psychiatric illnesses, assisting in the management of stress and unhappiness, and facilitating recovery.<sup>[11]</sup> It is described as a dynamic process that helps people cope with stress, hardship, trauma, danger, and/or tragedy.<sup>[12]</sup> Psychological resilience has been found to function as an inhibitor of the negative consequences of the job strain of HCPs.<sup>[13]</sup>

HCPs included only physicians and nurses who were directly involved in patient care, while Admins included employees who had no direct involvement in patient care, such as secretaries or employees in the human resources, information technology, customer service,

procurement, management, and medical records departments.

According to recent studies, organizational and systemic factors, such as the nature and intensity of the job, have a negative effect on HCPs well-being and retention.<sup>[2,14]</sup> We, therefore, compare workers who have the same place of work but do different jobs. Another study showed a connection between psychological resilience and cognitive function in older persons. However, few studies analyzed this relationship in HCPs.<sup>[15]</sup> The aim of this study was to assess the associations between working as an HCP and as an Admin in Suez Canal University Hospital, by comparing their cognitive function and work resilience.

## Materials and Methods

This was a comparative cross-sectional study conducted at Suez Canal University Hospital in Ismailia Governorate from April 2023 to August 2023. The study compared HCPs with administrative employees (Admins). A total sample size of 256 (HCPs = 171; Admins = 85) was calculated using G\*Power 3.1.9.7.<sup>[16]</sup> Two-tailed *t*-test procedure for the difference between two independent means was performed, giving an effect size (*d*) of 0.374 corresponding to an expected two-point difference in the Mini-Mental State Examination (MMSE) score between the study groups ( $\pm 5.35$  within each group), 95% level of confidence, 80% power of the study, and 2:1 allocation ratio. With an expected response rate of 75%, the total calculated sample size increased to 342 participants. Ethical approval was obtained from the Institutional Research Ethics Committee vide Letter No. 5279 dated 27/03/2023, and written informed consent was taken from all participants in the study.

Data regarding work (nature, shift, work schedule, duration, and hours) and demographic characteristics (age, gender, residence, marital status, educational level, and special habits including smoking and physical activities) were collected via a self-administered questionnaire. Shift is any work arrangement other than the standard work performed during daylight hours, including fixed or permanent night shift, and rotating night and day shift. Accordingly, we combined the categories "night" and "rotating" into "shiftwork."

For the purpose of the study, smoking status was categorized into "nonsmokers" and "smokers." Smokers included those who were everyday or someday smokers, and nonsmokers included those who had never smoked or were former smokers.<sup>[17]</sup>

The presence or absence of regular physical activity was determined through participants reporting

with “Yes/No” to three questions about performing moderate-intensity aerobic physical activity for 150–300 min/week; vigorous-intensity aerobic physical activity for at least 75–150 min/week; and an equivalent combination of both throughout the week. Answering “Yes” to any of the three questions indicated “regular physical activity,” and answering “No” indicated the absence of regular physical activity.<sup>[18]</sup>

Five domains of global cognitive functioning were objectively evaluated using the MMSE orientation, registration, attention and calculation, recall, and language.<sup>[19]</sup> The MMSE scores ranged from 0 to 30, with higher scores indicating better cognitive functioning. MMSE score <27 indicated cognitive impairment and study participants were classified as having normal or impaired cognitive function accordingly. Work resilience was assessed with the Arabic version of the Brief Resilience Scale (BRS).<sup>[20]</sup> The BRS comprises six items that are scored on a 5-point Likert scale, from strongly disagree (1) to strongly agree (5). Negatively worded items were reversed before scoring. Scoring was made by adding responses from 1 to 5 for all six items to give a total sum ranging from 6 to 30 and dividing this total by the total number of questions answered. Resilience was defined as “high,” “normal,” and “low” based on total scale score of 4.31–5.0, 3.0–4.30, and 1.0–2.99, respectively.<sup>[21]</sup> However, we grouped “high” and “normal” categories together against the “low resilience” category. The Arabic version of the BRS scale showed an excellent internal consistency in a previous study (Cronbach’s alpha coefficient = 0.98) and good convergent and construct validity.<sup>[20]</sup> Psychological distress was assessed using the Arabic version of 21-item quantitative scale of Depression, Anxiety, and Stress Scale 21-items (DASS-21).<sup>[22]</sup> Normal as 0–4, mild 5–6, moderate 7–10, severe 11–13, and extremely severe  $\geq 14$  were the scores assigned to the depression category; mild as 4–5, moderate 6–7, severe 8–9, and extremely severe  $\geq 10$  were the scores assigned to the anxiety category; and normal 0–7, mild 8–9, moderate 10–12, severe 13–16, and extremely severe  $\geq 17$  were the scores assigned to the stress category. However, we chose to present the DASS-21 variables as a two-level categorical variable where the first category in each one of these variables is identified as “normal” and the second category identified as having “depression,” “anxiety,” and “stress” regardless of its level, to avoid small frequencies owing to sample size limitation. The data were collected via self-administered questionnaires distributed at the beginning of the work day to the two target groups chosen from the list of workers obtained from the department in the facility by simple random sampling method and collected at the end of the day.

The Statistical Package for the Social Sciences (SPSS for Windows, version 25.0 IBM Corporation, Armonk, NY, USA) was used for all statistical analyses. The Kolmogorov–Smirnov test was used to determine the normality of continuous variables. As the continuous variables were not normally distributed, the Mann–Whitney *U*-test was used to examine the variations in distribution in the two groups. The association of categorical variables was tested using the Chi-square test or the Fisher’s exact test (if more than 20% of expected values were <5). Simple and multiple binary logistic regression models were conducted to identify the unadjusted and adjusted associations, respectively, between the main outcomes (cognitive impairment and low resilience) and the main covariate (working as HCPs vs. Admins), adjusted for all potential confounders in the study. Covariate selection for inclusion in the adjusted model was based on the *P* value of bivariate associations where covariates with *P* < 0.05 were included. However, gender was included despite not being significantly different in the two groups since it was an important determinant according to relevant literature. The findings of the regression models were presented as odds ratio (OR), its 95% confidence interval (CI), and *P* value. Statistical significance was set at *P* < 0.05.

## Results

In this study, 235 were HCPs (75 physicians and 160 nurses) and 107 were Admins (administrative employees). The age of HCPs ranged from 20 to 53, with a mean of 32.2 years, while the age of Admins ranged from 19 to 55, with a mean of 34.4 years. Table 1 shows that there were insignificant differences between HCPs and Admin groups regarding their gender distribution, education level, or smoking status. However, Admins were significantly older than HCPs (*P* = 0.020). The HCPs had significantly higher proportions of urban residents, unmarried, and physically active participants (*P* < 0.05). About half of HCPs reported that they run shifts, either as fixed night or rotating shifts (20.4%, and 28.5%, respectively), which was significantly higher than the Admins (20.6%, *P* < 0.001). The mean duration of working shifts and the mean working hours per shift were significantly longer for the HCPs than for the Admins (*P* < 0.05).

Table 2 shows that the total and most domain-specific scores of the cognitive function in the HCPs group were significantly lower than Admins (*P* < 0.001). The mean resilience score of the HCPs was significantly lower than the Admins (*P* < 0.001); however, the mean DASS-21 scores of the HCPs were significantly higher than the Admins denoting increased psychological stress of HCPs (*P* < 0.001). Accordingly, the prevalence of cognitive impairment, low resilience, and DASS-21 in HCPs was significantly greater than Admins (*P* < 0.05).

**Table 1: Comparison of sociodemographic, work-related, and lifestyle-related variables between healthcare professionals and administrative employees at Suez Canal University Hospital, Egypt, 2023**

Variables	HCPs (n=235) N (%)	Admin (n=107) N (%)	P-value
Gender			
Male	80 (34.0)	30 (28.0)	0.270 <sup>b</sup>
Female	155 (66.0)	77 (72.0)	
Age (years)			
Mean±SD	32.20±8.59	34.44±7.47	0.020 <sup>*a</sup>
Range	20–53	19–55	
Age groups (years)			
≤40	183 (77.9)	93 (86.9)	0.049 <sup>*b</sup>
>40	52 (22.1)	14 (13.1)	
Education level			
Tertiary/vocational and technical	33 (14.0)	8 (7.5)	0.083 <sup>b</sup>
Higher education	202 (86.0)	99 (92.5)	
Residence			
Urban	154 (65.5)	44 (41.1)	<0.001 <sup>*b</sup>
Rural	81 (34.5)	63 (58.9)	
Marital status			
Unmarried	70 (29.8)	19 (17.8)	<0.001 <sup>*b</sup>
Married	165 (70.2)	88 (82.2)	
Smoking			
Nonsmokers	215 (91.5)	101 (94.4)	0.348 <sup>b</sup>
Smoker	20 (8.5)	6 (5.6)	
Regular physical activity			
No	184 (78.3)	95 (88.8)	0.020 <sup>*b</sup>
Yes	51 (21.7)	12 (11.2)	
Shiftwork			
No	120 (51.1)	85 (79.4)	<0.001 <sup>*b</sup>
Yes	115 (48.9)	22 (20.6)	
Work schedule			
Standard day	120 (51.1)	85 (79.4)	<0.001 <sup>*b</sup>
Fixed night shift	48 (20.4)	11 (10.3)	
Rotating (day/night)	67 (28.5)	11 (10.3)	
Duration of shiftwork (years)	4.75±6.14	2.41±5.22	0.001 <sup>*a</sup>
Average hours of shiftwork	5.93±6.08	2.28±4.51	<0.001 <sup>*a</sup>

<sup>\*a</sup>Statistically significant at  $P < 0.05$  using Mann–Whitney U-test, <sup>\*b</sup>Statistically significant at  $P < 0.05$  using Chi-square test. HCPs=Healthcare professionals, Admins=Administrative employees, SD=Standard deviation

The unadjusted binary logistic regression model showed that the odds of impaired cognitive function were 3.33 times higher in HCPs compared to the Admins ( $P = 0.015$ ) [Table 3]. However, the multivariate model yielded greater odds of impaired cognitive function in HCPs than the Admins (OR: 4.45, 95% CI: 1.27–15.67,  $P = 0.020$ ), adjusted for age, gender, residence, marital status, physical activity, shiftwork, resilience, stress, anxiety, depression, and the depression -by- gender interaction term. Furthermore, the adjusted association between impaired cognitive function and low resilience was statistically insignificant (OR: 0.55, 95% CI: 0.23–1.33,  $P = 0.185$ ).

**Table 2: Comparison of cognitive function, resilience level, and psychological distress between healthcare professionals and administrative employees at Suez Canal University Hospital, Egypt, 2023 groups**

Variables	HCPs (n=235) N (%)	Admin (n=107) N (%)	P-value
Cognitive domains scores (MMSE)			
Orientation	9.10±1.45	9.20±1.20	0.540 <sup>a</sup>
Registration	2.33±0.55	2.89±0.10	<0.001 <sup>*a</sup>
Attention and calculation	3.03±1.05	3.98±0.55	0.010 <sup>*a</sup>
Recall	1.88±1.80	2.50±0.60	<0.001 <sup>*a</sup>
Language	7.93±1.22	8.68±0.53	<0.001 <sup>*a</sup>
Cognitive total score (MMSE)	26.76±3.40	29.90±1.60	<0.001 <sup>*a</sup>
Cognitive function			
Normal	202 (86.0)	102 (95.3)	0.011 <sup>*b</sup>
Impaired	33 (14.0)	5 (4.7)	
Resilience score (BRS)	2.92±0.48	3.14±0.44	<0.001 <sup>*a</sup>
Resilience level			
Normal/high	108 (46.0)	74 (69.2)	<0.001 <sup>*b</sup>
Low	127 (54.0)	33 (30.0)	
Psychological distress scores (DASS-21)			
Depression score	4.51±5.7	0.65±1.39	<0.001 <sup>*a</sup>
Anxiety score	4.98±5.20	1.97±2.53	<0.001 <sup>*a</sup>
Stress score	6.37±5.55	1.74±2.01	<0.001 <sup>*a</sup>
Psychological distress			
Depression	87 (37.0)	5 (4.7)	<0.001 <sup>*b</sup>
Anxiety	105 (44.7)	28 (26.2)	0.001 <sup>*b</sup>
Stress	89 (37.9)	0	<0.001 <sup>*b</sup>

<sup>\*a</sup>Statistically significant at  $P < 0.05$  using, <sup>a</sup>Mann–Whitney U-test, <sup>b</sup>Chi-square test. Scores are presented as mean±SD. HCPs=Healthcare professionals, Admins=Administrative employees, MMSE=Mini-mental state examination, BRS=Brief Resilience Scale, DASS-21=Depression, Anxiety, Stress Scale - 21-items

Similarly, in Table 4, the crude odds of low resilience were 2.64 times higher in HCPs than the Admins ( $P < 0.001$ ). However, adjusting for study covariates (age, gender, residence, marital status, physical activity, shiftwork, stress, anxiety, depression, and the interaction terms of depression × gender and anxiety × HCPs) yielded higher OR of 5.81 (95% CI: 2.72–12.44,  $P < 0.001$ ).

## Discussion

Of all the professional categories, HCPs are the most vulnerable to stress at work. Cognitive impairment of HCPs negatively affects their work and increases the risk of mistakes and transmission of infection.<sup>[23]</sup>

A previous study observed that cognitive impairment was a typical complaint of those experiencing stress at work. However, it is unclear if the detrimental effects of these complaints lead to any discernible deterioration in cognitive abilities.<sup>[24]</sup>



**Table 3: Associations between cognitive function and work type among healthcare employees at Suez Canal University Hospital, Egypt, 2023 (n=342)**

Predictors	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
HCPs (reference admins)	3.33	1.26–8.79	0.015*	4.45	1.27–15.67	0.020*
Age >40 (reference ≤40 years)				0.35	0.07–1.73	0.197
Female (reference male)				0.49	0.13–1.81	0.285
Rural residence (reference urban)				4.67	1.93–11.31	<0.001*
Married (reference unmarried)				2.37	0.92–6.12	0.074
Regular physical activity (reference none)				1.48	0.53–4.11	0.453
Shiftwork (reference standard day work)				1.10	0.38–3.15	0.860
Low resilience (reference normal or high)				0.55	0.23–1.33	0.185
Stress (reference normal)				2.18	0.45–10.46	0.330
Anxiety (reference normal)				0.51	0.15–1.73	0.277
Depression (reference normal)				1.56	0.40–6.11	0.520
Depression×gender				6.41	1.08–38.11	0.041*
Constant	0.05		<0.001*	0.02		<0.001*

\*Statistically significant at  $P<0.05$ , \*Binary logistic regression model: Overall prediction-accuracy=90.6%, Model Nagelkerke  $R^2=0.266$ , Hosmer and Lemeshow test:  $\chi^2$  (df=8)=9.13,  $P=0.331$ . Dependent variable: Cognitive function (impaired vs. normal). HCPs=Healthcare professionals, Admins=Administrative employees, OR=Odds ratio, CI=Confidence interval

**Table 4: Associations between resilience and work type among healthcare employees at Suez Canal University Hospital, Egypt, 2023 (n=342)**

Predictors	Crude OR	95% CI	P-value	Adjusted OR	95% CI	P-value
HCPs (reference admins)	2.64	1.63–4.28	<0.001*	5.81	2.72–12.44	<0.001*
Age (years)				1.01	0.97–1.04	0.754
Female (reference male)				0.25	0.11–0.55	<0.001*
Rural residence (reference urban)				1.73	0.99–3.02	0.054
Married (reference unmarried)				1.46	0.74–2.90	0.278
Regular physical activity (reference none)				2.22	1.03–4.80	0.042*
Shiftwork (reference standard day work)				0.28	0.14–0.58	<0.001*
Stress (reference none)				0.29	0.11–0.76	0.012*
Anxiety (reference none)				6.58	2.36–18.29	<0.001*
Depression (reference none)				33.2	5.64–195.44	<0.001*
Depression×gender				0.18	0.03–0.96	0.045*
Anxiety×HCPs				0.17	0.05–0.60	0.006*
Constant	0.05		<0.001*	0.30		0.122

\*Statistically significant at  $P<0.05$ , \*Binary logistic regression model: Overall prediction-accuracy=70.2%, Model Nagelkerke  $R^2=0.304$ , Hosmer and Lemeshow test:  $\chi^2$  (df=8)=10.77,  $P=0.215$ . Dependent variable: Work resilience (low vs. normal). HCPs=Healthcare professionals, Admins=Administrative employees, OR=Odds ratio, CI=Confidence interval

Not much research has been done to examine cognitive functions in HCPs, and the little published studies utilized various metrics to evaluate cognitive functions, making it challenging to compare findings.<sup>[8,25,26]</sup>

In the current study, the proportion of cognitive impairment in HCPs was approximately three times that of administrators, with a statistically significant difference between the two groups.

In this study, the mean duration of working in shifts and the mean working hours per shift were significantly longer for HCPs than Admins. We also found that the mean resilience score of HCPs was significantly lower than Admins; however, the mean DASS-21 scores of

HCPs were significantly higher than Admins denoting increased psychological distress of HCPs. Consequently, the prevalence of cognitive impairment, low resilience, and DASS-21 in HCPs was significantly greater than for the Admins.

This is in agreement with previous studies which defined resilience as a protective factor for people's well-being and is defined as the ability to cope, adapt, or thrive in the face of adversity.<sup>[12,27]</sup>

Similarly, previous studies have discovered an inverse relationship between the experience of stress and anxiety at work and resilience.<sup>[28,29]</sup>

The results of the 2018 Physician Workload Survey showed that for over half of doctors, burnout was linked

to stress at work.<sup>[30]</sup> This validates our findings that a substantial degree of health-related stress is encountered by HCPs at work.

In our sample, 37% of HCPs reported having depression, which is slightly higher than the 30% reported by a previous study that polled over 10,000 HCPs nationwide.<sup>[31]</sup>

In our study, there was a significantly higher rate of depression and anxiety in participants with affected cognitive function compared to those with unaffected cognitive function. Similarly, previous studies have linked depression to cognitive disorders as executive dysfunction, poor learning and memory, reduced concentration and attention, and delayed processing speed.<sup>[32,33]</sup>

In this study, HCPs, rural residence, and depression were predictors of impaired cognitive function. Furthermore, HCPs, gender, stress, shift work, physical exercise, anxiety, and depression were the predictors of low resilience.

This is in agreement with the literature in which factors such as obesity, comorbidities, age, sex, education, and lifestyle choices were known to affect cognitive function. Furthermore, a well-known condition that might influence cognitive performance in later life is a history of depression.<sup>[34]</sup>

During the COVID-19 epidemic, an Indonesian research found a substantial relationship between healthcare practitioners' anxiety and their level of resilience. A person's resilience decreases with increasing worry.<sup>[35]</sup>

Yıldırım and Solmaz discovered that resilience was a negative predictor of mental health problems in a survey of 204 Turkish HCWs, whereas perceived danger and the fear of coronavirus were positive predictors of stress, sadness, and anxiety.<sup>[36]</sup>

However, this study has some limitations. The cross-sectional design is a limitation, so the causality of the observed associations cannot be assured. Furthermore, the study was conducted post-COVID-19, when the impact of the pandemic still had an extended negative influence on HCPs. However, this cannot be examined because of the shortage of data of the prepandemic and pandemic times related to the current study outcomes. Follow-up is, therefore, necessary for the achievement of genuine outcomes.

## Conclusion

Healthcare professionals showed a significantly higher cognitive impairment, low resilience, DASS-21 than

Admins. The odds of impaired cognitive function were significantly higher in HCPs than the Admins, adjusted for all potential covariates. Similarly, the odds of low resilience were significantly higher in HCPs compared to the Admins. However, the adjusted association between impaired cognitive function and low resilience was not statistically significant. Workplace policies and interventions to control depression, stress, anxiety, and the encouragement of physical activity are needed to promote work resilience and cognitive function in HCPs. Embracing a positive attitude, trust building between with management and colleagues, increases employee engagement, considers challenges as lessons, and improves communication. Programs that combine positive coping skills training (e.g., relaxation training, positive thinking, and problem solving) with resilience-building interventions (e.g., taking a proactive approach to solving problems, being flexible and adaptive) should be developed, giving special attention to HCWs who have a higher sense of self-efficacy.

## Financial support and sponsorship

Self-funded by authors.

## Conflicts of interest

There are no conflicts of interest.

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