



Effects of remote virtual work environment during COVID-19 pandemic on technostress among Menoufia University Staff, Egypt: a cross-sectional study

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Received: 23 March 2021 / Accepted: 21 May 2021 / Published online: 25 May 2021

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Abstract

Technostress during the COVID-19 pandemic has become more prevalent as a result of the global preventive measures applied to limit the spread of infection. These measures included remote working from home in both public and private organizations. The objective of this study is to study technostress and challenges of remote virtual work environment among university staff members at Menoufia University, Egypt. A cross-sectional study was conducted over Menoufia University academic staff members in Egypt. The participants were chosen from both practical and theoretical colleges in Menoufia University using a multistage random sample. Tarfadar technostress questionnaire was used. Cortisol blood level was measured for all participants. This study included 142 participants. The mean age of the group was 36.32 ± 6.41 years. 52.1 percent worked in practical colleges, and 60.6% were lecturers or higher. Their mean cortisol level was 15.61 ± 7.07 mcg/dl. Participants who were females, reside in rural areas, held a lecturer or higher position, had poor work-environment WiFi, and lacked technical training had significantly higher levels of technostress subscales. Most of the technostress subscales were significantly correlated with age and blood cortisol levels. The predictors of work overload in multivariate regression were female gender and a work environment with poor WiFi. Female gender, theoretical colleges, being lecturer or higher, and poor WiFi were the predictors for invasion. Among university staff members, technostress was found to be evident. High levels of technostress were significantly influenced by age, higher professions, female gender, and a bad workplace environment.

Keywords Job stress · Homeworking · COVID-19 · University staff members · Egypt

Introduction

COVID-19 became a pandemic at the beginning of 2020, affecting many countries worldwide. Many measures have been implemented to reduce its spread, the most significant of which was remote home working, which kept people at home and socially separated (Coccia 2020b; Spagnoli and Molinaro 2020).

Following this public health disaster, quarantine and lockdown measures have been implemented globally. These measures can cause a variety of psychological issues, including

increased stress and decreased emotional well-being (Coccia 2021b; Sica et al. 2021).

Many factors may contribute to fear and stress following COVID-19, including not only the direct impact on people's health, but also fears for unemployment due to COVID-19-related restrictions, economic difficulties, and concerns about one's health. These stressors and concerns may result in a lower quality of life and negative coping strategies especially after the COVID-19 lockdown (Achterberg et al. 2020; van Ballegooijen et al. 2021).

Over the past few years, various information and communication technologies (ICTs) such as television, mobile phones, the internet, satellite systems, and computer technologies have changed daily. Education, health, the environment, culture, art, and entertainment are all affected by these changes Hoffman et al. (2004). As a result, the majority of the population is struggling to keep up with rapid technological advancements. Change is an unavoidable part of life, and everyone treats it differently. The ICTs have a dual effect

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(Ayyagari and Purvis 2011; Hoffman et al. 2004; Liaw 2002). Whereas the use of ICTs has made substantial productivity gains, creativity, and organizational efficiency, their negative impact should not be ignored on organizations and staff. Organizational culture has become a major source of stress for today's workforce as a result of disruptions in business processes, employee duties, and roles caused by ICTs (Rowden and Conine 2005).

Stress is defined as a mental and physical situation that influences an individual's health, work, and quality of life, with a focus on work-related stress that deprives workers of work satisfaction and quality of life. Technostress is defined as modern disorders of adaptation resulting from a lack of safe handling of new technologies. It is driven by technological tasks like planning meetings, business plans, and concern over time limits for work (Choudhury 2013).

ICT is not the only cause of technostress; many other factors contribute to the development of this stress. Many organizations make the use of ICT one of their primary requirements Tarafdar et al. (2010a, 2010b), as do coworkers, who frequently have an impact on individuals' use of ICT (Avanzi et al. 2018). Technostress caused by misfits between teachers and different aspects of the university setting may influence university teachers' performance negatively, leading to job burnout and even plans to leave the profession (Al-Fudail and Peterson 2004; Ragu-Nathan et al. 2008; Pignata et al. 2016). This stress may manifest itself in both physical and psychological symptoms, and this has been reported by researchers in the computer science, health, and accounting fields (Sami and Pangannaiah 2006). This stress can cause an increase in blood pressure and heart rate, as well as muscle tension, such as a clenched jaw and increased skin conductance. These various symptoms shed light on the physical effects of ICT on users, the presence of which can indicate the presence of technostress. Technostress psychological symptoms include the inability to focus on a single issue, increased irritability, and a sense of loss of control. Technostress also has an impact on employee job satisfaction and commitment, as well as organizational outcomes (Sami and Pangannaiah 2006).

To the best of our knowledge, there is a scarcity of studies on technostress among Egyptian university staff members. Thus, the purpose of this research was to investigate the impact of rapid technological development, particularly in the field of education, on Egyptian university faculty members.

Participants and methods

Sample and data

A cross-sectional study was conducted from the first of December 2020 to the end of February 2021 on a probability

sample of Egyptian university academic staff members from Menoufia University. The study included staff members who are affiliated with practical and/or theoretical colleges and fulfill the inclusion criteria. A multistage random sample was used to select practical and theoretical colleges from Menoufia University, then the second stage to select the departments in each selected college, and finally staff members were chosen from each selected department by simple random sampling technique.

The sample size was calculated using the EPI 7™ info program (Dean 1999) with a 95% confidence interval, a 5% margin of error, and a 10% prevalence of technostress among university academic staff (KM 2017). The minimum representative sample size was estimated to be 138, but this was increased to 150 to account for the non-response rate. A total number of 142 staff members responded, for a 94.7% response rate.

The criteria for inclusion were Egyptian staff members who are affiliated to the selected departments of Menoufia University for 3 years or more, have good English language skills, and agreed to participate.

Subjects with hormonal disorders such as Cushing syndrome or Addisonian disease, subjects on steroid therapy, females taking oral contraceptives, and subjects with known psychological disorders that could influence the results of the technostress subscales were excluded from the study.

Measures of variables

All participants were subjected to the following:

1- A predesigned self-administered questionnaire that included two main parts:

The first part included:

Sociodemographic data such as age (in years), gender, residence, college specialty (practical or theoretical), and academic grade.

Questions about the presence of modern computers, good WiFi in the virtual work environment, and attendance at training ICT workshops. Modern computers were considered highly efficient computers with windows 7 or 10 and core i3 or higher. Good WiFi was considered to be a continuous presence of online access at or above 25Mbps.

The second part included:

The survey tool is an adapted version of the technostress questionnaire that was developed by Tarafdar and his colleagues in the English language (Tarafdar et al. 2010a). It has three dimensions: (1) techno-overload, the feeling of increased workload due to ICTs (four items); (2) techno-invasion, the feeling of work entering into other areas of life due to ICTs leading to higher levels of family-to-work conflict (three items); and (3) techno-complexity, refers to the user's lack of confidence in using new technologies (four items). Responses

to the statements were given on a five-point Likert scale ranging from zero (strongly disagree) to four (strongly agree).

Validity and reliability of the three domains (techno-overload, techno-invasion, and techno-complexity) were tested by Ragu-Nathan and his colleagues (Ragu-Nathan et al. 2008) where they found it to be 0.82, 0.80, and 0.77 for each domain respectively that indicated internal consistency of the scale.

2- Blood cortisol level measurement by Cobas e411 immunoassay analyzer (Roche Diagnostics, Mannheim, Germany). Venous blood samples were withdrawn from each participant at a fixed time of the day (9–12 am), to overcome diurnal variation of the cortisol level.

Data analysis

Data were tested for normality with the Wilks Shapiro test. The Student's t-test was used to compare quantitative variables of normally distributed data, while Mann Whitney's test was used for not normally distributed ones. Pearson correlation was used to test the correlation between two continuous normally distributed variables, while Spearman correlation was used for not normally distributed ones. Multiple linear regressions were used to test the association between multiple possible risk factors and each component of the technical stress. Two-sided P-value of < 0.05 was considered statistically significant. All the analyses were done using SPSS V. 23 (SPSS Inc. Released 2015. IBM SPSS statistics for windows, version 23.0, Armonk, NY: IBM Corp.).

Results

The study included 142 participants with full valid questionnaires. Their mean age was 36.32 ± 6.41 years (ranging from 25.0 to 60.0). Fifty-three percent (75 participants) were males, 64.1% were of rural residence, 52.1% were working in practical colleges, 60.6% were lecturers or higher, 54.9% had training workshops/courses, 78.2% had good WiFi, and 85.9% had modern computers (see Table 1). Their mean cortisol level was 15.61 ± 7.07 mcg/dl (ranging from 6.0 to 29.0 mcg/dl).

Among the entire participants, the mean score (\pm SD) of work overload was 9.45 (\pm 2.92) out of 15, the mean invasion score was 6.61 (\pm 2.76) out of 12, and the mean complexity score was 12.47 (\pm 4.20) out of 20.

Female participants, participants who were lecturers or higher grades, and participants who did not have good WiFi or modern computers had significantly higher mean overload, invasion, and complexity than males or participants who were teaching assistants or up (P-value <0.001 for each).

Participants who are living in rural areas had a significantly higher overload and complexity scores than participants living in urban areas (P-value 0.002 and 0.001, respectively), while participants working in practical colleges had significantly

Table 1 Sociodemographic characters of the participants (n=142)

Character	No. (%)
Age	
Mean \pm SD	36.32 \pm 6.41
Range	25.0–60.0
Gender	
Male	75 (52.8)
Female	67 (47.2)
Residence	
Urban	51 (35.9)
Rural	91 (64.1)
Work type	
Theoretical	68 (47.9)
Practical	74 (52.1)
Academic degree	
Up to ass. lecturer	56 (39.4)
Lecturer and higher	86 (60.6)
Training workshops	78 (54.9)
Good WiFi	111 (78.2)
Modern computers	122 (85.9)
Cortisol (mcg/dl)	
Mean \pm SD	15.61 \pm 7.07
Range	6.0–29.0

higher mean invasion than participants in theoretical ones (P-value 0.004). Participants who did not attend training had significantly higher mean overload, invasion, and complexity than participants who had training (P-value 0.007, 0.021, <0.001) (see Table 2).

Age had a significantly significant positive correlation with all three aspects of the technostress scale (P <0.001 for each) (Fig. 1).

The multivariate linear regression model showed that overload was significantly related to female gender and work environment with poor WiFi (P-value <0.001 and 0.002, respectively). The invasion was significantly related to the female gender, theoretical colleges, being lecturer or higher, and poor WiFi (P-value 0.001, 0.023, 0.030, and 0.002, respectively), while complexity was significantly related to the female gender, rural residence, no training, poor WiFi, and absence of modern computers (P-value <0.001, 0.014, <0.001, <0.001, and 0.001, respectively) (Table 3). The three models were statistically significant (P <0.001 for each). The adjusted R² was 0.482, 0.362, and 0.705 for overload, invasion, and complexity, respectively.

Blood cortisol level was found to be higher among participants with higher scores of the technostress subscales. It was significantly correlated with overload and complexity scores (P-value = 0.001 and <0.001, respectively) (Fig. 2).

Table 2 Mean values of technical stress component with different risk factors

Character	Overload* Mean ± SD	Invasion** Mean ± SD	Complexity*** Mean ± SD
Gender			
Male	7.65 ± 2.23	5.37 ± 2.09	9.76 ± 2.71
Female	11.46 ± 2.21	8.01 ± 2.78	15.52 ± 3.42
P-value	<0.001	<0.001	<0.001
Residence			
Urban	8.52 ± 2.41	6.01 ± 2.40	10.78 ± 3.64
Rural	9.96 ± 3.07	6.95 ± 2.91	13.42 ± 4.21
P-value	0.002	0.109	0.001
Work type			
Practical	9.16 ± 2.93	5.95 ± 2.69	11.91 ± 4.04
Theoretical	9.71 ± 2.92	7.22 ± 2.71	13.00 ± 4.30
P-value	0.235	0.004	0.142
Degree			
Up to ass. lecturer	8.16 ± 2.57	5.25 ± 2.05	10.00 ± 2.97
Lecturer or higher	10.29 ± 2.84	7.51 ± 2.81	14.09 ± 4.10
P-value	<0.001	<0.001	<0.001
Training			
No	10.17 ± 3.04	7.20 ± 2.79	14.60 ± 3.84
Yes	8.85 ± 2.70	6.14 ± 2.67	10.73 ± 3.66
P-value	0.007	0.021	<0.001
Good WiFi			
No	12.09 ± 2.03	9.12 ± 2.37	17.16 ± 2.64
Yes	8.71 ± 2.70	5.91 ± 2.45	11.17 ± 3.58
P-value	<0.001	<0.001	<0.001
Modem computers			
No	12.15 ± 1.89	9.10 ± 2.22	18.05 ± 1.43
Yes	9.00 ± 2.82	6.21 ± 2.64	11.56 ± 3.78
P-value	<0.001	<0.001	<0.001

*Overload: the feeling of increased workload due to ICTs
 **Invasion: the feeling of work entering into other areas of life due to ICTs leading to higher levels of family-to-work conflict
 ***Complexity: refers to the user’s lack of confidence in using new technologies

Discussion

COVID-19’s global lockdown had impacted everyone’s quality of life by disrupting their daily routines. Students, as an example, had higher levels of “perceived academic stress” and higher depressive symptoms (De Man et al. 2021; Vyas and Butakhieo 2020). Policymakers should support appropriate long-run strategies that prevent the negative effects of infectious diseases especially those causing pandemics as COVID-19 on public health, the economy, and society (Coccia 2020a, 2021a).

Employees who work from virtual offices can do their work anywhere at any time, which may blur the lines between work and home. As a result, workplace stress has been

allowed to spread from traditional offices to virtual offices, potentially leading to fewer social interactions and poor communication (KM 2017; Stich 2020)

Participants in this study reported moderate to high levels of the technostress questionnaire’s various subscales. Job overload had a mean score of 9/15, which was 60% of the maximum overload score, followed by work complexity (57% of the maximum score) and invasion (50% of the max. score). Remote working was found to be strongly associated with the three technostress subscales by Molino and his colleagues. Work-family conflict on the one hand and work overload on the three technostress subscales on the other were found to have a strong positive association in their analysis. They also discovered a significant positive relationship between behavioral stress and workload, as well as technostress subscales and work-family conflict (Molino et al. 2020). Moretti et al. (2020) have reported that the home environment appears to be inappropriate, with an increased risk of mental health issues.

The higher levels of stress among employees who use ICT were explained by the constant availability of the individual, predicting quicker and better work Ayyagari and Purvis (2011).

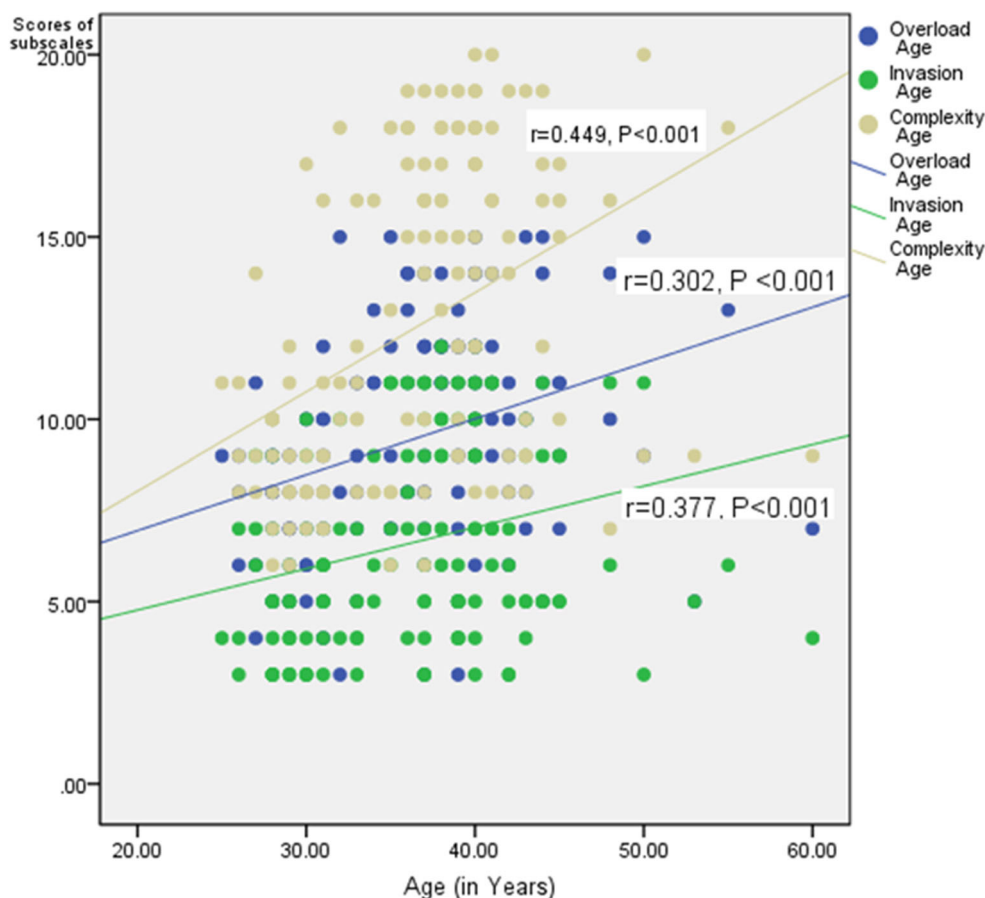
Technostress caused by virtual work is multifactorial. The induced technostress was caused by both personal and environmental risk factors. The multivariate analysis of our findings revealed that gender and WiFi quality both contributed significantly to all subscales of technostress. Other risk factors may differ depending on the subscale.

In our study, senior participants with higher academic degrees were found to be significantly associated with higher levels of the three domains of technostress. In the study done by Orlando (2014), old-age teachers who have taken years in establishing their teaching practices suffered greatly to change them than the younger teachers. Also, Tsertsidis et al. (2019) stated that older people have more negative attitudes towards the use of new technologies and feel less competent. Sahin and Coklar found that technostress increase with age (Şahin and Çoklar 2009). According to a meta-analysis by Hauk et al. (2018), older adults have more difficulty using technology than younger adults, especially with techno-overload and techno-complexity, which necessitate a diverse set of cognitive abilities and physical condition.

Female participants in this study reported higher technostress levels than males. This was also reported by Efiltili and Naci Çoklar (2019) and Thomée et al. (2012) who found that women experience higher levels of anxiety and exhaustion than men in the use of ITC’s. Margetić et al. (2021) found that emotional distress during COVID-19 pandemic was more intensive in women and younger participants.

Liaw’s study also indicated that males had more positive perceptions towards computers and Web technologies than females (Liaw 2002). Broos survey revealed that males had less computer anxiety than females as they use computers for longer periods so they show less computer anxiety (Broos

Fig. 1 Scatter plot of age correlation with technical stress components



2005). Females’ high technostress in our sample could be due to the fact that they have to care for their children and families when working from home during the lockdown, which adds to their burden.

Table 3 Multivariate regression of possible risk factors of technical stress components

Variables	Overload		Invasion		Complexity	
	Beta	P	Beta	P	Beta	P
Age	0.145	0.117	-0.066	0.523	0.129	0.066
Gender	0.495	<0.001	0.270	0.001	0.391	<0.001
Residence	-0.076	0.225	-0.040	0.567	-0.118	0.014
Work type	0.023	0.706	0.157	0.023	0.021	0.655
Degree	-0.027	0.782	0.233	0.030	0.080	0.273
Training	0.013	0.841	0.035	0.628	-0.206	<0.001
Good WiFi	-0.231	0.002	-0.259	0.002	-0.214	<0.001
Modem computers	-0.058	0.408	-0.090	0.247	-0.187	0.001
F	17.42	<0.001	11.01	<0.001	43.02	<0.001
R ² adj	0.482		0.362		0.705	

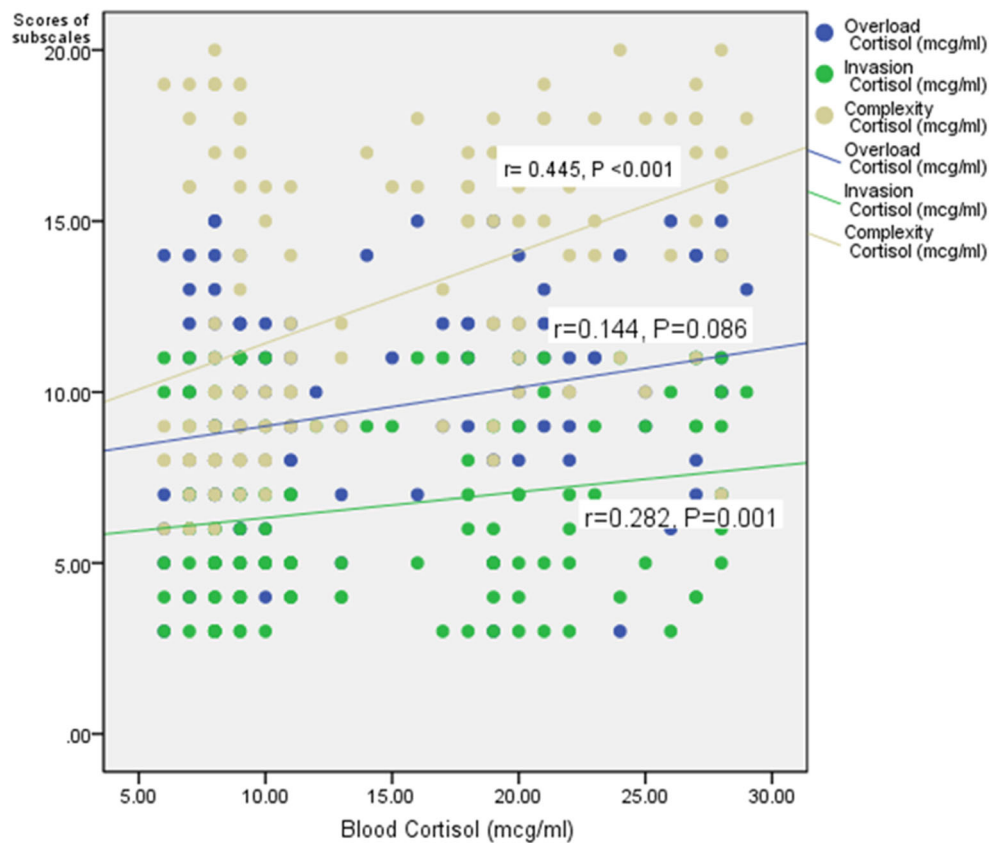
Even though industrialized areas in Italy had substantially higher COVID-19 infection and death rates (Coccia, 2021), participants in our study who lived in rural areas had higher levels of technostress. This may be explained by the rural areas’ lack of resources. Poor WiFi and recurrent interruptions of internet access will make it difficult to complete necessary tasks and create a stressful virtual work environment (Chuang et al. 2015).

Poor WiFi connection was significantly associated with higher levels of technostress. KM (2017) stated that a slow internet network was considered a factor contributing to technostress.

Participants in practical colleges experienced significantly higher mean invasion technological stress than those in theoretical colleges. According to Mishra et al. (2020), because of the need for equation manipulation and laboratories, practical subjects have traditionally been difficult to teach online. This may also be due to educators’ negative attitudes toward new technologies and tools. Educators also have limited time and patience to address minor technical issues throughout the process of adjustment to new tools.

Participants who did not attend technological training workshops had significantly higher mean overload, invasion, and complexity than participants who had. This was in agreement

Fig. 2 Scatter plot of cortisol level (mcg/dl) association with technical stress components



with Tarafdar et al. (2007, 2010b) who indicated that users with high levels of computer knowledge could avoid technostress to a larger degree. Gaither Shepherd (n.d.) concluded that computer skills influenced technostress levels.

University support was considered an essential component of preparing teachers to use ICT effectively (Luchman and González-Morales 2013). According to Shedletsky and Aitken (2001), teachers frequently avoid university supplies such as professional development workshops and technical seminars.

K.M (2017) stated that there was no statistically significant relationship between technostress and respondents’ age group, gender, or attendance at technology-related training.

According to our study, cortisol level was significantly higher with overload and complexity domains of technostress (P-value 0.001 and <0.001, respectively). Riedl et al. (2012) found that cortisol levels increased significantly as a result of system breakdown in a human-computer interaction task. Also Riedl et al. (2012) revealed significantly elevated cortisol levels due to human interaction with ICT.

Conclusion

Technostress was prevalent among university staff members. Female participants, being lecturers or higher profession, and not having rapid WiFi or modern computers were predictors

of technostress. Age had a significant positive correlation with all three aspects of the technostress scale (overload, invasion, complexity). Cortisol level was significantly higher with overload and complexity.

Cross-sectional design was a limitation to our study as longitudinal studies will be needed to determine the causal relationship among these variables.

Another limitation was the negligence of the personality traits and considering the sociodemographic factors as the only factors that affect the level of technostress. So, it is critical to investigate and explain the effects of shorter/longer periods of lockdown on staff members’ mental health to design effective containment measures aimed at reducing and/or containing the impact of potential COVID-19 waves and future epidemics similar to the COVID-19 in communities, as well as not affecting the mental health and well-being of staff members.

To ensure a technostress free work environment, the following measures should be considered:

- By staff members: Set clear boundaries between working and non-working hours, create a separate working area in your home, and stick to a strict schedule.
- By the administration: Provide training courses and a responsive IT team and assign the right job to the right people, and workers should be inspired and encouraged by motivational messages.

- By the government: Organizations must use behavioral monitoring techniques to track any signs of technostress. This is especially critical during periods of crisis, as targeted actions can be used to implement immediate corrective measures, preventing harmful behavior patterns. Further research should take personality traits into account.

Acknowledgements The authors would like to express their gratitude to all the staff who agreed to participate in this study.

Author contribution Dr. Hala Marawan Gabr has conceived the idea, Dr. Shaimaa Sherif Soliman has conducted the statistical analysis, Dr. Heba Khodary Allam edited the manuscript and do reference check. Dr. Shaimaa Yaihya Abd El Raouf has written the draft of the manuscript. All the authors contributed to the design and implementation of the research, collection of data, and the revision of the manuscript.

Data availability Data are available upon reasonable request.

Declarations

Ethical considerations Institutional Review Board of Faculty of Medicine, Menoufia University, Egypt, had ethically approved the study before data collection.

Consent to participate All responders have participated voluntarily after written informed consent (to participate and publish) had been signed. The participants' data were kept confidential and were used only for research purposes.

Consent for publication The authors assign publication rights to the journal, and we guarantee that this contribution is unique and that we have full authority to make this grant.

Competing interests The authors declare no competing interests.

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