

# The Effect of COVID-19 Pandemic on Performance of Postgraduate Medical Trainee Doctors: A Nationwide Epidemiological Study in Pakistan

Saira Afzal<sup>1</sup>, Muhammad Hasan Masood<sup>2</sup>, Fariha Salman<sup>1</sup>, Khalid Masud Gondal<sup>2</sup> and Amber Arshad<sup>1</sup>

<sup>1</sup>Department of Community Medicine, King Edward Medical University, Lahore, Pakistan

<sup>2</sup>Department of Surgery, King Edward Medical University, Lahore, Pakistan

## ABSTRACT

**Objective:** To find out various organizational, personal, and systemic factors influencing the performance of the postgraduate trainee doctors in managing COVID-19 pandemic.

**Study Design:** Analytical cross-sectional study.

**Place and Duration of Study:** Conducted in various medical institutions of Pakistan from 15<sup>th</sup> April to 30<sup>th</sup> June, 2020.

**Methodology:** An analytical cross-sectional study was conducted on 11,656 postgraduate doctors. They were contacted through the e-log system of College of Physicians and Surgeons Pakistan. Semi-structured questionnaire was used consisting of demographic details, presenting symptoms, systemic involvements, clinical features, diagnostic tests, management of cases, authenticity of the information used, telemedicine services, practice of preventive measures, training and interactive educational activities, performance-based tasks and details about workplace environment. Mean and standard deviation was reported for continuous variables. Bivariate and multivariate analyses were used to report p values.

**Results:** Among 11,656 postgraduate doctors, 3,193 (27.4%) were directly involved in the management of COVID-19 patients in designated special corona facilities. Multivariate analysis was performed to control confounders. The risk factors, found statistically significant with performance, were presence of comorbidity (OR 1.261; 95% C.I.1.06-1.50), allergic and autoimmune disorders (OR 1.18; 95% C.I.1.03-1.35), confirmed COVID-19 status due to exposure (OR 0.570; 95% C.I.0.41-0.81), and care provision to old parents (OR 1.299; 95% C.I.1.19-1.42).

**Conclusion:** The effect of COVID-19 on performance of postgraduate doctors was multi-factorial. Significant risk factors were presence of a comorbidity, allergic and autoimmune disorders, and confirmed COVID-19 due to exposure.

**Key Words:** COVID 19, Postgraduate trainee, Pandemic, Comorbidity, PCR.

**How to cite this article:** Afzal S, Masood MH, Salman F, Gondal KM, Arshad A. The Effect of COVID-19 Pandemic on Performance of Postgraduate Medical Trainee Doctors: A Nationwide Epidemiological Study in Pakistan. *J Coll Physicians Surg Pak* 2021; **31(02)**:182-187.

## INTRODUCTION

COVID-19 was declared as a public health emergency by World Health Organization (WHO).<sup>1</sup> The spread of disease was very rapid in this era of globalization.<sup>2</sup> In Pakistan, postgraduate doctors were involved in prevention and control of this deadly disease; and they played a significant role in containment of the disease.<sup>3,4</sup> Most of them performed extraordinary duties, and spend their time in hospitals.

There is a dire need for these postgraduate doctors to maintain balance between the existing obstacles and their overall well-being while fronting inimitable challenges of this COVID-19 pandemic. The physical, mental and emotional burden and general wellbeing of these warriors was under constant threat, with increased incidence of exhaustion, inner anxiety, and suicidal thoughts. The incidence of comorbidities, like heart diseases, lung diseases, kidney diseases, and cancers have been reported during this stressful pandemic.<sup>5</sup> They experienced tiredness and psychological pressures, which has increased the odds of technical medical errors. The capacity of the postgraduate doctors to adequately cope with stressors is important for overall performance. Hospitals and medical institutions must conduct regular medical checkups, especially for the frontline healthcare workers, at their work site.<sup>6</sup> The wide spectrum of clinical features, scarce diagnostic resources, heterogeneity in complications and atypical presentations were numerous challenges. Spectrum of this disease ranges from asymptomatic to critical patients with complications.<sup>7</sup>

Correspondence to: Dr. Saira Afzal, Department of Community Medicine, King Edward Medical University, Lahore, Pakistan

E-mail: sairamust@gmail.com

Received: September 21, 2020; Revised: January 01, 2021;

Accepted: February 02, 2021

DOI: <https://doi.org/10.29271/jcpsp.2021.02.182>

These complicated cases presented to intensive care units with pulmonary and extrapulmonary complications of COVID-19.<sup>8</sup>

Contribution of postgraduate trainees, especially the frontline doctors, towards COVID-19 was admonitory. Postgraduate residents are used to spend maximum time with patients during their training under the guidance of senior staff and supervisors. COVID-19 is a disease where evidence is emerging on daily basis and nothing is conclusive. Postgraduate medical doctors have faced the challenging situation of COVID-19 either as frontline or as second line healthcare workers by managing the cases, reducing disease burden, promoting health, preventing disease progression, reducing complications and prolonging lives of their patients.

The objective of this study was to determine the effect of COVID-19 on health of the postgraduate doctors to provide information regarding various personal, diagnostic, and systemic risk factors that affect their performance and training.

## METHODOLOGY

This analytical cross-sectional study was conducted across Pakistan. Doctors currently enrolled in postgraduate training programmes under the College of Physicians and Surgeons Pakistan were contacted. The responses from these doctors were recorded through temporal sampling on the e-log system after obtaining informed consent, from 15<sup>th</sup> April till 30<sup>th</sup> June 2020. Postgraduate trainees on leaves or who had completed the prescribed duration of training were excluded from the study. Ethical permissions were obtained from Institutional Review Board of King Edward Medical University (No. 299/R-C/KEMU, dated 29/04/2020). The performance of postgraduate trainee doctors was classified as direct performance in COVID-19, who were performing duties in corona wards, specialized centres for corona management, intensive care unit (ICU), and high dependency units (HDU) for COVID-19. However, postgraduate trainee doctors, who were allocated duties in laboratories, radiology departments, diagnostic facilities, preventive facilities, corona help desks, telemedicine centres, updating mortality records on dash boards, and other duties were defined as having indirect performance. The assessment of direct and indirect performance was made on the basis of responses from the study participants. Performance of the postgraduate doctors was assessed by using a subjective criteria based on responses recorded via a detailed semi structured pretested questionnaire (Cronbach alpha reliability measure of 0.773), which was administered online through google forms; and link was given on the logbook of trainee for voluntary participation.

The questionnaire was administered, which consisted of demographic characteristics of study participants, seniority in postgraduate training years, specialty, and questions regarding frequency of sources of information used, utilisation and satisfaction with telemedicine, presenting symptoms of COVID-19 cases, systemic involvement with clinical features, availability of diagnostic tests and options used for management of COVID-19 patients, sources of authentic information, utilization and

practice of preventive measures, use of personal protective equipment, performance-based tasks, and details about workplace environment.

The comorbidities include heart diseases, lung diseases, kidney diseases, and cancers as reported by postgraduate doctors.

Junior residents were those who had two years or less of training experience after induction; and those with greater duration of experience were grouped as senior residents. The scientific integrity was ensured and the information about the study participants were kept confidential.

Data were entered and analysed by SPSS version 26. Analytical statistical procedure includes descriptive statistics and inferential statistics. Descriptive statistics were used to report proportions, mean and standard deviations. Inferential statistics were used to report significance at the set value for alpha error equal to or less than 0.05. Chi-square test, and logistic regression analysis were used to report p-values of association among the organizational, personal, diagnostic and systemic factors. The factors showing significant association with outcome variable during bivariate analysis were further included in multivariate analysis to report adjusted odds ratio and 95% confidence intervals after removal of confounding variables.

## RESULTS

A total of 11,656 participants completed the questionnaire having mean age of  $28.67 \pm 3.29$  years. Among them 8,463 (72.6%) were not directly performing duties for management of COVID-19; whereas, 3,193 (27.4%) were performing duties in special corona units/facilities. Most of the study participants were female doctors (57.4%), below 30 years of age (73%), junior residents with one to two years training as postgraduate trainee doctors (65.4%). Comparison of demographic features showed training years, gender and geographical area (province) were statistically significantly ( $p$ -value  $< 0.05$ , Table I). Majority of the postgraduate trainee doctors involved in COVID-19 patient care and management were from major cities (Lahore, Karachi, Peshawar, Rawalpindi and Islamabad, Figure 1).

About 8,463 doctors were indirectly involved in performing duties at healthcare facilities during pandemic. About 60.4% were care-givers to old parents at home. Among postgraduate doctors, 68.6% reported to have family support and encouragement for their contribution to national cause during pandemic; whereas, 31.3% lack family support because of the apprehensions and fears about their safety and risks of getting the infection during exposure to the cases while performing duties during pandemic situation. Training year was significantly associated with comorbidities among the postgraduate trainee doctors (Table II).

The risk factors found statistically significant with performance were presence of comorbidity (OR 1.261; 95% C.I = 1.06-1.50), allergic and autoimmune disorders (OR 1.18; 95% C.I = 1.03-1.35), confirmed COVID-19 cases due to exposure (OR 0.570; C.I = (0.41-0.80), care providers to old parents (OR 1.299; 95 % C.I = 1.19-1.42, Table III).

**Table I: Demographic characteristics of postgraduate trainee doctors n=11656.**

Variable	Frequency (n=11656)	Directly involved (n=3193)	Indirectly involved (n=8463)	p-value
Age				
Below 30 years, n (%)	8505 (73.0)	2304 (27.1)	6201 (72.9)	0.227
30 & above, n (%)	3151 (27.0)	889 (28.2)	2262 (71.8)	
Province				<0.001
Azad Kashmir n (%)	155 (1.3)	43 (27.7)	112 (72.3)	
Baluchistann (%)	370 (3.2)	62 (16.8)	308 (83.2)	
Khyber Pakhtunkhwa n (%)	2670 (22.9)	866 (32.4)	1804 (67.6)	
Punjab n (%)	5616 (48.2)	1512 (26.9)	4104 (73.1)	
Sindh n (%)	2845 (24.4)	710 (25.0)	2135 (75.0)	
Gender				<0.001
Male, n (%)	4965 (42.6)	1721 (34.7)	3244 (65.3)	
Female, n (%)	6691 (57.40)	1472 (22.0)	5219 (78.0)	
Residency status				0.019
Junior resident (Jr), n (%)	7619 (65.4)	2141 (28.1)	5478 (71.9)	
Senior resident (Sr), n (%)	4037 (34.6)	1052 (26.1)	2985 (73.9)	

**Table II: Factors affecting the performance of postgraduate trainee doctors.**

Factors	Total	Age (years)		p-value	Gender		p- value	Residency status		p-val ue
		<30	>30		M	F		Jr.	Sr.	
		Factors affecting the indirect performance of postgraduate trainees (n=8,463)								
High risk group comorbidity, n (%)	703 (8.3)	497 (70.7)	206 (29.3)	0.107	229 (32.6)	474 (67.4)	0.001	418 (59.5)	285 (40.5)	0.002
Allergic & autoimmune disorders, n (%)	1189 (14.0)	901 (75.8)	288 (24.2)	0.035	401 (33.7)	788 (66.3)	<0.001	768 (64.6)	421 (35.4)	0.915
COVID										
Confirm COVID (in isolation), n (%)	157 (1.9)	111 (70.7)	46 (29.3)	0.462	81 (51.6)	76 (48.4)	0.001	100 (63.7)	57 (36.3)	0.784
Exposed (In quarantine), n (%)	911 (10.8)	696 (76.4)	215 (23.6)	0.024	381 (41.8)	530 (58.2)	0.022	609 (66.8)	302 (33.2)	0.156
Lack of family support, n (%)	2649 (31.3)	1995 (75.3)	654 (24.7)	0.004	962 (36.3)	1687 (63.7)	0.010	1715 (64.7)	934 (35.3)	0.987
Care provider to old parents, n (%)	5111 (60.4)	3840 (75.1)	1271 (24.9)	<0.001	1827 (35.7)	3284 (64.3)	<0.001	3303 (64.6)	1808 (35.4)	0.806
Factors affecting direct performance of trainess (n = 3,193)										
Source of information										
Media & social media, n (%)	924 (28.9)	700 (75.8)	224 (24.2)	0.014	453 (49.0)	471 (51.0)	(0.002)	636 (68.8)	288 (31.2)	0.339
Journals & websites, n (%)	396 (12.4)	277 (69.9)	119 (30.1)		221 (55.8)	175 (44.2)		258 (65.2)	138 (34.8)	
	1873 (58.7)	1327 (70.8)	546 (29.2)		1047 (55.9)	826 (44.1)		1247 (66.6)	626 (33.4)	
All others, n (%)										
Telemedicine, n (%)	2340 (73.3)	1686 (72.1)	654 (27.9)	0.824	1261 (53.9)	1079 (46.1)	0.985	1557 (66.5)	783 (33.5)	0.306
Facility of environmental Sanitation, n (%)	1345(42.1)	941 (70.0)	404 (30.0)	0.018	720 (53.5)	625 (46.5)	0.722	899 (66.8)	446 (32.2)	0.827
Diagnostic test										
PCR, n (%)	2436 (76.3)	1782 (73.2)	654 (26.8)	0.022	1321 (54.2)	1115 (45.8)	0.008	1639 (67.3)	797 (32.7)	0.9305
PCR; CT scan (high resolution), n (%)	498 (15.6)	332 (66.7)	166 (33.3)		285 (57.2)	213 (42.8)		333 (66.9)	165 (33.1)	
PCR, Serology (IgG&IgM), n (%)	222 (7.0)	165 (74.3)	57 (25.7)		99 (44.6)	123 (55.4)		145 (65.3)	77 (34.7)	
All combined (PCR, CT, IgG&IgM), n (%)	37 (1.2)	25 (67.6)	12 (32.4)		16 (43.2)	21 (56.8)		24 (64.9)	13 (35.1)	
*Jr = Junior residents, Sr = Senior resident										

\*Jr = Junior residents, Sr = Senior resident.

**Table III: Multivariate analysis for COVID-19 factors associated with performance of postgraduate trainees.**

Factors	Crude odds ratio (95% confidence interval)	p-value	Adjusted odds ratio (95%CI)	p-value
Co-morbidity	0.760 (0.65-0.90)	0.001*	1.261 (1.06-1.50)	0.008*
Allergic & Autoimmune Disorders	0.793 (0.70-0.90)	<0.001*	1.180 (1.03-1.35)	0.016*
Trainee confirmed COVID -19 status due to exposure	1.733 (1.26-2.38)	0.001*	0.570 (0.41-0.80)	0.001*

Exposed To COVID-19 (self-quarantine)	1.177 (1.02-1.35)	0.022*	0.864 (0.75-1.00)	0.050
Care Provider to old parents	0.760 (0.70-0.83)	<0.001*	1.299 (1.19-1.42)	<0.001*

\*Statistically significant at  $p < 0.05$ .

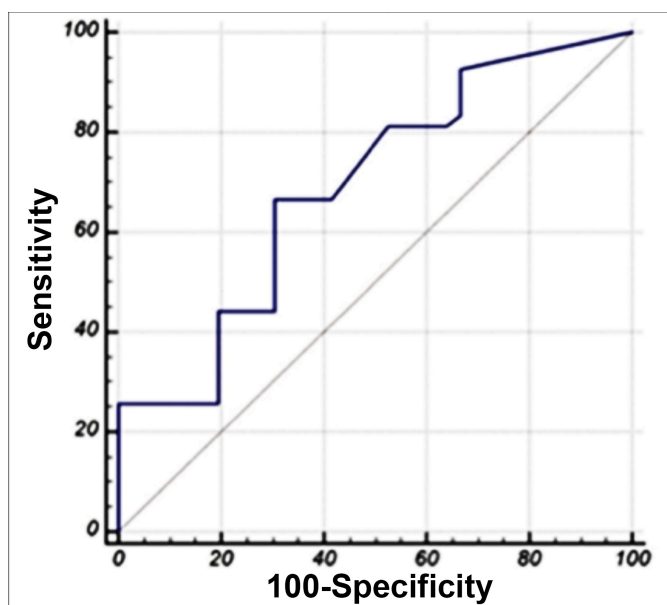


Figure 1: Geographical distribution of postgraduate trainees.

Geographical distribution is shown in Figure I. Presenting complaints of COVID-19 observed by trainees were grouped together according to the occurrence. Respiratory symptoms were mostly observed. Presenting complaints were reported as pulmonary clinical features in 2,111 (66.1%), and extra-pulmonary in 1,082(33.9%).

## DISCUSSION

The World is facing a new unprecedented disease of COVID-19 after the Spanish Flu pandemic of 1918.<sup>9</sup> Burden of the disease has been reported quite high and new cases are constantly being reported among the postgraduate trainees, who are the main service-providers, either directly or indirectly in the fight against COVID-19 in Pakistan.<sup>10</sup> The postgraduate trainees, who were already providing healthcare services round-the-clock in emergency and health care facilities, were affected more. Doctor-patient ratio in different geographical areas of Pakistan is 1:1,764, so the postgraduate trainee workload was out of proportion to the existing human resources.<sup>11</sup>

The postgraduate doctors, especially those with high risk comorbidities, working directly in corona facilities, not only had higher risk of acquiring infection but were also at a risk of severe Covid-19 outcomes. This situation highly affected their performance in the respective fields. A study by Gibson and Greene revealed that out of 3.8% of adult healthcare workers dealing directly with corona patients in the USA, 38.6 % were at higher risk. Most of them reported numerous highrisk comorbidities, leading to adverse post-COVID-19 outcomes. The conditions labelled high risk by NHIS were cardiovascular disease, diabetes, chronic lung disease, liver

disease, kidney disease, asthma (in past three year), cancer (in past 3 years), and active smoker.<sup>12</sup> These results are consistent with current study findings, which is comparable with the study by Rodríguez and Sánchez. They highlighted that quarantine could have physical consequences on front-line healthcare, who actively participated during the COVID-19 pandemic.<sup>13</sup>

During this pandemic, postgraduate doctors were more concerned about their family members. In our study, most of the postgraduate doctors were care-providers to old parents; and reported to have family support and encouragement for their contribution to the national cause during pandemic. Similar facts were reported in a study by Jafar *et al.* The fear of getting infection from COVID-19 patients and transferring it to the family members was daunting. Likewise, their family members were equally concerned about them in this deadly situation.<sup>14</sup>

In this pandemic, female postgraduate doctors (57.40 %) have suffered more than the male doctors. They are facing the double burden in terms of longer duty hours and added work at home. In current study, the female postgraduate trainees have emerged as an important warrior in the fight against this deadly pandemic, especially for old parents and family. This research has unmasked the famine contributions to the existing challenges in the healthcare system and highlighted the evidence about provision of healthcare at home to the old parents. This study findings are consistent with study of Lakhani *et al.*, conducted in 2020. About 72% of female doctors were affected as compared to 28% of male doctors.<sup>15</sup>

In Pakistan, most of the cases of COVID-19 were from major cities.<sup>16</sup> These findings support the worst effects were closely linked with mega cities, where death rates tend to be higher because of a complex combination of factors.<sup>17</sup> In the UK and USA for example, mega cities have higher death rates.<sup>18</sup>

Arrangements for environmental disinfection were limited at the health amenities that increased the odds of transmission of infectious agents to the susceptible host in this study. A study conducted in Malaysia showed good hand-hygiene-practices among doctors (87.8%) due to the availability of resources in contrast to the results of this study.<sup>19</sup>

Globally, testing and diagnostic services served as a strong pillar of healthcare provision. There was provision of rapid diagnostic testing, antibodies testing, chest radiographs, chest computed tomography scan, stool testing, saliva testing, and RT-PCR as gold standard diagnostic test for COVID-19.<sup>20,21</sup> Most of the postgraduate trainee doctors in this research used RT-PCR on nasal and pharyngeal swabs.



The pulmonary complications were most frequently reported in this study. Similar results were seen in China, where 67.8% of patients showed pulmonary symptoms and only 10 % patients presented with extra-pulmonary symptoms.<sup>22</sup>

In the current study, most of the postgraduate trainees updated their knowledge from sources including media, social media, journals and websites. Telemedicine services have gained popularity in Pakistan during this COVID-19 crisis because of decrease in waiting time and footsteps to hospital facilities.<sup>23</sup> In this study, most of the doctors recommended telemedicine services during pandemic. It has a better communication, better satisfaction, and good quality response from the doctors.

COVID-19 posed a great challenge by disrupting the routine training activities, academic grand rounds, and educational conferences. These new challenges were met by online educational activities and rounds. Currently, total postgraduate trainees of the College of Physicians and Surgeons are 21,922. Among them, 10,031 are male doctors and 11,891(54%) are lady doctors. The performance of these doctors was reported through the e-log book, which is a protective data entry system that include daily academic activities and psychomotor skills attained by the PG trainees, along with presenting complaints, clinical features, diagnosis and management, compliance to treatments and follow-up of patients.<sup>24</sup>

This study has few limitations as well as strengths. Due to the cross-sectional study design, the temporality and causality among risk factors cannot be established. The likelihood of selection bias and ascertainment bias cannot be eliminated in this study. Despite few limitations, this study has significant strengths as it is a nationwide study that enlightens knowledgeable readers about the effect on performance of the postgraduate trainees and care-provided to old family members in home quarantine and isolation, working at different levels, either in healthcare facility or in the community setting/homes. This study has reported the lady doctors' performance in reducing the disease burden. Moreover, significance of online services and telemedicine were fully recognised by the healthcare professionals. Especially its effect on postgraduate training and academic activities.

The impact of COVID-19 on the performance of postgraduate medical doctors was multi-faceted challenge. Residency status, female gender, and geographical areas were associated with better performance in the management of the patients. The risk factors, found statistically significant with performance, were presence of comorbidities, allergic and autoimmune disorders, suffered from COVID-19 due to exposure among postgraduate doctors.

## CONCLUSION

The effect of COVID-19 on the performance of postgraduate

doctors was multi-factorial. Significant risk factors were personal factors like female junior residents of younger age groups. Diagnostic and systemic risk factors include comorbidities, allergic and autoimmune disorders, and PCR confirmed COVID-19 status due to exposure to the patients.

## ETHICAL APPROVAL:

Ethical permissions were obtained from Institutional Review Board of King Edward Medical University (No. 299/RC/KEMU, dated 29/04/2020).

## CONFLICT OF INTEREST:

The authors declared no conflict of interest.

## AUTHORS' CONTRIBUTION:

SA, MHM, FS, KMG, AA: Conception design, acquisition, analysis, interpretation, drafting, revising final approval, and agreement.

## REFERENCES

1. World Health Organisation. WHO Timeline - COVID-19. [www.who.int/news-room/detail/27-04-2020-who-timeline-covid-19](http://www.who.int/news-room/detail/27-04-2020-who-timeline-covid-19). (Accessed on 9/2/2020).
2. Wells C, Sah P, Moghadas S, Pandey A, Shoukat A, Wang Y, et al. Impact of international travel and border control measures on the global spread of the novel 2019 coronavirus outbreak. *Proc Natl Acad Sci U S A* 2020; **117(13)**:7504-9. doi:10.1073/pnas.2002616117.
3. Worldometer.COVID19VirusPandemic.Availablefrom:<http://www.worldometers.info/coronavirus/>.(Accessed on 9/2/2020).
4. Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *Int J Surg* 2020; **76(1)**:71-6. doi:10.1016/j.ijsu.2020.02.034.
5. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W, et al. Risk of COVID-19 among front-line healthcare workers and the general community: A prospective cohort study. *Lancet Public Health* 2020; **5(9)**:e475-83.doi: 10.1016/S2468-2667(20)30164-X.
6. Imran N, Masood HM, Ayub M, Gondal KM. Psychological impact of COVID-19 pandemic on postgraduate trainees: A cross-sectional survey. *Postgrad Med J* 2020; **0**:1-6. doi: 10.1136/postgradmedj-2020-138364.
7. Zhang J, Wang X, Jia X, Li J, Hu K, Chen G, et al. Risk factors for disease severity, unimprovement, and mortality in COVID-19 patients in Wuhan, China. *Clin Microbiol Infect* 2020; **26(6)**:767-772. doi:10.1016/j.cmi.2020.04.012.
8. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020; **323(11)**:1061-9. doi:10.1001/jama.2020.1585.
9. Clay K, Lewis J, Severini E. What explains cross-city variation in mortality during the 1918 influenza pandemic? Evidence from 438 US cities. *Econ Hum Biol* 2019; **35(1)**:42-50.doi. 10.1016/j.ehb.2019.03.010.
10. Saleem M, Dastgeer S, Durrani A, Saad A, Manzoor Z, Hussain H. Self-control mediates the relationship between psychosocial strengths and perceived severity of COVID-19 among front-line healthcare professionals of Pakistan: A single center experience. *Int J Health Med Sci* 2020; **36(COVID19-S4)**:2662. doi:

- 10.12669/pjms.36.COVID19-S4.2662.
11. Ehsan SB, Hasnain M. Factors influencing medical students' choice for family medicine as a specialty in Pakistan. *J Ayub Med Coll Abbottabad* 2018; **30(2)**:203-8.
12. Gibson DM, Greene J. Risk for severe COVID-19 illness among healthcare workers who work directly with patients. *J Gen Intern Med* 2020; **35(9)**:2804-6. doi: 10.1007/s11606-020-05992-y.
13. Rodríguez B, Sánchez T. The psychosocial impact of COVID-19 on healthcare workers. *Int Braz J Urol* 2020; **46 (Suppl 1)**:195-200. doi: 10.1590/S1677-5538.IBJU.2020.S124.
14. Jafar M, Shoukat A. Factors affecting performance of healthcare workers during COVID-19 in Pakistan. *Space and Culture India* 2020; **8(2)**:62-73. doi:10.20896/saci.v8i2.1059.
15. Lakhani A, Sharma E, Gupta K, Kapila S, Gupta S. Corona virus (COVID-19) and its impact on health care workers. *J Assoc Physicians India* 2020; **68(9)**:66-9.
16. Malik UR, Atif N, Hashmi FK, Saleem F, Saeed H, Islam M, et al. Knowledge, attitude, and practices of healthcare professionals on COVID-19 and risk assessment to prevent the epidemic spread: A multicenter cross-sectional study from Punjab, Pakistan. *Int J Env Res Pub He* 2020; **17(17)**:6395. doi: 10.3390/ijerph17176395.
17. The centre for evidence-based medicine. What impacts are emerging from Covid-19 for urban futures? <http://www.cebm.net/covid-19/what-impacts-are-emerging-from-covid-19-for-urban-futures>. (Accessed on 9/6/20).
18. Miller IF, Becker AD, Grenfell BT, Metcalf CJ. Disease and health-care burden of COVID-19 in the United States. *Nature Medicine* 2020; **26(8)**:1212-1217. doi:10.1038/s41591-020-0952-y.
19. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public Knowledge, Attitudes and Practices towards COVID-19: A cross-sectional study in Malaysia. *Plos one* 2020; **15(5)**:e0233668. doi:10.1371/journal.pone.0233668.
20. Chan JF, Yip CC, To KK, Tang TH, Wong SC, Leung KH, et al. Improved molecular diagnosis of COVID-19 by the novel, highly sensitive and specific COVID-19-RdRp/HeL real-time reverse transcription-PCR assay validated *in vitro* and with clinical specimens. *J Clin Microbiol* 2020; **58(5)**:1-35. doi: 10.1128/JCM.00310-20. doi: 10.1128/JCM.00310-20.
21. Pan Y, Li X, Yang G, Fan J, Tang Y, Zhao J, et al. Serological immunochromatographic approach in diagnosis with SARS-CoV-2 infected COVID-19 patients. *J Infect* 2020; **81(1)**: 28-32. doi:10.1016/j.jinf.2020.03.051.
22. Johnson KD, Harris C, Cain JK, Hummer C, Goyal H, Perisetti A. Pulmonary and extra-pulmonary clinical manifestations of COVID-19. *Front Med* 2020; **7(1)**:526. doi:10.3389/fmed.2020.00526
23. Usman N, Mamun MA, Ullah I. COVID-19 infection risk in Pakistani healthcare workers: The cost-effective safety measures for developing countries. *J Health Soc Behav* 2020; **3(3)**:75. doi: 10.4103/SHB.SHB\_26\_20.
24. Gondal KM. Current challenges in globalisation of medical education; Looking through the lens of health reforms. *Ann King Edw Med* 2019; **25(5)**:1-4.

.....