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An Analysis of Factors Associated with Internet Connectivity Challenges in Post-COVID Medical Education Settings

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ABSTRACT

Introduction: In Pakistan, digital technology has not been considered for medical education under normal circumstances. Hence, Corona virus disease–2019 (Covid–19) caused abrupt transition to online medical education. This study was conducted at the AJK (Azad Jammu & Kashmir) Medical College, Muzaffarabad to compare post–Covid online education with traditional face–to–face teaching. The AJK is "Pakistan–administered Kashmir" which is internationally recognized as a disputed territory whose topography is mainly mountainous with an urban–rural ratio of 17:83.

Methods: A quantitative questionnaire was electronically circulated to medical students of third, fourth and fifth year MBBS (Bachelor of Medicine & Bachelor of Surgery) classes in this public sector medical college of the capital city of the AJK using a descriptive cross–sectional study design.

Results: In our study, 70% of the undergraduate medical students out of a study population of 122 faced difficulty during online learning due to unstable internet connectivity. Logistic regression analysis concluded residing in rural settings and non–availability of the DSL (Digital Subscriber Line) at home as predictors of the difficulty being faced by the students due to unstable internet connection.

Discussion: Undergraduate medical students were found to be dissatisfied with the post–Covid online education because they were hurriedly shifted to it without technological infrastructure and digital equity.

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However, Covid–19 pandemic has provided an impetus for the future advancement in medical education by ensuring digital equity and establishment of technological infrastructure.

Keywords: online; AJK; COVID–19; medical teaching; Pakistan

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INTRODUCTION

Corona virus disease–2019 (Covid–19) pandemic has caused educational institutions worldwide to close down. Developed world is ahead of the developing countries in the use of digital technology [1]. But, transition to online education was unforeseen when the Higher Education Commission (HEC) of Pakistan decided to continue teaching using distance learning approaches. Majority of public sector universities in Pakistan initiated online teaching despite non–available technological infrastructure or funds required for going digital. Under normal circumstances, online education was never considered as part of the medical education in Pakistan [2]. This study was, therefore, conducted to examine perceptions of the undergraduate medical students at the AJK (Azad Jammu & Kashmir) Medical College, Muzaffarabad about post–Covid online education and to compare online with face–to–face learning based on the opinion of the students.

METHODS

A quantitative questionnaire was circulated to third, fourth and fifth years MBBS classes at the AJK Medical College, Muzaffarabad using a convenience sampling technique. First and second years MBBS classes were excluded from this descriptive cross–sectional study because students are not exposed to clinical rotations at hospitals affiliated with the medical college before third year MBBS class. Hundred students are enrolled annually in this public sector medical college. The questionnaire was circulated to 300 students of three MBBS classes for self-administration in their WhatsApp groups during April-June 2020. Participation in the study was voluntary and students were not required to reveal their names or roll numbers. A total of 122 students who voluntarily agreed to participate in the study returned back the filled in questionnaire.

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In addition to the variables examining perception of the undergraduate medical students towards post-Covid online learning, questionnaire contained variables related to the sociodemographic profile of the students such as place of residence, family system of the household, occupation and education of their parents. Level of difficulty of the students during online learning was assessed on 5-point Likert scale for variables such as difficulty faced by the students due to non-availability of laptop, unstable internet connection, distraction at the household and lack of training of the learner and the teacher. For example, level 1 (+) difficulty due to unstable internet connectivity on 5-point Likert scale showed negligible degree of difficulty faced by a student during online learning. Level 2 (++) difficulty was gauged when student was able to manage his/her difficulty, however, level 3 (+++) difficulty due to unstable internet connectivity was posing hindrance to the students' online learning occasionally. Level 4 (++++) difficulty often hindered the students' online learning while level 5 (+++++) difficulty due to unstable internet connectivity always posed hindrance to the students during the online education.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive information for variables was tabulated or graphed as frequencies or percentages. Logistic regression analysis was performed to identify most influential predictor of the difficulty faced by the students due to unstable internet connectivity (dependent variable). Predictor variables in the logistic regression model included place of residence, gender, family system of the household, devices used by the students for internet connectivity and education of both the parents of the undergraduate medical students. Variable named "family system of the household" had three responses. "Nuclear family system"

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meant that the respondent was living with his/her parents and siblings. On the contrary, a student was living in the "joint family" if his/her family was living with grandparents, uncles and their families and sharing the same kitchen. However, if student's family was not sharing the kitchen with the other families (grandparents, uncles), he/she was living in the "extended family system."

Data on the numerical variables regarding education of mother and father of the undergraduate medical students were collected in "number of years" which categorized for logistic regression analysis into primary (0 to 5 years), matriculation or matric (10 years), F.Sc. (12 years), graduation (14 years) and post-graduation (> 14 years) in line with the educational system of Pakistan. Variable regarding devices used by the students to achieve internet connectivity during online education had four responses – student used mobile data packages, had DSL (Digital Subscriber Line) at home, had student's own internet device and used someone's internet device.

RESULTS

Out of a total number of 122 undergraduate medical students in our study, place of residence of 33% was urban. Female students comprised of 74% of the study population.

Ninety six percent of the study population was of the view that clinical skills could not be covered by the online teaching. Ninety three percent of the students were using smartphone for online education **(table 1)** in our study**.**

Place of residence	**No**	**%**

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Rural	40	33
Urban	82	67
Total	**122**	**100**
Gender	**No**	**%**
Male	32	26
Female	90	74
Total	**122**	**100**
Can online teaching cover clinical skills?	**No**	**%**
No	117	96
Yes	05	04
Total	**122**	**100**
Device used for online learning	**No**	**%**
Use smart phone	114	93
Use laptop	08	07
Total	**122**	**100**

Table 1: Student's place of residence, gender, status of clinical skills learning and device used for online education

One hundred and seven undergraduate medical students (88%) preferred face–to–face learning over online education **(figure 1)**, in our study.

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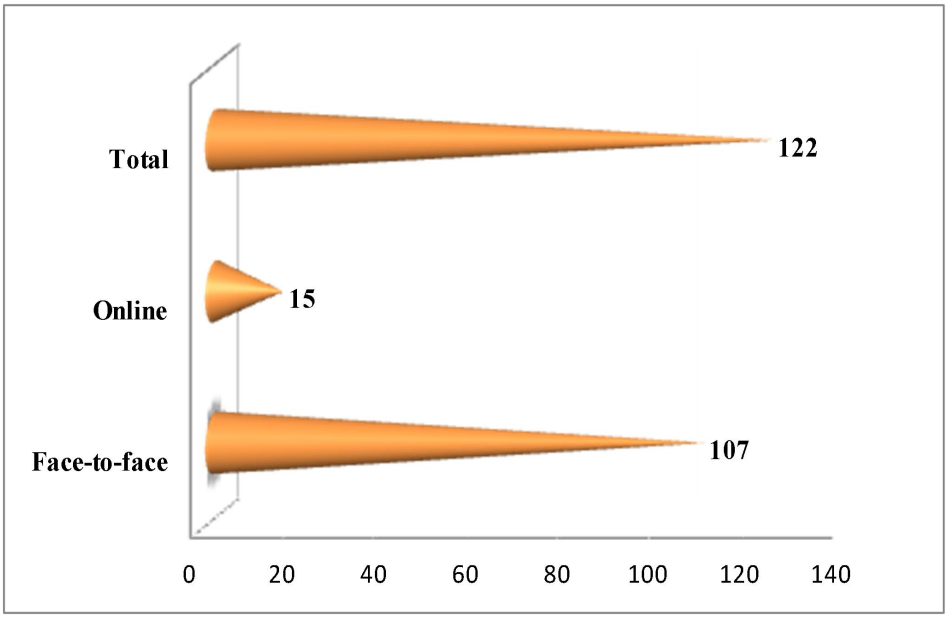
Figure 1: Students' preferred method of learning



Internet connectivity was achieved through mobile data packages by 43% of the students **(figure 2)** while 30% of the students had availability of the DSL (Digital Subscriber Line) at home for online learning. Twenty percent of the students had their own internet devices while 07% used someone's internet device.

Figure 2: Device used by students for internet connectivity

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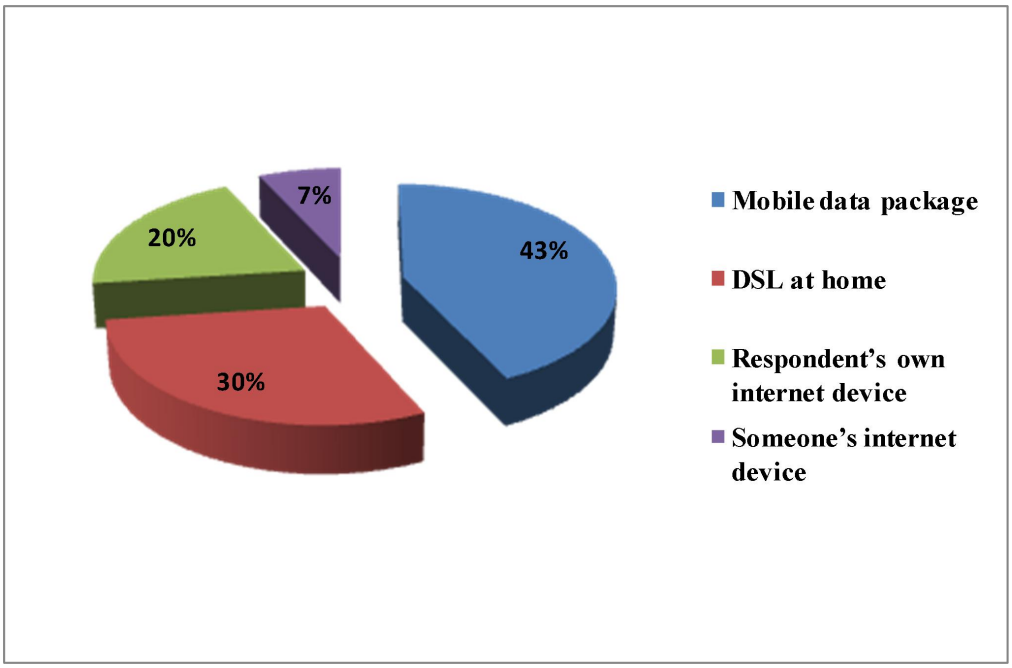
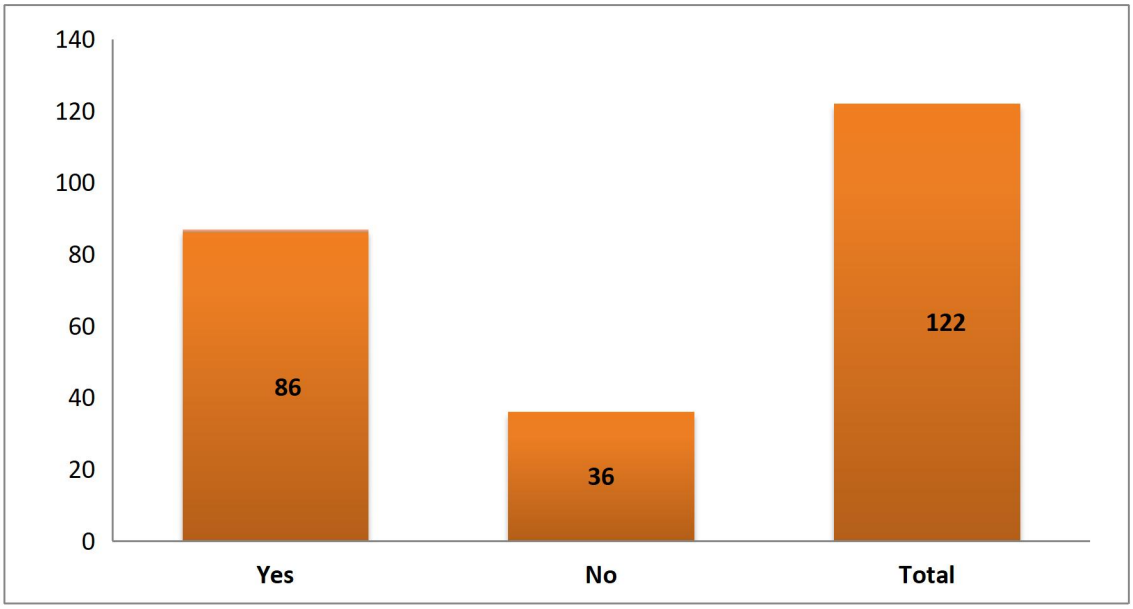


Figure 3: Difficulty faced by students due to unstable internet connection



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In our study, over 70% of the students were facing difficulty during online learning due to unstable internet connectivity **(figure 2).** Thirty percent of the students faced level 5 (+++++) difficulty due to unstable internet connectivity which meant that the online learning of 30% of the students was always hindered due to unstable internet connectivity **(table 2)**.

Level of difficulty due to unstable	**Number**	**Percentage**
Level 1 (+)	29	24
Level 2 (++)	21	17
Level 3 (+++)	21	17
Level 4 (++++)	14	12
Level 5 (+++++)	37	30
Total	**122**	**100%**

Table 2: Magnitude of difficulty due to unstable internet connectivity

Coding of predictor variables		**Regression coefficient B**	**p value**	**Odds Ratio Exp(B)**	**95% C.I. for EXP(B)**	
					Lower	**Upper**
Place of residence§						
0	Urban	Comparison				

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1	**Rural**	**1.448**	**0.021**	**4.255**	**1.249**	**14.502**
Gender						
0	Female	Comparison				
1	Male	–0.319	0.632	0.727	0.197	2.678
Family system of the household						
0	Extended	Comparison				
1	Nuclear	0.665	0.462	1.944	0.331	11.427
2	Joint	0.753	0.529	2.122	0.204	22.065
Availability of DSL at home‡						
0	Yes	Comparison				
1	**No**	**1.333**	**0.019**	**3.793**	**1.245**	**11.555**
Student used own internet device						
0	Yes	Comparison				
1	No	0.043	0.946	1.044	0.297	3.677
Student used someone's internet device						
0	Yes	Comparison				
1	No	–0.321	0.763	0.726	0.090	5.826
Student used data package						
0	Yes	Comparison				
1	No	–0.391	0.491	0.677	0.222	2.058

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Mother's education						
0	Primary	Comparison				
1	F.Sc.	–0.576	0.592	0.562	0.068	4.633
2	Graduation	–1.233	0.240	0.291	0.037	2.279
3	Matriculation	–0.035	0.974	0.966	0.118	7.933
4	Post–graduation	–0.552	0.593	0.576	0.076	4.364
Father's education						
0	Primary	Comparison				
1	F.Sc.	0.092	0.943	1.097	0.089	13.439
2	Graduation	0.291	0.813	1.338	0.120	14.937
3	Matriculation	0.552	0.667	1.737	0.141	21.441
4	Post–graduation	1.719	0.184	5.580	0.441	70.658

Table 3: Logistic regression analysis for examining predictors of students' difficulty due to unstable internet connectivity

§,‡Stratum–specific analysis showed that residing in rural settings and non–availability of the DSL at home increased student's difficulty in online learning due to unstable internet connectivity.

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Logistic regression analysis was performed to identify most influential predictor of the difficulty faced by students due to unstable internet connection (dependent variable). Predictor variables in the logistic regression model were students' place of residence, gender, family system of the household, devices used by students for internet connectivity (mobile data package, DSL, student's own internet device & someone's internet device) and education of both the parents. Stratum–specific logistic regression analysis showed that residing in rural settings and non–availability of DSL at home as predictors of the students' difficulty during online learning due to unstable internet connectivity **(table 3)**.

Predictor variables of the difficulty faced by students due to unstable internet connectivity during online education were also confirmed by the OR (Odds ratio) statistic of the rural place of residence and non–availability of the DSL at home. Values of OR statistic were significantly different from one, the p values were less than 0.05 and 95% confidence interval did not contain one. Therefore, it was concluded that students residing in rural settings were 4.2 times more likely to face difficulty due to unstable internet connection compared to those residing in urban areas and non–available DSL at household was 3.8 times more likely to cause difficulty to the students during their online learning **(table 3)**. Non–availability of internet device (own & someone's) and mobile internet data packages were not found to be significant in the binary regression model in addition to gender, family system of the household and parents' education.

DISCUSSION

In our study, 88% of the undergraduate medical students preferred face-to-face learning over online education. Same finding has been reported in many other studies as well [2,7]. Despite the adoption of online learning worldwide particularly in higher education, digital technology has not been considered for

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medical education under normal circumstances in Pakistan. A host of barriers ranging from lack of readiness to pay for the digital technology to the natural human inclination to resist change impeded the implementation of the digital technology [8].

When educational institutes were closed down in the post-Covid lockdown, the Higher Education Commission (HEC) of Pakistan decided to continue teaching using distance learning approaches. The HEC guidelines distinguish “online readiness” of the universities in Pakistan into three levels - ‘Basic’, ‘Effective’, and ‘Exemplary’ based on the standards such as availability of functional Learning Management System (LMS), training of the faculty, digital library, technological infrastructure, and the readiness of the students [9]. Unexpected transition to online education in Pakistan has exposed a divide between public and private universities. Many public sector universities are at the ‘Basic’ level of the “online readiness” because they do not have the technological infrastructure or funds required for going digital [10]. The AJK Medical College, Muzaffarabad and is affiliated with the University of Health Sciences, Lahore. Both are public sector entities recognized by the PM&DC (Pakistan Medical & Dental Council). Online teaching at the AJK Medical College, Muzaffarabad has been started with free ‘Zoom’ software, however, installation of the LMS (Learning Management System), technological infrastructure, training of the faculty and digital library are yet to be accomplished. This explains students’ preference, seen in our study, for the traditional face-to-face teaching over online education.

There is a learning curve for teachers to master the optimal use of online educational tools, hence, post-Covid online teaching could partially replace the cognitive component of the medical education in majority of the public sector medical institutes. Clinical training is paused completely because teaching of

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clinical skills is difficult to go online. In our study, 96% of the undergraduate medical students considered online education unsuitable for the learning of clinical skills. Advancement in medical education and curricular transformation are required to make use of the innovations in clinical online education such as virtual learning and simulation technology [11] which have not been considered, under normal circumstances. Departments of medical education (DMEs) need to play leadership role for curricular reforms which have been established in medical colleges just to fulfill the mandatory requirement for accreditation with the Pakistan Medical & Dental Council (PM&DC). However, DMEs in majority of medical colleges lack leadership and technical staff and have unclear role and responsibilities to influence medical education. This is particularly true for the public sector medical colleges, in Pakistan [12]. Hence, presently online clinical education is not plausible in public sector medical colleges devoid of technological infrastructure and functional DMEs (departments of medical education).

In our study, 93% of the students were using smartphone for online education which is consistent with other studies [2,13]. Proportion of students residing in rural settings was 33%. Female students comprised of 74% of our study population in comparison to 26% boys. This asymmetry is not surprising for countries such as Pakistan, India and Saudi Arabia where female medical students outnumber their male counterparts owing to the cultural acceptance of medical degree as a ‘safety net’ should something go wrong in marriage. In Pakistan, 70% of medical students are female [14].

Over 70% of the students, in our study, faced difficulty during online learning due to unstable internet connectivity. Analysis of the magnitude of difficulty showed severe level of difficulty been faced by 30% of the students due to unstable internet connection that caused disruption in their online learning

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constantly. Similar issues in online education have been reported by the students living in remote and conflict-ridden areas of the Pakistan [10]. The Azad Jammu & Kashmir (AJK) is internationally recognized as a disputed territory [3].

Logistic regression analysis was performed, in our study, to identify most influential predictor of the difficulty faced by students due to unstable internet connection (dependent variable). Predictor variables in the logistic regression model were students' place of residence, gender, family system of the household, devices used by students for achieving the internet connectivity (mobile data package, DSL, own internet device & someone's internet device) and education of both the parents. Stratum-specific logistic regression analysis showed residing in rural settings and non-availability of the DSL (Digital Subscriber Line) at home increased students' difficulty in online learning due to unstable internet connectivity.

With an urban-rural ratio of 17:83 and mainly mountainous topography [15], internet connectivity to the scattered rural communities of the disputed territory of the AJK has been a challenge. In our study, 43% of the students achieved internet connectivity through mobile data packages while 30% of the students had DSL (Digital Subscriber Line) at home. Twenty percent of the students had their own internet device while 07% used someone's internet device. The DSL brings an internet connection through telephone lines and allows the household to use the internet and make telephone calls at the same time. The DSL system separates the telephone signals into three bands of frequencies. The lowest band allows for telephone calls, while the other two bands take care of uploading and downloading the online activity [16].

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Digital Subscriber Line (DSL) is a fixed broadband internet service whose benefit is unlimited downloads and stable download speed. The bandwidth is a measure of the quantity of data that enters the network over a period of time and is measured in bps (bits per second). On the other hand, wireless broadband is one of the newest internet connection types. Instead of using telephone or cable networks for internet connection, radio frequency bands are used. Wireless broadband provides internet access via the same radio towers that provide voice service to the mobile phone [17]. Mobile data packages and internet devices utilize 2G, 3G and 4G service.

The fourth generation of mobile phone technology is called 4G while 3G is third generation and 2G is second generation. The 2G technology was launched in the 1990s and made it possible to make digital phone calls and send texts. Then 3G came along in 2003 and made it possible to browse web pages, make video calls and download music and video on the phone. Standard 4G is around five to seven times faster than 3G. A smartphone compatible with 4G is required to utilize the 4G service [18]. In Pakistan, majority of students enrolled in the public sector institutes come from low- to middle socio-economic backgrounds and they do not own laptops or smartphones of good quality [10].

Only 36.2% of the population in Pakistan has internet access including 2G internet. Access to online education is particularly limited for students living in remote and conflict-ridden areas where electricity shutdown and non-available internet services put them at a disadvantage with their peers from larger cities [19]. The AJK's lack of access to high quality wireless broadband internet services (3G and 4G) has posed enormous difficulty for students during post-Covid online education [20]. The Higher Education Commission (HEC) of Pakistan has committed to ensure digital equity in online learning and held talks

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with telecommunication companies to introduce subsidized internet packages for students but to no avail [10]. This is consistent with the findings of regression analysis performed in our study to examine predictors of students' difficulty due to unstable internet connectivity. Undergraduate medical students residing in rural settings were found to be 4.2 times more likely to face difficulty due to unstable internet connection compared to those residing in the urban areas and non-available DSL at household was 3.8 times more likely to cause difficulty in online learning. Digital Subscriber Line (DSL) is the most effective source of internet access in the disputed territory of the AJK whose topography is mainly mountainous with an urban-rural ratio of 17:83 (12) and where high quality wireless broadband 3G and 4G internet services are yet to be provided [21].

CONCLUSION

Undergraduate medical students were found to be dissatisfied with post–Covid online education mainly because they were hurriedly shifted to online teaching without required technological infrastructure and digital equity. Digital technology has not been considered for medical education in Pakistan, under normal circumstances. However, Covid–19 pandemic has provided an impetus for the future advancement in medical education by ensuring digital equity and establishment of technological infrastructure.

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