



Research Article

Prioritizing COVID-19 response strategies to reopen higher educational institutes in Pakistan

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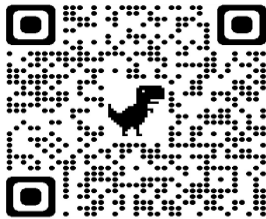
ARTICLE INFO

Keywords:

COVID-19 response strategies, Reopening higher educational institutes, Analytical hierarchical process, Multi-criteria decision-making method

ABSTRACT

The pandemic COVID-19 affected almost 188 countries' higher education systems across the globe. The global closure of educational institutions not only impacts students, teachers, and families but also economic and societal effects. The teachers and students promptly shifted to virtual learning due to the global pandemic. The ministry of higher education invested tremendous effort to find ways for the gradual reopening of higher educational institutions in Pakistan. The national and international governing bodies developed COVID-19 response strategies to reopen higher educational institutes. The study aimed to measure significance of COVID-19 response strategies. The COVID-19 response strategies: social norms and etiquette, maintain a healthy environment, maintain healthy operations, and caring programs were considered for safe return to colleges and universities. A multi-criteria decision-making method, known as Analytical Hierarchical Process (AHP) was applied to analyze and determine the relative importance of SARS-CoV-2 preventive strategies in response to the COVID-19 pandemic. The results indicated that wearing a face mask, maintain social distance between students, hand hygiene, class ventilation, properly clean and disinfection of classrooms, limit sharing of your objects, and awareness of regulation are significantly important to prevent the spread of this infection.



Received 28 March 2022; Received in revised form 27 April 2022; Accepted 8 May 2022

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DOI: <https://doi.org/10.5281/zenodo.6559155>

1. Introduction

The worldwide spread of novel coronavirus disease (COVID-19), initially detected in Hubei province China 2019. The coronavirus disease (COVID-19) was declared a Public Health Emergency of International Concern (PHEIC) and the virus spread to many territories. When coronavirus infects people, it can result in SARS-CoV-2 with symptoms, sore throat, fever, shortness of breath, cough, runny nose, and loss of sense of smell and taste (Li, Long-quan, et al., 2020). In severe conditions, infected people require hospitalization and intensive care with ventilation to assist breathing. The number of COVID-19 infected people increased nationally and internationally. Considering the COVID-19 situation and WHO recommends social/physical distancing is one of the most important precautionary measures to minimize the transmission of the virus. The government took strict actions lockdown operation. Due to lockdown, the educational sectors including schools, colleges, and universities became closed. The classes were suspended and exams were postponed (International Baccalaureate, 2020). It was an exceptional situation in the country. So, the spread of COVID-19 lead to the closure of schools, colleges, and universities globally (UNESCO, 2020). The government of Pakistan also decided temporarily close education institutions to minimize the spread of coronavirus. It is reported that 1.6 billion students are affected due to the closure of educational institutes. According to UNICEF, 91 % of the world's students were affected in response to COVID-19. Now it was dropped to 61%. The closure of the institution not only impact student, teacher, and families but also have economic and societal effects. Global closure of the educational sector shows an unprecedented risk to student's education and protection and well-being (UNESCO, 2020). The World Bank reported that the current cohort of learners might be lost approximately 10 trillion US dollars in earnings because of a lower level of earnings and drop out of education. The five months closure of education institutes might lose more than a year's worth of students learning (Aristovnik et al, 2020). The further closure of educational institutes might have long-term negative effects on student's learning. The educational institutes are important infrastructure for communities.

Thus, the COVID-19 has made numerous challenges and opportunities for the education sector to strengthen its infrastructure (Toquero, 2020). The Higher Education Commission (HEC) and the education ministry of Pakistan took necessary actions to continue the teaching system. The HEC and Ministry of education introduced an online teaching method and successfully implemented it in the education sector of Pakistan. The teachers deliver their lectures via the internet using various applications such as google meet, zoom, YouTube, Skype, etc. During online teaching, several students faced many problems, some students belong to poor families, and they do not have high-speed internet and digital gadgets to manage their classes properly. Numerous educational institutes are not well equipped with digital facilities to deal with the sudden change from conventional to online teaching systems.

Education losses in Pakistan due to SARS-CoV-2

As a result of the pandemic COVID-19, Pakistan was among the countries in the world that temporarily close educational institutes. The closure of educational institutes started on 14th March 2020. The purpose of a temporary closure of institutes was to support the social/physical distancing. It is an estimated 930,000 children are expected to drop out of primary and secondary schools (World Bank report, 2020). Furthermore, 22 million are left the school, this presents a 4.2 percent increase. Globally, Pakistan is a country where we expect the highest dropout of students due to the COVID-19 crisis (World Bank report, 2020). Due to the COVID crisis, 54 percent of households lose their income. A Gallup survey showed 27 % of families were not considering returning their children to schools. They pushed their children into labor (World Bank report, 2020).

COVID-19 vaccine hesitancy

A vaccine is an effective tool to protect people against deadly diseases. Now, many vaccines are available to keep safe people in response to COVID-19. People are hesitant means accept or refuse the vaccination being available. (Tavolacci, M. P. et al, 2021) conducted a cross-sectional study among

university students to determine the student vaccination decision. The results indicated 58 % of students have the will to vaccinate, 17 % would not have a will, and 25 % were not sure. (Saied, S. M) explored vaccination barriers among Egyptian medical students. It showed 96.8 % of students had much concerned about the vaccine's adverse effects. (Silva, J. et al., 2021) developed a survey questionnaire to measure successful vaccination against coronavirus among college students, the findings revealed 50 % will vaccinate as soon as possible and 3 % of students reported they would never get the COVID-19 vaccine. (Almalki, M. J et al., 2021) COVID-19 vaccination survey was conducted in Saudi Arabia. The study results stated 90.4 % are not vaccinated yet but they have the will to vaccinate themselves in response to COVID-19. The past studies indicated COVID-19 vaccine hesitancy among students. Many students have a positive attitude toward the COVID-19 vaccination, as well as so many students, have a negative intention to receive the COVID-19 vaccine. So, it is significant for higher educational institutes to strictly follow the COVID-19 response strategies for safe return to college and universities.

Reopening educational institutes during COVID-19

The closure of educational institutes disrupts the delivery of in-person instruction that has a negative impact on students and society. Educational institutes are important infrastructure for societies, as they have to provide a safe and supportive learning environment to students. On 23rd June 2020, UNICEF, UNESCO, and World Bank reported and set the dates for reopening primary and secondary schools. Globally, some countries decided to reopen the educational institutes. Countries from North Africa, Middle East, Latin America, the West, and Central reported, they had a date for the reopening of educational institutes. Most of the countries were planning gradual reopening or phased reopening. The ministry of higher education held a meeting with the National command operation center (NCOC) of Pakistan to make an important decision to reopen the higher educational institutes with strict consideration of standard operating procedures (SOPs). They adopted the staged/phased approach means gradually reopening higher

educational institutions. In phase I initially started college students, phase II includes university students.

COVID-19 response strategies to reopen higher educational institutes

The Ministry of National Health Services, Regulation & Coordination Pakistan developed COVID-19 response strategies for a safe return to educational institutes. The objective of COVID-19 preventive strategies is to reduce the transmission of infection in educational institutes in the context of ongoing COVID-19. It was strictly instructed by the educational institute's management to implement COVID-19 mitigation strategies. The COVID-19 response strategies are social norms and etiquette, maintain a healthy environment, maintain healthy operation, and caring program. The hierarchical structure of COVID-19 response strategies is presented in figure 1.

To identify the most effective preventive strategies, the decision-making problem influenced by several preventive measures is structured in the hierarchical framework of multiple criteria decision making (MCDM). The MCDM is concerned to solve the complex decision problems associated with multiple factors. The analytical hierarchical process (AHP), VISeKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method, and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) most used for evaluation and selection of alternate (Saaty, RW. 1980; Duckstein, L., & Opricovic, S. 1980; Hwang et al, 1981). The research presented by sarwar A, and Imran M, used the AHP method to analyze and prioritize the SARS-CoV-2 prevention measures to limit the spread of this infection. (Hezam, I. M. et al, 2021) applied AHP and neutrosophic TOPSIS methods prioritize the people who take the first dose of vaccine. The results indicated healthcare personnel and people with high-risk health have priority over others. In this paper, a multi-criteria decision-making method associated with COVID-19 response strategies for reopening higher educational institutes is constructed. This paper is aimed is to analyze the significance of COVID-19 response strategies for safe return to colleges/universities.

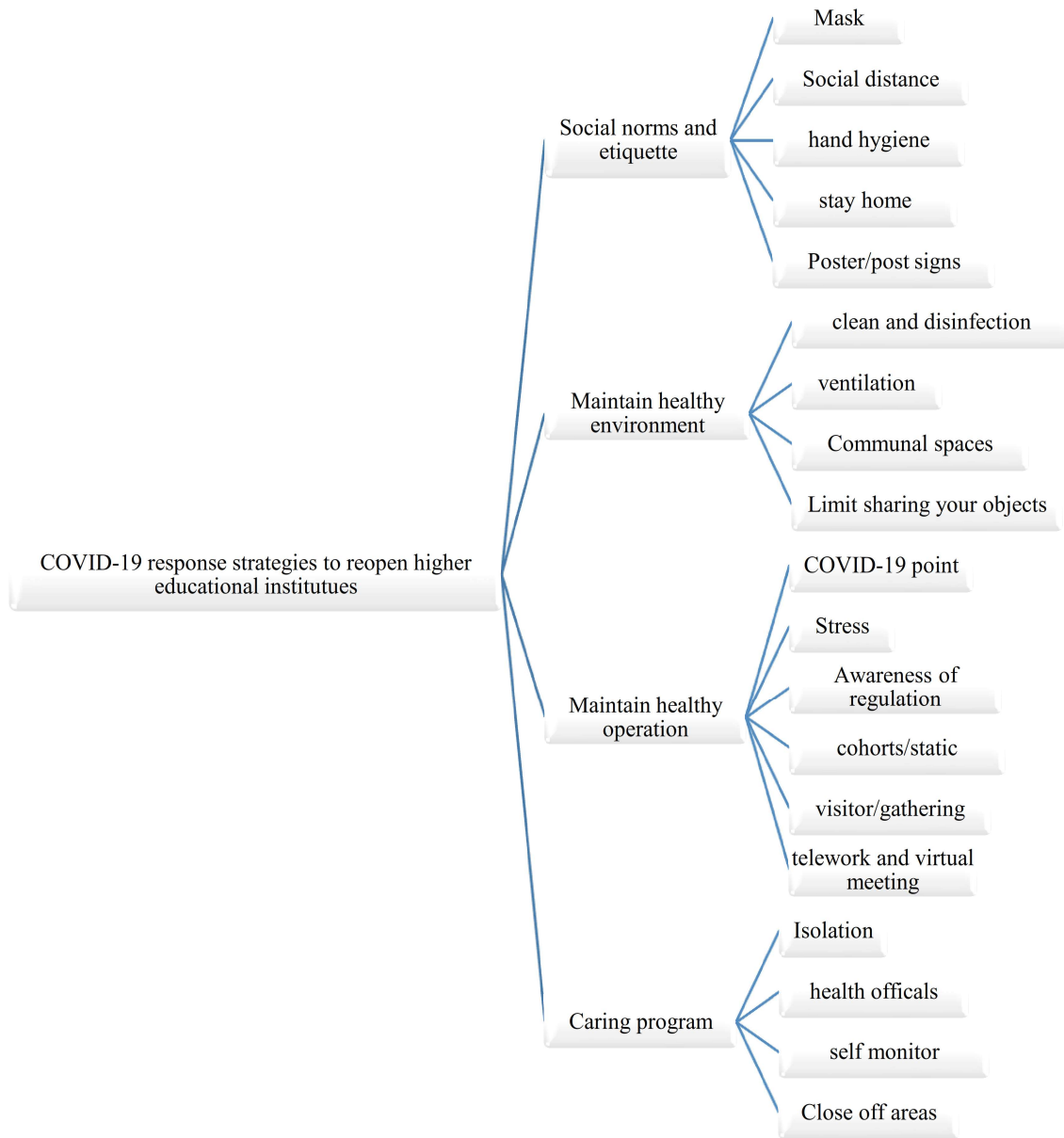


Fig. 1The hierarchical structure of COVID 19 response strategies for safe return to educational institutes

2. Methodology detail

The Analytical Hierarchal Process (AHP) was developed by (Saaty, 1980) is a powerful method that has been used in various fields to solve the multi-criteria decision-making problem (Saaty, 1980). It is one of the most preferred methods where issues related to multi-criteria judgment. (Saaty, 2008) himself point out, it is an important method to solve multi-criteria decision problems. To understand and well manage such problems, it was proposed a hierarchical structure and develop a pairwise comparison between n alternates.

Develop the hierarchy

The first stage of the AHP model consists of a hierarchical structure, in which all relevant COVID-19 preventive strategies are considered for decision making: Social norms and Etiquette, Maintain a healthy environment, Maintain healthy operations, and a Caring program. The expert team (healthcare professionals) was asked to establish a hierarchy of COVID-19 response strategies. The hierarchal structure of the decision problem is shown in figure 1. The structure looks like a tree, where roots present the overall goal, and nodes mean main criteria and sub-criteria. It consists of a multi-level hierarchal structure: structure of the problem, comparative judgment of criteria, and synthesis of priorities. The most significant feature of the AHP method, it enables decision-makers to develop an unbiased and consistent pair-wise comparison matrix while assigning weights to criteria.

Saaty’s priority scale

A predefined scale (saaty’s scale) is adopted to determine the relative importance of mitigation strategies by developing the pairwise comparison matrix. A pairwise comparison matrix contains two factors that are on the same level of scale (being measured to determine relative priority). The comparison matrix must involve the higher node exclusively, which is affected by the rest of the criteria. The saaty’s priority scale is presented in table 1.

Table 1 Pairwise comparison scale

Saaty’s priorities scale	Values
Indifference	1
Moderate preference	3-1/3
Strong preference	5-1/5
Very strong preference	7-1/7
Extreme preference	9-1/9
Intermediate	2-1/2, 4-1/4, 6-1/6, 8-1/8

Calculation of eigenvector and consistency

Let $A = \{A_j \mid j = 1, 2, \dots, n\}$ be the set of preventive strategies. The result of the pairwise comparison on n preventive strategies can be summarized in an (n_n) evaluation matrix A in which every element a_{ij} ($i, j = 1, 2, \dots, n$) is the quotient of weights of the criteria, as shown:

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}, a_{ii} = 1, a_{ji} = 1 / a_{ij}, a_{ij} \neq 0. \dots\dots\dots(1)$$

At the last step, the mathematical process commences to normalize and find the relative weights for each matrix. The relative weights are given by the right eigenvector (w) corresponding to the largest eigenvalue λ_{max} , as

$$A_w = \lambda_{max} w \dots\dots\dots(2)$$

If the pairwise comparisons are completely consistent, the matrix A has rank 1 and $\max = n$. In this case, weights can be obtained by normalizing any of the rows or columns of A Wang and Yang (2007).

It should be noted that the quality of the output of the AHP is strictly related to the consistency of the pairwise comparison judgments. The consistency is defined by the relation between the entries of A: $a_{ij} = a_{jk} = a_{ik}$. The consistency index (CI) is

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \dots \dots \dots (3)$$

The final consistency ratio (CR), usage of which lets someone conclude whether the evaluations are sufficiently consistent, is calculated as the ratio of the CI and the random index (RI), as indicated.

$$CR = \frac{CI}{RI} \dots \dots \dots (4)$$

The 0.1 is the accepted upper limit for CR. If the final consistency ratio exceeds 0.1, the evaluation procedure has to be repeated to improve consistency. The measurement of consistency can be used to evaluate the consistency of decision-makers as well as the consistency of the overall hierarchy (Wang & Yang, 2009). The random index values are presented in table 2.

Table 2 Random index (Saaty, 1998)

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

3. Results

Although the reopening of an educational institute is critical. It can be a reason for the spread of coronavirus. As discussed earlier, WHO, CDC,

UNICEF, and other international bodies surveyed to know parent’s suggestions regarding reopening the higher educational institutions. It was suggested that institutions must be reopened with strict SOPs. With the closure of the educational sector, students are facing several problems to continue their education.

Table 3 COVID-19 preventive strategies and CR

COVID- 19 preventive strategies	SNE	MHE	MHO	CG	Priority weights	
Social norms and Etiquette (SNE)	1	5	3	3	0.51614	CI= 0.032897
Maintain a healthy environment (MHE)	0.2	1	2	3	0.22374	RI= 0.9
Maintain healthy operations (MHO)	0.33	0.5	1	2	0.15667	CR= 0.036552
Caring program (CG)	0.33	0.33	0.5	1	0.10344	

The COVID-19 pandemic continues to reshape the globe. The healthcare professionals are running in the clinical trial and the coronavirus vaccine is approved for humans. The teachers, students, and societies were hesitant whether to get vaccinated or not. For considering this situation and safe return to educational institutions, the national and international governing bodies developed COVID-19 response strategies to reduce the transmission of this virus. The

AHP method was adopted to analyze and prioritize the COVID-19 response strategies for safe return to colleges/universities. For this purpose, COVID-19 response strategies with their elements were measured to determine the importance of each strategy. The medical specialist/physicians were asked to make a pairwise comparison matrix between COVID-19 preventive strategies and their measures. The saaty’s priority scale was used to determine the relative

importance of each strategy with its measures. The deeper insights of healthcare professionals and AHP results are shown in Table 3. The results indicated that social norms and etiquette strategies hold the highest weight (0.51614). Maintain a healthy environment strategy weight (0.22374) is placed second. Maintain healthy operations (0.15667) and a caring program (0.10344). The priority weights of preventive strategy components are demonstrated in table 4. The consistency allowed for the pairwise matrix is 0.05. The consistency ratio is 0.036552 which is less than 0.05. The study result suggested that COVID-19 response strategies are important to minimize the spread of virus and protection of students for safe return to colleges and universities.

4. Discussion

Social norms and etiquette

The AHP results indicated that social norms and etiquette are the most significant strategy to reduce the transmission of SARS-CoV-2 in educational institutes. This strategy demonstrated that wearing a face mask is mandatory. The seating plan of the classroom must have 6 feet of distance between students. The educational institute has sinks and adequate supplies (soap, sanitizer) for regular hand hygiene, and displays poster signs at different places to promote behavior to minimize the spread of COVID-19. After finishing classes, students must stay at home.

Maintain a healthy environment

It is the second most important strategy to reduce the spread of coronavirus. The management of educational institutes must engage staff to clean and disinfect touched surfaces doorknob/stair banisters and sink handles. It must be scheduled at every 4-6 hours intervals. There must be a proper ventilation system and outdoor air (open windows) in the

classrooms. Communal spaces such as the cafeteria and playground must be closed. Sharing your objects must be discouraged.

Maintain healthy operations

It is the third essential strategy mean educational institutes must develop COVID-19 point to protect the students, faculty, and staff in case of severe illness. The institutes must assign duties to staff for regulatory awareness of COVID-19. The teacher must encourage students to fight with coronavirus rather than stress. It must ensure that students and staff are as cohort/static having the same. The staff must limit the mixing of students between groups. The management limits non-essential visits/gatherings/activities with students. The hybrid system (virtual and in-class learning) must be adopted in the education system.

Caring program

It is another COVID-19 response strategy. Any student/staff/faculty who is feeling sick or COVID-19 symptoms (fever, sore throat, cough, and shortness of breath) found. They go home or get a healthcare facility depending on how severe their symptoms are. In this strategy, the educational institute must specify some room for isolation, arrange health officials, and deliver awareness regarding self-monitor of health. The institutions must close off the area used by a student who was sick and ensure cleaning and disinfection of that area.

The COVID-19 preventive strategies are significant to reopening higher educational institutes because COVID-19 vaccine hesitancy prevails among college and university students. Many students have the will to get vaccinate but several students have a negative attitude to receive the COVID-19 vaccine (Tavolacci, M. P. et al, 2021; Silva, J. et al., 2021; Almalki, M. J et al., 202; Saied, S. M).

Table 4 COVID-19 preventive strategies (PS) and sub-element with global weights and ranking

PS codes	Criteria	Weight of main criteria	Weights of sub-criteria	Global weights	Ranking
SNE	Social norms and etiquette	0.516142656			
SNE_1	Mask		0.382248	0.197294498	1
SNE_2	Social Distance		0.229497	0.118453191	2
SNE_3	Hand hygiene		0.152124	0.078517685	4
SNE_4	Stay home		0.129389	0.066783182	5
SNE_5	Poster/post sign		0.106741	0.055093583	6
MHE	Maintain a healthy environment	0.223741352			
MHE_1	Clean and disinfection		0.511174	0.114370762	3
MHE_2	Ventilation		0.152267	0.034068424	9
MHE_3	Communal spaces		0.110573	0.024739753	14
MHE_4	Limit sharing your objects		0.225984	0.050561966	7
MHO	Maintain healthy operations	0.156673543			
MHO_1	COVID-19 point		0.168242	0.02635907	13
MHO_2	stress		0.194896	0.030535047	11
MHO_3	Awareness of regulations		0.205253	0.032157715	10
MHO_4	Cohorts/static		0.136956	0.021457382	15
MHO_5	Visitor/gathering		0.097502	0.015275984	19
MHO_6	Telework and virtual meeting		0.191715	0.030036668	12
CP	Caring program	0.103442449			
CP_1	Isolation		0.450822	0.046634132	8
CP_2	Health official		0.182717	0.018900694	17
CP_3	Self-monitor		0.164222	0.016987526	18
CP_4	Close off area		0.202239	0.020920097	16

5. Conclusion

Since the WHO, CDC, and UNICEF declared SARS-CoV-2 is a global pandemic, several precautionary measures have been recommended to prevent and reduce the spread of coronavirus worldwide. Due to COVID-19, educational

institutions were closed temporarily to minimize the transmission of the virus. The closure of educational institutes negatively affected the students learning. The NCOC and The Ministry of Education of Pakistan took some important decisions to reopen the higher educational institutes in Pakistan. Although, the COVID-19 response strategies are critically analyzed

in the context of pandemic COVID-19. Adopting coronavirus response strategies is significantly important to limit the transmission of the virus and safe return to colleges and universities.

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