



Knowledge, attitude and practices towards COVID-19 among higher education students in India: a cross sectional study

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Abstract

Aim This study explored the knowledge, attitude and practices (KAP) of higher education students towards COVID-19. In addition, this study analysed the association of socio-demographic variables with KAP apart from finding the relationship between KAP.

Subject and methods This is a cross-sectional study conducted in India. Study participants were selected using a convenient sampling method from various higher educational institutions across 22 states in India. Data was collected using self-administered close-ended questionnaires via Google forms. The data were analysed using frequencies and percentage for descriptive purposes. A chi-square test was used to determine the association between groups, and correlation analysis was used to illustrate the significant relationship between KAP.

Results The majority, that is, 65.5% of students possess a high level of knowledge about the disease. It was noteworthy that 71.0% of them had a positive attitude towards COVID-19 and 66.7% of them exhibited desirable practices to mitigate COVID-19. Furthermore, the results showed a significant association between KAP and some of the socio-demographic variables studied. Social media emerged as a vital source of information regarding COVID-19 for the majority (81.0%) of students. Also, a strong significant positive correlation was observed between KAP variables.

Conclusion One-fourth of the students demonstrated only low and moderate levels of knowledge, negative attitude and undesirable practices in preventing COVID-19. The implications suggesting various approaches to enhance KAP to moderate the spread of COVID-19 among the students were recommended to aid the higher educational institutions.

Keywords Knowledge · Attitude · Practices · COVID-19 · Higher education students

Introduction

India, the second most populated country (US Census Bureau 2020) in the world, has 37.4 million students in higher education (All India Survey on Higher Education-AISHE 2019). The rate of growth of the higher education system in India was tremendous irrespective of various challenges in terms of enrolment, equity, quality, infrastructure, faculty, privatisation, research and innovation, accreditation etc., (Sharma and Sharma 2015). In the wake of COVID-19 in India, the students of higher education are facing specific challenges related to online teaching–learning. Also, they are prone to health problems brought on directly or indirectly due to COVID-19.

India was reported to be in the first position among the South-East Asian countries with over 2,97,535 (including 0956 new confirmed cases) confirmed cases and 8498 deaths (WHO Situation Report 144 13 June 2020) and the fourth

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position across the globe. Furthermore, it was reported that three in four COVID-19 cases (42%) were between 21 to 60 years of age as of the date (The Hindu Businesslin 2020).

The World Health Organization (WHO) highlighted the need for preparedness to challenge COVID-19. Keeping the global strategic plan in mind, the governments of the respective countries were advised to organize their administrative structure related to public health and hygiene. This preparedness will help the countries to combat the challenges posed by COVID-19 (WHO 2020). Amidst the various action plans taken by the Govt. of India, the total number of confirmed cases continues to rise since the outbreak began. Even if a community spread of COVID-19 has not been reported, an individual needs to follow precautionary measures throughout daily life. This will help to safeguard the self and the society from COVID-19 specifically and for healthy living in general. An individual should possess the basic information (such as sources of COVID-19, mode of transmission, symptoms, at-risk groups and preventive measures to be followed) regarding COVID-19 as the first step in precautionary measures. As the antiviral vaccines and medicines for preventing this disease are under trials (with limited distribution to date) (WHO 2020), the practice of safety measures will go a long way in reducing the spread of COVID-19.

The present study is based on the three concepts – head (knowledge), heart (attitude and beliefs) and hand (skills and doing) – proposed by Shulman (2005) in his signature pedagogies which can be integrated for productive learning. The desirable KAP concerning COVID-19 in students will give them a holistic learning experience that enables them to act wisely in preventing this viral infection.

The recent literature (Al-Hazmi et al. 2018; Erfani et al. 2020; Zhong et al. 2020; Modi et al. 2020; Tomar et al. 2020; Rugarabamu et al. 2020; Haque et al. 2020; Al-Hanawi et al. 2020; Zhang et al. 2020; Maheshwari et al. 2020; Modi et al. 2020; Prasad Singh et al. 2020; Saqlain et al. 2020; Srichan et al. 2019) conducted in various parts of the world has revealed the necessity for an adequate knowledge to make an individual exhibit a positive attitude that further directs them to demonstrate desirable behaviour to protect themselves from MERS, SARS-CoV-1 and SARS-CoV-2. It is to be noted that the majority of studies quoted in this section were conducted either with medical students/health care professionals or the general public. In the Indian context, Modi et al. (2020) explored the awareness level among health care professionals and medical students towards COVID-19 in the Mumbai metropolitan region. In another study, Maheshwari et al. (2020) analysed the medical students KAP towards COVID-19. Prasad Singh et al. (2020) identified KAP of the students belonging to a particular University towards COVID-19. As there are only a few KAP towards COVID-19 studies on higher education students in the Indian context, the present study is significant in documenting

the same. Furthermore, the present study supports similar studies conducted in knowing the student levels of KAP towards COVID-19. In addition, the present study embraces the heterogeneous group of higher education students scattered across different parts of the nation.

Also, this kind of KAP study acts as a lynchpin for organizing any health intervention programmes. The health intervention programmes can be planned based on the KAP relationship determined. The results of this study will guide the educational institutions in India to know the students' readiness to protect themselves from this disease and plan the health intervention programmes at the right time (Muleme et al. 2017).

The present study assesses the higher education student's (HES) level of experiences (knowledge, attitude and practices) towards COVID-19. Furthermore, the study examines the relationship between these three variables and determines the association of socio-demographic variables. This study plays a pivotal role because it targets young people belonging to the age group of 18–23 years. It is to be noted that over 50% of the population in India is under 25 years old (British Council 2014), which is significant to the present study.

Materials and methods

Study design This cross-sectional survey was conducted among higher education students all over India from April 2020 to May 2020. After obtaining the consent of each participant, a semi-structured questionnaire was administered using the Google platform.

Sampling The target sample size for the present study was calculated by considering the awareness percentage of 71.2% regarding COVID-19 among health care students (Modi et al. 2020). Taking alpha error as 2.0% and an absolute error of margin as 3.0%, the target sample size was calculated to be 1243. The students were chosen by a convenient sampling method owing to the COVID-19 pandemic. Students from 22 states were contacted via college administration and friends over email and phone.

Data collection The semi-structured questionnaire was developed with four sections, namely demographic details (13 questions), knowledge (15 questions), attitude (10 questions) and practices (10 questions) regarding COVID-19. The questionnaire consisted of closed-ended questions requiring either one or multiple responses from the choices provided. The content validation of the questionnaire was done by the subject and research experts from the departmental research committee of the Institute.

The link to the Google form was posted and circulated using various social media platforms used by the students.

All the participants were informed about the details of the study objectives. The students who had given informed consent were directed to respond to the semi-structured questionnaire. The 1252 students actively participated in the study and gave their response. The anonymity of the participants was also assured and ensured.

Scoring Each correct response in the knowledge section was scored with ‘2’ marks. Based on the total scores, the levels of knowledge was divided into low, moderate and high knowledge. The cumulative scores of 23 and below 23 were considered as poor knowledge, the scores of 24 to 34 were considered as moderate knowledge and score 35 and above 35 was considered as high knowledge.

The third section (attitude) includes three responses viz. ‘agree’, ‘neutral’ and ‘disagree’. These responses were scored on a three-point Likert scale: a score of ‘3’ is assigned for a favourable response, ‘2’ for a neutral response and ‘1’ for an un-favourable response. Scores ranging from 1 to 22 were considered as a negative attitude; scores ranging from 23 to 28 were considered as a neutral attitude; and a score of 29 and above was considered as a positive attitude towards COVID-19.

The fourth section includes ten statements with the response of ‘always’, ‘sometimes’, and ‘never’. These responses were scored on a three-point Likert scale: a score of ‘3’ is assigned for a favourable response, ‘2’ for a neutral response and ‘1’ for an unfavourable response. The cumulative scores ranging from 0 to 21 were considered as undesirable practices, neutral practice scores ranged from 22 to 27 and a score of 28 and above was considered as desirable practices towards COVID-19.

Data analysis All the data were analysed using the Statistical Package for Social Sciences (SPSS) version 20 software. Descriptive univariate analysis of the demographic characteristics was performed. Categorical variables were summarised through frequencies and percentages. Chi-square (Mann–Whitney test and Kruskal–Wallis test were used to determine significant differences between two groups, and two or more groups of an independent variable, respectively) and correlation analysis was used to report the association between the demographic and KAP, and the relationship between KAP variables, respectively.

Ethical approval

The approval of the study protocol was obtained from the Internal Human Ethics Sub-Committee of the Central University of Tamil Nadu, Thiruvavur, India, with the reference number CUTN/IHESC/2020-001R1.

Results

Socio-demographic characteristics of students surveyed

A total of 1252 students from 22 states of India participated in the study and responded to the questionnaire. The male students comprised 32.0%, whereas 68.0% of students were female; 59.0% of students belonged to the less than or equal to 21 years of age group, whereas 40.7% of students belonged to greater than 21 years of age group. Among 1252 students, the majority, that is, 82.8%, 65.6% and 84.0% of them were married, were residing in a rural area and belonged to the Hindu religion, respectively. Furthermore, 54.0% of students were studying in the higher education institutions funded by the Central Govt., whereas 26.0% and 19.0% of students were from state and self-financed higher education institutions, respectively. Also, 51.0% and 50.0% of students were attending classes from home and hostel, respectively. The socio-economic status of the students reveal that the majority (61.0%) of students belong to the class III socio-economic group (Rs.2260 – Rs. 3765 per month) followed by 23.0% of students were belonging to class IV (Rs.1130 – Rs. 2259 per month) group as per modified BG Prasad scale (Mathiyalagen et al. 2020). Furthermore, the majority (40.5%) of students were studying courses related to science and engineering followed by 38.0% of students, who were studying social science, law and management related courses and 19.0% of students were pursuing arts and humanities related courses. Among 1252 students, only 12.7% of students were pursuing a research programme, whereas, 45.5% and 41.8% of students were studying under-graduation and post-graduation programmes, respectively (Table 1).

Sources of information regarding COVID-19

The majority of students (81.0%) surveyed reported social media as a vital source of information to know about COVID-19, followed by TV (79.0%), newspaper (56.0%), friends (42.0%), family (40.0%) and authentic sources (25.0%). It is unfortunate to document that only a small number of students relied on authentic sources to learn about COVID-19. The detailed distribution is illustrated in Fig. 1.

Knowledge regarding COVID-19 among the higher education students ($n = 1252$)

It was noted that 76 students were not aware of corona infection and their responses had been excluded for analysing the level of knowledge towards COVID-19.

The correct answer rate of the 15 questions on the COVID-19 knowledge test was 71.0%. The mean COVID-19

Table 1 Socio-demographic characteristics of students surveyed

Factors	Frequency	Percentage
Age		
<=21 years	742	59.3
>21 years	510	40.7
Gender		
Male	401	32.0
Female	851	68.0
Marital status		
Married	1037	82.8
Unmarried	212	16.9
Divorced	3	0.2
Programme		
Under-graduation (UG)	570	45.5
Post-graduation (PG)	523	41.8
Research	159	12.7
Field of study		
Arts/humanities/music	242	19.3
Science/engineering	507	40.5
Medical/paramedical	26	2.1
Social science/law/commerce/management/education	477	38.1
Management of the institution		
Central	679	54.2
State	330	26.4
Self-finance	243	19.4
Locality		
Rural	821	65.6
Urban	431	34.4
Socioeconomic status (modified BG Prasad scale, 2020)		
More than Rs. 7533 per month (Class I)	92	7.3
Rs.3766 – Rs.7532 per month (class II)	118	9.4
Rs.2260 – Rs. 3765 per month (class III)	758	60.5
Rs.1130 – Rs. 2259 per month (class IV)	284	22.7
Religion		
Hindu	1052	84
Muslim	135	10.8
Christian	51	4.1
Non-religious	14	1.1
Residential status		
Day scholar	632	50.5
Hosteller	620	49.5

knowledge score was 29.81 (SD = 5.042), suggesting an overall 71.0% correct rate on this knowledge test.

Table 2 clearly illustrates that the majority, that is, 99.8% of students had rightly understood that the corona belongs to the virus family. Also, 83.0% of students accurately marked (the option yes to confirm) that both COVID-19 and corona viral

infection was the same, only 11.3% perceived that both were different, indicating their lack of knowledge on the basics of COVID-19. Out of 1252, 61.8% of students exactly selected SARS to be similar to COVID-19, while approximately 5.8% of students opted for HIV, plague (6.0%) and cholera (3.3%). Surprisingly, 23.1% of students lack knowledge as they marked the ‘do not know’ option. The acronym COVID-19 indicates Corona Virus Disease 19 which was rightly answered by less than half of the students, that is, 40.7%. However, 43.0% of students wrongly opted for Corona Virus Infectious Disease 19, 8.5% opted for Coronavirus Immune Disease 19, 2.3% opted for Corona Virus Induced Disease 19.0 and 5.0% opted for do not know. The WHO declared COVID-19 as a pandemic disease and the majority (73.0%) of the surveyed students have rightly understood the concept of the pandemic. However, 10.5% of students consider COVID-19 an epidemic, 2.0% of students as endemic, 1.0% as sporadic and 13.3% of them do not know the answer.

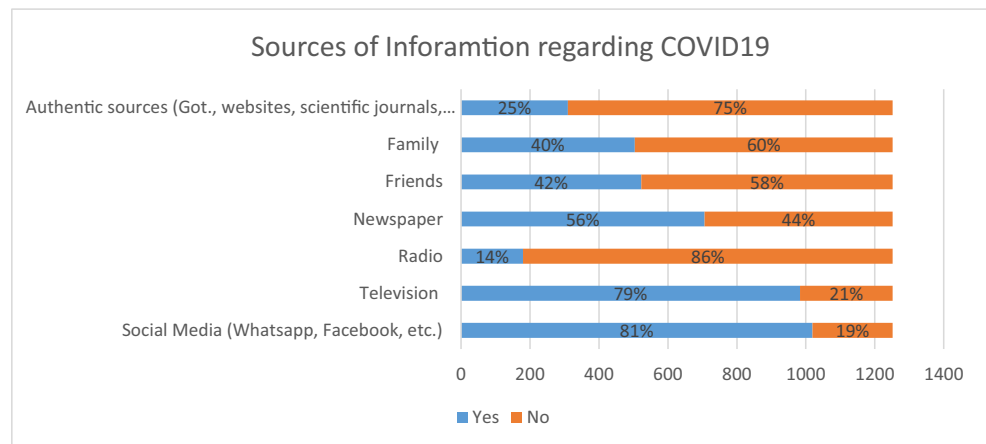
As the information about the mode of transmission of COVID-19 among humans had invited several issues, the same was reflected in the students’ answer. In the face of the ongoing dilemma, 92.4% of students rightly opted for respiratory droplets as one of the main modes of transmission of COVID-19, while others also chose blood (48.1%), fomites (42.3%), tears (36.9%), faeces (36.1%) and urine (22.9%) as a mode of COVID-19 transmission.

About at-risk groups, 33.2% of students made the right choice in identifying that all individuals irrespective of their age group are at risk of getting COVID-19. However, the majority (57.0%) of students had wrongly perceived that the individuals belonging to above 60 years are at-risk to get COVID-19. Likewise, 8.0% of students had wrongly identified that individuals belonging 30 to 60 years of age group are susceptible to COVID-19.

Concerning co-morbidities owing to COVID-19, the majority of students, that is, 73.0% have rightly opted that persons with hypertension, diabetes and cancer are at risk of getting COVID-19 infection. However, approximately 8.0% of students opted for infants less than one year, doctors, policemen and sweepers against the right option, indicating they possess inadequate information against the coronavirus infection.

The incubation period is the time interval from the entry of a virus into the human body to the development of symptoms (WHO 2020). The knowledge regarding the incubation period of COVID-19 was vital for students to remain in self-quarantine to prevent the spread of viruses. Almost half of the surveyed students (53.3%) had the right comprehension (2 days to 2 weeks) regarding the incubation period of the COVID-19. Unfortunately, 37.1% of students believed that the incubation period is between 2 weeks and one month.

The main symptoms of COVID-19 were fever, sore throat, cough, difficulty in breathing and diarrhoea (WHO 2020).

Fig. 1 Sources of information regarding COVID-19

More than 95.0% of students cognicised the right symptoms (fever & sore throat/difficulty in breathing/cough). However, 68.0% of students had not holistically comprehended all the symptoms of COVID-19 and ignored diarrhoea that should not be overlooked.

Apart from 7.0% of the surveyed students, the other 93.0% of them rightly understood that COVID-19 causes death in extreme conditions. About the test that confirmed the presence of COVID-19, only 43.0% of the students selected the PCR test. However, 41.0% of students opted ‘do not know’ which indicates their inadequate knowledge about COVID-19 diagnostic test procedures. Very few students (5.9%, 6.6% and 3.4%) had wrongly marked other tests (NAAT, HbA1C, CBC). In COVID-19 testing laboratories, nasal and throat samples are collected from individuals to test the presence of COVID-19 (ICMR 2020). The right choice (nasal and throat swab) was opted by 62.0% of students, while 33.0% of students had wrongly opted for blood as the sample for COVID-19 testing.

It is apparent that everywhere thermal scanners were conveniently used to detect the temperature and no doubt that 72.0% of students possess good knowledge in choosing the right answer. Conversely, 18.6% of students (opted do not know) lack knowledge about thermal scanners that are used as a screening instrument in almost all crowded places. Maintaining social distancing, wearing masks and washing hands with soap and water will prevent the individuals from COVID-19. Approximately 97.0% of students were thoroughly aware of these strategies that prevent them from getting COVID-19. However, 16.0% and 18.0% of students wrongly perceived that alcohol consumption and intake of self-medication, respectively, will prevent COVID-19, which is alarming.

On one hand, the majority of higher education students, that is, 65.5% had a good knowledge level regarding COVID-19. On the other hand, 34.0% of students had only low and moderate levels of knowledge related to COVID-19 (Refer Fig. 2).

Nature of attitude prevailing among higher education students towards COVID-19

The mean attitude answer score of the ten questions regarding the attitude towards COVID-19 rate was 25.81 (SD = 2.798), suggesting an overall 86.0% of positive attitude score in this test.

Table 3 demonstrates that 56.7% of students disagreed that COVID-19 is a non-curable disease and approximately 80.0% of students disagreed that COVID-19 will affect people belonging to high socio-economic status and also do not hold any false belief that it is caused owing to the usage of 5G technology. Similarly, 94.5% of students were very clear that COVID-19 patients should be kept in isolation. Also, a considerate number of students (73.4%) believed that the manifestation of cough and fever in people does not guarantee COVID-19. Likewise, 78.0% of students rightly agreed that wearing a mask can reduce the prevalence rate of COVID-19. Furthermore, 56.7% and 59.0% of students agreed that COVID-19 can be cured and reduced by spraying disinfectant, respectively, thereby having a positive attitude towards it. Also, the majority of students (69.6%) had rightly predicted the influence of COVID-19 on the country’s economic development. More than half (53.4%) of the students willingly agreed to take the COVID-19 vaccine on its availability. Unfortunately, 24.7% of the surveyed students believed that COVID-19 is sinful. In conclusion, the majority (71.0%) of higher education students were perceived to have positive attitudes towards COVID-19. However, approximately one-fourth of them had neutral and negative attitudes. The nature of the attitude of higher education students towards COVID-19 was illustrated in Fig. 3.

The extent of practices followed by higher education students to prevent COVID-19

The average score of ten questions regarding the practices in preventing COVID-19 was 25.22 (SD = 2.866), suggesting an overall 86.0% desirable practice score in this test.

Table 2 Knowledge regarding COVID-19 among the higher education students (n = 1252)

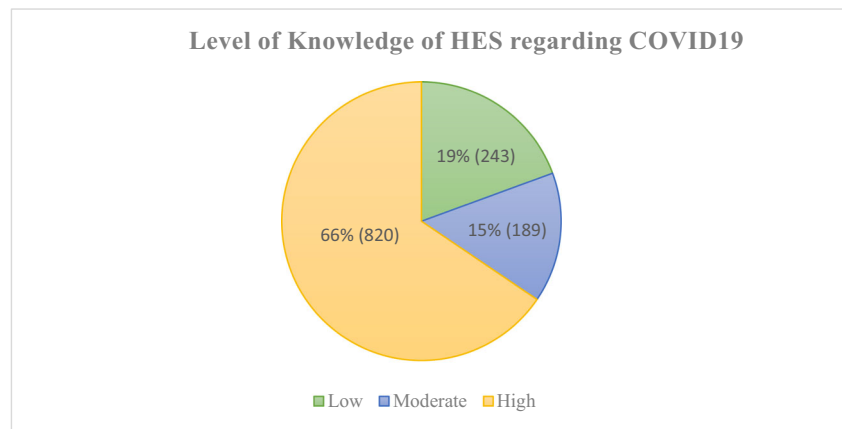
Knowledge questions	Number	Percentage
Corona is a		
Bacteria	1	0.1
Protozoa	2	0.2
Virus	1249	99.8
COVID-19 and corona viral infection are the same		
Yes	1039	83.0
No	142	11.3
Do not know	71	5.7
COVID 19 virus is similar to		
HIV	73	5.8
SARS	774	61.8
Plague	75	6.0
Cholera	41	3.3
Do not know	289	23.1
Full form of COVID-19		
Corona Virus Infectious Disease 19	545	43.5
Corona Virus Induced Disease 19	29	2.3
Corona Virus Immuno Disease 19	106	8.5
Corona Virus Disease 19	510	40.7
Do not know	62	5.0
COVID-19 is		
Epidemic	132	10.5
Endemic	26	2.1
Pandemic	916	73.2
Sporadic	12	1.0
Do not know	166	13.3
COVID-19 spread through		
Respiratory droplet	1157/95	92.4/7.6
Urine	287/965	22.9/77.1
Feces	452/800	36.1/63.9
Fomites	529/723	42.3/757.7
Blood	602/650	48.1/51.9
Tears	462/790	36.9/63.1
At risk age group affected by COVID-19		
0 to 10 years	11	0.9
10 to 30 years	4	0.3
30 to 60 years	100	8.0
Above 60 years	714	57.0
All age group	416	33.2
Do not know	7	0.6
Persons prone to serious problems owing to COVID-19		
Persons with Hypertension/diabetes/cancer	916	73.2
Healthy persons	18	1.4
Babies less than 1 year	115	9.2
Doctor/policemen/ wweepers	103	8.2
Do not know	100	8.0
Incubation period of COVID-19		
Less than 2 days	26	2.1

Table 2 (continued)

Knowledge questions	Number	Percentage
2 days to 2 weeks	667	53.3
2 weeks to 1 month	465	37.1
More than a month	44	3.5
Do not know	50	4.0
Symptoms		
Fever & Sore throat	1227/25	98.0/2.0
Dehydration	393/859	31.4/68.6
Loss of smell sensation	591/661	47.2/52.8
Difficulty in breathing	1216/36	97.1/2.9
Cough	1203/49	96.1/3.9
Diarrhoea	400/852	31.9/68.1
Severe complications- COVID-19		
Blindness	6	0.5
Cancer	9	0.7
Death	1160	92.7
Hearing difficulty	12	1.0
Do not know	65	5.2
Diagnostic test for COVID-19		
NAAT	74	5.9
HbA1C	83	6.6
PCR	540	43.1
CBC	43	3.4
Do not know	512	40.9
Sample collected for diagnosing COVID-19 in PCR test		
Urine	3	0.2
Nasal & throat swab	777	62.1
Stool	7	0.6
Blood	418	33.4
Do not know	47	3.8
Screening instrument used to detect fever		
Stethoscope	31	2.5
Thermal scanner	907	72.4
Endoscope	53	4.2
Otoscope	28	2.2
Do not know	233	18.6
Prevention –COVID-19		
Exposing to sunlight	547/705	43.7/56.3
Hand-washing with soap and water	1226/26	97.9/2.1
Consumption of alcohol	200/1052	16.0/84
Taking own medication	235/1017	18.8/81.2
Social distancing	1226/26	97.9/2.1
Wearing mask	1221/31	97.5/2.5

From Table 4 it is evident that more than 85.0% of students had avoided playing outside; covered their face with masks while going out; regularly washed hands and maintained appropriate social distancing in the wake of the COVID-19

Fig. 2 Level of knowledge of HES regarding COVID-19



pandemic. Likewise, the majority of students (75.7%) had restrained their family members from going out unnecessarily. Furthermore, 69.0% of students had tried to stay away from people who cough and sneeze and approximately half of the students surveyed covered their mouth while sneezing or coughing and disinfected the surfaces that they often come into contact with. However, only 45.0% of students restrained themselves in bringing their hands towards their face. In addition, 51.4% of students had never checked for information regarding COVID-19 which is very essential to stay updated on the disease. Overall, the majority (66.7%) of higher education students exhibited desirable practices towards COVID-19. However, 18.7% and 14.5% of students exhibited only neutral and undesirable practices, respectively (see Fig. 4) towards COVID-19 which will be intimidating to the students who exhibited desirable practices to prevent COVID-19.

Association of demographic variables of HES with their KAP scores

Table 5 shows that knowledge of higher education students towards COVID-19 was significantly associated with the

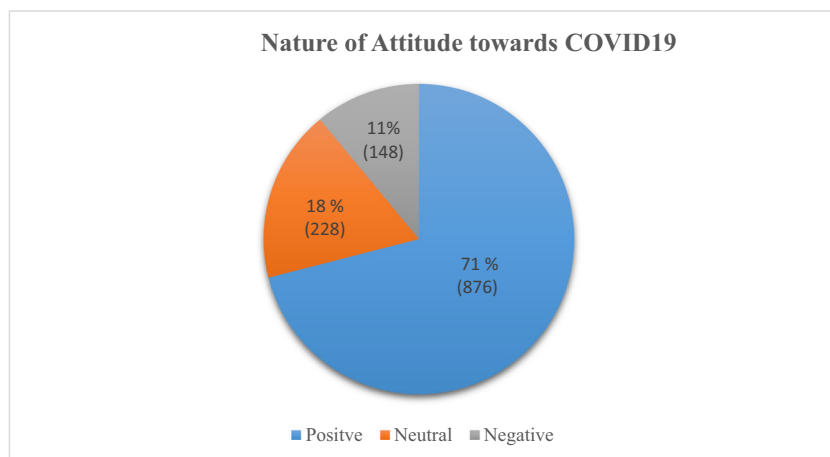
socio-demographic variables such as marital status ($p < 0.05$); programme of study ($p < 0.01$); field of study ($p < 0.01$); the locality ($p < 0.01$) and socioeconomic status ($p < 0.01$). Also, it was observed (Kruskal–Wallis Test) that the knowledge scores in COVID-19 of unmarried students’, research scholars’, students pursuing medical-related studies and students belonging to class IV socio-economic group were better than the divorced, post-graduate (PG) students, students pursuing social science/law/management related courses and class III socio-economic group, respectively. In addition, students from rural areas had better knowledge than students from urban areas. However, other variables age, gender, management of the institution, religion and residential status of the students studied were not significantly associated with their knowledge level regarding COVID-19.

It was also evident that there was a significant association between total attitude scores and the socio-demographic variables such as the programme of study ($p < 0.05$), management of the institution ($p < 0.01$), the field of study ($p < 0.05$), socioeconomic status ($p < 0.01$), religion ($p < 0.05$) and residential status of the students ($p < 0.01$). Furthermore, Kruskal–Wallis test analysis showed that the

Table 3 Attitude among higher education students towards COVID-19

Attitude statements	Agree (No/%)	Neutral (No/%)	Disagree (No/%)
COVID-19 is non-curable	171(13.7)	371 (29.6)	710 (56.7)
High socioeconomic status persons will get COVID-19	119 (9.5)	106 (8.5)	1027 (82.0)
Using 5G technology leads to COVID-19	60 (4.8)	140 (11.2)	1052 (84.0)
Wearing a mask will prevent COVID-19	980 (78.3)	247 (19.7)	25 (2.0)
Spraying of disinfectant will reduce COVID-19	743 (59.3)	383 (30.6)	126 (10.1)
COVID-19 is a sinful disease	309 (24.7)	337 (26.9)	606 (48.4)
COVID-19 influences economic development	871 (69.6)	194 (15.5)	187 (14.9)
All persons with cough and fever will have COVID-19	155 (12.4)	178 (14.2)	919 (73.4)
COVID-19 patients should be kept in isolation	1183 (94.5)	42 (3.4)	27 (2.2)
Will you take vaccine for COVID-19, if available	668 (53.4)	281 (22.4)	303 (24.2)

Fig. 3 Nature of attitude towards COVID-19



students who were doing research, students from central educational institutions, students pursuing medical-related studies, class IV socio-economic group and Christian students exhibited a less positive attitude than under-graduate (UG) students, students from state educational institutions, students pursuing social science/law/management related courses, class III socio-economic group and the Hindu students. Also, Mann–Whitney test analysis revealed that the students who were residing in hostels had a less positive attitude towards COVID-19 than the students residing at home. At the same time, no significant associations were found between the total attitude scores and student’s age, gender, marital status and locality.

Furthermore, statistically significant associations were observed between the total practice scores and the student’s gender ($p < 0.05$), management of the institution ($p < 0.01$), socio-economic status ($p < 0.01$) and the residential status ($p < 0.05$). Further analysis (Kruskal–Wallis test) proved that the students from central educational institutions and students belonging to class IV socio-economic groups had more desirable practices to prevent infection from COVID-19 than the

students from state-run educational institutions and students belonging to class III socio-economic groups, respectively. Mann–Whitney test results showed that female students and students residing at a hostel displayed more desirable practices in preventing COVID-19 than the male counterparts and day scholar students, respectively. On the contrary, no significant associations were reported between the variables age, marital status, religion, the field of study, the programme of study and locality of the students with their practices towards COVID-19.

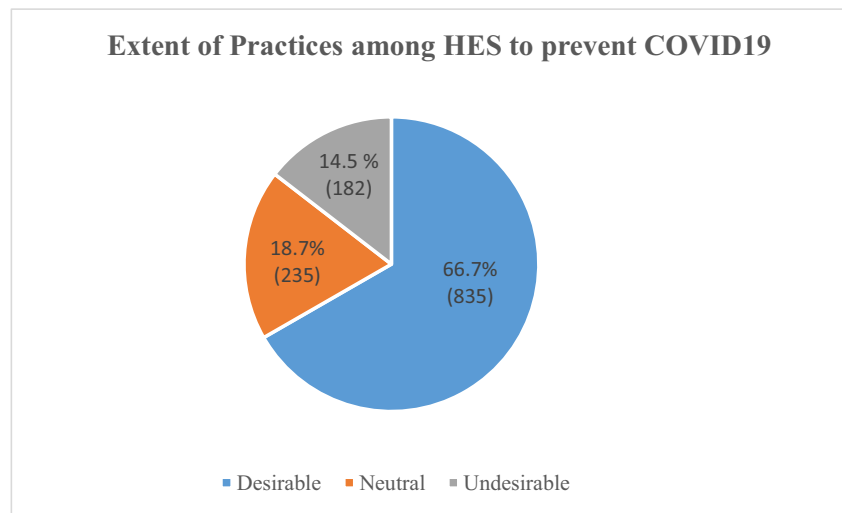
Association between the KAP scores of HES towards COVID-19

Chi-square test results from Table 6 revealed a strong positive association between students total knowledge scores and the total attitude scores towards COVID-19 ($p < 0.001$). Similarly, the association between students total knowledge scores were positive and strong with the total practice scores ($p < 0.001$).

Table 4 The extent of practices followed by higher education students to prevent COVID-19

Practices statement	Always (No/%)	Sometimes (No/%)	Never (No/%)
Restrain family members from going out unnecessarily	948 (75.7)	211 (16.9)	93 (7.4)
Playing outdoor games with friends	1082 (86.4)	110 (8.8)	60 (4.8)
Wearing mask while going out	1114 (89.0)	65 (5.2)	73 (5.8)
Staying away from people who cough or sneeze	866 (69.2)	183 (14.6)	203 (16.2)
Checking information regarding COVID-19	218 (17.4)	391 (31.2)	643 (51.4)
Following cough/sneeze etiquette	663 (53.0)	327 (26.1)	262 (20.9)
Washing hands regularly	1104 (88.2)	91 (7.3)	57 (4.6)
Bringing hands near the face	563 (45.0)	515 (41.1)	174 (13.9)
Maintaining social distancing	1112 (88.8)	74 (5.9)	66 (5.3)
Disinfecting the surface/places that are often contacted	682 (54.5)	383 (30.6)	187 (14.9)

Fig. 4 Extent of practices among HES to prevent COVID-19



Correlation between the KAP scores of HES towards COVID-19

The correlation analysis revealed significant positive linear correlations between knowledge and attitude ($r = 0.353$); knowledge and practices ($r = 0.284$) and; attitude and practices ($r = 0.383$), as shown in Table 7. From these results, it was evident that the student's knowledge, attitude and practices towards COVID-19 are interdependent. The higher the students' knowledge towards COVID-19, their attitudes would be positive and practice desirable behaviour to prevent COVID-19. Figure 5 illustrates the correlation scatter among knowledge, attitude and practices among higher education students towards COVID-19.

Discussion

The spread of COVID-19 in India was placid at the initial pace but slowly gained momentum in the month of May and June 2020. Several factors influenced the rapid spread of COVID-19 viz. seriousness of the illness, the vulnerability of people, lack of knowledge about COVID-19, negative attitude, fall of economy of the country, lack of medical facilities, sharing of information regarding the virus, measures implemented by the Govt., etc.. Among all these factors, the investigators felt that the adequate knowledge, positive attitude and safety practices among the higher education students would go a long way in preventing the spread of COVID-19 in the Indian context.

The studies on KAP towards COVID-19 conducted by Tomar et al. (2020); Maheswari et al. (2020) and Prasad Singh et al. (2020) in India; Zhong et al. (2020) in China; Azlan et al. (2020) in Malaysia; Erfani et al. (2020) in Iran; Haque et al. 2020 in Bangladesh; Rugarabamu et al. 2020 in Tanzania; Al-Hanawi et al. (2020) in Saudi Arabia and

Saqlain et al. (2020) in Pakistan were taken to support the present discussion by the investigators.

About knowledge scores of students towards COVID-19, the majority of them (65.5%) displayed a quite good comprehension regarding the same. Likewise, the majority of participants surveyed by Rugarabamu et al. (2020) in Tanzania (84.4%), Haque et al. (2020) in Bangladesh (54.9%) and Saqlain et al. (2020) in Pakistan (93.2%) reported good and sufficient knowledge. However, 34.5% of students possessed only low and moderate levels of knowledge towards COVID-19.

The overall correct answer rate of the knowledge test of students towards COVID-19 was 71.0%. Similarly, the health care professionals and medical students from the Mumbai metropolitan region, India, exhibited an overall correct rate of 71.2% regarding awareness towards COVID-19 (Modi et al. 2020). However, the obtained knowledge score was 19.0% lower than the correct answer rate (90%) of the COVID-19 knowledge test reported by Zhong et al. (2020) in China and Erfani et al. (2020) in Iran and 9.5% lower than the correct answer rate (80.5%) of the COVID-19 knowledge test reported by Azlan et al. (2020) in Malaysia and Tomar et al. (2020) in India. Even though the Govt. is regularly and frequently disseminating information regarding COVID-19 to the public, the correct answer rate of higher education students in the knowledge test was only 71.0%. This may be because the higher education students were relying more on social media sites such as WhatsApp, Facebook, etc., than the authentic sources (Govt. websites) to learn about COVID-19. This was evident because out of 1252 students surveyed, 1212 students used social media, whereas only 200 students used Govt. websites to get information regarding COVID-19. Azlan et al. (2020) documented false information and information overload as possible reasons for poor knowledge about COVID-19 among the Malaysian people. A similar tendency was seen in the Indian context, where several cases have been

Table 5 Association between the socio-demographic variables and the total KAP scores of the higher education students towards Covid-19

Independent variables	Total	Knowledge scores			Attitude score			Practices score			X ² (p value)
		Low	Moderate	High	Positive	Neutral	Negative	Desirable	Neutral	Undesirable	
Age											
<=21 years	742 (59.3)	111 (8.9)	524 (41.9)	107 (8.5)	141 (11.3)	479 (38.3)	122 (9.7)	109 (8.7)	580 (46.3)	53 (4.2)	2.377 (0.305 [ⓔ])
>21 years	510 (40.7)	86 (6.9)	347 (27.7)	77 (6.2)	95 (7.6)	351(28.0)	64 (5.1)	66 (5.3)	416 (33.2)	28 (2.2)	
Gender											
Male	401 (32.0)	60 (4.8)	279 (22.3)	62 (5.0)	63 (5.0)	284 (22.7)	54 (4.3)	68 (5.4)	313 (25.0)	20 (1.6)	5.918 (0.052 [*])
Female	851 (68.0)	137 (10.9)	592 (47.3)	122 (9.7)	173 (13.8)	546 (43.6)	132 (10.5)	107 (8.5)	683 (54.6)	61 (4.9)	
Marital status											
Married	1037 (82.8)	170 (13.6)	721 (57.6)	146 (11.7)	190 (15.2)	695 (55.5)	152 (12.1)	136 (10.9)	837 (66.9)	64 (5.1)	5.885 (0.208 [ⓔ])
Unmarried	212 (16.9)	26 (2.1)	148 (11.8)	38 (3.0)	45 (3.6)	133 (10.6)	34 (2.7)	38 (3.0)	157 (12.5)	17 (1.4)	
Divorced	3 (0.2)	1 (0.1)	2 (0.2)	0	1 (0.1)	2 (0.2)	0	1 (0.1)	2 (0.2)	0	
Programme											
Under-graduation (UG)	570 (45.5)	88 (7.0)	400 (31.9)	82 (6.5)	118 (9.4)	374 (29.9)	78 (6.2)	78 (6.2)	461 (36.8)	31 (2.5)	4.104 (0.392 [ⓔ])
Post-graduation (PG)	523 (41.8)	87 (6.9)	368 (29.4)	68 (5.4)	85 (6.8)	364 (29.1)	74 (5.9)	72 (5.8)	416 (33.2)	35 (2.8)	
Research	159 (12.7)	22 (1.8)	103 (8.2)	34 (2.7)	33 (2.6)	92 (7.3)	34 (2.7)	25 (2.0)	119 (9.5)	15 (1.2)	
Field of study											
Arts/humanities/music	242 (19.3)	46 (3.7)	173 (13.8)	23 (1.8)	59 (4.7)	153 (12.2)	30 (2.4)	43 (3.4)	191 (15.3)	8 (0.6)	11.409 (0.077 [ⓔ])
Science/engineering	507 (40.5)	78 (6.2)	358 (28.6)	71 (5.7)	76 (6.1)	349 (27.9)	82 (6.5)	59 (4.7)	409 (32.7)	39 (3.1)	
Medical/paramedical	26 (2.1)	2 (0.2)	16 (1.3)	8 (0.6)	4 (0.3)	15 (1.2)	7 (0.6)	5 (0.4)	18 (1.4)	3 (0.2)	
Social science/	477 (38.1)	71 (5.7)	324 (25.9)	82 (6.5)	97 (7.7)	313 (25.0)	67 (5.4)	68 (5.4)	378 (30.2)	31 (2.5)	
law/commerce											
/management /education											
Management of the institution											
Central	679 (54.2)	96 (7.7)	462 (36.9)	121 (9.7)	85 (6.8)	462 (36.9)	132 (10.5)	69 (5.5)	564 (45.0)	46 (3.7)	21.146 (0.000 ^{**})
State	330 (26.4)	60 (4.8)	233 (18.6)	37 (3.0)	79 (6.3)	221 (17.7)	30 (2.4)	61 (4.9)	254 (20.3)	15 (1.2)	
Self-finance	243 (19.4)	41 (3.3)	176 (14.1)	26 (2.1)	72 (5.8)	147 (11.7)	24 (1.9)	45 (3.6)	178 (14.2)	20 (1.6)	
Locality											
Rural	821 (65.6)	138 (11.0)	576 (46.0)	107 (8.5)	158 (12.6)	540 (43.1)	123 (9.8)	120 (9.6)	649 (51.8)	52 (4.2)	0.840 (0.657 [ⓔ])
Urban	431 (34.4)	59 (4.7)	295 (23.6)	77 (6.2)	78 (6.2)	290 (23.2)	63 (5.0)	55 (4.4)	347 (27.7)	29 (2.3)	
Socioeconomic status											
(modified BG Prasad scale, 2020)											
More than Rs. 7533 per month	92 (7.3)	23 (1.8)	64 (5.1)	5 (0.4)	28 (2.2)	62 (5.0)	2 (0.2)	22 (1.8)	69 (5.5)	1 (0.1)	27.524 (0.000 ^{**})
(class I)	118 (9.4)	32 (2.6)	73 (5.8)	13 (1.0)	39 (3.1)	63 (5.0)	16 (1.3)	25 (2.0)	90 (7.2)	3 (0.2)	
Rs.3766 – Rs.7532 per month	758 (60.5)	93 (7.4)	538 (43.0)	127 (10.1)	103 (8.2)	518 (41.4)	137 (10.9)	88 (7.0)	606 (48.4)	64 (5.1)	
(class II)	284 (22.7)	49 (3.9)	196 (15.7)	39 (3.1)	66 (5.3)	187 (14.9)	31 (2.5)	40 (3.2)	231 (18.5)	13 (1.0)	
Rs.2260 – Rs. 3765											
per month (class III)											
Rs.1130 – Rs. 2259 per											
month (class IV)											
Religion											
Hindu	1052 (84)	162 (12.9)	737 (58.9)	153 (12.2)	205 (16.4)	702 (56.1)	145 (11.6)	145 (11.6)	840 (67.1)	67 (5.4)	2.849 (0.828 [ⓔ])
Muslim	135 (10.8)	23 (1.8)	92 (7.3)	20 (1.6)	27 (2.2)	83 (6.6)	25 (2.0)	20 (1.6)	105 (8.4)	10 (0.8)	
Christian	51 (4.1)	10 (0.8)	33 (2.6)	8 (0.6)	4 (0.3)	33 (2.6)	14 (1.1)	9 (0.7)	38 (3.0)	4 (0.3)	
Non-religious	14 (1.1)	2 (0.2)	9 (0.7)	3 (0.2)	0	12 (1.0)	2 (0.2)	1 (0.1)	13 (1.0)	0	
Residential status											
Day scholar	632 (50.5)	107 (8.5)	440 (35.1)	85 (6.8)	142 (11.3)	417 (33.3)	73 (5.8)	105 (8.4)	489 (39.1)	38 (3.0)	7.520 (0.023 [*])
Hosteller	620 (49.5)	90 (7.2)	431 (34.4)	99 (7.9)	94 (7.5)	413 (33.0)	113 (9.0)	70 (5.6)	507 (40.5)	43 (3.4)	

*p < 0.05; **p < 0.01; ⓔp > 0.05

Table 6 Association between the knowledge score, attitude score and the practices scores of higher education students towards COVID-19

Variables	Level of knowledge				X ² (p value)
	Low	Moderate	High	Total	
Nature of attitude					
Positive	78 (6.2)	144 (11.5)	14 (1.1)	236 (18.8)	102.221 (0.000**)
Neutral	106 (8.5)	608 (48.6)	116 (9.3)	830 (66.3)	
Negative	13 (1.0)	119 (9.5)	54 (4.3)	186 (14.9)	
Extent of practices					
Desirable	53 (4.2)	109 (8.7)	13 (1.0)	175 (14.0)	52.224 (0.000**)
Neutral	142 (11.3)	706 (56.4)	148 (11.8)	996 (79.6)	
Undesirable	2 (0.2)	56 (4.5)	23 (1.8)	81 (6.5)	

**p < 0.01

reported regarding the propagation of fake information regarding COVID-19 (Purohit 2020; Dore 2020 and; Swaminathan 2020). Also, it was evident that 51.0% of students never check for the information regarding COVID-19 (Table 4) which made them score less on the knowledge aspect. Also, the difference in the knowledge scores may be because of the place and time of study apart from the varied knowledge questions included in the study.

Students pursuing research, studying medical-related courses, from rural areas and belonging to class IV SES performed slightly better than their counterparts in the knowledge test. This may be because of their scholastic maturity. These students can be motivated further to share factual information regarding COVID-19 with their friends to inculcate knowledge.

The attitude scores revealed that the students' overall positive attitude rate was 86.0% in the attitude test. This was 4.0% less than the overall attitude scores (90.0%) reported by Zhong et al. (2020) in China and Erfani et al. (2020) in Iran. Even though higher education students scored less in the knowledge test compared to other countries, their attitude was positive, indicating their optimistic behaviour in managing COVID-19. The reason for the positive attitudes among the majority of students (71.0%) may be because of their young minds challenging behaviours that lead them to perceive the current crisis optimistically. The other reasons could be the proactive measures taken by the respective State and the

Central Govt. of India from the beginning of the outbreak of COVID-19. Similar reasons for positive attitudes among the general public were reported by Zhong et al. (2020) and Azlan et al. (2020).

Also, the results obtained regarding the positive attitude of students towards COVID-19 in this study gives scope for insemination of accurate knowledge on COVID-19 and to carry out safety practices among students effectively to combat COVID-19.

The students pursuing medical-related courses, from central educational institutions, belonging to class IV SES group, belonging to the Christian religion, residing at a hostel and research scholars hold more optimistic attitudes than their counterparts. The scholastic maturity of the research scholars and student's medical courses might have resulted in their optimistic attitudes towards COVID-19. Furthermore, students residing at the hostel compared to the students at home were more socialized and might have shared information about COVID-19 resulting in their confidence towards challenging COVID-19.

The overall desirable practice rate of students was 86.0% on the practice scale which was less than 3.0% of the results (89.0%) documented by Erfani et al. (2020) and Zhong et al. (2020) in their overall practice test scores. The extent of practices carried out by higher education students was satisfactory as the majority of them (66.7%) were cautious and followed safety measures such as wearing masks, washing hands and maintaining social distancing. However, 20.9% of students have not covered their mouth appropriately while coughing and sneezing, 5.8% never wore masks while going out and 5.0% knowingly does not maintain social distancing which was a disturbing fact despite repeated propaganda from the Govt. of India and increasing positive cases of COVID-19.

The students from state-managed educational institutions, belonging to the class III SES group, staying at home and male students reported to have more undesirable practices in dealing with COVID-19 than their counterparts. The investigators

Table 7 Correlation between KAP scores

	Knowledge	Attitude	Practices
Knowledge	1	0.353**	0.284**
Attitude		1	0.383**
Practices			1

r < 0.01 (2-tailed)

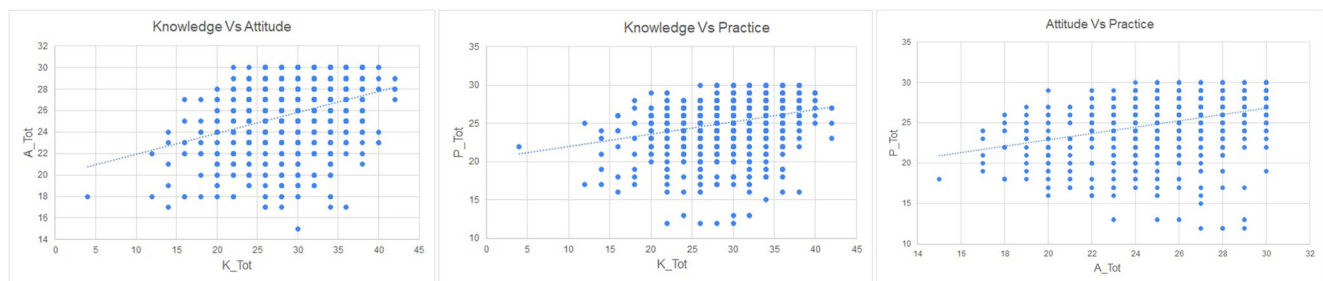


Fig. 5 Correlation scatter – KAP among HES towards COVID-19

presume that the male students compared to the female and the students staying at home compared to those in hostels were more willing to go out frequently to meet the various needs. They were intended to exercise desirable practices, but unfortunately, these groups indulge in undesirable practices that potentially increase the risk of COVID-19.

Also, the obtained study results showed an association and positive relationship between the KAP scores of students. The study results of Al-Hanawi et al. (2020) and Zhong et al. (2020) were akin to the present findings. Likewise, Erfani et al.'s (2020) findings corroborate with the present results where a significant positive relationship between knowledge, attitude and practices of the people were reported.

Conclusion

A need has arisen to enhance the KAP among students to successfully mitigate COVID-19. Accurate information regarding COVID-19 is essential to reduce the rapid spread, even a moderate level of knowledge would not be sufficient as sometimes it will be precarious. Most of the higher educational institutions (HEI) in India have uploaded protocols about COVID-19 on their websites. The concerned HEI should make sure that the information scrolled in their website are authentic and instruct their students to regularly check for the same. Also, standards of best practices to alleviate COVID-19 can be formulated by the HEI and oriented among the students to follow them. After reopening, the higher educational institutions can positively reinforce the students following the protocols to prevent COVID-19 by observation. This would also motivate other students. In addition, students' involvement in health education intervention programmes would go a long way to inculcate confidence in them. The findings related to the association of KAP with the demographic characteristics of higher education students suggest the administrators, health workers and the academicians of higher educational institutions prioritize the student population while giving health intervention programmes to combat COVID-19.

Also, the obtained results showed that there was a strong positive relationship between the three variables studied that again make sense of integrating these three components while organizing any professional learning activity regarding COVID-19. This ensures students to gain professional knowledge and skills to challenge COVID-19 and be organized for any other infectious disease in the future.

Limitations

The convenient sampling techniques used might have limited the students who do not have access to the network and thus generalizing the study results to the whole of the Indian higher education students were limited. Furthermore, the responses of the students may be biased as the measurement tool was a self-administered one. Also, the student's accessibility to the network while answering the knowledge questions might have influenced their knowledge scores.

Availability of data and materials The datasets used and/or analysed during the current study are available from the corresponding author on request.

Authors' contributions SP designed the study, supervised the data collection process and carried out the statistical analysis, PR prepared the manuscript, supervised data collection, interpreted the results, drafted and critically reviewed the manuscript. PD designed the data collection forms, contributed to study design, coordinated & supervised data collection, reviewed the manuscript and prepared the manuscript for submission. PV contributed in critically reviewing, data editing and drafting the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate All procedures performed in this study involving human participants were in accordance with the ethical standards of the Internal Human Ethics Sub-Committee of the Central University of Tamil Nadu, Thiruvavur, India, with the reference no CUTN/IHESC/2020-001R1 and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication Written informed consents from study participants were obtained for publication.

Competing interests The authors declare that they have no competing interests.

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