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Research Article

Evaluation of Knowledge, Attitude, and Practice towards the Coronavirus Disease 19 Pandemic: A Cross-Sectional Study in Delhi-NCR Regions of India

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Background

The severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2)-induced pandemic: a viral outbreak reported initially in Wuhan, capital of China's Hubei province, in late December 2019, has led to millions of deaths and considerable debilitation. Therefore, evaluation of awareness among people with the respect to the various aspects of the disease to make an informed decision for creating awareness among the masses may play an important role as an effective non-pharmaceutical intervention in disease containment. The present study aimed at evaluating the knowledge, attitude and practices about the various aspects of SARS-CoV-2 to aid and strengthen the decision-making capability of individuals. A cross-sectional scientific survey, entailing 521 participants from diverse economic backgrounds, gender, differential level of qualifications, diverse professions, and urban/rural locations with a mean age of 22.17 years (SD: 10.29) [Interquartile range (IQR):19-21 years], was conducted. The majority of the participants belong to Delhi/National Capital Region (NCR) region. The chi-square (χ^2) test of independence was used to compare categorical variables to see the potential associations. In addition, a student's t-test was employed to compare the mean values of variables. In general, the chi-square (χ^2) test of independence analysis showed significantly higher scores with respect to COVID-19 knowledge, practice, and attitude ($p < 0.05$) among urban participants, especially in females and higher income group participants. It highlights the need for removing significant disparity concerning basic COVID-19 knowledge by communicating evidence-based information through regular educational programs and campaigns to help the community and common people in fighting against the pandemic.

Abstract

The SARS-CoV-2-induced pandemic initially began as a local viral outbreak in Wuhan in late December 2019. Thereafter, it rapidly spread to the remaining parts of the globe, causing substantial psychosomatic disorders and socioeconomic disruption. Consequently, millions of lives have been lost due to the ongoing pandemic. Furthermore, common people have also been at the receiving end, and continue to struggle daily on multiple fronts of sustenance, existence, and survival. To date, there has not been the successful development of effective therapeutic drugs (except for a few prophylactic vaccines) to contain this pandemic. Therefore, focus on non-pharmacological interventions, including spread of public health awareness, and inculcating good practices and attitudes among the general population, have become crucial at this juncture, facilitating the transition from pandemic to post-pandemic life. Here, we conducted a questionnaire-based survey to evaluate COVID-19-related knowledge, attitude, and practice (KAP) of the general population residing in and around Delhi, the National capital of India, involving a random sample of 521 participants. Our comprehensive data analyses unravel a statistically significant ($p<0.05$) disparity in knowledge, attitude, and practices about COVID-19 in the general population based on contrasting variables, such as gender, educational qualification, location, and economic background. This highlights the crucial need for removing significant disparity concerning basic COVID-19 knowledge by communicating evidence-based information through regular educational programs and awareness campaigns to help the community and common people in fighting against the ongoing pandemic.

Keywords: Knowledge, Attitude, Practice, Community awareness, coronavirus disease-19, Lockdown, Pandemic

Introduction

Severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 19 (COVID-19), belongs to the genus *Betacoronavirus*, order *Nidovirales*, and the family *Coronaviridae* [1]. This virus is capable of infecting both human and several animal

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species, leading to widespread infection, morbidity, and fatality [2]. The initial SARS-CoV-2 outbreak was reported in China's Wuhan, in December 2019 [3], and has rapidly spread worldwide thenceforth, resulting in the current pandemic. The established crucial routes of infection are nasal and oral passages, nevertheless, other routes of infection may not be underestimated and ruled out completely. Having realized the emerging situation based on the recommendation of the Emergency Committee (EC), the World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 [4]. The crucial aim of such a declaration was to promptly alert countries with infirm public health infrastructure so that they can prepare themselves in anticipation of rapidly emerging and evolving infectious disease. Furthermore, considering various variables of situations arising out of disease outbreaks, WHO further proposed the COVID-19 Strategic Preparedness and Response Plan aimed at accelerating the research and development (R&D) process related to the disease [4]. As of 6:03 am CEST, 24 May 2023, there have been a worldwide report of around 766 million confirmed infections and 6.93 million deaths, respectively (https://covid19.who.int/). Besides, the ongoing COVID-19 pandemic has devastated socioeconomic growth [5, 6], overwhelmed health infrastructure, crippled the working of a myriad of academic and non-academic institutions [7], and caused considerable psychosomatic suffering [8] to millions of people worldwide.

Having carefully studied global COVID-19 dynamics, the Government of India (GOI), also started implementing several non-pharmacological interventions, mitigation, and stringent containment measures. The empirical study-based knowledge was communicated to common people through multiple communication channels, such as mainstream television, digital media outlets, social networking websites, and government press releases, to contain the disease and consequent mortality [9]. Moreover, strategically adopted containment measures by the Government of India also entailed restriction on *de facto* mobility and gathering, closure of public transport/schools/workplaces, stay-at-home order, regulation over domestic and international travels, quarantine, and isolation, among others. Simultaneously, several suggestions of health experts, such as routine health check-ups, testing and tracing, massive disinfection of public and private spaces, and incessant spread of COVID-19-related educational programs, were also adopted quickly to check the virus spread. Universities and colleges switched to online modes of teaching, learning, examination, and evaluation. Cumulatively, such measures have resulted in varied degree of disease containment, being more successful in certain regions compared to others. As far as India is concerned, the effect of such measures has been quite positive, varying across Indian states and its associated geographical divisions. Although, the precise quantitative aspect of the same is not yet known, nevertheless, the number of reported infections and deaths would have been quite large had such stringent containment measures based on the evolving scientific knowledge and empirical facts about the disease not been adopted in time [10, 11]. Here, we aim at understanding the effect and/or association of multiple variables, such as diverse economic backgrounds, gender, differential level of educational qualifications, diverse professions, and urban/rural locations, on the basic knowledge, attitude, and practice (KAP) towards ongoing pandemic.

A KAP study aims to collect quantitative as well as qualitative information by the methodology of assessment of predefined questionnaires to measure parameters of a situation. The response of the participants helps to unveil their thoughts and way to respond to the situation. The understanding from such a survey helps in bringing about a change in their practices in the future combatting of any such situation.

Infectious diseases are a cause of major concern in a country as densely populated as India. They are contagious and spread through direct or indirect contact. The only way to stop or slow down the spread of such diseases is to maintain hygiene, cleanliness and practice good habits. The KAP study can be used to survey and explore people's hygiene and healthy habits. This will help us reflect on the lacunae between the public health policies and attitude of the people. Policies should be designed in a way to change the attitude of people so that they adapt good practices keeping in mind their socio–economic background.

The concept of KAP surveys originated decades back and focused on population research studies. The survey targets a population under study and extracts the knowledge, beliefs and steps taken relevant to the topic. Data collected by means of the questionnaires prepared, aims to learn all about the niche population under study. These surveys have become extremely popular in the healthcare sector, as their correct interpretation is valuable for resource allotment and judicious planning of public health programs. Any such survey is required to precede an intervention program and the data obtained can be used for predicting the success of such programs. Our study focused on seeking a clear picture about the baseline awareness of the COVID-19 pandemic amongst the youth pursuing their graduation belonging to certain demographic regions. Their practices followed and attitudes toward the ongoing pandemic were significant to plan any intervention strategy which can be a roadmap to design effective government policies that would help in containment of future such infectious diseases and prevent them reaching a status of a pandemic that can bring the entire globe to a halt.

Our study unravels significant associations that may help in adopting a targeted approach towards spreading knowledge, adopting a redemptive attitude, and developing better practices. Such studies may go a long way in understanding and developing effective non-

pharmacological interventions, which may be swiftly applied in case of recurring COVID-19, as well as other globally emerging infectious diseases, including the monkey pox outbreak.

Methodology

Study Subjects

This cross-sectional scientific survey entails 521 participants with a mean age of 22.17 years (SD: 10.29) [Interquartile range (IQR):19-21 years], belonging to diverse economic backgrounds, gender, differential level of qualifications, diverse professions, and urban/rural locations. The majority of the participants belong to Delhi/National Capital Region (NCR) region, whereas the remaining participants are from the other Indian States, such as Uttar Pradesh and Haryana. Data were collected online by employing Google form-based questionnaire as a survey tool. This cross-sectional survey was conducted amongst inhabitants residing in and around Delhi-NCR regions from February-March, 2021, the week immediately before the onset of the second wave of COVID-19 in India. The first step was to obtain the informed consent of each participant, and the cogent message was conveyed to each one of them that the data obtained would be part of a research study purely to be used for the scientific purpose with the maintenance of strict confidentiality. A total of 521 participants voluntarily filled the circulated Google forms online.

Questionnaire-based Survey tool and scoring method

Our work involved a questionnaire-based survey, entailing various demographic variables, such as gender, age, profession, qualification, income status, and location. The reason behind selecting such demographic variables was their distinct features and potential for categorization. Of five variable categories, each was evaluated with respect to Knowledge, Attitude, and Practice (KAP). The five variables relating to knowledge (K) of COVID-19 included causative agent type, mode of transmission, alcohol content (percentage) in sanitizer, gold standard diagnostic test, and the most affected organ in human body. Similarly, five variables relating to attitude (A) towards COVID-19 included time spent on electronic gadgets, effect on eating habits, yoga and disease susceptibility, vaccination, and Nationwide lockdown. The five variables relating to practices (P) about COVID-19 involved immediate response to symptoms, hand sanitization method, mask-wearing style, physical distancing, and willingness to spread awareness in the community. The five questions under the knowledge section were framed based on the scientific information available on World Health Organisation (WHO) portal as "Q&As on COVID-19 and related health topics" (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19). The questions framed under the remaining two distinct sections—Attitude and Practice—were based on the emerging scenarios most likely to be faced by the target population. The evaluative scoring method deployed is as follows: Knowledge section: 1 and 0 marks, respectively, for the correct and incorrect answer; Attitude section: 1, 0, and -1 marks, respectively, for positive, neutral, and negative options; Practice section: 1, 0 and -1 marks, respectively, for being proactive, neutral, and passive options. Therefore, the total score of each participant ranges from 0-5, -5 to 5, and -5 to 5 for the Knowledge, Attitude, and Practice sections, respectively.\

Statistical analysis

Descriptive statistics was used to understand the demographic characteristics of participants. Data analyses were carried out using appropriate inferential statistical tests. For example, Chi-square (χ^2) test of independence was used to compare categorical variables to see potential association. To this end, observed frequencies with regard to each variable was compared to that of their corresponding expected frequencies calculated using the contingency table, consisting of row and column. In addition, a student's t-test for independence was employed to compare the mean values of variables. Only, $p<0.05$ was taken as statistically significant.

Results

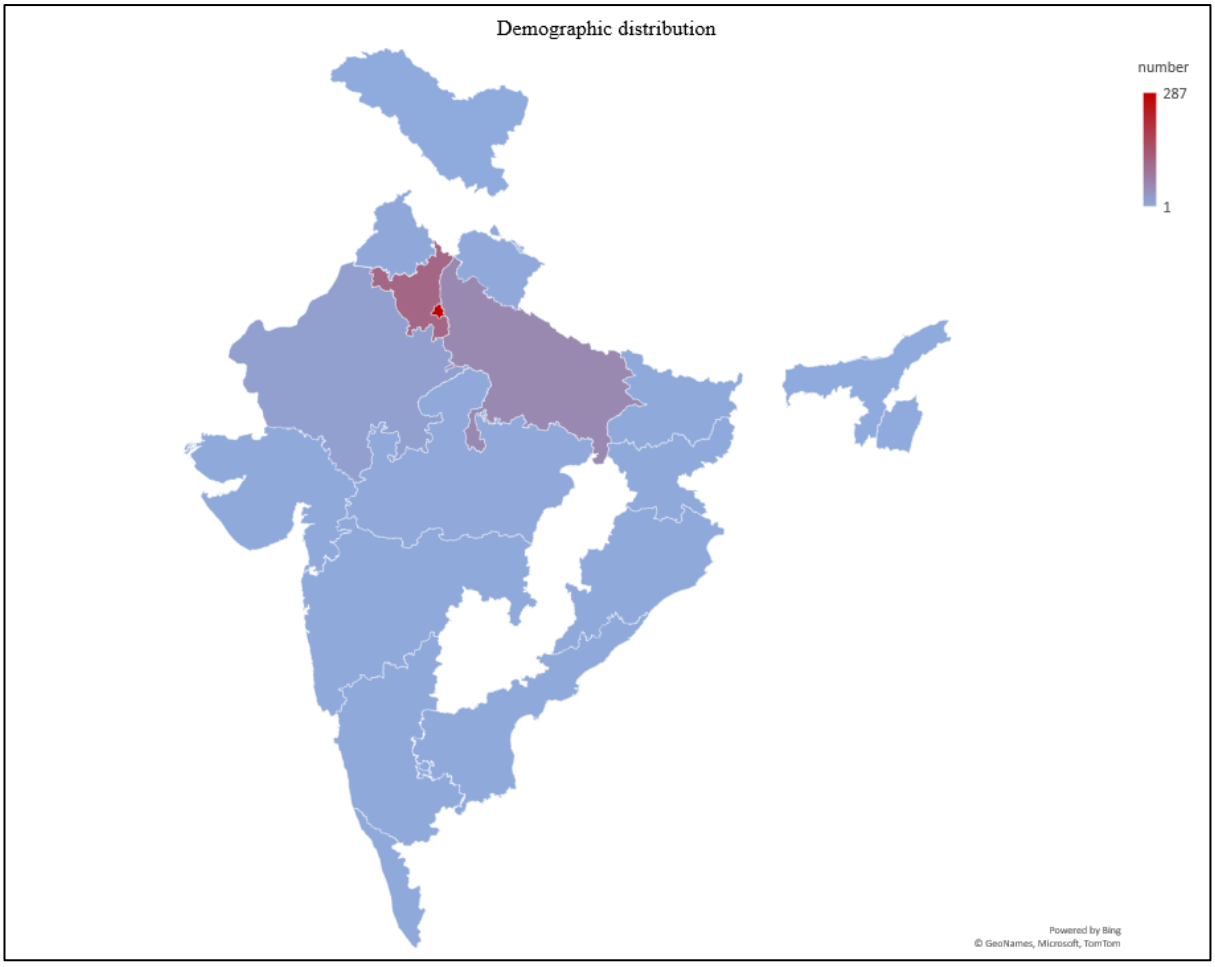

Figure 1: Demographic distribution of 521 participants. The majority of participants (~55%) were from Delhi/NCR (red-colored region), whereas the remaining participants (45%) belong to 20 other Indian states.

Demographic characteristics of participants

Our survey is based on the involvement of 521 participants (n=521) with a mean age of 22.17 years (SD: 10.29) [Interquartile range (IQR):19-21 years], who voluntarily approved for their participation after having been categorically informed about the scientific aim of the study. The majority of participants (~55%) were from Delhi/NCR, whereas the remaining participants (45%) belong to 20 other states of India (Figure 1). Among the total participants, 41.07% (214/521) and 58.92% (307/521) were male and female, respectively. There were 70.05% (365/521) participants with secondary education and 29.94% (156/521) with higher education. Furthermore, 68.52% (357/521) and 31.47% (164/521) were from urban and rural areas, respectively. In our survey, 66.21% (345/521) and 33.78% (176/521) belong to lower (≤ INR 6 lakhs annually) and higher (> INR 6 lakhs annually) income groups, respectively.

COVID-19 Knowledge

Owing to the inclusion of the common target population, five general questions, each with multiple options about COVID-19 knowledge, were framed and responses were collected. Thereafter, the graded scoring pattern was followed (Table 1a). Following analysis of 2605 (521 × 5) responses regarding COVID-19 knowledge, 84.14% (2192 out of 2605) were found to be correct, whereas, 15.85% (413 out of 2605) were incorrect. To understand whether two variables were related in the population, the chi-square (χ^2) test of independence was employed. Result analysis showed female participants with significantly higher scores for K2 than males ($p<0.05$). In addition, urban participants showed significantly higher scores for K1, K2, K3, and K4 than their rural counterparts ($p < 0.05$). Significantly higher scores ($p<0.05$) for K3, K4, and K5 were achieved by participants belonging to higher income groups (Table 1b). This indicates differential access and receptivity to available information and knowledge regarding COVID-19.

Table 1a: Assessment of COVID-19 knowledge amongst participants

Questions/ Variable categories	Options: (Correct:1) (Incorrect: 0)
K1. What is the causative agent of COVID-19?	(a)Bacteria (0) (b)Virus (1) (c)Fungus (0) (d) Do not know (0)
K2. What is the major mode of transmission of SARS-CoV-2?	(a) Virus-laden respiratory droplets (1) (b) Food (0) (c) Water (0) (d) Do not know (0)
K3. What should be the ideal percentage of alcohol content in hand sanitizer?	(a) 100% (0) (b) 60-90% (1) (c) < 50% (0) (d) Do not know (0)
K4. What is the gold standard diagnostic test of SARS-CoV-2?	(a) Complete blood count (0) (b) Urine test (0) (c) RT-qPCR (1) (d) Rapid antigen test (0)
K5. The most affected organ by SARS-CoV-2 in the human body	(a) Lungs (1) (b) Liver (0) (c) Pancreas (0) (d) Do not know(0)

Table 1b. Comparison of COVID-19 knowledge (K) between different groups of gender, education, location, and income

	MALE (n, %)	FEMALE (n, %)	$\chi2$	p	UPTO SECONDARY EDUCATION (n, %)	HIGHER EDUCATION (n, %)	$\chi2$	p	URBAN (n, %)	RURAL (n, %)	$\chi2$	p	BELOW 6 LAKHS (n, %)	ABOVE 6 LAKHS (n, %)	$\chi2$	p
K1-CORRECT	201 (93.92)	296 (96.41)	1.781	0.1819	347 (95.06)	150 (96.15)	0.292	0.588	347 (97.19)	150 (91.46)	8.309	0.003	326 (94.49)	164 (97.04)	1.655	0.198
K2-CORRECT	185 (86.44)	283 (92.18)	4.536	0.0331	328 (89.86)	140 (89.74)	0.0017	0.967	329 (92.15)	139 (84.75)	6.735	0.0094	307 (88.98)	156 (92.30)	1.4	0.236
K3-CORRECT	162 (75.70)	226 (73.61)	0.2497	0.6172	272 (74.52)	116 (74.35)	0.0015	0.969	278 (77.87)	110 (67.07)	6.892	0.0086	243 (70.43)	139 (82.24)	8.294	0.0039
K4-CORRECT	138 (64.48)	191 (62.21)	0.2794	0.597	221 (60.54)	108 (86.66)	3.54	0.0598	238 (66.66)	91 (55.48)	6.034	0.014	201 (58.26)	123 (72.78)	10.263	0.0013
K5-CORRECT	193 (90.18)	277 (90.22)	0.00024	0.9876	331 (90.68)	139 (89.10)	0.309	0.0577	326 (91.31)	144 (87.80)	1.569	0.21	306 (88.69)	159 (94.08)	3.817	0.05

Attitude towards COVID-19

To evaluate the attitude of common people towards COVID-19, we framed five questions, each with multiple choices/options and graded scores as shown in table 2a. The χ^2 test of independence aiming to see if two variables were related in the population, showed significantly higher positive attitude as reflected in scores for A1 ($p < 0.05$), A2 ($p < 0.05$), and A5 ($p < 0.05$) (Table 2b) towards COVID-19 in females *vis-à-vis* male participants, indicative of sex-specific differences in attitudes as commonly observed in populations. Participants with higher education scored significantly higher for A5 ($p < 0.05$) compared with those up to the secondary level of education (Table 2b). Furthermore, as expected owing to strict implementation of lockdown and higher awareness about the beneficial aspect of vaccination in general, urban participants scored significantly higher for A1 ($p < 0.05$) and A4 ($p < 0.05$) compared with their rural counterparts (Table 2b). Lower income group (below 6 lakhs) participants scored significantly higher for A1 ($p < 0.05$), whereas higher income group (above 6 lakhs) scored substantially higher for A4 ($p < 0.05$) due to susceptible employment and higher awareness, respectively (Table 2b).

Table 2a: Assessment of attitude towards COVID-19 amongst participants

Questions/ Variable categories	Options: (Positive:1) (Neutral: 0) (Negative:-1)
A1. Has your duration for screen (electronic gadget) exposure increased due to the pandemic?	(a) Yes (1) (b) No (-1) (c) Not sure (0)
A2. Has the pandemic affected your eating habits?	(a) Yes, I have started eating healthy & home-cooked food (1) (b) No, I depend on takeaway (-1) (c) Not sure (0)
A3. Do you think being physically active/practicing yoga can decrease susceptibility towards COVID-19?	(a) Yes (1) (b) No (-1) (c) Not sure (0)
A4. Will you get yourself vaccinated?	(a) Yes (1) (b) No (-1) (c) Not sure (0)
A5. Do you think that the nationwide lockdown was effective in containing the spread of disease (COVID-19)?	(a) Yes (1) (b) No (-1) (c) Not sure (0)

Table 2b. Comparison of attitude (A) towards COVID-19 between different groups of gender, education, location, and income

	MALE (n, %)	FEMALE (n, %)	χ2	p	UPTO SECONDARY EDUCATION (n, %)	HIGHER EDUCATION (n, %)	χ2	p	URBAN (n, %)	RURAL (n, %)	χ2	p	BELOW 6 LAKHS (n, %)	ABOVE 6 LAKHS (n, %)	χ2	p
A1-CORRECT	161 (75.23)	256 (83.38)	5.247	0.0219	291 (79.72)	120 (76.92)	0.515	0.472	308 (86.27)	109 (66.48)	27.605	1.50E-07	267 (77.39)	59 (34.91)	88.239	5.80E-21
A2-CORRECT	147 (68.69)	203 (66.12)	43.7	3.80E-11	244 (66.68)	106 (67.94)	0.059	0.806	241 (67.50)	109 (66.46)	0.0555	0.8137	231 (66.95)	101 (59.76)	2.566	0.1091
A3-CORRECT	28 (13.08)	33 (10.74)	0.665	0.414	45 (12.32)	16 (10.25)	0.454	0.5004	40 (11.20)	21 (12.80)	0.278	0.597	34 (9.85)	22 (13.01)	1.168	0.279
A4-CORRECT	122 (57.00)	178 (57.98)	0.048	0.8253	211 (57.80)	78 (50)	2.697	0.1005	218 (61.06)	82 (50)	5.632	0.0176	192 (55.65)	115 (68.04)	7.245	0.0071
A5-CORRECT	152 (71.02)	250 (81.43)	7.746	0.0053	227 (62.19)	125 (80.12)	16.043	6.20E-05	274 (76.75)	128 (78.04)	0.1074	0.743	269 (77.97)	129 (76.33)	0.1745	0.676

Practices with respect to COVID-19

Assessment of COVID-19-related practices was carried out by framing appropriate questions, each with three choices and graded scores as shown in table 3a. The χ^2 test of independence, aiming to see if two variables were related in the population, helped us make the following predictions/conclusions based on our participants' responses. Among the participants, females scored significantly higher for practice questions P3, P4, and P5 ($p < 0.05$). Whereas urban participants scored significantly higher on all practice questions ($p < 0.05$) except P4 ($p > 0.05$). Furthermore, higher income group participants scored significantly higher for P1 and P2 ($p < 0.05$) as shown in table 3b. The differences in the results may be attributed to differential social backgrounds and their awareness towards the situation.

Table 3a: Assessment of COVID-19-related practices (P) amongst participants

Questions/ Variable categories	Options: (Proactive:1) (Neutral: 0) (Passive: -1)
P1. What would you do if you experienced fever, sore throat, and dry cough?	a) I will quarantine myself at home and monitor the physiological parameters (1) b) I will prefer immediate hospitalization (0) c) Will follow a routine lifestyle and follow home remedies (-1)
P2. What is your frequency of hand sanitization?	a) Every hour or two (-1) b) Every time I am exposed to any possible risk (1) c) Once or twice a day (0)
P3. What is the correct way of wearing a mask?	a) Nose and mouth fully covered (1) b) Only mouth covered (0) c) Not sure (-1)
P4. Do you maintain physical distancing when you step out of the house?	a) Yes, at least six feet away from an individual (1) b) No, Not required (-1) c) Not sure (0)
P5. Would you like to volunteer to spread awareness about COVID-19 in the community?	a) Yes, I am already a part of volunteer group (1) b) Yes, I would like to do it in the future (0) c) No, I do not want unnecessary exposure to the disease (-1)

Table 3b: Comparison of COVID-19-related practice (P) between different groups of gender, education, location, and income

	MALE (n, %)	FEMALE (n, %)	χ2	p	UPTO SECONDARY EDUCATION (n, %)	HIGHER EDUCATION (n, %)	χ2	p	URBAN (n, %)	RURAL (n, %)	χ2	p	BELOW 6 LAKHS (n, %)	ABOVE 6 LAKHS (n, %)	χ2	p
P1-CORRECT	160 (74.76)	242 (78.82)	1.18	0.277	276 (75.61)	125 (80.12)	1.25	0.262	285 (79.83)	116 (70.73)	5.24	0.0219	255 (73.91)	141 (83.43)	5.811	0.0159
P2-CORRECT	126 (58.87)	202 (65.79)	2.58	0.1	224 (61.36)	105 (67.30)	1.65	0.198	243 (68.06)	84 (51.21)	13.64	0.0002	200 (57.97)	121 (71.59)	8.982	0.0027
P3-CORRECT	203 (94.85)	306 (99.67)	12.98	0.0003	354 (94.52)	155 (99.35)	2.73	0.098	354 (99.15)	156 (95.12)	8.864	0.0029	335 (97.10)	167 (98.81)	1.447	0.226
P4-CORRECT	190 (88.78)	288 (93.81)	4.206	0.0402	334 (91.50)	145 (92.94)	0.306	0.579	332 (92.99)	146 (89.02)	2.342	0.125	314 (91.01)	157 (92.89)	0.525	0.468
P5-CORRECT	65 (30.37)	58 (18.89)	9.216	0.002	85 (23.28)	38 (24.35)	0.069	0.791	68 (19.04)	55 (33.53)	13.08	0.00029	80 (23.18)	41 (24.26)	0.0724	0.787

Comparison of KAP scores between different groups

Considering the whole study population, we came across the overall scores of 4.12 ± 1.06 (out of 5) for knowledge, 2.92 ± 1.03 (out of 5) for attitude, and 3.53 ± 0.86 (out of 5) for practice. Subgroup analysis showed a significantly higher positive attitude in participants belonging to urban and higher income groups vis-à-vis their rural and lower income group counterparts ($p<0.05$) (Table 4). Similarly, participants with higher education, urban habitation and higher income scored a significantly high compared to their secondary level-educated, with rural and lower income groups, respectively ($p<0.05$) (Table 4). Scores did not show significant difference with respect to knowledge between groups pertaining to gender, location, education, and income ($p>0.05$) (Table 4). Total KAP score (10.60 ± 2.11 out of 15) was found significant amongst urban and higher income groups ($p < 0.05$) (Table 4).

Table 4: Independent (two sample) T-test: Comparison of the KAP scores between different groups: male vs. female, secondary vs. higher education, urban vs. rural, lower vs. higher income

Variables	(n)	Knowledge			Attitude			Practice			Total KAP		
		$\bar{x} \pm s$	t	p	$\bar{x} \pm s$	t	p	$\bar{x} \pm s$	t	p	$\bar{x} \pm s$	t	p
Male	214	4.10 ± 1.07	-0.406053117	0.342435467	2.85 ± 1.06	-1.563505287	0.059321517	3.471 ± 1.010	-1.196460879	0.116132341	10.4299 ± 2.379	-1.4346197	0.0760884
Female	307	4.14 ± 1.08			2.99 ± 1.02			3.570 ± 0.7738			10.7133 ± 1.9643		
Sec. Edu	365	4.10 ± 1.07	-0.7614886	0.223492039	2.92 ± 1.08	-0.28064686	0.389575982	3.4876 ± 0.9065	-1.755901563	0.040019276	10.5232 ± 2.251	-1.2881174	0.0992805
Higher Edu.	156	4.18 ± 1.08			2.95 ± 0.93			3.6282 ± 0.8049			10.7692 ± 1.8762		
Urban	357	4.24 ± 1.01	-14.21060022	6.16111E-37	3.01 ± 0.97	2.534327476	0.005914878	3.5810 ± 0.8746	1.972977966	0.024690252	10.8407 ± 2.034	3.72401829	0.0001183
Rural	164	3.88 ± 1.18			2.75 ± 1.16			3.4171 ± 0.8806			10.0613 ± 2.292		
Lower (>6 lakhs)	345	4.0 ± 1.12	-4.063266589	2.90527E-05	2.87 ± 1.07	-2.043556576	0.020854516	3.4318 ± 0.9032	-3.613351109	0.000171964	10.3188 ± 2.189	-4.476097	5.064E-06
Higher (< 6 lakhs)	176	4.38 ± 0.90			3.07 ± 0.96			3.7159 ± 0.8031			11.1715 ± 1.945		

Discussion

The severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) has been the underlying cause of dreaded infection, resulting in the COVID-19 (Coronavirus disease 19) pandemic. COVID-19 has, since its outbreak in December 2019, caused around 766 million confirmed infections and 6.93 million deaths, respectively, as of 24 May 2023 [12]. Around 13 billion vaccine doses have been administered worldwide as of 22 May 2023 (https://covid19.who.int/). Despite coherent and consistent study efforts globally, investigators have not been able to develop an effective therapeutic regimen [13]. As a consequence, the regional and global academia, health care, as well as socioeconomic status have been substantially devastated and crippled, impacting almost all walks of human life. One of the COVID-19 containment strategies is physical/social distancing; however, it has increased mental stress, social isolation, loneliness, unhealthy lifestyle behaviours, and social relationship, thereby collectively bringing paradigm change in psychosomatic conditions [14, 15]. Moreover, self-isolation, physical distancing, and forcefully imposed travel restrictions have unequivocally caused a considerable reduction in the workforce, leading to the loss of jobs across the various sectors of economic growth and development [16].

In addition to medical and pharmacological interventions, there have been advertisements and adaptation of multiple containment measures, including public health education and awareness, to effectively mitigate and contain the SARS-CoV-2-induced infections. For instance, the imposition of intermittent lockdown, selective night curfew, switching to an online mode of teaching and learning, and restriction on public gathering/conglomeration are amongst the effective containment measures. Spreading awareness amongst the public through digital and print media has played a very crucial role in disease containment. Such multifaceted public health education and/or communication has long been credited for the prevention of public health emergencies through the acquisition of knowledge, followed by the adoption and development of appropriate practices and attitudes [17, 18].

The cross-sectional questionnaire-based survey, involving 521 participants, found that majority had COVID-19-related general knowledge, in addition to being equipped with the positive attitude and good practices required to contain the infection. This highlights the effectiveness of spreading health education, primarily through digital and print media. Nevertheless, the effectiveness of public health education on knowledge, attitude, and practice is significantly associated with educational level, location of residence, annual income, and gender, as reviewed previously [19]. In consonance with such a study, we also found the differential effect of the abovementioned variables on the knowledge, attitude, and practice about COVID-19. In general, most of the participants (>60%) showed good scores concerning chosen variables of knowledge; however, female participants scored statistically significant score ($p<0.05$) with respect to the knowledge variable wherein, participants were asked, "What is the major mode of transmission of SARS-CoV-2?" Similarly, urban participants scored statistically significant ($p<0.05$) on account of variables, such as knowledge, causative agents, mode of transmission, hand sanitizer, and diagnostic test, indicating better access to information and receptivity amongst urban habitants. Participants belonging to the higher income group scored statistically significant ($p<0.05$) on account of knowledge variables involving hand sanitizer, diagnostic test, and most susceptible organ in the body (Table 1b). These findings explain that participants are better in terms of possession of basic knowledge related to COVID-19 owing to better access to information based on their location and economic status.

Female participants showed a better attitude ($p<0.05$) concerning screen exposure, eating habits, and the effect of lockdown on disease spread than their male counterparts. Participants belonging to the urban and high-income group displayed statistically significant scores for respect to screen exposure and willingness for vaccination whereas, the higher income group showed a significant score for willingness for vaccination. Moreover, female participants scored better on practices such as wearing masks, physical distancing, and willingness to spread awareness about COVID-19 compared to the male participants, which may partially indicate the differential

death rate between males and females. Both urban and high-income group participants scored significantly on account of decisions upon the appearance of symptoms and frequency of hand sanitization. In addition, urban participants also scored significantly on wearing masks and willingness to spread awareness about COVID-19. Globally, there have been several studies concerning non-pharmacological interventions, including spreading awareness and educating people, thereby bring positive change in their knowledge, attitude, and practices to contain COVID-19. Collectively, these studies have shown substantial positive impact of KAP towards COVID-19, which may be applied in case of recurrent COVID-19 surge for better management of disease [20-21].

Here, we would like to point out that our questionnaire-based investigation has certain limitations. One of such limitations is that our sample is geographically clustered, thereby unequivocal and categorical conclusion may not be drawn and extrapolated to represent the whole population. Second, the considerable impact of inequality in terms of access to information and educational program on the outcome may not be avoided. Third, the convenient sampling method may have unwittingly allowed subjective selection bias and partisanship.

Conclusions

COVID-19 is likely to be the most dreaded pandemic of the 21st century on account of morbidity and mortality, a huge disruption to infrastructure and socio-economic growth, as well as irretrievable loss to education and research. To date, the investigation into effective therapeutic drug development for COVID-19 has not come to the desired conclusion except for prophylactic vaccines, which have also been found to be less effective in the context of emerging variants of concerns [22–24]. With the current variants of SARS-CoV2, we need to educate common people to follow COVID appropriate behavior despite being vaccinated. People need to behave responsibly in wake of the intermittent disease waves, such as wearing a mask, avoiding crowded places and unnecessary travel, willing to go for diagnosis immediately after the appearance of symptoms. Our findings unravel statistically significant ($p<0.05$) disparity in knowledge, attitude, and practices about COVID-19 amongst participants based on gender, educational qualification, location, and economic status, thereby necessitating greater communication of evidence-based information to help the community and common people in containing the disease.

Our survey has carried out a thorough study of a specific population of undergraduate students to assess their knowledge about the pandemic, their beliefs regarding it and how they approach the current situation as well. When evaluating in detail the spread of any infectious disease that is largely communicable, such studies are very efficient to identify knowledge gaps that maybe hampering the efforts to combat the cure.

Strengthening awareness among the masses through evidence-based communication regarding infectious diseases may go a long way in disease control. Moreover a health model can be developed based on the work and research done in managing COVID-19 to equip the authorities to manage such future epidemics and pandemics. To prevent infectious diseases the understanding and knowledge of causative agents and risk factors is indispensable. Such a KAP study can determine these parameters of a population and can help in designing methods to raise awareness and plan long-term interventions that require changes in lifestyle and behaviours. Studies have also shown that a complete lockdown of the nation to control the spread of disease might have helped in the immediate spread of disease but had several long term effects including financial problems and mental health issues. This pandemic has taught us that designing a graded approach to control an infectious disease is a much better approach than complete lockdown in a country like India where majority of population is dependent on their day to day earning.

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Data Availability

All relevant data are within the manuscript, whereas supporting data of this study are available from the corresponding authors upon reasonable request

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