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COVID-19 vaccine's knowledge, attitude, and perception of healthcare students in India after the second wave of a pandemic: An online questionnaire-based survey

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Abstract---Background: The COVID-19 vaccine has been increasingly discussed in India since its first approval in January 2021, prioritizing healthcare workers including healthcare students. Since healthcare students (future healthcare workers) play a vital role in vaccination coverage, this study aimed to assess the knowledge, attitude, and perception toward the COVID-19 vaccine of healthcare students after the second wave of the Pandemic. Method: A web-based questionnaire survey tool was developed, delivered over "Google Forms", and was filled out randomly among the intended population in many states of India after the COVID-19 pandemic second wave. The questionnaire contained an informed consent form along with questions related to socio-demographics, knowledge, attitude, and perception, toward the COVID-19 vaccine. The data was collected in excel and based on the result we prepared our statistical graphs. Multivariate regression and Bivariate were utilized to identify differences among subgroups with diverse sociodemographic characteristics. Result: Most students had below-average knowledge regarding the COVID-19 vaccine. The highest percentage of correct responses were from postgraduate medical students living in urban areas and the lowest was from undergraduate nursing students living in rural areas. Most

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participants could not identify the names of all approved vaccines in India and only (18%) of participants identified the correct timeframe to wait for receiving optimal protection from the COVID-19 vaccine. Doctors, mass media, social media, and professors/ teachers were the most common source of information. Almost all participants agreed to suggest the COVID-19 vaccine to their prospective patients and had favorable opinions regarding vaccinations. However, only 37% of participants considered themselves “pro” toward the COVID-19 vaccine. Conclusion: This study among Indian healthcare students reflects inadequate knowledge with many misconceptions, a positive attitude, and moderate perception towards the COVID-19 vaccine, consequently, emphasizing the need for an effective educational-based intervention to disseminate accurate information regarding effectiveness and safety to promote the COVID-19 vaccine uptake in the future.

Keywords---COVID-19, healthcare, vaccination, students, knowledge, attitude, perception.

Introduction

The World Health Organization (WHO) announced the "Corona Virus Disease 2019" widespread to be a global health emergency [1], due to the SARS-CoV-2 virus's speedy spread across 200 countries, which has resulted in more than a million deaths and tens of millions of affected individuals worldwide. The epidemic has also harmed the global economy and national healthcare systems. Considering the COVID-19 pandemic, India, the second-most populous nation in the world (1.34 billion people), must pay more attention to its present healthcare delivery systems, which have been plagued by issues with pricing and accessibility. Additionally, the second wave of the epidemic has resulted in an unprecedented number of hospital admissions and fatalities [2], resulting in a severe humanitarian disaster. Currently, mass vaccination against COVID-19 has appeared as a crucial preventative measure since there are no known antiviral therapies specifically for COVID-19 [3].

In an extremely unusually short period, India has already licensed seven vaccine candidates for use against COVID-19 for emergency use [4]. Healthcare personnel and healthcare students were given priority in the first roll-out of vaccination. A documented body of data from earlier research studies points to the vaccination of healthcare workers as one of the most potent and economically viable health strategies to reduce the likelihood of cross-transmission and thereby restrain the development of epidemics [5]. The continuing epidemic has shown that, in addition to healthcare professionals, healthcare students may contribute significantly as volunteers to healthcare systems in times of crisis. In the fight against the pandemic, vaccinated members of the future healthcare workforce (healthcare students) can remain on the front lines, responsible for recommending vaccination and giving advice to their future patients, as well as serving as advocates for a more extensive vaccination program for younger

generations. To pave the road for better vaccination coverage rates, immunizing healthcare students on a priority basis is consequently crucial.

There was a lot of reluctance when the COVID-19 immunization program was introduced in India on 16th January 2021, for front-line healthcare personnel [6]. Even though a lot of effort is being put into creating and distributing COVID-19 vaccines, uncertainty over their acceptability is one of the major obstacles to effective COVID-19 immunization [7]. Decision-making about vaccine acceptability is likely influenced by several variables, including more information, a positive outlook, an awareness of how illnesses spread, and the potential advantages of vaccination [8,9]. Health care students' future infection control practices and the transmission of illness may be directly impacted by their limited understanding of and wrong attitudes concerning the COVID-19 vaccine [10]. Students studying health care who have a background in education and a basic comprehension of COVID-19 may contribute

significantly by raising community members' awareness of the gravity of the pandemic crisis [11]. The study conducted among 310 medical students in one hospital in Germany discovered that enhanced knowledge eventually affected willingness to take vaccination [12]. One of the studies conducted on Canadian medical, pharmacy, and nursing healthcare detected a considerable association between a positive attitude and improved knowledge [13]. It is advised that knowledge of the obstacles and facilitators of vaccination should be assessed before any intervention is designed to promote vaccine uptake. The outcome of the next vaccination trials will also be determined by the healthcare professionals' approval of the COVID-19 vaccine [14, 15]. Worldwide, medical students and other healthcare professionals have been extensively examined concerning vaccine reluctance [16]. However, In India, there is currently not enough research available on healthcare students' knowledge, attitude, and perception regarding COVID-19 vaccination, especially after the second pandemic wave, even though many other studies are being carried out all over the globe. To adopt the most efficient intervention plan to increase vaccine coverage during the campaign, it is essential to comprehensively assess the knowledge, attitude, and perception of future healthcare professionals (healthcare students) about COVID-19 immunization.

Method and Materials

Study design and participants

From December 2021 to January 2022, an online-based cross-sectional survey was carried out using a "Google Form" to collect answers from undergraduate and postgraduate healthcare students, currently enrolled in any of the government, private, or deemed universities of India, who had net access, could deliver informed consent, and understand the English language. For sample size, based on the past study [17], for the power of 80% level significance of 5%. along with the dropout rate, the desired sample size was 596 healthcare students.

Ethical consideration

The survey was carried out under the ethics of the Declaration of Helsinki. The informed Consent Form, questionnaire, and study protocol were reviewed and approved by the Institutional Ethics Committee (Sangini Hospital Ethics Committee, Reg. No. ECR/Ist/147/GJ/2013). Before participating in the Survey, Informed consent was taken from each interested participant. All study participants' confidentiality was kept by making their data anonymous.

Tool development, authentication, and distribution

A questionnaire (in the English language) was formulated using an extensive literature review, and fact sheets, by eliciting the opinion of subject experts, prior literature, and information booklets on COVID- 19 formed by the Indian Health Ministry, CDC, and WHO. The survey tool was first created and validated to pretest the questionnaire among a small group of 5-10 chosen experts for importance, clarity, and acceptance. Multiple choice questions were included in the survey's final questionnaire took 5 to 10 minutes to complete. The survey was composed of two components: an informed consent form, and a questionnaire form. The questionnaire form was comprising questions regarding, socio-demographic characteristics knowledge perception, and attitude toward the COVID-19 vaccine. The final survey link was sent to the healthcare students through multiple media channels, including Gmail and WhatsApp, in the form of a "Google Form." By completing the informed consent form and responding to an agree/disagree question, each subject willingly decided to participate in the research. All the participants' anonymity was ensured, and the privacy of the data will be confidential.

Socio-demographic characteristics information

All participants' sociodemographic data, including gender, age residence area, household income, academic stream, direct/indirect contact with COVID-19 patients during coursework, any pre-existing medical comorbidities, past vaccination history, and any record COVID-19 diagnosis were collected through 13 questionnaires.

Knowledge, attitudes, and perceptions

A total of 14 items tried to incorporate important questions including 10 items for knowledge mainly focused on knowledge about the infection, vaccine, self-rating to have COVID-19 vaccine knowledge, understanding, current source of information; 2 items for attitude; 2 items for perceptions, concerns, and its risk-benefits. A point was added to the final score for each right response. Each section included a 5-point Likert scale (strongly disagree to strongly agree), multiple choice questions (select one/ more than one option) and forced-choice questions (yes/no/I don't know) items. The 'yes' response was coded as 1, while the 'No/I Don't know responses were conducted as 0. Few questions had possible responses to choose correct options and true/false options A correct answer was assigned one point, and an incorrect/unknown answer was assigned 0 points.

Study hypothesis

- H1: There is a significant difference of Socio-demographic characteristics on knowledge and/or attitude and/or perception about COVID-19 vaccination.
- H0: There is no significant difference of Socio-Economic characteristics on knowledge and/or attitude and/or perception about COVID-19 vaccination.

Data analysis and statistical consideration

Data was gathered utilizing snowball sampling via a web-based (anonymous) questionnaire survey. To maintain its correctness, all the gathered data was put into Excel and double-checked to eliminate any errors. Reading, summarizing, extracting, and encoding the data and statements connected to the research objectives were used to conduct data analysis. Then, the excel sheet was introduced into SPSS software to comprehend the findings of the statistical analysis, constant variables. The frequencies and proportions were determined using descriptive statistics. (i.e., means, standard deviations percentages, frequencies). To analyze the connections between co-variates and to gauge the degree of correlation among study variables, chi-square tests, one-way ANOVA tests, and multivariable logistic regression was used. Statistical significance was considered to exist if the *P-value* was lower than 0.05**.**

Result

Socio-demographics characteristics

A sum of 596 students from various states of India took part in the survey (Table 1). About two-thirds of participants (57.4%) were from living in rural parts of India (Figure 1).

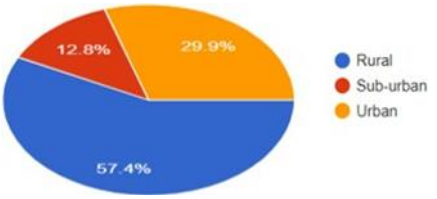


Figure 1. Response distribution of Question 4. “What best characterizes the area where you live”

The student’s gender was almost evenly distributed (44.6% females). The majority (94.8%) of students were between of age 18-24 and had income capita of below 50,000 INR (62.6%). Most students were studying in the undergraduate pharmacy, followed by the nursing and medical stream (Table 1). Almost half of the students (52%) were not involved indirectly or directly in taking care of COVID-19-infected patients during the course work. Approx. 63% of students did not have any premedical conditions. Approx. 60% of students did not vaccinate for or remember past vaccination. The students (40%) who had the past vaccinations have majorly been vaccinated for (Polio= 70. %, Tuberculosis (23%), and others). Most students did not have a COVID-19 diagnosis, but they personally knew family or friends who had COVID-19 impact (Figure 2).

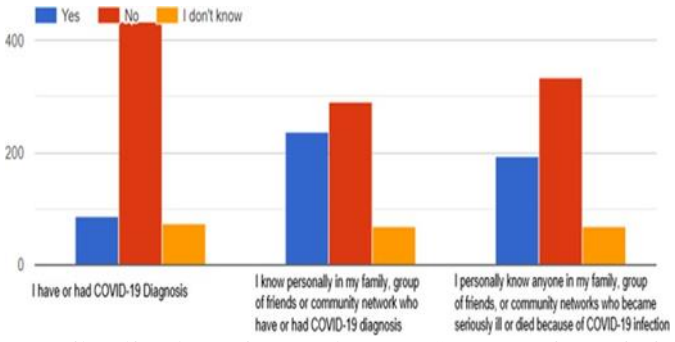


Figure 2. Response distribution of Question 14. "To your knowledge, please select the option which is applicable for the below statements?"

Participants' Socio-demographic characteristics details were depicted in Table 1. Applying only variables that were statistically significant in the bivariate analysis (P - value < 0.05), adjusted multiple regression maintained having a degree of academic stream and living area as significant predictors of knowledge, attitude, and perception.

Table 1. Socio-Demographics Characteristics of the participants

Variables		Frequency	Percentage
Gender	Male	331	55.40%
	Female	265	44.60%
Age Group	18-24	565	94.80%
	25-34	26	4.40%
	35-44	5	0.80%
Residence Area	Rural	342	57.40%
	Sub-urban	76	12.80%
	Urban	178	29.90%
Income	100,000 to 300,000 INR	44	7.40%
	300,000 to 500,000 INR	28	4.70%
	51,000-100,000 INR	115	19.30%
	Above 500,000 INR	36	6%
	Below 50,000 INR	373	62.60%
Academic Stream	Medical	21	3.50%
	Nursing	48	8.10%
	Pharmacy	519	87.10%
	Other allied science	8	1.30%
Current Academic Study	Postgraduate / Master's degree	56	9.40%
	Undergraduate / Bachelor's degree	540	90.60%

Knowledge regarding COVID-19 vaccine

The allocation of every COVID-19 vaccine-related knowledge category is presented in Table 2. Without implementing correlation variables, overall, we found most of

the participants were not much knowledgeable of COVID-19 vaccines approved in India except COVAXIN and COVISHEILD (Figure 3).

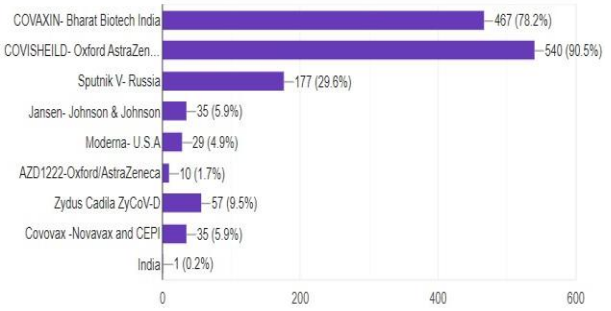


Figure 3. Response distribution of Question 14. "Which of the following COVID-19 vaccine(s) have you heard of? (Select more than one options that apply)"

As mentioned in Figure 4, only 18.3% of participants correctly identified the time to receive optimal protection from the vaccine

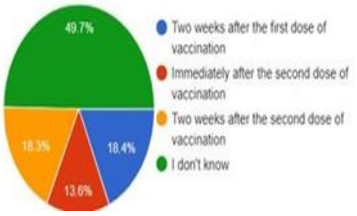
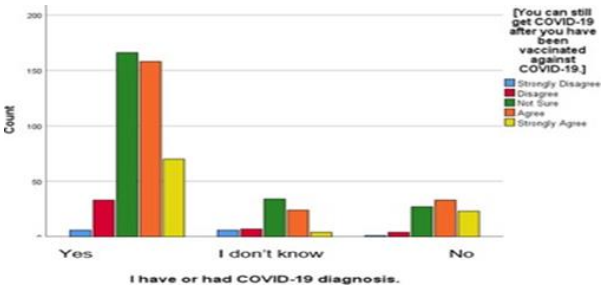


Figure 4. Response distribution of Question 16. "How long do you have to wait to receive optimal protection from the COVID-19 vaccine?"

Apart from 64.2% of respondents, other participants were confused about the scheduling/number of the COVID-19 vaccine. Statements regarding COVID-19 vaccine knowledge were not correctly reported. Most respondents failed to identify the vaccines' correct types. The mean score of knowledge is noticed for all the COVID-19 vaccination knowledge in the range of 5 and found to be significantly better among the respondents who reported having a higher healthcare degree post graduate medical, living in urban/suburban areas, (Table 3, Bar Graph 2). The respondent who had been detected with COVID-19 infection earlier agreed that they can still get COVID-19 after having been vaccinated against COVID-19 (Bar Graph 1).



Bar Graph 1. Dependent variables of knowledge regarding the COVID-19 vaccine

Additionally, Table 2 reveals the participants' sources of knowledge on the COVID-19 vaccine, which are mostly from the mass media news, and online social media. As mentioned in Figure 5, more than half of the respondents did not attend any lectures/discussions about the COVID-19 vaccine which draws attention.

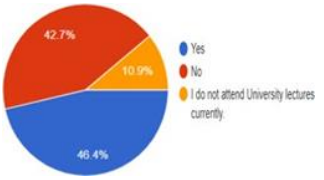
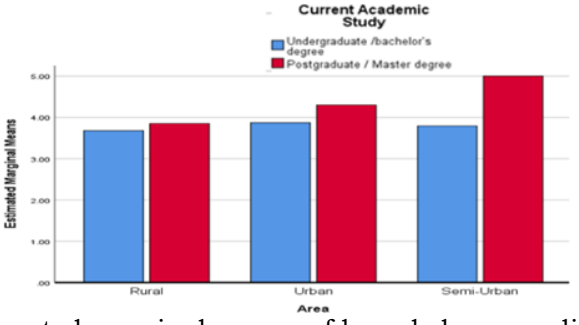


Figure 5. Response distribution of Question 22" Have you attended any of the discussions/ lectures regarding the COVID-19 vaccine?

Table 3
Univariate Tests; Dependent variables of knowledge regarding the COVID- 19 vaccine

Socio-demography factors	Sum of Squares	df	Mean Square	F	Sig.
Residence Area	7.081	2	3.54	4.786	0.009
Academic Stream	4.257	2	2.128	2.877	0.043
Household Income Per Year	7.329	4	1.832	2.477	0.047

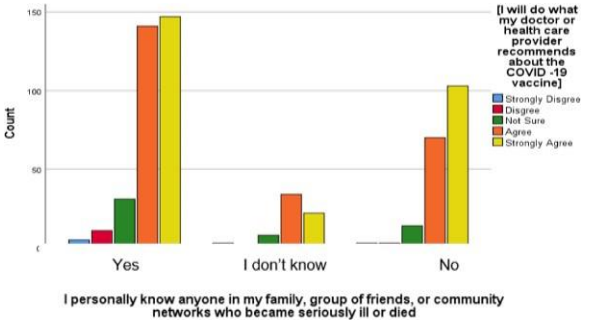


Bar Graph 2. Estimated marginal means of knowledge regarding the COVID-19 vaccine

Attitude toward COVID-19 vaccine

Table 4 displays the allocation of each attitude component about the COVID-19 vaccination. The median score of attitudes had a 79 % "good attitude" rating overall. However, even though only about a quarter of those questioned feel that COVID- 19 should be mandatory for children under 18 years of age. Nearly 80% of those surveyed agreed that it is their responsibility to learn about the COVID-19 vaccine as future healthcare workers and that the COVID-19 vaccination should be compulsory for all healthcare workers as well as healthcare students. Regulated multiple regression, which only considers factors that are statistically significant in bivariate analysis, found that participants, highly educated

(medical/pharmacy/postgraduates), and residing in urban/suburban areas had considerably higher mean attitude scores significant predictors of attitudes (Bar Graph 4). As per Bar Graph 3, 57.6% of healthcare respondents who personally knew someone in their family, friends, or community groups who became extremely sick or died, agreed that they will listen to their healthcare provider or doctors' advice regarding the COVID -19 vaccine.



Bar Graph 3. Dependent variables of attitude regarding the COVID- 19 vaccine

However, as mentioned in Figure 6, only 37.4% of respondents described themselves as "Pro-vaccination" which indicates community health measures are necessary to impact attitudes toward the COVID-19 vaccine in a favorable direction.

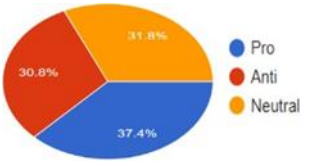
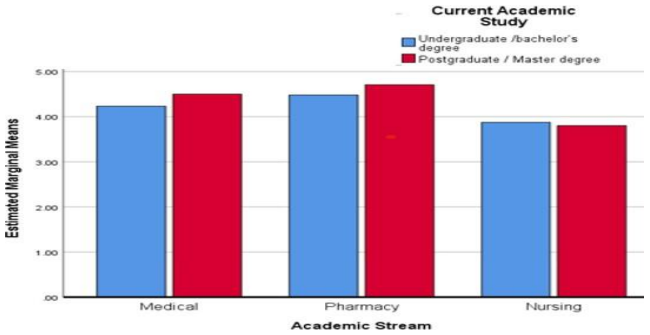


Figure 6. Response distribution of Question 25. "Would you describe yourself as being pro-vaccination or anti-vaccination or neutral?"

Table 5
Univariate Tests; Dependent variables of attitude regarding the COVID- 19 vaccine

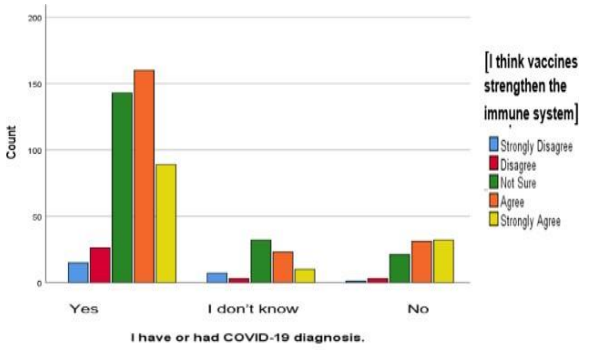
Socio-demography factors	Sum of Squares	df	Mean Square	F	Sig.
Residence Area	6.143	2	3.071	4.630	0.010
Academic Stream	10.123	2	5.062	7.631	0.001
Household Income Per Year	6.958	4	1.740	2.623	0.034



Bar Graph 4. Estimated marginal means of COVID- of attitude regarding the COVID-19 vaccine

Perception toward COVID-19 vaccine

Table 6 indicates that quarters of respondents weren't sure that the advantages of the COVID-19 vaccine overshadow the risks or side effects, or life can be "pre-COVID-19" after "post-COVID-19 vaccination". The correlation analysis revealed that most of the participants agreed that the recently launched COVID-19 vaccination could help to boost the body's natural defenses (81.2 %) had COVID-19 diagnosis in the past (Bar Graph 5). Descriptive statistics of all perception parameters established those urban residents had a considerably better sense of perception than rural residents (*P-value* < 0.05). Among pharmacy respondents compared to nursing, over 80% responded that the COVID-19 vaccine is essential for them to remain healthy as future health care workers and important for overall communities. Regarding the question (Bar Graph 6), Over half (52%) of the participants said that they should stop wearing masks, avoid using hand sanitizer and that there is no need to keep their social distance.



Bar Graph 5. Dependent variables of attitude regarding the COVID-19 vaccine

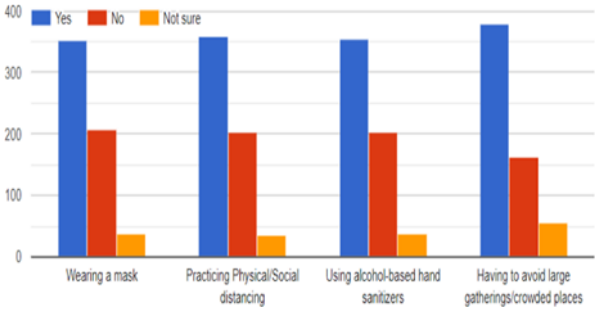
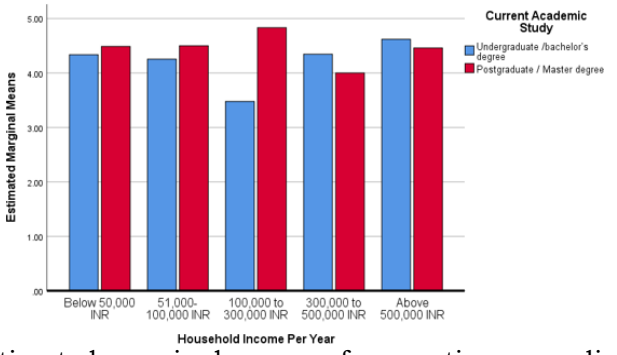


Figure 7. Response distribution of Question 26. "Does getting a COVID-19 vaccine indicate that you should stop"

Table 7
Univariate Tests; Dependent variables of perception regarding the COVID-19 vaccine

Socio-demography factors	Sum of Squares	df	Mean Square	F	Sig.
Residence Area	2.244	2	3.122	1.680	0.037
Academic Stream	2.812	1	2.812	4.213	0.041
Household Income Per Year.	3.683	2	1.841	2.759	0.064



Bar Graph 6. Estimated marginal means of perception regarding the COVID-19 vaccine

Hence, from the above Tables and Graphs, it can be concluded that since *P-value* is lesser than 0.05 for all mentioned factors of socio-economic determinants, hence we accept an alternate hypothesis i.e., There is a significant difference between Socio-demographics determinants on Knowledge, attitude, and perception towards COVID-19 vaccination. Table 8 represents the overall correlation among attitude, knowledge, and perception of the participants and exhibited a highly significant positive relationship between knowledge, attitude, and perception (*P*- value < 0.05).

Table 8
Correlations between knowledge, attitude, and perception

		Knowledge	Attitude	Perception
Knowledge	Pearson Correlation	1	.570**	.494**
	Sig. (2-tailed)		.000	.000
	N	596	596	596
Attitude	Pearson Correlation	.570**	1	.612**
	Sig. (2-tailed)	.000		.000
	N	596	596	596
Perception	Pearson Correlation	.494**	.612**	1
	Sig. (2-tailed)	.000	.000	
	N	596	596	596
**. (2-tailed) Correlation is significant at the 0.01 level.				

Discussion

The COVID-19 vaccine is found to be the most ideal answer to the pandemic. Even though the Indian government already has begun the COVID-19 vaccine roll-out [18], the immunization of COVID-19 raises questions regarding the acceptability of vaccinations in this nation. Since, patients often believe healthcare professionals for reliable data about vaccines and vaccine-inevitable diseases, healthcare professionals' knowledge, attitudes, and perceptions towards the COVID-19 vaccine after the second wave's tragic impact were questionable. The future healthcare workforce (healthcare students) with higher knowledge, positive attitudes, and a good perception toward vaccinations are more expected to advise vaccinations to their future patients. This paper introduces important outcomes by evaluating the knowledge, attitudes, and perceptions among healthcare students towards COVID-19 vaccinations after the second pandemic wave in India. The findings indicate many socio-demographic components persuading knowledge, attitudes, and perceptions towards COVID-19 vaccine and thus can acts as a guide for Indian health ministries and community health to develop COVID-19 vaccine awareness health education programs and targeted education-based intervention.

More than half of the students were found to have poor knowledge of the COVID-19 vaccine. In this research, the healthcare degree domain, residence area, family income, and prior vaccination history were all strongly correlated with knowledge. There was no substantial gender difference found in participants' knowledge regarding the COVID-19 vaccine, however, research carried out in Bangladesh on knowledge of COVID-19 disease suggested that males achieved somewhat higher than average than females on knowledge exams. Participants with no prior history of COVID-19 and neither witnessed close family/friends having COVID-19 were found to be had less knowledge about the vaccine. They were worried about the possible side effects of getting a vaccine and exhibit a negative attitude toward the COVID-19 vaccination. Participants who had a higher level of knowledge also believed that they would wear masks, and maintain social distance, even after

getting COVID-19 vaccination. Significantly, most medical and Pharmacy students (79%) had a favorable opinion toward the COVID-19 vaccination than other participants (nursing and other alliance science), which is also supported by earlier research conducted in China demonstrating that individuals with a higher educational (medical) background demonstrated more knowledge and good attitude regarding COVID-19 then the non-medical background [19].

The living area and level of healthcare study domain had a significant connection with attitude toward getting vaccinated against COVID-19. We found that more than half (52%) of the respondents thought that everyone in India should get the COVID-19 vaccine. Additionally, individuals in our research, who had all the required immunizations earlier in childhood had higher favorable views regarding receiving COVID-19 shots. Our findings are in line with a study from Hong Kong that found past vaccination history to be one of the key factors influencing the inclination to get the influenza vaccine [20], which was additionally endorsed by a previous study from China [21]. In our study, 30.7% feels that it's their responsibility as future health care worker to learn about COVID -19 vaccines for themselves and their future patients. 45.6 % of participants responded that they would do what their doctor or health care provider recommends about the COVID -19 vaccine. One of the correlations was discovered that students found with high knowledge were the ones who attended lectures/sessions on COIVD-19 vaccination from colleges and got source information from colleges teachers/professors on COVID-19 vaccine. The variations in awareness of COVID-19 vaccinations that we discovered in our research may be caused by a lack of healthcare professional recommendations or information about COVID-19 vaccines since the vaccine distribution began. Concerns regarding the safety of vaccines may also be diminished by the probable underreporting or misinterpretation of data on COVID-19 mortality and incidence severity [22]. Therefore, it is crucial to assist members of the community by giving them simple access to reliable, information on vaccines.

Vaccinology does not happen in the curricula of most Indian healthcare colleges' education programs in-depth; this study provides insightful information on educational awareness about COVID-19 vaccination to include at all levels of healthcare education [23]. If we freeze the correlation of the sociodemographic variables, the overall results revealed that most students establish a positive attitude and average perception toward the COVID-19 vaccine. Holding in mind the earlier mentioned findings that the participants showed in general positive attitudes toward vaccination, we can be understandably hopeful in believing that they will be crucial advocates and promoters of the vaccination practice.

Conclusion

In conclusion, our study discovered inadequate knowledge regarding the COVID-19 immunizations among future healthcare workers in India although attitude was found to be more positive with an average level of perception. The identified knowledge gaps found in this study suggest introducing a targeted educational inclusive specialized vaccination curriculum at both the postgraduate and undergraduate levels of healthcare studies emphasizing the importance of their knowledge, attitude, and perception regarding the vaccines so students can

provide correct information to their future patients. To lessen the vaccine reluctance enabled and promoted by false information in the media, the relevant health authorities and policymakers should immediately disseminate and publicize health education programs and more precise information which will also help in developing appropriate vaccination strategies for broader coverage of the population.

Strength and Limitation

Data discovered here will assist to detect viable issues to be focused on to make sure the vaccine's sufficient acceptance by this group and support the advancement of learning programs to educate skills to promote and deliver vaccine recommendations to the future vaccine-hesitant communities. Our survey had the limitation that it was performed amid the third wave when COVID-19 vaccination had started among healthcare students. Therefore, it could have underrated the initial vaccine attitude of those who consequently switched to a good attitude and were ultimately vaccinated. Furthermore, the survey was performed among healthcare students so do not know if the outcomes can be generalized to healthcare professionals or members of the public at lower risk of COVID-19.

Financial Relationship

The authors have acknowledged that no financial funding was collected from any organization.

Other Relationship

All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Animal Subjects

The authors have verified that this research did not include animal tissue or subject.

Conflict of Interest

The authors proclaim that they have no conflict of interest.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

The data produced and evaluated during the existing study are not openly accessible due to confidentiality and privacy contracts as well as other limitations but are presented by the author with a satisfactory application.

Acknowledgment

We are thankful to all participants for taking part in this study.

References

1. Almaghrabi RS, Omrani AS. Middle East respiratory syndrome coronavirus (MERS-CoV) infection. British Journal of Hospital Medicine. 2017 Jan 2; doi: 78(1):23-6.
2. Bennett RG. Influenza vaccination of health care workers in long- term-care hospitals reduces the mortality of elderly patients. Journal of the American Geriatrics Society. 1997; doi:45(7):898-9.
3. Betsch C, Wicker S. E-health use, vaccination knowledge and perception of own risk: drivers of vaccination uptake in medical students. Vaccine 2012; doi: 30(6):1143–8.
4. Callaghan T, Moghtaderi A, Lueck J, Hotez P, Strych U, Dor A, et al. Correlates and Disparities of COVID-19 Vaccine Hesitancy. SSRN Electron J. 2020. doi:10.2139/ssrn.3667971
5. Chan EY-Y, Cheng CK-Y, Tam GC-H, Huang Z, Lee PY. Willingness of future A/H7N9 influenza vaccine uptake: A cross-sectional study of Hong Kong community. Vaccine. 2015;33: 4737–4740. doi: 10.1016/j.vaccine.2015.07.046
6. D. Cucinotta and M. Vanelli, "WHO declares COVID-19 a pandemic," Acta Biomed., vol. 91, no. 1, pp. 157–160, 2020, doi: 10.23750/abm.v91i1.9397.
7. Doshi D, Karunakar P, Sukhabogi JR, Prasanna JS, Mahajan SV. Assessing coronavirus fear in Indian population using the fear of COVID-19 scale. International journal of mental health and addiction. 2021 Dec;19. doi: (6):2383-91.
8. Dubé E. Addressing vaccine hesitancy: the crucial role of healthcare providers. Clinical Microbiology and Infection. 2017 May 1; doi: 23(5):279-80.
9. Gohel KH, Patel PB, Shah PM, Patel JR, Pandit N, Raut A. Knowledge and perceptions about COVID-19 among the medical and allied health science students in India: An online cross-sectional survey. Clinical epidemiology and global health. 2021 Jan 1;doi: 9:104-9.
10. Gupta R, Pal SK, Pandey G. A comprehensive analysis of COVID-19 outbreak situation in India. MedRxiv. 2020 Jan 1.
11. K. Dhama, "Covid19 vaccine acceptance: Beliefs and barriers associated with vaccination among the general population in india," J. Exp. Biol. Agric. Sci., vol. 8, no. Special Issue 1, pp. S210-S, 2020, doi: 10.18006/2020.8(Spl-1-SARS-CoV-2). S210. S218
12. K. Sharun, C. K. Faslu Rahman, C. V. Haritha, B. Jose, R. Tiwari, and
13. Kashte S, Gulbake A, El-Amin III SF, Gupta A. COVID-19 vaccines: rapid development, implications, challenges and future prospects. Human cell. 2021 May; doi: 34(3):711-33.
14. Kumar VM, Pandi-Perumal SR, Trakht I, Thyagarajan SP. Strategy for COVID-19 vaccination in India: the country with the second highest population and number of cases. npj Vaccines. 2021 Apr doi: 21;6(1):1-7.
15. Larson HJ, De Figueiredo A, Xiahong Z, Schulz WS, Verger P, Johnston IG, Cook AR, Jones NS. The state of vaccine confidence 2016: global insights

through a 67-country survey. EBioMedicine. 2016 Oct 1 doi: ;12:295-301.
16. Liyan Gao, Siman Su, Niuniu Du, Yu Han, Jiayi Wei, Meijuan Cao, Qunfang Miao, Xiaolei Wang Medical and non-medical students' knowledge, attitude and willingness towards the COVID-19 vaccine in China: a cross-sectional online survey, Human Vaccines & Immunotherapeutics, (2022) 18:5, 2073757,doi: 10.1080/21645515.2022.2073757
17. Mallapaty S. India's massive COVID surge puzzles scientists. Nature. 2021 Apr 21; doi: 592(7856):667-8.
18. Omrani AS, Shalhoub S. Middle East respiratory syndrome coronavirus (MERS-CoV): what lessons can we learn?. Journal of hospital infection. 2015 Nov 1;doi: 91(3):188-96.
19. Pelly LP, Pierrynowski Macdougall DM, Halperin BA, Strang RA, Bowles SK, Baxendale DM, THEVAXED PROJECT: an assessment of immunization education in Canadian health professional programs. BMC Med Educ 2010;10:86
20. Peretti-Watel P. The management of health crises. Political and social issues. 2010(971).
21. Rackimuthu S, Hasan MM, Bardhan M, Essar MY. COVID-19 vaccination strategies and policies in India: the need for further re- evaluation is a pressing priority. The International Journal of Health Planning and Management. 2022 May; doi: 37(3):1847-50.
22. Ritchie H, Mathieu E, Rodés-Guirao L, Appel C, Giattino C, Ortiz- Ospina E, Hasell J, Macdonald B, Beltekian D, Roser M. Coronavirus pandemic (COVID-19). Our world in data. 2020 Mar 5.
23. Sallam M. COVID-19 vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. Vaccines (Basel) 2021 Feb 16; 9 (2): 160. doi: 10.3390/vaccines9020160
24. Wang J, Jing R, Lai X, Zhang H, Lyu Y, Knoll MD. Acceptance of COVID-19 vaccination during the COVID-19 pandemic in China. Vaccines. 2020;8: 482. doi:10.3390/vaccines8030482

Table 2
Distribution of each knowledge item among healthcare students and significant difference between socio-demographic characteristics

Variables	Female	Male	$\chi 2$	Urban	Rural	Sub-urban	$\chi 2$	Pharmacy	Medical	Nursing	Others	$\chi 2$	PG	UG	$\chi 2$	*P-value*
Q. Have you ever felt confused about the number/ scheduling of COVID-19 vaccine(s)?																
Yes	49	30		44	20	15		23	33	19	4		69	10		
No	213	170	0.11	178	125	82	10.269	120	116	112	35	5.175	346	37	2.149	0.00
I am not sure	68	66		78	26	30		39	42	42	11		125	9		
Q. How long do you have to wait to receive optimal protection from the COVID-19 vaccine?																
I don't know	166	130		143	92	61		93	89	91	23		278	18		
Immediately after the second dose of vaccination	42	39		40	26	15		22	27	21	11		71	10		
Two weeks after the first dose of vaccination	63	45	1.071	63	20	25	7.518	31	37	31	9	5.399	96	12	8.305	0.00
Two weeks after the	59	52		52	33	26		36	38	30	7		95	16		

second dose of vaccination															
Q. Which source of information how significantly impacted your opinion regarding COVID-19 vaccination?															
1. My doctor, Health care provider															
Very significant impact	215	191	3.982	201	117	88	1.935	126	125	119	36	5.836	366	40	3.178	0.00
Somewhat significant impact	83	59		69	41	32		39	55	37	11		133	9		
Insignificant impact	32	16		28	13	7		17	11	17	3		41	7		
2. My University/College, Professor/Teachers															
Very significant impact	176	139	0.413	158	92	65	0.734	94	102	95	24	7.441	283	32	0.467	0.00
Somewhat significant impact	129	103		115	64	53		74	76	65	17		212	20		
Insignificant impact	25	24		25	15	9		14	13	13	9		45	4		
3. Government websites (WHO, FDA, DCGI, ICMR, MoHFW, etc.)															
Very significant impact	191	176	4.81	178	114	75	9.908	119	118	100	30	4.509	332	35	0.097	0.00
Somewhat significant impact	107	73		86	49	45		48	57	61	14		163	17		
Insignificant impact	32	17		34	8	7		15	16	12	6		45	4		
4. Scientific Journals/ Research articles															
Very significant impact	173	142	1.418	160	94	61	6.189	100	105	85	25	2.919	285	30	0.198	0.00
Somewhat significant impact	116	99		99	60	56		60	69	67	19		196	19		
Insignificant impact	41	25		39	17	10		22	17	21	6		59	7		
5. Immunocompromised patients															
Very significant impact	137	95	2.163	115	73	44	3.474	74	73	69	16	4.575	206	26	1.713	0.00
Somewhat significant impact	138	120		126	69	63		70	85	79	24		238	20		
Insignificant impact	55	51		57	29	20		38	33	25	10		96	10		
6. Mass media (Radio, Television. Newspaper)															
Very significant impact	176	142		152	100	66		102	102	88	26	10.63	284	34		

Somewhat significant impact	106	84	0.038	93	49	48	7.212	45	67	58	20	6	178	12	3.145	0.00
Insignificant impact	48	40		53	22	13		35	22	27	4		78	10		
7. Online social media (such as Facebook, WhatsApp, Twitter, Instagram, and YouTube)																
Very significant impact	180	150	1.482	155	104	71	6.268	105	104	93	28	2.152	297	33	0.357	0.00
Somewhat significant impact	103	87		98	47	45		51	65	58	16		174	16		
Insignificant impact	47	29		45	20	11		26	22	22	6		69	7		
8. Other																
Very significant impact	141	104	1.072	118	78	49	9.78	88	79	63	15	12.306	219	26	1.088	0.00
Somewhat significant impact	121	108		110	58	61		55	78	70	26		211	18		
Insignificant impact	68	54		70	35	17		39	34	40	9		110	12		
Q. To your knowledge, please select the option applicable for the below statements.																
1. COVID-19 vaccine can inhibit COVID-19 infection and control its complications.																
Strongly Agree	101	84	7.06	88	52	45	13.818	62	56	51	16	17.504	161	24	9.686	0.00
Agree	125	121		117	75	54		75	78	70	23		224	22		
Not sure	87	54		77	37	27		39	51	40	11		135	6		
Disagree	12	4		8	7	1		6	5	5	0		14	2		
Strongly disagree	5	3		8	0	0		0	1	7	0		6	2		
2. You can still get COVID-19 after you have been vaccinated against COVID-19																
Strongly Agree	55	42	9.818	44	32	21	11.713	29	27	32	9	12.861	86	11	7.499	0.00
Agree	129	86		95	74	46		67	70	58	20		188	27		
Not sure	113	114		127	53	47		75	77	57	18		213	14		
Disagree	22	22		23	10	11		8	13	20	3		42	2		
Strongly disagree	11	2		9	2	2		3	4	6	0		11	2		
3. The COVID-19 vaccination won't make you test positive. COVID-19 virus testing was positive for COVID-19.																
Strongly agree	48	32	3.938	36	23	21	8.585	25	25	24	6	14.977	72	8	7.202	0.00
Agree	76	72		69	41	38		52	44	36	16		136	12		

Not sure	154	124		147	78	53		81	97	81	19		257	21		

Disagree	37	32		32	25	12		22	20	20	7		58	11		
Strongly disagree	15	6		14	4	3		2	5	12	2		17	4		
4. Mass COVID-19 vaccination plays a crucial role in achieving herd immunity in the population than immunity acquired through naturally																
Strongly agree	81	50	16.232	56	42	33	22.218	44	37	35	15	20.759	110	21	13.17	0.00
Agree	103	111		94	61	59		62	82	55	15		202	12		
Not sure	105	91		114	54	28		66	54	58	18		181	15		
Disagree	22	10		18	11	3		7	12	12	1		28	4		
Strongly disagree	19	4		16	3	4		3	6	13	1		19	4		
5. Children under 18 years of age should get COVID-19 vaccination once as soon as they are eligible for it.																
Strongly agree	115	98	13.531	94	72	47	15.038	63	74	55	21	14.873	189	24	7.152	0.00
Agree	101	108		98	61	50		70	65	58	16		190	19		
Not sure	82	47		75	31	23		40	38	39	12		123	6		
Disagree	16	9		18	4	3		6	9	9	1		22	3		
Strongly disagree	16	4		13	3	4		3	5	12	0		16	4		
Q. Have you attended any of the discussions/ lectures regarding the COVID-19 vaccine?																
Yes	149	128	0.62	140	70	67	9.867	81	95	74	27	6.174	250	27	1.067	0.00
No	143	111		119	88	47		80	80	74	20		233	21		
I do not attend University lectures currently.	38	27		39	13	13		21	16	25	3		57	8		

Table 4
Distribution of each attitude item among healthcare students and significant difference between socio-demographic characteristics

Variables	Male	Female	χ^2	Urban	Rural	Sub-urban	χ^2	Pharmacy	Medical	Nursing	Others	χ^2	PG	UG	χ^2	*P-Value*
Q. Please select the option which is applicable for the below statements. (Select the option that reflects your point of view)																
1. I must educate myself about COVID-19 vaccines for both me and my future patients as an aspiring healthcare professional.																
Strongly Agree	167	167	16.184	151	108	75	14.235	112	101	95	26	17.558	300	34	2.946	0.00
Agree	104	79		94	50	39		52	63	47	21		167	16		
Not sure	44	15		38	10	11		14	23	19	3		56	3		
Disagree	8	2		8	1	1		2	2	6	0		8	2		
Strongly disagree	7	3		7	2	1		2	2	6	0		9	1		
2. I will do what my doctor or health care provider recommends about the COVID -19 vaccine.																
Strongly Agree	127	145	20.75	118	97	57	19.73	82	83	77	30	13.57	245	27	8.003	0.00
Agree	146	99		129	60	56		82	81	66	16		222	23		
Not sure	36	17		32	10	11		12	19	18	4		52	1		

Disagree	13	2		11	1	3	4	2	5	8	0	7	13	2		
Strongly disagree	8	3		8	3	0		4	3	4	0		8	3		
3. I will recommend the COVID-19 vaccine to my fellow students/ friends/family/relative and future healthcare patients																
Strongly Agree	150	147	12.586	123	108	66	32.046	92	85	94	26	19.593	267	30	2.79	0.00
Agree	110	89		106	49	44		66	72	42	19		182	17		
Not sure	50	18		44	9	15		15	27	22	4		64	4		
Disagree	12	7		15	2	2		7	3	8	1		16	3		
Strongly disagree	8	5		10	3	0		2	4	7	0		11	2		
4. I think most of the students at my university/college will get a COVID-19 vaccine if it is recommended for them																
Strongly Agree	137	140	12.027	118	98	61	22.915	76	85	85	31	20.43	248	29	9.177	0.00
Agree	128	94		115	60	47		79	75	54	14		204	18		
Not sure	41	23		41	9	14		22	20	17	5		62	2		
Disagree	12	7		14	3	2		3	6	10	0		15	4		
Strongly disagree	12	2		10	1	3		2	5	7	0		11	3		
5. All healthcare professionals and students should be required to get the COVID-19 vaccine.																
Strongly Agree	147	137	7.656	125	97	62	21.603	91	84	85	24	19.465	252	32	10.662	0.00
Agree	116	97		107	61	45		69	73	50	21		196	17		
Not sure	46	22		42	11	15		16	26	21	5		67	1		
Disagree	9	4		11	0	2		2	5	6	0		10	3		
Strongly disagree	12	6		13	2	3		4	3	11	0		15	3		
6. For the general public, COVID-19 immunization should be mandated.																
Strongly Agree	149	133	11.752	118	101	63	21.846	88	85	81	28	15.917	249	33	9.612	0.00
Agree	111	102		115	54	44		66	74	58	15		198	15		
Not sure	46	20		40	12	14		19	23	17	7		64	2		
Disagree	13	9		15	3	4		7	7	8	0		19	3		
Strongly disagree	11	2		10	1	2		2	2	9	0		10	3		

7. Children under the age of 18 should be compelled to get COVID-19 immunization.															
Strongly Agree	126	105	11.229	104	76	51	11.115	72	68	70	21	8.153	204	27	2.943	0.00
Agree	111	108		111	63	45		69	74	58	18		202	17		
Not sure	57	42		52	25	22		27	34	28	10		92	7		
Disagree	18	7		19	2	4		8	10	7	0		22	3		
Strongly disagree	18	4		12	5	5		6	5	10	1		20	2		
8. I want to take part in the clinical study for the COVID-19 vaccination.															
Strongly Agree	106	110		95	71	50		68	64	65	19		197	19		
Agree	128	110		124	65	49		75	76	64	23		215	23		

Not sure	50	35	20.31	45	22	18	8.48	25	33	21	6	10.16	80	5	4.53	0.00
Disagree	22	8	1	20	7	3		7	9	14	0	1	26	4		
Strongly disagree	24	3		14	6	7		7	9	9	2		22	5		
Q. Would you describe yourself as being pro-vaccination or anti-vaccination or neutral?																
Anti	103	81	0.252	108	49	27	10.20	60	64	46	14	8.301	173	11	7.449	0.00
Neutral	107	83		90	54	46	3	48	69	57	16		175	15		
Pro	120	102		100	68	54		74	58	70	20		192	30		

Table 6
Distribution of each perception item among healthcare students and significant difference between socio-demographic characteristics

Variables	Female	Male	χ2	Urban	Rural	Sub-urban	χ2	Pharmacy	Medical	Nursing	Others	χ2	PG	UG	χ2	*P-value*
Q. Does getting a COVID-19 vaccine to indicate that you should stop...																
1. Wearing a mask																
Yes	202	150	18.734	181	99	72	4.263	116	106	101	29	5.896	318	34	0.235	0.00
No	97	110		94	64	49		56	75	57	19		189	18		
Not sure	31	6		23	8	6		10	10	15	2		33	4		
2. Practicing Physical/Social distancing																
Yes	204	153	2.839	170	109	78	11.426	114	110	105	28	3.991	325	32	2.682	0.00
No	104	100		101	57	46		57	72	55	20		181	23		
Not sure	22	13		27	5	3		11	9	13	2		34	1		
3. Using alcohol-based hand sanitizers																
Yes	200	154	7.72	181	98	75	12.337	111	113	101	29	4.336	324	30	0.872	0.00
No	102	102		89	68	47		60	69	56	19		182	22		
Not sure	28	10		28	5	5		11	9	16	2		34	4		
4. Having to avoid large gatherings/crowded places																
Yes	211	168	6.733	185	110	84	19.136	122	116	113	28	7.369	347	32	3.993	0.00
No	80	81		70	53	38		48	56	39	18		140	21		
Not sure	39	17		43	8	5		12	19	21	4		53	3		
Q. Please select the option which is applicable for the below statements.																
1. I think COVID-19 vaccines strengthen the immune system																
Strongly Agree	131	108	5.766	120	65	54	7.924	80	71	69	19	8.114	215	24	3.318	0.00
Agree	128	117		114	81	50		71	88	65	21		223	22		
Not sure	60	35		56	19	20		26	27	33	9		88	7		
Disagree	8	6		6	5	3		3	5	5	1		11	3		
Strongly	3	0		2	1	0		2	0	1	0		3	0		

disagree																
2. As a future healthcare professional, getting the COVID-19 vaccination is crucial for my health.																
Strongly Agree	125	118	9.772	112	74	57	7.119	76	75	73	19	13.198	222	21	8.307	0.00
Agree	131	112		125	67	51		75	84	60	24		215	28		
Not sure	58	32		47	26	17		25	29	29	7		86	4		
Disagree	10	2		7	3	2		3	3	6	0		9	3		
Strongly disagree	6	2		7	1	0		3	0	5	0		8	0		
3. It will be crucial for the general public health of our communities to have the COVID-19 vaccination.																
Strongly Agree	123	136	21.479	112	83	64	15.446	85	74	72	28	13.798	235	24	1.776	0.00
Agree	134	99		122	63	48		67	83	65	18		210	23		
Not sure	56	30		50	22	14		25	30	27	4		80	6		
Disagree	11	1		8	3	1		3	4	5	0		10	2		
Strongly disagree	6	0		6	0	0		2	0	4	0		5	1		
4. If the WHO or the FDA approves the COVID-19 vaccine, it will be effective.																
Strongly Agree	122	101	15.486	108	67	48	9.801	73	68	66	16	10.379	202	21	8.992	0.00
Agree	126	119		116	75	54		72	80	68	25		220	25		
Not sure	59	44		57	27	19		31	38	26	8		98	5		
Disagree	18	2		13	1	6		5	4	10	1		17	3		
Strongly disagree	5	0		4	1	0		1	1	3	0		3	2		

5. The benefits of the COVID-19 vaccine outweigh the risks or side effects															
Strongly Agree	95	78	2.676	77	56	40	7.829	60	49	48	16	9.622	152	21	5.484	0.00
Agree	125	99		112	66	46		66	78	59	21		203	21		
Not sure	88	76		86	43	35		44	54	54	12		155	9		
Disagree	12	10		13	4	5		7	8	6	1		19	3		
Strongly disagree	10	3		10	2	1		5	2	6	0		11	2		
6. I think life will come back to 'pre-COVID-19 normal' post-COVID-19 vaccine?																
Strongly Agree	108	72	9.164	87	56	37	8.774	70	48	48	14	19.165	158	22	3.167	0.00
Agree	128	101		109	67	53		65	76	65	23		210	19		
Not sure	76	86		83	45	34		42	60	47	13		150	12		
Disagree	14	5		14	2	3		5	5	9	0		17	2		
Strongly disagree	4	2		5	1	0		0	2	4	0		5	1		
7. The COVID-19 vaccine will be effective for children under 18 years of age.																
Strongly Agree	98	71	1.453	77	53	39	4.639	55	53	48	13	6.559	148	21	3.442	0.00
Agree	125	108		121	62	50		71	80	61	21		213	20		
Not sure	87	73		80	46	34		45	49	51	15		149	11		
Disagree	9	8		9	5	3		6	5	5	1		15	2		
Strongly disagree	11	6		11	5	1		5	4	8	0		15	2		