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COVID-19 vaccination up-take in three districts of Nepal

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ABSTRACT

Vaccine hesitancy during the COVID-19 pandemic continues to be an issue in terms of global efforts to decrease transmission rates. Despite high demand for the vaccines in Nepal, the country still contends with challenges related to vaccine accessibility, equitable vaccine distribution, and vaccine hesitancy. Study objectives were to identify: 1) up-take and intention for use of COVID-19 vaccines, 2) factors associated with vaccine up-take, and 3) trusted communication strategies about COVID-19 and the vaccines. A quantitative survey was implemented in August and September 2021 through an initiative at the Nepali Ministry of Health and Population Department of Health Services, Family Welfare Division. Data were collected from 865 respondents in three provinces (Bagmati, Lumbini, and Province 1). Ordinal multivariate logistic regression was utilized to determine relationships between vaccination status and associated factors. Overall, 62% (537) respondents were fully vaccinated and 18% (159) were partially vaccinated. Those respondents with higher education ($p < .001$) and higher household income ($p < .001$) were more likely vaccinated. There were also significant differences in vaccine up-take across the three provinces ($p < .001$). Respondents who were vaccinated were significantly more likely to perceive vaccines as efficacious in terms of preventing COVID-19 ($p = .004$) and preventing serious outcomes ($p = .010$). Among both vaccinated and unvaccinated individuals, there was a high level of trust in information about COVID-19 vaccines provided through local health-care workers [e.g. nurses and physicians]. These results are consistent with other findings within the South Asia region. Targeted advocacy and outreach efforts are needed to support ongoing COVID-19 vaccination campaigns throughout Nepal.

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Introduction

A broad range of policy, programmatic, historical, socioeconomic, and behavioral factors affect vaccine acceptance and uptake.[1] Three key components of vaccine hesitancy have been defined as 'convenience' (e.g., accessibility), 'complacency' (e.g., disease risk, importance of vaccines), and confidence (e.g., trust in product, providers, and policymakers, perceived vaccine safety, and efficacy).[2,3] Studies of acceptance of COVID-19 vaccines have also utilized behavioral change theories to understand predictors of vaccine up-take.[4–6]

Although there is evidence that there is higher willingness to receive a COVID-19 vaccine in low- and middle-income countries, there are differences in acceptance rates across social-cultural and economic groups and across and within countries.[7] In a systematic review of 11 countries, differences in vaccine acceptance rates also varied across countries by the number of COVID-19 deaths per one million persons.[8] COVID-19 vaccine hesitancy studies have been undertaken in South Asia, including in Bangladesh, India, and Pakistan.[9–12] However, there remains limited research in Nepal.

Overall, Nepal is a high-coverage country in terms of the National Immunization Program (NIP) with an estimated pentavalent (DTP3HibHepB) up-take of 93% as of 2019.[13] However, there are significant variations in routine immunization uptake in different provinces of the country and lower vaccine up-take is associated with maternal low literacy and poverty.[14]

Since 3 January 2020, there have been over 992,000 confirmed cases of COVID-19 and 11,951 deaths in Nepal. There have been three peak periods of COVID-19 infections. The first peak occurred between September and November 2020, the second peak between April and August 2021, and the third peak occurred in January 2022.[15]

Existing immunization structures under the authority of the Family Welfare Division at Ministry of Health and Population (MOHP) were harnessed for the COVID-19 vaccine rollout. Nepal deployed COVID-19 vaccines on 27 January 2021 in all seven provinces. Initial implementation focused on health professionals and other frontline workers and adults >60 years. At the time of the survey in August–September 2021, with increasing access to vaccines, the campaign was extended

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to all adults >18 years. There were no mandatory vaccination policies throughout the campaigns. Six vaccines were approved by the Nepali government prior to the survey including AstraZeneca-University of Oxford, Sinopharm, Bharat Biotech International Limited, Gamaleya Research Institute and Health Ministry of the Russian Federation, Sinovac Research & Development, Ltd., and Janssen Pharmaceutical. In late September, Pfizer-BioNTech and Moderna-NIAID were approved.[16] As of August 2022, over 53 million doses of COVID vaccines have been delivered.[15]

The COVID-19 pandemic seriously impacted health systems at a global level.[17] Health systems were overwhelmed caring for COVID-19 patients, national and regional lockdowns decreased access to care, and health systems were shut down for routine services.[18,19] Within this context, the introduction of new COVID-19 vaccines has posed challenges in terms of allocation, distribution, introduction, and community uptake. In Nepal, despite high demand for the vaccines and a successful roll-out, challenges continue in relation to vaccine accessibility as well as vaccine hesitancy and uptake.[20]

The objectives of this paper are to: 1) identify up-take and intention to receive COVID-19 vaccines among 18- to 59-year-old adults including those engaged in prioritized occupations and older adults >60 years living in Kathmandu Valley (Bagmati Province) and rural areas in Eastern (Province 1) and Western (Lumbini Province) Nepal; 2) identify factors associated with COVID-19 vaccine status; and, 3) identify trusted sources of information regarding COVID-19 and COVID-19 vaccines within the study populations.

Materials and methods

Study sites and population

The project utilized a quantitative cross-sectional survey design. Nepal is divided into three north-to-south regions [Mountains, Hills, and Terai (Plains)] and seven provinces. One urban site from Bagmati province (which includes Kathmandu Valley) and two rural sites from Province 1 and Lumbini Provinces were purposefully selected to represent three geographical regions of the country. Approximately 46% of the population lives in the Hills region with 2.5 million persons in Kathmandu Valley.

At the municipal and ward levels, simple random sampling was employed to select study sites. Lists of municipalities and wards within the three study provinces were created and selected using randomly generated numbers. Within Bagmati, four municipalities were randomly selected (Kathmandu, Kirtipur, Lalitpur, and Mahalaxmi). In Province 1, two rural municipalities (Koshi and Gadi) in the Susari District and in Lumbini, two rural municipalities (Bagnaskali and Ripdikot) in the Palpa District were randomly selected. In each municipality, three wards were randomly selected as survey sites for a total of 12 urban and 12 rural wards (see Figure 1).

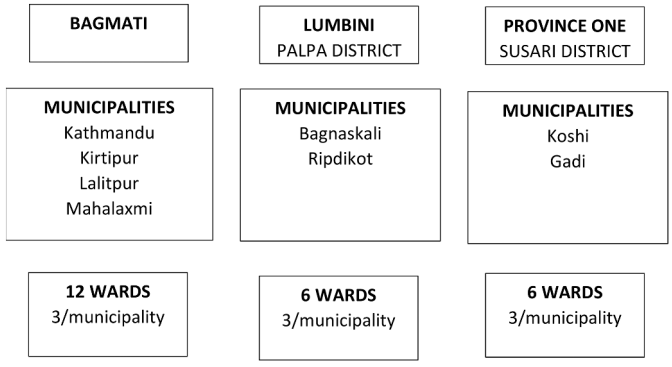

Figure 1. Research sites by province, district, and municipality.

The study population was defined as the targeted populations at the beginning of COVID-19 vaccine introduction (persons >60 years and those in prioritized occupations) and the general population of persons 18–59 years. For prioritized occupations, data collectors went to health facilities and other offices of frontline workers in the selected regions to conduct the survey. For community respondents, households were sequentially selected based on the number of households and sample size for that ward.

Sample size

The sample size was calculated to enable comparison across urban and rural areas and across populations (18–59 years general population, 18–59 years prioritized occupations, 60+ years). Based on an estimate of 25% hesitancy (prevalence [P] =.25), level of confidence =.99, and precision =.03 for a sample size of 840 (Figure 2).

Survey development and data collection

The survey was designed based on previous global research on vaccine hesitancy and adapted for specific issues related to adult vaccination, COVID-19, and the sociocultural context of Nepal.[2,21,22] The survey consisted of eight sections: 1) respondent demographics and household characteristics; 2) experience with COVID-19; 3) perceived disease vulnerability

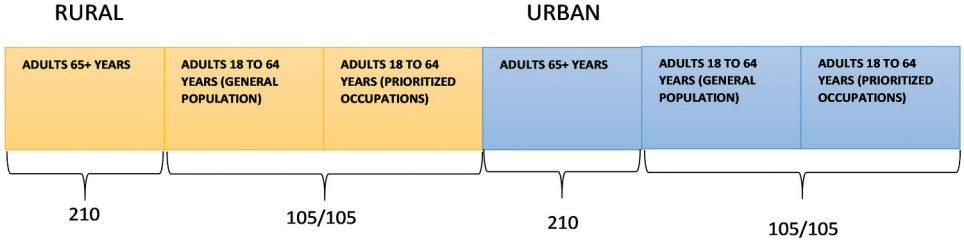

Figure 2. Sampling strategy.

and severity; 4) general experience with vaccines; 5) information sources and general perceptions of COVID-19 vaccines; 6) COVID-19 vaccine access, up-take/intent to use; 7) COVID-19 vaccine confidence; and, 8) Preferred sources and communication strategies for receiving information about COVID-19 vaccines. The survey was piloted with 25 respondents and minor revisions were made prior to implementation.

Survey data were collected through personal digital assistants (PDAs) using REDCap between 2 August 2021 and 15 September 2021. REDCap is a secure web application for building and managing online surveys and databases.[23] Through REDCap, both Nepal- and US-based investigators had immediate access to survey data as it was collected. Surveys were conducted face-to-face in Nepali and data collection took an estimated 30–45 minutes per survey.

Data management and analysis

Data cleaning includes creation of variables for scales and use of descriptive statistics to screen for missing cases, outliers, and normality of distributions. Ordinal multivariate logistic regression was performed to determine the relationships between vaccination status (fully, partial, unvaccinated) and demographic and exposure variables. Analysis also focused on descriptive statistics and bivariate analysis to identify significant differences which indicate potential associations and relationships across independent variables. Bivariate analysis included Pearson's chi-square and independent t-tests and ANOVA (continuous variables). Pairwise comparisons were made using chi-square test with a Benjamini Hochberg multiple comparisons adjustment. The statistical significance is set at $p < .05$. Analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA) and SPSS 25 (IBM Corp, Armonk, NY, USA).

Ethical approval

This study was reviewed and approved by the Nepal Health Research Council, Kathmandu, Nepal (protocol number 385/2021 P). All participants signed a consent form prior to completing the survey.

Results

Demographics

A total of 865 surveys were collected. Overall, 50.5% ($n = 437$) of respondents were male. Mean age was 50.3 years (SD 18.0) with a range from 18 to 90 years. Fifty percent ($n = 432$) of respondents lived in Bagmati Province [urban], 25.1% ($n = 217$) in Province 1 [rural], and 24.9% ($n = 215$) in Lumbini [rural]. Bivariate analysis indicates differences across study sites by gender ($p = .02$), education ($p < .001$), employment status ($p < .001$), and monthly household income ($p < .001$). In Lumbini Province there were significantly more female respondents than in Bagmati or Province 1. In Lumbini and Province 1, there were more respondents with no formal schooling compared to Bagmati Province and there were more respondents with university/professional education in Bagmati Province compared to the two rural sites. More respondents reported full-time employment in Bagmati Province than Lumbini or Province 1 and there were more unemployed/retired respondents in Lumbini compared to Province 1. In terms of monthly household income, Bagmati respondents reported higher income than respondents in both Lumbini and Province 1 (Table 1).

Demographics and COVID-19 vaccination status

Overall, 62% (537) of respondents reported being fully vaccinated, 18% (159) were partially vaccinated [received one dose of a two-dose vaccine] and 20% (168) were unvaccinated. Among those who were not vaccinated, 71% (118) said that they would get the vaccine as soon as possible. Among the remaining unvaccinated respondents, 13% (22) were undecided, 12% (20) would probably not take the vaccine, and 4% (7) stated they would delay one to 2 months before receiving the vaccine.

There was no difference in terms of vaccination status [fully vaccinated, partially vaccinated, unvaccinated] by gender ($p = .17$) or by employment status ($p = .14$). Respondents fully/partially vaccinated (51.8 years, SD 17.47) were older than those unvaccinated (44.1 years, SD 19.10) [$p = .001$]. There were also significant differences in vaccination status by education, province, and household income. Respondents with primary (52.3%, 81) [$p < .001$] or secondary school (57.8%, 115) [$p < .001$] education were more than 2 times less likely to be fully vaccinated than respondents with university or professional degrees (81.4%, 171). Compared to respondents in Lumbini Province (63.0%, 136), Province One respondents (33.2%, 72) [$p < .001$] were less likely to be fully vaccinated (63.0%, 136) and Bagmati respondents were more likely to be fully vaccinated (76.3%, 329) [$p = .011$]. Respondents with a household income of less than 15,000 Nepali Rubee (NPR)/month (33.3%, 31) [<0.001] were 3 times less likely to be fully vaccinated than respondents with incomes over 45,000 NPR/month (75.8%, 184) and those with incomes 15,000 to 30,000 NPR/month (48.6%, 136) [$p = .001$] were 2 times less likely to be fully vaccinated than the highest income group (Table 2).

Personal experiences and impact of COVID-19 and vaccination status

Respondents were asked a series of questions regarding their experiences with COVID-19 and the impact of the pandemic on their lives. Respondents in the urban province (Bagmati) reported more experiences with COVID-19 than residents in the two rural provinces (Lumbini and Province 1). However, nearly 40% of Bagmati and Lumbini participants reported personally knowing someone who died from COVID. Across all three provinces, greatest impact related to job loss and decrease in income, inability to see family and friends, and feelings of sadness, depression, and anxiety. (Table 3) In terms of vaccination status, those individuals who reported having been tested for COVID-19 were less likely to be partially/unvaccinated (OR 0.54 [0.35–0.82, $p = .004$]). In terms of the impact of COVID-19, those that lost their job and/or experienced a decrease in income were more than two times as likely to be partially/unvaccinated (OR

Table 1. Pairwise comparisons for significant demographic variables.

Variable	Categories	Province 1 vs Bagmati	Province 1 vs Lumbini	Bagmati vs Lumbini
Gender	Male vs Female	0.5433	0.0278	0.0333
Education	No formal schooling vs Primary/lower school	0.9481	0.9481	0.2119
	No formal schooling vs Secondary school	0.9481	0.9481	0.7301
	No formal schooling vs University/Professional school	**0.0031**	0.9481	**0.0044**
	Primary/lower school vs Secondary school	0.9481	0.9481	0.9481
	Primary/lower school vs University/Professional school	0.2105	0.9481	0.9481
	Secondary school vs University/Professional school	0.1878	0.9481	0.9481
Employment Status	Employed full time vs Unemployed/Retired	0.5767	0.6117	0.9744
	Employed full time vs Employed part time/temporary	0.1712	**<.0001**	**0.0002**
	Unemployed/Retired vs Employed part time/temporary	0.0567	**<.0001**	0.0923
Monthly Income	<15,000 NPR vs 15,000–30,000 NPR	0.4313	0.5483	**0.0147**
	<15,000 NPR vs 30,000–45,000 NPR	**<.0001**	0.7388	**0.0002**
	<15,000 NPR vs > 45,000 NPR	**<.0001**	0.7388	**<.0001**
	15,000–30,000 NPR vs 30,000–45,000 NPR	**<.0001**	0.0514	0.5483
	15,000–30,000 NPR vs > 45,000 NPR	**<.0001**	0.3806	**<.0001**
	30,000–45,000 NPR vs > 45,000 NPR	**0.0158**	0.7388	**0.0011**

Pairwise *p*-values have a multiple comparisons adjustment using the Benjamini Hochberg method.

Table 2. Demographic characteristics and vaccine status.

		Vaccinated, Partially Vaccinated, Unvaccinated		
Covariate	Level	Odds Ratio (95% CI)	OR *P*-value	Type3 *P*-value
Gender	Female	1.24 (0.91–1.68)	.172	.172
	Male	–	–	
Education	No formal schooling	1.36 (0.80–2.32)	.249	**<.001**
	Primary/lower school	2.67 (1.59–4.48)	<.001	
	Secondary school	2.80 (1.74–4.50)	<.001	
	University/Professional school	–	–	
Employment Status	Employed full time	0.72 (0.49–1.07)	.104	.140
	Employed part time	0.85 (0.48–1.49)	.566	
	Employed temporary	1.25 (0.50–3.13)	.634	
	Retired	0.39 (0.17–0.90)	**.027**	
	Unemployed	–	–	
Province	Province 1	2.64 (1.78–3.90)	**<.001**	**<.001**
	Bagmati	0.62 (0.43–0.89)	**.011**	
	Lumbini	–	–	
Monthly Income	<15,000 NPR	2.99 (1.72–5.20)	**<.001**	**<.001**
	15,000–30,000 NPR	1.98 (1.30–3.01)	**.001**	
	30,000–45,000 NPR	0.87 (0.57–1.35)	.540	

*Number of observations in the original data set = 865. Number of observations used = 861.
Ordinal multivariate logistic regression.

Table 3. COVID-19 experiences and impact by provinces.

	Bagmati	Province 1	Lumbini
Have you or anyone else in your household been tested for COVID-19 in the past 12 months?[c]	59.7% (258)	35.0% (76)	45.8% (99)
Have you or anyone else in your household been isolated/quarantined due to COVID-19 in the past 12 months?[c]	39.4% (170)	15.7% (34)	27.3% (59)
Have you or anyone else in your household been hospitalized due to COVID-19 in the past 12 months?[c]	11.1% (48)	2.8% (6)	4.2% (9)
Do you know anyone personally who has died from COVID 19?[c]	39.5% (169)	15.2% (33)	39.4% (85)
Job loss/decrease in income[c]	75.0% (324)	67.7% (147)	45.1% (97)
Inability to obtain food or other needed personal/household items[b]	26.7% (113)	32.7% (71)	19.2% (42)
Not able to access healthcare for other conditions or preventive care	18.1% (78)	24.4% (53)	17.3% (37)
Inability to see family/friends[c]	66.2% (286)	58.1% (126)	50.2% (108)
Feelings of sadness, depression, anxiety[c]	63.3% (273)	52.5% (114)	41.4% (89)

[a]$p < .05$; [b]$p < .01$; [c]$p < .001$.
Pearson chi square.

2.02 [1.39–2.93, $p < .001$]). Those that reported feelings of sadness, depression, and/or anxiety during the pandemic were less likely to be partially/unvaccinated (0.59 [0.41–0.86, $p = .006$]) (Table 4).

Perceptions of COVID-19 vulnerability and severity

On a four-point scale, participants were asked about perceptions of personal vulnerability and disease severity related to COVID-19 and four other infectious diseases, which are endemic in Nepal (typhoid fever, cholera, influenza, and dengue fever). Overall, COVID-19 was perceived as significantly more severe and participants reported perceiving that they or household members were more likely to contract COVID-19 compared to other diseases. (Table 5) However, there was no relationship between vaccination status and either perceptions of vulnerability (OR 0.73 [0.47–1.12]/$p = .147$) or severity (OR 1.00 [0.25–4.06]/$p = .446$).

Table 4. Experience and impact of COVID-19 by vaccination status.

		Vaccinated, Partially Vaccinated, Unvaccinated		
Covariate	Level	Odds ratio (95% CI)	OR *P*-value	Type3 P-value
Have you or anyone else in your household been tested for COVID-19 in the past 12 months?	Yes No	0.54 (0.35–0.82)	**.004**	**.004**
Have you or anyone else in your household been isolated/quarantined due to COVID-19 in the past 12 months?	Yes No	0.72 (0.44–1.18)	.193	.193
Have you or anyone else in your household been hospitalized due to COVID-19 in the past 12 months?	Yes No	1.63 (0.83–3.22)	.157	.157
Do you know anyone personally who has died from COVID 19?	Yes No	0.76 (0.54–1.08)	.130	.130
Job loss/decrease in income	Yes No	2.02 (1.39–2.93)	**<.001**	**<.001**
Inability to obtain food or other needed personal/household items	Yes No	1.13 (0.79–1.63)	.506	.506
Not able to access healthcare for other conditions or preventive care	Yes No	1.21 (0.81–1.82)	.347	.347
Inability to see family/friends	Yes No	1.17 (0.80–1.71)	.412	.412
Feelings of sadness, depression, anxiety	Yes No	0.59 (0.41–0.86)	**.006**	**.006**
Inability to continue with education (physical settings)	Yes No	1.43 (0.90–2.27)	.135	.135
Inability to continue with education (virtual settings)	Yes No	1.40 (0.94–2.08)	.102	.102

*Controlling for gender, education, employment, monthly household income, province.
*Number of observations in the original data set = 865. Number of observations used = 849.
Ordinal multivariate logistic regression.

Table 5. Perceptions of vulnerability and severity for COVID-19 compared to dengue fever, typhoid fever, cholera, and influenza.

	Vulnerability (range 1 to 4, higher score more vulnerable)	Severity (range 1 to 4, higher score more severe)
COVID-19	3.09 (SD 0.62)	3.08 (SD 0.68)
Dengue Fever	1.78 (SD 0.62)[c]	2.11 (SD 0.73)[c]
Typhoid Fever	2.40 (SD 0.74)[c]	2.43 (SD 0.82)[c]
Influenza	2.07 (SD 0.68)[c]	2.13 (SD 0.75)[c]
Cholera	1.92 (SD 0.63)[c]	2.14 (SD 0.74)[c]

[a]$p < .05$; [b]$p < .01$; [c]$p < .001$.
Analysis of variance (ANOVA).

Vaccine confidence and vaccination status

Vaccination confidence includes a broad range of factors including positive and negative perceptions of the characteristics, benefits, and risk of the product (vaccine), trust in pharmaceutical companies that produce vaccines, trust in government agencies that approve and implement vaccination programs, and trust in the health system and healthcare providers.[24] In terms of perceptions regarding COVID-19 vaccines, those respondents who agreed that COVID-19 vaccines would decrease risk for getting COVID-19 ($p = .004$) or decrease risk of a serious case of COVID-19 ($p = .010$) were significantly less likely to be partially/unvaccinated. (Table 6) Alternatively, those respondents who were concerned the vaccine could have a negative effect on babies in the future were more likely to be partially/unvaccinated ($p = .021$) (Table 7).

Respondents indicated greatest confidence in local health-care workers (e.g., nurses and physicians) as trusted sources for information about COVID-19 vaccines. Female Community Health Volunteers (FCHVs) were significantly more trusted in Lumbini than in either Bagmati or Province 1. In addition, across the three study sites there were significant differences in levels of trust in pharmacists/medical shop owners, representatives of district and local health services, pharmaceutical companies, and experts and scientists. (Table 8) Those respondents who reported trust in health-care workers were less likely to be partially/unvaccinated (OR 0.13 [0.03–0.05]/$p = .01$). There were no significant differences in relation to vaccination status and trust for the other groups.

Perceptions of COVID-19 vaccines among healthcare workers

Health-care workers were one of the first groups of vaccine recipients in Nepal. Overall, 88.9% (176/198) of healthcare workers were fully vaccinated, (8.6%, 16) were partially vaccinated, and 2.5% ($n = 5$) were unvaccinated. A vast majority of health-care workers agreed that use of the vaccine would decrease risk of contracting COVID (91.9%/$n = 182$) and decrease risk of serious COVID (e.g., hospitalization) (94.9%/186). However, health-care workers did report concerns about the vaccine in terms of side effects, the risk of getting COVID-19 from the vaccine, and concerns about the development, production, and vaccine trials (Table 9).

Discussion

A range of factors have been identified at a global level affecting up-take of COVID-19 vaccines. In a review of global studies, these factors include gender, age, education, occupation, trust in authorities, vulnerability, and vaccine efficacy and safety.[25] In our study, higher education and higher monthly household income were associated with vaccine up-take, as well as, COVID-19 socio-economic impact and experience, vaccine safety and efficacy, and trust in health-care workers. Other regional studies in Bangladesh, India, and Pakistan have also found differences in vaccine acceptance by education and income, as well as vaccine efficacy. Within the region, other

Table 6. Positive perceptions about COVID-19 vaccines and vaccination status.

		Vaccinated, Partially Vaccinated, Unvaccinated		
Covariate	Level	Odds Ratio (95% CI)	OR *P*-value	Type3 *P*-value
The risk of short-term serious side effects from the COVID-19 vaccine is very low COVID 19	Agree	0.80 (0.54–1.18)	.260	.260
	Disagree	–	–	
The risk of long-term serious side effects from the COVID-19 vaccine is very low COVID 19	Agree	1.13 (0.79–1.61)	.491	.491
	Disagree	–	–	
The COVID-19 vaccine will decrease my risk for getting COVID 19	Agree	0.44 (0.25–0.77)	**.004**	**.004**
	Disagree	–	–	
The COVID-19 vaccine will decrease my risk of getting a serious case of COVID-19 (e.g., hospitalization)	Agree	0.46 (0.25–0.83)	**.010**	**.010**
	Disagree	–	–	

*Controlling for gender, education, employment, monthly household income, province.
*Number of observations in the original data set = 865. Number of observations used = 855.
Ordinal multivariate logistic regression.

Table 7. Negative perceptions about COVID-19 vaccines and vaccination status.

		Vaccinated, Partially Vaccinated, Unvaccinated		
Covariate	Level	Odds Ratio (95% CI)	OR *P*-value	Type3 *P*-value
If I receive the vaccine, it could cause me to get COVID 19	Agree	0.86 (0.62–1.19)	.357	.357
	Disagree	–	–	
I am concerned that the COVID-19 vaccines were developed too quickly	Agree	1.03 (0.69–1.53)	.901	.901
	Disagree	–	–	
I am concerned that the COVID-19 vaccines were produced in other countries	Agree	1.14 (0.70–1.85)	.602	.602
	Disagree	–	–	
I am concerned that COVID-19 vaccine trials have not been conducted with Nepali people	Agree	0.87 (0.57–1.34)	.532	.532
	Disagree	–	–	
I am concerned that COVID-19 vaccines could have a negative effect on babies I have in the future	Agree	1.64 (1.08–2.49)	**.021**	**.021**
	Disagree	–	–	
I am concerned that COVID-19 vaccines will affect my ability to have children in the future (effect fertility)	Agree	1.19 (0.72–1.95)	.501	.501
	Disagree	–	–	

**Controlling for gender, education, employment, monthly household income, province.
*Number of observations in the original data set = 865. Number of observations used = 831.
Ordinal multivariate logistic regression.

Table 8. Trusted sources for information about COVID-19 vaccines ('trust a lot') by province.

	Bagmati	Province 1	Lumbini	Total
Local Healthcare Providers[a]	69.7% (301)	64.4% (139)	77.2% (166)	70.2% (606)
Female community health volunteers[c]	14.8% (64)	22.8% (49)	64.0% (137)	29.1% (250)
Pharmacists/medical shop owners[a]	29.6% (128)	24.5% (53)	35.3% (76)	29.8% (257)
Representatives of Federal government	41.2% (178)	46.5% (101)	38.0% (79)	41.8% (358)
Representatives of district health services[a]	33.8% (146)	44.2% (96)	30.8% (65)	35.7% (307)
Representatives of local health services[b]	28.9% (125)	42.4% (92)	28.6% (61)	32.3% (278)
Pharmaceutical companies (producers of COVID-19 vaccines[a]	33.9% (146)	28.1% (61)	34.0% (70)	32.4% (277)
Experts/scientists[c]	29.2% (126)	14.3% (31)	35.0% (70	26.8% (229)

[a]$p < .05$; [b]$p < .01$; [c]$p < .001$.

studies have also indicated differences in acceptance by gender, age, perceived personal risk, and vaccine production country of origin.[9–12]

In Nepal, there were variations by the study site for vaccine acceptance including significant differences between the two rural sites. Differences in COVID-19 acceptance by geopolitical and socio-economic regions was similarly reported in a study in Bangladesh.[9] These differences highlight the need for in-country studies within and across regions to identify both generalized and specific factors contributing to vaccine acceptance. Variations by regions also require that outreach and communication efforts need to focus on different

Table 9. COVID-19 vaccine perceptions among health-care workers.

	Agree/Strongly Agree	Disagree/Strongly Disagree
Low risk of short-term effects from COVID-19 vaccine	79.2% (157)	20.8% (41)
Low risk of long-term effects from COVID-19 vaccine	63.1% (125)	36.9% (73)
Vaccine will decrease risk for getting COVID-19	91.9% (182)	8.1% (16)
Vaccine will decrease risk for serious COVID-19 (e.g., hospitalization)	93.9% (186)	6.1% (12)
Vaccine could cause me to get COVID-19	35.5% (70)	64.5% (127)
Concern that the COVID-19 vaccines were developed too quickly	52.0% (103)	48.0% (94)
Concern that the COVID-19 vaccines are produced in other countries	58.1% (115)	41.9% (83)
Concern that there have been no trials of the COVID-19 vaccines in Nepal	63.6% (126)	36.4% (72)
Concern that the COVID-19 vaccines could have negative effect on babies I have in the future	21.9% (43)	78.1% (153)
Concern that the COVID-19 vaccines could affect my ability to have children in the future (fertility)	13.2% (26)	86.8% (171)

messaging in different areas of the country and not rely on "all-in-one" messaging for the entire country. This is in keeping with consistent widescale findings regarding COVID-19 messaging in general and for vaccines.[26]

Over 50% of the total respondents reported feelings of depression, anxiety, and sadness during the pandemic with the highest rate in the urban site (63.3%). Literature suggests that concurrent with the pandemic, there is a mental health crisis both in terms of care for those who are diagnosed and identification of emerging mental health challenges across demographic groups and populations.[27, 28–30] In addition, over 65% of the respondents reported loss of job or decrease in income. These respondents were less likely to be fully vaccinated. On the other hand, those reporting feelings of depression, anxiety, and sadness were more likely to be fully vaccinated. At a global level, more research is needed to increase our understanding of the impact of complex socio-economic and psychosocial factors on families and communities during the pandemic and how these factors might contribute to engagement in preventive practices including vaccine up-take.[31]

In terms of vaccine hesitancy and complacency, severity, and vulnerability have been shown to contribute to decision-making about the use of vaccines.[32] In this study, there was no difference in perceptions about COVID-19 in terms of personal risk or disease severity between vaccination groups. This may be related to the overall high scores regarding perceptions of COVID-19 vulnerability and severity which suggests a general high level of concern among respondents about the disease.

Those who reported having been tested were more likely to be vaccinated. One interpretation of these data is that personal exposure (and therefore perceived risks) may affect vaccination acceptance. Alternatively, those who go for testing may be more concerned about disease spread and prevention and therefore more likely to be vaccinated.

Respondents who were vaccinated had more positive perceptions of COVID-19 vaccines in relation to vaccine effectiveness both in terms of preventing COVID-19 and decreasing risk for serious COVID (e.g., hospitalization). Those who perceived that the vaccine could have an effect on babies born in the future were more likely to be unvaccinated. Concerns about fertility and/or potential impact on future pregnancies are often associated with vaccine hesitancy. In the case of the COVID-19 vaccines, multiple factors have contributed to these concerns including the relatively short period of time for vaccine development, exclusion of pregnant women in early trials, and the persistent and rapid dissemination of information/misinformation through social media.[33–35] However, specific concerns about fertility and other negative perceptions including risk of contracting COVID from the vaccine, rapid vaccine development, and country of origin for vaccines and trials were not significantly related to vaccination status.

Health-care workers can also be vaccine hesitant.[36,37] In a 23 country study, approximately 15% of health-care workers were hesitant regarding use of COVID-19 vaccines.[38] Reasons cited include vaccine safety and efficacy, and distrust in vaccine science. In Nepal, less than 3% of health-care workers respondents were unvaccinated. However, negative perceptions of vaccine risks were reported by health-care workers including those who were vaccinated. In Nepal, the overall trust in local health-care workers can provide one approach that will ensure that specific barriers in different areas are addressed. Because of this level of trust, it is imperative that health-care workers are trained and have up-to-date information available to share with their patients and in their communities.[39] This could support a two-tiered approach in which local health-care providers receive training and training materials that they can use within their clinics and communities.

COVID-19 vaccination campaigns continue to be an essential component of disease prevention at a global level. Based on the differences contributing to vaccine hesitancy by demographics, experiences, and perceptions, public health communications must pursue a range of strategies to increase public confidence in available COVID-19 vaccines.[40] COVID-19 vaccine hesitancy remains an issue in Nepal and there is a need for ongoing efforts to communicate about the disease and vaccines, including boosters and vaccination of children and adolescents. However, these campaigns need to be locally focused on factors affecting vaccine up-take in diverse communities throughout Nepal and globally.[41]

There are limitations to this study. First, the study is cross-sectional and so assumptions cannot be made about direction or causality. The study was initiated in July 2021 and approved by the national ethics council in time for data to be collected in August and September 2021. The situation with COVID-19 in terms of prevalence, vaccine accessibility, vaccine policies concerning eligible recipients, and other prevention strategies change quickly. The oversampling of older adults may skew the results as these demographic groups were initially targeted for receipt of the vaccine. Due to funding restrictions, we were only able to conduct surveys in three provinces. However, the study team calculated a sample size which allowed data analysis by residency (urban/rural), province, and demographic groups. There was only one item to measure feelings of sadness and anxiety. Validated scales for depression or anxiety were not included in the survey and therefore may limit comparability with other studies of COVID-19 and mental health.

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