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Covid-19 vaccine compliance among residents of Kathmandu Valley

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ABSTRACT

Background: The Coronavirus disease 2019 (COVID-19) pandemic is a public health threat. Equitable access to safe and effective vaccines is critical to end the COVID-19 pandemic. Promoting the uptake of vaccines (particularly those against COVID-19) require the understanding whether people are willing to be vaccinated, and the reasons behind their decision.

Objectives: This study aimed to assess COVID-19 vaccine compliance and factors associated with it among residents of Kathmandu valley.

Methods: A cross-sectional analytical study was conducted among residents of Kathmandu valley through a pre-tested web-based self-administered questionnaire. A total of 390 respondents were selected to carry out this study. The collected data were entered into MS-excel and analyzed using SPSS IBM v. 25. Multivariable analysis was performed.

Results: Vaccine compliance was found in 94.1% of 390 respondents. Among the respondents, 91.5% had low risk perception of COVID-19; 85.4% had complete prior vaccination history; 61.3% perceived COVID-19 vaccine as effective; 65.6% perceived. COVID-19 vaccine as necessary whereas only 24.6 % believed the COVID-19 vaccine to be safe. Regarding COVID-19 vaccine compliance, females demonstrated a 3-fold higher likelihood than males (AOR= 3.0, 95%CI: 1.01-9.21). Complete vaccination history which had 31.9 times higher odds than no vaccination history (AOR=31.96, 95%CI: 9.72-105.14), perceived vaccine effectiveness which had 7.7 times higher odds than perceived ineffective (AOR= 7.75, 95%CI: 2.37-25.38), and high social influence which had 7.7 times higher odds compared to low social influence (AOR= 7.72, 95%CI: 2.19-27.12) were the associated factors with increased compliance.

Conclusion: This study revealed significantly high vaccine compliance rate in Kathmandu valley. Sex, complete vaccination history, perceived vaccine effectiveness and high social influence were the determinants for vaccine compliance which indicated the importance of ensuring people trust the vaccine's safety, utilizing social influence to encourage vaccination, and tailoring strategies to suit different demographics.

Keywords: COVID-19 vaccine, Prior vaccination history, Risk perception, Vaccine compliance

1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19, reached pandemic status on March 11th, 2020. SARS-CoV-2, the seventh human coronavirus, was discovered in Wuhan, Hubei province, China. As of October 25th, 2021, the virus had spread to 221 countries and territories, infected over 244 million people, and resulted in over 4 million deaths worldwide [1]. As with other respiratory viruses, SARS-CoV-2 transmission occurs with high efficacy and infectivity mainly through the respiratory route. Estimates of the reproduction number (R0) of SARS-CoV-2 range from 1.4-2.5 to 2.24–3.58 [2].

The latest estimates on COVID-19 pointed out a range of 60–75% immune individuals that would be necessary to halt the forward transmission of the virus and community spread of the virus [3-5]. However, vaccine hesitancy can be a decisive factor that would hinder the successful control of the current COVID-19 pandemic [6,7]. Factors that affect the attitude towards acceptance of vaccination included complacency, convenience and confidence [8,9]. The coronavirus disease 2019 (COVID-19) pandemic is a public health threat. Therefore, equitable access to safe and effective vaccines is critical to end the COVID-19 pandemic [9].

Promoting the uptake of vaccines (particularly those against COVID-19) will require understanding whether people are willing to be vaccinated, and the reasons behind them. Thus, estimates of vaccine acceptance rates can be helpful to plan actions and intervention measures necessary to increase the awareness and assure people about the safety and benefits of vaccines, which in turn would help to control virus spread and alleviate the negative effects of this unprecedented pandemic [10,11]. Hence, this study aimed to explore vaccine compliance rate and the factors associated with it.

2. Methods

2.1 Study Area

This study was conducted in Kathmandu valley, Nepal.

2.2 Study Design

This study employed a quantitative approach, conducting an analytical cross-sectional study to assess COVID-19 vaccine compliance and its associated factors among eligible individuals for vaccination.

2.3 Sample size and sampling

The study used purposive sampling for a web-based survey, with a sample size of 390 determined using the formula for sample size

calculation, considering a 10% non-response rate. Inclusion criteria involved eligible vaccination candidates in Kathmandu valley who were willing to participate, while exclusion criteria included respondents aged 18 or below and those facing technical difficulties in completing the survey.

2.4 Data Collection

The questionnaire used in this study was created by initially selecting relevant questions from previous research [12]. These questions were chosen based on their alignment with the study's objectives and the characteristics of the surveyed population. A panel of experts reviewed and validated the questionnaires, assessing them for clarity, relevance, and appropriateness. A pre-test was then conducted with a sample of 45 vaccine eligible respondents from Pokhara Metropolitan City to ensure consistency and to refine and finalize the questionnaires based on their feedback. Data were collected through self-administered questionnaires distributed via Google Forms. The study ensured validity through a comprehensive literature review and the adoption of questions from previous studies.

2.5 Data Analysis

Data were coded and organized using MS-Excel and SPSS-v22, followed by three phases of analysis: univariate, bivariate and multivariable analysis. Uni-variate analysis calculated percentages for each category of variables, while bivariate analysis determined the associations between independent and dependent variables through cross-tabulation. Thereafter, multiple logistic regression between the significantly associated variables ($p < 0.05$) resulted from bivariate analysis and vaccine compliance was performed. The findings were presented using charts, tables, and graphs.

2.6 Ethical Clearance

Ethical considerations were adhered to, with formal approval from the Institutional Review Committee (IRC) of Manmohan Memorial Institute of Health Science with the reference number of MMIHS-IRC617, informed consent from participants, and confidentiality maintained throughout the research process. The results were disseminated through research presentations within the college and submission of the research report to the Institutional Review Committee (IRC).

3. Results

3.1 Socio-demographic characteristics of the respondents

Table 1 shows the socio-demographic characteristics of the respondents. The mean age of respondents was 31.54. Out of 390 respondents, 50.3% were male and 49.7% were female. Most of the respondents belonged to Brahmin (35.6%) and Chhetri

(17.9%) community. The majority of the respondents (64.9%) were single. Almost all the respondents (92.3%) had formal education. More than half (55.4%) of respondents were un-employed/students. The field of occupation of the respondents was mainly from health sector (55.1%) followed by non-health sector (44.9%).

Table 1: Socio-demographic characteristics of respondents(n=390)

Variables	Frequency (n)	Percentage (%)
Age group		
18-25	188	48.2
26-35	81	20.8
36-45	55	14.1
Above 45	66	16.9
Mean ± SD	31.54 ± 12.267	
Sex		
Male	196	50.3
Female	194	49.7
Ethnicity		
Brahmin	139	35.6
Chhetri	70	17.9
Janjati	94	24.1
Dalit	39	10.1
Others	48	12.3
Marital status		
Single	253	64.9
Married	126	32.3
Divorced/Widowed	11	2.8
Educational status		
Formal education	359	92.3
Informal education	30	7.7
Employment status		
Employed	174	44.6
Un-employed/ Not-working	216	55.4
Field of occupation		
Non-health sector	175	44.9
Health sector	215	55.1

3.2 Independent variables

Table 2 shows the measurement of independent variables among the respondents. Among 390 respondents, the majority of the respondents (91.5%) had low perceived risk regarding COVID-19. Most of the respondents (85.4%) had a complete vaccination history in their lifetime as per national immunization schedule. More than half of the respondents (61.3%) perceived COVID-19 vaccine as effective. Most of the respondents (75.4%) perceived COVID-19 vaccine as unsafe or were afraid of vaccine's side-effects. Majority of respondents (90.8%) had high social influence by the family/community whereas only 9.2% respondents had low social influence. Around two-third (78.2%) of respondents had low trust in the health system of the country.

Table 2: Independent variables(n=390)

Variables	Frequency (n)	Percentage (%)
Perceived risk		
Low	357	91.5
High	33	8.5
Prior vaccination history		
Incomplete	57	14.6
Complete	333	85.4
Perceived effectiveness		
Ineffective	151	38.7
Effective	239	61.3
Perceived safety		
Unsafe	294	75.4
Safe	96	24.6
Social influence		
Low	36	9.2
High	354	90.8
Trust in the health system		
Low	305	78.2
High	85	21.8

3.3 Vaccine Compliance

Table 3 shows the COVID-19 vaccine compliance of residents of Kathmandu valley. Out of 390 respondents, almost all (94%) respondents were vaccinated whereas only 6% respondents were unvaccinated.COVID-19

Table 3: Vaccine Compliance (n=390)

Variable	Frequency (n)	Percentage (%)
COVID-19 Vaccine Compliance		
Unvaccinated	23	5.9
Vaccinated	367	94.1

3.4 Association of socio-demographic variables with vaccine compliance

Table 4 shows the association between socio-demographic variables and vaccine compliance. Females were more likely to comply COVID-19 vaccine in compared to males (p=0.019). Also, significant association was found between field of occupation and vaccine compliance(p=0.043). Respondents belonging to health sector were more likely to comply COVID-19 vaccine than respondents belonging from non-health sector.

Table 4: Association of socio-demographic variables with vaccine compliance (n=390)

Socio-demographic characteristics	Vaccine Compliance		P-value
	Unvaccinated n (%)	Vaccinated n (%)	
Age			0.543
18-25	9(4.8)	179(95.2)	
26-35	4(4.9)	77(95.1)	

Socio-demographic characteristics	Vaccine Compliance		P-value
	Unvaccinated n (%)	Vaccinated n (%)	
36-45	4(7.3)	51(92.7)	
Above 45	6(9.1)	60(90.9)	
Sex			0.019
Male	17 (8.7)	179(91.3)	
Female	6(3.1)	188(96.9)	
Ethnicity			0.175
Brahmin	7(5.0)	132(95.0)	
Chhetri	8(11.4)	62(88.6)	
Janjati	5(5.3)	89(94.7)	
Dalit	0(0.0)	39(100.0)	
Others	3(6.3)	45(93.8)	
Marital status			0.576
Single	14(5.5)	239(94.5)	
Married	9(7.1)	117(92.9)	
Divorced/Widowed	0 (0.0)	11 (100.0)	
Educational status			0.694
Formal education	21(5.8)	339(94.2)	
Informal education	2(6.7)	28(93.3)	
Employment status			0.328
Employed	8(4.6)	166(95.4)	
Un-employed/Not-working	15(6.9)	201(93.1)	
Field of occupation			0.043
Non-health sector	15(8.6)	160(91.4)	
Health sector	8(3.7)	207(96.3)	

3.5 Association of independent variables with vaccine compliance

Table 5 shows the association between other independents variables and vaccine compliance. Prior vaccination history, perceived effectiveness of COVID-19 vaccine and social influence were found to be significantly associated with vaccine compliance ($p<0.001$).

Table 5: Association of independent variables with vaccine compliance(n=390)

Variables	Vaccine Compliance		P-value
	Unvaccinated n (%)	Vaccinated n (%)	
Perceived risk			0.708
Low	22(6.2)	335(93.8)	
High	1(3.0)	32(97.0)	
Prior vaccination history			<0.001
Incomplete	16(28.1)	41(71.9)	
Complete	7(2.1)	326(97.9)	
Perceived effectiveness			<0.001
Ineffective	17(11.3)	134(88.7)	
Effective	6(2.5)	233(97.5)	
Perceived safety			0.407
Unsafe	19(6.5)	275(93.5)	
Safe	4(94.2)	92 (95.8)	
Social influence			<0.001
Low	7(19.4)	29(80.6)	
High	16(4.5)	338 (95.5)	
Trust in the health system			0.117
Low	21(6.9)	284 (93.1)	
High	2 (2.4)	83(97.6)	

3.6 Analysis of associated factors with vaccine compliance

Table 6 shows the results from binary logistic regression between the significantly associated variables and vaccine compliance. Females were about 3 times more likely to comply towards COVID-19 vaccine in compared to males (COR= 2.98, 95% CI: 1.15-7.72). Similarly, respondents belonging to health sector were 2.4 times more likely to comply towards COVID-19 vaccine as compared to respondents from non-health sector (COR=2.43, 95% CI: 1.01-5.86). Respondents having complete prior vaccination history were 18.17 times more likely to be vaccinated against COVID-19 than incomplete vaccinators (COR= 18.17, 95% CI: 7.06-46.79). Respondents perceiving COVID-19 vaccine as effective were 4.9 times more likely to comply towards vaccination rather than those perceiving it as non-effective (COR= 4.93, 95% CI: 1.89-12.79). Respondents having high social influence were 5 times more likely to comply towards vaccination than those with low social influence (COR=5.0, 95% CI:1.94 to 13.39).

Table 6: Bivariate logistic regression between the significantly associated variables and vaccine compliance

Factors	COVID-19 Vaccine Compliance		P-value
	COR	95% CI	
Sex			0.025
Male		1	
Female	2.98	1.15-7.72	
Field of occupation			0.049
Non-health		1	
Health	2.43	1.01-5.86	
Prior vaccination history			<0.001
Incomplete		1	
Complete	18.17	7.06-46.79	
Perceived effectiveness of COVID-19 vaccine			0.001
Ineffective		1	
Effective	4.93	1.89-12.79	
Social Influence			0.001
Low		1	
High	5.00	1.94-13.39	

3.7 Multiple logistic regression between the significantly associated variables resulted from bivariate analysis and vaccine compliance

Table 7 shows the multiple logistic regression between the significantly associated variables resulted from bivariate analysis and vaccine compliance. All explanatory variables were adjusted in this model. Females were 3 times more likely to comply towards COVID-19 vaccine as compared to males (Adjusted Odds Ratio (AOR)=3.043, 95% Confidence Interval (CI):1.005-9.213). Respondents having

complete prior vaccination history were 31.9 times more likely to be vaccinated against COVID-19 than incomplete vaccinators (AOR=31.96, 95% CI: 9.72-105.14). Respondents perceiving COVID-19 vaccine as effective were 7.7 times more likely to comply towards vaccination rather than those perceiving it as non-effective (AOR=7.75, 95% CI:2.37-25.38). Respondents having high social influence by their family/community were 7.7 times more likely to comply towards vaccination than those with low social influence (AOR=7.72, 95% CI: 2.19 - 27.12).

Table 7: Multiple logistic regressions between the significantly associated variables and vaccine compliance (n=390)

Variables	COVID-19 Vaccine Compliance		P-value
	AOR	95% CI	
Sex			0.049
Male		1	
Female	3.0	1.01-9.21	
Prior vaccination history			<0.001
Incomplete		1	
Complete	31.96	9.72-105.14	
Perceived effectiveness of COVID-19 vaccine			0.001
Ineffective		1	
Effective	7.75	2.37-25.38	
Social Influence			0.001
Low		1	
High	7.72	2.19-27.12	

4. Discussion

According to a systematic review of vaccine acceptance rates, the highest COVID-19 vaccine acceptance rates among adults representing the general population were found in Ecuador (97.0%), Malaysia (94.3%), Indonesia (93.3%) and China (91.3%) [13]. In Nepal, the COVID-19 vaccine compliance is 75.5% as of April 18,2022 [2]. In contrast, the current study conducted within the Kathmandu valley revealed a significantly higher vaccine compliance rate of 94.1%. The Kathmandu valley, being the capital and the most densely populated region in Nepal, might have benefited from better vaccine distribution infrastructure and a more extensive network of healthcare facilities, leading to higher accessibility. Additionally, increased awareness campaigns and educational efforts within the Kathmandu valley, driven by its urban environment and concentration of media outlets, might have contributed to a better-informed population regarding the importance of vaccination. Furthermore, government policies and regulations might also play a pivotal role in vaccine compliance. The observation that the government mandated the presentation of vaccination cards in public service areas may have had a major influence on residents of the Kathmandu valley, encouraging them to get

vaccination. Such measures could effectively create a sense of obligation and responsibility, driving individuals to participate in vaccination efforts.

In Nepal, a study found that more than half of young adults had a positive view of COVID-19 vaccines, and most felt satisfied with them. The study revealed links between factors like the field of study, having health insurance, fear of COVID-19, and education level with people's attitudes and perceptions [12]. This study also identifies the interconnected factors, such as perceived effectiveness and safety of vaccines, in shaping what people think about vaccines, highlighting the influence of different factors in how individuals perceive and approach vaccination. Both studies have unified stance for the widespread dissemination of accurate vaccine information and the dispelling of misinformation. These commonalities highlight the need for tailored interventions addressing these factors to enhance vaccine compliance.

A similar study conducted about COVID-19 vaccine acceptance in Nepal showed that vaccine acceptance was generally high among Nepalese (93%) and increased after the safety of vaccine was examined by the regulatory bodies (98%).In addition, perceived effectiveness of vaccine was found to be a significant predictor of vaccine acceptance [14]. The findings of both studies align affirming a generally high acceptance of COVID-19 vaccines among the Nepalese population. Furthermore, the identified significance of perceived vaccine effectiveness as a predictor of acceptance is consistent across studies, emphasizing the importance of conveying the efficacy of COVID-19 vaccines in promoting widespread compliance. The collective insights from these studies emphasize the need for comprehensive vaccination campaigns that not only address safety concerns but also highlight the effectiveness of the vaccines, fostering a robust foundation for enhanced vaccine acceptance in the Nepalese context.

A study in Greece showed that respondents who had been vaccinated for seasonal flu were significantly more likely to be willing to get vaccinated for COVID-19 (Odds Ratio (OR)=4.2, 95% CI :3.09 - 5.73) [9]. Prior history of receiving an influenza vaccine, both >12 months prior (AOR= 1.35, 95% CI: 1.24 -1.47) and during the last influenza season (AOR=1.44; 95% CI: 1.3 - 1.58), was associated with increased acceptability for vaccination against COVID-19 [15]. Our study results were aligned with previous research regarding the influence of prior vaccination history on COVID-19 vaccine compliance. This suggested that individuals with a history of vaccination may have a

heightened awareness of the benefits of immunization, making them more receptive to COVID-19 vaccines. Moreover, this study extended the understanding of the impact of prior vaccination history, emphasizing the enduring effect of past vaccination experiences on shaping attitudes toward COVID-19 vaccines and solidifies prior vaccination history as a significant predictor of COVID-19 vaccine compliance.

Consistent with prior research, healthcare workers had consistently demonstrated a higher level of support for COVID-19 vaccination. For instance, a multitude of studies had shown that healthcare professionals tend to exhibit a stronger inclination toward vaccine acceptance [16]. In the context of Nepal, a study revealed that respondents with a background in health science were 1.712 times more likely to hold a favorable perception of COVID-19 vaccines [17]. Building upon this evidence, the present study added to this understanding by showing that participants affiliated with the healthcare sector exhibited a 2.1-fold higher likelihood of complying with COVID-19 vaccination compared to those in non-health-related occupations. These findings highlighted the pivotal role that healthcare workers play in setting an example and fostering trust in vaccines, emphasizing the need to prioritize vaccine distribution and education among this group.

The study results revealed a significant positive association between perceived efficacy of the COVID-19 vaccine and the intention to receive it. This aligned with findings from previous studies conducted internationally within the context of this research. A study based in Eastern Europe showed that perceived efficacy of the COVID-19 vaccination had positive association with the intention to receive the COVID-19 vaccination ($\beta = 0.12, p < 0.001$).Vaccine compliance was positively associated with higher levels of perceived effectiveness of a COVID-19 vaccine (Risk ratio **(**RR**)** = 1.46, 95% CI: 1.40 to 1.52) [8]. Perceived efficacy serves as a critical determinant of vaccine acceptance because it directly influences an individual's risk perception. This study revealed that participants who perceived COVID-19 vaccine as effective were 7.751 times more likely to comply COVID-19 vaccine. The plausible reason behind this lies in the fundamental principle of vaccination acceptance: individuals are more likely to accept a vaccine when they believe it will effectively protect them from a specific disease. This perception of reduced risk in turn motivates them to comply with vaccination recommendations.

A study in Hong Kong showed that the vaccination decisions of respondents were heavily influenced by the decisions of their

family [18]. This study too indicated that social influence is a positive predictor of COVID-19 vaccine compliance. This can be attributed to the power of peer norms and conformity, where individuals tend to follow the behaviors of their social circles. Trusted recommendations from family members, healthcare professionals and respected figures within the community also contribute to this positive effect.

This study's finding of females being three times more likely to comply with COVID-19 vaccination was consistent with research conducted in the United States [2]. One possible explanation might be the disproportionate representation of females in the healthcare workforce. Globally, a significant portion of healthcare workers are women, and their direct exposure to COVID-19 patients may enhance their understanding of the virus's risks and the importance of vaccination. Additionally, women often play key roles as caregivers within families and communities, which can contribute to a higher likelihood of seeking out preventive healthcare services. These factors highlight the need for targeted vaccination campaigns that consider the unique roles and perspectives of different gender groups to ensure equitable vaccine distribution and coverage.

These findings offer valuable insights into demographic, perceptual, and societal determinants of vaccination behavior. To effectively combat the pandemic, it is imperative to apply these insights to tailored strategies that address specific demographic groups, build trust, and leverage the positive influence of social networks. By doing so, we can work collectively towards achieving higher vaccine acceptance rates and advancing the global effort to control and ultimately overcome the challenges posed by COVID-19.

The strengths of this study lie in its comprehensive assessment of various factors influencing vaccine compliance. It not only provided valuable insights into the demographic characteristics associated with vaccine acceptance but also delved into the crucial aspects of perceived risk, prior vaccination history, the perception of vaccine effectiveness and safety, social influence, and trust in the healthcare system.

Building upon the identified factors associated with COVID-19 vaccine compliance, several recommendations emerge. Firstly, targeted interventions should be designed to address safety perceptions, as a substantial proportion of respondents expressed hesitancy regarding the safety of the COVID-19 vaccine. Comprehensive educational campaigns addressing

misconceptions and emphasizing safety can play a pivotal role. Secondly, the observed gender disparity in vaccine compliance suggests the need for gender-specific strategies. Tailored communication and outreach efforts could be implemented to better engage and inform male populations, fostering increased vaccine acceptance. Furthermore, recognizing the significant influence of prior vaccination history and perceived effectiveness, future vaccination campaigns should highlight the success and benefits of prior vaccination experiences while

emphasizing the efficacy of the COVID-19 vaccine. Lastly, given the substantial impact of social influence on vaccine compliance, collaborative efforts involving community leaders, healthcare providers, and influential figures should be intensified. Community-based initiatives and partnerships can enhance trust and positively shape public attitudes toward COVID-19 vaccination.

5. Conclusion

Vaccine compliance was found to be high. Participants' sex, field of occupation, perceived effectiveness of vaccine, social influence and prior vaccination history were found to be significantly associated with the COVID-19 vaccine compliance. Therefore, this study highlights the high vaccine compliance rate in the Kathmandu valley and identifies key factors associated with it. These insights lay the groundwork for tailored strategies to ensure equitable vaccine access and acceptance across Nepal, ultimately contributing to the global effort to control and ultimately end the COVID-19 pandemic.

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