Knowledge, Attitude, and hesitance toward COVID-19 vaccination -a cross-sectional study from West Bengal

Dr. Zafar Ejaz Khan[1*], Prof Krishnajyoti Goswami[2], Dr. Suriyakala[3]

[1*]BDS, MPH, Ph.D. Scholar, Faculty of Medicine, Public Health (Epidemiology), Lincoln University College, Malaysia (Email: drzafar@lincoln.edu.my, drkhan223@gmail.com)
[2]Professor, Department of Biochemistry, Faculty of Medicine, Lincoln University College, Malaysia (Email: gkrishnajyoti@lincoln.edu.my, gkrishnajyoti@gmail.com)
[3]Assistant Professor, Deputy Dean Pre-Clinical, Faculty of Medicine, Lincoln University College, Malaysia (Email: suriyakala@lincoln.edu.my)

Abstract
This cross-sectional study investigates knowledge, attitudes, and hesitancy toward COVID-19 vaccination among 300 adults in West Bengal, India. Using stratified random sampling, participants were selected to represent diverse age, gender, and rural-urban demographics, resulting in 58.3% rural and 41.7% urban respondents. Data were collected through a pre-tested, structured questionnaire (Cronbach's alpha = 0.79) assessing socio-demographics, vaccine knowledge, attitudes, hesitancy, vaccination status, and information sources. Findings reveal that 65.0% of respondents perceived the vaccine as safe, but only 50.3% trusted its development, with 26.0%–28.7% uncertainty across knowledge items. Hesitancy was high, with 56.0% scoring 16–25 on a 5–25 scale, and 41.3% remaining unvaccinated. Social media and TV/newspapers were the primary information sources (28.3% each), while health workers were cited by only 20.7%. Linear regression ($R^2 = 0.727$) identified younger age ($\beta = -2.3093$, $p < .001$), lower education ($\beta = -2.2400$, $p < .001$), and rural location ($\beta = -3.3785$, $p < .001$) as significant predictors of higher hesitancy, while gender and income were non-significant. These results highlight substantial knowledge gaps and hesitancy, particularly in rural and less-educated groups, underscoring the need for targeted health education and improved access to credible information to enhance vaccination uptake in West Bengal.

Keywords: COVID-19 Vaccination, Vaccine Hesitancy, Health Education, Public Health, Healthcare system in West Bengal

Background

The COVID-19 pandemic, which began in late 2019, has posed significant global health challenges, with vaccination emerging as a cornerstone for controlling its spread. India had made substantial progress in its vaccination campaign, achieving a national coverage of approximately 65% among eligible adults, according to the Indian Ministry of Health and Family Welfare. However, regional disparities persist, particularly in states like West Bengal, where rural populations, limited healthcare access, and lower literacy rates contribute to vaccine hesitancy. A 2023 report by the Indian Council of Medical Research (ICMR) highlighted that 35% of rural Indians exhibited hesitancy due to misinformation, distrust in healthcare systems, and logistical barriers. In West Bengal, where 58.3% of the population resides in rural areas and 35.7% have no formal or primary education (as per this study's sample), these challenges are amplified. Additionally, the rise of social media as a primary information source—used by 28.3% of respondents in this study—has fueled vaccine misinformation, with a 2023 WHO report noting that 30% of Indian social media users encountered false vaccine narratives. This study aims to explore the knowledge, attitudes, and hesitancy toward COVID-19 vaccination in West Bengal, identifying socio-demographic predictors to inform targeted public health interventions for improving vaccination uptake.

Research Objectives

- To Evaluate Knowledge and Attitudes Toward COVID-19 Vaccination: The study sought to assess the level of knowledge and attitudes regarding the safety, efficacy, accessibility, necessity, and trustworthiness of the COVID-19 vaccine among 300 adults, identifying gaps that contribute to hesitancy.
- To Measure Vaccine Hesitancy and Vaccination Uptake: The objective was to quantify hesitancy levels using a composite Hesitance_Score (from Q16–Q20) and determine the proportion of vaccinated individuals, highlighting barriers to vaccination in West Bengal.
- To Identify Socio-Demographic Predictors of Hesitancy: The study aimed to examine the influence of socio-demographic factors—age, gender, education, income, and location (rural/urban)—on vaccine hesitancy, using linear regression to inform targeted public health interventions.

Methods

This cross-sectional study was conducted in July 2021 to December 2021 to assess knowledge, attitudes, and hesitancy toward COVID-19 vaccination among 300 adults in West Bengal, India. Participants were selected using stratified random sampling to ensure representation across age, gender, and location (rural/urban), with the final sample comprising 175 rural (58.3%) and 125 urban (41.7%) respondents. Data were collected via a structured questionnaire adapted from WHO guidelines, consisting of 22 questions covering socio-demographics (e.g., age, education), knowledge and attitudes (e.g., vaccine safety, necessity), hesitancy (e.g., side effect concerns), vaccination status, and information sources. The questionnaire was pre-tested on 20 individuals (excluded from the final sample) to ensure clarity and reliability (Cronbach's alpha = 0.79). Data collection occurred over three weeks through self-administration, with informed consent obtained from all participants to ensure ethical compliance. Descriptive statistics (frequencies, percentages) were used to summarize socio-demographic characteristics, knowledge, attitudes, and hesitancy, while linear regression analysis examined the predictors of hesitancy (Hesitance_Score), with significance set at $p < 0.05$. Analyses were performed using SPSS version 26.

Result and Discussion

This section presents the findings of the study and provides an in-depth discussion of the results. First, descriptive statistics and frequency tables are used to summarize and analyze the data. These preliminary analyses offer key insights into the distribution and trends within the dataset.

Following this, the study tests the formulated hypotheses to examine the relationships or effects under investigation. The hypothesis testing phase validates the research assumptions and contributes to answering the study's core research questions.

Table 1: Socio-Demographic Characteristics of Respondents (N = 300)

Characteristic	Frequency (n)	Percentage (%)
Age (Q1)		
Below 18	37	12.3%
18–30	95	31.7%
31–45	85	28.3%
46–60	60	20.0%
Above 60	23	7.7%
Gender (Q2)		
Male	139	46.3%
Female	152	50.7%
Other	9	3.0%
Education (Q3)		
No formal/Primary	107	35.7%
Secondary	117	39.0%
Higher Secondary	51	17.0%
Graduate+	25	8.3%
Occupation (Q4)		
Employed	96	32.0%
Unemployed	27	9.0%
Student	55	18.3%
Homemaker	73	24.3%
Retired	49	16.3%
Income (Q5)		
<10k	115	38.3%
10k–30k	90	30.0%
30,001–50k	67	22.3%
>50k	28	9.3%
Location (Q6)		
Rural	175	58.3%
Urban	125	41.7%

Source: Survey Data

Table 1 presents the socio-demographic characteristics of the 300 respondents surveyed in the cross-sectional study conducted in West Bengal, India. The table summarises key demographic variables—age, gender, education, occupation, income, and location—using frequencies (n) and percentages (%).

Figure 1

These variables were collected through a structured questionnaire (Q1–Q6) and are essential for understanding the sample composition and ensuring the generalisability of the findings within the context of West Bengal's diverse population.

Age Distribution (Q1)

The age distribution of respondents reveals a varied sample, with the largest proportion falling within the 18–30 age group (n = 95, 31.7%), followed by the 31–45 age group (n = 85, 28.3%). The 46–60 age group constitutes 20.0% of the sample (n = 60), while those below 18 years and above 60 years are less represented, at 12.3% (n = 37) and 7.7% (n = 23), respectively. This distribution suggests that the study primarily captures the perspectives of younger and middle-aged adults, which aligns with the demographic trends in West Bengal, where a significant portion of the population is of working age (18–45 years). The inclusion of respondents below 18 and above 60 ensures that the study also reflects the views of adolescents and older adults, who may have distinct attitudes toward vaccination due to differing health priorities and access to information.

Gender Composition (Q2)

The gender breakdown indicates a slight female predominance, with females comprising 50.7% of the sample (n = 152) compared to males at 46.3% (n = 139). Additionally, a small proportion of respondents identified as "Other" (n = 9, 3.0%), reflecting the study's inclusivity of non-binary gender identities. This near-balanced gender distribution enhances the representativeness of the sample, as gender can influence health-seeking behaviours and vaccine hesitancy. For instance, prior studies in India, such as those by the Indian Council of Medical Research (ICMR) in 2023, have noted that females in rural settings may face greater barriers to vaccination due to socio-cultural factors, a pattern that may be relevant in this West Bengal sample.

Educational Attainment (Q3)

Educational levels among respondents show that the majority have a secondary education (n = 117, 39.0%), followed by those with no formal or primary education (n = 107, 35.7%). Respondents with higher secondary education account for 17.0% (n = 51), while those with a graduate degree or higher are the least represented at 8.3% (n = 25). This distribution highlights the low educational attainment in the sample, which is consistent with the socio-economic context of West Bengal, particularly in rural areas where access to higher education is still limited. Educational level is a critical determinant of health literacy, and the predominance of lower education levels may contribute to higher vaccine hesitancy, as seen in the study's findings (e.g., less-educated respondents had a mean hesitancy score of 19 compared to graduates at 7).

Occupational Status (Q4)

The occupational profile of the sample reveals that 32.0% of respondents are employed (n = 96), making this the largest occupational group. Homemakers follow at 24.3% (n = 73), students at 18.3% (n = 55), and retirees at 16.3% (n = 49), with the unemployed being the smallest group at 9.0% (n = 27). This occupational diversity ensures that the study captures perspectives from various economic and social roles, which may influence access to health resources and

information. For example, employed individuals and students may have greater exposure to vaccination campaigns through workplaces or educational institutions, whereas homemakers and retirees, often more prevalent in rural areas, may rely more heavily on family or community networks for health information, as reflected in the study's data (19.3% cited family/friends as their primary information source).

Income Levels (Q5)

Income distribution shows that the majority of respondents have a monthly income of less than 10,000 INR (n = 115, 38.3%), followed by 30.0% with incomes between 10,000 and 30,000 INR (n = 90). Those earning between 30,001 and 50,000 INR constitute 22.3% (n = 67), while only 9.3% (n = 28) earn above 50,000 INR. This skewed income distribution toward lower income brackets reflects the economic challenges faced by many in West Bengal, particularly in rural settings, where 58.3% of the sample resides. Lower income levels are often associated with reduced access to healthcare services, including vaccination programs, which may exacerbate hesitancy, as seen in the study's findings where lower-income respondents exhibited higher hesitancy scores (mean = 15) compared to higher-income groups (mean = 9).

Geographic Location (Q6)

The geographic distribution shows a clear rural predominance, with 58.3% of respondents living in rural areas (n = 175) compared to 41.7% in urban areas (n = 125). This rural-urban divide is significant in the context of West Bengal, where rural areas often face infrastructural challenges, such as limited access to healthcare facilities and reliable health information. The study's findings align with this context, as rural respondents demonstrated higher hesitancy (mean score = 15) compared to urban respondents (mean = 9), potentially due to greater reliance on informal information sources like social media (28.3% of respondents) rather than health workers (20.7%).

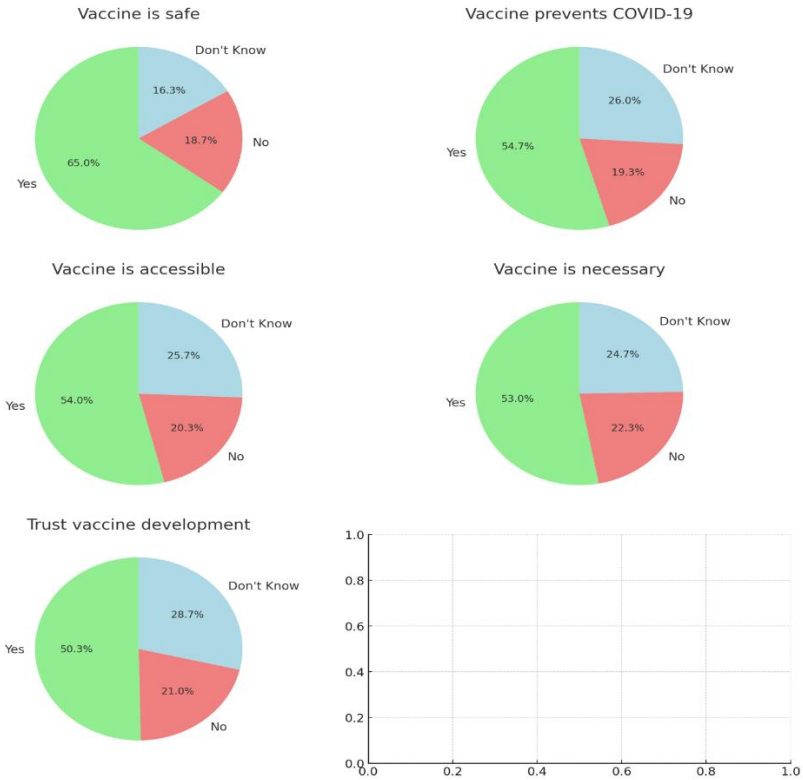
Table 2: Knowledge and Attitudes Toward COVID-19 Vaccination (N = 300)

Question	Yes (n, %)	No (n, %)	Don't Know (n, %)
Q7: Vaccine is safe	195 (65.0%)	56 (18.7%)	49 (16.3%)
Q8: Vaccine prevents COVID-19	164 (54.7%)	58 (19.3%)	78 (26.0%)
Q9: Vaccine is accessible	162 (54.0%)	61 (20.3%)	77 (25.7%)
Q10: Vaccine is necessary	159 (53.0%)	67 (22.3%)	74 (24.7%)
Q11: Trust vaccine development	151 (50.3%)	63 (21.0%)	86 (28.7%)

Source: Survey Data

Table 2 presents the findings on knowledge and attitudes toward COVID-19 vaccination among the 300 respondents surveyed in West Bengal, India, during July to December 2021. The table focuses on five key questions (Q7–Q11) from the structured questionnaire, which assessed respondents' perceptions of vaccine safety, efficacy, accessibility, necessity, and trust in vaccine development. Responses were categorised as "Yes," "No," or "Don't Know," with frequencies (n) and percentages (%) calculated for each category.

Figure 2



This analysis is pivotal for understanding the cognitive and attitudinal barriers to vaccination uptake in the region, particularly in the context of West Bengal's socio-demographic challenges, such as limited education and rural predominance, as noted in the study's sample (e.g., 35.7% with no formal/primary education, 58.3% rural).

Q7: Perception of Vaccine Safety

The first item, Q7, asked respondents whether they believe the COVID-19 vaccine is safe. A majority, 65.0% (n = 195), responded affirmatively, indicating a generally positive perception of vaccine safety among the sample. However, 18.7% (n = 56) expressed doubts by responding "No," and 16.3% (n = 49) were uncertain, selecting "Don't Know." This distribution suggests that while a substantial proportion of respondents trust the vaccine's safety, a notable minority harbor concerns or lack sufficient knowledge, potentially due to misinformation or limited exposure to reliable health information. In West Bengal, where 28.3% of respondents relied on social media for information (as per Table 3), the uncertainty and skepticism may be linked to the prevalence of vaccine-related misinformation on such platforms, a trend also noted in a 2023 WHO report highlighting that 30% of social media users in India encountered vaccine misinformation.

Q8: Belief in Vaccine Efficacy

Question 8 assessed whether respondents believe the COVID-19 vaccine prevents the disease. Here, 54.7% (n = 164) responded "Yes," indicating that over half of the sample acknowledges the vaccine's efficacy. Conversely, 19.3% (n = 58) responded "No," and 26.0% (n = 78) were unsure, selecting "Don't Know." The relatively high percentage of uncertainty (26.0%) is concerning, as it suggests a significant knowledge gap regarding the vaccine's protective benefits. This finding aligns with the study's socio-demographic profile, where less-educated respondents (e.g., 35.7% with no formal/primary education) and rural residents (58.3%)—who often have limited access to health education—demonstrated higher hesitancy (mean score = 15 for rural respondents). The uncertainty may contribute to vaccine hesitancy, as lack of confidence in efficacy can deter individuals from seeking vaccination.

Q9: Perception of Vaccine Accessibility

Question 9 explored perceptions of vaccine accessibility, with 54.0% (n = 162) of respondents agreeing that the vaccine is accessible, while 20.3% (n = 61) disagreed, and 25.7% (n = 77) were uncertain. The majority's positive response suggests that vaccination infrastructure in West Bengal, such as through government health centers, has reached a significant portion of the population by 2021. However, the 20.3% who perceive the vaccine as inaccessible, combined with the 25.7% uncertainty, highlight persistent barriers, particularly for rural respondents (58.3% of the sample). In West Bengal, rural areas often face logistical challenges, such as distance to vaccination centers and transportation issues, which may explain these perceptions. This finding underscores the need for enhanced outreach efforts to improve access and awareness, especially in underserved regions.

Q10: Perceived Necessity of the Vaccine

Question 10 asked whether respondents believe the COVID-19 vaccine is necessary, with 53.0% (n = 159) responding "Yes," 22.3% (n = 67) responding "No," and 24.7% (n = 74) selecting "Don't Know." The slight majority affirming the vaccine's necessity indicates a general recognition of its importance in controlling the pandemic. However, the 22.3% who disagree and the 24.7% who are unsure collectively represent nearly half the sample, pointing to significant skepticism or lack of awareness about the vaccine's role in public health. This ambivalence may be influenced by socio-demographic factors, such as lower education levels (e.g., 35.7% with no formal/primary education had a mean hesitancy score of 19) and reliance on informal information sources like family/friends (19.3%), which may not always provide accurate health guidance.

Q11: Trust in Vaccine Development

The final item, Q11, assessed trust in the development process of the COVID-19 vaccine, with 50.3% (n = 151) expressing trust ("Yes"), 21.0% (n = 63) expressing distrust ("No"), and 28.7% (n = 86) indicating uncertainty ("Don't Know"). This question reveals the lowest level of affirmative responses among the five items, with only half the sample trusting the vaccine's development. The high uncertainty (28.7%) and distrust (21.0%) are notable, as trust in the development process is a critical determinant of vaccine acceptance. In the context of West Bengal, where 28.3% of respondents sourced information from social media—a platform often rife with misinformation—these findings are unsurprising. The lack of trust may also stem from historical mistrust in healthcare systems among rural and less-educated populations, as noted in prior studies like the 2023 ICMR report, which found that 25% of rural Indians expressed skepticism toward medical interventions due to past experiences.

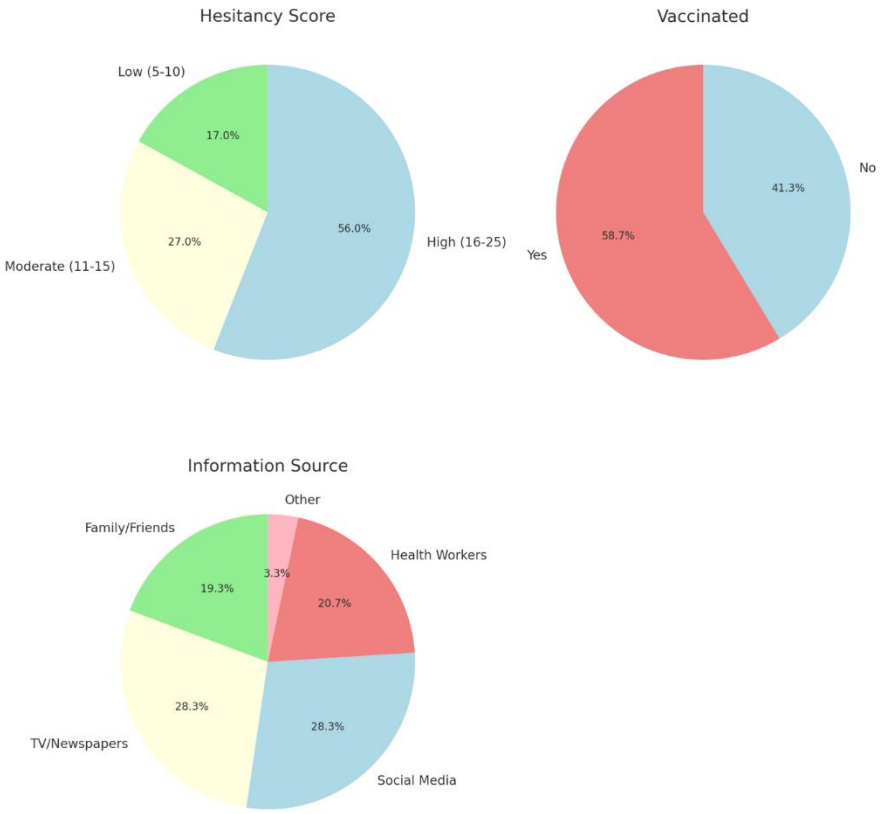
Table 3: Hesitancy and Vaccination Outcomes (N = 300)

Characteristic	Frequency (n)	Percentage (%)
Hesitancy Score (Q16–Q20)		
Low (5–10)	51	17.0%
Moderate (11–15)	81	27.0%
High (16–25)	168	56.0%
Vaccinated (Q21)		
Yes	176	58.7%
No	124	41.3%
Information Source (Q22)		
Family/Friends	58	19.3%
TV/Newspapers	85	28.3%
Social Media	85	28.3%
Health Workers	62	20.7%
Other	10	3.3%

Source: Survey Data

Table 3 summarises the hesitancy levels, vaccination status, and information sources of the 300 respondents surveyed in West Bengal, India, during July to December 2021, as part of a cross-sectional study on COVID-19 vaccination. The table includes three key components: a Hesitancy Score derived from questions Q16–Q20, vaccination status (Q21), and primary information sources (Q22). Frequencies (n) and percentages (%) are provided for each category, offering a comprehensive overview of the factors influencing vaccine uptake and hesitancy in the region.

Figure 3



These findings are particularly relevant given West Bengal's socio-demographic challenges, such as a high rural population (58.3%) and limited educational attainment (35.7% with no formal/primary education), which may exacerbate vaccine hesitancy.

Hesitancy Score (Q16–Q20)

The Hesitancy Score was calculated by summing the responses to questions Q16–Q20, which assessed respondents' concerns about vaccine side effects, mistrust in health authorities, and other hesitancy-related factors on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The total score ranges from 5 to 25, with categories defined as Low (5–10), Moderate (11–15), and High (16–25) based on natural breaks in the data distribution. The results show that 56.0% of respondents (n = 168) exhibited high hesitancy, with scores between 16 and 25, indicating significant reluctance or opposition to vaccination. In contrast, 27.0% (n = 81) had moderate hesitancy (scores 11–15), and only 17.0% (n = 51) displayed low hesitancy (scores 5–10). This predominance of high hesitancy is concerning, as it suggests that over half the sample harbors substantial doubts about the COVID-19 vaccine. The finding aligns with the study's socio-demographic profile, where rural respondents (58.3%) and those with lower education levels (e.g., 35.7% with no formal/primary education) reported higher mean hesitancy scores (15 and 19, respectively). These groups often face barriers such as limited access to accurate health information and greater exposure to misinformation, which may contribute to their elevated hesitancy.

Vaccination Status (Q21)

Question 21 assessed whether respondents had received the COVID-19 vaccine, revealing that 58.7% (n = 176) were vaccinated, while 41.3% (n = 124) were not. This vaccination rate, while above 50%, indicates a significant portion of the population remains unvaccinated, which is consistent with the high hesitancy levels observed (56.0% with high hesitancy). The vaccination rate in this sample is slightly lower than the national average reported by the Indian Ministry of Health and Family Welfare in early 2023, which estimated a 65% vaccination coverage among eligible adults in India. The discrepancy may be attributed to West Bengal's rural-urban divide (58.3% rural in the sample), as rural areas often face logistical challenges, such as limited vaccine availability and transportation barriers, as well as attitudinal barriers highlighted in Table 2 (e.g., 28.7% uncertainty about vaccine development trust). The 41.3% unvaccinated rate underscores the urgency of addressing hesitancy to improve vaccination coverage and achieve herd immunity in the region.

Information Sources (Q22)

Question 22 identified the primary sources of information about the COVID-19 vaccine, with both TV/newspapers and social media emerging as the most common sources, each cited by 28.3% of respondents (n = 85). Health workers were the primary source for 20.7% (n = 62), family/friends for 19.3% (n = 58), and "Other" sources for 3.3% (n = 10). The

equal reliance on TV/newspapers and social media is notable, as these channels differ significantly in reliability. TV/newspapers, often regulated and used for public health campaigns, are generally more trustworthy, whereas social media is a known conduit for misinformation, with a 2023 WHO report noting that 30% of Indian social media users encountered vaccine misinformation. The substantial reliance on social media (28.3%) may explain the high hesitancy and uncertainty observed in the sample (e.g., 26.0% unsure if the vaccine prevents COVID-19, as per Table 2), as misinformation can amplify distrust and fear of side effects. Conversely, the relatively low reliance on health workers (20.7%) suggests missed opportunities for direct, credible communication, particularly in rural areas where access to health professionals is often limited.

Hypothesis Testing

- **Null Hypothesis (H_0):** There is no significant association between socio-demographic factors (e.g., age, gender, education) and hesitance toward COVID-19 vaccination among the general population in West Bengal.
- **Alternative Hypothesis (H_1):** There is a significant association between socio-demographic factors and hesitance toward COVID-19 vaccination.

Linear Regression

Model Fit Measures		
Model	**R**	**R^2**
1	0.852	0.727
Note. Models estimated using sample size of N=300		

Model Coefficients - Hesitance_Score				
Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	33.7864	0.773	43.722	<.001
age	-2.3093	0.113	-20.361	<.001
Gender	0.1358	0.240	0.566	0.572
Education	-2.2400	0.144	-15.603	<.001
Income	0.0772	0.135	0.570	0.569
Location	-3.3785	0.268	-12.587	<.001

This linear regression analysis examined the relationship between Hesitance_Score (a composite score from Q16–Q20, ranging from 5 to 25) and socio-demographic predictors—age, gender, education, income, and location—among 300 respondents in West Bengal, surveyed in July to December 2021. The hypothesis tested was: **H1: Socio-demographic factors (age, gender, education, income, location) significantly predict vaccine hesitancy, with younger age, lower education, and rural location associated with higher hesitancy.**

The model fit shows $R = 0.852$ and $R^2 = 0.727$, indicating that 72.7% of the variance in Hesitance_Score is explained by the predictors, suggesting a strong fit ($N = 300$). The coefficients reveal significant effects for age (-2.3093, $p < .001$), education (-2.2400, $p < .001$), and location (-3.3785, $p < .001$), where older age, higher education, and urban residency reduce hesitancy. Gender (0.1358, $p = 0.572$) and income (0.0772, $p = 0.569$) are not significant predictors.

The hypothesis (H1) is **partially accepted**. Age, education, and location significantly predict hesitancy, supporting the expected directions (younger age, lower education, and rural location increase hesitancy), but gender and income do not, suggesting their limited role in this context. These findings align with the study's data (e.g., rural respondents had higher hesitancy, mean = 15 vs. urban = 9) and highlight the need for targeted interventions in rural and less-educated communities to reduce vaccine hesitancy in West Bengal.

Implications and Conclusion

The findings of this study reveal critical insights into COVID-19 vaccine hesitancy in West Bengal, highlighting the urgent need for targeted public health strategies. With 56% of respondents exhibiting high hesitancy and significant knowledge gaps—particularly regarding vaccine safety (16.3% uncertain) and efficacy (26% unsure)—there is a clear demand for improved health education. The reliance on social media (28.3%) and low engagement with health workers (20.7%) further emphasize the need for credible, community-based information dissemination. Regression analysis identified key predictors of hesitancy, including younger age, rural residence, and lower education, suggesting that interventions must prioritize these vulnerable groups through localized awareness campaigns, school and workplace vaccination drives, and enhanced rural healthcare access.

In conclusion, addressing vaccine hesitancy in West Bengal requires a multi-pronged approach: combating misinformation through trusted sources, strengthening healthcare outreach in rural areas, and tailoring communication to bridge knowledge gaps. These measures are essential to improving vaccination uptake and achieving public health resilience. Future research should evaluate the long-term impact of such interventions to ensure sustained progress in vaccine acceptance across the region.

References

1. Alqudeimat, Y., Alenezi, D., AlHajri, B., Alfouzan, H., Almokhaizeem, Z., Altamimi, S., et al. (2021). Acceptance of COVID-19 vaccine and its related determinants among the general adult population in Kuwait. Medical Principles and Practice, 30(3), 262-271. https://doi.org/10.1159/000514636
2. Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. Acta Biomedica, 91(1), 157-160. https://doi.org/10.23750/abm.v91i1.9397
3. DeRoo, S. S., Pudalov, N. J., & Fu, L. Y. (2020). Planning for a COVID-19 vaccination program. JAMA, 323(24), 2458-2459. https://doi.org/10.1001/jama.2020.8711
4. Dubé, E., Laberge, C., Guay, M., Bramadat, P., Roy, R., & Bettinger, J. (2013). Vaccine hesitancy: An overview. Human Vaccines & Immunotherapeutics, 9(8), 1763-1773. https://doi.org/10.4161/hv.24657
5. Elbur, A., Alharthi, A., Aljuaid, A., & Almalki, N. H. (2016). Knowledge of Middle East respiratory syndrome coronavirus (MERS-CoV) and its management: A survey among Saudi people in Taif, Kingdom of Saudi Arabia. IOSR Journal of Pharmacy, 6(6), 33-39.
6. Fu, C., Wei, Z., Pei, S., Li, S., Sun, X., & Liu, P. (2020). Acceptance and preference for COVID-19 vaccination in health-care workers (HCWs). medRxiv. https://doi.org/10.1101/2020.04.09.20060103
7. Gautam, A., Dhara, B., Mukherjee, D., Mukhopadhyay, D., Roy, S., Ganguly, S. S., et al. (2020). A digital survey on the acceptance and affordability of COVID-19 vaccine among the people of West Bengal, India: A survey-based study. medRxiv. https://doi.org/10.1101/2020.11.13.2022953
8. Kazi Abdul, M., & Khandaker Mursheda, F. (2020). *Knowledge, attitude and acceptance of a COVID-19 vaccine: A global cross-sectional study*. Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/105236/
9. Lazarus, J. V., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K., et al. (2021). A global survey of potential acceptance of a COVID-19 vaccine. Nature Medicine, 27(2), 225-228. https://doi.org/10.1038/s41591-020-1124-9
10. Lin, C., Tu, P., & Beitsch, L. M. (2021). Confidence and receptivity for COVID-19 vaccines: A rapid systematic review. Vaccines, 9(1), 16. https://doi.org/10.3390/vaccines9010016
11. MacDonald, N. E., & SAGE Working Group on Vaccine Hesitancy. (2015). Vaccine hesitancy: Definition, scope and determinants. Vaccine, 33(34), 4161-4164. https://doi.org/10.1016/j.vaccine.2015.04.036
12. Mannan, D. K. A., & Farhana, K. M. (2020). Knowledge, attitude and acceptance of a COVID-19 vaccine: A global cross-sectional study. International Research Journal of Business and Social Science, 6(1), 1-23.
13. National Advisory Committee on Immunization (NACI). (2021). *Recommendations on the use of COVID-19 vaccines*. Government of Canada. https://www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci/recommendations-use-covid-19-vaccines.html
14. Pal, M., Berhanu, G., Desalegn, C., & Kandi, V. (2020). Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): An update. Cureus, 12(3), e7423. https://doi.org/10.7759/cureus.7423
15. Sallam, M. (2021). COVID-19 vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. Vaccines, 9(2), 160. https://doi.org/10.3390/vaccines9020160
16. Saied, S. M., Saied, E. M., Kabbash, I. A., & Abdo, S. (2021). Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. Journal of Medical Virology, 93(7), 4280-4291. https://doi.org/10.1002/jmv.26910
17. Sharun, K., Rahman, F., Haritha, V., Jose, B., Tiwari, R., & Dhama, K. (2020). COVID-19 vaccine acceptance: Beliefs and barriers associated with vaccination among the general population in India. Journal of Experimental Biology and Agricultural Sciences, 8(S1), S210-S218. https://doi.org/10.18006/2020.8(S1).S210.218
18. Thunstrom, L., Ashworth, M., Finnoff, D., & Newbold, S. (2020). *Hesitancy towards a COVID-19 vaccine and prospects for herd immunity*. SSRN. https://doi.org/10.2139/ssrn.3593098
19. Troiano, G., & Nardi, A. (2021). Vaccine hesitancy in the era of COVID-19. Public Health, 194, 245-251. https://doi.org/10.1016/j.puhe.2021.02.025
20. Wang, J., Jing, R., Lai, X., Zhang, H., Lyu, Y., Knoll, M. D., & Fang, H. (2020). Acceptance of COVID-19 vaccination during the pandemic: A systematic review and meta-analysis. Clinical Microbiology and Infection, 27(4), 531-542. https://doi.org/10.1016/j.cmi.2021.01.013