Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Navigating Systemic Challenges in Rural Health Care Utilization During COVID-19 Infection

Richa panchgaur

richa.gaur@vupune.ac.in

Vishwakarma University

Ashish Kumar Verma

Banaras Hindu University

Alok Kumar

Banaras Hindu University

Research Article

Keywords: Suspected COVID-19, Health, Primary data, Log linear model

Posted Date: May 21st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9575974/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Navigating Systemic Challenges in Rural Health Care Utilization During COVID 19 Infection

Richa Panchgaur[1*], Ashish Kumar Verma[2], Alok Kumar[2]

1- Corresponding Author*
email: richa.gaur@vupune.ac.in
Department of Mathematics & Statistics, Vishwakarma University, Pune, Maharashtra
2-Department of Statistics, Banaras Hindu University, Varanasi, Uttar Pradesh

Abstract

Background: During the second wave of the COVID-19 pandemic, rural populations in India were significantly affected. However, limited access to testing facilities, a lack of awareness, and inadequate healthcare infrastructure led many individuals in these areas to misinterpret COVID-19 symptoms as those of a common cold or seasonal illness.

Objectives: This study examined the socio-demographic characteristics of suspected COVID-19 individuals in rural communities as well as their medication-taking status during COVID-19 symptoms.

Data and Methods: A cross-sectional survey was conducted through personal interviews with rural individuals from March to April 2022. Multistage sampling techniques were employed to collect the data. For analysis, we used a sample of 1,703 individuals. We assessed the suspicion of COVID-19 in relation to the sociodemographic characteristics of the participants using the Chi-square test. Additionally, a log-linear regression model was utilized to examine the association between socio-demographic characteristics, suspected COVID-19, and the medications taken during the experience of COVID-19 symptoms.

Findings: The study revealed that 40.4% individuals were suspected with COVID-19. Age, religion, caste and socio-economic class were significantly associated with suspected COVID-19 cases. The log-linear analysis shows a significant association between socio-economic variables and medicine intake for COVID-19 symptoms, with higher odds among non-SC/ST and upper and middle-class individuals ($p < 0.01$).

Policy Implications: The findings highlight the urgent need for targeted health awareness campaigns and improved access to healthcare in rural areas, especially for Scheduled Castes /Scheduled Tribes, and lower socio-economic groups. Community-level interventions and culturally sensitive outreach are essential for bridging the gaps in health literacy and effectively reducing disparities during future pandemics.

Keywords: Suspected COVID-19, Health, Primary data, Log linear model

Introduction

The rural healthcare system within the Indian context is characterized by inadequate infrastructure, a limited availability of health professionals, and an unequal distribution of health resources. This systemic structure is deeply entrenched in the rural environment, resulting in significant disparities in the utilization of healthcare services between rural and urban populations. Furthermore, socio-economic factors such as education, income, caste, and geographical accessibility provide a solid foundation that enables this system to maintain its deep-rooted presence.

The COVID-19 pandemic had a concerning impact on health systems across the globe. This pandemic exerted its most severe impact on rural areas and regions with limited resources. Consequently, health systems worldwide faced numerous obstacles in their efforts to combat this pandemic. According to the WHO (2020), the essential health services were disrupted in many countries. In India, this was more experienced in rural areas due to the pre-existence of infrastructural limitations. The health care accessibility was declined due to the several factors such as reallocation of healthcare personnel, reduced outpatient services and limited availability of medical supplies. The health seeking behavior in rural populations was altered significantly due to the COVID-19 pandemic. the major deterrent was fear of infection which led delays or avoid seeking medical care among individuals. Socio-economic and demographic factors affected the healthcare utilization in rural areas.

On March 11, 2020, the World Health Organization officially designated COVID-19 as a global pandemic. In the absence of a specific and effective treatment during the initial phase, countries worldwide adopted preventive public health measures such as physical distancing and compulsory face mask usage, alongside restrictive interventions including nationwide lockdowns and quarantine protocols.[1]. Similar to numerous regions across the globe, particularly Europe, India had been grappling with a significant surge in COVID-19 cases and fatalities.

The symptoms of COVID-19 encompassed fever, headache, cough, breathing challenges, sore throat, and fatigue, all of which closely resembled the typical signs of the common flu or cold.[2]. This similarity in symptoms with the common flu or cold could have contributed to the reluctance of individuals in rural communities to undergo COVID-19 testing. Consequently, rural populations may have experienced a considerable number of unnoticed COVID-19 cases. The lack of disease-related knowledge, combined with hesitation and disbelief regarding the infection, contributed to delayed recognition and underreporting of cases during the pandemic.

The Ministry of Health and Family Welfare (Government of India (GoI)) has established pandemic management taskforces, established helplines, enabled mHealth surveillance through the Arogya Setu app, and provided awareness materials for the general public in order to ensure that public health safety measures are implemented [3]. Despite the Government of India's considerable efforts to protect people from the COVID-19 pandemic, the second wave of the virus had a severe impact on the population. Consequently, hospitals faced shortages of essential resources like oxygen masks, and people were deprived of proper medical facilities. The situation was so dire that some individuals even refrained from performing traditional body rituals for their deceased relatives [4].

The upsurge in COVID-19 worst outcomes was believed to be primarily caused by the insufficient implementation of pandemic mitigation measures and the occurrence of large mass gatherings related to religious and political interests. These factors contributed to the rapid spread of the virus and led to severe consequences [5]. This study aimed to characterise the rural people with suspected COVID-19 during the pandemic, including subgroups based on their socio-demographic characteristics. There are several empirical studies highlight that rural populations, compared to their urban counterparts, utilize formal health services less frequently. The economically and socially vulnerable sections of society face the most significant barriers in accessing health services; these barriers are also evident in the utilization of maternal health services [6],[7].
These pre-existing disparities created a fragile healthcare environment, making rural populations particularly vulnerable to external shocks such as the COVID-19 pandemic.

A noticeable gap in existing studies pertains to the investigation of suspected COVID-19 cases specifically within rural settings. This study aims to fill this knowledge void by focusing on the experiences and challenges faced by suspected COVID-19 patients residing in rural areas. The primary objective is to contribute valuable insights into the unique dynamics of the pandemic in rural contexts. In addition to addressing the gap in knowledge regarding suspected COVID-19 cases.

Furthermore, this study explores the myriad challenges faced by rural individuals in accessing healthcare during the COVID-19 pandemic. It delves into the obstacles and difficulties encountered by rural residents when seeking medical assistance. Additionally, the reasons that contribute to the barriers preventing individuals in rural settings from accessing healthcare services are thoroughly examined and elucidated. By expanding the scope of investigation to healthcare accessibility challenges i.e., systemic challenges, this study aims to present a holistic picture of the impact of COVID-19 on rural populations.

Materials and Methods

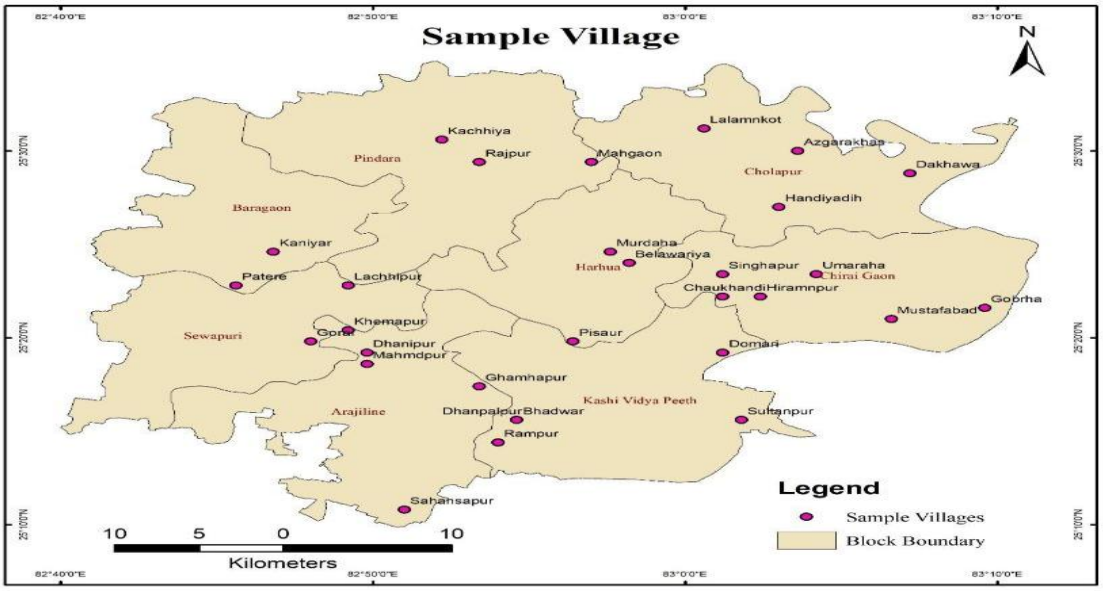
Study Design and Participants

The data was collected through a primary survey in rural settings of the eastern Uttar Pradesh in the Varanasi district. The sample size for this study was calculated using the "Coverage Survey Builder Software," assuming an expected COVID-19 symptom coverage of 50% due to lack of prior data.
Using the formula (1):

$$n = \frac{(Z^2_{1-\alpha/2})(p)(1-p)}{\delta^2 (1-r)} * (DEFF) \qquad \ldots . (1)$$

with DEFF (design effect) = 4, p (proportion of the population with COVID-19 symptoms = 0.5, δ (desired precision) = 0.05, and r (non-response rate) = 0.15, the required sample size was estimated to be 1,828 individuals. Based on NFHS-4 data, the average household size in rural Varanasi is 6.15, resulting in an estimated 297 households to meet the target sample. The software computed a household sampling interval of 5 and 10 households per segment. Using a 30-cluster (village) design, 300 households were surveyed across 30 villages (10 households per village). Systematic sampling was used within each village segment. If selected households were unavailable or non-responsive, a second round of systematic sampling was conducted from a new starting point within the same segment to ensure complete coverage. Figure 1 shows the sample villages selected for the data collection.

Figure 1: Map of Varanasi District Showing Blocks and Selected villages for Data Collection



Measures

Outcome Measures

The first outcome variable for this study was experiencing any COVID-19 symptoms by the individuals. A question was asked form the respondents if they had any of the symptoms (fever, cough, running nose, difficulty in breathing, headache, vomiting, body pain, loss of taste, loss of smell, sore throat, and diarrhoea) of COVID-19 indicated by WHO (World Health Organisation, 2020b). Household members experienced any COVID-19 symptoms from the starting of the pandemic were responded in binary form as "Yes" or "No". The second outcome variable in the study was suspected COVID-19 individuals. The term suspected COVID-19 individuals refer to those individuals who had the onset of any symptom/s (fever/cough/sore throat) along with a loss of taste and smell were suspected to have COVID-19. For children (ages 1-6), this term is limited to fever along with cough and sore throat. Further, the individuals were categorized as Suspected COVID-19 individuals and non-suspected COVID-19 individuals. The third outcome variable was use of any medicine/s by the individuals while experiencing any COVID-19 symptoms. Further, this variable was also coded in binary form as "Yes" or "No".

Explanatory Variables

The survey included several independent variables, including participant's demographic information such as gender, age, religion, caste, socio economic status. Gender of individuals were categorised into two categories as male and female. Age of household members were recorded as discrete numbers and further categorised into six age groups such as 1-6 years, 7-14 years, 15-29 years, 30-44 years, 45-59 years and 60+ years. The reason behind choosing this age group category was that the COVID-19 vaccination was stepping into this age group gradually. Religion was categorised into two groups mainly in Hindu and Muslims. Caste was divided into three groups namely, Other Backward Caste (OBC), Schedule Caste (SC)/ Schedule Tribe (ST), and Others. People with Muslim religion were excluded from the caste categorization. Socio economic status of the individuals was categorised using Modified Kuppuswamy scale of 2021. On the basis of this the SES was categorised into Upper Middle class, Middle class, Lower Middle Class, and Lower Class.

Statistical Analysis

Descriptive analyses were conducted to evaluate the distribution of study variables. Chi-square tests were used to assess the association between socio demographic variables and suspected COVID-19 symptoms, suspected COVID-19 individuals and medicine use during the experience of COVID-19 symptoms. Further, the different log linear model was used for studying the relationship between more than two categorical variables. This model also investigated the importance of higher-order interactions, whose presence or absence has a substantial effect on the model's predictive capacity for the observed data. In this study, first log linear model was constructed using the categorical variables as A= Caste, B= Suspected COVID-19 individuals, C= Medicine taken for any COVID-19 symptom(s).
The study Model-I is given as:

$$\log E(\alpha_{ijk}) = \lambda + \lambda_i^A + \lambda_j^B + \lambda_k^C + \lambda_{ij}^{AB} + \lambda_{ik}^{AC} + \lambda_{jk}^{BC} + \lambda_{ijk}^{ABC} \quad \ldots\ldots\ldots \text{Model-I}$$

Where, A: Caste of the individuals
B: Suspected COVID-19 individuals
C: Medicine taken for any COVID-19 symptom/s.
Λ: Independence term
λ_i^A- Main effect of the caste of the individuals
λ_j^B: Main effect of the suspected COVID-19 individuals
λ_k^C: Main effect of the medicine taken for any COVID-19 symptom/s
λ_{ij}^{AB}: Second degree interaction impact of variables caste and suspected COVID-19 individuals
λ_{ik}^{AC}: Second degree interaction effect of variables caste and medicine taken for any COVID-19 symptom/s

λ_{jk}^{BC}: Second degree interaction effect of variables suspected COVID-19 individuals and medicine taken for any COVID-19 symptom/s
λ_{ijk}^{ABC}: Third degree interaction effect of variables caste, suspected COVID-19 individuals and medicine taken for any COVID-19 symptom/s
Similarly, second log linear model was defined as using the three categorical variables socio economic status of the individuals, Suspected COVID-19 and medicine taken for any COVID-19 symptom/s.
α_{ijk} is the observed frequency in the cell (i,j,k), and the λ's satisfies the usual constraints (sum to zero). An effect (interaction between any two or three variables) is identified here only by superscript: e.g.: AB describes the parameters λ_{ij}^{AB} for all i and j and so on.
The likelihood ratio statistic χ^2_{LR} (which for the log linear model is equivalent to the minimum discriminant information statistic) was used for to check the inadequacy of fit of the models (Ku and Kullback 1974).

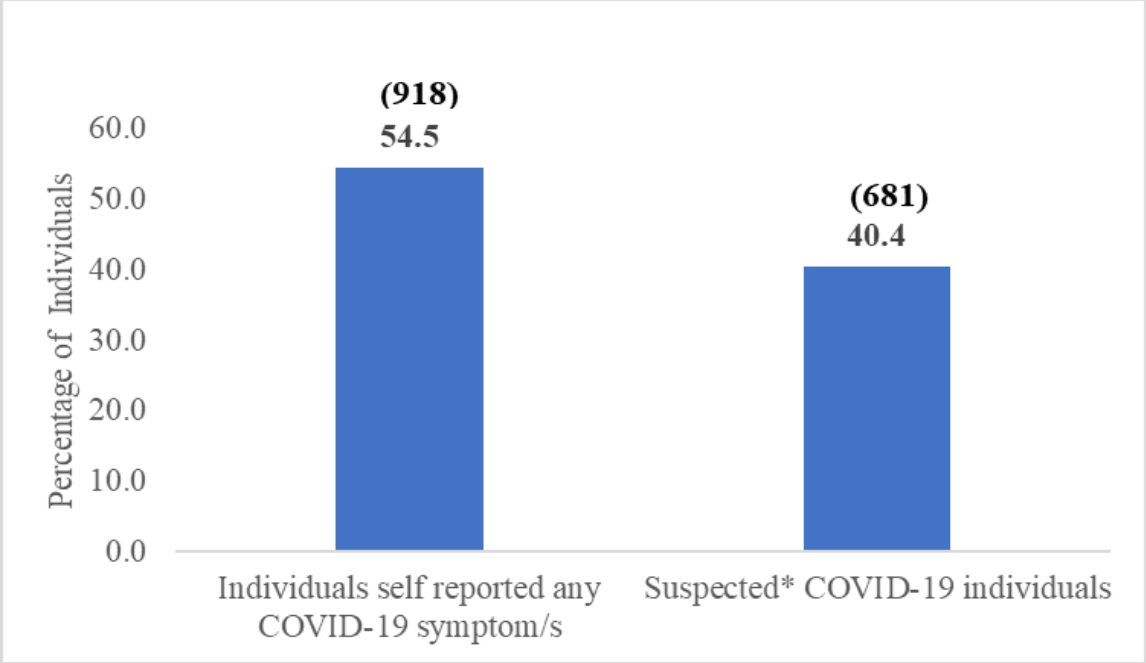
$$\chi^2_{LR} = 2 \sum_{ijk} \quad log_e(f_{ijk}/F_{ijk})$$

where $F_{ijk} = E(f_{ijk})$ for the model being fit.

Results

In Figure 1, the presentation illustrates the self-reported COVID-19 symptoms among individuals and the identification of Suspected COVID-19 cases. The figure reveals that over half of the individuals reported experiencing various COVID-19 symptoms, including fever, cough, sore throat, and loss of taste and smell, among others. Notably, more than one-third of these individuals met the criteria outlined in our operational definition, classifying them as Suspected COVID-19 cases.

Figure 1: Individuals self-reported COVID-19 symptom/s and Suspected COVID-19 cases



Note: *Individuals who had loss of taste & smell together with at least any one of the symptoms i.e., fever, cough, and sore throat. Children belonging to the age group 0-1 years (=19) were excluded.

Table 1 represents the frequency distribution of individuals who experienced common COVID-19 symptom/s during the years 2020 and 2021. Notably, the age group significantly influenced the manifestation of symptoms, showcasing an upward trend in prevalence as age increased. The association between age and common COVID-19 symptoms such as sore throat and loss of taste and smell was statistically significant ($p<0.01$), underscoring the impact of age on the susceptibility to these symptoms. Religion and caste also played a significant role in influencing the reported symptoms of COVID-19. Socio-economic class emerged as a significant factor influencing reported symptoms, with notable variations across different classes.

Table 1: Individuals experienced common COVID-19 symptoms during the years 2020 and 2021

Variables	Fever	Cough	Sore throat	Loss of taste & smell	Breathing difficulty	Tiredness	Others
Gender							
Male (N=844)	51.8	51.2	37.9	36.7	6.1	95.7	52.0
Female (N=840)	55.7	55.1	41.8	40.4	6.5	96.8	56.3
p-value	NS	NS	NS	NS	NS	NS	NS
Age group							

1-6 (N=174)	19.5	19.5	4.6	--	2.9	97.1	19.5
7-14 (N=267)	43.1	42.7	25.8	28.5	8.4	93.3	43.4
15-29 (N=508)	54.9	53.9	40.4	41.3	4.3	95.4	55.1
30-44 (N=323)	64.1	62.8	48.6	52.9	9.0	97.6	65.0
45-59 (N=223)	66.4	67.3	50.7	51.1	6.0	96.0	67.3
60+(N=189)	64.6	63.5	51.3	52.9	5.7	99.2	64.6
p-value	NS	NS	<0.01	<0.01	NS	NS	NS
Religion							
Hindu(N=1525)	55.0	54.4	38.8	40.1	6.8	96.0	55.5
Muslims(N=151)	43.7	43.7	38.4	39.1	--	100.0	43.7
p-value	NS	NS	<0.01	<0.01	NS	NS	NS
Caste†							
OBC (N=922)	56.1	54.6	40.7	41.6	3.6	92.2	55.6
SC/ST (N=348)	48.0	47.4	27.6	29.9	8.5	97.3	48.0
Others(N=263)	58.9	61.2	45.6	47.1	4.8	95.8	63.1
p-value	<0.01	NS	<0.01	NS	<0.05	<0.05	NS
Socio-economic Class**							
Upper Middle Class(N=59)	45.8	45.8	39.0	39.0	--	100.0	45.8
Middle Class(N=310)	61.6	64.5	40.0	39.0	5.4	92.6	65.1
Lower Middle Class(N=816)	51.5	49.5	35.5	37.9	7.1	96.2	51.3
Lower Class (N=491)	54.4	53.8	43.2	44.4	6.4	98.9	53.8
p-value	<0.01	NS	<0.01	<0.01	NS	<0.05	NS

NS: Not Significant ($p \geq 0.05$)
†Caste categories include the individuals belonging to Hindu religion only.
**Modified Kuppuswamy scale 2021 was used here to construct the socio-economic class.
Note: p-value was observed using Chi-square test.

The data presented in table 2 reveals notable associations between various demographic variables and the experience of COVID-19 symptoms among individuals. The younger age group of 1-6 years had a lower incidence of symptoms (19.5%) compared to elder age groups, and a similar pattern was observed with suspected COVID-19 cases. The p-value of less than 0.05 underscored the significance of these differences. There was a 12.2% disparity observed in the occurrence of any COVID-19 symptoms between individuals belonging to the Hindu and Muslim religions. This trend was reflected in suspected cases as well, and the p-value<0.05, indicating statistical significance. Caste differences were evident, with individuals categorized as Others having a higher percentage of experiencing any COVID-19 symptoms (63.4%) compared to OBC (56.2%) and SC/ST (47.9%). This difference was significant as the observed value of p-value<0.05. Similar patterns were observed in suspected COVID-19 cases, with significant p-values (<0.05). Socio-economic class exhibits a noteworthy association with COVID-19 symptoms. The p-value is less than 0.05, emphasizing the statistical significance of these differences.

Table 2: Individuals experienced any COVID-19 symptom/s and suspected COVID-19 cases according to their socio-demographic characteristics

Variables	**Experienced any COVID-19 Symptom/s N (%)**	**Suspected COVID-19 Cases‡ N (%)**
Gender		
Male (N=844)	444 (52.8)	326(38.6)
Female (N=840)	474 (56.4)	355 (42.2)
p-value	NS	NS

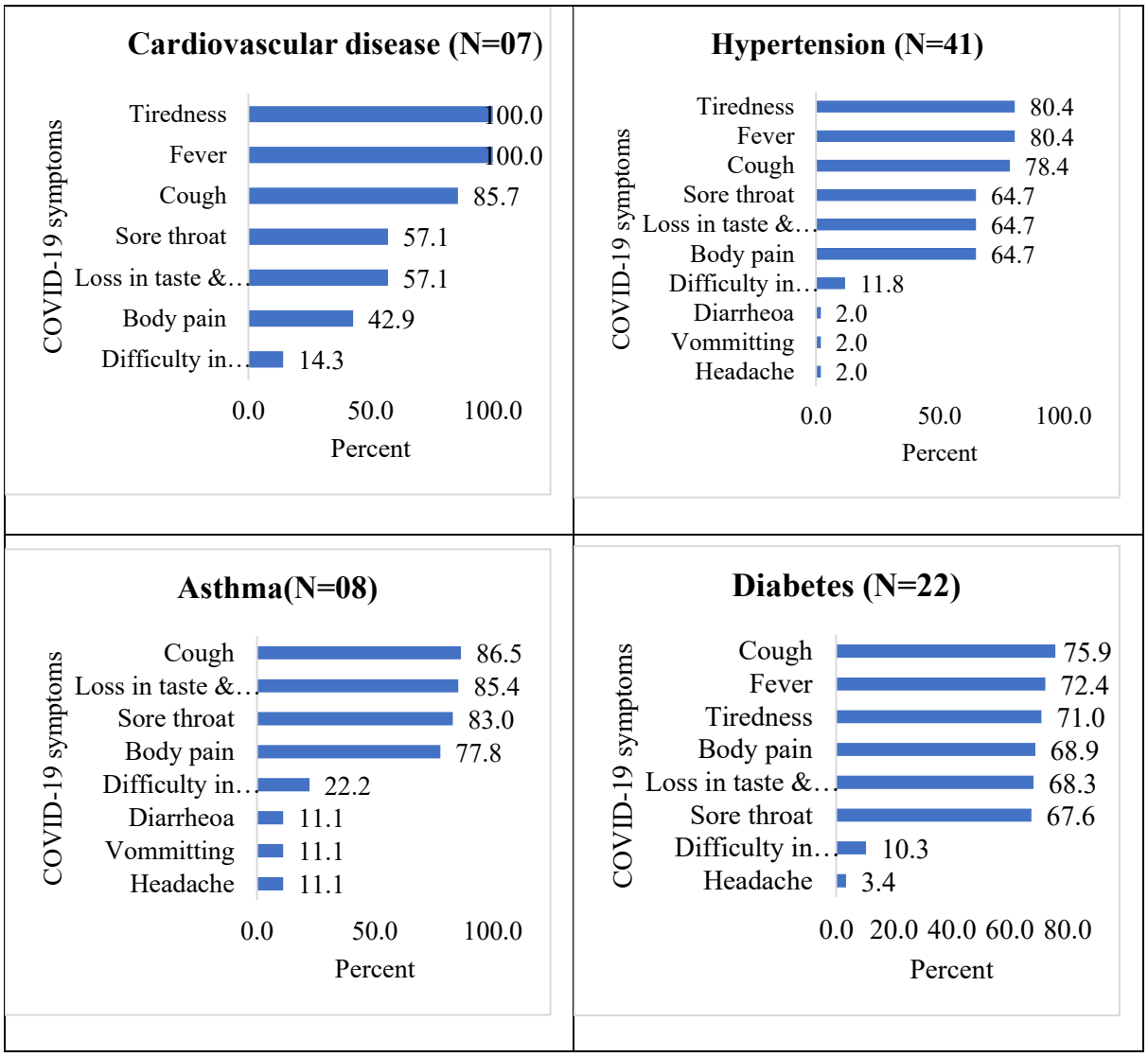
Age- group		
1-6 (N=174)	34 (19.5)	10 (5.74) *
7-14 (N=267)	119 (44.7)	76 (28.5)
15-29 (N=508)	282 (55.5)	210 (41.3)
30-44 (N=323)	210 (65.0)	171 (52.9)
45-59 (N=223)	151 (67.7)	114 (51.1)
60+(N=189)	122 (64.6)	100 (52.9)
p-value	<0.05	<0.05
Religion		
Hindu(N=1525)	852(55.9)	621 (40.7)
Muslims(N=151)	66 (43.7)	60 (39.7)
p-value	<0.05	<0.05
Caste†		
OBC (N=922)	518 (56.2)	388 (42.1)
SC/ST (N=348)	167 (47.9)	108 (31.0)
Others(N=263)	167 (63.4)	125 (47.5)
p-value	<0.05	<0.05
Socio-economic Class**		
Upper Middle Class(N=59)	27 (45.8)	21 (35.6)
Middle Class(N=310)	203 (65.5)	122 (39.4)
Lower Middle Class(N=816)	421 (50.8)	313 (38.4)
Lower Class (N=491)	267 (51.3)	224 (45.6)
p-value	<0.05	<0.05

‡ Includes confirmed COVID-19 cases.
***** Cases that were reported based on fever, cough, and sore throat simultaneously.
† Caste is mentioned here for individuals/households belonging to the Hindu religion (N=856) only.
****Modified Kuppuswamy scale 2021 was used here to construct the Socio-economic classes.
Note: p-value was observed using Chi-square test.
NS: Not Significant ($p \geq 0.05$)

Figure 2 illustrates the percentage distribution of individuals in the 30+ age group who reported pre-existing co-morbidities or illnesses and subsequently experienced COVID-19 symptoms. In Figure 2, it is evident that individuals with pre-existing comorbidities such as asthma or cardiovascular disease were more likely to encounter breathing difficulties, as indicated by the higher percentage in comparison to those without such conditions. All of the people who had pre-existing co-morbid diseases shared similar symptoms, such as fever, cough, sore throat, and loss of taste and smell.

Figure 3 illustrates the percentage distribution of individuals who used medication when experiencing COVID-19 symptoms. The majority of individuals (91.3%) took medicine during their encounter with COVID-19 symptoms, while a smaller proportion (8.7%) did not use medication. This difference may stem from the fact that those who took medicine often experienced three or more common COVID-19 symptoms, whereas those who did not take medicine typically had one or two such symptoms. Additionally, some individuals who refrained from taking medicine might have perceived the common COVID-19 symptoms as indicative of a common flu or cold.

Figure 2: Percentage distribution of individuals (30+ age group) with some self-reported pre-existing co-morbidities/Illness experienced COVID-19 symptom/s.



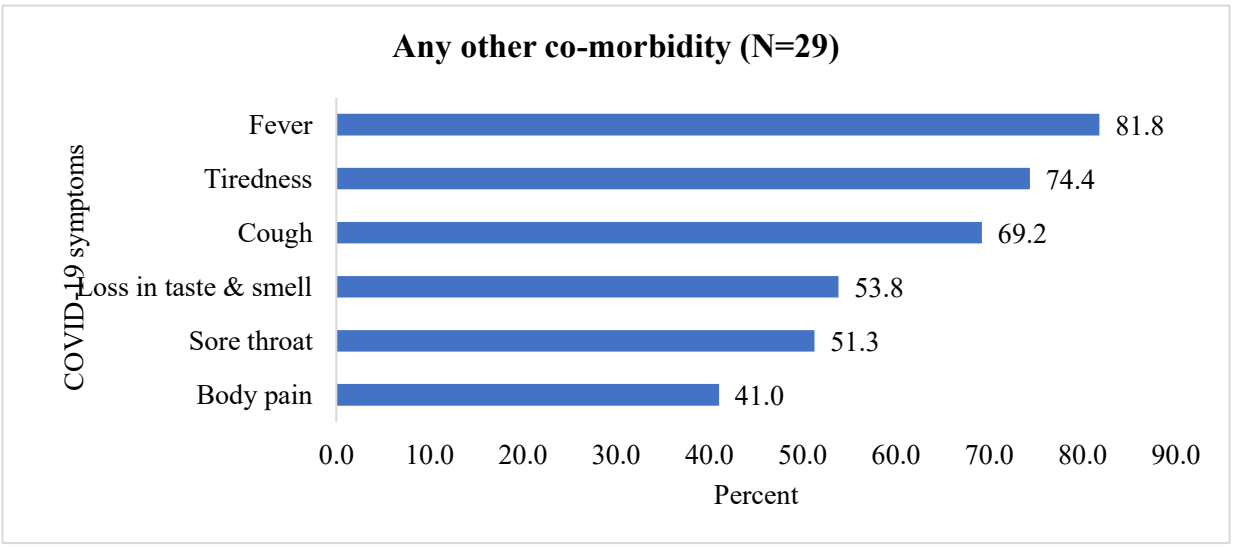


Figure 3: Medicine/s taken by the individuals who experienced COVID-19 symptom/s

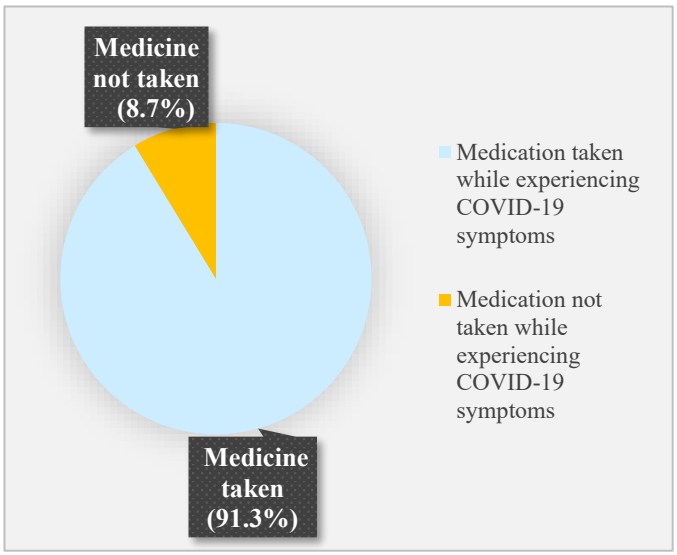
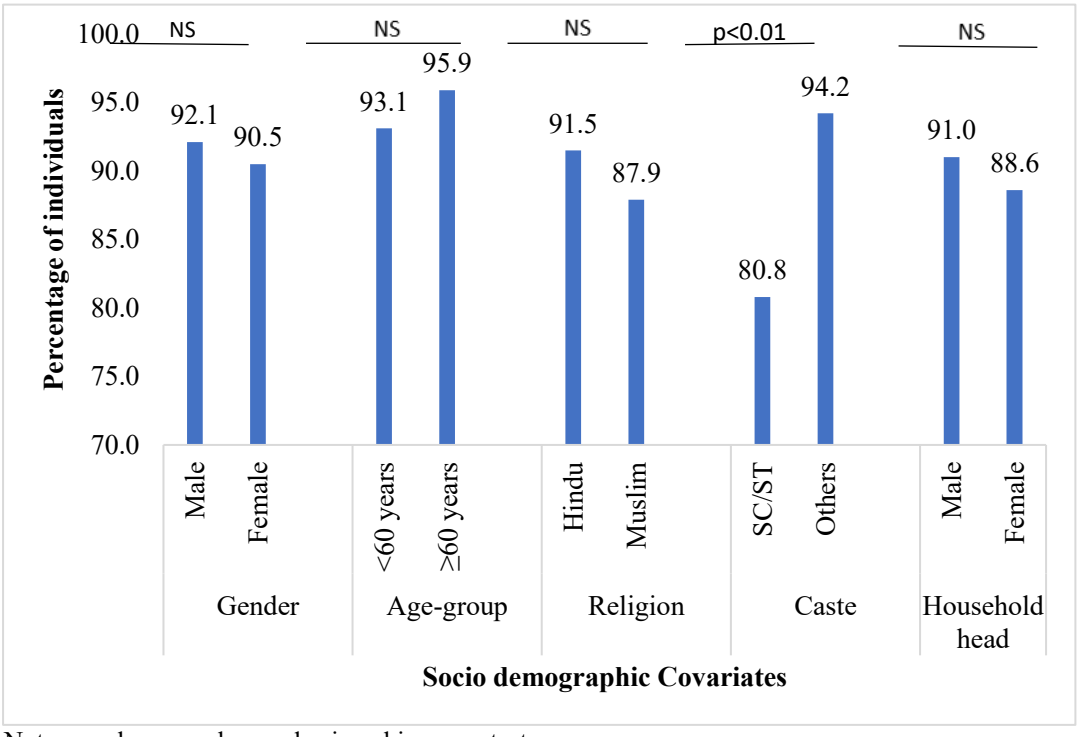


Figure 4 shows the percentage distribution of medicine/s taken by the individuals who experienced COVID-19 symptom/s according to their socio-demographic characteristics. There was a significant association found between caste and medicine taken during the experience of COVID-19 symptom/s. Moreover, household heads did not play a significant role in taking medicine by individuals during their experience of COVID-19 symptom/s.

Figure 4: Medicine/s taken by the individuals experienced COVID-19 Symptom/s according to their socio-demographic characteristics



Note: p-value was observed using chi-square test.
NS: Not Significant ($p \geq 0.05$)

Log linear models

Table 3 summarizes the description about different variables which was used in different log linear models. Log linear model-I consists of three variables namely, caste, suspected COVID-19 individuals and medicine taken for any COVID-19 symptom/s. Similarly, model-II was defined using the variables socio-economic status, suspected COVID-19 individuals and medicine taken for any COVID-19 symptom/s. Further, Socio-economic status category was restructured after merging the categories Upper middle class with middle class and lower middle class with lower class.

Moreover, the odds ratio for SC/ST shows that individuals who belonged to SC/ST and had suspected COVID-19 had a 4.25 times higher chance of taking medicine than those who had not suspected COVID-19 and this odds ratio was significant at 1% level of significance. Similarly, the odds ratio for others shows that individuals who belonged to others and had suspected COVID-19 had a 6.35 times higher chance of taking medicine than those who had not suspected COVID-19 and this odds ratio was significant at 1% level of significance. In brief, individuals who belonged to others caste and had suspected COVID-19 had higher chance of taking medicine during their experience of COVID-19 symptom/s in comparison to those who belonged to SC/ST and had suspected COVID-19.

Furthermore, table 3 shows that the odds ratio for socio-economic status shows that individuals who belonged to upper middle class & middle class and had suspected COVID-19 had a 5.54 times higher chance of taking medicine than those who had not suspected COVID-19 and this odds ratio been significant at 1% level of significance. Similarly, the odds ratio for others shows that individuals who belonged to lower middle class and lower class and had suspected COVID-19 had a 4.71 times higher chance of taking medicine than those who had not suspected COVID-19 and this odds ratio was significant at 1% level of significance. In brief, individuals who belonged to upper middle class & middle class and had suspected COVID-19 had higher chance of taking medicine during their experience of COVID-19 symptom/s in comparison to those who belonged to lower middle class and lower class and had suspected COVID-19.

Table 3: Cross classification between suspected COVID-19 & medicine taken for any COVID-19 symptom/s among different categories of socio-economic variables using log linear models

Variables				
Caste	**Suspected COVID-19**	**Medicine taken for any COVID-19 symptom/s**		**Odds Ratio (95% C.I.)**
		Yes N (%)	**No N (%)**	
SC/ST	Yes	97 (88.9)	12 (11.1)	4.25**(1.89, 9.54)
	No	38 (65.5)	20 (34.5)	
Others	Yes	499 (97.2)	14 (2.8)	6.35**(3.23, 12.47)
	No	146 (84.9)	26 (15.1)	
Socio-economic status				
Upper middle+ Middle class	Yes	441 (96.3)	17 (3.7)	5.54**(3.01, 10.20)
	No	159 (82.4)	34 (17.6)	
Lower middle+ Lower class	Yes	207 (92.4)	17 (7.6)	4.71**(2.05, 10.81)
	No	31 (72.1)	12 (27.9)	

**p<0.01 (statistically significant at 1% level of significance).

Table 4 shows the parameter estimates of different log linear models. This table 4 interprets that the most important main effects in log linear model-I was medicine taken for any COVID-19 symptom/s followed by caste. The important interaction effects in log linear model-I were suspected COVID-19 and medicine taken for any COVID-19 symptom/s followed by the interaction effect of caste and medicine taken for any COVID-19 symptom/s. Similarly, for the log linear model-II, the most important main effects were medicine taken for any COVID-19 symptom/s followed by socio economic status. The important interaction effects in log linear model-II were suspected COVID-19 and medicine taken

for any COVID-19 symptom/s followed by the interaction effect of suspected COVID-19 and socio-economic status.

Table 4: Parameter estimates of log-linear models

Model-I						
Parameter	**Estimate**	**Std. Error**	**Z**	**p-value**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Caste × Suspected COVID-19 × Medicine taken for any COVID-19 symptom/s	0.051	0.066	0.766	0.444	-0.079	.180
Caste × Suspected COVID-19	-0.024	.066	-0.357	0.721	-0.153	.106
Caste × Medicine taken for any COVID-19 symptom/s	-0.321	0.066	-4.843	<0.001	-0.450	-.191
Suspected COVID-19 × Medicine taken for any COVID-19 symptom/s	0.407	0.066	6.143	<0.001	0.277	.536
Caste	0.422	0.066	6.373	<0.001	0.292	.552
Suspected COVID-19	-0.132	0.066	-1.998	0.046	-0.262	-.002
Medicine taken for any COVID-19 symptom/s	-0.992	0.066	-14.979	<0.001	-1.121	-.862
Model-II						
Suspected COVID-19 × Medicine taken for any COVID-19 symptom/s × Socio-economic status	0.019	0.065	0.286	0.775	-0.108	.145
Suspected COVID-19×Medicine taken for any COVID-19 symptom/s	0.406	0.065	6.265	<0.001	0.279	.362
Suspected COVID-19×Socio-economic status	0.235	0.065	3.633	<0.001	0.108	-.043
Medicine taken for any COVID-19 symptom/s ×Socio-economic status	-0.170	0.065	-2.629	0.009	-0.297	.533
Suspected COVID-19	-0.320	0.065	-4.944	<0.001	-0.447	.551
Medicine taken for any COVID-19 symptom/s	-1.020	0.065	-15.744	<0.001	-1.146	-.193
Socio economic status	0.424	0.065	6.548	<0.001	0.297	-.893

*p<0.05 is statistically significant at 5% level of significance.
**p<0.01 is statistically significant at 1% level of significance.

Section-II: Health care utilization by the members of the household during the second wave (March-June) of 2021

In Figure 5, the distribution of households with at least one member visiting healthcare facilities during the second wave is depicted. More than half of the households had at least one member who visited a healthcare facility, while approximately one-third of households reported that none of their members sought medical attention during the second wave of 2021.

Figure 6 illustrates the percentage distribution of household members visiting various healthcare facilities and the reasons for their visits. From Figure 6(a), it is evident that around one-tenth of household members visited public healthcare facilities such as Clinical Health Centre (CHC) / Primary

Health Centre (PHC) or government hospitals. Most household members sought medical care at private clinics or hospitals.

In Figure 6 (b), the reasons for household members visiting healthcare facilities during the second wave of 2021 are highlighted. A significant proportion (97.0%) sought medical attention due to COVID-19 symptoms, including fever, cough, sore throat, loss of taste and smell, and breathing difficulties. Additionally, 8.5% of household members visited healthcare facilities for reasons unrelated to COVID-19, such as vaccination, surgery, ante-natal checkups, etc.

Figure 5: Households whose at least one member visited healthcare facilities during second wave

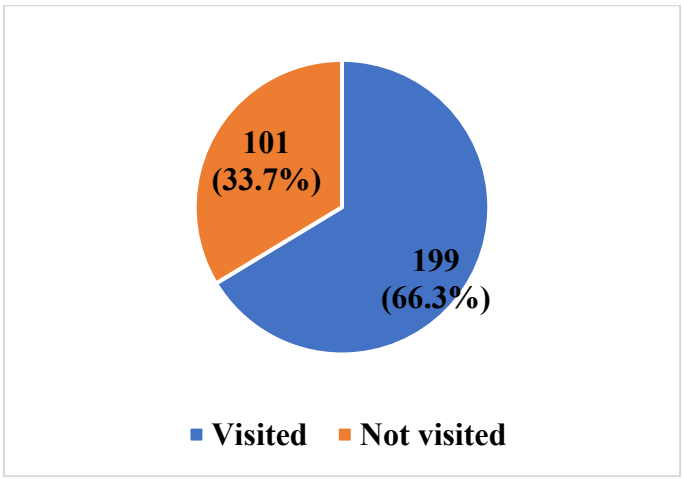
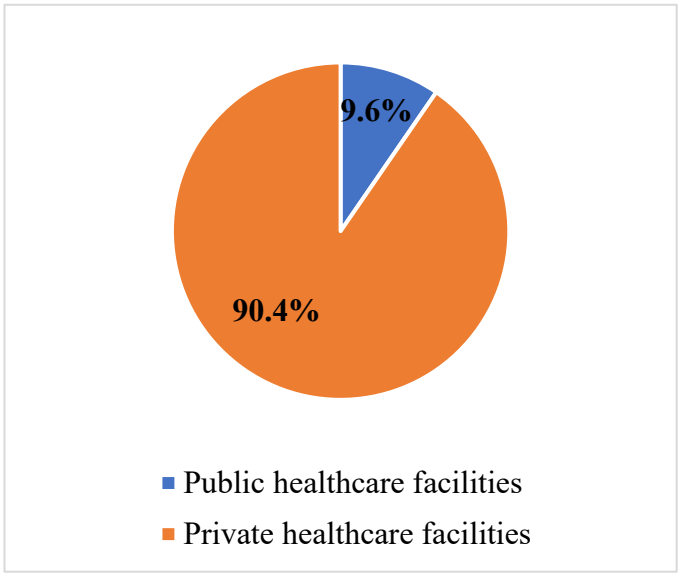
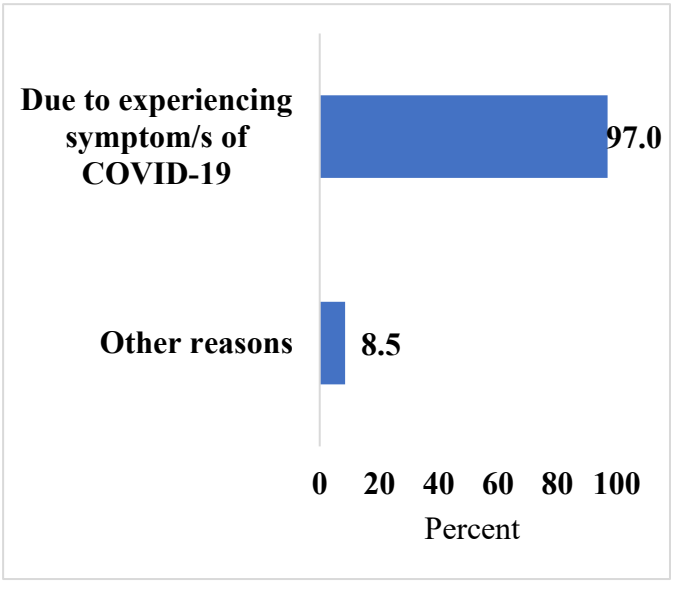


Figure 6: Percentage distribution of household whose member/s visited different health care facilities and reasons of visit

(a) Visited different types of Healthcare Facilities (N=199)



(b) Reasons for visiting Healthcare Facilities (N=199)



Households whose member/s visited and received healthcare facilities during the second wave of COVID-19 pandemic

Table 5 presents data on the variables related to households where members visited health care facilities (N=199) and those where household members received health care as needed (N=169). The distribution is categorized into public and private healthcare facilities, with percentages provided for each subgroup. Examining the data by household head's gender, it is observed that the majority of male-headed households sought healthcare from private facilities (95.2%), while female-headed households exclusively utilized private healthcare (100.0%). In terms of religion, both Hindu and Muslim households predominantly accessed private healthcare (95.7% and 100.0%, respectively). When considering caste, OBC households primarily relied on private healthcare (96.7%), while the least percent of SC/ST households relied on public (3.0%) healthcare facilities. Other castes showed a preference for private healthcare (90.3%). The socio-economic class analysis indicates that upper-middle-class households solely sought private healthcare (100.0%). Similarly, across the middle, lower-middle, and lower classes, a significant proportion preferred private healthcare facilities, i.e., 95.0%, 96.0%, and 96.2%, respectively.

Table 5: Households whose member/s visited and received healthcare facilities during the second wave of COVID-19 pandemic

Variables	Visited health care facilities (N=199)		Household members who got health care in need (N=169), N (%)
	Public N (%)	Private N (%)	
Household head			
Male	08(4.8)	157(95.2)	141(63.2)
Female	NA	34(100.0)	28(62.2)
Religion			
Hindu	08(4.3)	179(95.7)	159(64.4)
Muslims	NA	12(100.0)	10(47.6)
Caste†			
OBC	04(3.3)	119(96.7)	105(69.5)
SC/ST	01(3.0)	32(97.0)	29(50.0)
Others	03(9.7)	28(90.3)	25(65.8)
Socio-economic Class**			
Upper Middle Class	NA	06(100.0)	06(60.0)
Middle Class	02(5.0)	38(95.0)	38(66.7)
Lower Middle Class	04(4.0)	96(96.0)	80(62.5)
Lower Class	02(3.8)	51(96.2)	45(61.6)

NA: Not available/Not applicable
† Caste is mentioned here for individuals/households belonging to the Hindu religion (N=856) only.
**Modified Kuppuswamy scale 2021 was used here to construct the Socio-economic classes.

Healthcare services need of individuals in COVID-19

Figure 7(a) reveals that during the second wave of COVID-19, more than one-fourth of individuals needed healthcare services. However, more than half of the individuals did not need health care services. It is clear from Figure 7(b) that more than four-fifths of the individuals received healthcare services when they were in need and visited healthcare facilities.

Figure 8 illustrates the percentage distribution of individuals not received the services among those who visited health care facilities for given reasons. More than three fourth of the individuals did not receive the treatment of symptoms of COVID-19 such as fever, cough, sore throat, loss of taste and smell, body pain etc., after visiting the healthcare facilities followed by routine health checkup (23.3%) and others (such as chronic illness treatment, ante-natal checkup, COVID-19 vaccination etc.) (23.3%), monitoring pregnancy/delivery services/surgery (10.3%) and COVID-19 test (3.3%).

Figure 8(b) illustrates the percentage distribution of reasons for not getting healthcare services after visiting healthcare facilities by individuals. More than half of the individuals did not get the health services they needed after visiting the healthcare facilities during the second wave of COVID-19 because the healthcare services did not entertain the patients without COVID-19 tests. Less than one-fourth of the individuals did not benefit from healthcare services because the medical services were very costly at that time, such as the price hike in the medicine/oxygen cylinder due to high demand.

Moreover, the closure of health facilities (6.7%) and shortage of medicines and vaccines in health facilities (3.3%) also contributed to the hurdle to getting healthcare services when individuals needed them.

Figure 7(a): Individuals needed healthcare services

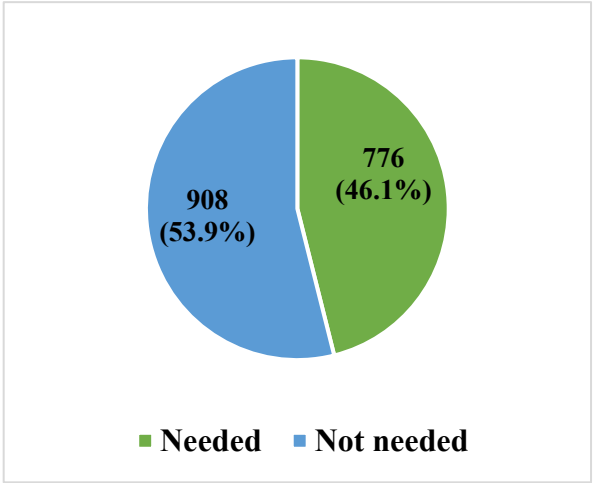


Figure 7(b): Individuals received healthcare services

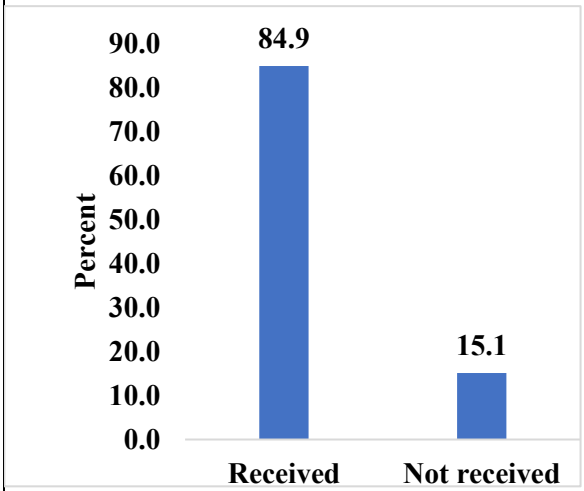


Figure 8(a): Percentage of individuals not received the services among those who visited health care facilities for given reasons (N=138)

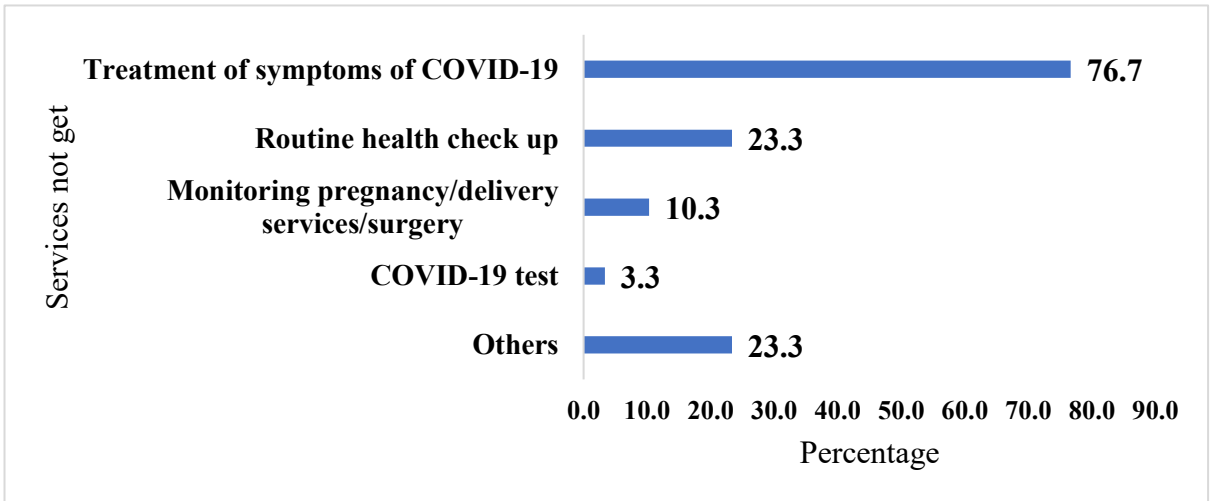
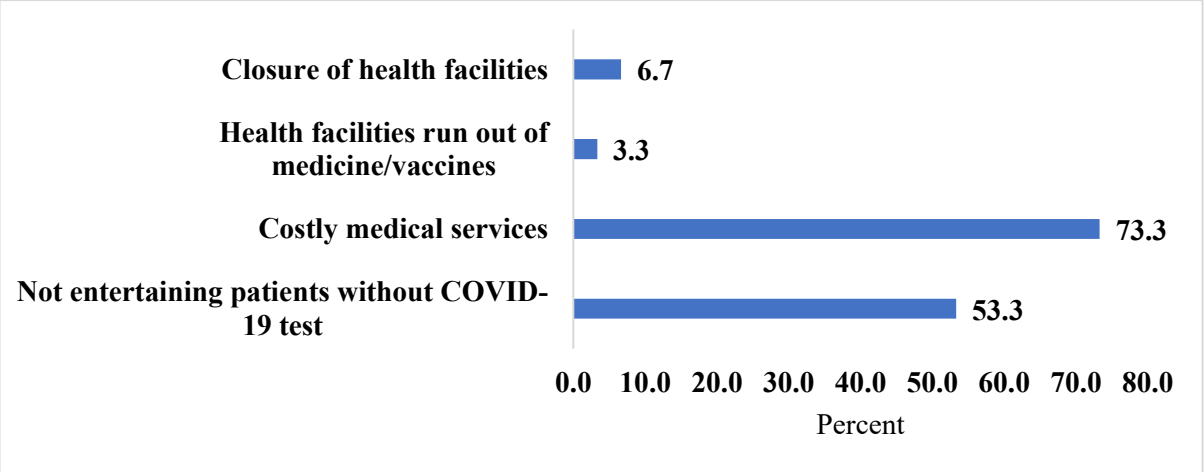


Figure 8(b): Reasons for not getting healthcare services (N=138)



Discussion and Conclusion

This study indicates that the transmission of COVID-19 was consistent across genders in rural areas. This finding aligns with the study conducted by Sarkar et al. (2021), which demonstrated that there was no relation between gender and susceptibility to COVID-19. This study concludes that there was a larger proportion of individuals (40.4%) who were suspected COVID-19 infected individuals among which most of the individuals belonged to the elder age group and had co-morbidities. This finding was in favor with the study of Singh *et.al.,* (2020). Moreover, this result also aligned with the study of Inabaraj *et.al*., (2021) which revealed that the rural population of a district situated in South India, was found susceptible of COVID-19.

An inter-relatedness of socio demographic characteristics with experienced suspected COVID-19 symptoms and COVID-19 immunization was observed. Findings from the study revealed that there is a strong and significant link between the variables used in the study i.e., socio-demographic characteristics of the rural individuals, experienced any suspected COVID-19 symptoms, and medicine taken during suspected COVID-19 symptoms. Most of the individuals who were hypertensive/diabetic/asthma patients, experienced COVID-19 symptom/s compared to individuals having any other pre-existing comorbidities which indicates that they had higher risk of getting infected. This result was found to be similar with the study of Gupta *et.al* (2021) and Oduro et.al (2023) which provides direct evidence of healthcare avoidance behavior in rural India during the COVID-19 pandemic. The study found that a considerable proportion of individuals avoided seeking healthcare due to fear of contracting the virus, lockdown-related mobility restrictions, and socio-economic constraints. The findings also indicate that healthcare avoidance was more prevalent among vulnerable groups, including the elderly and economically disadvantaged populations.

The loglinear model-I with the categorical variables such as caste, suspected COVID-19 individuals and medicine taken during COVID-19 symptom/s produced a final model that retained only two-way effects. Odds ratio indicated that the odds of medicine taken during COVID-19 symptoms among SC/ST with suspected COVID-19 was 4.25 whereas among others caste categories this was only 6.25.

The loglinear model-II with the categorical variables such as socio-economic status, suspected COVID-19 individuals and medicine taken during COVID-19 symptom/s produced a final model that retained only two-way effects. Odds ratio indicated that the odds of medicine taken during COVID-19 symptoms among upper middle class and middle class with suspected COVID-19 was 5.54 whereas among lower middle class and lower class this was only 4.41.

The free COVID-19 vaccination program implemented by the Indian government fulfilled its objective in terms of vaccination as more than three-fourth (87.8 %) of the rural individuals of 15+ age group received either one or two doses of the COVID-19 vaccine till the survey time.

The findings are expected to inform public health strategies, policy recommendations, and targeted interventions that address the unique needs and circumstances of rural communities in the ongoing battle against the pandemic. The findings of preset study illuminate the complex interplay of demographic, socio-economic, and cultural factors in shaping the reported COVID-19 symptoms among individuals.

Understanding these nuances is crucial for tailoring public health interventions and healthcare strategies to address the diverse needs of different population groups, ultimately contributing to more effective pandemic management. COVID-19 has impact on health and well-being of the individuals of the all ages and gender both. This study examined the impact of COVID-19 in relation to the socio demographic characteristics of the rural individuals, where the data collected through primary survey was used for analysis.

Conflicts of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data Availability Statement

The data that support the findings of this study are collected by the corresponding author which is not available in the public domain. The data are, however, available from the authors upon reasonable request.

Declarations

Ethical Approval

All experimental protocols involving human participants were reviewed and approved by the **Institutional Ethics Committee, Banaras Hindu University (IEC-BHU)**. The study was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki. Informed written consent was obtained from all participants prior to their inclusion in the study. Participation was voluntary, and respondents were informed about the objectives of the study, confidentiality of responses, and their right to withdraw at any stage without any consequences.

Consent to Participate

Written informed consent was obtained from all participants prior to their inclusion in the study. In case of children (age group 01-14 years), their parents/legal guardians give consent behalf on them.

Clinical Trial Number

Not applicable

Consent to Publish

Not applicable

Funding
No source of funding.

Acknowledgments
We thank the Head of the Department of Statistics (Banaras Hindu University) to grant permission for collecting the data. We acknowledge the generous support of all the village heads in Varanasi and the household's family in providing information-related to the study.

References:

1. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. 2020;(2531- 6745)
2. Huang, X., Wei, F., Hu, L., Wen, L., & Chen, K. (2020). Epidemiology and clinical characteristics of COVID-19. *Archives of Iranian medicine*, *23*(4), 268-271.
3. MoHFW. Ministry of Health & Family Welfare. [cited 2021 Jul 17]. Government of India. Available from: https://www.mohfw.gov.in/
4. Kumari, R., Kumar, S., Poonia, R. C., Singh, V., Raja, L., Bhatnagar, V., & Agarwal, P. (2021). Analysis and predictions of spread, recovery, and death caused by COVID-19 in India. *Big Data Mining and Analytics*, *4*(2), 65-75.
5. Bhowmick, S., Parolia, S., Jana, S., Choudhury, D., & Das, N. (2021). A study on the anxiety level and stress during Covid19 lockdown among the general population of West Bengal, India-A must know for primary care physicians. *Journal of Family Medicine and Primary Care*, *10*(2), 978-984.
6. Mohanty, S. K., Dwivedi, L. K., Singh, P. K., & Mishra, R. S. (2021). Inequality in healthcare utilization in India: Evidence from National Sample Survey data. *Social Science & Medicine, 269*, 113602. https://doi.org/10.1016/j.socscimed.2020.113602
7. Ali, B., & Chauhan, S. (2020). Inequalities in the utilisation of maternal health care in rural India. *BMC Public Health, 20*, 369. https://doi.org/10.1186/s12889-020-08480-4
8. Sarker, M. R., Sarkar, M. A. R., Alam, M. J., Begum, I. A., & Bhandari, H. (2023). Systems thinking on the gendered impacts of COVID-19 in Bangladesh: A systematic review. *Heliyon*, *9*(2).
9. Singh AK, Gupta R, Ghosh A, Misra A. Diabetes in COVID-19: prevalence, pathophysiology, prognosis, and practical considerations. Diabetes Metab Syndr Clin Res Rev. 2020;14(4):303–10
10. Inbaraj LR, George CE, Chandrasingh S. Seroprevalence of COVID-19 infection in a rural district of South India: A population-based seroepidemiological study. PLoS One. 2021 Mar 31;16(3):e0249247. doi: 10.1371/journal.pone.0249247. PMID: 33788873; PMCID: PMC8011723.
11. Gupta, N., Agrawal, S., Ish, P., Mishra, S., Gaind, R., Usha, G., ... & Safdarjung Hospital COVID 2019 working group. (2020). Clinical and epidemiologic profile of the initial COVID-19 patients at a tertiary care centre in India. *Monaldi archives for chest disease*, *90*(1).
12. Oduro, M. S., Peprah, P., Morgan, A. K., & Agyemang-Duah, W. (2023). Staying in or out? COVID-19-induced healthcare utilization avoidance and associated socio-demographic factors in rural India. *BMC Public Health, 23*, 1439. https://doi.org/10.1186/s12889-023-16282-7
13. World Health Organization. (2020). *Pulse survey on continuity of essential health services during the COVID-19 pandemic*. Geneva: WHO.