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Original Research Article

A socio-demographic study on seroprevalence of SARS-CoV-2 antibodies and associated factors in a rural population in Andhra Pradesh

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ABSTRACT

Background: SARS-CoV-2 is an enveloped, single stranded RNA beta corona virus that belongs to the family Coronaviridae. The S and N proteins are the principal immunogens used for the detection of anti – SARS-CoV-2 specific antibodies.[2] The first subunit (S1) mediates the attachment of the virus to human cells via its receptor - binding domain (RBD), and the second one (S2) mediates membrane fusion for viral entry. Antibodies that bind to the S protein can neutralize corona viruses.
Methods: It was a community based analytical cross-sectional study done in rural areas of Eluru district, A.P. State. From each village 30 members were selected by using systematic random sampling. A sample of 120 was included. Blood samples from the selected individuals were taken Humoral responses (Ig G) were assessed using an ICMR approved Micro well ELISA test for the semi-quantitative detection of COVID 19 (SARS-CoV-2) neutralizing antibodies in Human serum samples.
Results: In the present study 46 (28.3%) had higher education, 15 (12.5 %) belong to farmers, 84 (70%) of them belong to Hindus, 94 (78.3%) of them belong to nuclear family. History of COVID 19 (p=0.02), period from recent dose of covid vaccination (p=0.04) were found to be statistically significant.
Conclusions: High seroprevalence in this study suggests that COVID-19 vaccination remains the best method to control the COVID-19 pandemic. It is necessary to encourage the public to take vaccination.

Keywords: Antibodies, Cross-sectional, SARS Cov2, Sampling interval, Seroprevalence, Vaccination

INTRODUCTION

Corona virus disease-2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) which was declared as a pandemic on 11th March 2020.[1] The clinical diagnosis of COVID-19 is mainly based on epidemiological history, clinical symptoms, Computed Tomography (CT) scan, and nucleic acid detection by a Real-Time Polymerase Chain Reaction technique (RT-PCR).[1]

SARS-CoV-2 is an enveloped, single stranded RNA beta corona virus that belongs to the family Coronaviridae. It has four major structural proteins; Envelope (E), Membrane (M), Nucleocapsid (N), and Spike (S) protein. The S and N proteins are the principal immunogens used for the detection of anti-SARS-CoV-2 specific antibodies.[2] The S protein consists of two subunits. The first subunit (S1) mediates the attachment of the virus to human cells via its receptor-binding domain (RBD), and the second one (S2) mediates membrane fusion for viral

entry. Antibodies that bind to the S protein can neutralize corona viruses.[3]

The humoral immune response to infection or vaccination or Herd immunity has two basic outcomes: Antibody production by Antibody Secreting Cells (ASCs), which can provide rapid humoral immune response, and the development of long-lived memory B cells, which can mount recall responses. Memory B cells drive the recall response by producing new antibodies by establishing new ASCs or re-entering germinal centers for subsequent rounds of somatic hyper mutation if circulating antibodies fail to protect against a future exposure.[3,4]

COVID-19 vaccination approaches aimed to generate neutralizing antibodies against S, hence preventing SARS CoV-2 infection in its early stages. Several vaccines have been demonstrated to be safe and effective in clinical studies and vaccination in huge numbers (when used in combination with other existing control measures) is recognized as one of the most important aspects of pandemic management. Although the results of clinical trials are encouraging, real-world evidence on vaccines is still lacking.

Hence, this study was planned to estimate the seroprevalence of SARS-CoV-2 antibodies and to determine the association of them with the socio-demographic profile of the study subjects.

METHODS

It was a community based analytical cross-sectional study done in rural areas of Eluru district, Andhra Pradesh State for a period of 2 months (1st October 2022 to 30th November 2022). There were 16 villages in rural field practice area, from which 4 villages were selected by using simple random method, from each village 30 members were selected by using systematic random sampling. Sampling interval was calculated for each village separately (Figure 1).

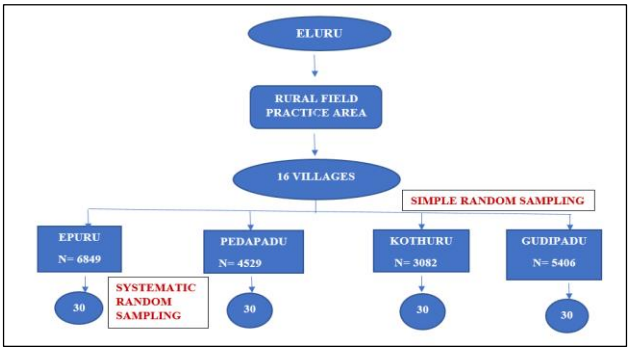

Figure 1: Sampling method.

According to the study conducted by Muro et al, in Salamanca, seroprevalence of SARS-CoV-2 antibodies was found to be 8.25%, Confidence interval (CI) at 95%, alpha error (α): 5%, absolute precision 5% a sample of 120 was included.[5] People residing in rural areas who were aged 15 years and above, who were willing to participate and gave consent were included and who were absent on the day of data collection were excluded.

The questionnaire used in the study was pretested among people from different areas and necessary modifications were made to make it more understandable. Prior to data collection, an elaborative briefing about the purpose of the study was done to study subjects. Data was collected from each subject by personal interview method.

Permission from Institutional Ethics Committee was obtained prior to start of study. An informed consent was taken from the study subjects after thorough explanation about the purpose of the study. An assent was taken if study subject's age was between 15 years and 18 years. Blood samples from the selected individuals were taken Humoral responses (Ig G) were assessed using an ICMR approved Micro well ELISA test for the semi-quantitative detection of COVID 19 (SARS-CoV-2) neutralizing antibodies in human serum samples. The antibodies titers (IgG) cut off >10 AU/ml were reactive- indicates presence of SARS CoV-2 IgG antibodies and <10AU/ml were non-reactive- indicates absence of SARS CoV-2 IgG antibodies. The collected data entered in Microsoft Excel 2019 and analysed using IBM-SPSS version 26 software, trial version.

RESULTS

Out of 120 study subjects, majority 104 (86.7 %) of them had reactive Ig G antibody titers for SARS Cov2, followed by 16 (13.3 %) had non-reactive Ig G antibody titers for SARS Cov2 (Figure 2).

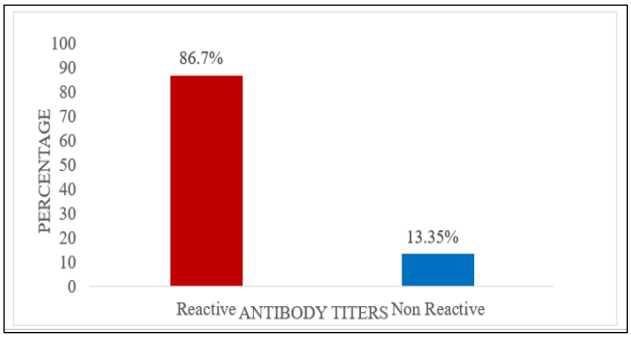

Figure 2: Distribution of study subjects based on antibody titers (IgG).

Sociodemographic factors were not significantly associated with antibody titers (Ig G) with ($p>0.05$) (Table 1).

Among associated factors, antibody titers (Ig G) were significantly associated with history of Covid-19 ($\chi^2=5.212$, $p<0.05$) and period of recent dose of covid vaccination ($\chi^2=7.894$, $p<0.05$). All other associated

factors were not significantly associated with antibody titers (Ig G) with (p >0.05) (Table 2).

Table 1: Association between sociodemographic factors and antibody titers (Ig G).

Sociodemographic factors		Reactive (%)	Non-reactive (%)	Total (%)	Chi-square test & p-value
Age group (years)	21-30	49 (86)	8 (14)	57 (100)	χ^2=0.291, p= 0.865
	31-60	44 (86.3)	7 (13.7)	51 (100)	
	61-80	11 (91.7)	1 (8.3)	12 (100)	
Gender	Male	29 (78.4)	8 (21.6)	37 (100)	χ^2=3.180 p= 0.07
	Female	75 (90.4)	8 (9.6)	83 (100)	
Education status	Illiterate	20 (83.3)	4 (16.7)	24 (100)	χ^2=0.599 P=0.897
	Primary school	20 (90.9)	2 (9.1)	22 (100)	
	Secondary school	24 (85.7)	4 (14.3)	28 (100)	
	Higher education	40 (87)	6 (13)	46 (100)	
Family type	Joint	79 (84)	15 (16)	94 (100)	χ^2=2.585 p= 0.108
	Nuclear	79 (84)	15 (16)	94 (100)	
Present occupation status	Farmer	14 (93.3)	1 (6.7)	15 (100)	χ^2=3.183 p= 0.672
	Business	9 (90)	1 (10)	10 (100)	
	Teacher	8 (80)	2 (20)	10 (100)	
	Daily labourer	19 (79.2)	5 (20.8)	24 (100)	
	Front line worker	37 (86)	6 (14)	43 (100)	
	Others	17 (94.4)	1 (5.6)	18 (100)	
Socioeconomic status (As per updated B.G. PRASAD'S classification 2021)	Class I	15 (88.2)	2 (11.8)	17 (100)	χ^2=1.719 p=0.787
	Class II	31 (83.8)	6 (16.2)	37 (100)	
	Class III	38 (86.4)	6 (13.6)	44 (100)	
	Class IV	17 (94.4)	1 (5.6)	18 (100)	
	Class V	3 (75)	1 (25)	4 (100)	
Religion	Hindu	72 (85.7)	12 (14.3)	84 (100)	χ^2=1.618 p=0.445
	Christian	30 (90.9)	3 (9.1)	33 (100)	
	Muslim	2 (50)	1 (50)	3 (100)	

Table 2: Association between associated factors and antibody titers (IgG).

Associated Factors		Reactive (%)	Non-Reactive (%)	Total (%)	Chi-square test & p-value
History of Covid19	Yes	44 (95.7)	2 (4.3)	46 (100)	χ^2=5.212, p= 0.02
	No	60 (81.1)	14 (18.9)	74 (100)	
Residing with frontline worker	Yes	41 (91.1)	4 (8.9)	45 (100)	χ^2=1.231 p= 0.267
	No	63 (84)	12 (16)	75 (100)	
History of Covid19 in the family	Yes	18 (81.8)	4 (18.2)	22 (100)	χ^2=0.548 p=0.459
	No	86 (87.8)	12 (12.2)	98 (100)	
Period of recent dose of covid vaccination	May, 2021	20 (90.9)	2 (9.1)	22 (100)	χ^2=7.894 p=0.04
	June, 2021	26 (86.7)	4 (13.3)	30 (100)	
	July, 2021	16 (69.6)	7 (30.4)	23 (100)	
	August, 2021	42 (93.3)	3 (6.7)	45 (100)	
Type of vaccine	Covishield	51 (83.6)	10 (16.4)	61 (100)	χ^2=1.005 p=0.316
	Covaxin	53 (89.8)	6 (10.2)	59 (100)	
No of doses of Covid vaccination	Single dose	4 (66.7)	2 (33.3)	6 (100)	χ^2=2.188 p=0.335
	Two doses	72 (87.8)	10 (12.2)	82 (100)	
	Three doses	28 (87.5)	4 (12.5)	32 (100)	

Comparison of means of antibody titers (Ig G) between Covishield and Covaxin by applying independent sample t- test this was found to be statistically non-significant with t-value 0.948 and p-value= 0.345 (Table 3).

Comparison of means of antibody titers (Ig G) between period of last dose of covid vaccination by applying ANOVA test this was found to be statistically significant with F-value 3.373 and p-value= 0.02 (Table 4).

Table 3: Comparsion of means of antibody titers (IgG) between Covishield and Covaxin.

Type of vaccine	N	Antibody titers (IgG) mean value	Standard deviation	Mean difference
Covishield	61	32.81	17.990	3.117
Covaxin	59	35.93	18.010	
t value: 0.948; df:118 p -Value = 0.345				

Table 4: Comparsion of means of antibody titers (IgG) between period of recent dose of Covid vaccination.

Period of recent dose of covid vaccination	N	Antibody titers (IgG) mean value	Standard deviation
May, 2021	22	36.59	19.511
June, 2021	30	30.46	16.727
July, 2021	23	26.91	18.868
August, 2021	45	39.63	16.162
F:3.373; df:3 p-value: 0.02			

DISCUSSION

In the present study, 104 (86.7%) of them had reactive Ig G antibody titers for SARS Covid 19, followed by 16 (13.3 %) had non-reactive Ig G antibody titers for SARS Covid 19. In the study conducted by Bawa, Mukesh et al, seropositivity for SARS-Cov-2 IgG antibodies was found to be higher 84.48%.[6] In the study conducted by Carolin et al, the overall seroprevalence of IgG antibody for COVID-19 was 57.9%.[7] Study conducted by Kumar et al, the seroprevalence of Covid 19 in the S. Andaman district was found to be 39%.[8] The results were similar to the studies conducted by Bawa, Mukesh et al, and lower than the studies conducted by the Carolin et al, Deepak Kumar et al.[7,8]

In the present study sociodemographic characteristics like age, gender, religion, education, occupation, type of family, Socio-economic status were found to be statistically not significant and not associated with the seroprevalence of covid 19 antibodies (p>0.05). In the study conducted by Bawa, Mukesh et al, there was no difference in seropositivity among participants as per religion, gender and SES.[6] The age group above 45 years had 91% of seropositivity, those between 18 and 44 years had 78.9%, while the age group between 6 to 18 years age had 70% seropositivity; this difference was found to be statistically significant (p = 0.001). Those participants who had confirmed COVID-19 in the past one year had 96% of seropositivity.

In the study conducted by Carolin et al, age, education, occupation, presence of comorbidities and presence of self-reported symptoms were not associated with seroprevalence (p-value>0.05) whereas female gender was significantly associated with seroprevalence.[7] The present study was not similar to the studies conducted by Bawa, Mukesh et al, Carolin et al, Deepak Kumar et al.[6-8]

In the current study, History of covid 19(p=0.02), period from recent dose of covid vaccination (p=0.04) were found to be statistically significant and associated with the seroprevalence of covid 19 antibodies.

In the present study comparison of means of antibody titers (Ig G) between period of most recent dose of covid vaccination by applying ANOVA test this was found to be statistically significant with F-value 3.373 (p-value= 0.02).

Study population was included only from rural population excluding the urban population. The study is limited because cellular immunity, which offers protective and long-lasting immunity against the virus, was not tested. It's been theorized that the real population level immunity to COVID-19 may be underestimated by IgG prevalence investigations.[9]

CONCLUSION

High seroprevalence in this study suggests that COVID-19 vaccination remains the best method to control the COVID-19 pandemic. It is necessary to encourage the public to take vaccination.

Recommendations

Awareness is mandatory for COVID-19 vaccination, promoting mass campaigns and encouraging public for vaccination and there is need in the development of COVID-19 vaccination for benefiting all age groups.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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