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Covid-19 Vaccine Acceptance and Determinants– An Online Cross-Sectional Survey in Kerala, India

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ABSTRACT

Background: Covid-19 vaccination threshold is key to pandemic control. This study aimed to assess the Covid-19 vaccine acceptance and determinants at Kerala, India.

Methods: A cross-sectional web- based study was conducted in Kerala, India from April-May 2021. A self-administered online questionnaire consisted of socio-demography, sources of information for Covid-19 updates, and perceptions about the Covid-19 vaccine. Analysis was done for determining the association of sociodemographic factors and Covid-19 vaccination perspectives with Covid-19 vaccine acceptance.

Results: Sources of information used for Covid-19 vaccine updates were Government sources (36%), social media (25%), mainstream media (21%), (WHO) World Health Organization (8%), doctors (5%) and peer-group (3%). The most trusted source for Covid-19 information was Government sources. Overall, the Covid-19 vaccine acceptance was 60% (n=93). The vaccine hesitancy was 40% (n=62). Covid-19 vaccine acceptance was significantly associated with healthcare profession, perceived vaccine safety and WHO or Health ministry recommendations. Covid-19 vaccine determinants were found to be vaccine safety and perception that Covid-19 vaccine was riskier than Covid-19 infection.

Conclusion: Covid-19 vaccine determinants; perceived vaccine risk and safety, need to be addressed to ensure the Covid-19 herd immunity threshold.

Keywords: Covid-19, vaccine, immunization, determinants, acceptance, hesitancy

BACKGROUND

The world is fighting the Covid-19 pandemic caused by the novel Coronavirus (SARS-CoV2). Globally, 1.82 billion cases and 3.94 million deaths have been reported so far.[1] India is reporting the highest number of cases per day.[1] Of 36 Indian states and Union Territories, Kerala ranks second in total Covid-19 cases as well as active caseload.[2]

A vaccine is central to Covid-19 prevention.[3] Approved Covid-19 vaccines provide significant immunity against serious infection.[3] Strategic Advisory Group of Experts (SAGE) is advising World Health Organization (WHO) on Covid-19 vaccines.[4] WHO emergency use listing comprises of eight vaccines; Pfizer/BioNTech, Astrazeneca-SK Bio, Serum Institute of India, Astra Zeneca EU, Janssen, Moderna, and Sinopharm [4]. Sinovac-CoronaVac was added in June 2021.[4]

Central Drugs Standard Control Organization (CDSCO), Govt. of India, granted emergency approvals to two vaccines: 1) Covishield® (AstraZeneca's

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vaccine by Serum Institute of India) and 2) Covaxin® (Bharat Biotech Limited).[5] Sputnik- V was given emergency authorization in April 2021.[5] The world has immunized 2.3 billion people against Covid-19 [6]. With 240 million vaccinated citizens, India is a close second to the USA.[6] In India, vaccination is accessible for all above 18 years.[7] The registration process is easy and simple with 73,600 vaccination centres.[7]

Indian government initiated a communication strategy to encourage Covid-19 vaccine uptake.[8] Yet, India ranks second in misinformation on Covid-19 vaccination.[9] Vaccine acceptance has been found 61% as per IMF's (International Monetary Fund) nationally representative surveys across 17 countries between November 2020 to April 2021.[10] Media reports have indicated that vaccine hesitancy was likely to be a major concern in Kerala.[11] A cross-sectional survey across Kerala reported side effects and fake vaccines as Covid-19 vaccine barriers.[12] The 2020 survey found that 58% Kerala population wanted to wait and watch before vaccination.[12] Hence, this study assesses the Covid-19 vaccine acceptance and determinants in Kerala, India.

METHODS

An internet-based cross-sectional survey was undertaken in April and May 2021. Online invitations were sent to internal and external WhatsApp groups available to the research team of this study in Malabar Medical College Hospital and Research Center, a private medical college in Kerala, India. The Institutional ethics committee of Malabar Medical College Hospital and Research Center, Kozhikode, Kerala, India approved the study in March 2021. To capture the particular study population through limited social media platforms, the purposive sampling method was used.

Inclusion and Exclusion criteria: Eighteen years and above Kerala residents using WhatsApp and willing to participate were included in the study. Less than 18 years, non-Kerala residents and those unwilling to participate were excluded from the study.

Sample size calculation: The sample size was calculated using Open Epi software [13]. Formula $Z\alpha^2$ pq /d ^{2} was used with Prevalence (p) = 61% (As per vaccine acceptance rate reported by an IMF [International Monetary Fund] study across 17 countries) [10]. The confidence level was taken as 95% and absolute precision as 8%. The sample size was calculated to be 143 which was approximated to 155.

Study tool: The study tool was a self-designed, pretested, semi-structured questionnaire. Six experts were consulted. The final questionnaire had 28 questions consisting of:

1) Socio-demographic characteristics: Age, Gender, State of origin, type of worker, Previous Covid-19 infection, Presence of Co-morbidities; Chronic Obstructive Pulmonary Disease, Bronchial Asthma, Diabetes, Cardiovascular disease, Stroke, Cancer, Renal disease and Chronic liver disease and Sources of information for updating on Covid-19.

2) Vaccination status and infection risk: Vaccine uptake and Self-perceived risk perception of acquiring Covid-19 infection. Risk perception was assessed using a single self-rating scale question. Self-perceived risk perception was categorized into - Very High, High, Low, and Negligible risk.

3) Perceptions and attitude about Covid-19 vaccine: Plan on Covid-19 vaccination and Factors influencing Covid-19 vaccination,

Self-administered online google questionnaire forms in English and local language (Malayalam) were circulated on internal and external WhatsApp groups available to the research team of this study in Malabar Medical College Hospital and Research center. Questionnaire was accompanied by the objectives and confidentiality of the study. The WhatsApp group users were requested to fill in the questionnaire within 72 hours. Online consent was taken before the submission of the questionnaire.

Variables

Independent Variables: Age**,** gender, profession, self-perceived Covid-19 infection risk, and co-morbidities (Chronic Obstructive Pulmonary Disease, Bronchial Asthama, Diabetes, Cardiovascular disease, Stroke, Cancer, Renal disease and Chronic liver disease), sources of information for Covid-19 updates, Covid-19 perspectives and factors influencing Covid-19 vaccine were considered independent variables.

Multiple choices were presented in the questionnaire for the sources of information - Government (Health ministry websites, apps, social media groups), WHO or other international organizations, mainstream media (Television / Newspapers), social media, doctors, peer group or others.

Factors influencing Covid-19 vaccination were asked using multiple options (Annexure)

Dependent Variables: Plan on vaccination was considered as the dependent variable.

Vaccine acceptance was defined as the participants who were ready to vaccinate as soon as possible. All the other options citing various reasons of delay were considered as vaccine hesitancy. The results were expressed in percentage.

Ethics approval and consent to participate: Protocol, as set out by the Helsinki Declaration, was followed. Institutional ethics committee of Malabar Medical College Hospital and Research Center, Kozhikode, Kerala, India, approved the study in March 2021. (Ethics approval No. MMCH&RC/IEC/2021 March). The confidentiality of participants was maintained. Participants' consent was taken online before questionairre submission.

Statistical analysis: Collected online data was transferred to Microsoft Excel. Analysis was done using SPSS 20.0. Univariate analysis was done and expressed as mean, standard deviation, and proportions. Bivariate analysis for associations with vaccine acceptance was tested using the Chi^2 test and Fisher's Exact test. Multivariable binary logistic regression analysis was done for determining the association of sociodemographic factors and vaccination perspectives with Covid-19 vaccine acceptance. Adjusted odds ratio (AOR) with corresponding 95% confidence interval (CI) were calculated to compare associations of sociodemographic factors and Covid-19 vaccination perspectives with Covid-19 vaccine acceptance. p-value of < .05 was considered statistically significant.

RESULTS

Socio-demography: The study received 155 responses. The mean age was 28±7 years. (Range: 20 to 57 years). The female to male ratio was 1:1.2. Professionally 71 (46%) were doctors, 35 (22.5%) were other health care workers and 49 (32%) were non-health workers. Co-morbidities were reported by 6.5% (n=10). Participants who had already been infected with Covid–19 were 12% (n=19). Half (49%, n=76) had received Covid-19 vaccine. (Table 1)

Table 1: Socio demographic characteristics

Characteristics	Respondents (%)
Age	
≤ 25	100 (64.5)
26-35	41 (26.5)
36-45	3 (1.9)
46-55	9 (5.8)
>55	2 (1.3)
Total	155 (100)
Gender	
Male	71 (45.8)
Female	84 (54.2)
Total	155 (100)
Health care worker	
Yes	106 (68.4)
No	49 (31.6)
Total	155 (100)
Co-morbidities	
Bronchial asthma	3 (1.9)
COPD	2 (1.3)
Diabetes	2 (1.3)
Cancer	1 (0.6)
Renal disease	1 (0.6)
Hypertension	1 (0.6)
No co-morbidities	145 (93.5)
Total	155 (100)
Had been infected with Covid-19	
Yes	19 (12.3)
No	86 (55.5)
Not sure	50 (32.3)
Total	155 (100)
Had received Covid-19 vaccine	
Yes	76 (49)
No	79 (51)
Total	155 (100)

Table 2: Sources and Trust towards Covid-19 information

	Source (%)	Trust (%)
Government	56 (36.1)	82 (52.9)
Social media	38 (24.5)	7 (4.5)
Mainstream media	33 (21.3)	7 (4.5)
WHO	12 (7.7)	30 (19.4)
Doctors	8 (5.2)	26 (16.8)
Peer group	5 (3.2)	0 (0)
Others	3 (1.9)	3 (1.9)

Table 3: Perspectives about Covid-19 and vaccine

Characteristics	Respondents (%)
Self-perceived risk of acquiring Covid-19 infection	
Very high	29 (18.7)
High	82 (52.9)
Low	39 (25.2)
Negligible	5 (3.2)
Plan on Covid-19 vaccination	
Get vaccine as soon as available	93 (60)
Delay and observe the side effects	22 (14.2)
Delay until more scientific research	15 (9.7)
Delay unless legally binding	9 (5.8)
Delay until mandated by my employer	5 (3.2)
Delay until mandated for travel	3 (1.9)
Delay due to non-specific reasons	8 (5.2)
Vaccine is riskier than Covid-19 infection	
Yes	19 (12.3)
No	104 (67.1)
Not sure	32 (20.6)
Vaccine is safe	
Yes	93 (60)
No	24 (15.5)
Not sure	38 (24.5)
Decision to receive the vaccine will depend on the brand of the vaccine	
Yes	71 (45.8)
No	82 (52.9)
Not sure	2 (1.3)
Already got Covid-19, I don't need vaccine	
Yes	14 (9)
No	141 (91)
If Covid-19 antibodies are there, I don't need vaccine	
Yes	31 (20)
No	124 (80)
If all others are vaccinated, I need not take vaccination	
Yes	22 (14.2)
No	133 (85.8)

Information regarding the Covid-19 vaccine: Covid-19 information was easy to get (91%, n=141). The government was the most preferred source (36%, n=56). It was also the most trusted (53%, n=83). Social media was the second most used source of information (51%, n=78). However, its credibility was considered low (5%, n=7). Despite high credence to WHO and medical professionals, their utilization as a source of information was low; 8% and 5% respectively. The Peer group was the least preferred information source (3%, n=5) and least trusted (0%). (Table 2)

Table 4: Associations of factors related to vaccination acceptance (n =155)

Factors	Acceptance (%)	Hesitancy (%)	Chi² value	p value
Age				
<25	35 (59.3)	24 (40.7)	0.018	0.893
≥25	58 (60.4)	38 (39.6)		
Gender				
Male	39 (54.9)	32 (45.1)	1.403	0.236
Female	54 (64.3)	30 (35.7)		
Health care worker*				
Yes	72 (67.9)	34 (32.1)	8.774	**0.003**
No	21 (42.9)	28 (57.1)		
Vaccine is riskier than Covid-19 infection*				
Yes	6 (31.6)	13 (68.4)		
No	87 (64)	49 (36)	7.288	**0.007**
Vaccine is safe*				
Yes	68 (73.1	25 (26.9)	16.671	**0.001**
No	25 (40.3)	37 (59.7)		
Decision to receive the vaccine will depend on the brand of the vaccine				
Yes	40 (56.3)	31 (43.7)		
No	53 (63.1)	31 (36.9)	0.732	0.392
Already got Covid-19, don't need vaccine*				
Yes	4 (28.6)	10 (71.4)		
No	89 (63.1)	52 (36.9)	6.334	**0.012**
If Covid-19 antibodies are there, I don't need vaccine*				
Yes	12 (38.7)	19 (61.3)		
No	81 (65.3)	43 (34.7)	7.319	**0.007**
If all others are vaccinated need not take vaccination*				
Yes	8 (36.4)	14 (63.6)		
No	85 (63.9)	48 (36.1)	5.5968	**0.015**
Indian manufactured vaccines				
Yes	17 (73.9)	6 (26.1)	2.178	0.140
No	76 (57.6)	56 (42.4)		
WHO / Health ministry recommendations*				
Yes	50 (70.4)	21 (29.6)		
No	43 (51.2)	41 (48.8)	5.930	**0.015**
A vaccine without side effects*				
Yes	3 (21.4)	11 (78.6)	9.540	**0.002**
No	90 (63.8)	51 (36.2)		
Covid-19 risk perception				
High	68 (61.3)	43 (38.7)	0.25	0.61
Low	25 (56.8)	19 (43.2)		
Ease of vaccination process**				
Yes	1 (50)	1 (50)		1.000
No	92 (60.1)	61 (39.9)	-	
High infection rates of Covid-19**				
Yes	6 (85.7)	1 (14.3)		
No	87 (58.8)	61 (41.2)	-	0.244
Co-morbidities' presence**				
Yes	4 (40)	6 (60)		
No	89 (61.4)	56 (38.6)	-	0.2

* Significant association with vaccine acceptance and hesitancy;
**Fisher's Exact test done due to expected count less than 5

Table 5: (Logistic regression table): The association between Covid-19 vaccine determinants and vaccine acceptance

Variable	Adjusted Odds Ratio (AOR)	95% CI for AOR	p value
Health care worker	0.548	0.245 – 1.224	0.142
Vaccine is riskier than Covid-19 infection*	3.768	1.175 – 12.086	**0.026**
Vaccine is safe*	0.304	0.140 – 0.660	**0.003**
Already got Covid-19, I don't need vaccine	2.311	0.518 –10.316	0.273
If Covid-19 antibodies are there, I don't need vaccine	1.571	0.546 – 4.525	0.402
If all others are vaccinated, I need not take vaccination	1.602	0.515 – 4.982	0.416
WHO / Health ministry recommendations	0.828	0.375 – 1.830	0.640
A vaccine without side effects	3.881	0.910 – 16.560	0.067

* Significant association with vaccine acceptance and hesitancy

Social media was more significantly utilized as a source of information for Covid-19 by participants less than 25 years. (Chi^2 value – 8.3, *p-value.004*)

Perspectives on the self-perceived risk of Covid-19 infection and Covid-19 vaccine: Based on the self-rated perceived risk of Covid-19 infection, participants rated themselves at very high (18.7%), High (52.9), Low (25.2%), and Negligiblerisks (3.2%). Covid– 19 vaccines were perceived safe by 93 (60%). Twenty-four (15.5%) believed vaccines were unsafe. Nineteen (12%) perceived the Covoid-19 vaccine as riskier than the infection. A fourth (n=38) were undecided on the vaccine safety. (Table 3).

Covid-19 vaccine acceptance was found in 60% (n=93). Covid-19 vaccine hesitancy was reported by 40% (n=62). Reasons of vaccine hesitancy were need of more data on side effects (14%, n= 22) and want of more scientific research (9.7%, n= 15). Few (11%, n=17) were reluctant to vaccinate unless compelled. (Table 3).

Associations of factors related to vaccination acceptance: Based on the Chi^2 test and Fisher's exact tests (Table 4), the likelihood of Covid-19 vaccine acceptance was significantly associated with healthcare profession, perceived vaccine safety and WHO or Health ministry recommendations. Vaccine hesitancy was associated significantly more with perceived protective effect of previous Covid-19 infection, perceived protective effect of Covid-19 antibodies, the protective impact of herd immunity, and vaccine side effects. No significant association of vaccine acceptance was found with age, gender, existing comorbidities, vaccine brand, Indian manufacture vaccine, ease of vaccine process and high Covid-19 infection rates. (Table 4)

The logistic regression table (Table 5) depicts the binary logistic regression analysis results determining associations between demographic factors, Covid-19 vaccination perspectives, and the acceptability of the Covid-19 vaccine. Adjusted odds ratio (AOR) with corresponding 95% confidence interval (CI) were presented to compare associations of sociodemographic factors and vaccination perspectives with Covid-19 vaccine acceptance. Using the logistic regression model, Covid-19 vaccine determinants were vaccine safety and perceived higher risk of Covid-19 vaccine compared with the risk of Covid-19 infection. (Table 5)

DISCUSSION

Risk-perception (72%, n=112) in our study was higher than perceived risk (40%) in general communities of the neighboring state Tamil Nadu, India, May 2020.[14] Our COVID-19 vaccine acceptance rates (60%) were lower than the populations of Ecuador (97%), Malaysia (94%), Indonesia (93%) and China (91%)[15], comparable to Bangladesh (60%) and USA (67%) [17] but greater than that in Greece (43%), Kuwait (24%), Jordan (28%), Russia (55%) and Poland (56%)[15].

Overall, our reported vaccine acceptance (60%) was similar to vaccine acceptance (61%) in IMF's (International Monetary Fund) nationally representative surveys across 17 countries (excluding India) between November 2020 to April 2021.[10] Sixty percent of our study participants considered the Covid-19 vaccine safe .Vaccine hesitancy (40%) in our study was lower than the 2020 cross-sectional study across Kerala which found 58% of participants wanted to wait and watch before vaccinating.[12] Decreased vaccine hesitancy time trends have been noted in various states in India; Kerala, Uttar Pradesh, Maharashtra, and Gujarat. These improved trends reflect efforts by the Government of India.[8]

In our study; non-healthcare profession, perception that Covid-19 vaccine is riskier than Covid-19 infection, perceived protective effect of Covid-19 antibodies, perceived protection of herd immunity, and vaccine side effects are significantly associated with vaccine hesitancy. More or less similar reasons for vaccine hesitancy have been observed across the globe including India. There is only one WHO-approved Covid-19 vaccine brand (Covishield®) available in India. Of the three approved vaccines in India, Covishield® was the only brand available in Kerala until a limited supply of Covaxin® was introduced in Feb 2021.

IMPLICATIONS

Pandemic control in India, particularly, in a high incidence state like Kerala, could be crucial. Vaccine hesitancy among health professionals adds to their pre-existing occupational risk. Vaccine hesitancy of 40% could be a hindrance to sufficient herd immunity. Delay in addressing misconceptions about the need of vaccines and their safety could affect Covid-19 control. As per our study, this age group depends on social media for the Covid-19 update. Scientifically unregulated social Medias are likely to lead to widespread misinformation in this age group.

LIMITATIONS

Despite a small sample size, the study gives valuable findings. However, purposive sampling design restricts the generalizability to the population. Online collection may have led to selection bias. The self-administered questionnaire can also cause reporting bias. More and larger studies, particularly qualitative research, are needed in the future.

CONCLUSIONS

Government sources were the most preferred and trusted sources for Covid-19 updates. Social media was ranked second with a significant preference by

<25 years age group. Vaccine brand mattered to 46%. The vaccine acceptance rate was 60%. Vaccine hesitancy was 40%. Using the Chi^2 and Fisher's Exact test, Covid-19 vaccine acceptance was significantly associated with healthcare profession, perceived vaccine safety and WHO or Health ministry recommendations. Vaccine hesitancy was significantly associated with non-healthcare profession, perspectives on Covid-19 vaccine risk and safety, perceived protective effect of Covid-19 antibodies, perceived protection of herd immunity, and vaccine side effects. Acceptance was similar across age, gender, vaccine brand, Indian manufacture vaccine, ease of vaccine process, high Covid-19 prevalence, and comorbidities. Using the logistic regression model, Covid-19 vaccine determinants were found to be vaccine safety and perception of Covid-19 vaccine being riskier than Covid-19 infection.

RECOMMENDATIONS

Availability of all the approved vaccines uniformly across states will help build trust. More Indian vaccines on the WHO-approved list are likely to increase uptake. Misconceptions about vaccine side effects and the need for vaccines in those already infected with Covid-19 infection must be countered scientifically. It is advisable to track not only the vaccine uptake but also the vaccine determinants. Trusted channels can then disseminate tailored messages to counter any misconceptions. Covid-19 vaccine determinants of vaccine safety need to be continuously addressed.

ABBREVIATIONS

Covid-19: Coronavirus Disease-19; SARS-CoV-2: **Severe acute respiratory syndrome coronavirus** 2; WHO: World Health Organization; SAGE: Strategic Advisory Group of Experts; CDSCO: Central Drugs Standard Control Organization; IMF: International Monetary Fund; COPD: Chronic Obstructive Pulmonary Disease; AOR: Adjusted odds ratio; CI: Confidence interval

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Availability of data and materials

Data will be available by emailing doctor-pratibha@gmail.com

Ethics approval and consent to participate

Protocol, as set out by the Helsinki Declaration, was followed. Institutional ethics committee of Malabar Medical College Hospital and Research Center, Kozhikode, Kerala, India, approved the study in March 2021. (Ethics approval No. MMCH&RC/IEC/2021 March). The confidentiality of participants was maintained. Participants' consent was taken online before form submission.

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Annexure:

Factors influencing Covid-19 vaccination were asked using below multiple options:

- If vaccines are produced in India
- If the vaccine is produced abroad
- Recommendation of WHO, Health ministry, other global agencies
- The vaccine has been used for a long time and proved effective
- The vaccine has been used for a long time and proved without side effects
- If the vaccine has been accepted by my peers
- If the infection rate of Covid-19 is high
- Whether the vaccine is free or charged
- Whether it is convenient to get the vaccine
- If there is an acceptance of vaccine with my colleagues and family
- If the vaccine is given within my hospital
- If the vaccine is given near to my house or workplace
- Any other

Plan on vaccination was asked using below options –

- Get the vaccine as soon as available
- Delay the vaccine unless legally binding
- Delay until more scientific research
- Delay and observe the side effects
- Delay until mandated by my employer
- Delay until mandated for travel
- Delay due to non-specific reason