UNDERSTANDING FACTORS IMPACTING COVID VACCINATION IN INDIA: A PRELIMINARY REPORT

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Abstract. The purpose of this study is to investigate the influence of various bio-psycho-social factors on COVID vaccination in a sample size of 200 in India using a Simple Random Sampling (SRS) method. The study comprises of selecting two groups of populations - who took vaccine (i.e., Group-1 or Acceptant group) and who are not in favor of taking vaccine (i.e., Group-2 or Hesitant group), having 100 individuals in each. Telephonic interviews are performed to identify various factors (through questionnaire) to identify and analyze various factors. The Key factors for vaccine adoption for Group-1 are: (1) infected with COVID-19 (2%), (2) free of cost (25%), (3) self-decided vaccine takers (15%), and (4) the pressure from peers, family and organizations (26%). For Group-2, the factors are: (1) news of post-vaccination morbidity and mortality (2%), (2) spontaneous decision not to take vaccine (30%), (3) non-availability of vaccine (14%), and (4) adapted to new normal life (30%). The study concludes that vaccination for preventing morbidity and mortality, on one hand, is encouraging to the people. Another encouraging part is free vaccines at the government hospitals, hence no cost is involved. On the other hand, news about post-vaccination morbidity and mortality are demotivating to adopt vaccination.
Keywords: *COVID 19 pandemic, health monitoring, health analysis, bio-psycho-social factor, COVID vaccination adoption*

Introduction

COVID19 is an infectious disease that has caused a pandemic situation across the world. The virus causes Severe Acute Respiratory Syndrome (SARS) Corona Virus 2 (COV 2), which is the predominant cause of severe morbidity and death. India, being a large country with the approximate population size of 130 crores and diversified culture, language, and socioeconomic status within, is facing a huge challenge in combating this pandemic. Until 24th May 2021 21:22 hr., there is 2,68,69,761 confirmed cases, 26,04,763 active cases, and 3,05,848 deaths; while, 2,39,48,435 have been recovered (Ministry of Health and Family Welfare, 2021). The daily trend shows rising number of fresh cases and deaths, although active cases show some degree of decline (Ministry of Health and Family Welfare, 2021). In order to combat this rising rates of morbidity and mortality, Govt. of India has summarily taken a four-pronged preventive approach – (i) compulsory social distancing and preventing crowding in the public places by imposing lockdown across the country, (ii) strict deployment of COVID protocols through local administrations, (iii) increasing the number of screening tests with RAT and RTPCR, and (iv) mass vaccination through trial.

Vaccines induce secondary immunity against a pathogen by developing memory cells, which can recognize the said pathogens and kill it when someone is exposed with it post vaccination. The pathogen is injected in an inert or inactive form through the vaccine. The newer vaccines, however, do not inject inert pathogen, but its blueprint for

antibody production (WHO, 2020). There are several vaccines, approved for COVID19, so far. As early as December 2020, mass vaccination against COVID19 had been conducted worldwide (WHO, 2020). Till date, at least 13 different vaccines across four major platforms have been administered (WHO, 2020). In India, COVAXIN manufactured by Bharat Biotech and COVISHIELD manufactured by AstraZeneca and Serum Institute of India are the currently available vaccines and until 23rd May 2021, 150,033,188 numbers of one doses have been administered, which covers 11% of the population and 41,686,052 numbers of double doses have been administered, which covers 3.1% of the population (Mathieu et al., 2021). All beneficiaries must register themselves through Co-WIN vaccinator App using national registered Id (Ministry of Health and Family Welfare, 2021).

Upon vaccination, there are COVID cases with mild to moderate degrees, called as "breakthrough infections", as reported from time to time in Indian dailies (Mascarenhas, 2021). Although very less, there are few deaths reported due to COVID even after full two courses of vaccination (Anqi and Kang, 2021; Bell et al., 2020). No vaccine is 100% protective, yet, this is plausibly a much perplexing picture to Indians causing severe dilemma to opt for vaccination. Many have started believing that vaccines are unable to combat COVID at its current trial stage, which has been endorsed further by the vaccine manufacturers by stating some percentage of efficacies their vaccines possess but certainly not 100%. COVISHIELD has a reported efficacy of 70% and after two doses it is raised up to 90%, while COVAXIN's efficacy is 78% and following two doses, the efficacy can go as high as up to 100% against severe COVID infection (Ghosh, 2021). Another dilemma is the delay in vaccine availability and supply (The Times of India, 2021), which is probably reducing the enthusiasm of the willing population with time in India.

This paper attempts to throw some light on why the vaccination rate in India is still not very much encouraging by studying various bio-psycho-social factors, which have possible influences on the vaccination preference within the population. The remaining part of the paper is structured as follows: Section II elaborates Study Design; Section III shows the results of the study; Section IV explains and discusses the results and draw relationships among the bio-psycho-social factors; Section V concludes the paper and shows some future scope of extension work.

Materials and Methods

Study design

Data collection

Research study area are focus on North-Eastern (Nagaland), Eastern (West Bengal), and Southern (Karnataka), India. Simple Random Sampling (SRS) has been chosen as it is able to represent a larger group of population most efficiently, where each individual is chosen by chance and each member of the population has an equal chance (Horton, 2021). The advantage of SRS is that it is 'simple' to conduct as being self-explanatory by its name and free from bias, while having the disadvantage of difficulty in gaining access to the larger population (Horton, 2021). Individual data (N = 200) has been collected from two equal groups of populations. Group-1 is consisted of those who took vaccines (N = 100), termed as "Acceptant" and Group-2 is comprised of people who did not take vaccine (N = 100), referred to as "Hesitant". The ages group are 35 – 70 years

adult males (total 128, average age: 47.6 years) and females (total 72, average age: 49.4 years). The mode of collection and ethical measures are telephonic one-to-one, based on pre-structured questionnaire having total 18 questions, seven for Group-1 and the remaining eleven for Group-2.

Participants were not divulged the objective of the conversation to prevent 'cooking' of answers so that the truthfulness of their answers stands throughout the interview. Average interview time was 23.4 minutes. The conversation was not recorded to maintain participants' privacy. The questionnaire design are set to various common bio-psycho-social factors that may influence human behavior towards adoption. Meanwhile, the research items implemented using the bio-psycho-social factors (F) that is taken into consideration to understand the vaccine-perception (i.e., acceptance and hesitancy) of the population under study. Below, 'F's for both the Groups (F1 for Group-1 and F2 for Group-2) and some additional or other factors, represented by 'OF's, have been considered in this study.

Factors for Group-1 (G1F1)

The number of participants in this group are Males (N=62) and Females (N=38). Under this group, namely, "Acceptant", there are seven factors (Id No: G1F1.1 to 7), identified in this study. Those are clustered under three constructs, such as 'Biological (B)', 'Psychological (P)', and 'Societal (S)'. Below *Table 1* shows the factors and the respective constructs. In this table, the factors with % population and its construct-fits are mentioned. It can be noted that G1F1.6, i.e., doctors' advice and their personal choice towards vaccination is the most important influence (42%) to the people.

Table 1. *Factors in Group-1.*

Id No.	Factors	Construct
G1F1.1	Pressure (Peer – 10%, Family – 15%, Organizational – 1%)	P
G1F1.2	Fear (Illness – 32%, Death – 25%, Financial loss – 13%)	P
G1F1.3	Spontaneous (Self-decided – 15%)	P
G1F1.4	Free of cost (25%)	S
G1F1.5	Indirect Influence (by media, Govt. etc. – 10%)	P
G1F1.6	Direct Influence (doctors are taking or advised – 42%)	P
G1F1.7	Infected with COVID (2%)	B

Factors for Group-2 (G2F2)

The number of participants in Group-2 are Males (N=66) and Females (N=34). Under this group, called as "Hesitant", there are eleven factors (Id No: G2F2.1 to 11). In turn, these factors are clustered under 'Biological (B)', 'Psychological (P)', and 'Societal (S)' constructs. Below *Table 2* shows the factors and their corresponding constructs.

Table 2. *Factors in Group-2.*

Id No.	Factors	Construct
G2F2.1	Pressure (Peer – 5%, Family – 5%)	P
G2F2.2	Fear (Adverse reaction, especially delayed type – 2%)	P
G2F2.3	Spontaneous (self-decided to not to take vaccine – 30%)	P
G2F2.4	Free (quality might be compromised – 21%)	S
G2F2.5	News (of post-vaccination morbidities and mortality– 2%)	P

G2F2.6	Post-infection immunity, no need of vaccination (12%)	B
G2F2.7	State of vaccine (Trial and not final product – 3%)	P
G2F2.8	Unavailability (lockdown, shortage of supply, closure of vaccination camp – 14%)	S
G2F2.9	Religious Belief (Astrology, God, alternative methods of protection – 15%)	P
G2F2.10	Follows COVID protocol so safe (37%)	P
G2F2.11	Adapted to new normal life (30%)	S

Hesitancy in adopting vaccination drive in Indian suburban is due to several factors, which have been shown in *Table 2* Two important predictors for not taking vaccine are most of the population (37%) are using masks, maintaining social distancing, hand-washing regularly and feel that following COVID protocols strictly would save them from catching the virus and hence close to that percentage (30%) of population spontaneously feel that they need not be vaccinated. Free vaccines have also raised concerns into their minds (21%), as they feel that 'free' means that the quality is compromised.

Other factors (OF) for the total sample size of 200

Table 3 shows two important Other Factors (OF1 and 2) that could play crucial role for vaccination adoption in the population, OF1 is the level of literacy and OF2 is the location, as it is presumed that higher educated residents of metros can access more information about vaccination and are able to analyse better.

Table 3. *Other factos.*

Id No.	Factors	Construct
OF1	Education (up to School – 31%, up to College – 59%, University -10%)	S
OF2	Location class (village – 12%, suburbs – 52%, metro city – 36%)	S

Glimpse of the raw date

The data is collected in a Binary form against each 'F'. During interview, if any 'F' is found to be satisfied by answering 'Yes', is given the value of '1', else given '0', which means 'No' and 'Not applicable' type of answers are given '0'. The advantage of this technique of data collection is that, it is simple and free from of any bias associated with the intermediary form of values, such as 'may be', 'perhaps', 'probably', which are represented by values between 0 and 1 (Papiewski, 2017). *Table 4* shows the real-valued data of each group of samples. 'Fs' in Group-1 are expressed as G1F1.1 to G1F1.7. Here, G1 and F1 refer to Group-1 and its sets of Factors, Group-2 and its' 'Fs' are expressed as G2F2.1 to G2F2.11. Here, G2 and F2 refer to Group-2 and its Factors (*Table 5*).

Table 4. *Group-1 (G1F1) data sets (example).*

G1F1.1	G1F1.2	G1F1.3	G1F1.4	G1F1.5	G1F1.6	G1F1.7
1	1	1	1	1	1	0
1	1	1	1	1	1	0
1	1	1	1	1	1	0

1	1	1	1	0	1	0
1	1	1	1	0	1	0
1	1	1	1	0	1	0
1	1	0	1	0	1	0
1	1	0	1	0	1	0
1	1	0	1	0	1	0
0	1	0	1	0	1	0
0	1	0	1	0	1	0
0	1	0	1	0	1	0

**Note: N=100*

Table 5. *Group-2 (G2F2) data sets (example).*

G2F2.1	G2F2.2	G2F2.3	G2F2.4	G2F2.5	G2F2.6	G2F2.7	G2F2.8	G2F2.9	G2F2.10	G2F2.11
1	1	1	1	0	1	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1	1
1	0	1	1	0	1	1	1	1	1	1
1	0	1	1	0	1	1	1	1	1	1
1	0	1	1	0	1	0	1	1	1	1
1	0	1	1	0	1	0	1	1	1	1
1	0	1	1	0	1	0	0	1	1	1
1	0	1	1	0	1	0	0	1	1	1
1	0	1	1	0	1	0	0	0	1	1
1	0	1	1	0	1	0	0	0	1	1

**Note: N=100*

Programming language and the Operating System (OS)

Python 3.8.3 with Spyder editor version 4.1.5, preloaded with matplotlib, sklearn, numpy, scipy.stat, ols, seaborn, and pandas. All simulations were primarily run on Windows 10 Pro 64 bits OS x 64-based Processor Intel(R) Core TM @ 2.80 GHz. All analysis has been made on a 'scaled' data.

Data fidelity measure

To establish eligibility, reliability or fidelity of the above data, that is how closely related the Fs are in defining the groups and analyze their interconnectedness, the data has been mined using Cronbach's α method (Goforth, 2015; Cronbach, 1951) using Equation 1:

$$\alpha = \frac{(r-\bar{c})}{\bar{v}+(r-1).\bar{c}} \qquad \text{(Eq. 1)}$$

Here, in the Equation 1, 'r' refers to the number of scaled data, $\bar{c}$ is the mean of all covariances between the data points, and $\bar{v}$ is the average variance. The Cronbach measure checks for internal consistency of the dataset and is the most important pre-processing step. The consistency score α is expressed as a number between 0 and 1, where $\alpha \geq 0.8$ is considered ideal while $\alpha \leq 0.5$ is deemed "unacceptable" (Goforth, 2015).

Data scaling

Data scaling is a conventional method of standardizing data during pre-processing. It can be achieved by either 'Normalizing' or 'Standardizing' the raw or real-valued data. Normalization scales each input variable between 0 and 1, e.g., max-min normalization;

while, Standardization scales input variables separately by subtracting the mean (called as centering) and dividing by the standard deviation (called as scaling) to have a distribution of mean equals to '0' and standard deviation equals to '1', i.e., yielding a Gaussian distribution. Standardization is also called as 'center scaling' method. In this work, the input data are binary in nature. Hence, instead of Max-min normalization, Standardization method of scaling has been used.

Statistical analysis

In descriptive statistics, it is a process where epidemiological data is expressed as a functional combination of its features and quantifying parameters like shape, frequency, central tendency (mean, median represented by 50% percentile, and mode), dispersion (range, standard deviation, variance), and position (percentile rankings, quartile ranking) (Sucky, 2020). Analysis of the Variance Test (ANOVA) is a generalization of the t-tests involving more than two groups (Fisher, 1936). ANOVA quantifies the difference in the mean value anywhere in the model (checking for a 'global' effect), but without informing where the difference lies (if there is any). To find where the difference is in between groups, post-hoc tests are required (Anwla, 2020).

One-way ANOVA has been conducted in this work to examine whether the sign-symptoms, classed under '0' or '1' categorization (variable "k"), are statistically different from each other. It has also been conducted to understand whether the Fs significantly differ between interviewees. For cases with statistically significant outcomes from one-way ANOVA, the Alternative Hypothesis (*HA*) was used instead of the Null Hypothesis (*H0*), indicating that there were at least two groups which are statistically significant while being different from each other (Anwla, 2020). The Null Hypothesis was validated against F-statistics, which is the ratio of variance of the group means to mean of the intra-group variances. F=1 points to null hypothesis. It tests the null hypothesis using Equation 2:

$$H_0 = \mu_1 = \mu_2 = \cdots = \mu_k. \qquad \text{(Eq. 2)}$$

Here μ represents the mean of the group and k measures the number of such groups. If, however, the one-way ANOVA returns a statistically significant result, the Alternative Hypothesis (*HA*) is accepted instead of the Null Hypothesis (*H0*), indicating that there are at least two group which are statistically significantly being different from each other (Anwla, 2020). F-statistic (the ratio of variance of the group means/mean of the within group variances) equals to 'one' accepts null hypothesis, else it accepts alternative hypothesis. For this work, F-static values (Anwla, 2020) are shown in the results section. In correlation, it is a measure of the extent of difference between any two variables and the direction of their relationships. In this work, Pearson's correlation has been used to determine the strength of relationships of the Fs, group-wise. It is an easy technique where the correlation values vary between -1 to 1. Values -1 indicate 'negative' correlation between any two Fs; while, '0' refers to non-correlation and '1' refers to positive correlation (Nettleton, 2014).

Results and Discussion

Data fidelity check

Cronbach's α value of Group-1 and 2 data are 84.39% and 91.70%, respectively, which refers to very *good quality* and internal consistency within the data. Hence, the data obtained by interviewing is reliable for analysis. This is the key finding. Factor/variable-wise plots are able to showcase the data *distribution* efficiently for both Group-1 and 2, which are shown in *Figure 1* and *Figure 2*.

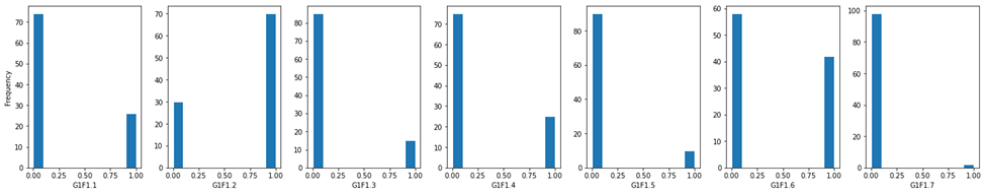

Figure 1. *Variable of Group-1.*

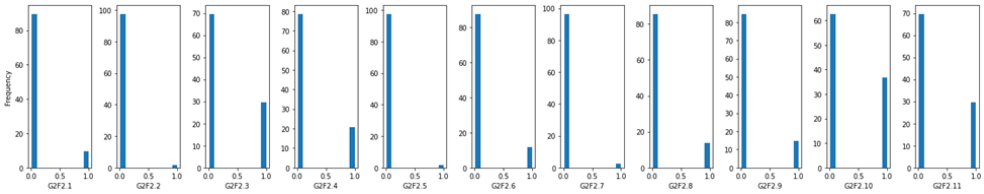

Figure 2. *Variable of Group-2.*

Descriptive statistics

Descriptive statistic tables show the Average (mean), Standard deviation (std), Minimum and maximum values (min and max, respectively), 1st Quartile (25%), 2nd Quartile i.e., median (50%), and 3rd Quartile (75%) values in the above tables. There are not many differences among the means and standard deviations factor-wise, which is explained in the next section (*Table 6(a)* and *Table 6(b*).

Table 6(a). *Descriptive statistics of Group-1.*

Type	G1F1.1	G1F1.2	G1F1.3	G1F1.4	G1F1.5	G1F1.6	G1F1.7
Mean	0.26	0.7	0.15	0.25	0.1	0.42	0.02
Std.	0.4408	0.4605	0.3588	0.4351	0.3015	0.4960	0.1407
Min	0	0	0	0	0	0	0
25%	0	0	0	0	0	0	0
50%	0	1	0	0	0	0	0
75%	1	1	0	0.25	0	1	0
Max	1	1	1	1	1	1	1
Count	N=100						

Table 6(b). *Descriptive statistics of Group-2.*

Type	G2F2.1	G2F2.2	G2F2.3	G2F2.4	G2F2.5	G2F2.6	G2F2.7	G2F2.8	G2F2.9	G2F2.10	G2F2.11
Mean	0.1	0.02	0.3	0.21	0.02	0.12	0.03	0.14	0.15	0.37	0.3
Std.	0.3015	0.1407	0.4605	0.4093	0.1407	0.3265	0.1714	0.3487	0.3588	0.4852	0.4605
Min	0	0	0	0	0	0	0	0	0	0	0
25%	0	0	0	0	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0	0	0	0	0
75%	0	0	1	0	0	0	0	0	0	1	1
Max	1	1	1	1	1	1	1	1	1	1	1
Count	N=100										

ANOVA analysis

For both the groups, ANOVA tables show *'F-stat' ≠ 1.0*, and hence *rejecting Null hypothesis* and accepting alternative hypothesis, which is also supported by *p-values >0.05* (*Table 7*).

Table 7. *ANOVA results.*

Category	Factors	Sum_sq	Df	F	PR(>F)
G1F1	Acceptant	0.137959	1	0.707778	0.402231
	Residual	19.10204	98	-	-
G2F2	Hesitant	2.333333	1	34.3	0.687191
	Residual	6.666667	98	-	-

Pearson Correlation matrix of Group-1 and Group-2 samples

Figure 3 and *Figure 4* show the heatmap with color bar to find the relationships among various factors. Both the figures are self-explanatory due to the color bar at the side, where colors are assigned based on the values inside the cells. Dark brown colored cells refer to *positively correlating factors*, while, dark blue cells represent the *negatively correlating factors*. Mid-values are non-correlating of weakly correlating between the factors and hence are not considered in this work.

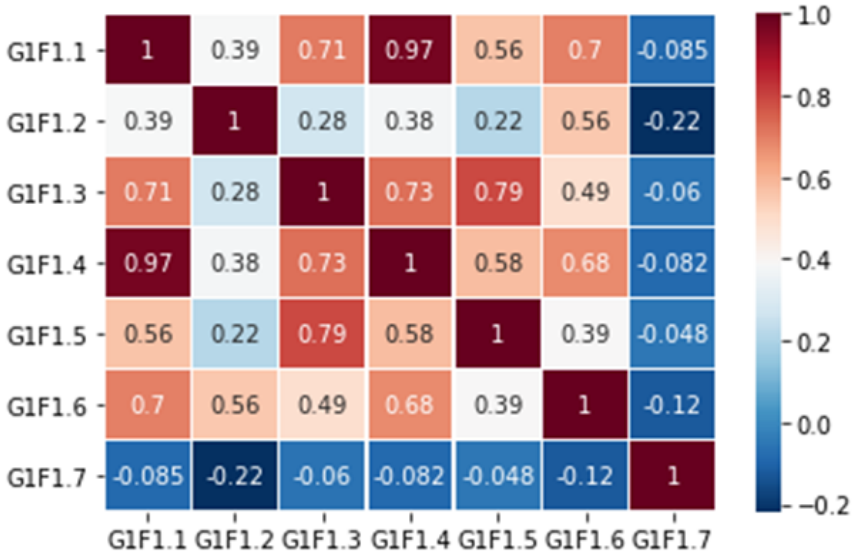

Figure 3. *Inter-relation of factors in Group-1 sample.*

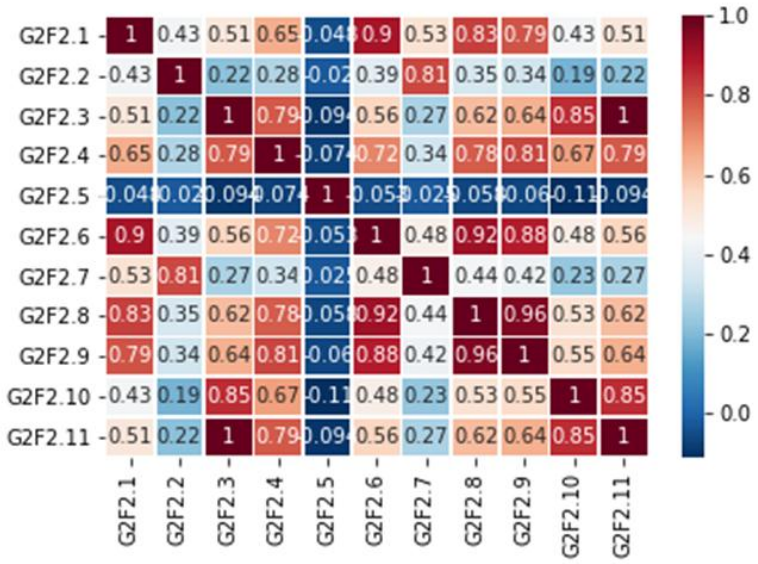

Figure 4. *Inter-relations of factors in Group-2 sample.*

The paper investigates various Bio-Psycho-Social factors, which might be the influencer of vaccine adoption in India. A small representative sample of population in the Eastern (West Bengal), North-Eastern (Nagaland), and Southern (Karnataka) has been interviewed based on the Bio-Psycho-Social constructs. Simple Random Sampling method has been used to represent the larger population in an unbiased way (Elfil and Negida, 2017; Sharma, 2017). Two groups have been identified. Group-1 is consisted of vaccine takers, termed as 'Acceptant' group and the individuals in this group have been interviewed with seven questions. Each question refers to a particular factor under a construct. The dataset, thus obtained, after interview reflects binary-valued data, where '1' refers to assertive answers and '0' otherwise (stated in *Table 1*). Similarly, the sample population of Group-2, who has not taken vaccine and has been referred to as 'Hesitant' to opt for it, has also been interviewed with eleven questions and answers are assigned as binary values, as mentioned in *Table 2*. The data sets, obtained finally are tested for internal consistency, i.e., the reliability for further analysis.

At the outset of the analysis, the fidelity of the data sets is examined by computing the 'α' values. It is expected that the value of 'α' should be above 50% to prove its acceptable internal consistency. It is found that Group-1 and Group-2 data sets are highly consistent having the values of 84.39% and 91.70%, respectively, which are high standard and good quality data (Chattopadhyay, 2013). In order to have a visual impression of the data sets, factor-wise, for both the groups, Density or Histogram plots are shown in *Figure 1* and *Figure 2*, respectively. The plots show the binary values, factor-wise (along its x-axis) and its' corresponding 'Frequency' (along the y-axis). Descriptive statistics of both the data sets shows the mean and standard deviations values of each factor are close to others with average variations of 27% and 37%, respectively for Group-1 data set (as stated in *Table 2*). While, for Group-2 data set, the variations are 16% and 32%, respectively (as stated in *Table 2*). One-way ANOVA has then been performed on the data set of both the groups to examine inter and intra group variations of the factors. The null hypothesis is that there is no difference, which is confirmed by the F-statistic value equals to 1.0 and p-values <0.05 (for the confidence interval of 95%). In this paper, for both the data sets, F-statistics are not equal to 1.0 and p-values are above 0.05, which rejects Null hypothesis and accepts the Alternate

hypothesis, which means there are inter and intra group variations among the factors (as stated in *Table 3*).

Pearson's correlation is then computed to note the influence of one factor on the other for both the data sets of both groups. Based on the Heatmaps of Pearson correlation scores for the Data set G1F1 ("Acceptant" group) (as stated in *Figure 3*), best three 'Positive' correlations can be noted between (G1F1.1 & G1F1.4 with correlation value of 0.97; G1F1.3 & G1F1.5 with correlation value of 0.79; G1F1.3 & G1F1.4 with correlation value of 0.73). From the list of factors, G1F1.1 refers to 'Pressure (peer or family or Organizational)', which is a 'Psychological' construct and G1F1.4 represents 'Free of cost' distribution of the vaccine, which comes under 'Social' construct. From this relationship, it may be presumed that, free vaccine and external pressure for taking it has pushed individuals to take it, which reflects the typical consumerism to opt for free commodity, which is also necessary at the same time (Lammers, 1991). G1F1.3 refers to 'Self-decided or Spontaneous decision for vaccination', while G1F1.5 represents 'Indirect influence of media, Government, advertisement, literature, Internet-based propaganda etc.' Both are 'Psychological' constructs. In this case of relationship, therefore, psychology of the taker is influenced by various advertisement and propaganda around him or her, which has played an important role to elevate the motivation for vaccination (Subroto and Samidi, 2018).

G1F1.3 and G1F1.4 are also found positive correlation, which indicates the fact that, free vaccine is the key mind-changer to spontaneity for vaccination (Lammers, 1991). On the other hand, best three 'Negative' correlations can be seen between G1F1.2 & G1F1.7 with correlation value of -0.22; G1F1.6 & G1F1.7 with correlation value of -0.12 and G1F1.1 & G1F1.7 with correlation value of -0.085. G1F1.7 refers to previously 'Infected with COVID-19', which is a 'Biological' construct. G1F1.2 represents 'Fear of Illness, death or financial loss', which is a 'Psychological' construct. Despite the fact that the individual had been infected with COVID-19 and might have developed antibodies naturally, still the individual preferred to take vaccine to prevent any further infection (Bell et al., 2020). G1F1.6 refers to 'Direct influence of Doctors who are taking vaccines or advising the individual to take vaccine', which is a 'Psychological' construct. As earlier case, here also, individual who was infected with COVID-19 did not depend on his/her natural immunity post-infection and opted for vaccination as per the advice of the doctors (Bell et al., 2020). In the third case (G1F1.1, G1F1.7), which are 'Psychological' and 'Biological' constructs, respectively, establishes the fact that 'Pressure from surroundings' (G1F1.1) for not opting for vaccination as the individual had 'already been infected' (G1F1.7) and so developed the antibodies against the virus, was denied by the individual and opted for vaccination to avoid any further infection (Baron et al., 2001).

Heatmaps of Pearson correlation scores for the Data set G2F2 ("Hesitant" group), which can be seen in *Figure 4*, best three 'Positive' correlations can be noted between G2F2.3 & G2F2.11 with correlation value of 1.0, i.e., perfect positive correlation, G2F2.8 & G2F2.9 and G2F2.6 & G2F2.8 with correlation value of 0.96 and 0.92, respectively. From the list, it may be noted that G2F2.3 refers to 'Self-decided not to take vaccine', which is a 'Psychological' construct. On the other hand, G2F2.11 refers to the factor 'Adapted to new normal life', which is a 'Social' construct. In this case, a sample size of 30%, who prefers not to get vaccinated and try their best to adopt and adapt to the new normal life due to COVID-19. G2F2.8 and G2F2.9 refers to 'Unavailability of the vaccine' and 'Religious belief', which are 'Social' and

'Psychological' constructs, respectively. Here, approximately 15% of the population, in the sample, believes that God would be saving them from this pandemic.

Such belief strengthens when the vaccines are not available due to short supply, lock down, closure of vaccinations camps, and so forth. Hence, they opted out vaccination. G2F2.6 refers to 'Previously infected with COVID-19' and G2F2.8 represents 'Unavailability of the vaccines' as mentioned before and are 'Biological' and 'Social' constructs, respectively. This sample represents a strong believer of post-infection immunity development and this belief has become even strong when vaccines are not available. As a result, they have not taken vaccines or hesitant to take. 'Negative' correlations can also be viewed between factors G2F2.5 & G2F2.10 (correlation value -0.11), G2F2.5 & G2F2.11 (correlation value -0.094), and G2F2.3 & G2F2.5 (correlation value -0.094) as the three best negative correlations of the lot. From the G2F2 list of factors, G2F2.5 stands for 'News on post-vaccination morbidities and even deaths' and G2F2.10 refers to 'COVID protocol followers', which are 'Psychological' constructs.

Here, people are hesitant to opt for vaccination is due to the 'risk' involved post-vaccination, which is out of their hand and prefers to maintain COVID-19 protocols, which are within their control. So, they preferred certainty over uncertainty. G2F2.11 refers to 'Adapted to new normal life', which is a Psychological construct and has become a choice over getting vaccinated and fall sick, influenced by G2F2.5. As a result, this population denies vaccination at this stage and prefers to adapt to the new normal life. The relationship of G2F2.3 and G2F2.5 is quite interesting. Both belong to 'Psychological' constructs and influence each other in a negative way, that is, not to take vaccine as a spontaneous decision by 30% of the population after hearing the news on post-vaccination morbidity and mortality. These are some novel and interesting findings of this study.

Based on the above observations, the key factors for vaccine adoption ('Acceptant' group) and refusal ('Hesitant' group) are identified based on its frequency of occurrence in the correlation matrices, respectively:

(1) Acceptant group – Rank 1: G1F1.7 – Infected with COVID-19 (2%) [Biological construct]; Rank 2: G1F1.4 – Free of cost (25%) [Social construct]; Rank 2: G1F1.3 – Self-decided vaccine takers (15%) [Psychological construct]; as well as Rank 2: G1F1.1 – Pressure from peers, family and Organizations (26%), [Psychological construct]. Here, out of seven factors, four i.e., 57.14% has turned up as game-changer for vaccine adoption and people opted for vaccination.

(2) Hesitant group – Rank 1: G2F2.5 – News of post-vaccination morbidity and mortality (2%) [Psychological construct]; Rank 2: G2F2.3 – Spontaneous decision not to take vaccine (30%) [Psychological construct]; Rank 2: G2F2.8 – Non-availability of vaccine (14%) [Social construct]; as well as Rank 2: G2F2.11 – Adapted to new normal life (30%) [Social construct].

Here, out of eleven factors, four i.e., 36.36% has turned up as negative deciders for vaccine adoption. Out of total eighteen factors, captured through the same number of questions, eight factors (i.e., 44.44%) came out as the key influencer for vaccine adoption in the study population, which means 44.44% questions have been successfully utilized. This indirectly supports the quality of questions asked. The role of other factors (OF) is then studied from the collected data. For both the groups, the level of education (up to school, Pre-university, University) and locality type of residence

(village, suburbs, metro city) has got not direct influence on vaccine adoption and has given a true pandemic picture.

Conclusion

From this study, a dilemma is clearly visible in the sample population, as on one hand, people are infected with COVID-19 with a rising rate and to prevent sufferings and death due to it, they are opting for vaccines. On the other hand, the news that is coming to them from various media and information sources on post-vaccination morbidity and mortality are restricting them to opt for vaccination. This is the preliminary sample scenario of vaccine adoption in India, which the paper has aimed to provide. The contribution of this study is that, it is able to identify few key factors, which are practically guiding vaccine adoption in the population. Careful representation and broadcasting post-vaccination morbidities and mortalities is mandatory to prevent injecting unnecessary threats, fear, and panic into the psyche of the population. It is evident that the load of Psychological construct dominates over Biological and Social on investigating the vaccine adoption in this sample population in India. Another contribution lies on the fact that the study has been conducted at a much faster pace and from the scratch as there is no similar study has yet been reported. This methodology, hence, can be cited as a ready reference to the researchers for investigating a larger population for vaccine adoption.

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Conflict of interest

The author confirm that there are no conflict of interest involve with any parties involved in this research.

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