INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

PSY 451A: PSYCHOLOGY OF ADJUSTMENT
ASSIGNMENT

TOPIC: VACCINATION HESITANCY DURING COVID -19 PANDEMIC
SUBTOPIC: ANALYSIS OF AGE AND GENDER BIAS IN VACCINATION HESITANCY

Group members and Contributions:

Preeti Kumari (190644)	Literature Review ,Introduction, Background (VH over time) & Discussion
Amrapali Pawar (190121)	Literature Review , Reasons affecting variation in VH for Age and Gender , Discussion
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INTRODUCTION

Although the COVID-19 pandemic is unprecedented, vaccine hesitancy has been a recurring issue throughout history. According to the Strategic Advisory Group of Experts on Immunization (SAGE), " Vaccine hesitancy refers to delay in acceptance or refusal of safe vaccines despite availability of vaccination services" [1]. Vaccine-hesitant individuals are typically seen as a diverse group situated in the middle of the spectrum that ranges from total acceptors to complete refusers. These "hesitant" individuals may refuse some vaccines, but agree to others, delay vaccines, or accept vaccines but are unsure of doing so [2],[3].

Vaccine-hesitancy has been reported to more than 90% of the countries worldwide and has been increasing globally from the past few years. Lowest COVID-19 vaccine acceptance rates were found in Kuwait (23.6%), Jordan (28.4%), Italy (53.7%) and Russia (54.9%) [4]. The attitude towards acceptance of vaccination is influenced by the factors such as misinformation, complacency, convenience and confidence [5]. Health misinformation can kill people, directly or indirectly. As many people acquire and share news via social media, misinformation can spread

quickly through their social networks, and the likelihood of exposure to disinformation and misrepresentation about the vaccine from unverified sources is very high [6]. Complacency refers to the situation when the risks of vaccination may outweigh any potential benefits, and vaccination is not always necessary to stop infection and transmission.The accessibility, availability and affordability in a comfortable context are all part of convenience. Trust in vaccine safety, efficacy, and the skill of the healthcare institutions are all examples of confidence. Studies have found that lack of vaccine confidence and complacency explains 38% and 21% of the variance in vaccine hesitancy respectively [7].

Apart from this, studies have shown a variety of other factors also associated but they do not allow a complete classification and confirmation of their independent and relative strength of influence. They are complex and context-specific, varying across time, place and vaccines. Including cultural and social variations such as age, gender, residence, education , income, occupation, marital status etc. constructs the health belief model [8],[9], constructs the attitude towards COVID-19 vaccination [10], miscommunication and conspiracies , and the perceived safety and side effects of the same [11],[12],[13]. If we see a high-level overview of the emerging issues, we find that by the end of June 2020, no vaccines were approved and most countries were experiencing the initial outbreak of SARS CoV-2 transmission. A study reported low acceptance of vaccines in 13,426 randomly selected individuals across 19 countries, most of them with a high COVID-19 burden [14]. On average, across the 53 countries, one in five adults were hesitant about getting the vaccine [15]. By June 2021, around 77% of the U.S. population were included in vaccinated households (all members have received at least one dose of the vaccine) [16]. By mid-December 2021, nearly 1 billion individuals globally were partially vaccinated, nearly 3.5 billion individuals were fully vaccinated. However, more than 44% of the world were still unvaccinated [17]. Understanding vaccination-related behavior is critical in expanding every determinant of vaccine hesitancy.

In this paper, we analyzed the reasons for the same on the basis of two major sociodemographic factors namely *age* and *gender* through literature review as well as data extraction. It helped us understand the underlying factors i.e. the mentality behind it that why certain age and gender groups are more hesitant to receive vaccination. Studies have found that younger age, females, not being of white ethnicity and lower education were associated with large vaccine hesitancy [18]. Research helps us understand these biases and by addressing disparities, we can work

towards more equitable distribution of vaccines. Not only does it improve vaccine uptake, it helps to identify effective interventions to address age and gender bias in the society. Including educational campaigns, targeted messaging and interventions tailored to specific concerns of different age and gender groups will prove beneficial in the long run.

BACKGROUND

Before looking into the age and gender analysis, let us first quickly break down the vast characteristics associated with COVID-19 vaccine hesitancy, how they are interrelated to each other, possible patterns and how they changed over time. This can influence individuals' decisions about getting vaccinated. A survey presented the percentage of 18 years or above hesitant about receiving a COVID-19 vaccine between January 2021 and March 2021.In 3 months, the percent of respondents showing hesitancy by saying they will "definitely not" or "probably not" receive a vaccine, lowered from 22 percent to 16 percent. [20] It shows that with time perception of people has changed in a positive manner. 'Hesitant' doesn't just mean people are totally refusing the vaccination , it also means they are unsure or confused about it , so we can break down the "hesitant" group into "definitely not" or "probably not". As people reported they will "probably not" receive the COVID-19 vaccine when available declined the hesitancy rate also declined . But the number of respondents who were "strongly hesitant," has lowered by only about 1 percentage point over time.

The timeline for the survey was administered between the start of January 2021 and mid-March 2021. It resulted in variation in hesitancy rates when grouped by age, gender, race/ethnicity and college completion. Hesitancy was slightly higher in women (around 23 percent) than men (around 21 percent) in January but it was similar in March (around 16 percent). It's important to note that although the rate eventually became similar, but with time, the hesitancy decreased by significant difference.[21] In the two survey periods, For age of 65 and older the hesitancy was lowest and highest among the 25-39 age group. With time, the hesitancy rates lowered by around 4-7 percent). When assessing reluctance by race/ethnicity, Asian (non-Hispanic) respondents showed the lowest levels in both poll periods, with a significant gap between them and other races. This gap narrowed further to 5% in March. In general, those without a college degree

showed more hesitation. The Other/Multiple Race group had the most difference in reluctance between the college and non-college groups when looking at the connection between race and education.

Almost all demographic groups have seen a considerable decline in vaccine hesitancy over time. When compared to seniors (aged 65+), the hesitation rate in the 18–24 age group has fallen by 8 percentage points (from 26 to 18 percent), although it has only decreased by 4 percentage points overall (from 11 percent to 16 percent)[22],[23]. Hesitancy rates among Black non-Hispanic people improved the most across racial/ethnic groupings, falling from 34% to 18%. (a decrease of 16 percentage points). We can also assume that there was a significant variation in hesitancy rates. The West Coast and the Northeast had the lowest hesitancy rates, whereas the South, the Great Plains, and Alaska had the highest rates[24],[25].

As one can see, a simultaneous review of different factors over time can help us explain patterns in a much clearer way. Due to the complexity and multitude of the factors and dimensions involved, we will focus on univariate analysis on 'Age' and 'Gender' within specified timeframes to facilitate clear and concise visualization.

METHOD

We used python programming language for most of our data analysis. We first did a literary survey of all datasets available pertaining to vaccine hesitancy. These datasets were then reviewed based on relevance and feasibility. The final datasets used were:

- https://www.kaggle.com/datasets/cid007/predicting-covid19-vaccine-hesitancy?resource=download
- https://www.nature.com/articles/s41591-022-02185-4#Sec4

The first dataset pertains to the collection of 3353 individual responses on vaccine hesitancy along with their personal details in the USA. This dataset was used to analyze the correlation of vaccine hesitancy with age and gender in the USA.
The second dataset contains the responses to a questionnaire designed to gauge vaccine hesitancy across 23 countries. In this dataset, we used 6 core questions(COVID-19 is a dangerous health

threat, COVID-19 can be prevented by vaccination, The risks of COVID-19 disease are greater than the risks of the vaccine, The COVID-19 vaccines available to me are safe, The COVID-19 vaccines available to me are safe, I trust the science behind the COVID-19 vaccines) and weighted them equally with options of 5 differing scores (5-strongly agree, 4-somewhat agree, 3-unsure, 2- somewhat disagree, 1- strongly disagree) to compute vaccine hesitancy. For our analysis, we only used the average of these response to compute the vaccine hesitancy.

For the data analysis, we used the various inbuilt libraries in python including pandas, matplotlib and numpy. In both cases, we first loaded the data from a file, filtered it to contain only statistically relevant ages and finally plotted it for visual analysis.

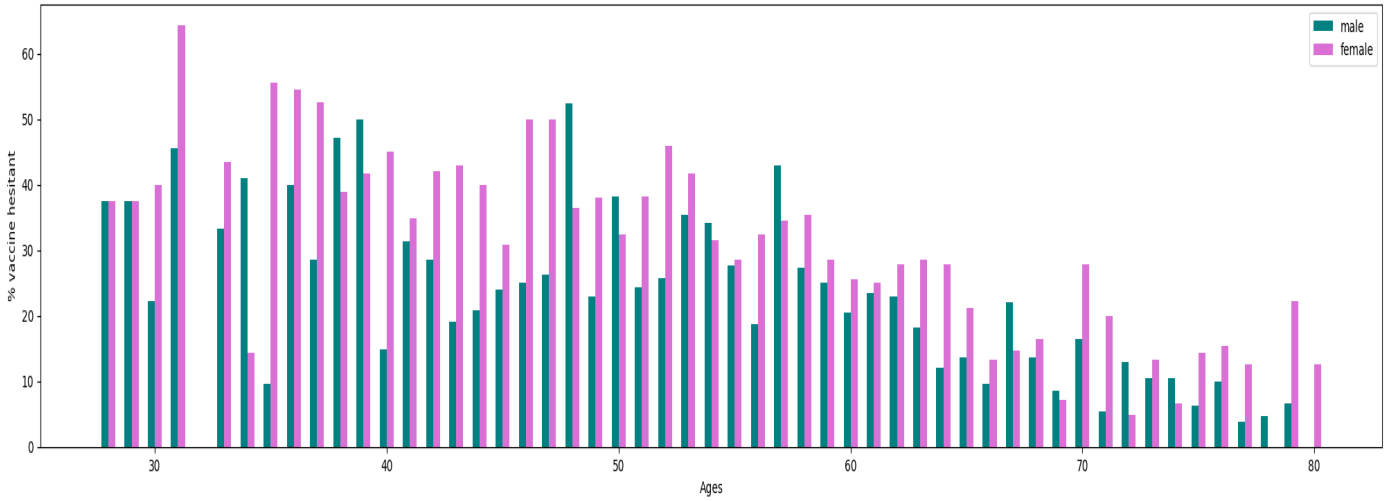
```
import matplotlib.pyplot as plt
import numpy as np
Percentage_VH_Male_List=[]
Percentage_VH_Female_List=[]
ages=[]
fig = plt.figure(figsize = (25, 5))
for age in age_frequency:
  Percentage_VH_Male_List.append(age_frequency[age]["Percentage_VH_Male"])
  Percentage_VH_Female_List.append(age_frequency[age]["Percentage_VH_Female"])
  ages.append(age)
Percentage_VH_Male=np.array(Percentage_VH_Male_List)
Percentage_VH_Female=np.array(Percentage_VH_Female_List)
ages_arr=np.array(ages)
rect1=plt.bar(ages_arr-0.15, Percentage_VH_Male_List, width=0.30, color='teal')
rect2=plt.bar(ages_arr+0.15, Percentage_VH_Female_List, width=0.30, color='orchid')
plt.xlabel("Ages")
plt.ylabel("% vaccine hesitant")
plt.legend((rect1[0], rect2[0]),("male", "female"))
plt.show()
```

Sample code

ANALYSIS

From the initial dataset pertaining to the correlation of age and gender with vaccine hesitancy, we obtained the following plot which showcases vaccine hesitancy across different age groups for both genders.

1st Dataset



The following observations were made from the above figure:

- Females in the USA were, on average, more vaccine hesitant than the male population.
- The population between 30 and 50 years of age showcases maximum vaccine hesitancy.
- The vaccine hesitancy kept decreasing with age after 60 years of age.
- The average vaccine hesitancy across all ages in USA was around 20%

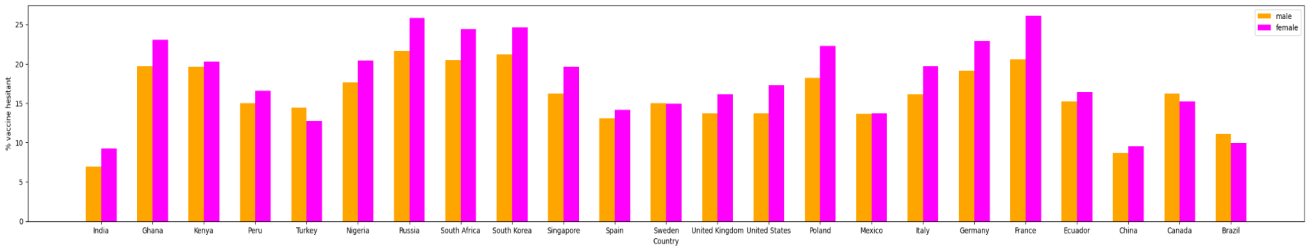
The possible reasons for this disparity in vaccine hesitancy could be because of political agenda and the distrust in science.

We see the vaccine hesitancy decreasing with old age possibly because of decrease in overconfidence as people become more likely to be/have been inflicted by diseases. This can also be accounted for based on the accessibility increasing with age owing to more free time.

The women in the USA seem to be more vaccine hesitant which may be a result of lesser knowledge and education and also because they were more influenced by political agenda.

2nd Dataset

From the country wise analysis, we obtained the following plot indicating the vaccine hesitancies across different countries.

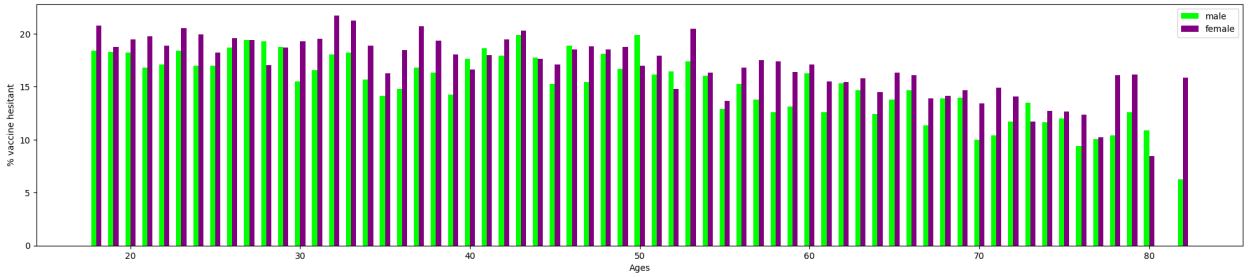


We see that certain countries like India and China have very low vaccine hesitancy, while countries like the UK, USA and Canada have mediocre vaccine hesitancy. Countries like Ghana, Kenya, Russia, South Africa, Poland, France and South Korea had vaccine hesitancies equal to or more than 20%.

This is mostly related to the political, religious views of the people in context to vaccination along with the availability of vaccines. Campaigns by the government for vaccination might have also played a role as seen in India where free vaccines were provided by the government, while the incumbent government in the USA was skeptical of vaccine effectiveness.

3rd Dataset

The following is the graphical plot of vaccine hesitancy with age and gender across 23 countries in the world:



We notice that we similarly notice a decrease in vaccine hesitancy in old age especially after 60 years of age. This is consistent with lesser confidence and increased risk of disease. This is because of lack of support and health resulting in possible fear and anxiety. They are also much less present in social media and so less influenced by social and political propaganda.

DISCUSSION

According to a study, the intention to get vaccinated or had at least one dose of available vaccine has been increased over the last year in 15 out of 19 countries studies in 2020,2021 and the metric reached 75.2% for all 23 countries studied in 2021.[26]The most consistent correlates of COVID-19 vaccination hesitancy is being discussed in detail.

1. **Distrust in Science and Technology** : People thought vaccines produced in a rush would be dangerous and thus refused to take it .This shows people don't trust the government or technology . it can be due to their previous experiences or lack of ability to trust . Studies have shown , people with lower education levels don't get access to accurate information , so they are more hesitant or ignorant about vaccination . Study conducted by University of Southern California found that college graduates were more likely to receive the vaccine compared to the ones who are not going to college , so the education level can surely affect the trust in science and technology . People had doubts about the efficiency of the vaccine , this can be due to misinformation or not understanding how the vaccine works . Again here education played an important role in understanding vaccination . People were worried about short term and long term side effects of the vaccine. Though the government has already declared that no vaccine is 100 % effective but it will be so much more effective compared to none taken , people drew the conclusion of the vaccine being not effective at all out of this . People were doubtful about the provenance of the vaccine .
2. **Denial of the virus** : People were considering covid-19 as a harmless disease thus thinking the vaccination is useless .Most of the people were in denial about covid-19 being a life threatening disease. Many people thought the spreading was intentionally done to create economical and medical chaos and vaccination was just a way of making money for pharmaceutical companies . The social media theories and different conspiracies made people believe that the virus is just a hoax . Some people believe only certain types of people (elderly or people with preexisting conditions) can get it , they are not at all at risk of covid .There were the same people who were not following safety guidelines as they were not taking the virus seriously and totally denying it.

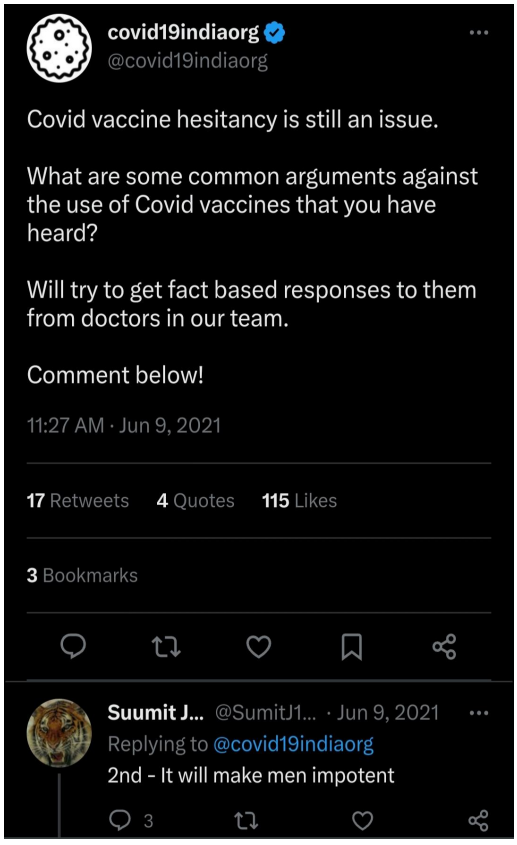
3. **Overconfidence** : People had a belief to be already immunized . Most middle aged people who had already undergone serious diseases like tuberculosis and flu several times during their lives were thinking that they had already conquered serious diseases like these and have a better immunity than anyone . People were thinking at some point of time they must have gotten the covid without showing much symptoms , they survived that time , so now there is no necessity of taking the vaccine . People who have tested positive for covid were also feeling that they need not to take the vaccine as they have developed the immunity now , ignoring the new variants of the virus . Some people experienced unsettling side effects after the first dose so refused to take the second , some thought only one dose was enough to boost their immunity thus refused to get fully vaccinated.
4. **Accessibility** : Access to the vaccine was also a major reason behind the hesitancy . The vaccination centers were crowded and it was hard to make an appointment for vaccination . People were avoiding crowded places and thus vaccination centers also . Though this problem decreased after the government decided to go door to door for the vaccination . Lack of transportation to the vaccination sites , not getting a time off work to get vaccinated could be reasons for the hesitancy . Most people didn't even know where and how to get a vaccine. The nearer the vaccination center , the higher the rate of vaccination . People with busy schedules were more likely to forget about the vaccination.
5. **Lack of Social Responsibility** : Collective responsibility played a great role in the case of vaccination . People who feel responsible about their own and other's health automatically tend to take all the precautions . Not feeling collectively responsible or showing lack of interest created a refusal towards vaccination . Some people think that if they get vaccinated, they have to go to work , which by not taking vaccines they can avoid easily. Peer influence played a great role in this , seeing friends or coworkers not getting vaccinated influenced the decision of people . People who have seen or been in vaccine campaigns were less hesitant about vaccines .
6. **Religious and Cultural differences** : People who were hesitant had some Spiritual / religious reasons also. Some were thinking someone's disease is a will of god or 'karma' so no one should go against it, not even the vaccine . Some were thinking there is no

need for medicines , the almighty will make people healthy . Some religious groups were concerned about the use of gelatin (animal product) in the making of vaccines and refused to take it as it is wrong according to their religious belief. Some Christian communities showed refusal by saying the vaccine has fetal cells which led to vaccine hesitancy in the communities . In the US , some African American communities showed refusal for vaccines due to previous mistreatments by medical centers . This hesitancy is based on cultural events or festivals also . One great example is Muslims were hesitant to vaccinate as it is advised that nothing should enter or leave the body during Ramadan , so this should be applicable to vaccines also .

7. **Financial Reasons** : People had some financial reasons also , though vaccination was free in government hospitals and but it also has a black market where covid medicines and vaccines were selled at a very costly price.People not having health insurance were afraid about the side effects of the vaccine . Studies have shown that people with low income and lower education levels were more hesitant . People with high income also have easy access to healthcare or vaccination sources , so it is easy for them to get vaccinated compared to others .
8. **Political influence**: In India , political beliefs had played a great role in the decision of vaccination . The main opposition party (Congress) raised questions about efficiency and implementation of vaccination at first , this resulted in the hesitation between their supporters . There were also some headlines showing political favoritism in the distribution of covid-19 vaccines which raised the question about equal availability of vaccines. Many politicians like Arvind Kejriwal , Narendra Modi made efforts to encourage people to consider the vaccination , but there were times when political parties set a bad example for citizens , the example of this is political rallies during the state assembly elections which were held violating the covid-19 guidelines and thus making people think whether the pandemic is a real threat or just a chance for implementing some political agenda.
9. **Child Vaccination** : Child vaccination was a great issue at covid times . Parents were thinking that their child has already taken vaccines for polio , dengue and taking another vaccine could create side effects or dangerous effects on their child's health . Some were thinking natural immunity is better for their child than acquired through vaccinations ,

giving reasons like today's generation is not strong compared to them due to these 'unnaturally created immunity'. Also parents were avoiding vaccination to avoid risk of exposure at covid 19 vaccines . The parents of a teenager who are hesitant for themselves also used to prohibit their children from the vaccination although their children wanted to take a vaccine . Being a family conservative nation , this behavior is more seen in India compared to the other nations like the USA .

10. **<u>Rumors were enough</u>** : Some groups had bizarre perceptions of vaccines . They thought the government is planting viruses intentionally and they are doing it through vaccines . In some areas of Uttar Pradesh, people were thinking the vaccines have another kind of medicine which will make them sexually impotent and the government is doing this intentionally to implement " hum do , humare do " and control the population. Social media was a great source for rumors . Here are some screenshots from Twitter (social media) which shows some misconceptions about the vaccine .



As we go through the analysis based on age-groups, we want to highlight the possible reasons for our findings. According to a CDC survey conducted in March 2021, there has been variations about vaccine hesitancy in different age groups . Main trends are -

1. **Older Adults (Age group 65 +)** : These were the least hesitant people about the covid vaccine . According to the survey more than 74% of this age group partially or completely had received one dose of a vaccine . We all know that the older people have a higher risk of getting the covid and higher chance of death due to this illness , this can be the main reason the vaccination rates were high in this age group . Being dependent on their offspring or other family members , older adults had to choose vaccination if given . This age group being extremely socially inactive and highly dependent on family members makes them distant from all the rumors or political influence . So if their family members or caretakers suggest taking a vaccine , they are more prone to take it .
This is consistent with our preliminary data analysis.

2. **Adults (Age group 18-64)** : According to a survey 58% of this group had received one dose of the vaccine . This group shows too much variation , factors like trust in government and science , education and income can contribute to the decision whether they want to take a vaccine or not . Many people in this age group were eager to get vaccinated for their and their loved ones health and many had mixed feelings about the vaccination . The people who are in their 40s or 50s are pretty mature and more likely to consider the vaccination as they know they also have higher chances of getting the covid , while the younger generation who gets easily influenced by others were refusing to do so. Availability was also a factor here , as this age group is basically a working capital , one must get the time off work to make a vaccination appointment . Various factors contribute to the decision making here .

3) **Young adults (Age group 18-29)** : Only 34% of this age group had taken the single dose of the vaccine . This age group is basically a young working capital of any nation ,

which is considered healthy and very much social . The reasons behind the refusal or confusion about the vaccinations can be social or political influence , distrust in the healthcare system and government . The main reason can be neglecting the need of a vaccine due to the feeling of being at a lower risk as they are young and healthy . This age group is also prone to social media rumors and influence , if the vaccination is shown as a social norm or some social media trend this group is more likely to consider it given the influence they had of social media . If the same social media shows some different kinds of narratives i.e. pandemic is pharmaceutical's dream come true , this age group is likely to oppose vaccination . It is very complex to determine the exact reason as there are several factors influencing the perspective of this age group mostly showing disorganization of unstable personality traits compared to elders , but one can surely say this age group is more hesitant towards the vaccination .

GENDER :

On the basis of analysis of vaccine hesitancy for different genders , we came to know that women are more hesitant towards the vaccination .

In most countries , the vaccination hesitancy level was high in women compared to men . We will first see the in general possible reasons behind this -

1} women, especially from marginalized or minority communities, may have a mistrust towards healthcare systems due to past experiences of discrimination .Many women didn't have correct information about the vaccines , especially women from rural areas .

2} Women generally play caregiving responsibilities in most households , it can be hard for them to take time off chores and work for vaccine appointments . Also most women think about who will take care of home if they get side effects of the vaccine .

3} Women are more likely to report side effects of vaccines , like blood clots or heart inflammation which created safety concerns about the vaccination .

4} Women with some transportation related issue or finance related issue are more likely to be hesitant towards vaccination. Women especially in India are working in low paying jobs or informal sectors which makes them unable to make vaccine appointments .

5}Misinformation about vaccines specially related to women can easily create vaccine hesitancy . In some parts of India , cultural beliefs affected the vaccination among

womens , for example some pregnant women were hesitant that the vaccine will affect their baby . Some were hesitant about taking the vaccine during their menstruation .

CODE AVAILABILITY

The code for the above analysis is available in the following link along with the graphical plot images:
https://github.com/GauriGMenon/PSY_Vaccine_Hesitancy

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