



Analyzing COVID-19 Vaccine Willingness Among Nigerian Students Using Data Mining

¹King Victory Echezonachukwu, ²Ardee Joy Ocampo

¹Medical Laboratory Scientist, ²Doctor of Information Technology

¹Laboratory,

¹Lorma Colleges, San Fernando City La Union, Philippines

Abstract: This study aimed to investigate the willingness of Nigerian students to receive the COVID-19 vaccine using data mining techniques. The study found that only a small percentage of respondents were willing to get vaccinated, with sociodemographic factors such as gender, age, and level of education driving vaccine hesitancy. Additionally, preferred type of information source, specific mistrust, and generalized beliefs were also significant factors driving vaccine hesitancy. The study recommends that school authorities implement systematic interventions to reduce vaccine hesitancy among students, including rebuilding trust in national health authorities and promoting educational awareness campaigns that offer clear and transparent information about the safety and effectiveness of COVID-19 vaccines. Further research is needed to identify the underlying reasons for vaccine hesitancy among Nigerian students.

Index Terms – COVID-19 Vaccine, Herd Immunity, Vaccine Willingness, Data Mining, Nigeria.

I. INTRODUCTION

Approximately two years have passed since the World Health Organization first recognized COVID-19 infection caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection. SARS-CoV-2 is a single-stranded positive-sense RNA virus that is a member of the Coronaviridae family and the Noroviruses order. It has a genomic size of roughly 30 kb (Hatmal et.al,2020). The virus can spread to any human cell that expresses the ACE2 receptors, however it is primarily disseminated from the lung. To enter host cells, the virus employs spike proteins that bind to ACE2 (Al-Hatamleh et.al,2021). Also, it can be spread through direct contacts with infected person or surface and by droplets infection when an infected person sneeze, talk, and cough and in the process, it causes a mild to severe respiratory symptoms (Di Nardo et al.2020).

The first case of SARS-CoV-2 was announced in late January 2019 in Wuhan China and was declared as a pandemic disease by the World Health Organization (WHO) on March 11th, 2020. The virus swiftly spread to 220 countries (Helmy et.al,2021), with Lagos, Nigeria announcing its first case on February 27th, 2020 (NCDC 2020). As of December 19, 2021, the total number of reported COVID-19 cases worldwide has surpassed 275 million, with over 5.4 million deaths. Globally, there have been 647,972,911 confirmed cases of COVID-19, including 6,642,832 deaths, reported to WHO as of December 16th, 2022. In Nigeria, there have been 266,381 confirmed cases of COVID-19 with 3,155 deaths as of December 16th, 2022 (WHO).

In response to the COVID-19 pandemic, governments and health authorities worldwide have recommended and enforced various health-protective measures, including mask wearing, physical distancing, and self-isolation. While these measures have proven effective in reducing COVID-19 transmission, they come at a significant cost to the public both economically and psychologically (Lazarus et al., 2020). Despite the widespread adoption of these measures, the most promising hope for recovery from the pandemic is through widespread vaccination against COVID-19 (Cordina et al., 2021). While mask-wearing, physical distancing, and other preventive measures have become a fundamental part of our daily lives, the success of these measures is limited without mass vaccination.

Vaccination and immunization have been proven to be highly effective in preventing infectious diseases (Kerr et al., 2020; Wang et al., 2020). The act of introducing a vaccine into the body produces immunity to specific diseases and is a safe and effective way to protect against infection from foreign agents such as viruses or bacteria (Seigris, 2018). However, the success of vaccines in preventing the spread of diseases is dependent on broad uptake within a given population (Kerr et al., 2020).

Despite the COVID-19 pandemic control protocols, policies, and guidelines measures, the spread of the virus has not been successfully halted (Olawade et al., 2022). As a result, researchers, industry, and funding organizations have collaborated to develop COVID-19 vaccines. Several vaccines such as Pfizer, Moderna, AstraZeneca, Janssen, Sputnik V, Sinovac, and Sinopharm have been approved and made accessible for usage globally. According to Samaranyake and Fakhruddin (2021), as of March 18, 2021, at least thirteen COVID-19 vaccines had been approved for usage at various levels, while another twenty-seven were undergoing extensive Phase III randomized controlled trials, and more were still in development. As of December 16th, 2022, 13,008,560,983 vaccine doses have been administered globally (WHO). In Nigeria, as of November 12th, 2022, 91,552,088 vaccine doses have been administered.

The success of COVID-19 vaccines is heavily dependent on the willingness of the population to get vaccinated in order to achieve herd immunity, which is the indirect protection from an infectious disease that occurs when a population is immune through vaccination or previous infection (Lincoln et al., 2022; WHO). Herd immunity is achieved when a large portion of the community population is immune to the disease, thereby reducing the risk of spread to others who are not immune (Dr. Howard Forman, Yale School of Public Health and Yale School of Management).

The development of a safe and effective COVID-19 vaccine is seen as the long-term solution to the pandemic for most countries. However, a critical step in extinguishing the pandemic is to vaccinate a high proportion of the population while addressing issues such as misinformation, lack of trust in science, and vaccine hesitancy (Edwards et al., 2021). While accepting vaccines is considered a personal decision and responsibility, it is also a right that individuals and communities should appreciate and demand (WHO, 2020). Unfortunately, many individuals deliberately choose not to accept vaccination, which is broadly described as vaccine hesitancy. Vaccine hesitancy is defined as “delay in acceptance or refusal of vaccination despite the availability of vaccination services” (MacDonald, 2015). A recent systematic review on vaccine hesitancy found that global acceptance rates for the COVID-19 vaccine were over 60% (Shakeel et al., 2022). However, a study conducted by Sallam (2021) reported that willingness rates varied between 65-75% in most surveyed countries, with African countries showing significantly lower acceptance rates. In fact, Africa had the lowest mean vaccine-acceptance rate (Shakeel et al., 2022). Eniade et al. (2021) also found that Nigerians had a low willingness to receive the COVID-19 vaccine.

Studies have been conducted to assess the factors responsible for vaccine willingness versus vaccine hesitancy. Allington et al. (2020), Bono et al. (2021), and Ebrahimi et al. (2021) found that higher COVID-19 risk perception was correlated with higher vaccine willingness. However, Zewude and Habtegiorgist (2021) found low willingness to take the COVID-19 vaccine due to concerns about safety, side effects, and lack of adequate information about the vaccines.

Zewude and Habtegiorgist (2021) also found that willingness to take the COVID-19 vaccine was significantly associated with respondents' attitudes, beliefs towards the vaccines, and perception that prevalence and death rate reports by the authorities are real. This suggests that there is generally low willingness to take COVID-19 vaccines.

Moreover, in another study conducted by Ahorsu et al. (2021) certain demographic factors were found to be associated with COVID-19 vaccination willingness. Specifically, age, being male, having primary education, and being married were positively associated with willingness to get vaccinated. On the other hand, living in urban areas, having a diploma or high school education, having a secondary school education, or having no formal education were negatively associated with willingness to get vaccinated. Additionally, Ahorsu et al. (2021) indicated that there was a positive association between generalized trust and COVID-19 vaccination willingness. This suggests that individuals with higher levels of generalized trust were more likely to be willing to receive the COVID-19 vaccine.

In Nigeria, Ifeanyi-chukwu et al. (2022) found that more than half of the respondents are willing to be vaccinated. However, attitudes and inadequate information towards COVID-19 vaccines were significant determinants of willingness to accept the vaccine. Vaccine hesitancy has led to a decline in vaccine uptake (Fridman et al., 2021), however, ironically, the objection to vaccines is commonly a consequence of their effectiveness which consequently led to greater vaccine hesitancy (Kestenberg and Feemster, 2016). Several studies have been conducted to ascertain the factors associated with COVID-19 vaccine hesitancy. COVID-19 vaccine hesitancy has been found to be correlated with vaccine safety and efficacy concerns among individuals (Bohme et al. 2020; Freeman et al. 2021; Malik et al. 2020; Pogue et al. 2020; Rhodes et al. 2020; Wong et al. 2021). Also, Younger age, female gender, lower income, lower education, unemployment, and migrant status were among sociodemographic factors associated with vaccine hesitancy (Malik et al., 2020; Pogue et al., 2020; Rhodes et al., 2020).

Furthermore, in the studies conducted by Peretti et al. (2020) and Murphy et al. (2021) shows that extreme political views, increased social media use, distrust of authorities, science, and medicine, general and COVID-19-specific conspiracy theories, and paranoid ideation are some of the elements that have been identified as COVID-19 vaccination hesitancy's drivers so far. Similarly, In Nigeria, vaccination hesitancy/resistance has been linked to conspiracy theories that arose from false information, fake news, and political sagas that spread across the internet during the production of vaccines (Olu-Abiodun et al. 2022). Understanding the readiness of communities to receive the COVID-19 vaccine, as well as the factors that influence their attitudes towards it, is crucial in developing and implementing effective strategies to promote vaccine uptake (Belsti et al. 2021).

Study Gaps

However, there's no prior study conducted among the Nigerian population to analyze their willingness to receive COVID-19 vaccine using Data Mining technique and Rapid Miner tool. Therefore, the current study analyzed the COVID-19 vaccine willingness among Nigerian Students using Data Mining.

Data Mining

Data mining (DM) is an advanced artificial intelligence (AI) technique that is used for discovering novel, useful, and valid hidden patterns or knowledge from dataset (Muhammad et al. 2020). The technique reveals relationships and knowledge or patterns among the dataset in several or single dataset thus, it has been widely used for the prognosis and diagnosis of many diseases including Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) that were so far discovered in 2003 and 2012, respectively (Muhammad et al. 2020). Data mining has been widely used in the healthcare sector for a variety of specific purpose, such as predicting patient outcomes, modeling health outcomes, hospital ranking, and evaluating the efficacy of treatment and the control of infection, stability, and recovery, according to studies by Al-Turaiki I et al. (2016) and Rahaman et al. (2019).

II. STATEMENT OF OBJECTIVES

This study aimed to analyze vaccination willingness of Nigerian students across three different schools. Specifically, it attained the following objectives:

1. Identified the respondents of the study in terms of:
 - a. Socio demographic profile,
 - b. Perception of COVID risk,
 - c. Preferred type information source,
 - d. Specific mistrust and generalized beliefs; and
 - e. Vaccine willingness of Nigerian.
2. Correlated vaccine willingness of Nigerian students in terms of:
 - a. Socio demographic profile,
 - b. Perception of COVID risk,
 - c. Preferred type information source; and
 - d. Specific mistrust and generalized beliefs.
3. Identified the key factors in driving vaccine hesitancy among Nigerian
4. Analyzed COVID 19 vaccine willingness using data mining

III. HYPOTHESIS (H₀)

There is no correlation between vaccine willingness of Nigerian students when grouped according to the following:

- a. Socio demographic profile
- b. Perception of COVID risk
- c. Preferred type information source
- d. Specific mistrust and generalized beliefs

IV. SCOPE AND LIMITATIONS

The major limitation of this study is the sampling frame, which used a convenience sampling technique and only included students from three schools within a specific age range. This means that the study may not be representative of the entire Nigerian population. Additionally, the survey was conducted through email and social media platforms, which may have excluded students who do not have access to these technologies. Participation in the survey was voluntary, which could have led to some selection bias. Finally, the study did not assess students' knowledge of well-established scientific limitations of vaccines, which requires a different approach to address. Counseling could be an important step in building students' confidence in the higher benefit-risk ratio profile of the vaccine.

V. SIGNIFICANCE OF THE STUDY

The findings of this study can benefit various stakeholders. Educational institutions can use the findings to understand the vaccination attitudes and behaviours of their student population, which can inform their policies and outreach efforts. Public health officials can develop targeted campaigns to increase vaccine uptake among young adults and identify factors that may be influencing vaccine hesitancy among students. The researcher can design effective intervention plans to educate Nigerian students on the need for herd immunity, contribute to the global understanding of vaccine hesitancy, and inform policy decisions on vaccine distribution and allocation. Future researchers can use the findings to contribute to the broader scientific community's understanding of vaccine hesitancy among students and determine overall awareness regarding COVID-19 vaccines, paving the way for focused efforts to fill in the knowledge gap. Policy makers can make informed decisions about vaccine distribution and allocation, and use the research findings to inform policy decisions related to vaccine distribution, communication, and education. Finally, the Nigerian government can use the findings to design targeted campaigns and strategies to increase vaccine uptake among students, achieve herd immunity, and control the spread of the virus.

RESEARCH METHODOLOGY

This chapter presents the discussion on the procedures conducted on this study in terms of the research design, participants and respondents of the study, data gathering tools and procedures

3.1 Research Design

This study aimed to analyze the COVID-19 vaccine willingness among the Nigerian students using Data mining. This study employed both descriptive and technological research designs. Descriptive research is a research method that describes the characteristics of the population or phenomenon that is being studied. This methodology focuses more on the "what" of the research subject rather than the "why" of the subject. This research analyzed what factors made the respondents either willing or unwilling to get the COVID-19 vaccine. Furthermore, a Technological Research design was employed using data mining to comprehend the causes of student's resistance to vaccination, the patterns of resistance, the level of resistance, and the characteristics of students who resist vaccination. Also, to ascertain the vaccine's acceptance for various circumstances and the variables that motivated the students to have vaccinations. And an intervention plan was developed.

3.2 Population and Locale of the study

The researcher chose to engage students from three schools in Nigeria due to the availability and sufficiency of potential study respondents. The study specifically recruited student respondents within the age range of 18 to 25 due to their high level of literacy and perceptions about the COVID-19 vaccine, as indicated in previous studies (James et al., 2022).

Table 1. The Distribution of Respondents

Respondents	Age	Gender	No. of Respondents
School A	18-25	Male/female	1873
School B	18-25	Male /female	915
School C	18-25	Male/female	226
Total			3014

3.3 Data Gathering Tool

The students had the choice of either answering through the school's portal, Social Media platforms or the individual links of the online questionnaire using google forms. The study provided a drop-down menu for most questions to enable students to conveniently select appropriate answers. For responses that were not included in the choices, an open option was also available. The questionnaire was validated by the Research ethics committee across the schools, a Psychometrician and Multiple senior researchers. The questionnaire was updated with the recommended suggestions, informed consent was obtained, and confidentiality was upheld. Additionally, no personally identifiable information was gathered or retained. it consisted of 3 sections: section 1 was informed consent and Demographic biodata for all participants, Section 2 was for unvaccinated people, Section 3 was for vaccinated people.

3.4 Statistical Analysis

The questionnaire responses were saved as a CSV file using Microsoft Excel 365, and then preprocessed to remove missing values. The data was analyzed using Statistical Package for the Social Sciences (SPSS version 23.0; IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to present means with standard deviation for continuous variables like age, while categorical variables were reported as frequencies and percentages. Chi-square test was used to establish associations or correlation between different study variables, such as demographics and willingness to get vaccinated. Independent sample t-test was used to find statistical significance between numerical variables (e.g., age) and categorical variables (e.g., willingness to get vaccinated). A p-value of less than 0.05 was considered significant for all cases. Finally, COVID-19 vaccine willingness was analyzed using Data Mining the Data set with the Rapid Miner tool.

3.5 Ethical Considerations

Nothing was done to cause harm to research participants in the study. Before the study began and the Google forms or Questionnaire was distributed, participants' informed consent was completely collected. It was also ensured that respondents participated voluntarily in the study, and if they chose to, they were free to leave the research at any time. Participants in the study also had their privacy protected

IV. RESULTS AND DISCUSSION

This chapter discusses the results of the study from identifying and selecting respondents of the study, the correlation of vaccine willingness of Nigerian students, identifying the key factors driving vaccine hesitancy, analyzing COVID-19 vaccine willingness using data mining, and developing of the intervention plan to educate Nigerian students.

Identifying respondents in terms of Socio-demographic Profile

The study included a total of three thousand fourteen (3,014) participants, which were students from the School A, School B, and School C located in Nigeria. The study population consisted majority of Female students (50.5%; n=1,522) and Male students (49.5%; n= 1,491). The age range of the study participants was from 18-25 years with 21 being the highest age in the study; The majority of the study participants were College or University students (91.2%; n=2,743).

Furthermore, 22 students from the total had a medical or disease condition at the time of this study such as Asthma/Chronic lung disease as the leading disease followed by Diabetes. The detailed Demographic profile is listed in Table 2

Table 2.1.*Gender of Participants*

Gender	Number of Respondents	Percentage (%)
Male	1492	49.5%
Female	1522	50.5%
Total Number	3014	100%

Table 2.1 shows the gender of the participants where the majority of respondents were female this implies that there is a high rate that the 3 schools are dominated by women or female

Table 2.2.*Age of Participants*

Age (In Years)	Number of Respondents	Percentage (%)
18	248	8.2%
19	203	6.7%
20	390	12.9%
21	722	24%
22	551	18.3%
23	593	19.7%
24	198	6.6%
25	93	3.1%

Table 2.2 shows the age of the participants and the highest number of respondents age from ages 21 which falls under the young adult age which implies that the participants have the freedom to decide on their own in the context of vaccine willingness.

Table 2.3.
Education of Participants

Educational Level	Number of Participants	Percentage
College or University Level	2744	91.2%
Secondary or High School Level	226	7.5 %

Table 2.3 shows the education levels of participants where Majority of the participants are from the college or university level which implies that they have more knowledge and Understanding about the Covid-19 vaccine

Table 2.4
Medical Conditions of Participants

Has Medical Condition	Number of Respondents	Percentage
Yes	22	0.7%
No	2992	99.3%

Table 2.4 shows the Medical Conditions of participants where Majority of the participants are healthy and without disease condition which implies that no terminally ill students participated in the study and therefore could perfectly make decisions concerning Covid-19 vaccine willingness.

Table 2.5.
List of Medical Conditions

Medical Condition	Number of Respondents
Diabetes	9
Hypertension	7
Cancer	7
Heart Disease	8
Asthma/Chronic Lung Disease	10
Kidney Disease	7
Neurological Disease	7
Autoimmune Disease	8

Table 2.5 shows the List of Medical Conditions where Asthma/ Chronic Lung Disease was the leading disease that the participants had which implies that none of the participants was at the end-stage of disease condition or near death and could make decisions regarding the Covid-19 vaccine willingness.

Identifying Respondents in terms of their Perception of COVID Risk

The respondents were surveyed about their perception of COVID risk in terms of the existence of coronavirus, infection of COVID virus, major problem of the community and awareness of the risks of not getting vaccinated. A total of 2,958 (98.1%) believed that Coronavirus existed, 2,948(99.1%) believed it was a major problem for the community and 2,875(95.4%) were aware of the risks of not getting vaccinated (See Table 3).

Table 3.1
Coronavirus existed

Do You Believe that Coronavirus exists?	Number of Respondents	Percentage (%)
Yes	2958	(98.1%)
No	56	(1.9%)

Table 3.1 Determines whether or not the participants believe that coronavirus exists of which Majority believed that coronavirus existed which implies that the participants were knowledgeable about the virus and therefore can make decisions on the Covid-19 vaccine.

Table 3.2
Previous infection

Have you ever been infected with COVID-19?	Number of Respondents	Percentage (%)
Yes	1(0%)	(0%)
No	2984	(99.1%)

Table 3.2 shows if the participants have ever been infected with the virus and majority of them were never infected with the virus which implies that it can help to determine if they are willing to get the Covid-19 vaccine.

Table 3.3
Major Community Problem

Do you think it is a major problem for the community?	Number of Respondents	Percentage (%)
Yes	2948	(97.8%)
No	66	(2.2%)

Table 3.3 shows if the participants viewed the Virus as a major community problem of which majority of them viewed the virus as a major community problem which implies the respondents can make decisions about willingness to get the Covid-19 vaccine.

Table 3.4

Perception of COVID-19 Risks

Are you aware of the risks of not getting vaccinated?	Number of Respondents	Percentage (%)
Yes	2875	(95.4%)
No	139	(4.6%)

Table 3.4 shows whether or not the participants are aware of the risks of not getting vaccinated of which majority of the participants were aware of the risks of not getting vaccinated which implies that it can help to determine if the participants are willing to get the COVID-19 vaccine.

Identifying Respondents in terms of preferred type of Information source

To understand the preferred type of information source it was important to establish the nature or background of the sources where the respondents obtained their information from the start of the Covid vaccination availability to the endorsements of the vaccine therefore, the Respondents were surveyed with the questions from where did you first hear about the Covid-19 vaccination, Most-trusted source of information regarding Covid-19 Vaccine and Where they get most of the updates and information regarding COVID-19 Vaccination in Nigeria respectively (see Table 4

Table 4.1
First Covid-19 vaccine Information

From where did first hear about COVID-19 Vaccination	Number of Respondents	Percentage (%)
Social (Facebook/Twitter/Instagram/WhatsApp)	2970	(98.5%)
News	38	(1.3%)
Magazines	—	—
Doctors	—	—
Friends or relatives	—	—

Table 4.1 Shows where the participants first heard about the COVID-19 vaccine information and Majority were from the social media which implies that the source of information would leave the first impression on the participants willingness to receive the COVID-19 vaccine.

Table 4.2

MOST TRUSTED source of Information

Who is your MOST TRUSTED source of information regarding COVID-19 vaccine?	Number of Respondents	Percentage (%)
Parent/Guardian	—	—
Doctor	561	(18.6%)
Social Media (Facebook/Twitter/Instagram/WhatsApp)	2448	(81.2%)

Table 4.2 Shows the participants MOST TRUSTED source of information regarding the COVID-19 vaccine and Majority trust the social media which implies that it would help determine the willingness of the participants to receive the COVID-19 vaccine

Table 4.3
COVID-19 vaccine updates in Nigeria

Where do you get most of the information and updates concerning COVID-19 vaccine in Nigeria?	Number of Respondents	Percentage (%)
Parent/Guardian	–	–
Doctor	–	–
Social Media (Facebook/Twitter/Instagram/WhatsApp)	2948	(99.9%)

Table 4.3 Shows where the participants get most of the information and updates concerning COVID-19 vaccine in Nigeria and Majority get the most information from social media which implies that it helps determine if the participant is willing to get the COVID-19 vaccine.

Identifying respondents in terms of specific mistrust and generalized beliefs

To understand the Specific Mistrust of the COVID-19 Vaccine the respondents were surveyed based on what discourages them to get the vaccine the term discouraged was used by the researcher for the better understanding by the respondents on the term mistrust. Furthermore, the respondents were equally surveyed based on their generalized beliefs on COVID-19 vaccine (See Table 5).

Table 5.1
Specific Mistrust

What discourages you from getting the COVID-19 vaccine?	Number of Respondents	Percentage (%)
Covid -19 vaccine was rapidly developed and approved	2431	(97.2%)
Lack of widespread trials	2405	(96.1%)
Fear of the unknown side effects	2418	(96.6%)
Risk of losing your fertility (ability to bear kids)	2376	(95%)
Lack of guidance from any doctor or health personnel	2385	(95.3%)
Attitude of health care workers like nurses, midwives etc.	2306	(92.2%)
Unaware of the COVID-19 vaccine existence	2232	(89.2%)
Death is inevitable and the vaccine cannot prevent it	2405	(96.1%)
It is a way of making money for the rich and nothing else	2404	(96.1%)
COVID-19 is just a flu and we don't need vaccine for flu	2409	(96.3%)
Social media posts	2374	(94.9%)

Table 5.1 shows the Specific Mistrust or discouragement from getting vaccinated which implies the factors that determine if the participant is unwilling or hesitant to get the COVID-19 Vaccine.

Table 5.2
Generalized Beliefs

What is /are your beliefs about the coronavirus vaccine?	Number of Respondents	Percentage (%)
Its fake	2401	(96%)
Its ineffective and cannot stop COVID-19	2449	(97.9%)
Its unsafe	2437	(97.4%)
It will give me COVID-19	2437	(97.4%)
It will make me infertile	2395	(95.7%)
It will slow my body and kill me	2341	(93.6%)

Table 5.2 shows the generalized beliefs of the participants which implies the factors that determine if the participant is hesitant to get the COVID -19 vaccine

Table 6
Vaccine Willingness of Nigerian Students

Are you willing to get the vaccine?	Number of Respondents	Percentage (%)
Yes	44	(1.8%)
No	2458	(98.2%)

Table 6 shows the vaccine willingness of the participants which implies whether or not the participant is willing to get vaccinated.

Correlation of vaccine willingness of Nigerian students in terms of Socio – Demographic Profile

To correlate the vaccine willingness of Nigerian students in terms of: sociodemographic profile, perception of covid risk, preferred type information source, specific mistrust and generalized beliefs. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 23.0 (IBM Corp, Armonk, NY, USA). Descriptive statistics were used to summarize the data using independent Sample t -test (see table 7).

Table 7
Independent samples t-test

	Are you willing to get the vaccine?	N	Mean	Std. Deviation	Std. Error Mean
Age (in years)	Yes	44	19.80	2.339	.353
	No	2457	21.37	1.820	.037
Gender	Yes	44	1.36	.487	.073
	No	2458	1.56	.496	.010
Education	Yes	44	1.64	.487	.073
	No	2458	1.92	.278	.006
Do you have any disease or medical condition	Yes	44	.07	.255	.038
	No	2458	.01	.080	.002

Note. Group statistics

Similarly, Chi-square test was used to determine the association between willingness to receive the vaccine and other variables. And a p value <0.05 was considered significant for all analysis (see table 8).

Table 8
Chi-square Correlation Analysis

	Cases Valid N	Percent	Missing N	Percent	Total N	Percent
Gender * Are you willing to get the vaccine?	2502	83.0%	512	17.0%	3014	100.0%
Age (in years) * Are you willing to get the vaccine?	2501	83.0%	513	17.0%	3014	100.0%
Education * Are you willing to get the vaccine?	2502	83.0%	512	17.0%	3014	100.0%
Do you have any disease or medical condition * Are you willing to get the vaccine?	2502	83.0%	512	17.0%	3014	100.0%

Note. Missing values are as a result of the vaccinated participants who also participated in this study.

Furthermore, by utilizing both tests individual correlations of vaccine willingness among Nigeria students were carried out in term of sociodemographic profiling the variables Age (in years), Gender, Education, the presence or Absence of a Disease Condition and the analysis were conducted as follows

Gender Correlated with willingness to get Vaccinated

In the correlated gender to vaccine willingness, a total of 1073 (97.5%) Male responded No thus unwilling and 28 (2.5%) were willing to get the vaccine while 16(1.1%) of the Female respondents were willing to get the vaccine and 1385(98.9%) responded No and therefore was unwilling to get the vaccine. The Degree of Freedom $df=1$, Phi Cramer's V value =.035, Count percent within unwilling = 98.2% and wiling =1.8%, P value =.008 which was less than the p value <0.05 used for all analysis (see Table 9). Therefore, the hypothesis can be rejected as a statically significant difference was established between the respondent's willingness and unwilling to get the vaccine based on their different genders. see (Figure 1).

Table 9.1

Pearson chi-square test of gender corelated to vaccine willingness

	Value	df	p	Decision
Pearson chi-square test	7.005 ^a	1	.008	Reject H_0
Phi Cramer's V	.053		.008	

Note. $P < 0.05$ and df =Degree of freedom

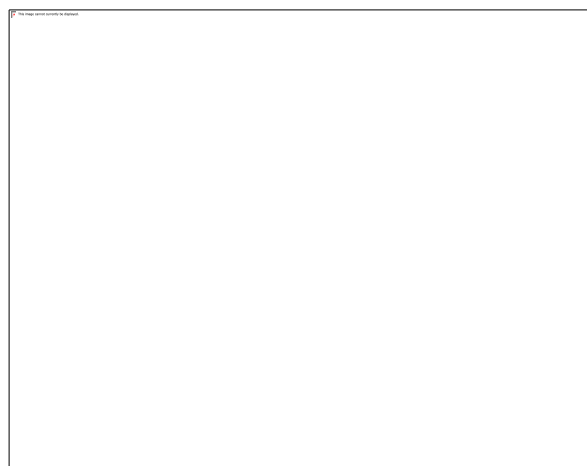


Figure 1 A bar chart showing the correlated vaccine willingness to gender

Age (in years) Correlated with vaccine Willingness

In the correlated Age to vaccine willingness, the respondents from Ages 18-25 years were surveyed. And a statistical difference was seen among the respondents as regards to their age as their decision on whether or not to get the vaccine as Majority of the respondents were unwilling to get vaccinated irrespective of their age. The Pearson chi-square value $X^2 = 139.071^a$, Degree of freedom(df)= 12, Phi Cramer's V =.236 and p value=.000 which is < 0.05 considered significant for all cases (see Table 10). Therefore, the hypothesis can be rejected as vaccination willingness can be correlated to age. However, majority of the respondents who were willing to get the vaccine were age 18 for detailed analysis please (see Figure 2).

Table 10

Age (in years) Correlated with willingness to get vaccine

	Value	df	p	Decision
Pearson Chi-Square	139.071 ^a	12	.000	Reject H ₀
Phi Cramer's V	.236		.000	

Note. $P < 0.05$ and df=Degree of Freedom

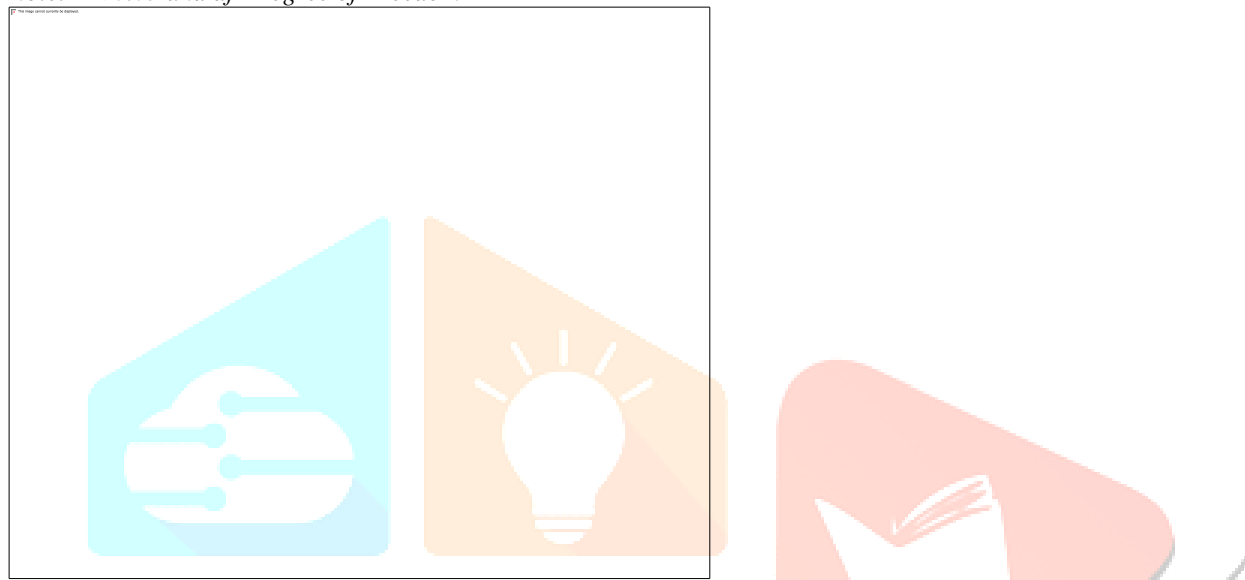


Figure 2 A bar chart showing correlated vaccine willingness to Age (in years)

Education Correlated with Willingness to get COVID-19 vaccine

In the correlated Education to vaccine willingness, the respondents were surveyed based on their educational levels Secondary/Highschool and College/University. The Secondary/ Highschool students' respondents were the SS3 or grade 12 students of the senior high school who were 18 years of age. Majority of the Respondents were College/ University students. A total of 207 (92.8%) were unwilling to get vaccinated. While, 16(7.2%) were willing to get vaccinated. Similarly, Majority 2251(98.8%) of the College/ University student were unwilling to get vaccinated while 28(1.2%) were willing to be vaccinated. The Pearson Chi-Square value gotten $X^2=41.571^a$, Degree of Freedom df=1, Phi Cramer's V=.129 and a p-value <0.05 was obtained for detailed Analysis and H₀ was Rejected (See Table 11). Therefore, a statically significant difference was observed among the respondents based on their educational levels whether in Secondary/ Highschool or College/ University (See Figure 3).

Table 11

Pearson chi-square test of education corelated to vaccine willingness

	Value	df	p	Decision
Pearson chi-square test	41.571 ^a	1	.000	Reject H ₀
Phi Cramer's V	.129		.000	

Note. $P < 0.05$ and df=Degree of Freedom

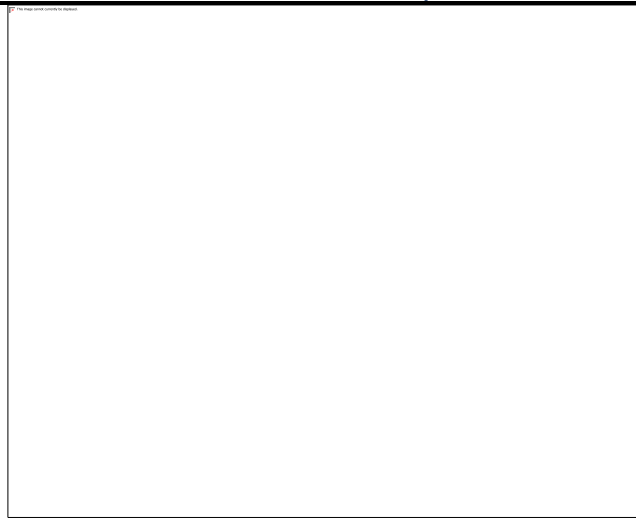


Figure 3 Clustered bar chart of vaccine willingness correlated to Education

Do you have any disease or medical condition Correlated with Willingness to get vaccinated

In the correlated do you have any disease or medical condition to vaccine willingness, The respondents were served based on the presence of absence of a diseased or medical condition. Majority 2458 (99.5%) of the Respondents indicated the absence of Disease/ Medical condition while a small group 22 (0.7%) of the Respondents had a disease condition at the time this study was conducted.

Majority of the Respondents 2442(98.3%) reported that they were unwilling to get the vaccine while a small group 41(1.7%) reported to be willing to get the vaccine within the group without any disease or medical condition. Similarly, Majority 16(84.2%) responded unwilling to get vaccinated and 3(15.8%) reported willing to get vaccinated within the diseased group.

The Pearson Chi-Square value gotten $X^2= 21.816^a$, Degree of Freedom $df=1$, Phi Cramer’s V value $=.093$, P value $=.000$ which was less than the p value <0.05 used for all analysis and H_0 was Rejected (see Table 12.). Therefore, a statically significant difference was established between the respondent’s willingness and unwilling to get the vaccine based on whether or not the respondents have any disease or medical condition. Therefore, it can be deduced that the respondents were unwilling to get the vaccine whether or not there’s the presence or absence of disease (See figure 4).

Table 12.

Pearson chi-square test of do you have any disease or medical condition correlated to vaccine willingness

	Value	df	p	Decision
Pearson chi-square test	21.816 ^a	1	.000	Reject H_0
Phi Cramer’s V	.093		.000	

Note. $P < 0.05$ and $df=$ Degree of Freedom

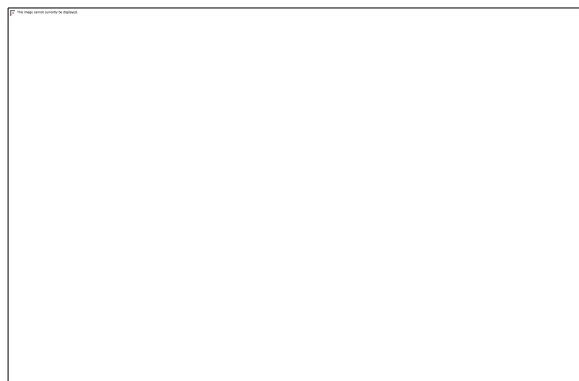


Figure 4 Clustered bar chart of vaccine willingness correlated to the presence or absence of disease condition.

Correlation of vaccine willingness of Nigerian students in terms of Perception of COVID-Risk

For the perception of COVID risk a total of 2334 (98.5%) respondents were aware of the risks of not getting vaccinated and 139 were not aware of the risks of getting vaccinated (See Figure 5).

The Chi-square value $X^2=20.394^a$, Degree of Freedom $df=1$, Phi Cramer’s V value $=.090$, P value $=.000$. And from the analysis it was deduced that theirs a statical significance between the Respondents willing and unwilling to get the vaccine (See Table 13). However, the high percentage of perception of risk by the respondents does not signify that they are willing to get the vaccine therefore H_0 was accepted (see Figure 6).

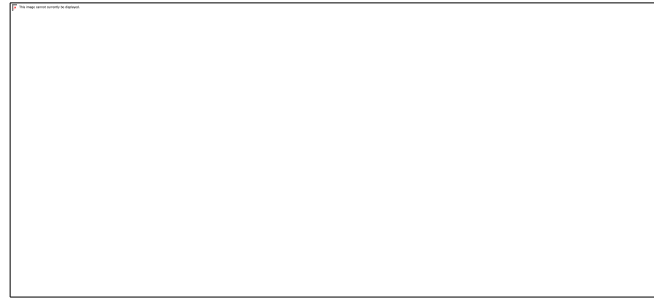


Figure 5 A clustered bar chart showing the correlated risk of not getting vaccinated and gender

Table 13

Pearson chi-square test of are you aware of the risks of not getting vaccinated correlated to vaccine willingness

	Value	df	p	Decision
Pearson chi-square tests	20.394 ^a	1	.000	Accept H_0
Phi Cramer’s V	.090		.000	

Note. $P < 0.05$ and $df=$ Degree of Freedom



Figure 6 Correlated risks of not getting vaccinated to vaccine willingness

Correlation of vaccine willingness of Nigerian students in terms of preferred type information source

To correlate Vaccine willingness to preferred type information source, the Respondents were Surveyed based on from where did you first hear about the COVID_19 vaccination, who is your MOST TRUSTED source of information regarding COVID_19 vaccination and where do you get most of the information and updates concerning COVID_19 vaccine in Nigeria. And The responses were analyzed as Follows:

From where did you first hear about the COVID_19 vaccination Correlated with willingness to receive the vaccine

A total of 2,970(98.5%) Respondents first heard about the Covid -19 Vaccination from the social media and 38(1.3%) Responded from the News, no responses were recorded for Friends or Relatives, Magazines and Doctors (See Figure7). and a statistical significant value $p < 0.05$ was also established for the willingness and unwillingness of the respondents to get the vaccine.

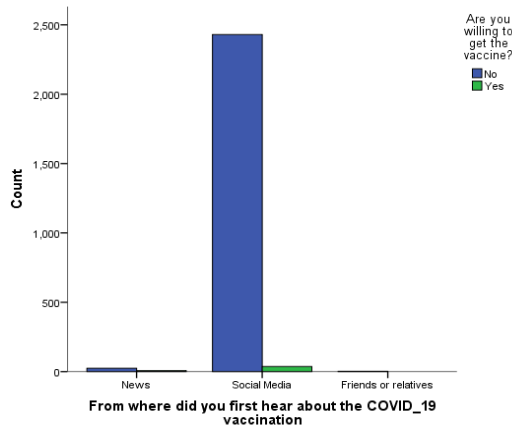


Figure 7 Clustered Bar Charts of from where did you first hear about the COVID-19 Vaccination Correlated to vaccine willingness.

MOST TRUSTED source of information regarding COVID_19 vaccination Correlated with willingness to get vaccinated

A total of 2,448(81.2%) Responded social media while 561(18.6%) Responded Doctors and No observable Responses were made for Parent/ Guardian (see Figure 8). Also, a statically significant association existed between their most trusted source of information to the Respondents willingness to get the Vaccine as a $p < 0.05$ value was obtained.

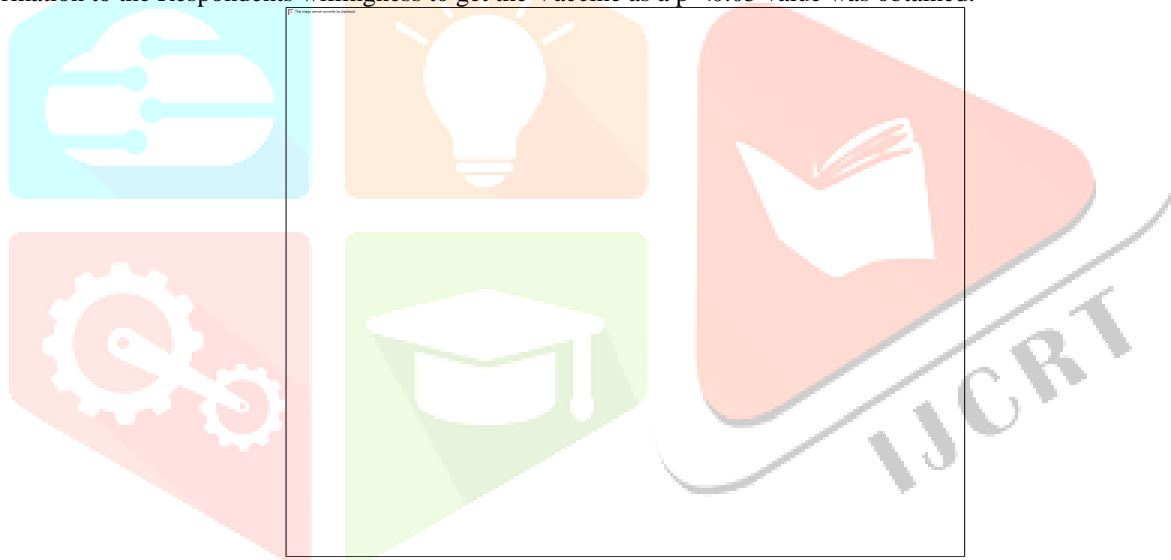


Figure 8 Clustered Bar charts of Most trusted source of information correlated to Vaccine Willingness.

Where do you get most of the information and updates concerning COVID_19 vaccine in Nigeria Corelated with willingness to get vaccinated

Majority of the respondents 2475(99.9%) obtained most of their information and updates concerning Covid-19 vaccination in Nigeria from social media (See figure 9) and because the total number of both the Unwilling and willing respondents were equal to the number of respondents who answered social media an equal $P = 0.000$ was obtained as statistically significant.

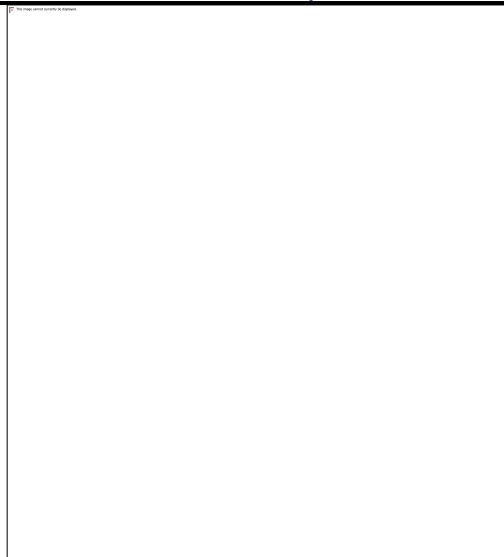


Figure 9. Clustered Bar charts of where do you get most of the information and updates concerning COVID-19 Vaccine in Nigeria correlated to vaccine willingness

Furthermore, to understand the Impact of social media on the Correlated Information type to Vaccine Willingness, the Respondents were surveyed based on the impact of social media to their willingness to get the vaccine and Majority of the respondents 2369(98.6%) agreed that social media has impacted their willingness to get the vaccine (see Figure 10)

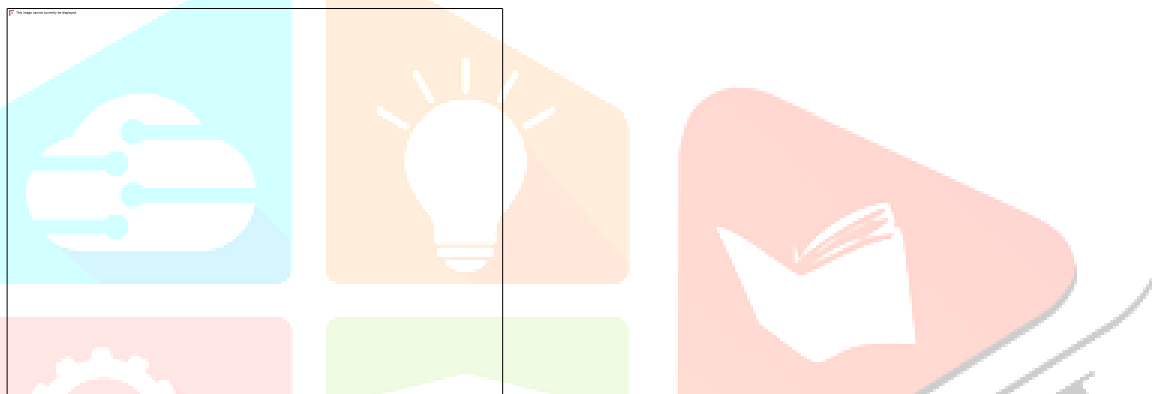


Figure 10 Clustered Bar Charts of social media influenced decision on getting Vaccinated correlated to Vaccine willingness.

In conclusion, a P value < 0.05 was obtained for all analyses of preferred type information source and a statistical significance was observed and the hypothesis(H₀) was rejected as significant correlation was seen with the respondent’s willingness to get vaccinated and their preferred type information source for further analysis (see Table 14)

Table 14

Preferred type information source correlated with vaccine willingness

	Value	df	p	Decision
Pearson chi-square	78.774 ^a	2	.000	
Phi Cramer’s V	.177		.000	Reject H ₀

Note. P < 0.05 and df=Degree of Freedom

Correlation of vaccine willingness of Nigerian students in terms of specific mistrust and generalized beliefs

To correlate Vaccine willingness to Specific Mistrust and Generalized beliefs, the Respondents were surveyed based on if they believed that the Covid-19 Vaccine was able to protect them from Covid and the Specific Mistrust and Discouragements or Barriers to getting vaccinated was Analyzed. The Analysis are as Follows:

Do you believe that COVID_19 vaccine would protect you against covid Correlated with willingness to get the vaccine

Many of the respondents believed that the Vaccine was not able to protect them against the Covid therefore was unwilling to get the vaccine (See Figure 11). And a p value < 0.05 was obtained thus showing the statically significant difference in the willingness and unwillingness to get the vaccine and therefore, the H₀ was rejected as the respondent’s willingness to get COVID-19 vaccine was correlated to their specific mistrust and generalized beliefs for further analysis (see Table 15)

Table 15

Covid-19 vaccine willingness correlated with specific mistrust and generalized belief

	Value	df	p	Decision
Pearson chi-Square	482.414	1	.000	
Phi Cramer's V	.439		.000	Reject H ₀

Note. $P < 0.05$ and $df = \text{Degree of Freedom}$

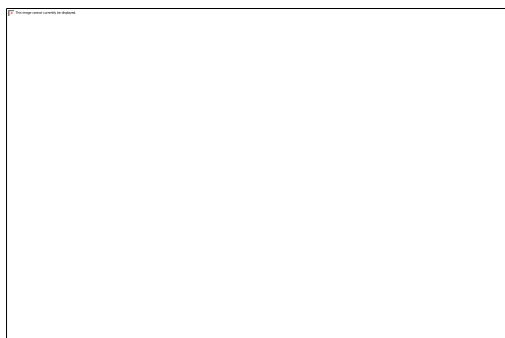


Figure 11 Clustered Bar charts of do you believe that Covid-19 vaccine would protect you against covid correlated to vaccine willingness.

Further Analysis was conducted to specifically identify the Specific Mistrusts and Generalized beliefs related to vaccine willingness

Specific mistrust

For the specific mistrust the Respondents were surveyed based on the Development, Clinical trials, Side effects, Specific Misconceptions like being a flu, making money for the rich, Internet or Media Influences, Attitudes and Guidance of healthcare professionals. Majority of the study participants 9.25% reported that the vaccine was rapidly developed and approved, while 9.21% reported that the virus is just a flu and therefore vaccination was not needed for the flu. The Detailed results are presented (See Figure 12).

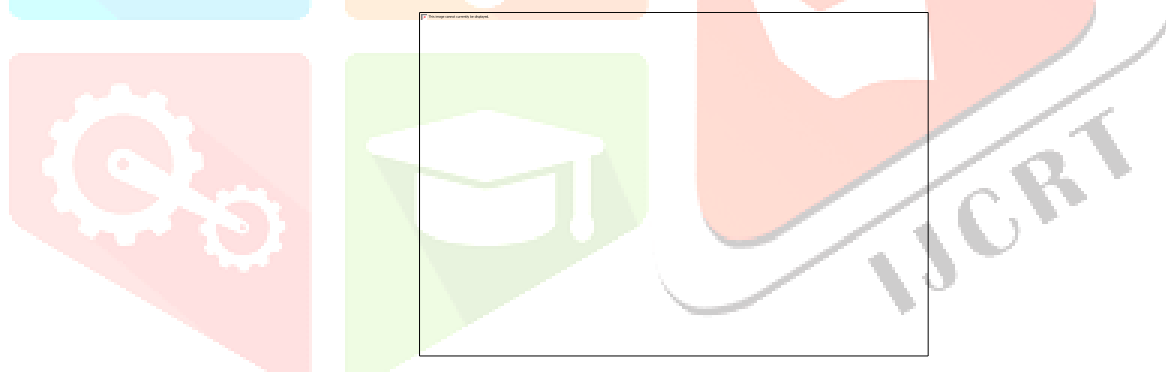


Figure 12 Covid-19 vaccination specific mistrust among Nigerian students

Generalized beliefs

The Respondents were Surveyed based on their beliefs on the safety, efficacy, effectivity, Slow down of body functions including fertility therefore resulting in death. Majority of the study participants (16.94%) reported that the vaccine was ineffective and therefore cannot stop the virus, 16.87% of the respondents also reported that the vaccine was unsafe while 16.85% believed that the vaccine will give them the virus instead of protecting them. The detailed analysis of the result is presented in (figure 13).



Figure 13 Covid -19 Generalized Beliefs among Nigerian students

Identified key factors driving vaccine hesitancy among Nigerian students

The key factors driving vaccine hesitancy among Nigerian students included Socio demographic profile, Social Media posts, Specific Mistrusts and Generalized Beliefs.

Sociodemographic profile

From the Socio demographic profile, Being Female, Education, Presence or absence of a disease condition. As, 1385(98.9%) Females reported to be unwilling to get the vaccine and 2458(98.2%) of the respondents reported unwilling to get the COVID-19 vaccine in terms of Age (in years), Education and presence or absence of any disease or medical condition. Similarly, the findings of this study could be correlated to the study of Syan et.al 2021 which concluded that males were more willing than females to receive a COVID-19 vaccination. In addition, individuals with less than a bachelor's degree education were more likely to refuse a COVID-19 vaccination compared to those with higher education levels.

Furthermore, younger age, female gender, lower income, lower education, unemployment, and migrant status were among sociodemographic factors associated with vaccine hesitancy (Malik et al., 2020; Pogue et al., 2020; Rhodes et al., 2020).

Social media

Based on Figure 10, a total of 2369(98.6%) respondents reported that social media has influenced their decision on whether or not to get vaccinated. In addition, the respondents 2448(81.2%) equally reported social media as their MOST TRUSTED information sources and 2475(99.9%) respondents reported to have obtained most updates and information concerning the vaccination updates in Nigeria from social media.

The ability to spread fake news on social media is well-known, False information and unfounded rumors (Schmidt et.al, 2020). Additionally, the pandemic has made this practice more prevalent (Obi-Ani NA et.al,2020). However, medical professionals, researchers, and academic publications contest and disprove these myths with using scientific Analysis (Zoumpourlis et.al,2020). Furthermore, in a study conducted by Sallam et.al 2021, Concluded that higher vaccine conspiracy beliefs were found in participants relying only social media platforms for vaccine-related information. Thus, it can be deduced that the respondents in this study were prone to have more misconceptions about the gravity of not getting vaccinated and likewise, adopt unfavorable attitudes and actions in response to being unwilling to get the vaccine which resulted in vaccine hesitancy.

Specific mistrust and Generalized Beliefs

Specific Mistrust and Generalized Belief were considered as the most critical factors resulting in vaccine hesitancy. Majority of the respondents disregarded the necessity to get vaccinated either because Covid-19 vaccine was rapidly developed and approved, Covid-19 is just a flu and they don't need vaccine for flu, Death is inevitable and the vaccine cannot prevent it, Fear of unknown side effects, It's a way of making money for the rich and nothing else, Lack of widespread trials, Social media posts, Lack of guidance from any doctor or health personnel and Risk of losing their fertility (ability to bear kids). While the rest reported Attitudes of health care workers like nurses, midwives etc. and Unaware of the Covid-19 vaccine existence as Factors that discouraged vaccination.

Finally, Majority of the respondents disregarded the necessity to get vaccinated because they believed that it was ineffective and cannot stop Covid-19, It's Unsafe, it will give me Covid-19. In addition, others responded that it was fake, it will make me infertile and it will slow my body and kill me thus, making them hesitant.

Similarly, the findings of the study can be correlated to other studies conducted by Arshad et.al 2021, which concluded that the Unawareness and misconceptions about the vaccine, considered COVID-19 to be a flu or denied the role of vaccine as lifesaving, merely a lucrative business for the rich, social media, religious scholar sermons, politics, and the myths about the loss of fertility proved to be critical hesitancy factors discouraging vaccination.

Also, in another study conducted by Saied et.al 2021. Participants reported barriers namely doubt of vaccine safety and effectiveness, fear of unknown side effects, fear of nano-chips in vaccine, lack of awareness, and financial cost as factors discouraging vaccination.

Analyzed covid 19 vaccine willingness using Data mining

For the Analysis of the Covid 19 vaccine willingness using data mining the Microsoft Excel 365, CSV data was imported into the local repository in RapidMiner, the loaded data set was retrieved and Basic preprocessing was done, the Model was trained, applied and evaluated. Furthermore, the K-means clustering algorithm used where k=2 which refers to the k-means clustering algorithm with two clusters. This algorithm is used to group data points into two clusters based on their similarity and the performance report was Analyzed.

In this study, Age and Gender were the clusters used to determine the willingness of Nigerian student to Receive the COVID-19 vaccine because there was no statically significant difference in the ages as correlated with vaccine willingness while a statical significance difference was noticed with gender this could help identify any gender-specific patterns or differences in vaccine hesitancy that may not be apparent when looking at age alone. Additionally, Clustering students based

on age and gender could help identify subgroups of students who may be more or less willing to receive the vaccine, which could inform targeted interventions to increase vaccine uptake.

Rapid Miner preprocess are as follows:

Basic Preprocessing:

Loads the data set and perform the basic preprocessing and the data is normalized (see figure 14).

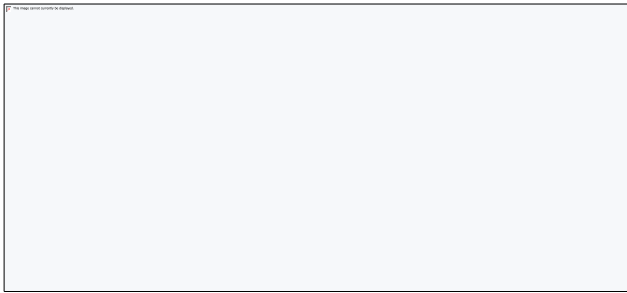


Figure 14 Basic data preprocessing using Rapid miner and k-means algorithm where $k=2$

Feature Engineering and Modeling

Performs automatic feature if desired and performs the actual clustering on the transformed data(see Figure 15)

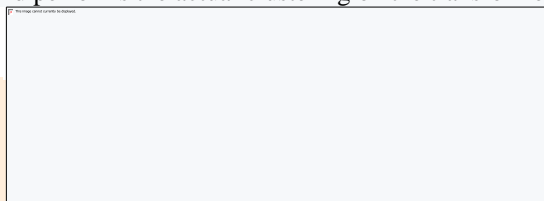


Figure 15 Feature engineering and modeling using Rapid miner and k-means algorithm where $k=2$.

Visualization and Tree

Creates the visualizations for the cluster model and creates a decision tree explaining which data points belong to which cluster (see Figure 16).

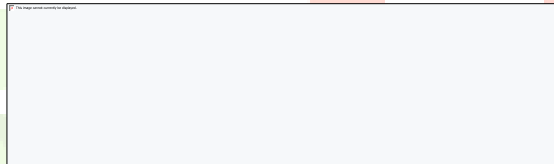


Figure 16 Visualization and Tree using Rapid miner and k-means algorithm where $k=2$

Process Results

The Process is run,output is analyzed and results interpreted (see Figure 17).

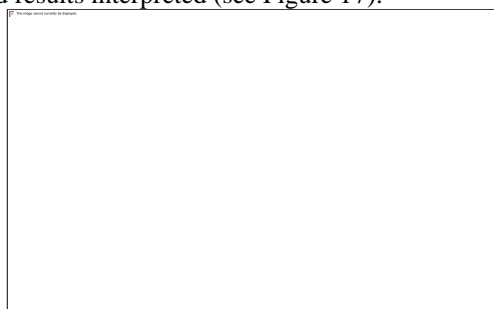


Figure 17 Process Results

The results are as follows:

K-Means-Summary

The number of clusters= 2 , the cluster 0 represents the number of respondents unwilling to get the vaccine as and cluster 1 represents the number of respondents willing to get vaccinated. For detailed analysis (See Figure 18).



Figure 18 K-Means-Summary using Rapid Miner where K=2

K-Means-Heat Map

The K-means -Heat Map displays the Vaccination willingness as a color-coded grip with each row representing a data point and each column representing a cluster. For detailed Analysis (See Figure 19).

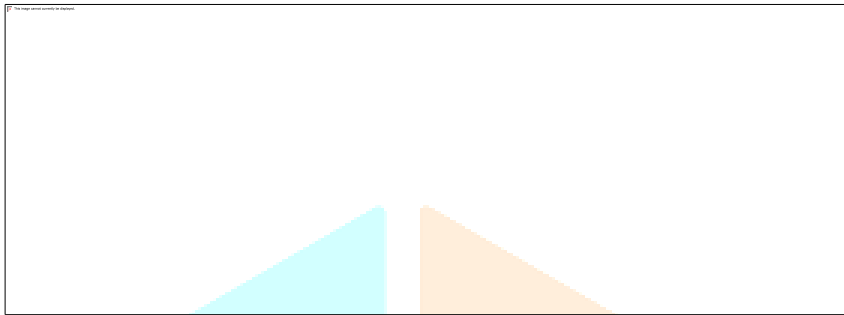


Figure 19 K-Means-Heat Map using Rapid Miner where k=2

K-Means -Cluster Tree

The K-Means -Cluster Tree displays the clusters as a hierarchical tree structure, with each node representing a cluster and the branches representing the relationships between clusters For Detailed analysis (See Figure 20).



Figure 20 K-Means-Cluster Tree Using Rapid Miner where K=2

K-Means-Centroid Chart

The K-Means-Centroid Chart presented the Cluster 0 (2970) and Cluster 1 (44) in a parallel chart for the Respondents willing and unwilling to get the COVID-19 vaccination for detailed analysis (see Figure 21).

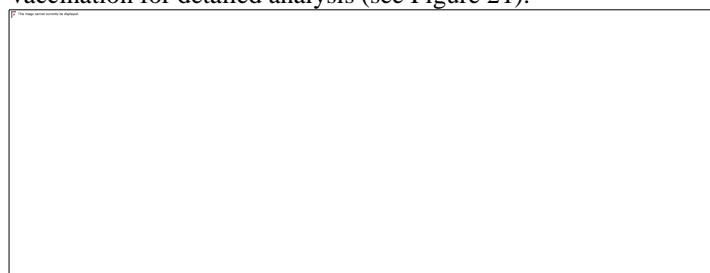


Figure 21 K- Means-Centroid Chart using Rapid Miner where k=2

K-Means-Centroid Table

The K-Means -Centroid Table represented the negative population for the respondents who were unwilling to get vaccinated and the positive value for the Respondents who are willing to get the vaccine For detailed analysis (see Figure 22).



Figure 22 K-Means-Centroid Table Using Rapid Miner where $K=2$.

K-Means-Scatter Plot

The K-means-Scatter Plot displays the data points in a two-dimensional space, with each point representing an example in the Example Set. The points are color-coded based on the cluster to which they belong, and the centroids of each cluster are displayed as symbols in the plot for Detailed analysis (See Figure 23 and 24).



Figure 23 The K-Means-Scatter Plot of Cluster 0 using Rapid Miner where $K=2$

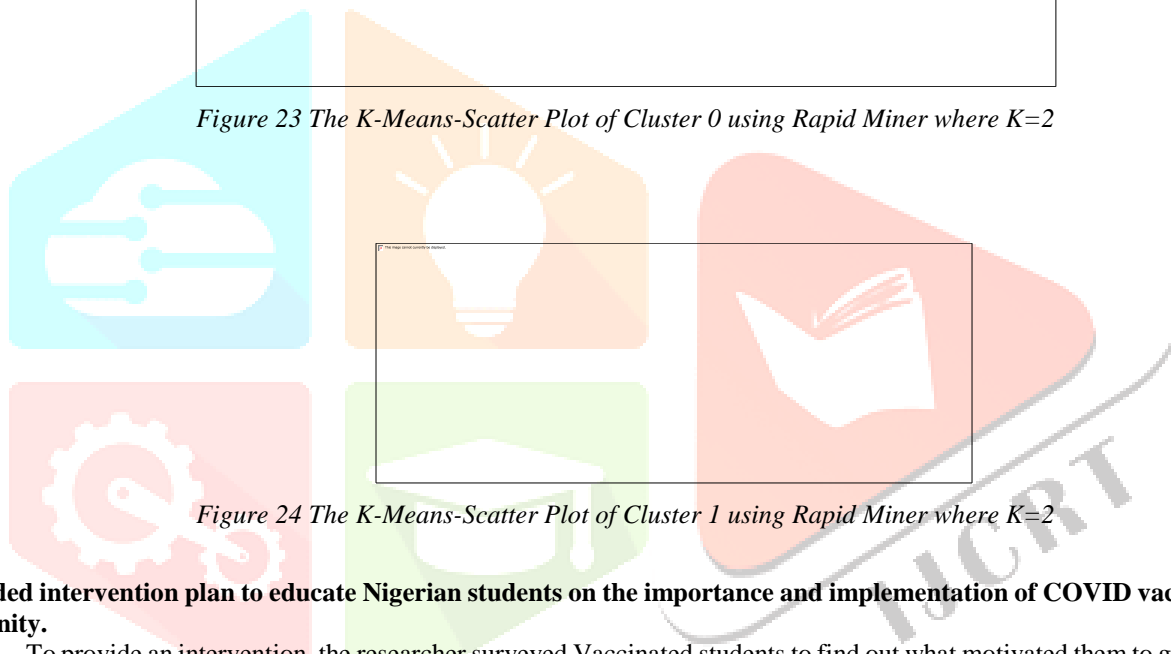


Figure 24 The K-Means-Scatter Plot of Cluster 1 using Rapid Miner where $K=2$

Provided intervention plan to educate Nigerian students on the importance and implementation of COVID vaccine for herd immunity.

To provide an intervention, the researcher surveyed Vaccinated students to find out what motivated them to get the vaccine. A total of 500 respondents were vaccinated at the time of this study. Majority of the Respondents Responded that it was free 450 (87.9%), Decrease chance of getting infected 201(39.3%), and Prior Vaccinations like Influenza, Hepatitis etc. Detailed Results are seen in (Figure 25).

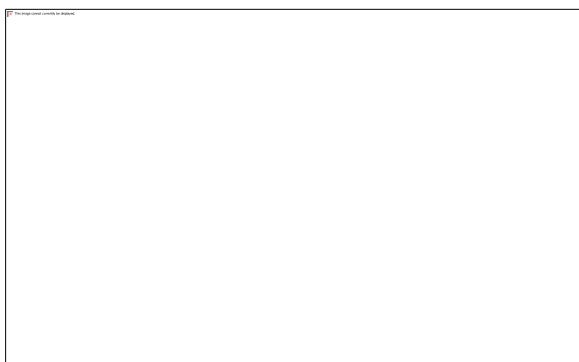


Figure 25 COVID-19 vaccine motivations of vaccinated respondents

Similarly, a small group of the Respondents 10(2%) considered the vaccine to be safe, effective and has no minimal side effects as the reason for getting vaccinated While the rest of the respondents 6(1.2%) Reported Risk perception as their motivational factor

for vaccination. Therefore, it can be deduced that the vaccinated Respondents are COVID-19 Vaccine Misinformed as they lack the proper Knowledge or understanding of how the vaccine works which is referred to as Vaccine literacy or knowledge.

These Findings lead to the Developed intervention plan to educate Nigerian students on the importance and implementation of COVID vaccine for herd immunity and also increase COVID-19 vaccination rates among students in which the objectives, Methods of delivery, timeline, evaluation were discussed for further analysis (See Table 16).

Table 16

COVID-19 vaccination Intervention plan of Nigerian students

Intervention Plan	Objectives	Method of Delivery	Timeline	Evaluation
Educate students	Increase awareness of the importance of Covid -19 vaccination among students	Through school's newsletters, posters, flyers	the email August 2023-September 2023	Track the number of students who get vaccinated before and after the intervention
Address Concerns	Address common concerns that students may have about the vaccine, such as side effects, long-term effects, and the speed of vaccine development	School Based vaccination events with health care professionals addressing each concern and questions	August 2023-September 2023	Conduct surveys to assess changes in knowledge, attitudes, and behaviors related to COVID-19 vaccination among students
Partner with local health Authorities	Provide easy access to COVID-19 vaccines for students and remove Barriers to getting vaccinated	On campus vaccination clinics with Chemonics International Nigeria	August 2023-December 2023	Use feedback from students to improve the intervention plan
Provide Incentives	Promote vaccination willingness among students	Free snacks, T-shirts and gift cards to students who gets vaccinated	August 2023-December 2023	
Address vaccine hesitancy	providing accurate information about the vaccine and addressing common myths and misconceptions.	Information Sessions via Zoom meetings with health care professionals to educate students on the need for Herd immunity	August 2023-September 2023	
Use social media	Encourage students to share their vaccination experiences on social media to promote vaccine acceptance	Social media platforms	August 2023 - December 2023	

VI. CONCLUSIONS AND RECOMMENDATIONS

The study focused on analysing COVID-19 vaccine willingness among Nigerian students using data mining. The study found that the majority of respondents were female college/university students without any medical conditions. The respondents had a high perception of COVID-19 risks of not being vaccinated, and their preferred and most trusted source of information was social media. However, only a small percentage of the population was willing to take the COVID-19 vaccine due to specific mistrusts and generalized beliefs.

The study also identified factors driving vaccine hesitancy among Nigerian students, such as preferred type information sources, specific mistrusts, and generalized beliefs. The findings could be used to develop a nationwide vaccination plan by working with public health departments, healthcare and educational institutions, and leveraging social media platforms to promote accurate scientific understanding of the vaccine and build trust in its reliability.

The researcher recommended further studies to assess the general level of knowledge about vaccines, maximum cooperation between public health departments, healthcare and educational institutions, and the Nigerian government's prioritization of vaccination efforts. Personalized educational messages should be developed for the general population to encourage COVID-19 vaccine uptake, and COVID-19 vaccine education should be added to school curriculums. Future researchers can further study sex-based differences in vaccine willingness and motivations behind vaccination.

VII. ACKNOWLEDGMENT

The Researcher considers it as a great privilege to express her sincere gratitude and appreciation to everyone who has inspired and contributed to the completion of this project. The joy and satisfaction gained from the completion of the study would be missing if the people who made it possible aren't acknowledge whose steady direction and inspiration successfully supports every effort. First and foremost, the Researcher would like to thank the Almighty God for his grace throughout the study and for his eternal source of inspiration, knowledge and wisdom. To him be all the Glory, honor and adoration forever and ever AMEN.

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The Respondents, the researcher wishes to express her gratitude to the students across the three schools who took part in this research and for their willingness and corporation to complete this study.

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K.V.E

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