COVID-19 Vaccine Conspiracy Theories and Hesitancies among Different Socio-Demographics: A Systemic Review and Meta-Analysis

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Abstract. The effectiveness of COVID-19 vaccination to control transmission, morbidity, and mortality is highly dependent on the population's readiness to embrace the vaccine. This study explores the level of willingness of various demographics in accepting COVID-19 vaccine. A narrative literature review using thematic analytical method was used to determine the level of vaccine acceptance among various socio-demographics. Conspiracy belief was used as the conceptual framework to explore the causes of vaccine hesitancies. It was discovered from the reviewed literatures that vaccine hesitancy was present in all surveyed countries and population. COVID-19 vaccine hesitancies correlated with age, gender, level of education, country of residence, race, ethnic and religion affiliations. The studied revealed that participants who were at least 55 years or older were more receptive to COVID-19 vaccines compared to those between 25 to 54, some studies revealed that those between 16 to 24 years were more receptive than those between 25 to 34 years. The studies showed vaccine hesitancies were higher in female than their male counterparts and also those with no education or low education were more prone to vaccine refusals than college and university graduates. Furthermore, religion affiliation and belief plays a significant role in vaccine hesitancies, those whose religion opposes vaccine acceptance had high refusal rate compared to those whose religion encourages vaccinations, while participants without any religion affiliations showed more willingness to get vaccinated. Ethnicity and racial characteristics were highly significant in all the reviewed literatures, with highest hesitancies among Black race than their Whites counterparts. Majority of Asians and Latinos had over 70% vaccine acceptances, the race and ethnic affiliations were further substantiated when it was observed that people from South America such as Ecuador, Brazil, some Asian countries such as India, Bangladesh had the highest vaccine acceptance compared to countries in Africa and Europe. The primary reason for this vaccine hesitancies was the various conspiracies theories in circulation that labelled the vaccines as either diabolic or unsafe. Targeting populations with high vaccine reluctance rates can help achieve high vaccination coverage. Effective communication should be adopted by using appropriate channels as this will foster trust and increase vaccine uptake.

Key words: conspiracy, vaccine, hesitancies, demographics

Introduction

According to WHO (2020), in December of 2019, Wuhan, Hubei Province, China, became the epicentre of an unknown-cause of pneumonia outbreak, which drew widespread concerns and attention not only in China but globally. The pandemic according to Zhu, Wei, & Niu (2020) infected a large number of people, vastly outnumbering the equivalents of Severe Acute Respiratory Syndromes (SARS) and Middle East respiratory disease (MERS), however with a lower fatality rate. According to the report by the Chinese government's surveillance statistics and reported by Zhu, Wei, & Niu (2020), in February 19, 2020, the number of confirmed infection cases had risen to 44,412 in Wuhan while the entire China recorded 74,280, with 1497 and 2009 deaths respectively. The World Health Organization declared Coronavirus disease (COVID-19), a rare viral disease, and a global pandemic on March 11, 2020 (WHO 2020). By 17th of March 2022 according to WHO (2022), over 500 million cases have been confirmed worldwide and well over 5.9 million deaths recorded and reported globally.

Echeverria-Londono et al., (2021), Preaud et al., (2014) and Bloom (2011) believes that vaccination is widely regarded as among the best tactics of disease prevention, as well as a cost-effective technique for improving health outcomes. Bloom (2011) argued that vaccination has proven over the years to be one of the effective ways in controlling the spread of infectious diseases globally and the attainment of a population level immunity. According to Randolph and Barreiro (2020), population level immunity is essential because it ensures the potential host of an infectious disease are immune thereby breaking the chain of transmission and leading to a decline in the number of recorded cases over time. According to WHO (2020), the population level immunity also known as herd immunity is achieved through the vaccination or natural immunity developed from previous illnesses. However, WHO (2020) further argued that it is better and safer for herd immunity to be attained through vaccination rather than exposure of persons to infection which may result to some fatal consequences. To attain herd immunity, a substantial level of a population should have been vaccinated against the infection. D'Souza & Dowdy (2021) and WHO (2020) posited that for herd immunity to be attained, the percentage of population to be immune varies from one disease to another, for Polio it is 80%, measles 90% while for COVID-19 according to Britton, Ball & Trapman (2020), it is between 50-75% of the entire population.

COVID-19 immunisation programmes came with a lot of challenges, according to Aschwanden, (2021) and Mcneil (2020), these challenges include selecting an appropriate biological formulation, availability and criteria for selection of human for the vaccine pilot studies, large scale production, and post-marketing monitoring, in addition to finances and distribution logistics, however the greatest threats to vaccine programs according to MacDonald, (2015), rely greatly on the population's willingness to receive it. Furthermore MacDonald, (2015) argued that however the availability of free and comfortable vaccination facilities with great proximity, a great number of the population may delay adopting a safe vaccine or outright refusal to get vaccinated. The increase rate of COVID-19 vaccine hesitancy has been a major cause of concern among global health players (Cooper, van Rooyen & Wiysonge, 2021; Eaton, 2021; Lance, 2021; National Academies of Sciences, Engineering, and Medicine 2021). A couple of recent national, continental, and global studies according to the work published by Fisher et al., (2020), and Lazarus et al., (2020), reveals that COVID-19 vaccination hesitation and refusal is becoming an emerging concern. According to the report published from, a swift systematic review of 126 studies on COVID-19 vaccination willingness (31 countries in total were covered), along with 23 academic studies and 103 opinion polls publication by October 20, 2020 by Lin, Tu and Beitsch (2020) and Cooper *et al.*, (2021) observed a sharp fall of vaccine (anticipated) acceptance, from more than 70% in March to less than 50% in October. In light of this, addressing existing and future COVID-19 vaccination apprehension is evidently crucial. Vaccine reluctances has had significant global presence and was not novel nor distinctive to COVID-19 vaccines, this led WHO naming vaccine hesitancy as being one of the top ten global health threats Wiysonge et al., (2022). The proclamation came according to Hickler, Guirguis & Obregon (2015), and Larson et al., (2014) due to rising global concern about an increasing number of people and communities questioning vaccines, wanting alternatives to vaccination, and delaying or refusing immunisation.

Causes of Vaccine Hesitancies

There has been different research by scholars to understand the cause of vaccine hesitancy globally, according to the work of Oliver and Wood (2014), the cause of hesitancy was narrowed to confidence, complacency, and convenience, this is called the "3 Cs" concept, which can be blamed for vaccine apprehension. Furthermore, De Figueiredo et al., (2020), Shen & Dubey (2019), Salmon et al., (2015) argued that vaccine reluctance is caused by absence of trust in vaccines and its providers, complacency about the necessity for immunisation, and

vaccine inconvenience in terms of affordability. Further investigation into vaccine refusal done by Dubé et al., (2014) demonstrates the role of personal, cultural, and religious views to have great influence on vaccine acceptance. Furthermore, the root cause of vaccine hesitancies according to Hornsey, Lobera, & Díaz-Catalán (2020), Crescitelli et al., (2020), Shen & Dubey (2019), Rosselli, Martini & Bragazzi (2016), has been narrowed to conspiracy theories, which contribute immensely to global vaccine refusal due to mistrust in governments, healthcare providers, and pharmaceutical companies.

Methodology

A narrative or semi-systematic approach is best suitable for this study because of it benefits and potential contributions. It can, for example according to Davis et al., (2014), determine whether an effect is consistent across studies and how many more trials are required to show the impact. This technique can also be used to ascertain which research or sample indicators influence the research problem, such as whether surveys done in one cultural context generate significantly different results than studies conducted in other cultural contexts. Due to the vastness of the sources of conspiracy theory and vaccine hesitancies among different socio-demographics, thematic analysis according to Miles & Huberman (1994) model will be adopted to analyse the results of this research, the attraction to this thematic analysis model is its ability to organise and categorise data from a narrative reviewed literatures into themes as further agreed by Braun & Clarke (2006), for instance, grouping same point of thought or perspectives into a single box and how it enables processed data to be shown and classified according to similarities and differences. As shown in the diagram, it comprises of three connection stages; data reduction, data display, and data conclusion-drawing/verifying.

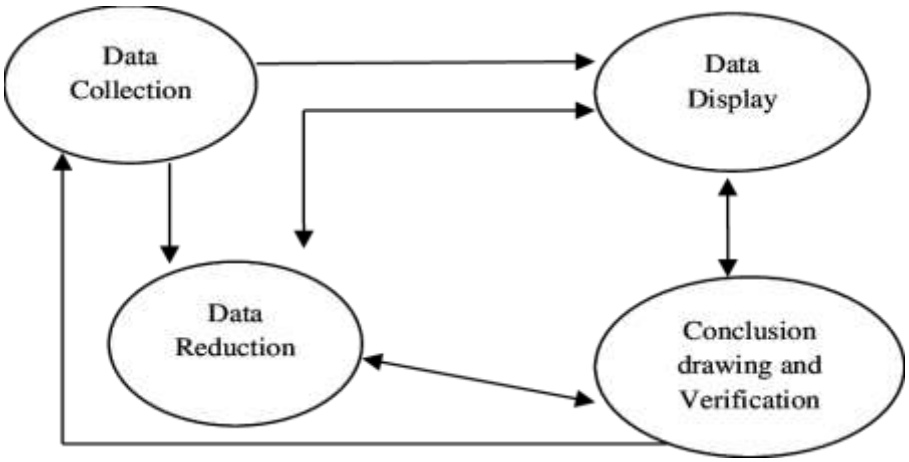

Figure 1: Thematic Analytical Framework
Adapted from Miles & Huberman (1994)

This model allows data extraction and classification from all the qualitative, quantitative and mixed method literatures that will be reviewed during the course of this work, Furthermore, Miles and Huberman (1994) explained that thematic model enables data presentation in a logical and organised pattern that allows decision-making to be easy, while allowing data presentation through various pattern such as quotations, narrative text, and figures, as well as tabulating differences and similarities and clarifying the link, as well as the data's related complexity. Thematic analysis best fit this research due to its vastness and complexity.

Conspiracy belief according to Douglas Sutton and Cichocka (2017) and Douglas et al., (2019), will be used by the author as an analytical lens to explore and explain why conspiracy theories have over the years gain global acceptance. Conspiracy believes according to Douglas *et al.*, (2017) attempts to explain the force that attracts people to believe in certain cause of

event. How people get knowledge or perceived reality also known as ontology and how this meaning are understood and transferred to others known as the epistemology (Everson, 1990; Hacking, 2002; Fumerton, 2009; Smith 2012; Douglas & Sutton, 2018). The analytical framework to understand and explain these conspiracy beliefs is presented diagrammatically below:

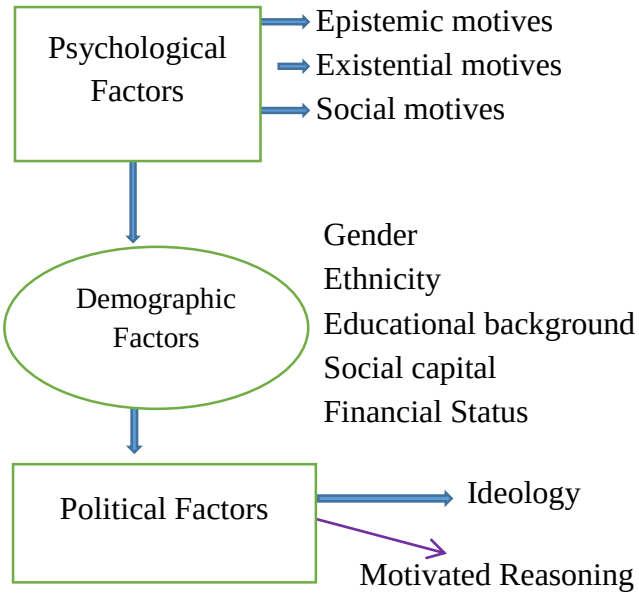

Figure 2: Conspiracy believes factors (Douglas et al., 2017): A diagram showing the Conceptual Framework of this study

Method

The first step performed in this research was to carry out preliminary literature search in line with the suggestion of Brian et al., (2016). The aim of this preliminary literature search according to Green, Johnson and Adams (2006), DePoy and Gitlin (1993) is to see what work has already been published and how many of the work fit into the research aims and objectives.

To conduct preliminary literature search related to COVID-19 pandemic and how vaccine acceptance is affected by different social demographics, the author used a variety of academic databases, including: Google Scholar, PubMed, the British Medical Journal, Elsevier, online books and Nottingham Trent University (NTU) library. The NTU one search pro which is an online version of the library was used to narrow down the search by entering specific word in the advance search. The NTU library database which host Wiley Online Library, Social Care Online, PubMed, Cochrane Library, and Science Direct allows literatures in the same category to be accessed by the author at no extra cost. The following Truncation and Boolean logic techniques according to Harter (1986) was used by the author to search the various databases: COVID-19 OR conspiracy OR theory OR vaccine OR acceptance OR social OR demographics.

The search outcomes gave 1324 papers, due to several publications on conspiracy theories not necessarily linked to COVID-19 and vaccine hesitancies among different socio-demographics. However, when the search was narrow down to the research topic, 768 results were found. The literature was further filtered by looking at publications whose population demographics are well stratified and research questions properly constructed, the literatures were further reduced to 17, however out of the 17 literatures, 10 were explicit and detailed in both methodology and result, these were selected by the author. Eight folders were created in the author's personal computer, seven of these folders were named according to the themes the

selected literature fit into and the 8th folder contains publications that the author will make reference to during the discussion of the findings.

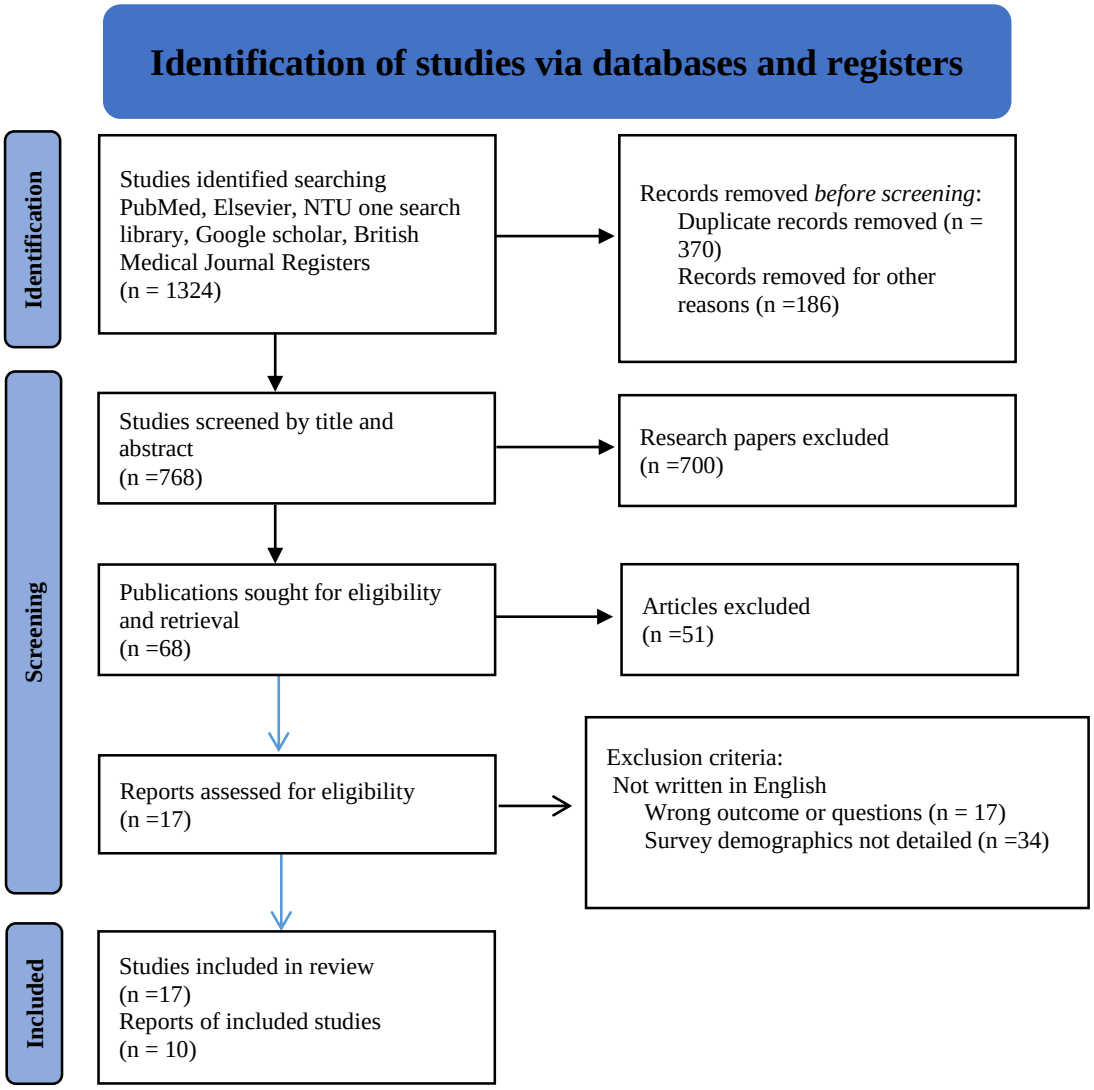

Figure 3: PRISMA flow diagram of study search and selection (Stovold et al., 2014)

Inclusion and Exclusion Criteria

The author applied two inclusion criteria when searching databases: the published work must be in English language and published within 2010 to 2022. Literatures not written in English language, and those beyond the stated years were excluded.

Result

The author used the following themes: Conspiracy beliefs with COVID-19 Vaccine, age related COVID-19 vaccine hesitancies, gender based COVID-19 vaccine hesitancies, level of education with COVID-19 vaccine hesitancies, ethnic/racial correlations with COVID-19 vaccine hesitancies, religion affiliation with COVID-19 vaccine hesitancies, and country of residence with COVID-19 vaccine hesitancies.

The author presents a table of the 10 selected literatures to understand vaccination trends among the different themes, the type of studies and an overview of the results; however the themes will be further analyse and discuss as the research progresses.

Table 1. Selected Literatures for the Study

Studies	No. of Participants	Types of Study	Correlation with higher vaccine acceptance
Tlale et al., 2022	5300	Cross-sectional	Male, Low education
Acheampong et al., 2021	2345	Cross-sectional	Male, Age, high Education
Cooper et al., 2021	619	Cross-sectional	Male
Robertson et al., 2021	12034	Longitudinal	Male, Age, High education, White
Sallam et al., 2021	3414	Cross-sectional	Male, education
Thelwall, Kousha & Thelwall, 2021	446	Cross-sectional	A review on various COVID-19 conspiracy theories
Lazarus et al., 2020, in UK	768	Cross-sectional	Female, age, education white
Lazarus et al., 2020, in US	773	Cross-sectional	Male, Age, High education
Lazarus et al., 2020, in Nigeria	670	Cross-sectional	Male, Age, High education
Reiter, Pennell & Katz, 2020	2006	Cross-sectional	Male, Age, Education, no religion Asian
Malik et al., 2020	672	Cross-sectional	Male, Age, high education, Asian
Syed et al., 2021	1411	Cross-sectional	Male, younger age, medium education, no religion

Conspiracy Beliefs with COVID-19 Vaccine

Different conspiracies theories have been linked to vaccine misconceptions, there's a wide believe from the study conducted by various researchers that vaccines contains unethical component or causes severe clinical conditions.

In a study conducted by Sallam et al., (2021), out of the 3414 participants, 1376 (40%) believe that the COVID-19 virus is man-made to force people get vaccinated, 947 participants believe the vaccine is a microchips created to control humans while 23.4% of the total participants believe the vaccine causes infertility in female. In another study conducted by Thelwall et al., (2021) on anti-vaccination sentiments, content analysis was done for the 446 handpicked tweets on COVID-19 Vaccine conspiracy beliefs; 23.5% believe that vaccines are out rightly fake intended for business purposes, 3.6% believes that the COVID-19 vaccines are risk to black people which has been seen in other arguments that it causes severe clinical condition among the black population. 2.5% of the studied tweets strongly believe that COVID-19 vaccines are made from aborted foetal tissues which render it sacrilegious and unethical. Furthermore, Thelwall et al., (2021) also discovered in their study that COVID-19 vaccine which is mRNA-based is believed by 10.5% of the analysed content to modify human DNA. Different demographics appear to show significant variation in the acceptance of COVID-19 vaccines, this next section will explore the relationship between vaccine acceptances with 6 socio-demographics.

Gender-based COVID-19 Vaccine Hesitancies

In Ghana, an adult citizens' vaccine acceptance study was conducted by Acheampong et al., (2021) to determine the possibility of participation or non-participation in the government's vaccination campaign, a complete anonymous cross-sectional online study of 2345 adult Ghanaians was conducted from 23rd to 28th of February 2021. Out of the total number of

participants, 1122 were male and 1223 were female, which amounted to 48 and 52 percent respectively, out of the total number of female participants, 518 which is 46% agreed to take the COVID-19 vaccine, 359 participants which make up 22% state that they are yet to decide if to get vaccinated or not, while the rest 245 female participant which is 22% stated they are unlikely going to take the vaccine. On the other hand, according to the study report by Acheampong et al., (2021), 679 amounting to 56% of the male participants, said they are likely to get vaccinated, 303 which is 25% of the participants stated that they have not yet decided. The reasons for this several hesitancies according to Acheampong et al., (2021) were due to the several misleading information about the COVID-19 vaccines.

In another study conducted by Sallam et al. (2021) in Jordan, 665 were male while 1508 were female respectively. The questionnaire was designed for participants to answer either 'yes' or 'no' to vaccine acceptance, 266 accounting to 40% of the male participants agreed to be vaccinated while 399 accounting for 60% said they will not accept the COVID-19 vaccine. On the other hand according to Sallam et al. (2021), from the 1508 female participants, only 301 agreed to accept the COVID-19 vaccine which accounts for 20% while 1207 accounting for 80% of the female participants disagreed to accept the vaccine. These whole hesitancies according to Sallam et al. (2021), were linked to several conspiracy theories in circulation on the COVID-19 viruses and its vaccines.

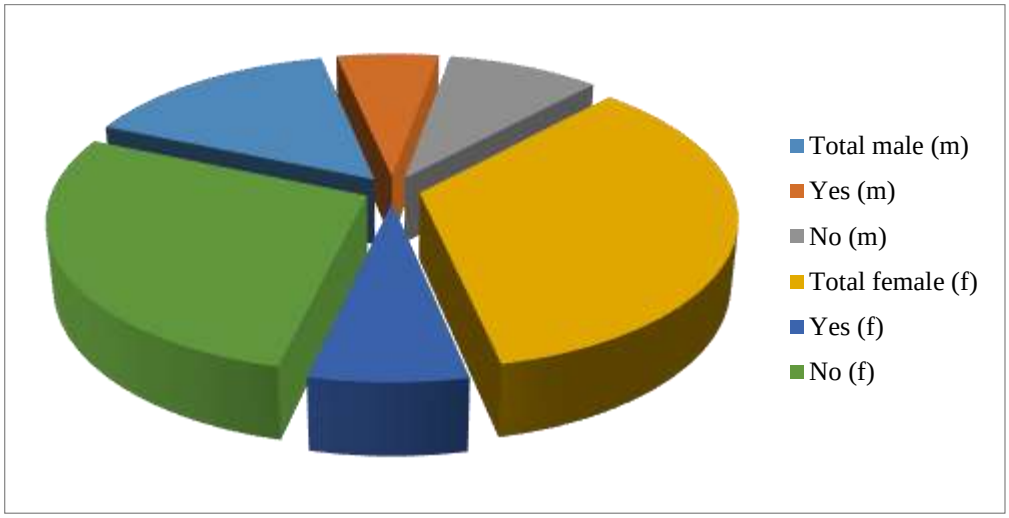

Figure 4: COVID-19 Vaccine Acceptance survey based on Gender in Jordan (Sallam *et al.*, 2021)

In another study conducted by Cooper *et al.*, (2021) in South Africa, 619 participants were recruited and questionnaires served online. The response of acceptance of the COVID-19 vaccine based on gender was again linked to distrust of the vaccine as a result of several conspiracy theories shared on several South Africa print and social media and without taking account of numerous fake news about the virus and vaccination program shared face to face among friends and family members. Cooper *et al.*, (2021) in their findings, out of the 619 participants, 45% of male who has trust issue said they will not get vaccinated while 60% of female with same issues also agree to refuse vaccination.

In a longitudinal study conducted in the United Kingdom by Robertson et al., (2021), 19,289 participants who had previously participated in other studies in the UK were invited to take part, however 12034 gave consent to be involved in the study. The demographics of the participants were collected and collated from Institute for Social and Economic Research data base. The study outcomes based on gender as reported by Robertson et al., (2021), saw vaccine

hesitancy reported in a higher percentage of female participants (21.0%) than male participants (14.7%).

In June 2020 a study was conducted by Lazarus et al., (2020) immediately the COVID-19 vaccines were rolled out, 13,426 persons from 19 countries participated in the study, the effects of age, gender, and educational level on vaccine acceptability were investigated in this study. The reasons for vaccines refusal by study participants according to Lazarus et al., (2020) were due to trust issues on the source, and safety of the vaccines.

In the United Kingdom, a total of 768 persons participated of which 408 females and 388 males, 70.1% of the females agreed to get the vaccination jab while 73.8% of the male counterparts agreed to be vaccinated.

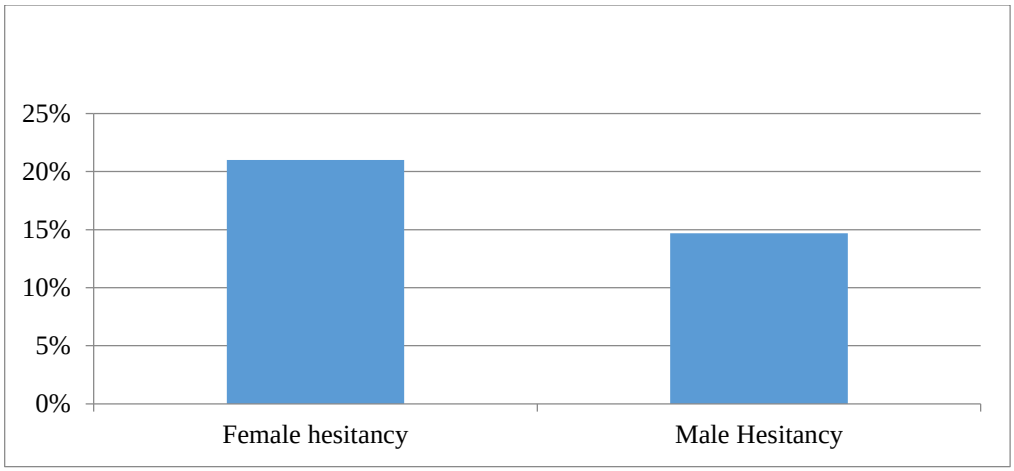

Figure 5: Vaccine Hesitancy based on Gender in UK (Robertson *et al.*, 2021)

In United State of America, according to the study outcome by Lazarus et al., (2020), a total of 773 participants were recorded, 423 and 337 were females and male respectively, 76.4% of the female participants and 74.8% of the male participants agreed to get vaccinated respectively. In Nigeria, out of the 670 participants, 373 were female and 275 were male respectively, out of the 373 female participants, 256 agreed to be vaccinated which accounts to 68.6% while from the 275 male participants, 176 accounting to 64.0% agreed to be vaccinated. The result of the study conducted by Lazarus et al., (2020), from South Korea, 752 interested participants were recruited of which 392 and 357 were female and male respectively. From this study, 311 accounting to 79.3% of the female participants agreed to be vaccinated while 286 of the 357 male participants accounting to 80.1% agreed to get vaccinated. In India from the same study conducted by Lazarus and colleagues, 742 participants were recruited and 485 were male, while 243 were female respectively. 73.6% of the female participants accounting to 357 said they will receive the vaccine while 186 accounting for 76.5% of the male participants agreed to get vaccinated. Contrarily, in a cross-sectional study conducted by Syed et al., (2021), out of the 1411 participants, 525 were male of which 82.9% agreed to get vaccinated while the female participants were 886 of which 83.5% agreed to be vaccinated which place the male more vaccine hesitant in this study.

Age Related COVID-19 Vaccine Hesitancies

According to the vaccine acceptance study outcome conducted by Acheampong et al., (2021), vaccine hesitancy was differentiated based on age demographics in Ghana. Participants between ages 15 to 25 were 177 out of which 70 accounting to 40% agreed to get vaccinated, 59 which is 34% said they have not decided while 47 amounting to 27% said they will not get the vaccination. Age ranging from 26-35 accounted for 1104 participants. From this number,

565 which is 51% agreed to get vaccinated, 311 (28%) said they have not decided while 228 which is equivalent to 27% said they will not take the vaccine. Participants between 36 to 45 ages were 546 of which 46% which is equal to 251 participants agreed to be vaccinated, 163 (31%) could not decide while 132 accounting to 24% said they will unlikely get vaccinated. 208 participants were between the age of 46 to 55, from which 107 accounting to 51% agreed to be vaccinated, 69 participants accounting to 33% were undecided while 32 which is equivalent to 16% were unlikely to get vaccinated. And finally, according to the study outcome on vaccine acceptance conducted by Acheampong et al., (2021), the participants that were 55 years and above were 310, of which 203 amounting to 66% agreed to be vaccinated, 60 persons (19%) did not decide if to get vaccinated or not while 15% which is 47 participants said they are unlikely to get vaccinated.

In the longitudinal study conducted in the United Kingdom by Robertson et al., (2021), vaccine hesitancy was also measured against age. The number of participants between 16 to 24 years that took part in the study was 920 which make up 9.2% of the entire participants, out of these persons, 73.5 % (676) agreed to get vaccinated while 26.5% accounting for 243 persons said they will reject the vaccine. Age between 25 to 34 that participated in the study were 1382 (13.8%), out of this figure, 71.7% accounting to 991 participants agreed to get vaccinated, while 28.3% which accounted for 391 participants said they are unlikely to get vaccinated. Participants between the ages of 35 to 44 that participated were 1545 accounting to 15.5%. Out of this population, 75.8% which is 1171 persons agreed to get the COVID-19 jab, while 373 (24.2%) said they are very unlikely to get vaccinated. The participants with age brackets 45 to 54 years accounted for 17.9% which is equivalent to 1784 persons, out of this number of people, 80.4% which is 1434 participants agreed to get vaccinated while 19.6% which is 350 persons said they will not accept the COVID-19 vaccine. Furthermore, participants with age 55 to 64 were 1938 (19.4%) out of which 85.7% accounting to 1661 participants agreed to be vaccinated while 14.3% which is 277 participants said they will unlikely get vaccinated. Robertson et al., (2021), study also reported feedbacks from participants within the age of 65 to 74, this accounted for 15.3% (1532 persons) of the entire studied population, out of which 91.90% agreed to take the vaccination against SARS-COV-2, while the reverse was the case for the remaining 8.10% that is 159 participants. And finally, the participants who were 75 years and above had the least vaccine hesitancy of 4.50% while 95.50% agreed to take the immunisation against COVID-19, although the percentage of participants from this age bracket were only 8.8% which is equivalent to 882 persons. Furthermore according to Robertson et al., (2021), the several reasons for vaccine refusal by the various respondents is due to the many conspiracy theories creating mistrust on the pandemic and its vaccine.

Table 2. Tabular Presentation of Age and Vaccine Hesitancy

AGE	No. of Participants	Likely (%)	Undecided (%)
16 – 24	920	73.5	26.5
25 – 34	1382	71.7	28.3
35 – 44	1543	75.8	24.2
45 – 54	1784	80.4	19.6
54 – 64	1938	85.7	14.3
65 – 74	1532	95.50	8.10
75 and above	882	95.50	4.50

Source: Robertson et al., (2021)

In South African study conducted by Cooper *et al.*, (2021), where 619 participants were recruited and questionnaires served online, the vaccine hesitancy were also measured against age, although the age distribution were not elaborate compare to the study conducted by

Acheampong et al., (2021), Robertson et al., (2021) and others. From the 619 South African correspondents that were 35 years or above who agreed to get vaccinated were 5% higher (that is 78%) while those that were below 35 years had a 73 vaccine acceptance percentage.

In the study conducted by Lazarus et al., (2020), age was part of the demographics considered while choosing respondents, from the countries where participants were recruited, the age distribution were classified into 2; those below 50 years and those who were or above 50 years of age. In Nigeria, a total of 620 persons were below 50 years out of which 399.9 (64.5%) agreed to get vaccinated while 70 correspondents were 50 years or above out of which 52 (74.0%) agreed to take the vaccine. In USA according to the report by Lazarus et al., (2020), 574 participants were below 50 years of which 75.4% (433 correspondents) agreed to get vaccinated. A total of 199 respondents were 50 years or above and 75.4% which is 150 participants agreed to get vaccinated. In Brazil, out of the participants, 545 were below 50 years of which 461 agreed to get the vaccine jab (84.6%) and 172 were above 50 years of which 87.8% (151 participants) agreed to get the vaccine. In Canada as reported by Lazarus et al., (2020), 483 participants were below 50 years of which 318 (66%) agreed to get vaccinated while participants above or exactly 50 years were 224 of which 74.6% agreed to get vaccinated. In China, Lazarus et al., (2020), had respondents who were above 50 years to be 267 of which 229 (85.8%) agreed to get the vaccine, 444 participants were below 50 years of which 401 accounting to 90.3% agreed to get the vaccine.

In United Kingdom, the results appears to be consistent with other countries with older ages showing more willingness to get the vaccine, from the total correspondents, 550 were below 50 years out of which 376 (68.4%) agreed to get the vaccine while from the 218 participants that were 50 years or above, 173 (79.4%) agreed to get the vaccine jab. In Sweden a total of 293 participants in this study as reported by Lazarus et al., (2020), were below 50 years of which 152 equivalents to 51.9% agreed to get the COVID-19 vaccine while 272 from the 357 participants accounting to 76.2% agreed to get vaccinated. The aforementioned data is represented in a table below:

Table 3. **Tabular Presentation of Age and Vaccine Hesitancy**

COUNTRY	**<50**	**≥50**
Nigeria demographics Vaccine acceptance	62.0 64.5(%)	70 74.0(%)
USA demographics Vaccine acceptance	574 75.4%	199 75.4%
Brazil demographics Vaccine acceptance	545 84.6%	172 87.8%
Canada demographics Vaccine acceptance	482 66.0%	224 74.6%
China demographics Vaccine acceptance	444 90.3	267 85.8%
UK demographics Vaccine acceptance	550 68.4%	218 79.4%
Sweden demographics Vaccine acceptance	293 51.9%	357 76.2%

Source: Lazarus et al., (2020)

Level of Education with COVID-19 Vaccine Hesitancies

In the study conducted by Lazarus et al., (2020), level of education was part of the demographics considered while choosing correspondents, from the countries participants were recruited, the level of education was stratified into three; Low that is those with basic education,

Medium which include those that are high school/college graduate, High/very high education which literally means those with first degree, masters or PhD. In South America, Brazil precisely, 176 correspondent had low education of which 150 agreed to get vaccinated accounting to 85.2% of the studied population, those with medium education accounted for 272 of which 230 participants (84.6%) agreed to get the vaccine. While those with high and very high education were 268 of which 86.2% (231 persons) agreed to get vaccinated. The study done by Lazarus et al., (2020) also sample vaccine acceptance intension from Canadians based on their education level, those with low education accounted to 204 were 149 agreed to get vaccinated which is equivalent to 73.0%. Those with medium education were 380 of which 254 (66.8%) agreed to get the vaccine, from the 121 sampled population with high/very high education, 81 agreed to get the vaccine which is 66.9% of the sampled population. In China according to the same study, 236 had low education of which 204 agreed to get the vaccine which is 86.4% of the sample population. Those with medium education were 436 and 389 (89.2%) agreed to get the vaccine. Those with high/very high education were the lowest, only 39 participants were recruited, however out of this number, 37 agreed to be vaccinated which accounted to 94.6%.

In India, according to Lazarus et al., (2020), 126 of the participants had low education of which 58(46%) agreed to get the vaccine, those with medium education were 429 and 78.3% (336 participants) of that population agreed to get vaccinated, 179 had high/very high education of which 84.9% accounting to 152 participants. Also in West Africa, Nigeria precisely, Lazarus et al., sampled 249 persons with low educational background of which 154 which is equivalent to 61.8% agreed to take the vaccine. And out of the 325 participants with medium education, 218 accounting to 67.1% agreed to be vaccinated, those with high/very high education among the sampled population were 96 of which 67.7% amounting to 65 participants agreed to get vaccinated. In Sweden, 325 participants were recorded to have low education of which 204 (62.8%) agreed to get the vaccine, 146 had medium education and 103 accounting to 70.5% agreed to take the COVID-19 vaccine. From the 179 participants with high or very high education according to the report of Lazarus et al., 117 accounting to 65.4% agreed to take the vaccine. The feedback from the United Kingdom seems to be a bit inconsistence with report from other countries based on education, it was observed that low educated participants which were 167 had 79.6% (133 participants) agreed to get the vaccine, from the 197 participants with medium education, 64.5% accounting to 127 persons agreed to get the vaccine, while those with high or very high education were 402 of which 71.9% which is equivalent to 289 participants, agreed to be vaccinated. Finally in the United States of America according to the study by Lazarus et al., (2020), 58 participants had low education accounting to 31 persons (53.4%), those with medium education were 143 of which 104 (72.7%) agreed to get immunised with the COVID-19 vaccine and participants with high and very high education were 568 of which 445 agreed to be vaccinated.

Table 4. Tabular representation of COVID-19 vaccine acceptance relating to Education

Country	Low Education	Medium Education	High/very high
Brazil	176	272	268
%Acceptance	85.2	84.6	86.2
Canada	204	380	121
%Acceptance	73.0	66.8	66.9
China	236	436	39
%Acceptance	86.4	89.2	94.9
India	126	429	179
%Acceptance	46.0	78.3	84.9

Nigeria %Acceptance	249 61.8	325 67.1	96 67.7
Sweden %Acceptance	325 62.8	146 70.5	179 65.4
UK %Acceptance	167 79.6	197 64.5	402 71.9
USA %Acceptance	58 53.4	143 72.3	568 78.3

Source: Lazarus et al., (2020)

In the study conducted in Ghana by Acheampong et al., (2021), the sampled population were also stratified into level of education and measured against COVID-19 vaccine acceptance. The categories were junior and senior secondary school, tertiary, postgraduate and others which may include vocational education, artisan or self-taught education.

The numbers of participants according to Acheampong et al., (2021), with junior secondary school (JSS) education were 30 of which 11 accounting to 38% said they are likely to take the vaccine, 13 persons which is 44% said they have not decided while the remaining 5 persons which account to 18% said they are unlikely to get vaccinated. For those with senior secondary school (SSS) education a total of 103 persons responded to the questionnaires, 64 (62%) agreed to get vaccinated, 21 (21%) were undecided and the remaining 18 which is 18% of the participants with this level of education said they were doubtful if they will take the vaccine. Those with tertiary education according to Acheampong et al., (2021), were 1339 of which 619 (46%) agreed to take the vaccine, 425 (32%) were not decided while the rest 295 which is 22% said they were unlikely to take the vaccine. Those with postgraduate education that took part in this study were 852, of which 499 (59%) said they were likely to take the vaccine, 194 (23%) said they have not decided while the remaining 159 which account to (19%) responded that they are unlikely to get the COVID-19 vaccine. Finally participants with other forms of education were 21 of which 21% which accounted to 4 persons said they will take the vaccine, 8 (37%) said they are yet to decide while the remaining 9 participants (4%) stated that they were unlikely to take the COVID-19 vaccine.

In the longitudinal study conducted in the United Kingdom by Robertson et al., (2021), vaccine hesitancy was also measured against level of education, in this study level of education of the participants were stratified into 5; degree or other degree holders, A level or its equivalent, General Certificate of Secondary Education (GCSE), other education and no qualification. According to the study from the 12034 persons who took part in the study, 4086 which accounts to 40.9% of the studied population in UK had a minimum of a first degree while others had some postgraduate degree although Robertson et al. grouped it as other degree. From the 4086 degree holders, 3547 which accounts to 86.8% agreed to get vaccinated while the remaining 13.2% which accounts to 539 participants said it is very unlikely they will get vaccinated. Those with advance level (A level) were 2202 (22.1%) of which 1783 (81.0%) of the studied participants agreed to take the COVID-19 vaccine while 418 (19.0%) reported to be unlikely to get the vaccine. Participants with GCSE or its equivalent were 2010 which is 20.1% of the 12034 total studied population, from this participants, 1516 (75.4%) agreed to take the COVID-19 vaccine while 24.6% which is 494 of the A level holders said they will not take the vaccine.

Furthermore, according to Robertson et al., (2021), those that participated in this study from the United Kingdom, 846 (8.5%) had other education although it was not specified what kind of qualification is grouped as others. From these participants, 698 which account to 82.5% agreed to get vaccinated. While those that responded negatively to the COVID-19 vaccine were 157 which is 18.6 percentages. Finally, according to Robertson et al., (2021), 501 (5.0%) of

the 12034 total surveyed population had no form of qualification, out of these, 81.4% which is 408 agreed to get the COVID-19 vaccine while 93 participants which is 18.6% said they are unlikely or very unlikely to get the vaccine

In the study conducted by Sallam et al., (2021) in Jordan, Kuwait, Saudi Arabia and other unspecified Arab countries, a total of 3414 participants responded to the study questionnaires, the education achievements were classified into high school or less, undergraduate and postgraduate, the number of participants from the surveyed countries with high school or less qualification were 359 of which 86 (24.0%) agreed to get vaccinated, while 373 which account to 76.0% said they will not accept the COVID-19 vaccine. From the 2562 participants with undergraduate degree according to Sallam et al., (2021), 696 which is 27.2% agreed to get vaccinated while 1866 (72.8%) said no to the vaccine. Those with some form of post graduate degree that participated in were 493 of which 40.2% which amount to 198 persons agreed to take the vaccine, furthermore, a larger number of postgraduate degree holders accounting to 59.8%, which is equivalent to 295 participants, said they will not accept the COVID-19 vaccine.

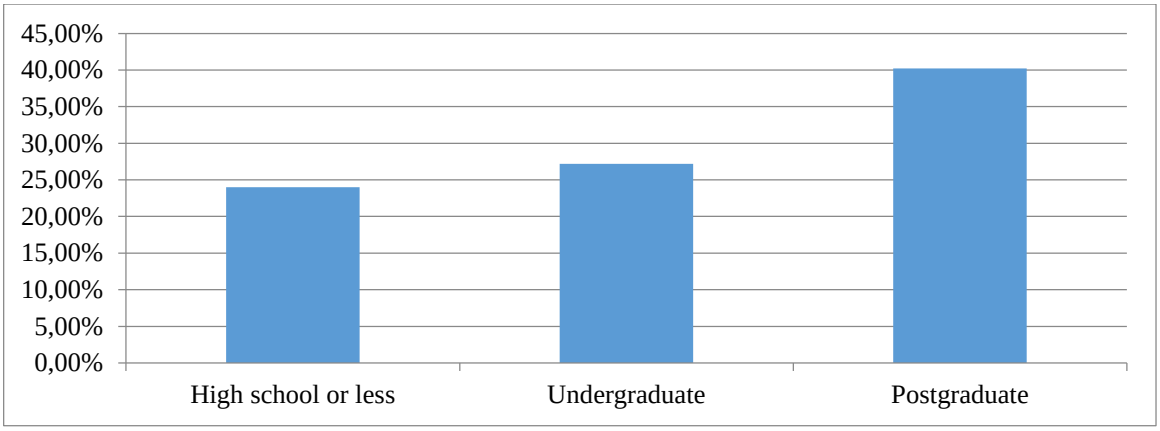

Figure 6: COVID-19 Vaccine Acceptance Based on level of Education (Sallam *et al.*, 2021)

Contrary to the above studies, the study done by Syed et al., (2021), had less educated participants less vaccine hesitant; the total number of participants in this study that had less than tertiary education were 185 of which 83.8% agreed to get vaccinated compare to the 1226 participants with tertiary education of which 83.2% agreed to get vaccinated.

Ethnic/Racial Correlations with COVID-19 Vaccine Hesitancies

In the longitudinal study conducted in the United Kingdom by Robertson et al., (2021), vaccine hesitancy was also measured against race and ethnicity in the United Kingdom, it was also discovered that conspiracy belief has greater expression among certain race and ethnic group. The stratification based on race and ethnicity was quite detailed. From the total number of 12,035 participants who completed the study, 8713 accounting to 87.3% were white British or Irish, from these ethnic majority, 7354 persons agreed to get the COVID-19 vaccine which is 84.4%, while a few which makes up 1359 (15.6) of the studied population said they are very unlikely to get vaccinated. Robertson et al., (2021), also differentiated other participants with White background which amounted to 269 (2.7%) of which 198 (73.6%) agreed to take the vaccine while the remaining 71 which is 26.4% of this race responded negatively. Those with mixed race were also accounted for, 168 (1.7%) participants had this identity of which 114 accounting to 67.6% agreed to get vaccinated while 54(32.4%) participants gave negative feedback. For the Asian or Asian British or India, 176(1.8) persons responded to the study

questions of which 140 which is 79.4% gave a positive answer while the remaining 36 persons which accounted to 20.6% responded otherwise.

Furthermore, according to Robertson et al., (2021), Asian or Asian British or Pakistan or Bangladesh accounted for 198 (2.0%) participants of which 114 (57.7%) agreed to take the COVID-19 vaccine jab, while 84 (42.4%) gave negative feedback. Asian or any other ethnic or racial population that took part in this study were 106 which is 1.1% of the entire studied population, from this figure, 84 participants accounting to 79.5% agreed to get vaccinated while the remaining 22 which is equivalent to 20.5% said they are unlikely or very unlikely to get vaccinated. Black or Black British seems to show great resentment to COVID-19 vaccination program, from the data gotten according to Robertson et al., (2021), a total number of 190 participants from this minority ethnic group responded to the questionnaires of which 54 accounting to 28.2% agreed to take the COVID-19 vaccine why the larger population accounting to 136 (71.8%) responded to be unlikely or very unlikely to get vaccinated. Finally, the last ethnic group that participated were group as other ethnic groups' the number of persons in this category were 59 (0.6%) of which 47 which accounts to 79.5% agreed, while the remaining 12(20.5%) participants gave negative feedback. Unfortunately, according to Robertson et al., (2021) reports, 102 participants could not be accounted for and reasons were not provided.

Table 5: A tabular representation of COVID-19 vaccine acceptance in respect to Race/Ethnicity in the United Kingdom

Ethnicity/Race	No. of Participants	Likely/very likely	Unlikely/very unlikely
White or British Irish	8713 (87.3)	7354 (84.4)	1359 (15.6)
Other White Background	269 (2.7)	198 (73.6)	71 (26.4)
Mixed	168 (1.7)	114 (67.6)	54 (32.4)
Asian or Asian British/Indian	176 (1.8)	140 (79.4)	36 (20.6)
Asian or Asian British/Pakistan/Bangladesh	198 (2.0)	114 (57.7)	84 (42.4)
Asian or Asian British/any other groups	106 (1.1%)	84 (79.5)	22 (20.5)
Black or Black British	190 (1.9)	54 (28.2)	136 (71.8)
Other ethnic groups	59 (0.6)	47 (79.5)	12 (20.5)

Source: Robertson et al., (2021)

In another cross-sectional study conducted by Reiter *et al.*, (2020) in the 50 United States of America, a total of 2,006 adults were recruited and gave consent to participate in this study. From the 2006 who took part in this study, 1347 were White Americans that are not Latinos (White, non-Latinx) of which 941 accounting to 70% agreed to get the vaccine, non-Latinos Black were 240 of which 133 (55%) agreed to get the vaccine, other race and ethnic groups that are non-Latinos accounted to 178 of which 122 (69%) agreed to get the vaccine. While Latinos who participated in the study were 241 and 178 which accounts to 74% agreed to take the vaccine.

In another study done in the USA by Malik et al., (2020), vaccine acceptance was also measured against ethnicity, out of the 672 participants, 487 were White majority accounting to 73%, of this figure 329 (68%) agreed to get vaccinated, from the 68 Hispanic participants, 46 (68%) agreed to get vaccinated, non-Hispanic Ethnic group were 604 of which 404 (67%) agreed to get vaccinated. Malik et al., (2020), also measured vaccine hesitancy against race, out of the 672 participants, 67 were Black African/American of which 27 accounting to 40% agreed to get vaccinated. Furthermore, American Indian/Alaska native were 19 persons of

which 14 (74%) agreed to get the COVID-19 jab, while native Hawaiian/other Pacific Islander according to Malik et al., (2020) accounted to 2, of which one (50%) of the participants agreed to get vaccinated.

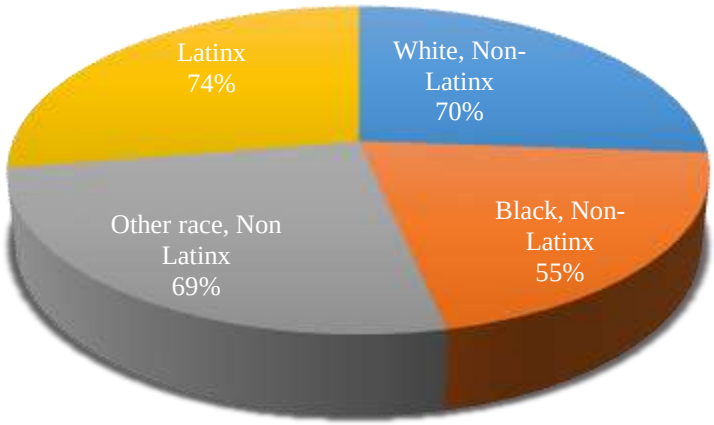

Figure 7: COVID-19 vaccine Acceptance Among Different Ethnic/Race in USA (Reiter *et al.*, 2020)

Religion Affiliation with COVID-19 Vaccine Hesitancies

The study conducted by Reiter *et al.*, (2020) in all the states in America, of the 2,006 participants, 715(35.6%) were not inclined to any religion of which 508 accounting to 71% agreed to get vaccinated. Also, a total of 1291(64.4%) of the 2006 participants were affiliated to an undisclosed religion of which 864(67%) agreed to take the COVID-19 vaccine when available.

In a cross-sectional study conducted in Botswana, a South Africa country by Tlale et al., (2022), vaccine hesitancy was also measured against several demographics, a total of 5300 persons gave consent to participate in the study of which 4777 were Christians, 33 Hindus, 57 practice Islam, 11 practice Buddhism, other religion accounted to 271, while 143 participants could not be accounted for. Respondents whose religious beliefs did not deter them from receiving the vaccine were more likely to do so than those whose religious beliefs did. It was discovered that just about half (49%) of those who indicated their religious and cultural views prevented them from getting the COVID-19 vaccine were willing to do so. Furthermore, the majority of people accounting to 77.6% who did not have religion or cultural convictions were willing to get the COVID-19 vaccine. Those who stated that religion or cultural views prevent vaccine uptake had a lower percentage to receive COVID-19 vaccine than those who did not (95%). Only 51% of participants who believed in other traditional or religious means to manage the COVID-19 infection, agreed to be vaccinated.

According to the cross-sectional study conducted by Syed et al., (2021) COVID-19 vaccine acceptance was measured against the different religion population in Malaysia. 1020 participants were Muslims of which 857 (84%) agreed to get vaccinated, the number of participants that are Christians' were 271 of which 228 (84.1%) agreed to be vaccinated, Buddhist were 80 that took part in the study of which 61 persons accounting to 76% agreed to get vaccinated, while participants from other religion not specified by the researchers were 40, of which 29 (72.5%) agreed to get the vaccine.

Country of Residence with COVID-19 Vaccine Hesitancies

Furthermore, in another research published by Sallam et al., (2021), it was discovered that COVID-19 vaccine acceptance due to various conspiracy belief also varies from different country; Ecuador had the lowest vaccine hesitancy with 97.0% of its population vaccinated,

Indonesia 94.3% while China had 91.3% of her population vaccinated. However, Kuwait had the lowest vaccine acceptance rate of 23.6% by her population while Jordan had 28.4% vaccinated and United State of America had 56.9% vaccinated population. Furthermore, in Ghana, according to Acheampong et al., (2021), the number of adult participants (15 years and above) who are mainly urban dwellers that took part in the study, 5 in 10 or 51% agreed to get vaccinated. In the study conducted by Lazarus et al., (2020), the overall percentage of participants from Brazil that agreed to get vaccinated were 85.4, in China it was 88.6, in Russia 54.9, in Nigeria 65.2, United Kingdom 71.5, in Ecuador 71.9, USA 75.4 and for Poland it was 56.3% respectively.

The author has been able to explore the various myths and conspiracies surrounding the COVID-19 vaccines, it was well established that the proponents of conspiracies theories have unproven answers to the cause of the COVID-19 pandemic and unverifiable argument on the vaccine's safety, intentions and effectiveness. It was also established that the various theories are false and unscientific. Different demographics have shown significant discrepancies in the acceptance of the COVID-19 vaccines from the results presented.

Discussion of the Findings

The author discuss the findings using the conceptual framework according to Douglas et al., (2017 and 2018) seven themes; Conspiracy beliefs on COVID-19 Vaccine, age related COVID-19 vaccine hesitancies, gender based COVID-19 vaccine hesitancies, level of education with COVID-19 vaccine hesitancies, ethnic/racial correlations with COVID-19 vaccine hesitancies, religion affiliation with COVID-19 vaccine hesitancies, and country of residence with COVID-19 vaccine hesitancies will be discussed in this section.

Conspiracy Beliefs on COVID-19 Vaccine

COVID-19 Vaccine Is Microchips to Control Human Race

The study done by Sallam et al., (2021) discovered that study participants hold a strong view that the COVID-19 vaccine is a hoax which agrees with other studies done by Ullah et al., (2020), Havey (2020), Fuchs (2021), these studies discovered a popular view that Bill Gates was using the virus as cover to implement a global surveillance project, others argued that the COVID-19 jab was the mark of the beast and that Bill Gates was the biblical anti-Christ and that microchips and not vaccines are injected with needles (Thomas & Zhang 2020; Kant, Varea, & Titifanue, 2021). These theories according to Evstatieva (2020) do not sound logical. Over the years Bill and Melinda Gates foundation has financed and promoted the equal access to immunizations through Gavi, a non-profit organization that works with low-income nations to immunize hundreds of millions of children. In 2020, the gates foundation also pledged to support WHO with $250 million to create a comparable delivery system for COVID-19 medications and vaccines (Suzman, 2020). In 2010 according to Bill and Melinda Gates being one of the world's wealthiest couples, pledged to give away 95% of their income, with £17 billion going to their charity foundation, which supports health projects throughout the world (BBC 2010). A large portion of the funds went into vaccines production for polio, malaria, and HIV (Rappuoli *et al.*, 2011; Gates, 2019). This simply indicates that Bill Gates has been a major driver of a disease-free world long before the COVID-19 pandemic and has invested massively to this cause.

The belief in Bill Gates as the cause of the pandemic from the conceptual lens of this research could be linked to existential motives. This motive according to Grzesiak-Feldman, (2013), Tetlock (2002), Abalakina-Paap et al., (1999), are usually exerted by people when they feel some powerful forces (like Bill Gates) has control over their lives and rendered them insecure, this existential motive is adopted to compensate for their perceived weakness and give them a feeling that they are still in control of their lives and territory. Blaming Bill Gate

who has invested so much on vaccine production and distribution globally is not morally correct, however, humans according to Douglas *et al.*, (2017) always hold on to beliefs that is appealing and popular within their circle of influence.

The author observed that the misconceptions that COVID-19 vaccine is a microchips to control human race have been a major cause of controversy from the inception of the COVID-19 vaccine campaigns, public health practitioners have to engage the public through various channels to dissociate the vaccine from such conspiracy, they can educate the public by differentiating the discrepancies between microchips that are usually a metallic object and vaccine that are in liquid form. There must be a concerted effort to pass the right information through the same channels that disseminate conspiracy theories with this the right population that are misinformed are targeted and guided adequately

COVID-19 Vaccine and Reproductive Health

The study outcome conducted by Sallam et al., (2021) and Sajjadi et al., (2021) that vaccines is used as a weapon to cause infertility is not only new to the COVID-19, it has been linked to several other disease outbreaks for example; according to Smallman (2018), Granmisterio (2016), the vaccine produced against the Zika virus was said to be sponsored by Eugenics movement and Bill Gates to eradicate the Latin America ethnic minority, In northern Nigeria, the Polio vaccination campaign in 2003 was brought to a halt by several conspiracies from political and religious leaders urging parents not to allow their children to be vaccinated accusing the West of injecting anti-fertility drugs (estradiol hormone), HIV, and carcinogenic agents to the polio vaccines, this single act saw the polio virus ravaging the children of the North and creating serious public health concerns (Jegede, 2007; Yahya, 2007; Kaler, 2009). Other vaccines such as the Flu jab, Smallpox and Syphilis according to Nguyen *et al.*, (2021) have also been linked to reproductive health. In a research conducted by Morris (2021) to ascertain the authenticity of several publications, that linked resemblance between syncytin-1 (a protein that aids placenta development in fertile women) and the SARS-CoV-2 spike protein causing immunological cross-reactivity and female infertility. Morris compared the implantation rates of SARS-CoV-2 vaccine seropositive and seronegative women using frozen embryo transfer as a model. Between the three groups, there was no difference in recorded human chorionic gonadotropin (a hormone produced during pregnancy) fertilization rates or prolonged implantation rates therefore, COVID-19 vaccinations or disease do not cause female sterility, according to reports. This study is in agreement to other studies conducted by (Evans *et al.*, 2021; Safrai *et al.*, 2021; Sajjadi *et al.*, 2021; Mirza *et al.*, 2022).

The belief that COVID-19 vaccines alter female reproductive health from the conceptual frame work of this research according to Douglas *et al.*, (2017), gained wide acceptance due to various psychological factor as explained by Douglas *et al.* (2017). This psychological factor is known as epistemic motives. This motive according to Heide (2013) is naturally embraced by people in order to find causal explanations that appear logical, coherent and consistent with view around close social network. Social motives according to Douglas *et al.*, (2017), Imhoff and Lamberty (2017); Lantian et al., (2017) can also cause people to accept such theory, this social motive is an ego booster that gives people the impression that they have privilege information which others do not, linking COVID-19 vaccines and Infertility appears to give an intellectual explanation on the motives of westernized vaccines advocates to depopulate certain ethnic groups. Douglas *et al.*, (2017) have been able to give a scientific analysis on why people can belief such conspiracy theory.

The author observed that Issues of reproductive health with vaccines have been a serious public health debates over the years and have been one of the major reasons why certain ethnic groups will not accept vaccines, public health professionals should change their strategies on how to make such conspiracies to be disregarded by educating community leaders on vaccine safety in females. Providing data of people known within the community who have taken

vaccines and yet reproductive, it is a popular opinion that population within a community tends to believe things when it comes from well-respected persons within the community rather than the central government.

The COVID-19 Vaccines Alters Human DNA

The study done by Sallam et al., (2021) and Thelwall *et al.*, (2021) discovered that one of the major causes of vaccine hesitancies is due to the conspiracy belief that the COVID-19 vaccines alter the genetic make-up of its recipient. This false information has been frequently expressed on social media and agrees with the study done by Weinzierl & Harabagiu (2021). Although some of the novel vaccines, such as Pfizer/BioNTech uses a piece of the virus's genetic material called messenger RNA and the introduction of RNA into a body has no effect on the DNA of the cells but It functions by instructing the body to manufacture a protein that is found on the virus surface which help to pair with the virus when present and triggers autolysis (Classen, 2021; Bukhari, Syed and Zain 2021; Zito 2020). Apparently, no mRNA vaccine has been licensed before now, however, several human investigations of mRNA vaccines have been conducted in recent years and also the COVID vaccine have been tested on thousands of volunteers all over the world (Thomas *et al.*, 2020; Polack *et al.*, 2020).

Social motives according to the conceptual frame work of this research adopted from the work of Douglas *et al.*, (2017) are the reasons why people believe in such conspiracy theory. Conspiracy belief of DNA and vaccine interactions are often times among those with certain class, they believe that the information can only be assimilated by certain status hence hold on to it as privilege information even when it is not scientifically proven.

The conspiracy belief of vaccines altering human DNA are usually common among certain socio-demographics which according to this research are the elites; therefore, outcome of several researches done on vaccine interactions with human genomics should not only be published on academic journals but can also be presented on newspapers, broadcasted through various television and radio programs and shared on social media to enable wide coverage. Such publications should be presented with a reader's friendly fonts, charts and pictorial demonstration that is catchy at first sight and should be self-explanatory; this will enable the right population to be targeted with the right information.

Gender-based COVID-19 Vaccine Hesitancies

Several studies have shown higher conspiracy belief resulting to lower vaccine acceptance in female than male, this correlate with the findings by Sallam et al., 2021 in Jordan were 40% of the male participants compared to 20% of their female counterparts agreed to take the vaccine. Also, other studies done by Acheampong et al., (2021), only 46% of the female participants compared to 56% of their male counterparts agreed to get vaccinated. In the UK, the research done by Robertson et al., (2021), also discovered high vaccine hesitancy of 21.0% in female compare to 14.7% of their male counterparts; the UK outcome also correlated with the research done by Lazarus et al., (2020), of which 70.1% of females agreed to get the vaccinated while 73.8% male from the studied population agreed to get vaccinated. Other studies have also shown higher vaccine hesitancies in female than male see (Fisher *et al.*, 2020; Lin, Tu, & Beitsch, 2020; Reiter *et al.*, 2020; Salali & Uysal 2020; Ward *et al.*, 2020; Andrade, 2021; Cooper *et al.*, 2021). From the ten reviewed literatures, eight showed consistencies in the results with female showing high vaccine hesitancies compare to their male counterpart. Although there are discrepancies in respect to research outcomes showing higher vaccine hesitancies in male than female; in a study done by Lazarus et al., (2020), to ascertain vaccine acceptance among Americans, 76.4% of female compare to 74.8% of the male participants agreed to get vaccinated and other studies have shown this trend see (Detoc *et al*., 2020; Harapan *et al*., 2020; La Vecchia *et al.*, 2020; Neumann-Böhme *et al*., 2020; Ward *et al*., 2020; Wong *et al*., 2020; Syed *et al*., 2021).

This finding according to conspiracy belief by Douglas *et al.*, (2017) is due to demography factor, certain demographics which is the female as seen from the result of this research are likely to have high affinity for conspiracy theory leading to vaccine hesitancies.

Public health practitioners should spend more time in encouraging females on the usefulness of vaccinations through their community primary health care providers, and other influential groups, otherwise if hesitancies continues in females it will also hinder their children who are often closer to their mothers from taking vaccines. The males within the family circle should be encourage by public health providers to be supportive of the females reassuring them they will assist in looking after the children and taking care of domestic chores should there be any side effects of vaccination such as dizziness, heavy arm and migraine which are often associated with some vaccines within the first 12 hours. This reassurance from close relatives will definitely see females become vaccine receptive.

Age Related COVID-19 Vaccine Hesitancies

Several researches have studied age and COVID-19 vaccine hesitancy. From the 10 reviewed literatures, there seems to be consistencies on vaccine acceptances with age, older population are more receptive than the lesser age demographics. According to the study done by Acheampong et al., (2021) in Ghana, older age appears to have high receptiveness to COVID-19 vaccine and also Robertson et al., (2021) research outcomes from South Africa residents also shown older age directly proportional to vaccine acceptance. The research done by Lin, Tu, & Beitsch (2020), in USA, data retrieved from international poll on COVID-19 vaccine acceptance also saw receptivity linked with older age. This result agrees with the study done by Neumann-Böhme et al., (2020) in which 7664 people from Denmark, France, Germany, Italy, Portugal, the Netherlands, and the United Kingdom participated, it was observed that participants over the age of 55 had the highest willingness to be vaccinated with over 70% acceptance rate, as the age decreases, the vaccine acceptance also declines. but it was discovered that participants between age 18-24 had higher vaccine acceptance than those between 25 to 54 years this finding of vaccine acceptance between the lowest and highest ages also correlates with other studies, see (Ali *et al.*, 2020; Bowman & Goldstein 2020; Druckman *et al.*, 2020; Acheampong *et al.*, 2021; Robertson *et al.*, 2021). There seems to be no explanation on why this age bracket (18-24) who are also exposed to social media were most of vaccine conspiracy theories are shared have high receptiveness to the COVID-19 vaccine, from the author of this research perspective, the high acceptance rate may be due to parental influence on these ages categories. Furthermore, the author discovered little discrepancies with the study report from other researchers, with younger age showing higher vaccine hesitancies see (Consult, 2020; Fisher *et al.*, 2020; Lin, Tu & Beitsch, 2020).

Douglas *et al.*, (2017) stated that certain age has higher affiliation to conspiracy belief, from the conceptual framework of this research, there seems to be consistency with the 10 reviewed literatures with older age showing high vaccine receptivity, it can be deduced from this study that certain age bracket especially between age 25 to 54 has high receptivity to conspiracy theory leading to vaccine hesitancies.

The issue of age and vaccine hesitancies can be improved by using peer groups to communicate the importance of vaccination, certain age bracket is in various socio-cultural groups, reaching them within the clusters will be of help. Certain population age is also greatly influenced by social media, public health practitioners should use public influencers like musicians, comedians with huge social media followings to reach out to the younger generation who appears from the study to be more vaccine hesitant. Ads can also be created with catching messages to promote vaccines importance.

Level of Education with COVID-19 Vaccine Hesitancies

With the exception of one, the ten reviewed literatures demonstrated a high level of education and greater vaccine receptivity. According to the research done by Robertson et al., (2021), in the UK, those with no qualification are more vaccine hesitant compare to those with some sort of qualification, and those with Advance level degree appears to be more receptive to vaccine than those with general secondary education, however degree holders showed the highest level of vaccine acceptance compare to those with less educational achievement and this agrees with the study done by Lin, Tu and Beitsch (2020), they discovered a growing gap between educational achievement and vaccine hesitancies in the United States; 42% of those with no degree shows vaccine receptiveness compare to 62% of college graduate, 72% of postgraduate degree holders among the studied population agreed to get the COVID-19 vaccine, this findings also confirms the study conducted by Sallam et al., (2021) in Jordan, Kuwait, Saudi Arabia were education level was directly proportion to vaccine receptiveness. These studies showing high vaccine acceptance with higher level of education correlate with other studies done (Freeman *et al.*, 2020; Pogue *et al.*, 2020; Reiter *et al.*, 2020; Thigpen, & Funk 2020; Ward *et al.*, 2020; Edwards *et al.*, 2021).

Furthermore, among the 19 countries studied by Lazarus et al., (2020), showed almost 98% consistencies with correlation between level of education to vaccine acceptance, those with higher education appears to be willing than those with low education, however, some countries like Canada, United Kingdom, Spain showed low educated participants to be more vaccine receptive than their highly educated counterparts. This trend is also consistent with the study done by Acheampong et al., (2021), out of the 2345 studied population in Ghana, 62% with senior secondary school degree compared to 59% with postgraduate degree showed vaccine receptiveness. The study done by Syed et al., (2021) and Harapan et al., (2020) also had less educated study participants more receptive to COVID-19 vaccine.

From the conceptual framework of this research according to Douglas *et al.*, (2017), education; which is both social motives and demography factor highly influences people's perception to believe in certain conspiracy theory. The result of this research showed that less educated participants are more vaccine hesitant due to high affinity for various conspiracy theories. The author believes that people with less education are vaccine hesitant due to inability to verify fake news and query certain illogical or unscientific assertions.

The author believes that using the same language, platforms and confined communication methods to reach out appears to naturally deny certain class of people access to such information. There are people who cannot read or understand the general formal language of communication except their local dialects; concerted efforts should be made to translate health related information to the local language people within a community can understand. It will be a challenging task to communicate in all languages especially in Africa due to the multilingual nature of the people; however, involving traditional leaders within a community will make it possible as they often have their community translators and town criers that can disseminate information without much hurdle.

Ethnic/Racial Correlations with COVID-19 Vaccine Hesitancies

The correlation of race and ethnicity has been an important factor when considering public health action plans (Carter-Pokras & Baquet 2002; Bowleg 2012). This study has shown correlations between ethnicity, race and vaccine hesitancies, in a UK study conducted by Robertson et al., (2021), Black ethnic minority both British and non-British showed the lowest vaccine acceptance, while White or Irish race had the highest vaccine acceptance, Asians also had above 55% vaccine acceptance rate. Thigpen & Funk (2020) conducted a study in USA among different race and ethnic group in respect to COVID-19 acceptance, Black ethnic group showed the highest vaccine hesitancy compare to the white non-Latinos and the White Latinos.

This trend was also observed in a study done by Malik et al., (2020), among America race and ethnic groups, 68% of both White majority and Hispanic agreed to take the vaccine, American Indian/Alaska native showed the highest level of vaccine acceptance accounting to 74%. While native Hawaiian and other Pacific Islander according to Malik et al., (2020) had 50% that agreed to get vaccinated, however Black Americans and Black ethnic groups from other Nations residing in America had the highest vaccine hesitancies of 60%.

Lack of trust for the vaccine according to Carter-Pokras and Baquet, (2002), has been the major drivers for Black ethnic group rejecting vaccination, all the reviewed literatures by the author showed consistency in COVID-19 vaccine acceptance in respect to ethnicity and race were Black ethnic group showed the highest which correlates with other studies see (Al-Mohaithef, & Padhi, 2020; Crane, 2020; Freeman *et al.,* 2020; Nguyen *et al.,* 2020; Razai *et al.,* 2020; Reiter *et al.*, 2020; Willis *et al.*, 2020; Kadambari & Vanderslott, 2021; Reid & Mabhala 2021; Syed *et al.,* 2021). Vaccine hesitancy has also showed different trends among same race in same nation but different region or ethnic affiliations, for example in a study conducted in Ghana by Acheampong et al., (2021) the 16 regions in Ghana showed differences in vaccine acceptance; 57.9% in Greater Accra, Savannah 54.55%, and the Upper West 65.10, Ahafo 45.41%, Northern 41.09%, Upper West 65.1%, Ashanti 54.7%, Bono 47.16% while Bono East 47.02%, Vota 42.09%. The study done in Botswana also saw different trends of vaccine acceptance among different ethnics' groups with vaccine receptivity more among urban dwellers see (Tlale *et al.,* 2022).

There is a major demographic factor in relation to vaccine hesitancies, the 10 reviewed literatures with other literatures cited by the author of this research showed consistencies of vaccine hesitancies with different races; black ethnic group showed the highest form of vaccine hesitancies compare to other racial or ethnic affiliations throughout the study.

The author believes that people will accept vaccines if they discover that the promoters have the same skin and hair colours with theirs. It has been observed that black race is more hesitant to vaccine; this may be due to the vaccine promoters coming from a different race further causing mistrust. Public health practitioners should be more diversified in engaging people from different race in the top management team, and also using highly influential persons within a race to promote vaccine safety this will see more black minorities becoming vaccine receptive.

Religion Affiliation with COVID-19 Vaccine Hesitancies

The literatures that took into cognisance vaccine hesitancy with religiosity were significant in their findings, with those whose religous belief opposes vaccination having higher vaccine hesitancy. Religion according to Rippentrop et al., (2005) play a significant role in the health of any population, COVID-19 vaccine acceptance was also influenced by religion believes and affiliations (Biswas *et al*., 2021; Milligan *et al.,* 2021). According to Compton (2019) and Eddy (2010) Christians rejects the use of vaccine due to the believe it will interfere with their faith on divine healing which is imbedded in motivated reasoning from the conceptual frame work of this research according to Douglas *et al.,* (2017), such beliefs are held tenaciously making any other explanations that contradicts such thinking false.

The claim that aborted foetal cells are used according to Hussain et al., (2018) and Diekema (2014) in the developmental stages of some vaccines also causes hesitancies among religious population. While some Muslims on the other hand according to Alzeer & Hadeed (2020), rejects vaccine due to believe that it is produced from forbidden products like gelatine Pork. The study in Botsawna according to Tlale et al., (2022) showed a correlation between COVID-19 vaccine acceptance and religiosity, it was observed that those whose religion do not preach against vaccines were more vaccine receptive, A study in Australia also showed this trend see (Edwards *et al.,* 2021). The researches done by Syed et al., (2021), and

Milligan et al., (2021) agrees that increased religiosity is inversely proportional to vaccine receptiveness.

Given that religion has strong hold on people, deliberate efforts must be taken to promote vaccine acceptance in a way that will appeal to their conscience and not confront their beliefs. Religion leaders which are often more trusted and respected than political leaders should be engaged by public health enthusiasts during vaccine promotions, they should be educated on the stages and components of vaccines and how clinically important it is to get vaccinated, when religion leaders are convinced, it will be easier for their members to believe that vaccine is not demonic nor unsafe.

Country of Residence with COVID-19 Vaccine Hesitancies

Several studies have showed that residents from some low-income countries are more likely to accept conspiracy theories which affect vaccine receptiveness (Bhopal & Nielsen 2021; Bono *et al.,* 2021). However, in a study conducted by Strupat et al., (2022) in Ethiopia a low-income country, saw 88% of the studied population showing willingness to be vaccinated and this high acceptance was based on trust of the government in power. A study conducted among some European countries by Neumann-Böhme et al., (2021), an average of 73% of the studied population agreed to get vaccinated. Lazarus et al., (2020) surveyed some Asian Countries and the lowest was Singapore 67.8%, previous studies have shown overall vaccine acceptance to be higher in Asia region see (Lane *et al.*, 2018). However, the trend with COVID-19 vaccine is not consistent by regions because some countries in Asia showed discrepancies in accepting COVID-19 vaccine compare to others, for example Kuwait and Jordan which are both Asia countries according to Sallam et al., (2021) have 28.4 and 23.6% respectively willing to take the vaccine.

Each nation's public health representative should be aware of its population's peculiarity and know the best ways to communicate with them. For example, religious leaders should be involved in vaccine promotion in Nigeria and other highly religious nations to increase the likelihood that the vaccine will be well received by locals. Some nations are also more multilingual than others, so different vaccine campaign translations should be made. Different ethnic and racial groups exist in different nations; these groups should be represented in the formulation and implementation of public health policies.

Limitations of the Study

From the articles reviewed by the author, various flaws in the studies have been recognized, which emphasized in this section. Firstly, this work focuses on 10 publications out of the many published articles, which is a limitation. The proportions of participants in some of the reviewed articles compared to the overall population in a country may not be enough to generalize the research outcome. Most of the studies used self-administered questionnaires and participants were recruited through online thereby restricting the studies to those that can read and write, exposed and living in big cities were access to internet is available. The reviewed literatures for this study were done at the earlier stage of the pandemic when the perceptions of people were tensed due to lockdown and different false information shared both physical and online this may have negatively impacted on the research outcome. The questionnaires from the reviewed literatures were all done in English language therefore the perceptions of those with other indigenous languages could not be accounted for.

Gaps in Knowledge

This research has identified a trend between level of education, age, gender, ethnicity/race, religiosity, and country of resident to vaccine hesitancies and has provided various recommendations for future vaccines campaigns to succeed.

Contributions to Practice

The results from this research indicates that there is an urgent need for global public health players to decentralised information sharing to communities by using different languages, channels and techniques to disseminate information. Public health advocates should also give proven scientific explanations to disease aetiology and the efficacies of recommended pharmaceutical and non-pharmaceutical methods for the prevention, treatment and management of subsequent infectious disease outbreaks. There should be concerted efforts to ensure people from different race/ethnicity are involved in top hierarchy of health administration this will help to build trust. Religion and social influencers should be engaged to be the major drivers of vaccines campaigns.

Conclusion

The COVID-19 pandemic impacted in almost all aspects of life. The pandemics further widen the mistrust that existed between countries and institutions such as seen between the US and China, the US and the WHO, North Korea and WHO this led to countries rejecting aides from their perceived enemies such as Iran refusing US aids, North Korea refusing to accept the existence of the virus and subsequent rejection of aides and vaccines from WHO and neighbouring South Korea, to mention but a few (DiResta *et al.*, 2020; Ebrahimi, Gassama, & bin Yusoff, 2020; Deudney & Ikenberry, 2021). Distrust between citizens and their governments, leading to several uprising across the globe; protesting against government measures such as sit at home policy, the use of face mask, social distancing etc. Political opponents as seen in several countries took advantage of the growing anxieties to plants citizens against the government of the day; there were alignments and re-alignments of citizens to political parties (Ezeibe *et al*., 2020; Lovari, 2020; Jennings *et al.*, 2021). The pandemics also resulted to global economic meltdown, several 5G towers were destroyed in UK leading to loss of millions of pounds by telecommunication companies, not taking into account the environmental hazards the flames from those burnt tower may have had on the environment (Bahja & Safdar, 2020; Liu *et al.*, 2020). The death toll from the pandemic is alarming, over 6 million deaths were recorded globally and over 500 million confirmed cases globally (WHO, 2022).

The mortality rate is not only based on the COVID-19 pandemic but on 'infodemics' which led to several hesitancies to pharmaceuticals and non-pharmaceutical measures from global health players see (Geldsetzer 2020; Iftekhar *et al.*, 2021; Wonodi *et al.*, 2022). The trends in vaccine hesitancies seems to be consistent from the several reviewed studies, females, low educated, younger age, Black minorities, and other minority ethnics groups appears to have higher percentage of believing in conspiracy theory and subsequent refusal of vaccines (Lazarus *et al.*, 2020; Acheampong *et al.*, 2021; Robertson *et al.*, 2021). The inception of internet according to Romero Meeder & Kleinberg (2011) changed the dynamics to information dissemination and gathering and during the early days of the pandemic, the internet according to Wilder-Smith & Freedman (2020), became the main source of information and unfortunately most of the information shared were conspiracies theories, this resulted to refusal of non-pharmaceutical and pharmaceutical measures prescribed by public health players (Zarocostas, 2020).

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References

Abalakina-Paap, M., Stephan, W.G., Craig, T. & Gregory, W.L., (1999). Beliefs in conspiracies. *Political Psychology*, *20*(3), 637-647.

Acheampong, T., Akorsikumah, E.A., Osae-Kwapong, J., Khalid, M., Appiah, A. & Amuasi, J.H., (2021). Examining vaccine hesitancy in Sub-Saharan Africa: a survey of the knowledge and attitudes among adults to receive COVID-19 vaccines in Ghana. *Vaccines*, *9*(8), p.814.

Ali, K.F., Whitebridge, S., Jamal, M.H., Alsafy, M. & Atkin, S.L., (2020). Perceptions, knowledge, and behaviors related to COVID-19 among social media users: cross-sectional study. *Journal of Medical Internet Research*, *22*(9), p.e19913.

Alzeer, J. & Hadeed, K.A., (2021). Halal certification of food, nutraceuticals, and pharmaceuticals in the Arab world. Handbook of healthcare in the Arab world, pp.765-787.

Andrade, G., (2021). Predictive demographic factors of Covid-19 vaccine hesitancy in Venezuela: A cross-sectional study. *Vacunas*.

Aschwanden, C., (2021). Five reasons why COVID herd immunity is probably impossible. *Nature*, pp .520-522.

Bahja, M. & Safdar, G.A., (2020). Unlink the link between COVID-19 and 5G networks: an NLP and SNA based approach. *IEEE Access*, *8*, 209127-209137.

Bhopal, S. & Nielsen, M., (2021). Vaccine hesitancy in low-and middle-income countries: potential implications for the COVID-19 response. *Archives of Disease in Childhood*, *106*(2), 113-114.

Biswas, M., Alzubaidi, M.S., Shah, U., Abd-Alrazaq, A.A. & Shah, Z., (2021). A scoping review to find out worldwide COVID-19 vaccine hesitancy and its underlying determinants. *Vaccines*, *9*(11), 1243.

Bloom, D.E., (2011). The value of vaccination. In *Hot topics in infection and immunity in children VII* (pp. 1-8). Springer, New York, NY.

Bono, S.A., Faria de Moura Villela, E., Siau, C.S., Chen, W.S., Pengpid, S., Hasan, M.T., Sessou, P., Ditekemena, J.D., Amodan, B.O., Hosseinipour, M.C. & Dolo, H., (2021). Factors affecting COVID-19 vaccine acceptance: an international survey among low-and middle-income countries. *Vaccines*, *9*(5), 515.

Bowleg, L., (2012). The problem with the phrase women and minorities: intersectionality—an important theoretical framework for public health. *American Journal of Public Health*, *102*(7), 1267-1273.

Bowman, K. & Goldstein, S., (2020). Giving Vaccines a Shot. *American Enterprise Institute (AEI): Washington, DC, USA*.

Braun, V. & Clarke, V., (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.

Brian, O., Lizette, N., Charles, N., Chika, P., Chiadichiem, C. & Ogechukwu, L., (2016). Impact of refugees and internally displaced persons on international health. *International Journal of Tropical Disease and Health*, *20*(1), pp.1-6.

Britton, T., Ball, F. & Trapman, P., 2020. A mathematical model reveals the influence of population heterogeneity on herd immunity to SARS-CoV-2. *Science*, *369*(6505), 846-849.

Bukhari, M.H., Syed, M. & Zain, S., (2021). The Differences between Traditional Vaccines and RNA Vaccines: Safety, Efficacy, Reliability and Future of COVID-19 Vaccines. *Annals of King Edward Medical University*, *27*(2).

Carter-Pokras, O. & Baquet, C., (2002). What is a" health disparity"?. *Public Health Reports*, *117*(5), 426.

Classen, J.B., (2021). COVID-19 RNA based vaccines and the risk of prion disease. *Microbiology Infectious Diseases*, *5*(1), 1-3.

Compton, J., (2019). "Inoculate Yourself with the Word of God": Persuasion Inoculation, Medical Inoculation, and Religious Rhetoric. *Journal of Media and Religion*, *18*(4), 115-121.

Consult, M., (2020). National Tracking Poll# 200395. *Morning Consult: Washington, DC, USA*, pp.1-38.

Cooper, S., van Rooyen, H. & Wiysonge, C.S., (2021). COVID-19 vaccine hesitancy in South Africa: how can we maximize uptake of COVID-19 vaccines?. *Expert Review of Vaccines*, *20*(8), 921-933.

Crane, M., (2020). Seven in 10 Americans Willing to Get COVID-19 Vaccine, Survey Finds. *Medical Xpress*.

Crescitelli, M.D., Ghirotto, L., Sisson, H., Sarli, L., Artioli, G., Bassi, M.C., Appicciutoli, G. & Hayter, M., (2020). A meta-synthesis study of the key elements involved in childhood vaccine hesitancy. *Public Health*, *180*, 38-45.

D'souza, G. & Dowdy, D., (2021). What is Herd Immunity and How Can We Achieve It With COVID-19? COVID-19| School of Public Health Expert Insights.

Davis, J., Mengersen, K., Bennett, S. & Mazerolle, L., (2014). Viewing systematic reviews and meta-analysis in social research through different lenses. *Springer Plus*, *3*(1), 1-9.

De Figueiredo, A., Simas, C., Karafillakis, E., Paterson, P. & Larson, H.J., (2020). Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. *The Lancet*, *396*(10255), 898-908.

DePoy, E. & Gitlin, L.N., (1993). Introduction to research: Multiple strategies for health and human services. St. Louis, MO: Mosby-Year Book.

Detoc, M., Bruel, S., Frappe, P., Tardy, B., Botelho-Nevers, E. & Gagneux-Brunon, A., (2020). Intention to participate in a COVID-19 vaccine clinical trial and to get vaccinated against COVID-19 in France during the pandemic. *Vaccine*, *38*(45), 7002-7006.

Deudney, D. & John Ikenberry, G., (2021). Misplaced Restraint: The Quincy Coalition Versus Liberal Internationalism. *Survival*, *63*(4), 7-32.

Diekema, D.S., (2014). Personal belief exemptions from school vaccination requirements. *Annual Review of Public Health*, *35*, 275-292.

DiResta, R., Miller, C., Molter, V., Pomfret, J. & Tiffert, G., (2020). *Telling China's Story: The Chinese Communist Party's Campaign to Shape Global Narratives*. Stanford Internet Observatory.

Douglas, K.M., Sutton, R.M. & Cichocka, A., (2017). The psychology of conspiracy theories. *Current Directions in Psychological Science*, *26*(6), 538-542.

Douglas, K.M., Uscinski, J.E., Sutton, R.M., Cichocka, A., Nefes, T., Ang, C.S. & Deravi, F., (2019). Understanding conspiracy theories. *Political Psychology*, *40*, 3-35.

Druckman, J.N., Ognyanova, K., Baum, M.A., Lazer, D., Perlis, R.H., Volpe, J.D., Santillana, M., Chwe, H., Quintana, A. & Simonson, M., (2021). The role of race, religion, and partisanship in misperceptions about COVID-19. *Group Processes & Intergroup Relations*, *24*(4), 638-657.

D'Souza, G. & Dowdy, D., (2021). Rethinking herd immunity and the covid-19 response endgame. *Johns Hopkins Bloomberg School of Public Health, September*, *13*.

Dubé, E., Gagnon, D., Nickels, E., Jeram, S. & Schuster, M., (2014). Mapping vaccine hesitancy—Country-specific characteristics of a global phenomenon. *Vaccine*, 32(49), 6649-6654.

Eaton, L., (2021). Covid-19: WHO warns against "vaccine nationalism" or face further virus mutations.

Ebrahimi, M., Gassama, S.K. & bin Yusoff, K., (2020). COVID-19: Threat and Response in Iran. *Iran and the Caucasus*, *24*(4), 423-443.

Echeverria-Londono, S., Li, X., Toor, J., de Villiers, M.J., Nayagam, S., Hallett, T.B., Abbas, K., Jit, M., Klepac, P., Jean, K. & Garske, T., (2021). How can the public health impact of vaccination be estimated?. *BMC Public Health*, 21(1), 1-12.

Eddy, M. B. (2010). *Science and health: With key to the scriptures*. The Christian Science Board of Directors: Distributed by the Christian Science Publishing Society.

Edwards, B., Biddle, N., Gray, M. & Sollis, K., (2021). COVID-19 vaccine hesitancy and resistance: Correlates in a nationally representative longitudinal survey of the Australian population. *PloS one*, *16*(3), e0248892.

Evans, M.B., Alexander, C., Barnard, E., Ezzati, M.M., Hill, M.J., Hoyos, L.R., Hariton, E., Mikhael, S., Penzias, A., Center, S.G.F. & Rockville, M.D., (2021). COVID-19 vaccine and infertility: Baseless claims and unfounded social media panic. *Fertility and Sterility*, *23*, 56 - 64.

Everson, S. ed., (1990). Epistemology (Vol. 1). Cambridge University Press. Pp. 781 – 794.

Evstatieva, M., (2020). Anatomy of a COVID-19 conspiracy theory. *NPR All Things Considered*.

Ezeibe, C.C., Ilo, C., Ezeibe, E.N., Oguonu, C.N., Nwankwo, N.A., Ajaero, C.K. & Osadebe, N., (2020). Political distrust and the spread of COVID-19 in Nigeria. *Global Public Health*, *15*(12), 1753-1766.

Fisher, K.A., Bloomstone, S.J., Walder, J., Crawford, S., Fouayzi, H. & Mazor, K.M., (2020). Attitudes toward a potential SARS-CoV-2 vaccine: a survey of US adults. *Annals of Internal Medicine*, 173(12), 964-973.

Freeman, D., Loe, B.S., Chadwick, A., Vaccari, C., Waite, F., Rosebrock, L., Jenner, L., Petit, A., Lewandowsky, S., Vanderslott, S. & Innocenti, S., (2020). COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. *Psychological Medicine*, 7, 1-15.

Fuchs, C., (2021). Bill Gates Conspiracy Theories as Ideology in the Context of the COVID-19 Crisis. In *Communicating COVID-19*. Emerald Publishing Limited.

Fumerton, R., (2009). Epistemology. John Wiley & Sons. *Personality and Individual Differences*, 166, 110201.

Gates, B., (2019). Bill Gates: The Best Investment I've Ever Made. *The Wall Street Journal*, *16*.

Geldsetzer, P., (2020). Knowledge and perceptions of COVID-19 among the general public in the United States and the United Kingdom: a cross-sectional online survey. *Annals of Internal Medicine*, *173*(2), 157-160.

Granmisterio, V.M., (2016). VIRUS ZIKA Toda la información y la patente de ROCKEFELLER, YouTube video.

Green, B.N., Johnson, C.D. & Adams, A., 2006. Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine*, 5(3), 101-117.

Grzesiak-Feldman, M., (2013). The effect of high-anxiety situations on conspiracy thinking. *Current Psychology*, *32*(1), 100-118.

Hacking, I., (2002). Historical ontology. In In the scope of logic, methodology and philosophy of science (pp. 583-600). Springer, Dordrecht.

Harapan, H., Wagner, A.L., Yufika, A., Winardi, W., Anwar, S., Gan, A.K., Setiawan, A.M., Rajamoorthy, Y., Sofyan, H. & Mudatsir, M., (2020). Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. *Frontiers in Public Health*, *8*, 381.

Harter, S.P., (1986). Online information retrieval: Concepts, principles, and techniques. Academic Press Professional, Inc..

Havey, N.F., (2020). Partisan public health: How does political ideology influence support for COVID-19 related misinformation?. *Journal of Computational Social Science*, *3*(2), 319-342.

Hickler, B., Guirguis, S. & Obregon, R., (2015). Vaccine special issue on vaccine hesitancy. *Vaccine*, 34(33), 4155-4156.

Hornsey, M.J., Lobera, J. & Díaz-Catalán, C., (2020). Vaccine hesitancy is strongly associated with distrust of conventional medicine, and only weakly associated with trust in alternative medicine. *Social Science & Medicine*, 255, 113019.

Hussain, A., Ali, S., Ahmed, M. & Hussain, S., (2018). The anti-vaccination movement: a regression in modern medicine. *Cureus*, *10*(7).

Iftekhar, E.N., Priesemann, V., Balling, R., Bauer, S., Beutels, P., Valdez, A.C., Cuschieri, S., Czypionka, T., Dumpis, U., Glaab, E. & Grill, E., (2021). A look into the future of the COVID-19 pandemic in Europe: an expert consultation. *The Lancet Regional Health-Europe*, *8*, 100185.

Imhoff, R. & Lamberty, P.K., (2017). Too special to be duped: Need for uniqueness motivates conspiracy beliefs. *European Journal of Social Psychology*, 47(6), 724-734.

Jegede, A.S., (2007). What led to the Nigerian boycott of the polio vaccination campaign?. *PLoS Medicine*, *4*(3), e73.

Jennings, W., Stoker, G., Valgarðsson, V., Devine, D. & Gaskell, J., (2021). How trust, mistrust and distrust shape the governance of the COVID-19 crisis. *Journal of European Public Policy*, *28*(8), 1174-1196.

Kadambari, S. & Vanderslott, S., (2021). Lessons about COVID-19 vaccine hesitancy among minority ethnic people in the UK. *The Lancet Infectious Diseases*, *21*(9), 1204-1206.

Kaler, A., (2009). Health interventions and the persistence of rumour: the circulation of sterility stories in African public health campaigns. *Social Science & Medicine*, *68*(9), 1711-1719.

Kant, R., Varea, R. & Titifanue, J., (2021). COVID-19 vaccine online misinformation in Fiji: Preliminary findings. *Pacific Journalism Review*, *27*(1/2), 47-62.

La Vecchia, C., Negri, E., Alicandro, G. & Scarpino, V., (2020). Attitudes towards influenza vaccine and a potential COVID-19 vaccine in Italy and differences across occupational groups, September 2020. *La Medicina del lavoro*, *111*(6), 445.

Lane, S., MacDonald, N.E., Marti, M. & Dumolard, L., (2018). Vaccine hesitancy around the globe: Analysis of three years of WHO/UNICEF Joint Reporting Form data-2015–2017. *Vaccine*, 36(26), 3861-3867.

Lantian, A., Muller, D., Nurra, C. & Douglas, K.M., (2017). I know things they don't know!. *Social Psychology*, 3(2), 81-86.

Larson, H.J., Jarrett, C., Eckersberger, E., Smith, D.M. & Paterson, P., 2014. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. *Vaccine*, 32(19), 2150-2159.

Lazarus, J.V., Ratzan, S., Palayew, A., Billari, F.C., Binagwaho, A., Kimball, S., Larson, H.J., Melegaro, A., Rabin, K., White, T.M. & El-Mohandes, A., (2020). COVID-SCORE: A global survey to assess public perceptions of government responses to COVID-19 (COVID-SCORE-10). *PloS One*, 15(10), e0240011.

Lin, C., Tu, P. & Beitsch, L.M., (2020). Confidence and receptivity for COVID-19 vaccines: a rapid systematic review. *Vaccines*, *9*(1), 16.

Lin, Y., Hu, Z., Zhao, Q., Alias, H., Danaee, M. & Wong, L.P., (2020). Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. *PLoS Neglected Tropical Diseases*, *14*(12), e0008961.

Liu, Z., Shan, J., Delaloye, M., Piguet, J.G. & Glassey Balet, N., (2020). The role of public trust and media in managing the dissemination of COVID-19-related news in Switzerland. *Journalism and Media*, *1*(1), 145-158.

Lovari, A., (2020). Spreading (dis) trust: Covid-19 misinformation and government intervention in Italy. *Media and Communication*, *8*(2), 458-461.

MacDonald, N.E., (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine*, 33(34), 4161-4164.

Malik, A.A., McFadden, S.M., Elharake, J. & Omer, S.B., (2020). Determinants of COVID-19 vaccine acceptance in the US. *EClinical Medicine*, *26*, 100495.

McNeil-Willson, R., (2020). Framing in times of crisis: Responses to COVID-19 amongst Far-Right movements and organisations. International Centre for Counter-Terrorism.

Miles, M.B. & Huberman, A.M., (1994). Qualitative data analysis: An expanded sourcebook. Sage.

Milligan, M.A., Hoyt, D.L., Gold, A.K., Hiserodt, M. & Otto, M.W., (2021). COVID-19 vaccine acceptance: influential roles of political party and religiosity. *Psychology, Health & Medicine*, 1, 1-11.

Mirza, S.A., Sheikh, A.A.E., Barbera, M., Ijaz, Z., Javaid, M.A., Shekhar, R., Pal, S. & Sheikh, A.B., (2022). COVID-19 and the Endocrine System: A Review of the Current Information and Misinformation. *Infectious Disease Reports*, *14*(2), 184-197.

Morris, R.S., (2021). SARS-CoV-2 spike protein seropositivity from vaccination or infection does not cause sterility. *F&S Reports*, *2*(3), 253-255.

National Academies of Sciences, Engineering, and Medicine, (2021). Strategies for building confidence in the COVID-19 vaccines.

Neumann-Böhme, S., Varghese, N.E., Sabat, I., Barros, P.P., Brouwer, W., van Exel, J., Schreyögg, J. & Stargardt, T., (2020). Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. *The European Journal of Health Economics*, *21*(7), 977-982.

Nguyen, L.H., Joshi, A.D., Drew, D.A., Merino, J., Ma, W., Lo, C.H., Kwon, S., Wang, K., Graham, M.S., Polidori, L. & Menni, C., (2021). Racial and ethnic differences in COVID-19 vaccine hesitancy and uptake. *MedRxiv*.

Nguyen, T., McBean, E., Martson, S. & Honorof, I., (2020). *Vaccines: The Biggest Medical Fraud in History* (Vol. 26). EnCognitive. com.

Oliver, J.E. & Wood, T., (2014). Medical conspiracy theories and health behaviors in the United States. *JAMA Internal Medicine*, 174(5), 817-818.

Pogue, K., Jensen, J.L., Stancil, C.K., Ferguson, D.G., Hughes, S.J., Mello, E.J., Burgess, R., Berges, B.K., Quaye, A. & Poole, B.D., (2020). Influences on attitudes regarding potential COVID-19 vaccination in the United States. *Vaccines*, *8*(4), 582.

Polack, F.P., Thomas, S.J., Kitchin, N., Absalon, J., Gurtman, A., Lockhart, S., Perez, J.L., Marc, G.P., Moreira, E.D., Zerbini, C. & Bailey, R., (2020). Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine. *New England Journal of Medicine*, 4(5), 81-88.

Preaud, E., Durand, L., Macabeo, B., Farkas, N., Sloesen, B., Palache, A., Shupo, F. & Samson, S.I., (2014). Annual public health and economic benefits of seasonal influenza vaccination: a European estimate. *BMC Public Health*, 14(1), 1-12.

Randolph, H.E. & Barreiro, L.B., (2020). Herd immunity: understanding COVID-19. *Immunity*, *52*(5), 737-741.

Rappuoli, R., Mandl, C.W., Black, S. & De Gregorio, E., (2011). Vaccines for the twenty-first century society. *Nature Reviews Immunology*, *11*(12), 865-872.

Razai, M.S., Osama, T., McKechnie, D.G. & Majeed, A., (2021). Covid-19 vaccine hesitancy among ethnic minority groups. *BMJ*, *372*.

Reid, J.A. & Mabhala, M.A., (2021). Ethnic and minority group differences in engagement with COVID-19 vaccination programmes–at Pandemic Pace; when vaccine confidence in mass rollout meets local vaccine hesitancy. *Israel Journal of Health Policy Research*, *10*(1), pp.1-9.

Reiter, P.L., Pennell, M.L. & Katz, M.L., (2020). Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated? *Vaccine*, *38*(42), 6500-6507.

Rippentrop, A.E., Altmaier, E.M., Chen, J.J., Found, E.M. & Keffala, V.J., (2005). The relationship between religion/spirituality and physical health, mental health, and pain in a chronic pain population. *Pain*, *116*(3), 311-321.

Robertson, E., Reeve, K.S., Niedzwiedz, C.L., Moore, J., Blake, M., Green, M., Katikireddi, S.V. & Benzeval, M.J., (2021). Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain, Behavior, and Immunity*, *94*, 41-50.

Romero, D.M., Meeder, B. & Kleinberg, J., (2011). Differences in the mechanics of information diffusion across topics: idioms, political hashtags, and complex contagion on twitter. In Proceedings of the 20th international conference on World wide web (pp. 695-704).

Rosselli, R., Martini, M. & Bragazzi, N.L., (2016). The old and the new: vaccine hesitancy in the era of the Web 2.0. Challenges and opportunities. *Journal of Preventive Medicine and Hygiene*, *57*(1), E47.

Safrai, M., Rottenstreich, A., Herzberg, S., Imbar, T., Reubinoff, B. & Ben-Meir, A., (2021). Stopping the misinformation: BNT162b2 COVID-19 vaccine has no negative effect on women's fertility. *medRxiv*.

Sajjadi, N.B., Nowlin, W., Nowlin, R., Wenger, D., Beal, J.M., Vassar, M. & Hartwell, M., (2021). United States internet searches for "infertility" following COVID-19 vaccine misinformation. *Journal of Osteopathic Medicine*, 121(6), 583-587.

Salali, G.D. & Uysal, M.S., (2020). COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the UK and Turkey. *Psychological Medicine*, 3, 1-3.

Sallam, M., Dababseh, D., Eid, H., Al-Mahzoum, K., Al-Haidar, A., Taim, D., Yaseen, A., Ababneh, N.A., Bakri, F.G. & Mahafzah, A., (2021). High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: a study in Jordan and Kuwait among other Arab countries. *Vaccines*, *9*(1), 42.

Salmon, D.A., Dudley, M.Z., Glanz, J.M. & Omer, S.B., (2015). Vaccine hesitancy: causes, consequences, and a call to action. *Vaccine*, 33, D66-D71.

Shen, S.C. & Dubey, V., (2019). Addressing vaccine hesitancy: Clinical guidance for primary care physicians working with parents. *Canadian Family Physician*, *65*(3), 175-181.

Smallman, S., (2018). Conspiracy theories and the zika epidemic. *Journal of International and Global Studies*, 7(5), 87-91.

Smith, B., (2012). Ontology. In The furniture of the world (pp. 47-68). Brill.

Stovold, E., Beecher, D., Foxlee, R. & Noel-Storr, A., (2014). Study flow diagrams in Cochrane systematic review updates: an adapted PRISMA flow diagram. *Systematic Reviews*, *3*(1), 1-5.

Strupat, C., Shigute, Z., Bedi, A.S. & Rieger, M., (2022). Willingness to take COVID-19 vaccination in low-income countries: Evidence from Ethiopia. *PloS one*, *17*(3), e0264633.

Suzman, M., (2020). Why we're giving $250 million more to fight COVID-19. *Bill & Melinda Gates Foundation*, *9*.

Syed Alwi, S.A.R., Rafidah, E., Zurraini, A., Juslina, O., Brohi, I.B. & Lukas, S., (2021). A survey on COVID-19 vaccine acceptance and concern among Malaysians. *BMC Public Health*, *21*(1), 1-12.

Tetlock, P.E., (2002). Social functionalist frameworks for judgment and choice: intuitive politicians, theologians, and prosecutors. *Psychological Review*, 109(3), 451.

Thelwall, M., Kousha, K. & Thelwall, S., (2021). Covid-19 vaccine hesitancy on English-language Twitter. *Profesional de la información (EPI)*, *30*(2).

Thigpen, C.L. & Funk, C., (2020). Most Americans expect a COVID-19 vaccine within a year; 72% say they would get vaccinated.

Thomas, E. & Zhang, A., (2020). *ID2020, Bill Gates and the Mark of the Beast: how Covid-19 catalyses existing online conspiracy movements*. Australian Strategic Policy Institute.

Thomas, S.J., Moreira Jr, E.D., Kitchin, N., Absalon, J., Gurtman, A., Lockhart, S., Perez, J.L., Pérez Marc, G., Polack, F.P., Zerbini, C. & Bailey, R., (2020). Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine through 6 months. *New England Journal of Medicine*, *385*(19), 1761-1773.

Tlale, L.B., Gabaitiri, L., Totolo, L.K., Smith, G., Puswane-Katse, O., Ramonna, E., Mothowaeng, B., Tlhakanelo, J., Masupe, T., Rankgoane-Pono, G. & Irige, J., (2022). Acceptance rate and risk perception towards the COVID-19 vaccine in Botswana. *PloS one*, *17*(2), e0263375.

Ullah, I., Khan, K.S., Tahir, M.J., Ahmed, A. & Harapan, H., (2020). Myths and conspiracy theories on vaccines and COVID-19: Potential effect on global vaccine refusals. *Vacunas*, 22(2), 93-97.

Ward, J.K., Alleaume, C., Peretti-Watel, P., Seror, V., Cortaredona, S., Launay, O., Raude, J., Verger, P., Beck, F., Legleye, S. & L'Haridon, O., (2020). The French public's attitudes to a future COVID-19 vaccine: The politicization of a public health issue. *Social Science & Medicine*, *265*, 113414.

Weinzierl, M.A. & Harabagiu, S.M., (2021). Automatic detection of COVID-19 vaccine misinformation with graph link prediction. *Journal of Biomedical Informatics*, *124*, 103955.

WHO (2020). Covid-19 updates (Online); https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports. (accessed April 23, 2022)

WHO (2022). Global COVID-19 report. https://covid19.who.int/ (Online) (Retrieved 23rd May, 2022)

Wilder-Smith, A. & Freedman, D.O., (2020). Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *Journal of Travel Medicine*, 1(5), 14-18.

Willis, D.E., Andersen, J.A., Bryant-Moore, K., Selig, J.P., Long, C.R., Felix, H.C., Curran, G.M. & McElfish, P.A., (2021). COVID-19 vaccine hesitancy: Race/ethnicity, trust, and fear. *Clinical and Translational Science*, *14*(6), 2200-2207.

Wiysonge, C.S., Ndwandwe, D., Ryan, J., Jaca, A., Batouré, O., Anya, B.P.M. & Cooper, S., (2022). Vaccine hesitancy in the era of COVID-19: could lessons from the past help in divining the future?. *Human Vaccines & Immunotherapeutics*, *18*(1), 1-3.

Wong, L.P., Alias, H., Wong, P.F., Lee, H.Y. & AbuBakar, S., (2020). The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. *Human Vaccines & immunotherapeutics*, *16*(9), 2204-2214.

Wonodi, C., Obi-Jeff, C., Adewumi, F., Keluo-Udeke, S.C., Gur-Arie, R., Krubiner, C., Jaffe, E.F., Bamiduro, T., Karron, R. & Faden, R., (2022). Conspiracy theories and misinformation about COVID-19 in Nigeria: Implications for vaccine demand generation communications. *Vaccine*, *40*(13), 2114-2121.

Yahya, M., (2007). Polio vaccines—"no thank you!" barriers to polio eradication in Northern Nigeria. *African Affairs*, *106*(423), 185-204.

Zarocostas, J., (2020). How to fight an infodemic. *The Lancet*, 395(10225), 676.

Zhu, H., Wei, L. & Niu, P., (2020). The novel coronavirus outbreak in Wuhan, China. *Global Health Research and Policy*, *5*(1), 1-3.

Zito, R., (2021). Vaccine Safety. *Journal of System Safety*, *57*(1), 10-25.