Chapter One

Introduction

1.1 Background of the Study

Coronavirus disease 2019 (COVID-19) which is famously called the novel Corona Virus Disease 2019 (Novel COVID-19), is a contagious and pathogenic viral infection that is believed to be caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and has in the past two years become a major public health issue ever since its outbreak in Hubei, Wuhan, China[1]. COVID-19 infection is transmitted through droplets from infected persons, or from direct contact with infected patients and it can also be transmitted by touching surfaces or objects that are contaminated with the virus[2]. As at Friday, 17th of June 2022, the Nigerian Center for Disease Control (NCDC) has tested 5,219,585 samples for COVID-19 infection, with 256,415 total confirmed cases, 3,123 active cases and 3,144 deaths recorded so far[3].

Pregnant women have been seen to be at a higher risk of severe illness and complications from COVID-19 when compared to women that are not pregnant, these was seen in a report gotten from the Centre for Disease Control (CDC) which showed that women that are pregnant were three times (3 times) more likely to be infected with COVID-19 and be admitted to the intensive care unit or require intubation and are also one and half times (1.5 times) more likely to die of complications from COVID-19 infection than women that are not pregnant[4]. Although pregnant women were initially not included during the trial stage of COVID-19 vaccine and also as treatment subject due to lack of enough information regarding safety, but more recently, pregnant and breastfeeding women have been included for vaccination with both messenger RNA (mRNA) vaccines and also with the adenovirus vector vaccines which has shown effectiveness and adverse effects were not reported in the pregnant women nor any neonatal outcome related to the vaccine's adverse effect was reported[5]. Studies has also shown that when pregnant women are

vaccinated against COVID-19, there is an efficient postvaccination transfer of antibodies (SARS-CoV-2 antibodies) through the placenta and also into the breastmilk which offers a reasonable degree of protection for the newborn against COVID-19 infection, thus, there is need for emphasis on COVID-19 vaccination during pregnancy with effective vaccination of pregnant women so as to protect them from COVID-19 infection. In this regard, In Nigeria, The National Agency for Food and Drug Administration and Control (NAFDAC) in 2021 gave approvalal for AstraZeneca/Oxford COVID-19 vaccine (ChAdOx1 nCoV-19) to be used for COVID-19 vaccination in the country and presently Pfizer among other vaccines brands have since gotten approval for use in Nigeria[5] [6].

Furthermore, Studies has shown that women that are pregnant are more likely to show hesitancy to COVID-19 vaccine when compared to women that are not pregnant or those that are breastfeeding even with the fact that pregnant women are faced with higher risk of COVID-19 infection [7]. The Strategic Advisory Group of Experts on Immunization (SAGE) of The World Health Organization (WHO) has described such vaccine hesitancy as "the delay in acceptance or refusal of vaccination" despite the availability of such vaccine and vaccination services in a region or within a particular group of people[8]. These COVID-19 vaccine hesitancy among pregnant women has most commonly been linked to lack of information and misinformation emanating from social media and other sources, which ends up misleading these pregnant women and the public at large about adverse effect caused by the COVID-19 vaccines to pregnant women, presumed lack of data that shows safety of the vaccine among pregnant women and also misinformation on fetal effect or harm to newborn[5]. Also, other factors that have been seen to influence the publics attitudes in general towards COVID-19 vaccines includes; cultural beliefs, knowledge, health literacy, religious and political views, lack of trust in the governments and also lack of trust in the companies producing the vaccines[2].

On the other hand, COVID-19 vaccine and other vaccines acceptance is said to be generally triggered by three parameters which includes: 1) Complacency; which describes the assumption that there is low risk of contracting a particular disease (COVID-19 infection in this case) and hence, vaccination is not essential and can be avoided, 2) Convenience; which has to do with the comfort that is provided to the populace in terms of accessing the vaccine, its affordability and also in terms of supply, and 3) Confidence; which describes the level of trust and conviction to how useful the vaccine and vaccination in general is[9]. In Nigeria, there was a growing distrust in government during the emergence of COVID-19 pandemic which initially resulted in the disbelief in the existence of COVID-19 with most people insinuating that it was a scam by the government, this lack of trust in government is one of the predicting factors for the acceptance of COVID-19 vaccine in the country. Although encouraging studies have shown that 0ne (1) in every two (2) Nigerian was willing to be vaccinated[10], much has not been done in respect to willingness or acceptance of COVID-19 vaccine among pregnant women in Nigeria.

1.2 Statement of the Problem

The COVID-19 pandemic of 2019 has claimed thousands of lives around the world and has created significant public health issues including disruption of the economy, overburdening the heath system in most countries, and precipitating mental health illness in many population groups with pregnant women having greater negative course. Although pregnant women were not part of the initial stage of COVID-19 vaccine trials, they have since been given approval for the Pfizer/BioNTech vaccine by the Food and Drug Administration (FDA) in early 2021 and the Center for Disease Control (CDC) and other organization has always recommended vaccination against COVID-19 infection in pregnant women[11]. And despite Studies in Nigeria and 17 other African countries on the effect of COVID-19 infection in pregnancy which found out that SARS-CoV-2 infection during pregnancy was highly associated with eclampsia, preeclampsia, higher

rates of admission at the intensive care unit (ICU), and maternal mortality when compared to women that are pregnant but not infected with the SARS-CoV-2 virus, pregnant women are still seen to show COVID-19 vaccine hesitancy which poses greater risk to them and their infants and will also create a barrier to preventing COVID-19 infection and its consequences[12]. Even with studies that has shown the safety of COVID-19 vaccine in pregnancy, African countries has generally reported lowest rate of COVID-vaccine acceptance[13].

1.3 Justification of the Study

The study would come up with findings that would bring better understand in the aspect of the knowledge of COVID-19 infection during pregnancy, the advantages of COVID-19 vaccine to pregnant women and also help to understand the main factors that leads to COVID-19 vaccine acceptance and hesitancy among pregnant women in Ibadan, Oyo State, Nigeria.

These findings would help healthcare workers especially those working in primary healthcare centers come up with more effective measures that will improve COVID-19 vaccine knowledge and acceptance among pregnant women receiving antenatal care in healthcare facilities in Ibadan and across the country in general. The findings would also be of great benefit to health policy makers and health planners as it could serve as a guide to identifying areas which needs attention, improvement and/or support programs that will aim at improve the health of pregnant women in an era of COVID-19.

Lastly, more research needs to be carried out in this field as there exist limited information to regards the acceptance and hesitancy of COVID-19 vaccine among pregnant women.

1.4 Aim and Objectives of the Study

The aim of this study is to determine the level of knowledge, acceptance and hesitancy to COVID-19 vaccine among pregnant women that are visiting primary healthcare centers in Ibadan for their antenatal

The specific Objectives of this study were to determine the:

i. Level of knowledge of COVID-19 vaccine among pregnant women attending antenatal clinic in primary healthcare centers in Ibadan.
ii. Attitudes towards COVID-19 and COVID-19 vaccine among pregnant women attending antenatal clinic in primary healthcare centers in Ibadan.
iii. Level of acceptance of COVID-19 vaccine among pregnant women attending antenatal clinic in Primary healthcare centers in Ibadan.
iv. Factors associated with COVID-19 vaccine acceptance among pregnant women attending antenatal clinic in Primary healthcare centers in Ibadan.

1.5 Research Question

The Following research questions were answered in this study;

1. What is the level of knowledge of COVID-19 vaccine among pregnant women attending antenatal clinic in PHCs in Ibadan?
2. What is the level of attitudes towards COVID-19 and COVID-19 vaccine among pregnant women attending antenatal clinic in PHC's in Ibadan?
3. What is the level of COVID-19 vaccine acceptance among pregnant women attending antenatal clinic in PHCs in Ibadan?
4. What are the factors associated with COVID-19 vaccine acceptance among pregnant women attending antenatal clinic in PHCs in Ibadan?

1.6 Significance of the Study

This study will investigate the knowledge, prevalence and extent of COVID-19 vaccine acceptance and hesitancy among pregnant women in Ibadan and will also look to understanding the various factors that influence their decision. Thus, the findings from this study would serve as a reference tool in the planning and implementation of COVID-19 immunization programs that will increase COVID-19 vaccine acceptance among pregnant women and as well reduce its hesitancy to the barest minimum among pregnant women.

This research work would also serve as a database for future researches in the public health field and other related fields of study pertaining to pregnant women and vaccination in an era of COVID-19. The findings in this study will also be of great value and importance to various stakeholders in healthcare system, the health administrators, health policy makers, health educators, public health practitioners and to the consumers of healthcare services.

1.7 Scope of the Study

The study will be limited to pregnant women attending antenatal clinic in primary health\care centers in Ibadan. However, there will be age limitation as the study will involve only pregnant women that are within the child bearing age of 15 to 49 years attending antenatal clinic at these primary healthcare centers in Ibadan.

1.8 Limitation of the Study

This study covers some part of Ibadan metropolis only and thus, a limitation lies on the generalizability of its findings as it may not represent the diverse Nigerian population.

The study did not look into the impact of cultural and religious beliefs on vaccine acceptance among pregnant women which could a contributing factor to vaccine hesitancy among the study population.

Also, data that were used in this study were self-reported data which may be affected by recall bias and social desirability.

Another limitation in this research is the fact that the research was a cross-sectional study and by so being, the findings in the research did not give or show relationships between causes and effects.

1.9 Operational Definition of Terms

Antenatal: This means or refers to the period from when a woman that is pregnant engages the services of licensed healthcare providers to when she gives birth to her baby (infant)[14].

Vaccines: Vaccines are substances which contains inactive, weakened or killed, agents gotten from toxins of the causative organism or other biological formulations consisting of antibodies or messenger RNA (mRNA) which is administered to stimulate immunity against a disease[15].

Vaccination: Vaccination is a process of administering a vaccine to help the body's immune system develop an immunity from a particular disease[16].

Immunity: Immunity refers to the body's ability to tolerate the existence (presence) of native (indigenous) material while eliminating foreign substances. The immune system is a complex system consisting of communicating cells that discriminatory performs the function of eliminate foreign substances[17].

Vaccine hesitancy: Vaccine hesitancy is simply defined as any delay that comes from accepting or refusing to accept a vaccination despite the availability of the vaccine and vaccination services[18].

Virus: A virus is a microorganism that is infectious in nature and consisting of segment(s) of nucleic acid which could either be DNA (deoxyribonucleic acid) or RNA (ribonucleic acid) and is surrounded by a coat made of protein. viruses do not replicate on its own, but will infect cells of host bodies and will make use of components in the body cells to replicate itself[19].

Gravity: The term gravidity is used in human medicine to refer to the number of times a woman (female) has been pregnant before and regardless of whether the pregnancies were interrupted at any point or the pregnancy resulted in a live birth. Thus, gravidity means the total number of pregnancies, which is regardless of outcome[20].

Parity: The term parity is also used in human medicine to refer to the number of times a woman (female) has given birth to a live neonate at any gestation or at twenty-four weeks (24 weeks) or more and is regardless of whether the child was viable or non-viable. Parity means the total number of live births[21].

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Chapter Two

Literature Review

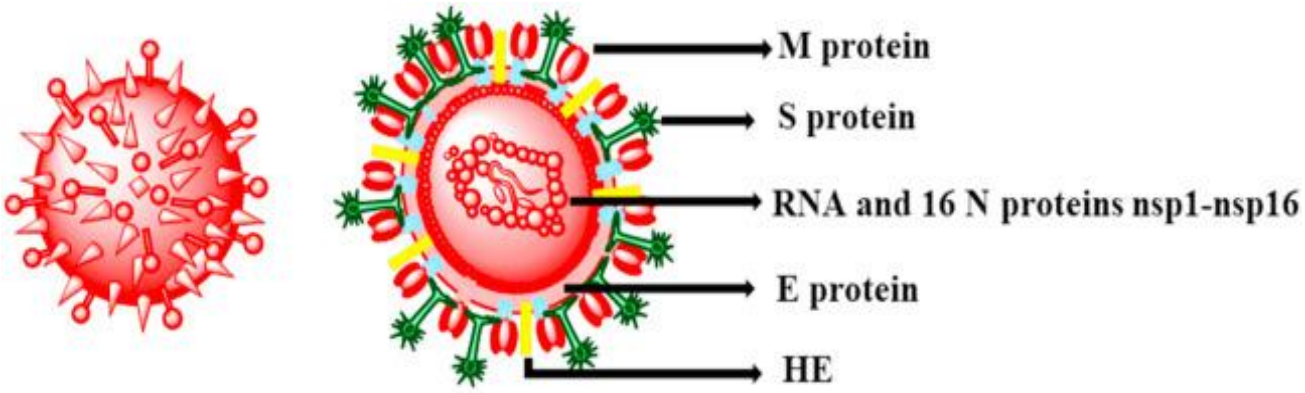
In this chapter, previous work done by other researchers which has relevance to this study will be presented and reviewed. A theoretical framework, theoretical review, empirical review, literature evaluation, and conceptual model were used to conduct the review of related and significant literatures.

2.1 Conceptual Review

2.1.1 Concept of COVID-19

COVID-19 (Coronavirus disease 2019) which is a clinical condition that is believed to be caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a new coronavirus that first appeared in Wuhan, Hubei province, China in December 2019 and then spread quickly throughout the world. Scientists have argued over the origin of the new coronavirus SARS-CoV-2 ever since it was discovered. It has been suspected that SARS-CoV-2 was created by manipulations in a laboratory. Genetic evidence, however, contradicts this hypothesis and reveals that SARS-CoV-2 did not originate from a previously recognized virus backbone[1]. On March 11, 2020, the World Health Organization (WHO) proclaimed it to be a pandemic. The SARS-CoV-2 is a beta-coronavirus, also in the past, the Middle East respiratory syndrome coronavirus (MERS-CoV) and the severe acute respiratory syndrome coronavirus (SARS-CoV) which are of public health importance are both beta-coronaviruses that have caused fatal infections throughout the past 20 years. Full genome sequencing has revealed that this virus, which is an enclosed, positive-sense, single-stranded RNA virus with a nucleocapsid, is closely linked to SARS-CoV, with which it shares roughly 79 percent (79%) of its genome[2]. According to the World Health Organization (WHO), COVID-19 is the fifth pandemic in the last ten decades. SARS-CoV-2 has spread to over 213 countries and 2 international ships around

the world. According to the previous report that is publicly available in their domain regarding the genesis of the virus, it was said that an unknown pneumonia-like disease was reported in Wuhan, China in December 2019. Later, the Centers for Disease Control and Prevention (CDC) diagnosed an infected person's throat swab, and the causative agent was named 2019-nCoV (Corona Virus) by the World Health Organization (WHO) in January 2020. On February 20, 2020, the agent causing the disease was named "COVID-19"[3].



S protein: Spike Glycoprotein having two subunits (S1 & S2)
M protein: Membrane protein
N protein: nuclear Protein
E protein: Envelope Protein
HE: Hem-agglutinin Esterase dimer

Figure 2.1: Structural elucidation of Coronavirus

Source: [3]

Origin and Classification of Coronavirus

COVID-19 (SARS-CoV) is a member of the Coronaviridae family and Nidovirales order. The family is made up of two sub-families;

1) Coronavirinae and
2) Torovirinae.

The members in the sub-family Coronavirinae which COVID-19 belongs to are further subdivided into four different genera:

a) Alphacoronavirus which contains the human coronavirus (HCoV)-229E and HCoV-NL63
b) The Betacoronavirus which includes HCoV-OC43, Severe Acute Respiratory Syndrome human coronavirus (SARS-HCoV), HCoV-HKU1, and Middle Eastern respiratory syndrome coronavirus (MERS-CoV)
c) The Gammacoronavirus which includes viruses of whales and birds and lastly
d) Deltacoronavirus which includes viruses that were isolated from pigs and birds.

The Coronavirus disease 2019 (COVID-19) which is SARS-CoV-2 belongs to Betacoronavirus together with two (2) other highly pathogenic viruses, which are Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV)[4].

COVID-19 Reservoir

Since SARS-CoV-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses, bats may be the major reservoir, according to genomic study. However, it is unknown where the intermediary source of origin and transfer to humans originated. The coronavirus disease 19 (COVID-19) is highly transmittable and it is a pathogenic viral infection with rapid human to human transmission which has been confirmed widely[5].

Mode of Transmission of COVID-19

Recent experimental studies on the stability of SARS-CoV-2 have demonstrated that the virus can survive for hours in aerosols and for days on surfaces before losing its infectious capacity. Temperature, humidity, microbial tolerance to external physical and biological challenges, and solar ultraviolet (UV) radiation are some of the factors that probably affect microbe survival and delivery in the air. The size and concentration of inhaled aerosols, which determine the quantity and pattern of respiratory deposition, affect the transmission and infectiousness of airborne viruses. When COVID-19 viruses are inhaled through the nose as is customary, they are continuously and directly deposited into the human respiratory tract, where they cause an infection with the SARS-CoV-2 virus[6].

The principal mode of transmission with SARS-CoV-2 is through exposure to respiratory fluids and droplets carrying infectious virus. Exposure can occur in three principal ways:

1) When very small respiratory droplets and aerosols are inhaled.
2) Direct splashes and sprays that deposit respiratory droplets and particles on exposed mucous membranes in the mouth, nose, or eye, and
3) By touching mucous membranes with hands that have been contaminated by respiratory secretions that contain viruses, either directly or indirectly, such as through touching surfaces that have viruses on them.

When breathing, speaking, singing, coughing, sneezing, etc., humans emit respiratory secretions in the form of droplets that range widely in size. These droplets spread infection and carry virus with the following traits.

a) Within seconds to minutes, the biggest raindrops quickly vanish from the atmosphere.

b) The tiniest very fine droplets, as well as the aerosol particles produced when these tiny droplets quickly dry, are so small that they can float in the air for a number of minutes to many hours.

Exposures to infectious respiratory fluids or droplets that are carrying SARS-CoV-2 can occur in three ways:

1. Inhaling air containing infectious virus-carrying aerosol particles and very minute, thin droplets. Within three to six feet of an infectious source, where the quantity of these extremely small droplets and particles is highest, there is the greatest risk of transmission.
2. Depositing of virus onto exposed mucous membrane by inhaled droplets and particles. Additionally, the proximity to an infectious source, where these inhaled droplets and particles are concentrated, increases the risk of transmission.
3. Touching mucosal membranes with hands that have been contaminated by exhaled respiratory fluids or after touching inanimate objects that have been exposed to virus-infected surfaces[7].

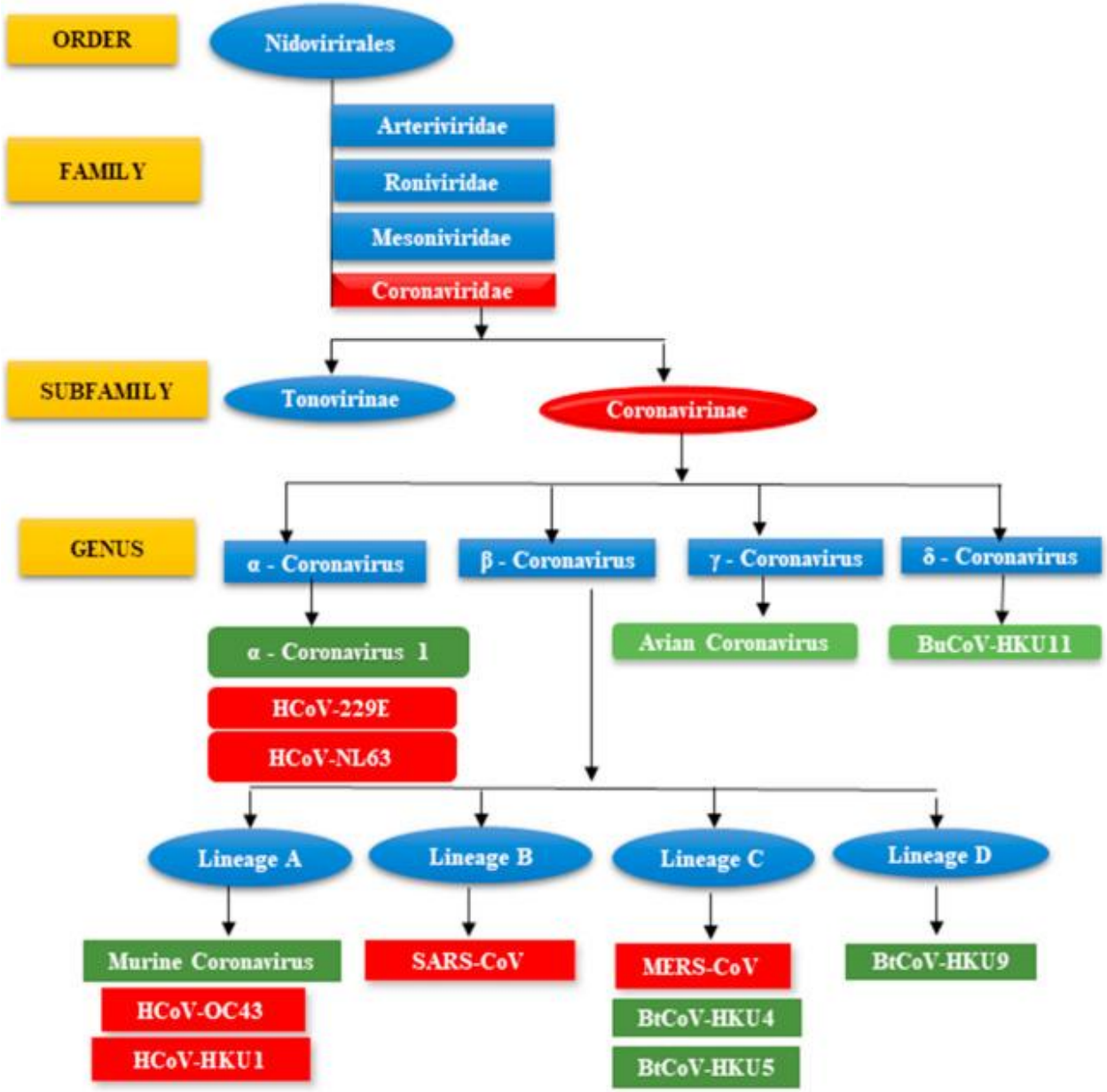


Figure 2.2: Taxonomy/classification of SARS-CoV.

Source: [3]

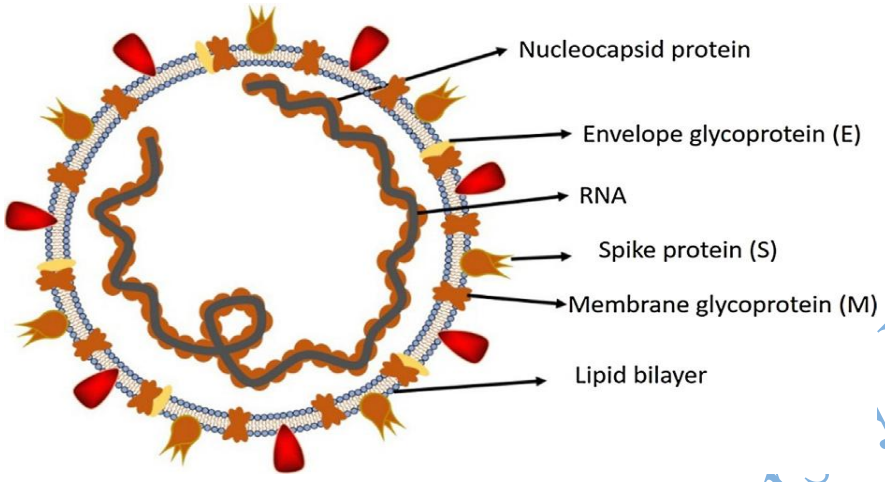


Figure 2.3: Structure of respiratory syndrome causing coronavirus

Source: [5]

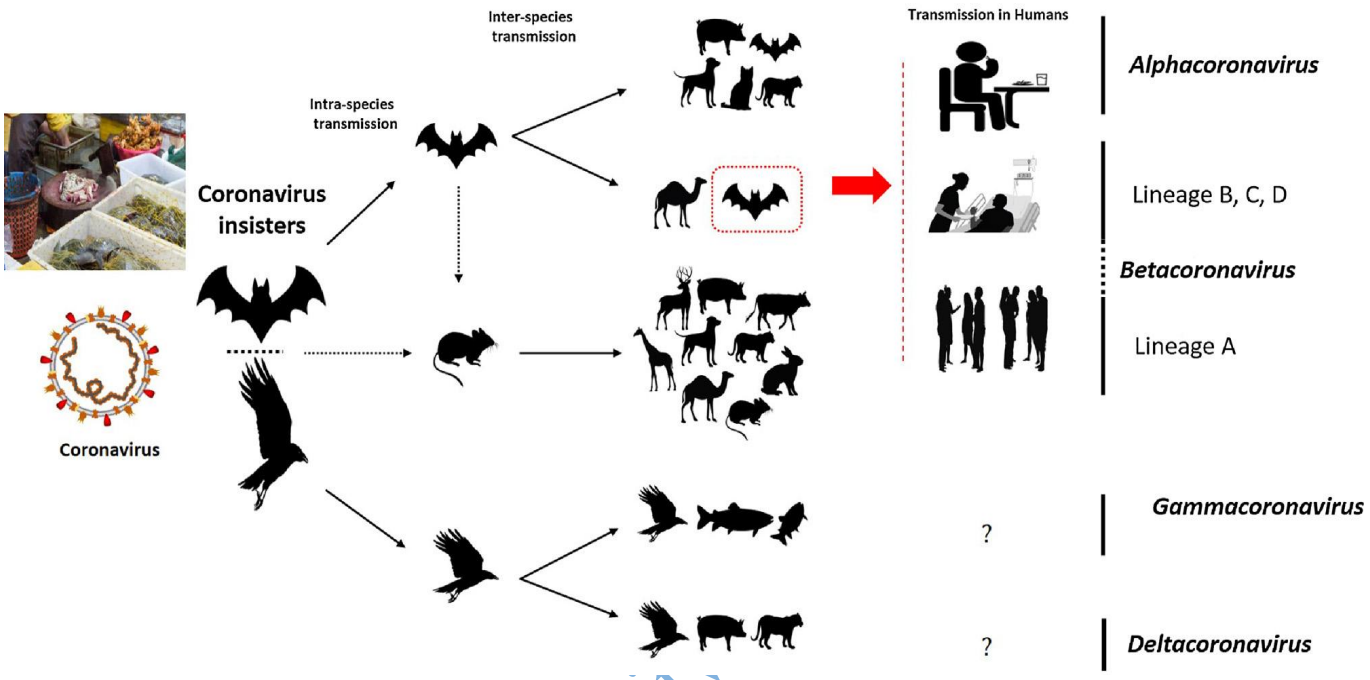


Figure 2.4: Classification, key reservoirs and mode of transmission of coronaviruses.

Source: [5]

Symptoms of COVID-19

Although COVID-19's clinical symptoms are not unique, they are comparable to those of numerous viral diseases. The majority of people experience symptoms, which can range from mild to extremely severe and even fulminant disease, after an incubation period of 4 to 14 days. Cough, fever, fatigue, anorexia, and myalgias are the most typical symptoms, though anosmia and dysgeusia, which are frequently observed and thought to be typical but not exclusive to COVID-19, are also thought to be common. There are also reports of a sore throat, headaches, and rhinorrhea. In some patients, gastrointestinal symptoms like nausea, diarrhea, and accompanying abdominal pain may appear before respiratory symptoms. Individuals who test positive for COVID-19 may not have any symptoms. The majority of patients, however, will have mild to moderate disease, and about 30% of patients may experience dyspnea around day five (day 5) after the disease starts. Patients with a more severe form of the disease frequently deteriorate during the second week of their illness. Hospitalization is frequently necessary for these patients[8].

Treatment of COVID-19

Because the efficacy of available antiviral drugs is unknown, the standard of care, particularly for people with mild to moderate disease, is centered on transmission prevention. Close monitoring is essential for patients being managed at home, and escalation of care is required as soon as deterioration occurs. The evidence on the risk of increased viral replication versus the anti-inflammatory advantages of corticosteroids is inconclusive. Also, to avoid aerosol-generating processes that could potentially increase the airborne viral spread, inhalers are preferred over nebulized therapies. Nonsteroidal anti-inflammatory drugs (NSAIDs) are thought to influence the levels of ACE2 receptor proteins in epithelial cells, potentially increasing viral infection[9]. As a result, the use of NSAIDs for relieving symptoms is tailored to the individual. Due to the increased risk of

bleeding and renal injury associated with NSAIDs, the European Medicines Agency (EMA) as well as the World Health Organization (WHO) do not recommend that NSAIDs be avoided, and the use of acetaminophen is generally preferred in hospital settings. The use of ACE inhibitors and angiotensin-converting enzyme inhibitors has also been debated. However, the American Society of Cardiology and also the European Society of Cardiology do not currently recommend starting or stopping these agents. Antiviral and other anti-inflammatory therapies are administered to COVID-19 patients on a case-by-case basis, through consultation with infectious disease specialists as part of a clinical trial. Patients with moderate to severe illness often benefit from oxygen supplementation, and those with acute respiratory failure frequently require noninvasive and invasive mechanical ventilation. Positive airway pressure (PAP) is used with the understanding that it is an aerosol-generating procedure that necessitates a higher level of personal protective equipment (PPE) for healthcare providers[8].

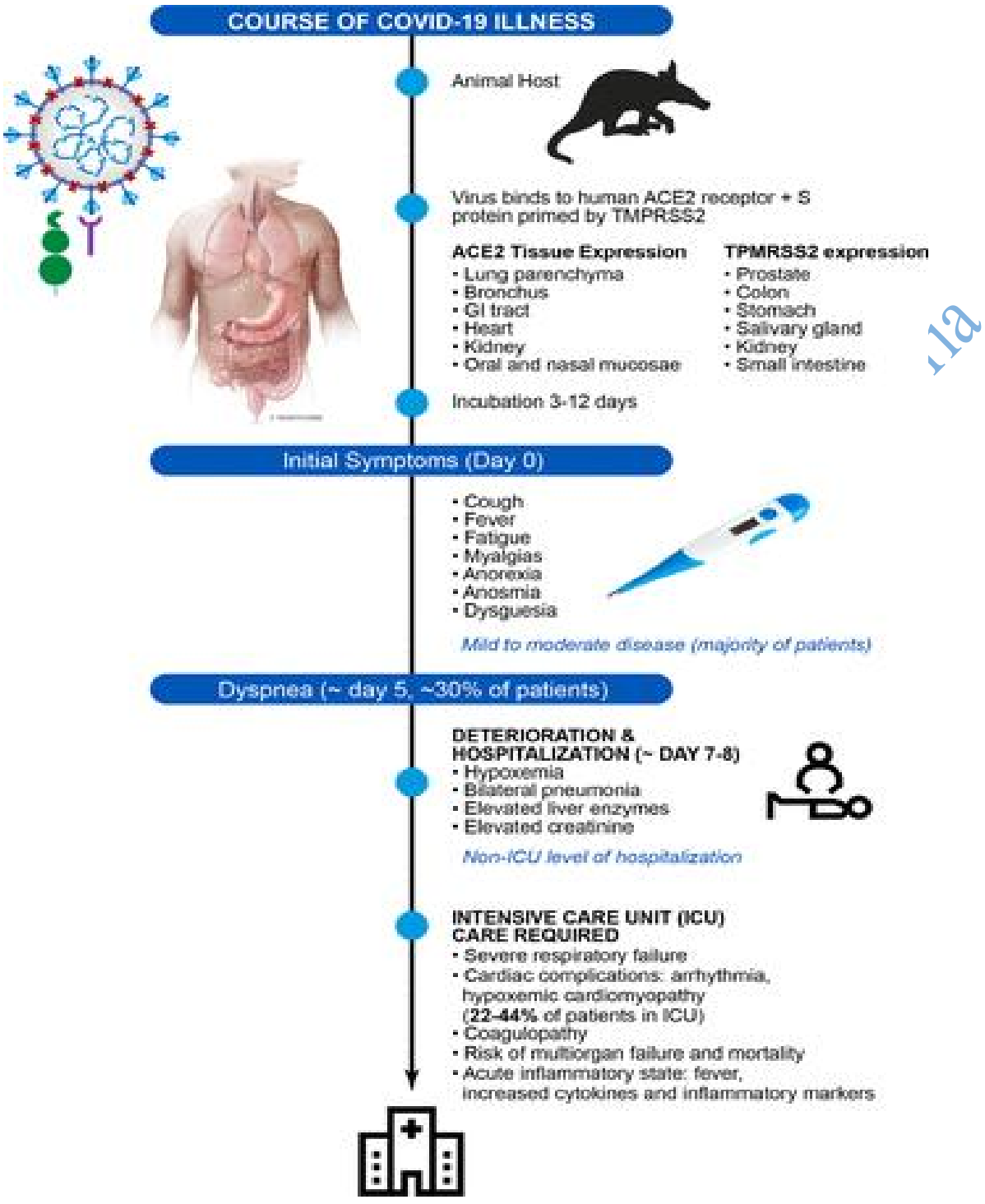


Figure 2.5: A visual representation of the course of COVID-19 illness.

Source: [8]

2.1.2 Emergence of COVID-19 in Nigeria

On Friday, January 28, 2020, Nigeria announced the first verified case of COVID-19 disease in Sub-Saharan Africa. The country's National Coronavirus Emergency Operation center was immediately activated as a result of this confirmation. On February 25, 2020, an Italian male who had just entered the nation reported having COVID-19 two (2) days after, making it the first COVID-19 confirmed case in Nigeria. The Italian national who was reported to be Nigeria's first case of coronavirus disease 2019 (COVID-19) on February 27, 2020 arrived in Lagos, Nigeria, two (2) days earlier on a flight from northern Italy, and had since traveled from Lagos to Ogun State, western Nigeria, where he fell ill and was immediately quarantined. In a hospital in Lagos, where he received treatment for minor COVID-19 symptoms. The National Emergency Operations Centers that were promptly created tracked down the contacts of the index case discovered. Twenty-seven (27) probable cases had been located across five states as of 9th March 2020, of which two (2) had been verified as positive, however there had been no fatalities. There were 1,216 contacts linked to the index case, and 136 of them were being tracked down. This explains why putting strict detection, prevention, and control mechanisms in place is essential for African nations to manage local COVID-19 transmission following importation. Nigeria demonstrated its capability by stepping up its COVID-19 import preparedness, building on recent successes in polio and Ebola epidemic containment. These encounters improved the ability of the health system to, among other things, quickly deploy high-quality surveillance and temperature screening at airports using equipment obtained during the Ebola epidemic; gather contact information from passengers and interview those arriving from COVID-19 hotspots; and issue travel bans across the country among other measures and policies[10].

The World Health Organization (WHO) declared the epidemic a Public Health Emergency of International Concern on January 30, 2020. As of June 18, 2020, Nigeria has tested 106,006 samples, of which 17, 735 had been confirmed as positive, with 11,299 of the positive cases being active as at

the time, with 5967 discharged cases and 469 individuals confirmed dead from the infection[11]. And of recent, the COVID 19 data from the Nigerian Center for Disease Control (NCDC) as at Monday, 11th July 2022 gave the total number of tested samples to be 5,313,596, with 258,517 total confirmed cases, 4,985 active cases and 3,144 deaths recorded[12].

2.1.3 Epidemiology of COVID-19 Infection

Numerous coronaviruses exist, the majority of which are spread by camels, cats, snakes, pangolins, and pigs. The majority of human coronaviruses only result in the common cold. Two other zoonotic coronaviruses that underwent species passage and caused several outbreaks before the SARS-CoV-2 pandemic are the Middle East Respiratory Syndrome coronavirus (MERS-CoV), that was discovered on the Arabian Peninsula in 2012, and the SARS-CoV, which first appeared in China at the end of 2002 and was discovered in Hong Kong in 2003. SARS-CoV-2, the agent responsible for the current epidemic, first appeared in China in late 2019 and spread fast to the rest of the world. The initial strain of Wuhan SARS-CoV-2, which is what causes COVID-19, most likely came from bats. It is spread by close contact between asymptomatic, pre-symptomatic, and also symptomatic people who have been exposed to contaminated droplets and, to a smaller extent, aerosols. The Omicron variant, formerly known as B.1.1.529, and the Delta variant, formerly known as B.1.617.2, have recently spread throughout the world due to the increasing transmissibility and increased rates of pre-symptomatic and asymptomatic transmission. These variants were produced as a result of genetic recombination within infected cells s. Infection in humans due to SARS-CoV-2 could be asymptomatic or can lead to symptoms that vary in severity that could be from mild common cold to critical respiratory ailments, such as pneumonia and acute respiratory distress syndrome. More frequently among older people with comorbidities and frailty, severe and acute symptoms, frequently associated with catastrophic results, manifest themselves[13].

The crossing over of animal β-Coronaviruses has led to severe diseases in humans over the last two decades. The first case of Coronavirus was recorded in 2002-2003, and the second, COVID-19, is the world's largest outbreak to date. Higher number of pneumonia patients were reported in the Wuhan Sea food market in December 2019. Following that, the Centers for Disease Control (CDC) examined a throat swab from an infected person; the World Health Organization (WHO) identified it as a novel Coronavirus in 2020, and the disease was given the name COVID-19 on February 11th. WHO also declared the outbreak to be the fifth pandemic in the previous ten (10) decades. Infected people have developed pneumonia, severe acute respiratory syndrome, and a variety of other serious complications. Coronavirus has been highly pathogenic and virulent to humans for the past two decades. This pandemic has caused moderate respiratory illness in infected people, necessitating special treatments, and has primarily targeted the elderly or people suffering from medical emergencies such as diabetes, cancer, chronic respiratory diseases, and cardiovascular disease[3].

In late September 2020, there were 1 million recorded COVID-19 deaths. The total mortality rates vary significantly between nations and regions. Early October 2020 found that 17 countries had more than 50 deaths per 100,000 people, compared to 66 that had fewer than one death per 100,000 people. These striking contrasts, which reflect enormous variation in viral dissemination, significant variation in infection fatality rate (IFR), and both under- and over-counting of deaths across regions, are largely factual. Some COVID-19 deaths continue to go unrecorded due to insufficient testing. On the other hand, several nations might include some false COVID-19 deaths. Death certificates are frequently inaccurate in general, and with COVID-19, it could make them even more prone to error[14].

As at 18 July 2022, the global confirmed COVOID-19 cases were recorded as 559,469,605 cases with a total of 6,361,157 deaths record globally[15]. In Nigeria, as at Monday, 11th of July 2022, the Nigerian Center for Disease Control (NCDC) has tested 5,313,596 samples for COVID-19 infection, with 258,517 total confirmed cases, 4,985 active cases and 3,144 deaths recorded so far[12].

When compared to countries from Africa, the COVID-19 infection in Spain and Italy was very severe. The virus's impact in Italy and other member states of the European Union was particularly severe for a number of reasons. First, there was hesitation to implement the "stay-at-home" isolation rule as well as a delay in analyzing the circumstances that contributed to the virus's spread. The public was not provided with enough information by the decision-makers. People were unable to respond to the epidemic in a proper manner due to lack of effective communication and knowledge. Additionally, Italy and Spain have a high number of senior citizens and older people are more fatally affected by the illness. This is because older individuals already have weaker immune systems, making them more susceptible to the virus's effects[16].

2.1.4 The Economic Impact of COVID-19

As the pandemic reached its apex, governments around the world hoped to flatten the curve and made efforts to persuade citizens to abide by directives to refrain from traveling and stay at home. To stop the virus from spreading, so many nations even locked their international borders. The entire economy was severely shaken by the coronavirus outbreak. Around 3.8 percent less European nations' GDP was produced in the first quarter of 2020. Therefore, in order to help the nation to emerge from the crisis, the government would have to develop a carefully thought-out economic strategy. Due to travel restrictions and flight cancellations made in an effort to lessen the impact of the coronavirus, the COVID-19 pandemic has had a significant negative impact on the airline sector. A significant slowdown was experienced by the aviation sector as well as airports all over the world due to a lack of air traffic and a decline in revenues. Additionally, the Organization of the Petroleum Exporting Countries (OPEC) and its affiliates' negotiations were disrupted as a result of the COVID-19 pandemic shock and the decline in oil prices. A 1.5 million barrel per day (mb/d) reduction in output for the second quarter of 2020 was scheduled by OPEC on March 5, 2020. A few nations were attempting to emerge from lengthy lockdowns as a result of the COVID-19 pandemic, while others

had the stay-at-home order in place to stop the spread of the coronavirus. It was unclear whether tourist locations in Europe or North America will have enough visitors to sustain the local industries, causing the COVID-19 pandemic to have a long-lasting impact on global tourism. The financial markets showed signs of risk, volatility, and uncertainty around the end of February 2020. The equity markets experienced a sudden fall, losing around 30% of their market value in a matter of weeks. This sell-off speed was greater than that of the Global Financial Crisis (GFC), which took place in 2008–2009. In addition, the COVID-19 pandemic control measures urged individuals to remain at home during a lockdown, so those who would often seek medical attention are now at home. Additionally, due to their fear of contracting the illness, people prefer to avoid visiting medical facilities[16].

In its 2020 report, the International Monetary Fund (IMF) noted that the COVID-19 epidemic is causing the worst global economic depression since the Great Depression. Following the IMF's lead, Oxfam International issued a 2020 report warning that the COVID-19 epidemic might cause 500,000 people to fall into poverty. With special reference to Nigeria, the research raises the topic of how the pandemic is harming Nigeria's economy. A quick study at the Nigerian economy reveals that COVID-19 had three key effects. The three effects are all extremely catastrophic. With their mutually reinforcing nature, the three of them together can pose a severe threat to any economy. The three major impacts include;

1) In Nigeria, COVID-19 has resulted in economic hardship due to the loss of jobs and other sources of income. As the lockdown wreaked havoc on small and medium-sized businesses, many workers were laid off or forced to work on reduced hours.
2) As a result of the circumstance, the Nigerian economy has been steadily sliding into recession. It is more difficult for Nigeria because the country is still sluggishly trying to emerge from the 2016 economic recession, which was brought on by the collapse of the global oil price and a lack of foreign exchange profits to pay for imports.

3) Nigeria's corporate and financial sectors are deteriorating. Markets have been severely damaged, financial systems are stressed, and banks' balance sheets are probably going to be under a lot of pressure. The decline in demand is detrimental to private businesses. Large-scale bankruptcies are becoming more likely.

The moment has come to concentrate on growing the local economy in the hopes of creating a country less dependent on importation and more dependent on domestic production. Africa has been dependent on goods produced from places like China, Europe, America, among others. Countries like Nigeria should step up domestic manufacturing for their citizens during this COVID-19 period when it has become tough to import commodities from other nations. It's interesting to see that the states of Aba, Cross River, and Anambra are starting to produce face masks and ventilators[17].

2.1.5 Concept of Vaccination

To understand the concept of vaccines in humans, one has to first understand what immunity is all about.

Immunity in humans refers to the body's ability to tolerate the existence (presence) of native (indigenous) material while eliminating foreign substances. The immune system is a complex system consisting of communicating cells that discriminatory performs the function of eliminate foreign substances. The ability to recognize and completely remove these foreign substances protects humans against infectious diseases. Immunity is usually restricted to a single organism or a family of related organisms[18].

The immune system develops resistance to antigens, which are substances are capable of stimulating the immune system. This protection is regarded as the immune response, and it typically involves the following:

- Production of protein molecules (antibodies or immunoglobulins) by the B-lymphocytes (also known as the B-cells)
- Production of specific cells which include T-lymphocytes (also known as cell-mediated immunity)

In general, the most powerful immune responses are those that are produced in response to antigens that are present in a living organism. Nevertheless, an antigen does not necessarily have to be present in a living organism to elicit an immune response.

There are basically two (2) types of immunity which are

1. Passive Immunity and
2. Active Immunity

1. Passive Immunity:

Passive immunity refers to protection provided by antibodies or antitoxins that is produced by one person or animal and passed on to another person or animal. Passive immunity protects against infection immediately but only temporarily. Passively acquired antibodies will degrade over time (weeks to months), and the receiver of such immunity would no longer benefit from such protection.

The most common type of passive immunity is seen when an infant receives certain immunity from his or her mother. Antibodies, specifically the immunoglobulin G (IgG) class of antibody, are transported across the placenta during the last one (1) to two (2) months of pregnancy. As a result, a full-term infant will have antibodies similar to the mother's, which can protect the infant against certain diseases in the first few months after birth[18].

2. **Active Immunity:**

Active immunity is defense produced by the body's own immune system. An antigen stimulates the immune system, resulting in antibody-mediated immunity and cell-mediated immunity. Active immunity, as opposed to passive immunity, normally lasts for several years, if not a lifetime. Surviving infection with a disease-causing form of an organism is one way to develop active immunity. In general, people who recover from an infectious diseases have lifelong immunity to the majority of the diseases. Immunologic memory refers to the persistence of defense (protection) for many years after infection. Certain memory cells (B-cells) circulate in the body plasma (blood) and reside in the bone marrow for a long time (many years) after the immune system is exposed to an antigen. When exposed to the antigen again, these memory cells begin to recreate (replicate) and produce antibody quickly in order to reestablish protection.

Vaccination is another method for producing active immunity. Vaccines contain antigens that can stimulate the body's immune system, resulting in an immune response that is frequently similar to that produced by a natural infection[18].

History of Vaccination

Historically, vaccination as an intentional attempt began in Louis Pasteur's laboratory. His discovery of attenuation epitomized his aphorism that "chance favors the prepared mind." Pasteur, who was on vacation in the summer of 1881, returned to a study of chicken cholera, caused by what is now known as Pasteurella multocida. A culture that had been left on the bench over the summer was inoculated into chickens, but it did not cause disease. Pasteur then created a new culture and inoculated the same chickens, but the chickens were resistant to the new challenge, indicating that the old culture had rendered them immune. Pasteur developed the hypothesis that pathogens could be weakened by exposure to external environmental factors such as high temperature, chemicals and Oxygen based on

these observations. His subsequent work that was done on anthrax and rabies confirmed the hypothesis.

Cell culture was adapted to virus growth in the mid-twentieth century, and it was not so long before it could be discovered that passage in cell culture was another method of attenuation, supposedly by coincidental selection of mutants best adapted to replication outside the living host (in vitro) than those in the living host. Cell culture also allowed for the deliberate selection of mutants through the separation (isolation) of single clones and incubation at temperatures lower than the host's normal temperature. Thus, between 1950 and 1980, numerous attenuated virus vaccines were developed, including vaccines for measles, polio, rubella, mumps, and varicella.

The concept of total inactivation as a method of vaccine development emerged in 19th century, not long after when Pasteur made an original insight. Priority here apparently goes to Daniel Salmon and Theobald Smith, though Pasteur's team led by Emile Roux discovered the same principle independently. Roux, Yersin, Behring, and Kitasato identified extracellular bacterial toxins, allowing Ramon to develop toxoids (inactivated toxins) for diphtheria and tetanus. With the advancement of technology, it became possible to isolate and then use subgroups of organisms in form of an extracts of an infected tissue (as seen in rabies), capsular polysaccharides (as seen in typhoid and pneumococci), and proteins (as seen in acellular pertussis). Late in the twentieth century, protein-polysaccharide conjugation became a potent weapon against encapsulated bacteria[19].

The development of molecular biology as well as genetic engineering, like in every other field of biology, has had a dramatic impact on vaccine development, opening up new avenues for the creation of inactivated antigens and the logical and reasonable attenuation of organisms which is done through directed mutation. The very first accomplishment of genetic engineering was with the hepatitis B vaccine made in a yeast recombinant carrying the S protein gene, which supplemented a vaccine

based on purifying the S particles from infected people's plasma. Following that, the incorporation of genes into yeast or into Escherichia coli allowed for the production of a wide range of recombinant proteins, including pertussis toxin.

Several notable trends in vaccine development can be observed in the early 21st century. As new components of routine vaccination became available, vaccine combinations have become increasingly important. In Europe, hexavalent vaccine combinations comprising diphtheria, tetanus, pertussis, H. influenzae type b (Hib), hepatitis B, and inactivated polio are already being used, and pentavalent vaccine combinations are being used in many other parts of the world. Varicella vaccine is now included in measles-mumps-rubella vaccines, and different combinations of H. influenzae type b, pneumococcal, and meningococcal conjugated bacterial polysaccharide vaccines will soon be available. While vaccination is typically thought of as a preventative measure, serious efforts are being made to produce therapeutic vaccines that would be used for chronic infections. The basic idea is to stimulate cellular immune responses that will suppress infection even when the host is unable to do so naturally[19].

Vaccine Classification

Vaccine can basically be classified into the following types

1. Live Attenuated Vaccine

Live attenuated vaccines contain pathogens that have been weakened, altered or selected to be less virulent than their wild-type counterparts. In their altered form, they cannot cause the actual disease or only mimic the disease in a very mild way. Live attenuated vaccines are generally produced from viruses rather than bacteria because viruses contain fewer genes and attenuation can be obtained and controlled more reliably.[20] In a laboratory, these infectious viruses or bacteria are weakened

(attenuated) through repeated culturing. Live attenuated vaccines will have to replicate in the vaccinated person in order to elicit an immune response. A small amount of virus or bacteria administered replicates in the body, producing enough organism to elicit an immune response. Although live, attenuated vaccines replicate, they rarely cause disease in the same way that the wild form of the organism does; however, when a live attenuated vaccine does cause a disease, it is usually much milder than the biological disease and it is considered an adverse reaction to the vaccine. As an outcome of uncontained replication of either the vaccine virus or bacteria, a live attenuated vaccine can cause severe or fatal infections. Heat and light have the potential to damage or destroy live, attenuated vaccines. As a result, they must be properly stored and handled in accordance with recommended standards[18].

2. Inactivated Vaccine

Vaccines that have been inactivated are not alive and cannot replicate. These inactivated vaccines cannot cause a disease, even in immunocompromised people. Because inactivated the antigens are less impacted by circulating antibody than live antigens, they can be used when there is antibody in the blood. In general, the immunity that is provided by these inactivated vaccines are not long lasting as that provided by live attenuated vaccines. Multiple doses of the inactivated vaccines over time are required to achieve long-term immunity. The first dose, in general, does not create protective immunity, but instead primes the immune system. After the second or third dose, a protective immune response develops. Unlike the live vaccines, which produces an immune response that closely matches natural infection, an inactivated vaccine produces mostly antibodies[21]. Among the inactivated vaccines are:

a) Whole-Cell Inactivated Vaccines

A physical or chemical process was used to kill the bacteria or viruses in whole-cell inactivated vaccines. Polio, hepatitis A, and rabies vaccines are examples of a whole-cell inactivated viral vaccine.

b) Subunit Vaccines

Subunit vaccines are made up of a portion of the bacterium or virus. The selected portion of the organism is the portion required to generate a protective immune response. Antigens in subunit vaccines may be protein, polysaccharide, or a polysaccharide-protein molecule complex (known as conjugate vaccine). Conjugate subunit vaccines such as Haemophilus influenzae type b and pneumococcal conjugate vaccines are manufactured by chemically attaching a polysaccharide from the bacterial surface to a protein molecule. Conjugating a polysaccharide antigen to such a protein molecule generates durable immunity against the polysaccharide antigen[20].

c) Toxoids Vaccines (example, diphtheria and tetanus toxoid)

Toxoid vaccines are made from bacteria-produced toxins that have been inactivated. Heat, chemicals, or other methods are used to inactivate these protein-based toxins. Toxins produced by bacteria such as tetanus and diphtheria can cause disease. The immune system's ability to identify and eliminate these toxins helps prevent disease[21].

d) Recombinant Vaccines

Recombinant DNA technology is used in the production of recombinant vaccines. When two or more DNA genomes are fused together, it is known as recombinant DNA technology. Genes from hepatitis B, human papillomavirus (HPV), and influenza viruses are inserted directly into the gene of yeast cells or viruses to produce vaccines. An organism that has been altered will produce hepatitis B surface antigen, HPV capsid protein or influenza hemagglutinin by the time it grows. Proteins and outer membrane vesicles produced by recombinant technology are used in Serogroup

B meningococcal vaccines Hepatitis B, HPV, and influenza are all examples of viruses that fall into this category[18].

2.1.6 COVID-19 Vaccines

As at 12 July 2022, the world has recorded a total of 12,130,881,147 doses of vaccines that has been successfully administered[15]. This is due to the successes recorded in the researches done in the development of COVID-19 vaccines.

To stop the pandemic, numerous efforts have been made to create vaccinations against COVID-19. The S-protein of SARS-CoV-2 is used in developing majority of the vaccine. Currently. Inactivated or live attenuated viruses, protein subunits, virus-like particles (VLP), viral vectors, DNA, RNA, nanoparticles, and a variety of other components form the basis for the vaccines that are now being developed. with each displaying particular benefits and drawbacks. Different adjuvant methods are now available to researchers for the creation of vaccines in order to increase immunogenicity. The target identification for SARS-CoV-2 vaccine candidates also uses the immuno-informatics approach, which can be used to find important cytotoxic T cell and B cell epitopes in the viral proteins[22].

To create COVID-19 vaccines, a variety of techniques have been employed, including the use of virus-like particles (VLPs), entire viruses, adjuvant recombinant protein nanoparticles, and nucleic acid-based vectors (both the replicating and the nonreplicating). Even though the S protein's expression to the immune system varies significantly among the various types of vaccines, it is actually the protective antigen of SARS-CoV-2 that is most frequently studied since it can trigger powerful neutralizing antibodies. Nucleocapsid (N) proteins, for example, are more preserved non-spike viral antigens that may play a role in the development of universal vaccines that provide long-lasting protection as well as in the fight against the emergence of new SARS-CoV-2 variants.

Numerous vaccines licensed for use in an emergency situation against COVID-19 contains both biomaterial and nanoparticles that help the vaccination be delivered to and operate on host cells. That is to say, lipid nanoparticles carrying the nucleic acid sequence encoding the S protein make up the mRNA vaccines created by pharmaceutical companies[13].

Current data has shown that there are about 18 COVID-19 vaccines that has so far been approved and are already in use in countries around the world. COVID-19 vaccines that have been approved and also those currently under development are in four categories primarily using different platforms.[23] This platform includes:

1. Whole virus vaccines
2. Protein-based vaccines
3. Viral vector vaccines, and
4. Nucleic acid vaccines

1. Whole Virus Vaccines

Whole virus vaccines employ an attenuated or inactivated version of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to induce protective immunity. Two (2) types of whole virus vaccines are in existence which are: a) The live attenuated vaccines, which makes use of the weakened form of the virus that can still grow and replicate but will not cause disease when used, and b) inactivated vaccines, in which consist of viruses that their genetic makeup has already been destroyed by application of heat, chemicals, or even radiation so that they can no longer infect cells and undergo replication but they can still elicit an immune response in the body. Both forms of whole viral vaccines have since been evaluated using a variety of methods, and this technique has served as the foundation for numerous already existing vaccines[20].

2. Protein-Based Vaccines

Protein-based vaccines come in two different varieties: a) protein subunit vaccines and b) virus-like particle vaccines. In contrast to whole virus vaccinations, protein subunit vaccines are simple to make, reasonably safe, and well-tolerated. They are made of viral antigenic pieces generated using recombinant protein processes. Due to the limited immunogenicity of protein subunit vaccinations, adjuvants are typically employed in conjunction with subunit vaccines to increase immunogenicity[20].

3. Viral Vector Vaccines

By invading and controlling the protein-making machinery of their host cells, viruses are able to read their genetic code and produce new viruses. Antigens, chemicals that can elicit an immunological response, are present in these virus particles. Also, viral vector vaccines, in which the host cells only get a code to create particular antigens, are supported by a similar theory. The viral vector serves as a vehicle for the transport of the SARS-CoV-2 antigens, enabling entry into the cell. It is chemically weakened so that the virus used as a vector cannot spread disease. By doing so, the body can develop an immunological response in a secure manner without contracting the illness. The adenovirus, which causes the common cold, the measles virus, and the vaccinia virus are examples of viruses that have been utilized as vectors. There are two types of viral vectors: those that still have the ability to reproduce inside of cells and those that are unable to do so because important genes have been deactivated. there has been just one viral vector vaccine was already authorized for use in the human population against the Ebola virus disease prior to the emergence of SARS-CoV-2. One problem with vaccines against viral vectors is that their efficacy may be compromised if recipients have already been exposed to the virus and have formed an immune response against it[18].

4. Nucleic Acid Vaccines

The SARS-CoV-2 nucleic acid vaccines employ genetic instructions to produce a SARS-CoV-2 protein that triggers an immunological response. These instructions are included in the form of DNA

(deoxyribonucleic acid) or RNA ribonucleic acid). This technology was unclear prior to COVID-19 because no approved vaccines at the time were using it. DNA vaccines work by inserting an antigen-coding fragment of DNA into the plasmid of a bacteria. Circular DNA fragments called bacterial plasmids are utilized to store and transfer genes that can help the organisms survive. Plasmids offer a straightforward method for transgenesis (transfer of genes) between cells and have the ability to replicate the chromosomal DNA independently. They are therefore already extensively utilized in genetic engineering. As a result, the host system is able to convert the antigen's information into protein from inside cells. Contrarily, RNA vaccines encode the desired antigen in a messenger RNA (mRNA) or self-amplifying RNA, a molecular building block utilized by cellular factories to create proteins. Using some of the same methods established for DNA vaccines, the RNA can be delivered directly into cells, enclosed within nanoparticles, or delivered into cells. When the DNA or RNA is already in the cell and begins to produce antigens, they are then shown on the surface of the cell, where the immune system may recognize them and respond. This response consists of killer T cells that hunt down and eliminate infected cells, as well as B cells that produce antibodies and helper T cells that facilitate the generation of antibodies[24].

Table 2.1: Outline of the vaccine production platforms for SARS-CoV-2 and their advantages and limitations

S/N	Vaccine	Advantages	Limitations
1	Live Attenuated Vaccine (LAV) /the whole virus	• It has the intrinsic ability to stimulate the immune system by inducing the toll-like receptors (TLRs) namely: TLR 3, TLR 7/8, and TLR 9 of the innate immune system that involves B cells, CD4 and CD8 T cells. • It can be derived from 'cold adapted' virus strains, reassortants, and reverse genetics.	• LAV requires an extensive accessory testing to establish safety and efficacy. • There is a probability of nucleotide substitution during viral replication, resulting in the creation of recombinants post-vaccination.
2	Inactivated Virus Vaccine	• Stable and safer as compared to the LAVs. • It has the pre-existing technology and infrastructure required for its development. • Has already been tested for SARS-CoV and various other diseases. • It can be used along with adjuvants to increase their immunogenicity.	• Require the booster shots to maintain the immunity. • Furthermore, large amounts of viruses need to be handled and the integrity of the immunogenic particles must be maintained.
3	Sub-unit Vaccine	• Do not have any live component of the viral particle. • Thus, it is safe with fewer side-effects.	• Induce an immune response. • Memory for future responses is doubtful
4	Viral vector-based vaccine	• Show a highly specific gene delivery into the host cell with a vigorous immune response. • Avoids handling of any infectious particle and it has been used widely for MERS-CoV with positive results from the trials.	• The host may possess immunity against the vector due to prior exposure, reducing the efficacy. • May lead to cancer due to the integration of the viral genome into the host

			genome.
5	DNA Vaccines	• The synthetic DNA is temperature stable and cold-chain free • It can be developed at an accelerated pace. • It does not require the handling of the infectious viral particle.	• Though it elicits both Cytotoxic and humoral immunity, the titers remain low. • Insertion of foreign DNA into the host genome may cause abnormalities in the cell. • May induce the antibody production against itself
6	RNA Vaccines	• The translation of mRNA occurs in the cytosol of the host cell averting the risk of any sort of integration into the host genome.	• Safety issues with reactogenicity have been reported for various RNA based vaccines. • It also shows instability

Source: [22]

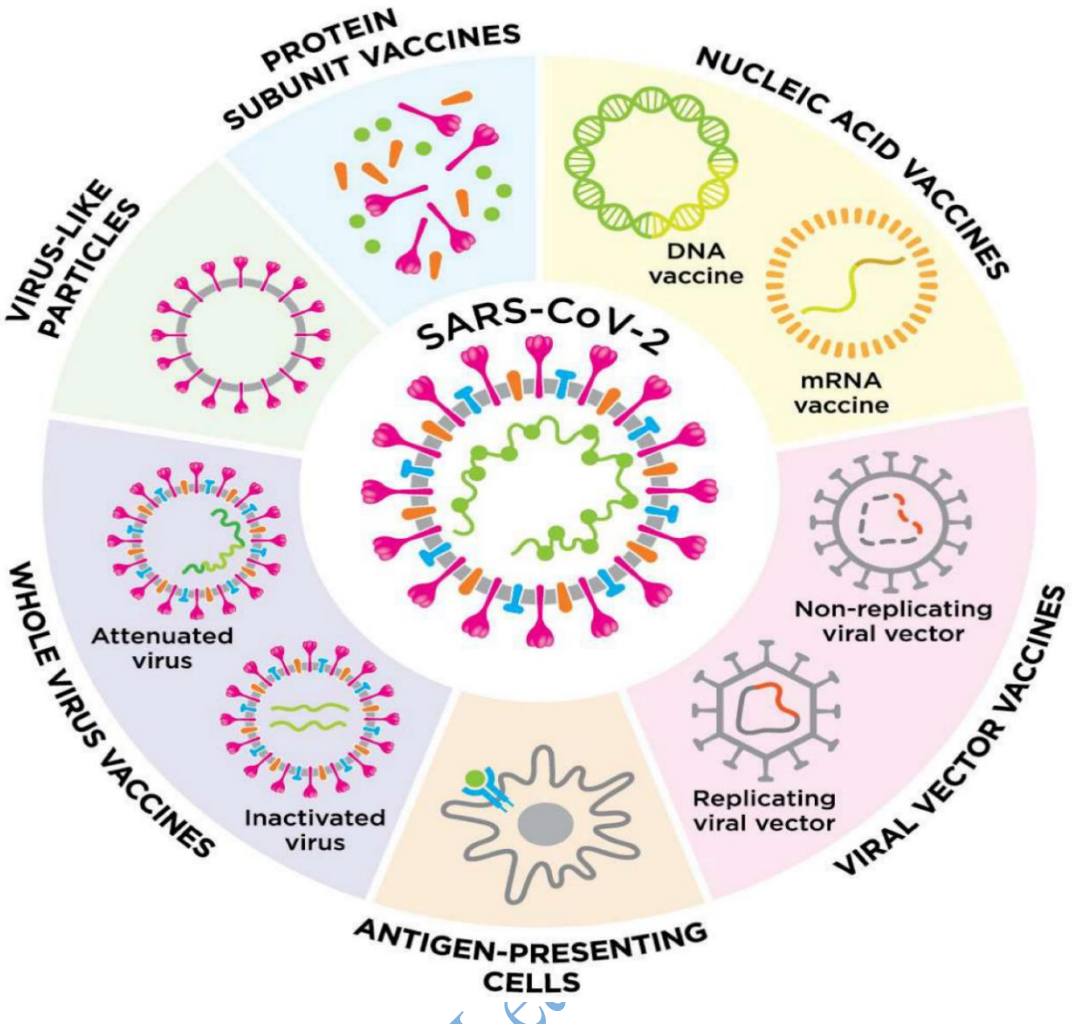


Figure 2.6: An overview of the different vaccine platforms against COVID-19

Source: [25]

2.1.7 COVID-19 Infection and its effect in Pregnancy

Pregnant women are now thought to be potentially vulnerable to SARS-CoV-2 infection due to complications associated with infection by the other coronaviruses (SARS and MERS) in the past. This is because the immune system, cardiovascular function, respiratory system and coagulation response are all affected significantly as a result of physiological changes that occur during pregnancy. These could accelerate or halt the progression of COVID-19 disease. A concerted, international effort is needed to ascertain the effects of SARS-CoV-2 during pregnancy on implantation, labor, fetal growth and development[26].

Physiological modifications in pregnancy and its implication to COVID-19

1. Immune Response

Since COVID-19 is a single-stranded RNA virus, an immune system that is functioning is necessary for the body to mount an effective immune response. Infection with COVID-19 can cause a mild illness in which the virus is successfully cleared by the immune system, or a severe illness with a high mortality rate. Uncertainty exists regarding where pregnant women fall on this spectrum. Pregnancy-related immune responses to infections change as a result of the immune system's adaptation to the development of a semi-allogenic fetus. Pregnancy-related immune system changes may have an impact on how the body reacts to infections, particularly viruses. These changes in the mother's immune system have an impact on the COVID-19 clinical course as well as COVID-19 treatment and prevention during pregnancy[27].

2. Respiratory Response

Anatomical changes are also present in the respiratory system, in addition to the systemic immunological modifications of pregnancy that may have an effect on lung function. Respiratory function changes as a result of physiological changes to the shape of the chest and elevation of the diaphragm brought on by diaphragmatic splinting by the gravid uterus. Despite a 30–40% increase in

tidal volume, end-expiratory volumes, functional residual capacity and residual volumes from early pregnancy all decrease as a result of the chest volume reduction. Pregnant women may be more vulnerable to severe respiratory infections due to the decreased total lung capacity and loss of the ability to clear secretions[27].

3. Coagulation response

COVID-19 is associated with a high rate of thromboembolic complications in the general population, which is due to the activation of coagulation pathways and the potential advancement to disseminated vascular coagulopathy (DIC) and fibrinolysis, with subsequent dynamic hypercoagulation occurring along with thrombocytopenia.

Pregnancy causes hypercoagulation, with elevated thrombin production and intravascular inflammation. There are higher levels of circulatory coagulation and fibrinolytic factors, like plasmin, during pregnancy, and these may be involved in the pathogenesis of infection with SARS-CoV-2. Women that are pregnant are at a higher risk of thromboembolic events, which can be fatal. As a result, pregnant women infected with COVID-19 may well have synergistic or additive thrombotic risk factors[28].

4. Endothelial Cell Function

The main cause of death in COVID-19 infection is acute respiratory distress syndrome (also known as ARDS). According to emerging evidence, pulmonary endothelial cell dysfunction plays an essential part in the onset and progression of ARDS. Endothelial cells are surrounded by mural cells (pericytes), which limit inflammation by limiting immune cell entry and prevent coagulation by expressing anticoagulant factors. This endothelial barrier is damaged in ARDS, resulting in tissue edema, hypercoagulability, excessive inflammation, and endothelial cell dysfunction is linked to COVID-19 risk factors such as increasing age, obesity, diabetes, and cardiovascular disease. Considering the importance of endothelial cell activity in the development and progression of COVID-19,

pregnant women may be especially vulnerable if infected, and an early systematic review discovered greater rates of preeclampsia in pregnant women that were hospitalized with COVID-19 infection[29].

2.1.8 COVID-19 Vaccine in Pregnancy

Initial research on SARS-CoV-2 infection in pregnant women, primarily from the Global North, suggested that the coronavirus illness 2019 (COVID-19) greatly raised the likelihood of adverse mother and newborn outcomes. In Ghana, Nigeria, and other nations, a multi-national prospective investigation of the impact of COVID-19 in pregnant women and the neonatal period discovered that SARS-CoV-2 disease among these pregnant women was linked to more occurrences of preeclampsia, eclampsia maternal mortality, etc. Pregnant mothers should also take birth outcomes into account. Initial research offered preliminary support for the immunogenicity, efficacy, and safety of messenger RNA (mRNA) vaccinations in pregnant women and found no negative impacts on pregnancy or neonatal outcomes. Furthermore, investigations on maternal vaccination have demonstrated rapid post-vaccination transmission of maternal SARS-CoV-2 antibodies from across the placenta into breastmilk, indicating a level of protection for nursing young infants[30].

The effectiveness of the COVID-19 vaccine in women that are pregnant is equivalent to that in the general population. According to studies, immunization in pregnant women results in a strong humoral immune response with reactogenicity and immunogenicity that are comparable to those in women that are not pregnant. The immunological response brought on by a vaccine is stronger than the one brought on by naturally occurring COVID-19. Additionally, the COVID-19 immunization during pregnancy benefits both the mother and the fetus by providing antibodies. Countries all across the world should incorporate immunizations into their standard antenatal care, just as they do with tetanus immunization, folic acid supplementation, and iron supplementation, as this is an effective strategy to protect pregnant women against COVID-19[31].

Pregnant women are permitted to get all licensed immunizations in the US. The Pfizer/Biontech vaccine has the greatest information on its effectiveness and safety in pregnant women, according to the CDC. m RNA vaccinations are advised for expectant mothers and nursing mothers in Australia. The Russian national recommendations concur with the international authorities, but they stress that there is not yet enough information on the safety of vaccines in this population to make a definitive determination[23].

Table 2.2: Barriers and Solutions to Ensure Promotion and Equity of Coronavirus Disease 2019 Vaccination Among Pregnant Women in Sub-Sahara Africa

Area of Focus	Barriers	Solutions/Recommendations
• **Policymaking**	• Many national guidelines in African countries are equivocal or lack recommendations on COVID-19 vaccination among pregnant women	• Urgent update of national guidelines in African countries for stronger recommendation of COVID-19 vaccination for pregnant and lactating women based on currently available efficacy and safety data
• **Vaccination communication and education**	• Low acceptance of COVID-19 vaccination among pregnant women and women of childbearing age • COVID-19 vaccine misinformation and disinformation disseminated on social media and other platforms	• Evidence-based, locally tailored COVID-19 vaccine promotional campaigns to target pregnant women and their families, dispelling misinformation and extolling the benefits of vaccination for both mothers and infants • COVID-19 vaccine promotional campaigns also targeting healthcare workers providing for pregnant women
• **Healthcare systems delivery**	• Heterogeneity of Pfizer and Moderna mRNA COVID-19 vaccine supply in African countries and their requirement for ultra-cold storage of −80°C and −20°C (−112°F and −4°F, respectively) • Low COVID-19 vaccine access for young women and women in rural and other underserved communities with very poor health infrastructure	• Innovative solutions for cold chain, including use of high-tech insulated and reusable containers that can maintain temperatures of −80°C for up to a week in the field • Need for additional safety data on use of non-mRNA COVID-19 vaccines with less cold-chain storage needs (eg, viral vector or inactivated vaccines) for pregnant women • Integration of COVID-19 vaccination into routine pregnancy-related vaccination (eg, tetanus) and expansion of vaccine administration points to include antenatal care and obstetrics/gynecology clinics as well as community clinics and centers to increase access/uptake for pregnant women and those of childbearing age • Mass campaigns for COVID-19 vaccination to include mobile clinics

		targeting pregnant women
• **Monitoring and evaluation**	• Lack of national COVID-19 uptake, coverage, and safety data for pregnant women to support policy and practice	• Create national registries for vaccination in pregnancy • Track COVID-19 vaccination uptake in pregnant women • Conduct routine surveillance and prospective cohort studies of SARS-CoV-2 infection and outcomes in pregnant women

Source: [30]

2.1.9 Vaccine acceptance and Hesitancy Models

Vaccine hesitancy is the delay or refusal to accept or refuse vaccination despite the availability of vaccination services. Vaccine apprehension is complex and context-dependent, varying across time, place, and vaccine. Factors such as complacency, convenience, and confidence all have an impact on it. Strategic Objective 2 of the Global Vaccine Action Plan, adopted by the World Health Assembly in May 2012, states that "individuals and communities understand the value of vaccines and demand immunization as both their right and responsibility"[32]. Vaccine hesitancy ranges from high vaccine demand to complete vaccine refusal, which is described as no demand for accessible and accessible vaccines. However, vaccine demand and vaccine hesitancy may not entirely be in synergy. Individuals or communities may show vaccine acceptance without any reservation, but they may not demand to be vaccinated or demand a specific vaccine.

Because hesitancy hinders demand, countries will need to take action to counteract hesitancy in order to meet the vaccine demand goal outlined in the Global Vaccine Action Plan. When hesitancy is high, demand is low; however, low hesitancy does not always imply that demand will be high. To achieve high individual and community vaccine demand, context, community, and vaccine-specific strategies must be developed in addition to those aimed at addressing hesitancy[32].

Models:

Vaccination acceptance is a behavior that results from a complex decision-making process that can be influenced by a variety of factors. Model complexity, global applicability, the breadth of factors considered, and potential usefulness in informing the development of vaccine hesitancy indicators and survey questions for use at the global and national levels were all taken into account in the evaluations. The WHO Working Group also considered whether the model could help those unfamiliar with the term understand the concept of vaccine hesitancy. The complexity of vaccine hesitancy and its determinants was confirmed by a review of these models. Figure 2.7 below depicts

the "3 Cs" model, which was first proposed to the WHO EURO Vaccine Communications Working Group in 2011. It highlights three categories: complacency, convenience, and confidence. Because this model was thought to be the most easily understood, the concepts were incorporated into the definition. According to the "3 Cs" model (which are Confidence, Complacency, and Convenience)[33].

Confidence:

Confidence is defined as trust in (i) the efficacy and safety of vaccines; (ii) the system that delivers them, including the dependability and competence of health services and health professionals; and (iii) the motivations of policymakers who decide on vaccine requirements. Vaccination complacency occurs when the perceived risks of vaccine-preventable diseases are low and vaccination is not regarded as a necessary preventive measure.

Complacency:

Many factors influence complacency about a specific vaccine or about vaccination in general, including other life or health responsibilities that may appear to be more important at the time. The success of an immunization program may, paradoxically, lead to complacency and, eventually, hesitancy, as individuals weigh the risks of vaccination with a specific vaccine against the risks of the disease that the vaccine prevents, which is no longer common. Self-efficacy (an individual's self-perceived or real ability to take action to be vaccinated) also influences the extent to which complacency helps determine hesitancy[34].

Convenience:

When physical availability, affordability and willingness to pay, geographical accessibility, ability to understand (language and health literacy), and appeal of immunization services affect uptake, vaccination convenience becomes a significant factor. The degree to which vaccination services are delivered at a time and place and in a cultural setting that is convenient and comfortable also influences the decision to be vaccinated and may lead to vaccine hesitancy[35].

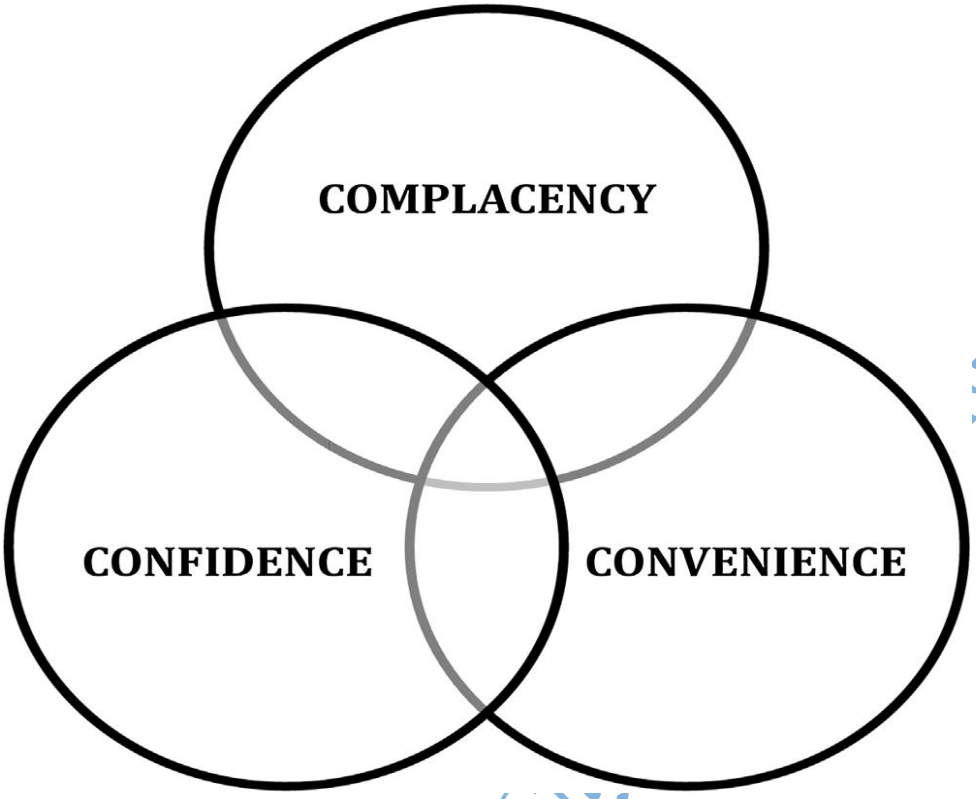


Figure 2.7: The "Three Cs" model of vaccine hesitancy.

Source: [32]

2.1.10 Factors Influencing COVID-19 Vaccine Acceptance and Hesitancy

COVID-19 vaccines became available in Nigeria early in 2021 at no cost to recipients. However, the quantity of vaccines given out has been restricted. So far, approximately 25 million doses of the vaccines have been given, covering approximately 5% of the total population with two doses.[36] This low vaccination coverage could be due to a variety of factors, one of which is vaccine hesitancy, as some past studies have indicated within Nigeria. One of the most well-known cases of vaccine hesitancy in Nigeria was the 2003 polio vaccination campaign boycott in northern Nigeria. The boycott that lasted 16 months resulted in the spread of polio infections both within the country and in neighboring countries. One of the major reasons for the boycott is believed to be a lack of trust in the federal government, which supported the polio eradication campaign. COVID-19 vaccination is strongly recommended by public entities in almost all countries during the current COVID-19 pandemic. In Nigeria, a lack of public trust may once again play a significant role in the (un)successful vaccination campaign against COVID-19, especially given the country's lack of government trust[36].

The fact that Nigeria is multiethnic and multireligious, with a variety of cultural beliefs and practices in different locations, may be another reason that will determine vaccine acceptance or hesitancy in general. Undoubtedly, this complexity might contribute to the growth of vaccine reluctance. The occurrence of vaccine hesitancy is influenced by numerous factors like cultural, social, demographic, and psychosocial factors. In our type of culture and social structure, where people are greatly influenced by what they believe others around them are doing or expecting them to do, these effects will multiply. Because several faiths in Nigeria view coincidences as the cause of events rather than seeking explanations for them, hesitancy might flourish there. In some religions, deaths are viewed as coincidences or ascribed to God, who is supreme over all, even when an obvious cause, such as a vaccine-preventable disease, could be identified. The push for vaccination will surely be influenced

because religion provides an alternative explanation for death. History has demonstrated in the country that, even during widely publicized National Immunization Days, parents are extremely hesitant to have their children vaccinated due to previous personal experiences, community experiences, rumors, or distrust. There have been reports of parents double-checking before vaccinating their children, either by asking their neighbors, reaching out to more knowledgeable people, or in some cases calling a familiar healthcare worker to confirm whether or not their children should be given the vaccinations. Simultaneously, many unfounded theories, myths, and misconceptions about the negative effects, unusually rapid development, and early regulatory approvals circulate in the social and print media. As a result, there is distrust in the vaccine and scepticism about participating in the vaccination program[37]. This interaction of psychosocial and structural factors is a significant underlying factor in vaccine hesitancy. Acceptance or refusal of vaccine by husband or head of household, his religion or beliefs, and socioeconomic status either predispose or prevent vaccine hesitancy. Vaccine hesitancy is also influenced by demographic variability across the country's six regions, as experiences differ from region to region, despite the country's poor overall outlook for vaccination uptake. This demographic variation, primarily in educational, socioeconomic, and religious levels, influences immunization uptake. However, in some areas or regions, the onset of insurgency has exacerbated vaccine hesitancy, and religious leaders are reported as sharing mistrust of vaccination as a Western plot to sterilize people of a particular religion. The influence of religion and the complex interplay with psychosocial factors in this region, for example, increases the occurrence of vaccine hesitancy in the country and may explain the observed trends in vaccine coverage reported from this region of the country[38].

COVID-19 vaccine acceptance or hesitancy has also been believed to be associated with two factors, which are (1) Non-psychological factors and (2) Psychological factors[39].

1. Non-psychological Factors Associated with COVID-19 Vaccine Acceptance and Hesitancy

a) Socioeconomic Status

Health literacy is defined as the ability to comprehend and apply information to one's general health. Lower income levels can also have an impact on many aspects of someone's life. Lack of transportation, inability to leave a job and obtain healthcare services, inability to pay for healthcare or to care for oneself or others when sick are all examples of healthcare barriers. Vaccination hesitancy can be exacerbated by a lack of education. Individuals may seek less reliable sources for a better understanding if they are unable to understand scientific information provided by health practitioners. This can lead to people receiving incorrect information and changing their minds about whether to get vaccinated or not. According to the same study, COVID-19 information should be made available to the public in an understandable manner, with less emphasis on scientific terms, to prevent consumers from seeking out alternative resources, reducing the use of unaccredited sites and improving vaccination uptake[40].

b) Race/Ethnicity and Vaccine Hesitancy

There have been opposing points of view on vaccination safety between White and Black people; Black people were more sceptical of the COVID-19 vaccination. The reluctance and hesitancy observed in Black people can be traced back to when these groups were subjected to experiments, such as the Tuskegee experiments. In 1932, the US Public Health Service (USPHS) collaborated with Tuskegee University to study and try to cure syphilis. The study included Black male participants who were not given informed consent and were bribed to participate. The male participants were given placebos all through the experiment and did not receive appropriate, effective syphilis treatment. Many of the participants suffered from blindness, insanity, and even death as a result of a lack of

medical care. Several studies have discovered a link between ethnicity and vaccination hesitancy[41]. There appears to be a pattern of mistrust in the healthcare system leading to health conditions, as well as previous historical events that have made minority groups wary of vaccinations.

c) Gender and Vaccination Hesitancy

Women were also found to be more hesitant to receive the COVID-19 vaccination, according to research. Women are more likely than men to engage in preventive behaviours and avoid risk-taking behaviours. Women are also more concerned when they hear about negative side effects related to fertility, pregnancy, and breast-feeding. This includes getting vaccinated against influenza and wearing masks to prevent the spread of COVID-19. Women are more likely to be concerned about COVID-19 public health standards, but they are less likely to get vaccinated, which may be due to vaccination complacency, vaccination confidence, and vaccination convenience. Complacency tends to result from a low potential threat or risk of getting sick and viewing vaccination as unnecessary. This can be influenced by external factors such as life concerns or quality health standards. Confidence is the ability to trust, be effective, dependable, and motivated. Convenience is determined by physical ability, affordability, geographic location accessibility, and vaccination competence[41].

2. Psychological Factors Related to Vaccine Hesitancy

a) Conspiracy Theories and Misinformation

Conspiracy theories can take many forms, such as COVID-19 being a hoax, a form of government control, or the virus being created in a Chinese laboratory. Conspiracy theories oppose explained narratives which can be used to help people rationalize and understand traumatic events. When people are in a crisis, the lack of control over their surroundings can have a psychological impact. Individuals who lack control may seek answers as a way of coping, offering a feeling of relief even if their answers are really not fact-based[39]. When people are in a panic, it is common for them to problem

solve by looking for means to find answers. In addition to the lockdown, people were forced to isolate themselves within their homes, where they had the time or the energy to use social media platforms.

b) Personality Traits and Vaccination Hesitancy

Internal influences such as personality traits could really influence how people respond, patterns in their thinking, habitual behaviours, or even simple interactions between people. There has been little research into how an individual's personality influences vaccine hesitancy. Extraversion, agreeableness, openness, conscientiousness, and neuroticism are the Big Five (5) Personality Traits. Examining and learning how a person functions through their personality can provide healthcare professionals with valuable information that can aid in treatment decisions and the ability to predict outcomes for potential mental disorders. Individuals are ranked based on a spectrum that is broken down into the following personality traits: Agreeableness (trust, straightforwardness, compliance), Conscientiousness (competence, dutifulness, organized), Neuroticism (irritable, anxious, vulnerable), Extraversion (sociable, center of attention, excitement seeking), and Openness (curious, imaginative, unconventional)[33].

c) Paranoid Ideations and Vaccine Hesitancy

Uncertainty as well as less predictability can result from crisis situations such as the COVID-19 pandemic. Is there a psychological impact associated with an increase in paranoid ideation? Mistrust and suspicion in others that can be interpreted as malicious is referred to as paranoid ideation. PPD (Paranoid Personality Disorder) describes eccentric people who exhibit paranoia and mistrust even when there is no reason to be suspicious. When deciding whether to receive the COVID-19 vaccine, an absence of information might very well cause paranoia, resulting in a reduction in vaccination uptake[42].

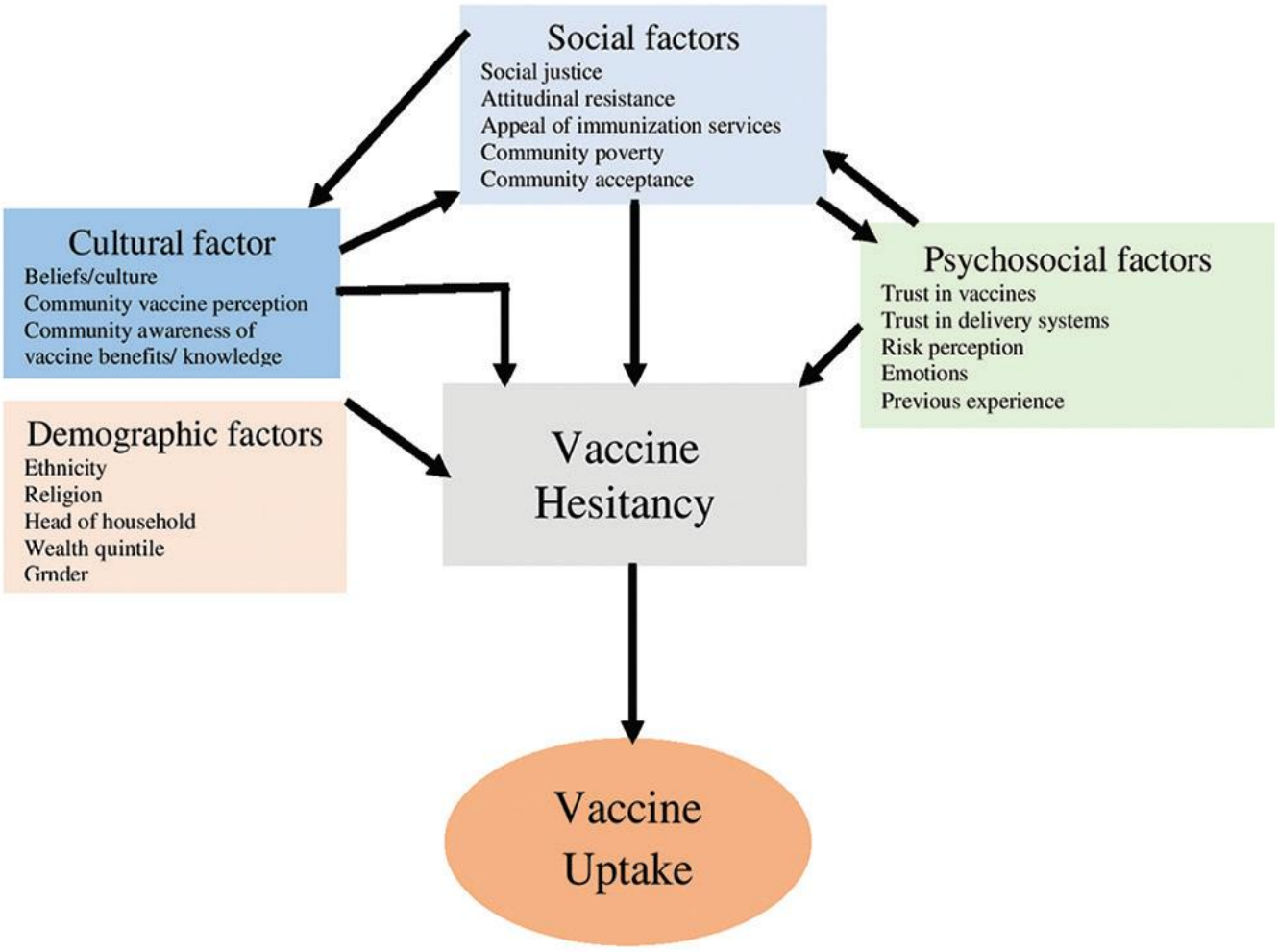


Figure 2.8: Context-specific factors associated with vaccine hesitancy and vaccine uptake

Source: [43]

2.2 Theoretical review

This sub-chapter will talk about the health behavior associated with COVID-19 vaccine knowledge and acceptance among pregnant women and will focus on the Health Belief Model (HBM) which is a behavior-specific cognition (also known as the Social Cognitive Models) that is related to this research.

Health behaviors is any activity that is done or undertaken for to achieve or for the purpose of preventing a disease, detecting a disease or for the purpose of improving health and general well-being. A number of health behaviors fall under this definition including vaccination, medical screening, hospital visitation etc. Social Cognition Models (SCMs) provides a basis for understanding the determinants of behavior and the change in behavior, and it also provides a bucket list of important target areas that health interventions can focus their design on so as to successfully change health behaviors. There exist different Social Cognitive Models which includes[44].

1) **Health Belief Model (HBM)**
2) Protection Motivation Theory
3) Self-Determination Theory
4) Theory of Planned Behavior
5) Social Cognitive Theory
6) Stage Models of Health
7) Implementation Intention
8) The Prototype-Willingness Model
9) Health Action Process Approach

2.2.1 Health Belief Model (HBM)

The Health Belief Model is among the oldest and mostly used social cognition models in health psychology which have been used to predict health behaviors by using two (2) aspect of individual's

perspectives of health behaviors in response to threat of an illness: a) the perception of illness threat, and b) the evaluation of behaviors to tackle (counteract) the threat. Threat perceptions are seen to depend on two (2) major beliefs which are a) the perceived susceptibility to the disease or illness and b) the perceived severity caused by the disease or illness. Thus, when the two beliefs are put together, it is said to determine the likelihood of an individual to follow or take a particular health-related action, although the effect can be affected by or modified by differences in individual's demographic variables, social pressure and also personality. The other two (2) other variables included in this model to determine health behavior include: a) Cue to action and b) health motivation[44]. According to the health belief model (HBM), an individual's assessment of the advantages and disadvantages of engaging in a healthy behavior affects the course of action. The health belief model (HBM) has six (6) dimensions, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy. The final two (2) were added as the health belief model (HBM) study progressed, whereas the first four (4) were developed as the initial components[45]. It is believed that a particular action that is being taken by an individual is determined by the evaluation of all available alternatives, putting emphasis on benefit or efficacy of the perceived cost or barrier to performing the behavior or action.

The health belief model (HBM) has been used to evaluate a wide range of pregnant women's health outcomes. Pregnant women have proven the health belief model (HBM) to be an effective framework for elements that improve diet, weight control behaviors, promote physical activity, reduce self-medication during pregnancy, and promote self-care. These choices a woman takes during her pregnancy, such as weighing the advantages and disadvantages of implementing new health behaviors, may have an effect on the general health and results of her pregnancy. These may serve as important markers for professionals and researchers working to improve pregnant women's health status. The health belief model (HBM) has also been used to assess health behaviors in a variety of contexts, and

it is not a new application to the acceptance of vaccines by pregnant women. Few research has looked at pregnant women's acceptance of the influenza vaccine while pregnant, while another study evaluated pregnant women's acceptance of the pertussis vaccine using the health belief model (HBM)[45].

A cross sectional study recently conducted in China applied the health belief model (HBM) to pregnant women's COVID-19 vaccine acceptance and the associated factors[46].

As per this study, the COVID-19 vaccination will likely be accepted by the target participants (pregnant women) if they are aware of its benefits and believe that receiving it will enhance their health. Contrarily, if these expectant mothers know and believe that skipping the COVID-19 vaccination will leave them vulnerable to infection and other pregnancy complications caused by the virus, which is seen to be a serious threat, they may choose to do so. The phrase "perceived severity" refers to an individual's subjective assessment of the importance of the danger to which they are exposed (for instance, developing eclampsia as a result of contracting the COVID-19 virus), which may influence how much attention they pay to the risk. The subjective true or supposed advantages of implementing recommended measures are described as perceived benefits (taking the COCID-19 vaccine in this case). The model attempts to capture pregnant women's barriers to doing recommended activities by assessing perceived barriers (inadequate knowledge and accessibility). The adoption of good COVID-19 preventative measures is indicated by cues to action. For instance, pregnant women will be able to accept suggested modifications if they have the appropriate information about COVID-19 preventive measures. It closely relates to the prior statement about perceived severity. The self-efficacy element of the health belief model (HBM) represents an individual's self-confidence that pregnant women can carry out and sustain the advised behavior with little to no assistance[45].

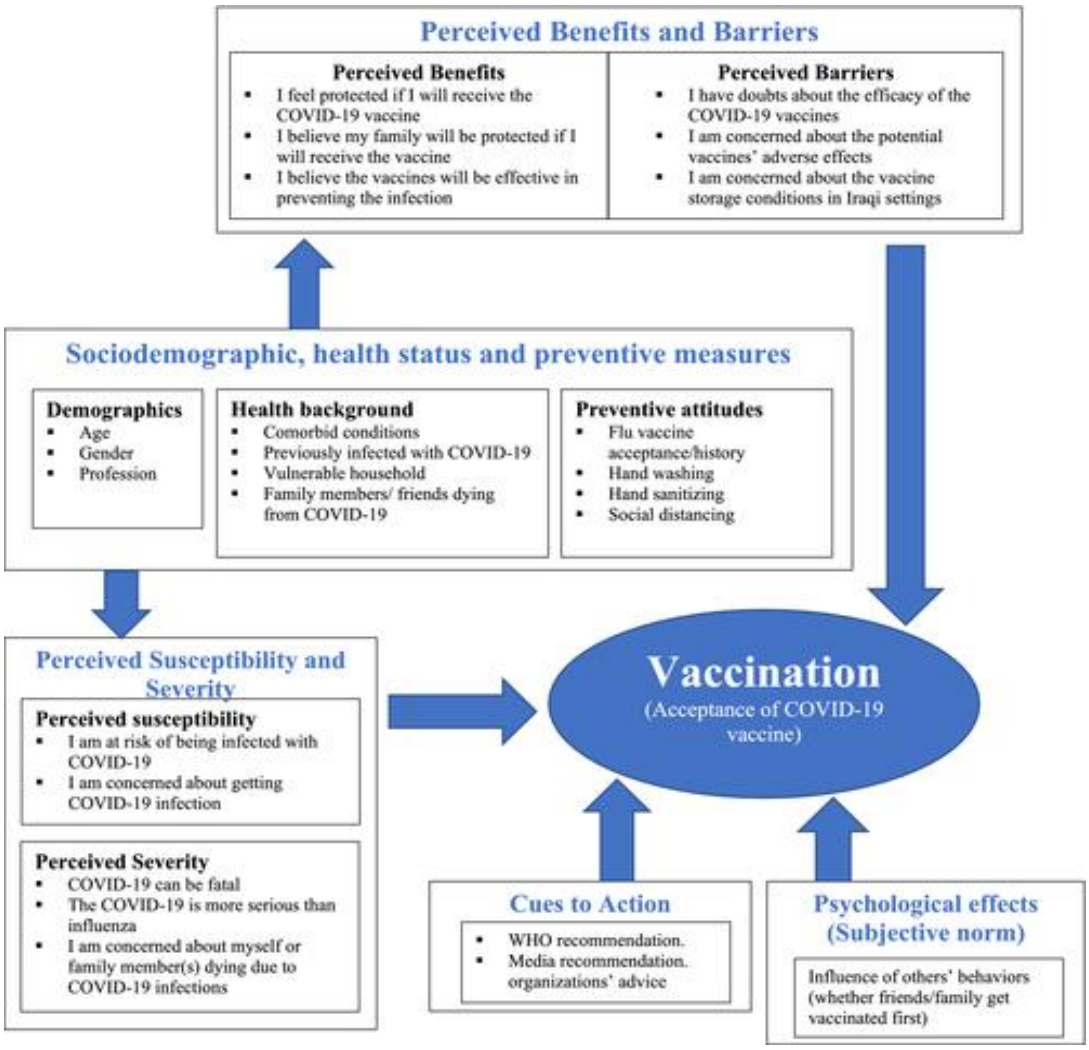


Figure 2.9: Health belief model domains and variables have the potential to influence people's acceptance of receiving a COVID-19 vaccine

Source: [47]

2.3 Review of Empirical Studies

2.3.1 Studies on Knowledge of COVID-19 Vaccine among Pregnant Women

An observational study carried out in seven (7) low-and-middle-income countries (LMIC) that seeks to determine the knowledge of COVID-19 vaccine among pregnant women reported a low level of knowledge on COVID-19 vaccine safety and effectiveness among these pregnant women across the seven low-and-middle-income countries (LMIC). The study included a total of 13,105 pregnant women from all the seven (7) LMIC who gave consent and participated in the research. The research reported that most of the women were educated to their primary and secondary education level except for those from Pakistan that recorded a poor educational level (primary and secondary) where 81% of the pregnant women that participated in the study were illiterates. Regarding the knowledge of COVID-19 vaccine, 29.2% considered the vaccine to be very effective and 21.7% said the COVID-19 vaccine was somewhat effective in preventing them against COVID-19 infection. Although the belief about how effective the COVID-19 vaccine is, varies from country to country with India having the highest at 48.8% followed by Zambia with 48.1% to as low as only 6.9% of the pregnant women in Bangladesh believing that the COVID-19 vaccine is effective in preventing the COVID-19 infection, while 36.6% of the respondents responded as having no information at all on the effectiveness of COVID-19 vaccine. In Bangladesh, 74.5% of the pregnant women that responded said they do not have any knowledge at all of the effectiveness of COVID-19 vaccine. The study also reiterated the fact that more efforts in education is needed to be achieve a higher rate of COVID-19 vaccination among pregnant women[48].

In a similar study carried out in California, United States of America involving 387 pregnant women (participants) which aim was to understand the knowledge on COVID-19 vaccine and also vaccine hesitancy among pregnant women in California, the study revealed that 98.7% of the respondents were aware of the availability of COVID-19 vaccine. In this study, 57% of the pregnant women

showed COVID-19 vaccine hesitancy, reasons being the fact that they do not have enough information on the newly developed COVID-19 vaccine and its safety in pregnancy[49].

Another study that was carried out among 812 pregnant women in Greece attributed the most reasons why 41.4% of the respondents had not been vaccinated against the COVID-19 infection to fears that the COVID-19 vaccine when taken might be harmful to the fetus (29.4%), doubts about the effective and the safety of the COVID-19 vaccine (31.4%), and concerns about the adverse side effects of the vaccine (29.4%). This study also stressed the need for a targeted educational campaign so as to increase the knowledge about the COVID-19 vaccine among pregnant women which will go a long way in reducing vaccine hesitancy among pregnant women[50].

A study that was carried out in the United States to determine COVID-19 vaccination intent among 1,516 pregnant women came up with interesting findings to regards how knowledgeable pregnant women in the United States are regarding COVID-19 vaccine. 25.7% of the respondents indicated that the COVID-19 vaccines are very effective while only 26.5 of the respondents indicated that the vaccines are safe and to weather pregnant women should take the COVID-19 vaccine, 52.6% of the respondents agreed to that[51].

In another interesting study seeking to assess the level of knowledge on COVID-19 infection among pregnant women that was carried out in Ebonyi State, Nigeria[52], it was revealed that among 460 pregnant women that participated in the study, 69.6% (320 respondents) had up to tertiary level of education, but with only 43.5% (200) having adequate knowledge about the disease, and 68.5% (380) of the pregnant women indicated not being afraid of contractingCOVID-19 infection with most reasons being that pregnant women are immune to COVID-19 infection. This study tends to reveal the fact that even with the high level of education of the study group (69.6%), little is known about the COVID-19 infection among pregnant women in Ebonyi State. This also calls for more structured

and targeted education on COVID-19 infection, COVID-19 vaccine safety and COVID-19 vaccine effectiveness among pregnant women[52].

2.3.2 Studies on Attitudes towards COVID-19 and COVID-19 Vaccine among Pregnant Women

In a study that was conducted in mainland China among 1392 pregnant women on COVID-19 vaccine attitude and acceptance which was believe to be the first of such study, it was reported that 89.4% of the pregnant women showed concern on getting COVID-19 infection, and 91.3% of the pregnant women were concerned about their newborn getting COVID-19 infection[46].

In Ebonyi State, Nigeria, a studied that was carried out among 460 pregnant women revealed that 65% (300) of the women were afraid of COVID-19 infection[52].

A study conducted in The United States among 1516 pregnant women reported that 30.6% of the pregnant women were worried about getting COVID-19 infection, while 36.3% reported that getting infected with COVID-19 could cause harm to their babies. The study also reported that COVID-19 vaccine acceptance was higher in pregnant women with good COVID-19 vaccine related attitude and being concerned about the infection when compare to those with negative attitude and not having concerns about COVID-19 infection[51].

2.3.3 Studies on COVID-19 Vaccine Acceptance among Pregnant Women

A study was conducted in Aminu Kano teaching hospital in Kano, Northern Nigeria involving a total of 399 pregnant respondents to determine the level of COVID-19 vaccine acceptability among these pregnant women. The analysis revealed that about 70.9% of the respondents (283 respondents) agreed that when pregnant women are infected with COVID-19, they will get very sick, also, 74.2% of the respondents (296 respondents) expressed how worried they are about the effects that COVID-19 infection will have on their unborn babies. But among the total of the 399 respondents, only 74 of them (18.6%) agreed to be at a high risk of infection with COVID-19 virus. And considering the

option of vaccination as a protective measure, 236 respondents (59.1%) were of the thought that vaccination could actually decrease their risk of coming down with COVID-19 infection while 55.6% of the respondents (222 respondents) have the believe that their unborn child would have a lower risk when they (the mother) get the COVID-19 vaccine shot. In terms of the COVID-19 vaccine safety and side effects, 339 respondents (85%) were worried about the safety of the vaccine while 360 respondents (90.2%) showed concern to regards the side effects of the vaccine. In terms of COVID-19 vaccine acceptance, only 33.8% of the pregnant women (135 respondents) agreed that they would accept to be vaccinated with the COVID-19 vaccine while they are pregnant and 23.3% of the respondents (93 respondents) said they will wait until after they have weaned their babies from breast milk before they will agree to collect a shot of the COVID-19 vaccine. The study thus gave a conclusion that there is a low acceptance level of COVID-19 vaccine among pregnant women attending antennal care in Nigeria[53].

In the Middle East, a similar study was carried out among 1,144 pregnant women to evaluate their level of COVID-19 vaccine acceptance and only 36.8% of the total respondent said they will take the COVID-19 vaccine while 26.4% were not sure if they will take the vaccine.[54] The findings in this study shows a low level of COVID-19 vaccine acceptance similar to that carried out in the Northern part of Nigeria[53].

Furthermore, an analytical cross-sectional survey-based study involving 362 pregnant and lactating mothers was carried out in The University Hospital Brno in South Moravia, Czechia (Czech Republic) out of which 278 of the respondents were pregnant women while 84 of the respondents were lactating mothers. The Study got a high level of delayed COVID-19 vaccine acceptance of 70.2% between both the pregnant women and lactating mothers, with pregnant women showing a high level of COVID-19 vaccine acceptance of 76.6%. But out of the 70.2% that agreed that they will take the vaccine, it was noticed in the study that only 3.6% gave immediate acceptance to the vaccine while

the remaining 66.6% indicated a delayed acceptance of the COVID-19 vaccine[55]. This study contradicts the ones done in the Middle East and in Northern Nigeria which shows a low level of COVID-19 vaccine acceptance among pregnant women and this difference could be due to various factors that affects vaccine acceptance among pregnant women[53 54].

Also, in a similar Institutional-based cross-sectional study that was carried out in Gurage Zone public hospitals in Southwest Ethiopia on the acceptance of COVID-19 vaccine among pregnant women, the study conducted involving a total of 396 pregnant women which also got a high level of COVID-19 vaccine acceptance of 70.7% (280 respondents), while 29.3% (116 respondents) of the respondents showed hesitancy (will not take the COVID-19 vaccine) with reasons for not accepting the vaccine being the fear of its side effect, might be ineffective, might turn to COVID-19 infection, the vaccine if taken might have effect their fetuses, while others opted to using other means of COVID-19 preventive measures[56]. This Study also showed a higher COVID-19 vaccine acceptance than that conducted in Nigeria, and the Middle East[53 54].

In Saudi Arabia, a study was carried out among pregnant women to also determine the level of COVID-19 vaccine acceptance. A total of 5,307 pregnant women were involved in the study with 68% of the total respondents accepting to take COVID-19 vaccine if provided while the remaining 32% were not willing to take the COVID-19 vaccine reasons being the lack of data on the safety of COVID-19 vaccine in pregnancy and also the risk of the vaccine harming the fetus. This study also recorded a high level of COVID-19 vaccine acceptance[57].

Also, a study that was conducted in Pennsylvania, United States of America among pregnant women on COVID-19 vaccine acceptance showed a high vaccine acceptance rate among the respondents. The study that had in participation 196 pregnant women reported a COVID-19 vaccine acceptance rate of 65%. 36% of the total respondents were willing to accept the vaccine and 29% were somewhat willing to accept the COVID-19 vaccine (which gave acceptance level of 65%), while 14% of the

total respondents answered "unwilling', 5% "somewhat unwilling" and 17% answered "I don't know"[58].

In another cross-sectional descriptive study that was caried out among 346 pregnant women in Kwandabeka Community Health Center, Durban in South Africa reported a high COVID-19 vaccine acceptance rate of 63.3% of the total respondents. This study reported a high COVID-19 vaccine acceptance among pregnant women in an African country[59].

2.3.4 Studies on Factors Associated with COVID-19 Vaccine Hesitancy among Pregnant Women

The occurrence of vaccine hesitancy is influenced by so many factors which includes cultural, social, demographic, and psychosocial factors[38]. COVID-19 vaccine acceptance or hesitancy has also been believed to be associated with non-psychological factors (socioeconomic status, race/ethnicity, gender) and psychological factors (conspiracy theories and misinformation, personality traits, and paranoid ideation)[60].

A studied that was carried out in China associated the acceptance of COVID-19 vaccine to being of young age, where 95%, high level of COVID-19 vaccine knowledge, and late pregnancy[46]. Similarly, I the same study, it was revealed that pregnant women with higher educational level showed high level of hesitancy to COVID-19 vaccine[46]. In another study in Ethiopia, showed association between COVID-19 vaccine and age, where younger women were 1.5 times more likely to accept COVID-19 vaccine than those women that are older. This was attributed to likelihood of pregnancy complication in older women[56].

In a cross-sectional study carried out in Saudi Arabia among 5307 pregnant women, it was observed that there was significant association that was seen with COVID-19 acceptance and primary education level with p-value at 0.002, place of residence, income more than 8000 Saudi Riyal (SR) at p-value

0.000, receiving the influenza vaccine and tetanus vaccine during the present pregnancy with p-values at 0.000 and 0.039 respectively[57].

An institution-based cross-section survey carried out in Ethiopia showed association between vaccine acceptance and age where younger women are 1.5% more likely to take the vaccine than older women[56]. The study also found association between maternal primary education and knowledge with COVID-19 acceptance among pregnant women.

A cross-sectional study that was carried out in Timisoara, Romania involving 345 respondents of which 184 were pregnant women and the remaining 161 were women who were not pregnant. The study was carried out to determine the possible factors that contributes to COVID-19 vaccine hesitancy among pregnant women. The study revealed that 60% of the responded did not have trust in the COVID-19 vaccines. The range of reasons provided to the women to respond to revealed that 78.1% of the respondents that did not trust the COVID-19 vaccines attributed it to trusting rumors from social media about the vaccines, while 26% of the women that showed hesitancy attributed it to lack of information on the safety of the vaccine. Also, 8.3% revealed that they do not believe in the COVID-19 vaccine while 13.5% said they were not afraid of COVID-19 infection. The study then concluded that social media and the society were contributory factors to COVID-19 vaccine hesitancy[61].

Another study that was carried out in Saudi Arabia involving 5307 pregnant women attributed COVID-19 vaccine hesitancy among pregnant women to lack of information on the safety of the COVID-19 vaccine (76%) with most of the respondents revealing that the COVID-19 vaccine might affect their unburn babies (51.9%)[57].

In an open cohort study conducted in Portugal, a multinomial regression was used to determine the associated factors that are responsible for COVID-19 vaccine hesitancy among the study population.

The study which included 1,948 respondents revealed a delay in vaccination acceptance to be 56% while refusal was 9%. The factors associated with this high hesitancy level of COVID-19 vaccine in Portugal according to the study included being younger, low confidence in the COVID-19 vaccine and the health service response during the pandemic, worse perception of government measures, perception of the information provided as inconsistent and contradictory[62].

Trust in a government can also be a factor which could be associated with COVID-19 vaccine hesitancy in many countries. A study done in Nigeria to determine how trust in the Nigerian government has influenced COVID-19 vaccine hesitancy among citizens and it revealed that the higher the distrust that people have for the government, the more likely they were to be against taking the COVID-19 vaccine (COVID-19 vaccine hesitancy). And also, lack of trust in government was seen to be directly correlated with great likelihood that citizens were not sure whether or not they will receive the COVID-19 vaccine (COVID-19 vaccine indecisiveness)[36].

2.4 Study Framework

2.4.1 Conceptual Framework

Conceptual framework for COVID-19 vaccine acceptance among pregnant women

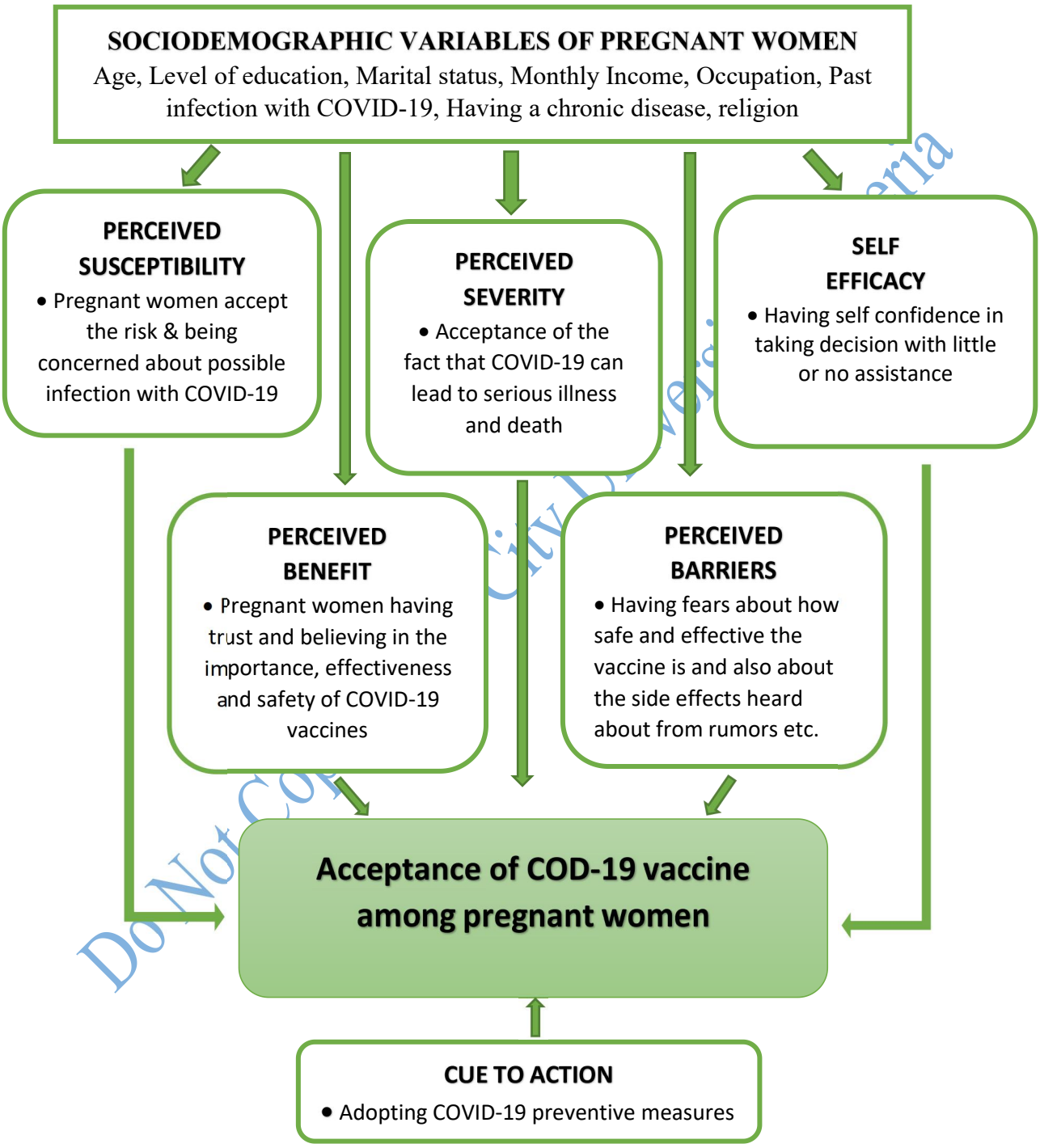


Figure 2.10: Conceptual framework for COVID-19 vaccine acceptance among pregnant women

Source: Researcher's conceptual model 2022

2.5 Summary of Gaps in Literature Reviewed

This study included a majority of respondents from the Yoruba ethnicity as the research location was Ibadan in Oyo state which is in the South-Western part of Nigeria. Thus, it will be of utmost importance for other future research that seek to determine the level of COVID-19 vaccine knowledge and acceptance among pregnant women in Nigeria to include other regions of the country. Another gap in this research was the fact that the research was a cross-sectional study and by so being, the findings in the research failed to give or show relationships between causes and effects.

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Chapter Three

Methodology

3.1 Study Design

This study adopted a facility-based descriptive cross-sectional survey among pregnant women attending antenatal clinics in Ibadan metropolis.

3.2 Study Area

The study area for this study was Ibadan metropolis, referred to as the urban and rural city of Ibadan which consist of five (5) and six (6) local government areas respectively (Fig 3.1). One of Nigeria's largest cities is Ibadan. Ibadan is a city in Nigeria that lies roughly 145 kilometers to the east of Lagos, at longitude 3°5 East of the Greenwich Meridian and latitude 7°2 North of the Equator. The urban local government areas make up around 463.33 km^2 of the 3,123.30 km^2 total land area of the Ibadan metropolitan region. Eleven (11) local government areas (LGAs) make up the city of Ibadan, of which five (5) are urban local governments and the remaining six (6) are peri-urban or rural local governments. According to the preliminary 2006 census data, Ibadan has a population of 2,550,593 people, with 1,338,659 of them living in the city (urban area) and 1,212,294 in the countryside (rural area)[1]. The five (5) urban local government areas are Ibadan North local government area with twelve (12) political wards, Ibadan North-East local government area having with twelve (12) political wards, Ibadan North-West local government area with eleven (11) political wards, Ibadan South-East local government area with twelve (12) political wards and lastly, Ibadan South-West local government area with twelve (12) political wards[2]. While the Rural local government areas include Ido local government area, Ona-ara local government area, Oluyole local government area, Akinyele local government area, Lagelu local government area and Egbeda local government area.

3.3 Study Population

A simple random sampling was used to seek study volunteers (participants) among pregnant women of reproductive age 15 - 49 years, attending antenatal clinic in Primary Healthcare Centers (PHCs) within Ibadan metropolis [3].

For the recruitment process, a list of pregnant women was obtained from the antenatal register of each of the selected primary healthcare centers, excluding their personal records. This gave an idea of the number of pregnant women that attended antenatal clinic on different antenatal days. In order to collect the target participant's responses, hardcopy (paper) questionnaires were employed after they gave their consent to participate in the study. The target participants (pregnant women) were generally invited to fill out the questionnaire as they are waiting in the clinic (PHC) for their antenatal screening and consultation. A Yoruba native was recruited as a project assistance whose duty was to administer the questionnaire to the respondents. A nurse working at each of the selected primary healthcare centers was also recruited to help in the administration process of the questionnaires by explaining the questionnaire in the native language to those who could not understand or read in English.to the participants at the clinics.

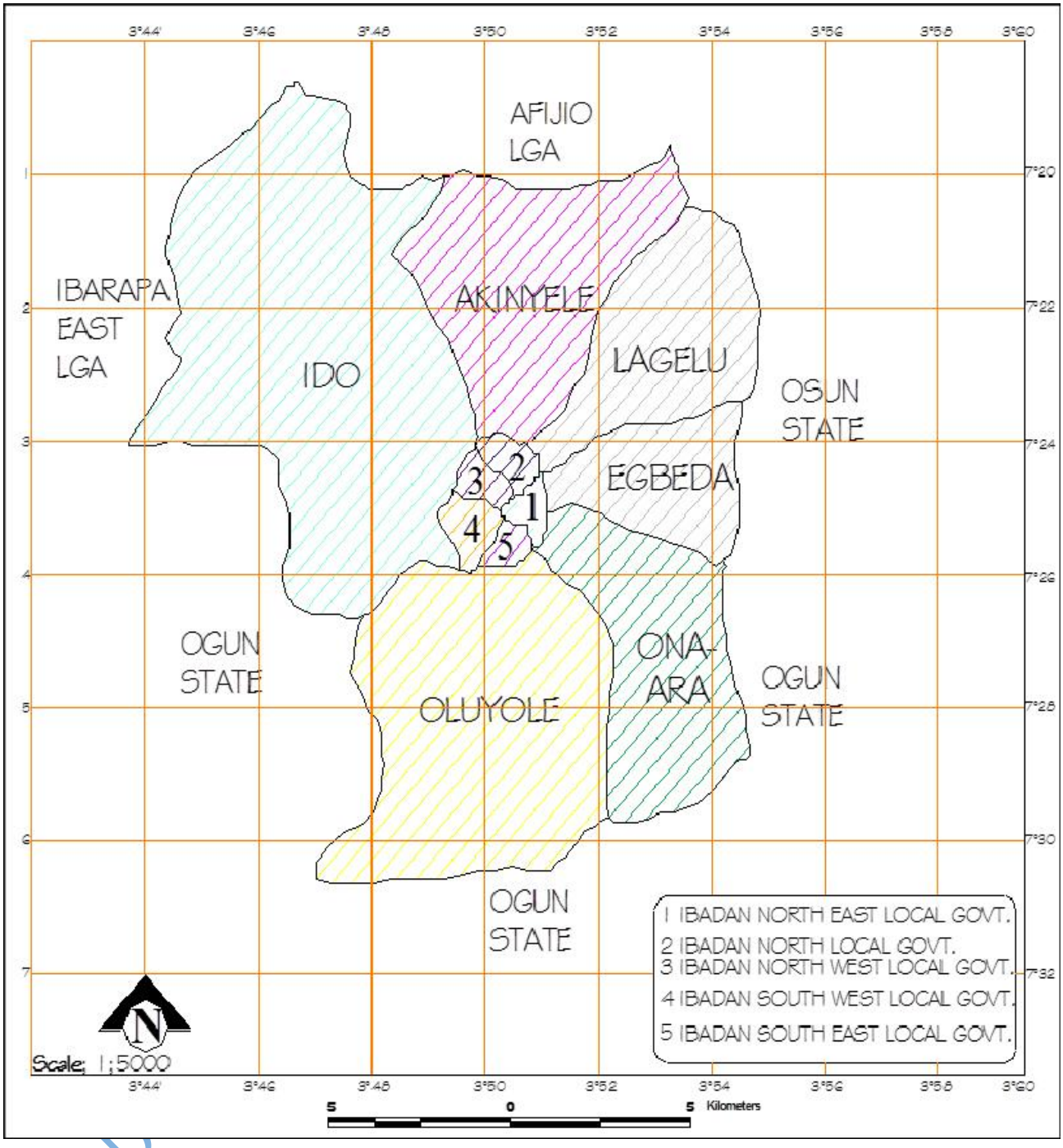

Figure 3.1; Map of Oyo State showing the five (5) urban local government councils and six (6) rural local government councils

Source: [4]

3.4 Sampling Method

A multistage random sampling technique was used in selecting pregnant women who participated in this study. The sampling was done in the following stages;

Stage 1; Simple random sampling method was adopted in selecting two (2) urban local government councils out of the five (5) local government areas that makes up Ibadan urban metropolis (Ibadan city) and also two (2) local government areas out of the six (6) local government areas that made up the rural Ibadan metropolis

Stage 2; Two (2) wards each were then selected from each of the four (4) selected local government areas (urban and rural) using a simple random sampling technique so as to narrow the population size further. Giving a total of eight (8) political wards with each ward having at least one (1) Primary Healthcare Center in it.

Stage 3; One (1) Primary Healthcare Center was further selected from each of the eight (8) political wards earlier selected in stage 2 above, making a total of eight (8) Primary Healthcare Centers (PHCs).

Stage 4; The participants for this study were then gotten from each of the selected primary healthcare centers using a cluster random sampling technique until the required number of respondents was reached.

All the participants (respondents) were contacted at the selected primary healthcare centers on their various antenatal visit days.

3.5 Eligibility Criteria

Inclusion criteria for this study was restricted to women who;

a) Are pregnant at any given trimester as at the time of data collection

b) Are 15 to 49 years of age as at the time of data collection

c) Attending antenatal clinics in the participating Primary Healthcare Centers as at the time of data collection

d) Voluntarily agreed to participate in the study and gave their consent.

Exclusion criteria for the study was any pregnant woman age 15 – 49 years who;

a) Are sick or have any form of complication and was not be fit to participate as at time of data collection

3.6 Sample Size

The Fisher's formula for calculating sample size was used to calculate the sample size for this investigation, and it was established that the desired level of reliability not to exceed 0.05 with 95% confidence interval. The following variables were taken into account when calculating the sample size for this study [5 6];

1) Proportion of COVID-19 vaccine acceptance of 37% base on previous literature[7].
2) A standard normal deviation of 1.96
3) A confidence interval of 95%
4) A margin of error of 5%

Thus, using the formular below;

$$n = \frac{Z^2 p\, q}{d^2}$$

*where $q = 1 - p$

$$n = \frac{Z^2 p\, (1 - p)}{d^2}$$

Where,

n = Minimum sample size required;

Z = Standard normal deviation; 1.96

p = Proportion of COVID-19 vaccine acceptance; 37%

d = Precision; 0.05

Then correction for a possible non- response rate of 10% (0.10) was also put into consideration, which brought the "n: to;

$$n = \frac{n}{(1 - 0.10)}$$

Thus, using;

Z = 1.96

p = 37% (0.37)

d = 0.05

$$n = \frac{1.96^2 \times 0.37 \times (1 - 0.37)}{0.05^2}$$

$$n = \frac{3.8416 \times 0.37 \times 0.63}{0.0025}$$

n = 358.19 Thus n is approximately = 358

Putting into consideration a non- response rate of 10% (0.10), further increased the minimum number of sample size needed (n) as shown below

$$n = \frac{358}{1 - 10\%} \qquad n = \frac{358}{1 - 0.10}$$

$$n = \frac{358}{0.9}$$

n = 397.7 which is approximately = 398

Thus, the total number of participants recruited for this study was 398.

3.7 Instrument for Data Collection

The study was carried out with the aid of a semi–structured interviewer-administered questionnaire that was adapted from previous studies, and given out to recruited respondents in the eight (8) different primary healthcare centers (PHCs) located in selected wards in Ibadan urban and Ibadan rural metropolis of Oyo State, Nigeria [8 9 10 11].

The questionnaire was divided into five (5) sections:

Section A: Socio-Demography Data of the study participants.

Section B: Obstetric health care characteristics of pregnant women attending antenatal clinic in primary healthcare centers in Ibadan

Section C: COVID-19 vaccine knowledge among these pregnant women

Section D: COVID-19 vaccine related attitude base on research theory among the pregnant women

Section E: COVID-19 vaccine acceptance among the pregnant women.

It is important to note that no incentive was given to the research participant to seek their consent in participating in this study.

3.8 Validity of the Study

An instrument's accuracy is referred to as its validity. How well it measures what it is designed to measure is important. The validity of the research instruments (questionnaire) was established through a thorough analysis of the pertinent literature and the establishment of study goals. The instrument was submitted for expert review by consulting with my project supervisor, co-supervisor and other expert in the department in order to get a good and valid research instrument through the guidance that was given to me on how the research instrument should be constructed.

3.9 Reliability of the Study Instrument

In ensuring reliability (measurement consistency) of the research instrument used, the questionnaire was adapted from four different studies done in different countries[8 9 10 11].

Questions that were judged to be unclear or pointless being in the questionnaire were changed or removed accordingly.

Also, for data collection, a project assistant was recruited and trained to facilitate and obtain accurate data from the respondents in each of the primary healthcare centers selected for the study. This is necessary as the questionnaire designed for the study will use an interviewer administered pattern. Nurses fluent in Yoruba language were also recruited to help explain to the respondents some terminologies in the questionnaire. This was necessary as Yoruba is the major language in the locality where the study was carried out.

Furthermore, the data collectors were not directly involved in healthcare delivery to the participants during the course of this study.

3.10 Data Collection Technique

This study used a serially numbered interviewer administered questionnaire. The data were collected by the researcher and research assistants and nurses, which gave the participants a more convenient and comfortable environment making them more relaxed in giving out needed information. The research assistants were trained prior to data collection and during the training, participatory approach was adopted and everyone was involved. Demonstration and return demonstration (role play) approached were also used. The research assistants were responsible for selecting the eligible participants who came to the clinic for their antenatal visit. After consent was gotten, the research assistants administered the questionnaire to all recruited participants. After the questionnaires were filled, checks for completeness and errors was done before the participants leaves the clinic.

3.11 Data Management and Analysis

The completed questionnaires were thoroughly checked for any possible error, completeness and consistencies of variables. After which cleaning, sorting, recording and coding of data for analysis purpose was also done. A coding guide was developed which facilitated data entry into the computer using the Statistical Package for Social Sciences (SPSS version 25) and was then analyzed. The result obtained from the analysis was summarized and presented in tables and charts.

The questions on knowledge and attitude were scored and graded. There were 10 questions on knowledge, 10 questions on attitude, and 1 question on the acceptance of COVID-19 vaccine among pregnant women attending antennal clinic in primary healthcare centers in Ibadan respectively.

Knowledge about COVID-19 vaccine: The highest possible score for knowledge is 10; knowledge was graded as less than seven (<7) being poor knowledge and greater than or equals to seven (≥ 7) being good knowledge.

Attitude towards COVID-19: The highest possible score for attitude is 40 (100%), and the lowest possible score is 10. Poor attitude was graded as <28 and good attitude at ≥28. Attitude of the participants was categorized as positive or good attitude if responds were above or equal to 28 (≥70% of the attitude related items) and negative or poor attitude if below 28 (<70% of the attitude related items). Attitude was scored using a five-point Likert scale adapted from a previous study on COVID-19 vaccine acceptance and its associated factors among pregnant women attending antenatal care clinic in southwest Ethiopia: Strongly agreed = 4, agree = 3, disagree = 2 and strongly disagree = 1, and it was graded as a negative and positive attitude. For COVID-19 vaccine acceptance, pregnant women who answered yes when asked if they have taken the vaccine or will take the vaccine when offered were considered as vaccine acceptance, while those whose answer was no were considered as vaccine hesitancy.

Frequency and proportion were used for the obstetric health care characteristics, and correlation was done to ascertain the significant association between the socio-demographic characteristics and COVID-19 vaccine acceptance. Also, factors affecting COVID-19 acceptance were analysed using logistic regression. The data obtained were presented on a frequency table.

3.12 Ethical Consideration

Ethical approval was obtained from;

1) Oyo State Ministry of Health Research and Ethics Committee.
2) Lead City University Health Research and Ethics Committee.

Confidentiality of all information obtained from the respondents was maintained throughout the course of the study

Also, informed consent was obtained from each respondent before administering the questionnaires. To ensure confidentiality of research participants, identifiers such as names and other information that can reveal the identity of research participants were not included in the research instruments. The nature of the study, benefits and objectives were explained to the respondents and assured that the information given would be treated with utmost confidentiality. Respondents were also intimated about the opportunity to withdraw their consent freely at any point during the study. Confidentiality of each participant was maximally maintained during and after the collection of their information.

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Chapter Four

Result and Discussion of Findings

This chapter presents the findings of the study and the discussion of the findings.

4.1 Socio-Demographic Characteristics of the Respondents

Table 4.1 shows that majority of the respondents are between the ages of 25 to 29 years with 130 (32.7%) respondents, while only 19 (4.8%) of the respondents are within the ages of 40 years and above. Majority of the respondents (362) are living with their partners, while only 9.0% (36) are not living with their partners. Also, 56.5% (225) of the respondents are Christians, while only 43.5% (173) are practicing other religion. 85.5% (340) of the respondents are Yoruba's, while only 14.6% (58) of the respondents are from other tribes. However, 51.8% (206) of the respondents are living in the urban areas, while 48.2% (192) are living in the rural areas. Majority of the respondents have gone through the secondary education (63.1%), and 25.9% having educational status above the secondary level, while only 11.1% have primary education as the highest education attained. However, 58% of the respondents are employed, while 42% are unemployed. It is shown that 40.7% of the respondents have no children alive, while 7.3% have 4 children and above alive.

Table 4.1: Socio-Demographic Characteristics of the Respondents

Variables	Frequency	Percent (%)
Age		
Less than 20 years	34	8.5
20 – 24 years	87	21.9
25 – 29 years	130	32.7
30 - 34 years	73	18.3
35 - 39 years	55	13.8
40 years and above	19	4.8
Marital Status		
Living with a partner	362	91.0
Not living with a partner	36	9.0
Religion		
Christianity	225	56.5
Islam	173	43.5
Traditional	0	0.0
Ethnicity		
Yoruba	340	85.4
Non-Yoruba	58	14.6
Place of Residence		
Rural	192	48.2
Urban	206	51.8
Educational Level		
Primary education	44	11.1
Secondary Education	251	63.1

Tertiary Education	103	25.9
Employment Status		
Unemployed	167	42.0
Employed	231	58.0
Number of Children Alive		
None	162	40.7
1 child	75	18.8
2 children	87	21.9
3 children	45	11.3
4 children and above	29	7.3

Source: Field Survey 2022

4.2 Obstetric Health Care Characteristics

It is observed in table 4.2 that only 15.1% (60) of the women have been pregnant for four times and above, while 39.7% (158) are pregnant for the first time. Also, only 6.5% of the women who have been pregnant four times and above have given birth four times and above. It is also shown from the result that only 1.0% (4) of the woman have cancer, with majority of them (91.5) having no co-morbidities. However, the result shows that only 16.6% said tetanus vaccine was not recommended in this present pregnancy, while 83.4% said tetanus vaccine was recommended in this present pregnancy. 33.9% of the respondents said they have never received any vaccine during this pregnancy, while 66.9% said they received vaccine during the present pregnancy. 65.8% said they received tetanus toxoid during this present pregnancy, while 14.1% had their Covid-19 vaccine shot during this pregnancy. The result also shows that majority (79.6%) of the respondents have never had covid-19 infection before, while only 20.4% said they have had covid-19 infection.

Table 4.2: Obstetric Health Care Characteristics

Variables	Frequency	Percent
Gravity		
Once	158	39.7
Twice	104	26.1
Thrice	76	19.1
Four times and above	60	15.1
Parity		
Never given birth	158	39.7
One time	79	19.8
Two times	86	21.6
Three times	49	12.3
4 times and above	26	6.5
Gestational Age		
0-13 Weeks (1st trimester)	60	15.1
14-28 weeks (2nd trimester)	177	44.5
Above 28 weeks (3rd trimester)	161	40.5
Pre-existing Comorbidities		
High Blood Pressure	7	1.8
Cancer	4	1.0
Overweight/Obesity	23	5.8
None	364	91.5
Tetanus Vaccine recommended in present pregnancy?		
No	66	16.6
Yes	332	83.4
Any Vaccine received during pregnancy?		
No	135	33.9
Yes	263	66.1

If yes, state which vaccine		
Tetanus Toxoid	173	65.8
TT and Covid 19	49	18.6
Covid 19	37	14.1
Others	4	1.5
Had COVID-19 infection before?		
No	317	79.6
Yes	81	20.4

Source: Field Survey 2022

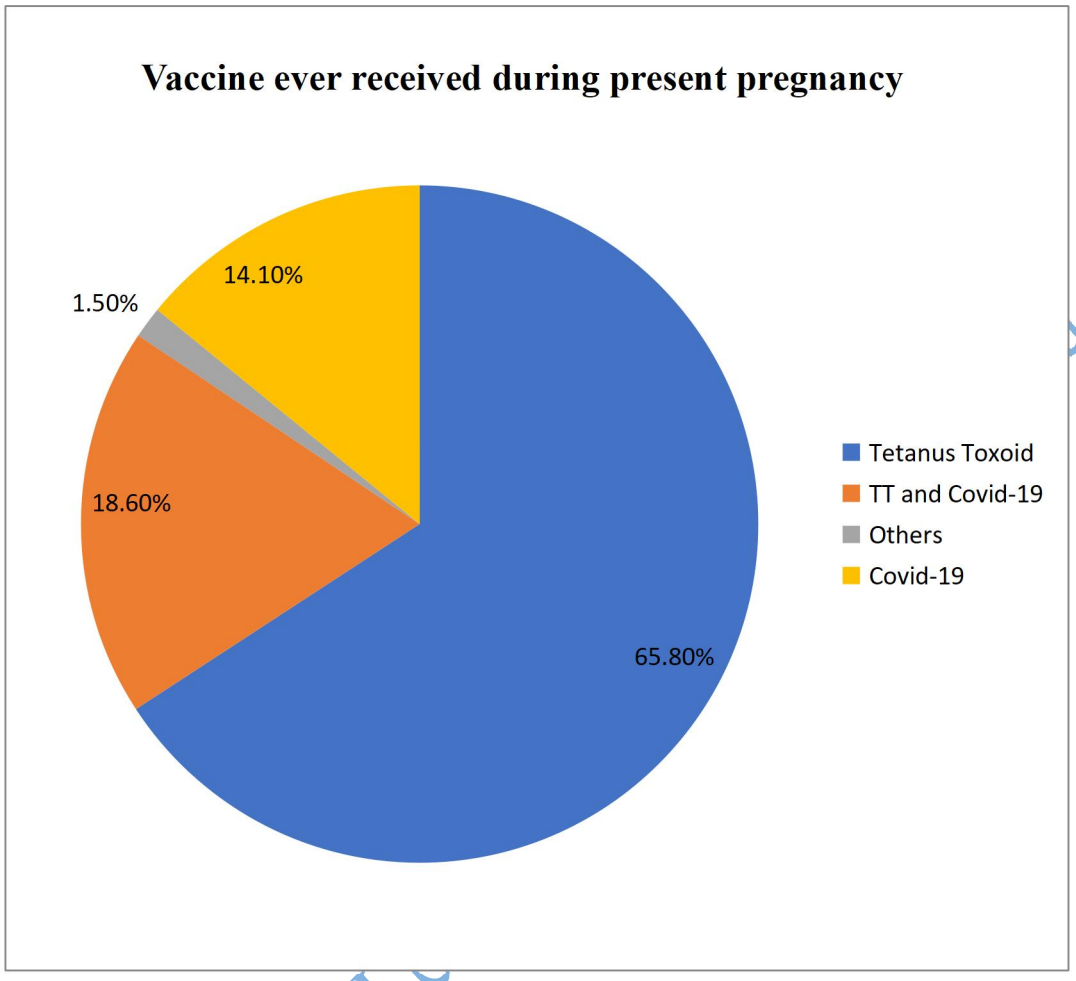

Figure 4.1: Percentage Distribution of Vaccine Ever Received during Present Pregnancy

Source: Field Survey 2022

It is observed from figure 4.1 above that majority of the vaccine received during present pregnancy is tetanus toxoid (65.8%), while 14.1% of the pregnant women had COVID-19 vaccine during the present pregnancy.

4.3 Percentage Distribution of Covid-19 Vaccines Knowledge

It is observed from table 4.3 that 77.9% of the respondents answered correctly that covid-19 vaccine is effective against the infection, while 22.1% were wrong to say that the Covid-19 vaccine is not effective against the infection. 38.2% of the respondents were correct to disagree with the question that some Covid-19 vaccines can give you covid-19 infection, while 61.8% answered the same question incorrectly. 66.3% of the respondent answered correctly that Covid-19 vaccine is given to pregnant women In Nigeria, while 33.7% answered the same question incorrectly. 63.1% of the respondent answered correctly that covid-19 vaccine is safe during pregnancy, while 36.9% answered the same question incorrectly. It is also shown that 57% of the respondent answered correctly that Covid-19 vaccine is safe for the unborn baby, while 43% answered the same question incorrectly. 17.6% of the respondent correctly disagreed with the question that said Covid-19 vaccines do not have side effects unlike other vaccines, while 82.4% answered the same question incorrectly. 31.4% of the respondent answered correctly by disagreeing with the question that says that only one (1) shot of Covid-19 vaccines is recommended in Nigeria, while 68.6% answered the same question incorrectly. 91% of the respondent answered correctly that covid-19 vaccines are administered free of charge in primary healthcare centers across the country, while 9% of the respondent answered the same question incorrectly. 5.3% of the respondent are correct to disagree that Covid-19 vaccine offers protection against Covid-19 infection immediately after receiving the vaccines, while 94.7% of the respondents are wrong to agree that Covid-19 vaccine offers protection against Covid-19 infection immediately after receiving the vaccines. Lastly on the knowledge of Covid-19 vaccines, 95.2% of the respondent answered incorrectly by agreeing that Covid-19 vaccines are stored at room temperature of 20^{o}C, while 4.8% of the respondents answered the same question correctly.

4.3.1 Research Question One: What is the level of knowledge of COVID-19 vaccine among pregnant women attending antenatal clinic in PHCs in Ibadan?

Table 4.3: Percentage Distribution of Covid-19 Vaccines Knowledge

Variables	Correct	Incorrect
Covid-19 vaccine is effective against the infection	77.9%(310)	22.1%(88
Some covid-19 vaccines can give you COVID-19 infection	38.2%(152)	61.8%(246)
COVID-19 vaccines is given to pregnant women in Nigeria	66.3%(264)	33.7%(134)
COVID-19 vaccines is safe during pregnancy	63.1%(251)	36.9%(147)
COVID-19 vaccine is safe for the unborn baby	57%(227)	43%(171)
COVID-19 vaccines do not have side effects unlike other vaccines	17.6%(70)	82.4%(328)
Only one (1) shot of COVID-19 vaccines is recommended in Nigeria	31.4%(125)	68.6%(273)
COVID-19 vaccines are administered free of charge in Primary Healthcare Centers (PHCs) across the country	91%(362)	9%(36)
COVID-19 vaccine offers protection against COVID-19 infection immediately after receiving the vaccines	5.3%(21)	94.7%(377)
COVID-19 vaccines are stored at room temperature of about 20 Degree Celsius	4.8(19%)	95.2%(379)

Source: Field Survey 2022

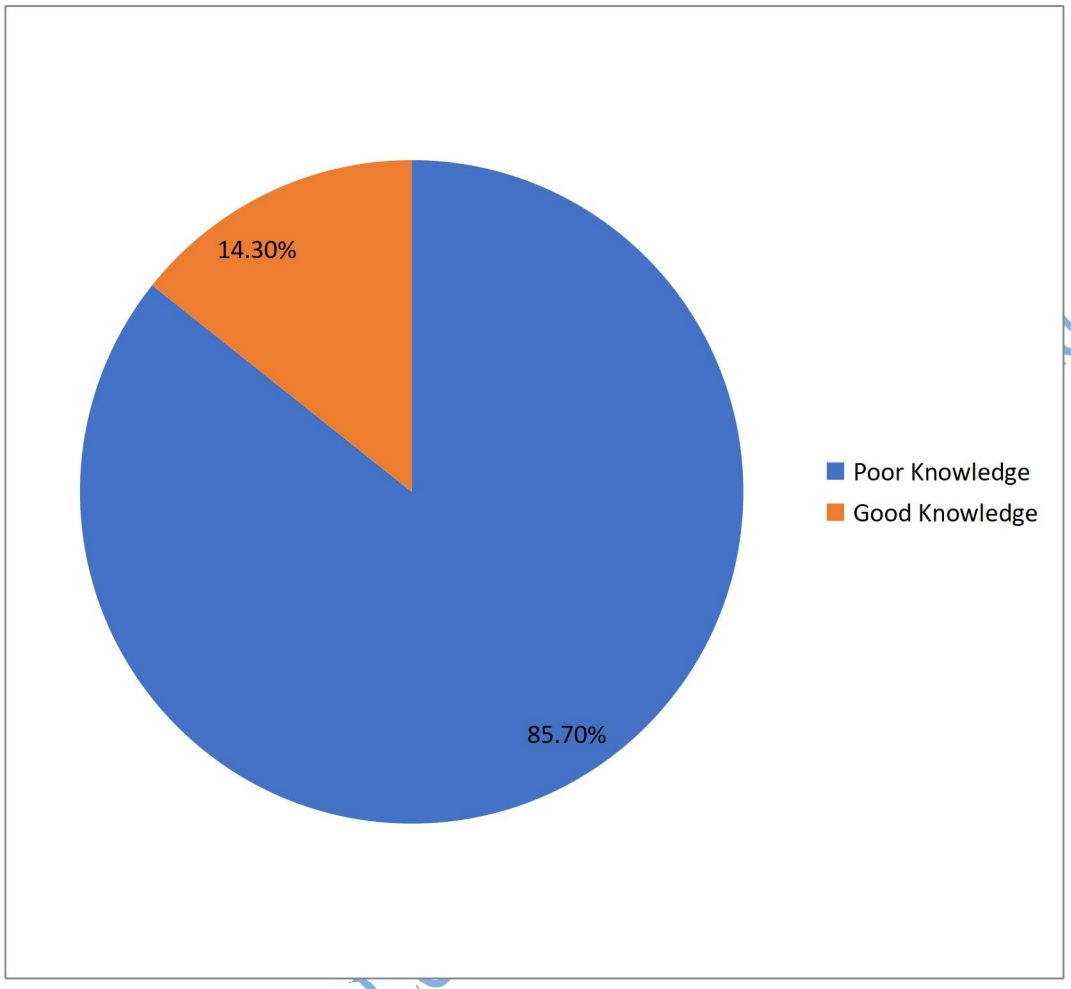

Figure 4.2: Level of Covid-19 Vaccines Knowledge

Source: Field Survey 2022

It is observed from figure 4.2 above that only 14.30% of the respondent have good knowledge of Covid-19 vaccines.

4.4 COVID-19 Vaccine Related Attitude Base on Research Theory

It is observed from table 4.4 that 67.1% of the respondents agreed to being concerned about getting Covid-19 infection while 32.9% showed no concern about getting Covid-19 infection. Also, 59.5% of the respondent agreed that they are concerned about their unborn baby getting Covid-19 infection, while 40.5% of the respondents disagreed to being concerned about their unborn child getting Covid-19 infection. 67.8% of the respondent agreed that if a pregnant woman gets Covid-19 infection, she is more likely to have severe illness, while 32.2% of the respondents disagreed that a pregnant is more likely to have severe illness if she gets infected with Covid-19. 69.1% of the respondents agreed that if a pregnant woman gets infected with Covid-19, the illness could harm her unborn baby, while 30.9% of the respondents disagreed with the statement. Also, as shown in the table, 62.1% of the respondent agreed that covid-19 vaccine can cause a person to get sick with covid-19 infection, while 37.9% of the respondents did not agree with the statement. Also, 49.2% of the respondents did not agree that Covid-19 vaccine is not an effective way to prevent a pregnant woman from getting Covid-19 infection, while 50.8% of the respondents agreed that Covid-19 vaccine is not an effective way of preventing a pregnant woman from getting Covid-19 infection. 81.7% of the respondents agree that giving vaccines to a pregnant woman will benefit her fetus and baby, while 18.3% disagreed. 84.2% of the respondents agree that getting vaccines during pregnancy is a benefit for the pregnant woman, while 15.8% disagreed. However, 81.7% of the respondent agree that if doctors recommended Covid-19 vaccine, they will agree to get vaccinated, while 18.3% said they will not agree to be vaccinated even when doctors recommend the vaccine to them. 55% of the respondent also agreed that if family members recommended the Covid-19 vaccine to them, they would agree to get vaccinated, while 45% of the respondent said they will not agree to get vaccinated even if it was recommended by family members.

4.4.1 Research Question Two: What is the level of attitudes towards COVID-19 and COVID-19 vaccine among pregnant women attending antenatal clinic in PHC's in Ibadan?

Table 4.4: COVID-19 Vaccine Related Attitude Base on Research Theory

Variables	Good	Poor
I am concerned about getting COVID-19 infection	67.1(267)	32.9%(131)
I am concerned about my unborn baby getting COVID-19 infection	59.5%(237)	40.5%(161)
If a pregnant woman gets COVID-19, she is more likely to have severe illness	67.8%(270)	32.2%(128)
If a pregnant woman gets COVID-19, the illness could harm her unborn baby	69.1%(275)	30.9%(123)
COVID-19 vaccine can cause a person to get sick with COVID-19 infection	62.1%(247)	37.9%(151)
COVID-19 vaccine is not an effective way to prevent a pregnant woman from getting COVID-19 infection	49.2%(196)	50.8%(202)
Giving vaccine to a pregnant woman will benefit her fetus and baby	81.7%(325)	18.3%(73)
Getting vaccine during pregnancy is a benefit for the pregnant woman	84.2%(335)	15.8%(63)
If doctors recommended COVID-19 vaccine, I would agree to get vaccinated	81.7%(325)	18.3%(73)
If family members recommended the vaccine, I would agree to get vaccinated	55%(219)	45%(179)

Source: Field Survey 2022

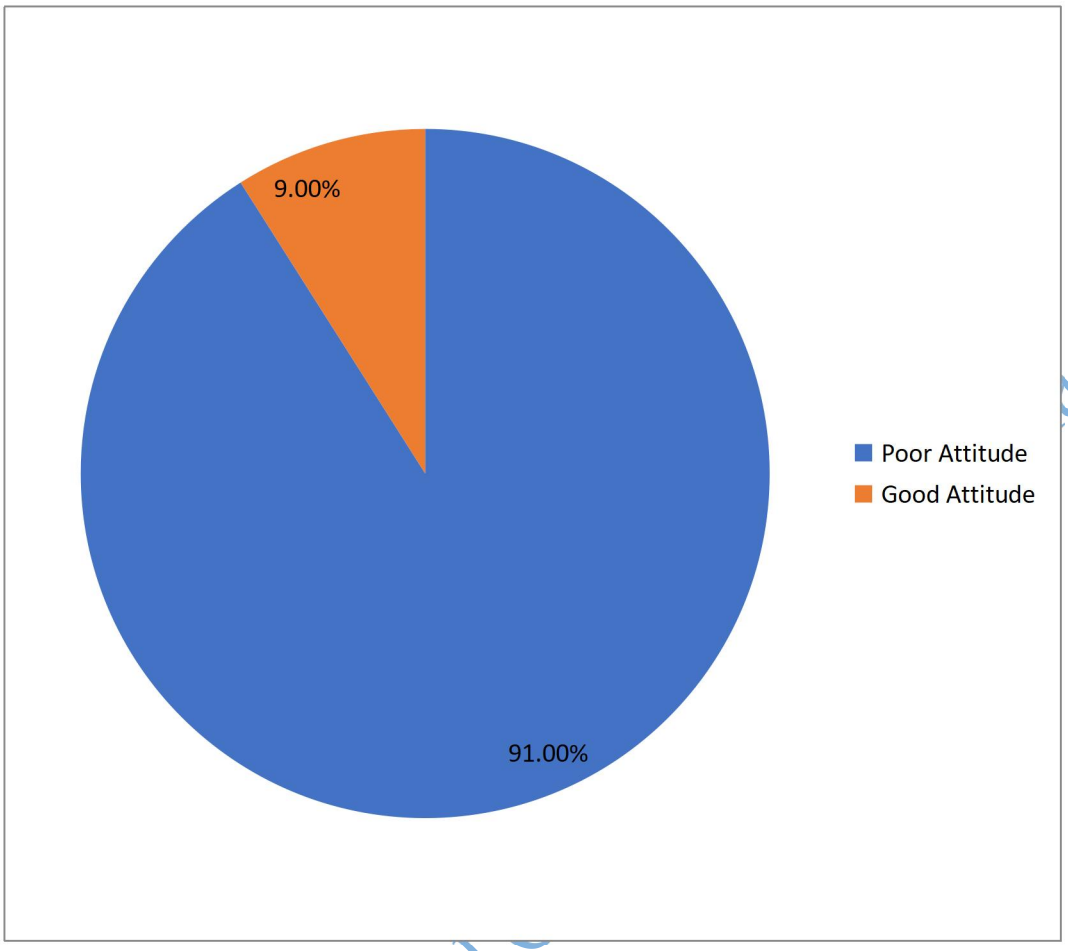

Figure 4.3: Percentage Distribution of COVID-19 Vaccine Related Attitude Base on Research Theory

Source: Field Survey 2022

It is observed from figure 4.3 above that only 9% of the respondents showed good attitude towards Covid-19 vaccine.

4.5 Research Question Three: What is the level of COVID-19 vaccine acceptance among pregnant women attending antenatal clinic in PHCs in Ibadan?

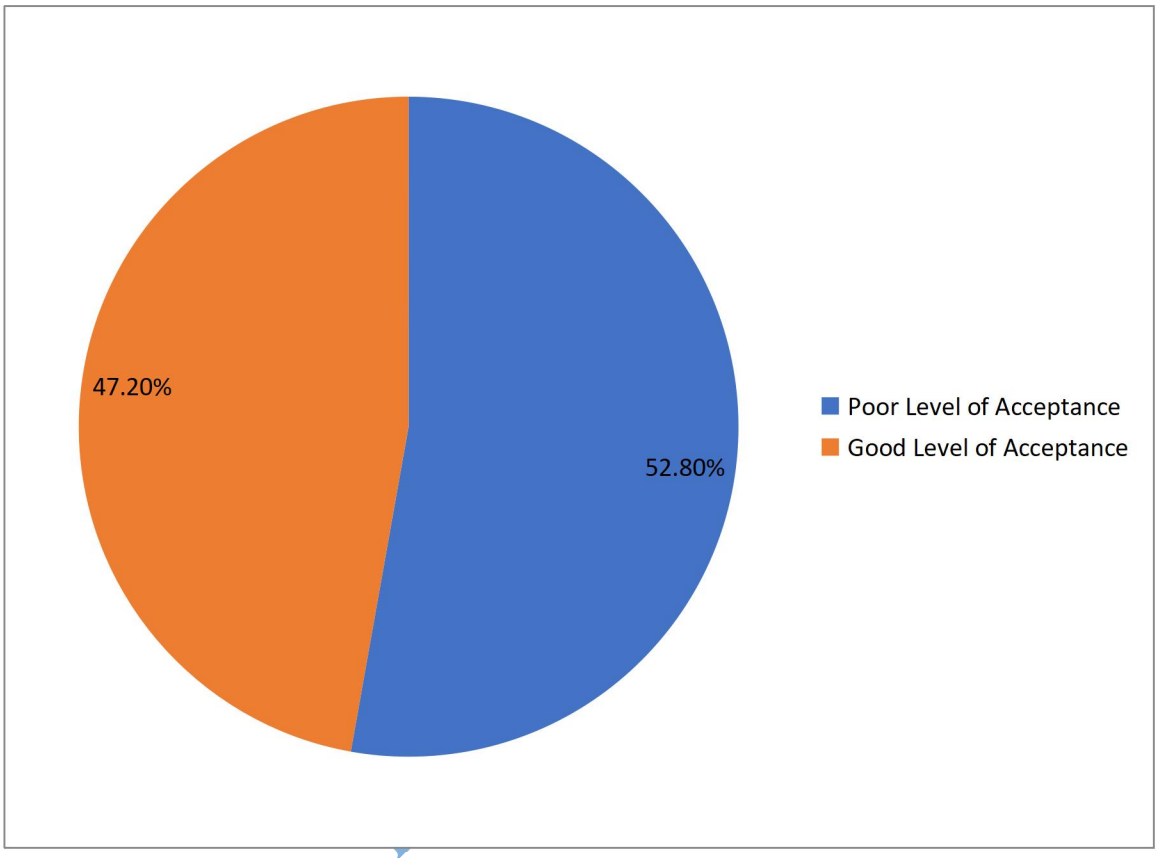

Figure 4.4: Percentage Distribution of COVID-19 Vaccine Acceptance

Source: Field Survey 2022.

It is shown in figure 4.4 that only 47.20% of the respondents have good level of Covid-19 vaccine acceptance.

4.6 Factors Associated with COVID-19 Vaccine Acceptance among Pregnant Women

It is observed from table 4.5 that there is significant association between ages of the respondent and vaccine acceptance at p-value of 0.000. It is also shown from the study that there is no significant association between marital status and vaccine acceptance at p-value of 0.293. The study shows that there is significant association between religion of the respondent and vaccine acceptance at p-value of 0.010. However, there is no significant association between ethnicity, place of residence and vaccine acceptance at p-value of 0.864 and 0.081 respectively. The study also shows that there is significant association between educational levels, number of children alive, gravity, parity, ever received any vaccine during this pregnancy, ever had covid-19 infection, knowledge, attitude and vaccine acceptance at p-value of <0.001, <0.001, 0.018, <0.001, 0.000, 0.029, <0.001, <0.001 respectively. Furthermore, there is no significant association between employment status, co-morbidities and vaccine acceptance at p-value of 0.213, 0.094 respectively.

4.6.1 Research Question Four: What are the factors associated with COVID-19 vaccine acceptance among pregnant women attending antenatal clinic in PHCs in Ibadan?

Table 4.5: Factors Associated with COVID-19 Vaccine Acceptance among Pregnant Women

Variables	Vaccine Acceptance		χ^2	P-value
	No	Yes		
Age			18.781	< 0.001
17-24 years	38.6	21.3		
25-31 years	41.9	44.1		
32-39 years	16.7	27.7		
40 years and above	2.9	6.9		
Marital Status			1.107	0.293
Living with a partner	89.5	92.6		
Not living with a partner	10.5	7.4		
Religion			6.636	0.010
Christian	50.5	63.3		
Islam	49.5	36.7		
Ethnicity			0.029	0.864
Yoruba	85.7	85.1		
Non-Yoruba	14.3	14.9		
Place of Residence			3.051	0.081
Rural	52.4	43.6		
Urban	47.6	56.4		
Educational Level			26.941	< 0.001
Primary Level	11.4	10.6		
Secondary Level	73.3	51.6		
Tertiary Level	15.2	37.8		
Employment Status			1.548	0.213

Unemployed	39.0	61.0		
Employed	45.2	54.8		
Number of Children Alive			23.091	< 0.001
None	46.7	34.0		
1 Child	23.8	13.3		
2 Children	16.2	28.2		
3 Children	7.6	15.4		
4 Children and above	5.7	9.0		
Gravity			10.022	0.018
Once	43.3	35.6		
Twice	29.5	22.3		
Thrice	15.7	22.9		
Four times and above	11.4	19.1		
Parity			23.074	< 0.001
Never given Birth	46.2	32.4		
One time	24.3	14.9		
Two times	14.8	29.3		
Three Times	9.0	16.0		
4 Times and Above	5.7	7.4		
Co-Morbidities			6.395	0.094
High Blood Pressure	1.0	2.7		
Cancer	0.5	1.6		
Overweight/ Obesity	3.8	8.0		
None	94.8	87.8		
Have you received any vaccine during this pregnancy?			25.410	0.000
No	45.2	21.3		
Yes	54.8	78.7		

Have you ever had COVID-19 infection before?			4.749	0.029
No	83.8	75.0		
Yes	16.2	25.0		
Knowledge			13.724	< 0.001
Poor Knowledge	79.5	92.6		
Good Knowledge	20.5	7.4		
Attitude			17.660	< 0.001
Poor Attitude	85.2	97.3		
Good Attitude	14.8	2.7		

Source: Field Survey 2022

4.7 Discussion of Findings

On the basis of COVID-19 vaccine knowledge, the findings of this study revealed that 77.9% of the respondents agree that COVID-19 vaccine is effective against the virus, this finding is not in agreement with that of an observational study that was carried out in seven (7) low-and-middle-income countries (LMIC) where only 29.2% considered the vaccine to be effective against the virus[1]. A study carried out in the united State of America among 1,516 pregnant women interestingly recorded only 25.7% knowledge on whether the COVIOD-19 vaccine is effective against the infection. Comparing this study with a study in Bangladesh, it showed that 57.02% respondent reported that the COVID-19 vaccine was effective against the virus as compared to 77.9% that was seen in this study. Furthermore, it could be seen in this study that 14.30% of the respondents had an overall good knowledge on COVID-19 vaccine which is small when compared to similar study carried out in Ebonyi State, Nigeria where about 43.5% of the respondents had good knowledge[2]. This contrast could be due to the fact that majority of pregnant women that attended antenatal visit in Primary Healthcare Centers have low educational status and low-income families [3].

This study revealed that pregnant women's attitude to COVID-19 vaccine has significant statistical relationship (association) with COVID-19 vaccine acceptance at p-value of <0.001 which is in agreement with a study carried out in China which saw statistical relationship between COVID-19 vaccine and attitude base on health believe, it was also observed from the same study in China that pregnant women who are concerned about getting COVID-19 infection, those who are in agreement about the benefit of the vaccine to their unborn baby, and those who agree to take the vaccine if recommended to them by healthcare practitioners were seen to be more likely to take the COVID-19 vaccine at p-value of <0.01[4]. This study showed 61.7% of the pregnant women being concerned about getting COVID-19 vaccine, this finding is in contrast with a study that was carried out in the United States where it saw only 30,6% of the pregnant women being worried about getting COVID-

19 infection[5]. In this study, COVID-19 vaccine acceptance was higher in pregnant women with poor attitude at 97.3%, this finding is not in agreement with the finding gotten from the study in the United States where COVID-19 vaccine acceptance was seen to be higher in pregnant women with good (positive) attitude[5].

The findings on COVID-19 vaccine acceptance among pregnant women in this study revealed that 47.20% of the respondents showed vaccine acceptance and interestingly, 92.6% of the pregnant women that showed vaccine acceptance had poor COVID-19 vaccine knowledge as against only 7,4% acceptance seen in respondents with good COVID-19 vaccine knowledge which is interestingly in agreement with a study that was carried out in mainland China where more educated pregnant women showed more COVID-19 hesitancy when compared to pregnant women with less education[4]. The finding in this study on COVID-19 vaccine acceptance among pregnant women shows a higher vaccine acceptance when compared to a study done in Kano State, Nigeria which saw 33.8% COVID-19 vaccine acceptance among pregnant women[6]. Also, a similar study in the middle east also revealed a low level of COVID-19 vaccine acceptance of 36.8% among pregnant women[7].Furthermore, the finding in this study is in contrast from a similar study carried out in Saudi Arabia where data revealed that 68% of the respondents agreed to take the COVID-19 vaccine[8], which is similar to another different study that was done in Kwandabeka Community Health Center, Durban, in South Africa which also revealed a COVID-19 acceptance rate of 63.3%[9] which is high when compared to the acceptance level in this study of only47.2%.

Findings from this study reported a significant association between ages of the respondent and COVID-19 vaccine acceptance at p-value of <0.001. This agrees with a study that was carried out in China which also showed significant association between age and COVID-19 vaccine acceptance[4]. Another strange agreement is based on the level of education and COVID-19 vaccine acceptance

which is seen in this study where only 37% of the pregnant women with tertiary education showed vaccine acceptance. This is in agreement with the study carried out in China where a lower acceptance was observed among pregnant women with higher education level which also corelated with the knowledge on COVID-19 vaccine[4]. An institution-based cross-section survey carried out in Ethiopia showed association between vaccine acceptance and age where younger women are 1.5% more likely to take the vaccine than older women[10]. which is in agreement with this study. This Study showed no association between marital status and COVID-19 vaccine acceptance at p-value of 0.293 which is in agreement with the previous study in Ethiopia where there was no association between marital status and COVID-19 vaccine acceptance[10]. In another cross-sectional study in Saudi Arabia, it was reported that educational level and receiving the tetanus vaccine during the present pregnancy had Signiant association with COVID-19 vaccine acceptance among pregnant women at p-value of 0.002 and 0.000 respectively, which is in agreement with result gotten from this study where it was reported that educational level and taking the tetanus vaccine had significant association with COVID-19 vaccine acceptance at p-value of <0.001 and <0.001 respectively[8].

Endnotes

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Chapter Five

Discussion

5.1 Summary of Findings

This study's primary objective was to determine the level of acceptance of COVID-19 vaccine among pregnant women attending antenatal care in primary healthcare centers in Ibadan. This research topic was chosen because there is a lack of research on this topic in Oyo State and in the South-Western region of Nigeria. The study reviewed existing literatures carefully to identify this gap and to set clear goals, definitions, and limits for the research.

The study was a facility-based cross-sectional survey involving 398 pregnant women. The respondents were recruited using a multistage random sampling technique and data were collected using an adapted semi–structured interviewer-administered questionnaire.

Results gotten from this study revealed that pregnant women have very low knowledge of COVID-19 vaccines with poor attitude to COVID-19 infection and COVID-19 vaccine. The research also revealed that pregnant women are hesitant when it comes to COVID-19 vaccine as result gotten showed poor level of COVID-19 vaccine acceptance. Data also showed that there is significant association between educational levels, number of children alive, gravity, parity, ever received any vaccine during this pregnancy, ever had covid-19 infection, knowledge, attitude and age of the pregnant women with COVID-19 vaccine acceptance.

5.2 Conclusion

This study has shown that the COVID-19 pandemic has had a significant impact on pregnant women and their babies. Pregnant women are at an increased risk of severe illness and hospitalization from COVID-19, and their babies are at an increased risk of premature birth and low birth weight. COVID-19 vaccination is the safest and most effective way to protect pregnant women and their babies against the virus. However, this study and other similar studies have revealed that many

pregnant women are hesitant to get vaccinated. This may be likely due to a number of factors which may include concerns about the safety of the vaccine, misinformation on the effectiveness of the vaccine and lack of long-term data on the safety profile of the vaccine. This study also revealed that the knowledge and acceptance of COVID-19 vaccine among pregnant women is low. The most common reason for vaccine hesitancy were concerns about the safety of the vaccine for the mother and the baby. Healthcare providers should be employed to play a vital role in educating pregnant women about the benefits of COVID-19 vaccination. Pregnant women should be encouraged to get vaccinated by address any fear and concerns that they may have on the vaccine. By increasing knowledge on the safety and efficacy of COVID-19 vaccine among pregnant women, COVID-19 vaccine acceptance among pregnant women will increase, this will help in protecting them and their babies from COVID-19 infection.

5.3 Recommendations

Base on the data and findings gotten from this research, some recommendations were made and are stated below:

1) Health care workers should do more by providing health education to pregnant mothers during antenatal care visits to primary healthcare centers across the county to increase their knowledge aboutCOVID-19 infection, COVID-19 vaccine and also preventive measures to take against the infection especially during pregnancy.
2) Government and policy makers should create awareness on the safety and effectiveness of COVID-19 vaccines and come up with policies that will drive the interest of pregnant women to accessing Primary Healthcare Centers {PHCs) across the country for their antenatal visits where they can have access to information on COVID-19 vaccines and also the vaccines.

3) To encourage and increase the acceptance of COVID-19 vaccine among pregnant women, the government should put in place adequate, accessible and affordable healthcare facilities across the country where these pregnant women can visit and get adequate healthcare and also information on COVID-19 vaccines and its safety.
4) Government should increase and intensify training and retraining of healthcare workers in Primary Healthcare Centers across the country and in other healthcare institution to increase their knowledge on COVID-19 and COVID-19 vaccines.
5) Government and policy makers should increase the health budget of the country so as to meet up the global best practice on health. By so doing, most of the challenges regarding COVID-19 vaccine acceptance will be address.
6) Public health campaigns and health advocacies should be developed to increase knowledge and acceptance of the COVID-19 vaccine among pregnant women. These campaigns should emphasize the safety and efficacy of COVID-19 vaccine, as well as the benefits of vaccination for both the mother and the baby.
7) Vaccination programs are higher when there is high acceptance of a vaccine, thus, Government needs to understand Nigerian's risk perception on COVID-19 vaccine, confidence in Government and also confidence in the health care system so as to put in mechanisms to increase confidence and acceptance of the vaccines.

5.4 Contribution to Knowledge

1) This study has in the course of its finding increased the knowledge of COVID-19 vaccines and emphasized on the need of constant education of pregnant women and health care workers on COVID-19 and COVID-19 vaccines.
2) The findings from this study would serve as a reference tool in the planning and implementation of COVID-19 immunization programs that will increase COVID-19 vaccine

acceptance among pregnant women and as well reduce vaccine hesitancy to the barest minimum among pregnant women.

3) Information and findings from this study should be of great value and importance to various stakeholders in healthcare system, the health administrators, health policy makers, health educators, public health practitioners and to the consumers of healthcare services.
4) By understanding the knowledge and attitude towards COVID-19 infection and COVID-19 vaccines, healthcare workers can provide adequate and credible information on the safety and effectiveness of COVID-19 vaccines, this will help in eliminating the fear of COVID-19 vaccine during pregnancy and in turn reduce vaccine hesitancy among pregnant women and the population in general.
5) The findings of this study have important implications for public health. It is clear that more needs to be done to increase knowledge and acceptance of the COVID-19 vaccine among pregnant women. This can be done through public health campaigns and interventions that emphasize the safety and efficacy of the vaccine, as well as the benefits of vaccination for both the mother and the baby. Healthcare providers can also play a role in educating pregnant women about the COVID-19 vaccine and addressing any concerns they may have.

5.5 Suggestions for Further Research

This study focused on pregnant women attending antenatal care in primary healthcare centers within Ibadan metropolis alone, it is therefore suggested that further studies should be done in this field so as to cover more scope as follows:

1) The studies should be carried out in other regions of the country such as the Southeast, Northwest, Northeast and Northcentral where less or no such studies have been carried out.
2) Future research work should be carried out on COVID-19 vaccine acceptance among breast feeding and physically challenged pregnant women.

3) Looking into the various variants of COVID-19 and the level of effectiveness the present vaccines are on the new variants is an aspect that more research should be focused on in Nigeria.
4) Studies should be carried out on the long-term effect of the COVID-19 vaccines on newborns and adult as a whole so as to get a clearer and more scientific evidence to back the safety profile of the vaccine on humans.

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Appendix i

Lead City University (LCU)

Motto: Knowledge for Self-reliance

Lagos - Ibadan Expressway, Toll Gate Area, Ibadan, Oyo State, Nigeria

Email: lcu.hrec@lcu.edu.ng

NHREC

University Research Ethics Committee

PROJECT TITTLE: **KNOWLEDGE AND ACCEPTANCE OF COVID-19 VACCINE AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC IN PRIMARY HEALTHCARE CENTERS IN IBADAN, OYO STATE.**

PROJECT NUMBER: **LCU-REC/22/192.**

APPROVAL LETTER

The above named proposal has been adequately reviewed; the protocol and safety guidelines satisfy the conditions of *LCU-REC* policies regarding experiments that use human subjects.

Therefore, the study under its reviewed state is hereby approved by the LCU - Research Ethics Committee.

Prof. Olusola Ladokun .....

Name of LCU-REC Chairman *Signature of LCU-REC Chairman*

Dr. Folahanmi Akinsolu .....

Name of LCU-REC Secretary *Signature of LCU-REC Secretary*

This approval is given with the investigator's Declaration as stated below;

By signing below I agree/certify that:

1. I have reviewed this protocol submission in its entirety and that I am fully cognizant of, and in agreement with all submitted statements.
2. I will conduct this research study in strict accordance with all submitted statements except where a change may be necessary to eliminate apparent immediate hazard to a given research subject.
   - I will notify the REC promptly of any change in research procedures necessitated in the interest of the safety of a given research subject.
   - I will request and obtain REC approval of any proposed modification to the research protocol or informed consent document(s) prior to implementing such modifications.

3. I will ensure that all co-investigator and other personnel assisting in the conduct of this research study have been provided a copy of the entire current version of the research protocol and are fully informed of the current (a) study procedures (including procedure modifications); (b) informed consent requirements and process; (c) potential risks associated with the study participation and the steps required to be taken to prevent or minimize these potential risks; (d) adverse events reporting requirements; (e) data and record-keeping; and (f) the current REC approval status of the research study.

4. I will respond promptly to all requests for information or materials solicited by the REC or REC Office.

5. I will submit the research study in a timely manner for the REC renewal approval.

6. I will not enroll any individual into this research study until such time I obtain his/her written informed consent, or if applicable, the written informed consent of his/her authorized representative (i.e unless the REC has granted a waiver of the requirement to obtain informed consent).

7. I will employ and oversee an informed consent process that ensures that potential research subjects understand fully the purpose of the research study, the nature of the research procedures they are being asked to undergo, the potential risks of these research procedures, and their rights as a research study volunteer.

8. I will ensure that the research subjects are kept fully informed of any new information that may affect their willingness to continue to participate in the research study.

9. I will maintain adequate, current, and accurate records of research data, outcomes, and adverse events to permit an ongoing assessment of the risks/benefits ratio of research study participation.

10. I am cognizant of, and will comply with, current federal regulations and REC requirements governing human subject research including adverse event reporting requirements.

11. I will make a reasonable effort to ensure that subjects who have suffered adverse event associated with research participation receive adequate care to correct or alleviate the consequences of the adverse event in the extent possible.

12. I will ensure that the conduct of this research study adheres to Good Clinical Practice guidelines.

Mr Jatau Gad ..... Sept 2022 .....

Principal Investigator's Name — Principal Investigator's Signature and Date

Appendix ii

TELEGRAMS..... TELEPHONE.....

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. .....
All communications should be addressed to the Honorable Commissioner quoting
Our Ref. No. AD 13/479/ 44591[B]

16th September, 2022

The Principal Investigator,
Department of Public Health,
Faculty of Public Health
Lead City University,
Ibadan, Nigeria.

Attention: Jatau Gad

ETHICS APPROVAL FOR THE IMPLEMENTATION
OF YOUR RESEARCH PROPOSAL IN OYO STATE

This is to acknowledge that your Research Proposal titled: "Knowledge and Acceptance of COVID-19 Vaccine among Pregnant Women Attending Antenatal Clinic in Primary Healthcare Centers in Ibadan, Oyo State." has been reviewed by the Oyo State Ethics Review Committee.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. Wishing you all the best.

Dr. Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State Research Ethics Review Committee

Appendix iii

Informed Consent Form

Knowledge And Acceptance of Covid-19 Vaccine Among Pregnant Women Attending Antenatal Clinic in Primary Healthcare Centers in Ibadan, Oyo State

Department Of Public Health

Faculty Of Public Health

Lead City University

Ibadan, Oyo State.

Names, Affiliations and Positions of the researchers conducting the study:

A. Name: Mr. Gad Jatau

Affiliation: Lead City University, Ibadan, Nigeria.

Position: Principal Investigator

B. Name: Dr. Tubosun Olowolafe

Affiliation: Lead City University, Ibadan, Nigeria.

Position: Supervisor

You will be given a copy of the full Informed Consent Form

PURPOSE OF THE STUDY

My name is Jatau Gad, a postgraduate student of Lead City University, Ibadan. I am conducting a study on the knowledge and acceptance of covid-19 vaccine among pregnant women attending antenatal clinic in Primary Health Care Centers in Ibadan, Oyo state, Nigeria.

I am interested in understanding the level of knowledge of COVID-19 vaccine among pregnant women attending antenatal clinic in primary healthcare centers within Ibadan metropolis of Oyo state. I equally want to know the level of COVID-19 vaccine acceptance and/or hesitancy among the

pregnant women and also to determine the associated factors that influence their decision to COVID-19 vaccine acceptance and/or hesitancy. Your insight and response to the research questionnaire will assist me understand the reasons behind COVID-19 vaccine acceptance and hesitancy among pregnant women.

RESEARCH PROCEDURE

If you agree to be in this study, you will be asked to answer questions about yourself as well as questions about COVID-19, COVID-19 vaccine, COVID-19 vaccine acceptance and factors that determine accepting or not accepting the COVID-19 vaccine. These questions will be asked using a structured questionnaire. To fill the questionnaire will take about 5 to 10 minutes of your time.

RISKS AND BENEFITS

There is minimum or no risks if you take part in this study. There are also no incentives but the information you provide will help you improve on your health and that of your loved ones.

COMPENSATION

There is no monetary compensation or incentive for this study. Participation is voluntary.

CONFIDENTIALITY

Like it is stated above, your comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality. Only the research team will have access to the answered questionnaires. Confidentiality and privacy will be maintained by keeping all materials under lock and key. Your name will not be recorded at any point in the course of filling in the questionnaire.

CONTACT INFORMATION

Who can I contact about this study? If I have questions or concerns about this research study, whom can I call?

You can call us with your questions or concerns. Our telephone numbers are listed below. Ask questions as often as you want

Mr Gad Jatau,

+2348034501885

gad2nv@gmail.com

Department of Public Health,

Lead City University, Ibadan.

If you want to speak with someone involved in this research study, please contact:

Dr. Tubosun Olowolafe

+2348033936388

Department of Public Health,

Lead City University, Ibadan.

You can talk to them about:

1. Your rights as a research subject
2. Your concerns about the research
3. A complaint about the research and also, if you feel pressured to take part in this research study, or to continue with it, they want to know and can help.

When you call or write about a concern, please provide as much information as possible, including the name of the researcher, the Ethics Committee number (at the top of this form), and details about

the problem. This will help Ethics Committee officials to look into your concern. When reporting a concern, you do not have to give your name unless you want to.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CERTIFICATE OF CONSENT

I have read and I understand the provided information and I have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I voluntarily agree to take part in this study..

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

If illiterate

A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb-print as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness_____ Thumb print of participant

Signature of witness _____

Date _____

Statement by the Researcher/Person Taking Consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that participants will be asked to fill a short questionnaire to assess their experience and views on contraceptive use.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Print Name of Researcher/Person taking the consent_____

Signature of Researcher /Person taking the consent_____

Date _____

Appendix iv

Questionnaire

Knowledge And Acceptance of Covid-19 Vaccine Among Pregnant Women Attending Antenatal Clinic in Primary Healthcare Centers in Ibadan, Oyo State

Department Of Public Health
Faculty Of Public Health
Lead City University
Ibadan, Oyo State.

QUESTIONNAIRE

Dear Respondent,

I am Jatau Gad, a master's student of the above-named institution. This research is in partial fulfillment of the award of Masters in Public Health (MPH). The purpose of this study is to investigate the knowledge and acceptance of COVID-19 vaccine among pregnant women attending antenatal clinic in primary health care centers in Ibadan, Oyo state, Nigeria. The study will determine the level of knowledge that pregnant women have on COVID-19 vaccine and will also determine the level of acceptance of COVID-19 vaccine among pregnant women attending antenatal clinic within Ibadan metropolis.

I request your assistance in completing the questionnaire and I promise that all information provided will be strictly confidential.

Thank You.

Yours Sincerely,

Jatau Gad.
Researcher

SECTION A: SOCIO – DEMOGRAPHIC CHARACTERISTICS.

Kindly tick (√) or fill in the space provided in the statements below.

1. Age as at last birthday: _____

2. Marital status: Married ( ) Divorced ( ) Widowed ( ) Separated ( ) Single ( )

3. Religion: Christianity ( ) Islam ( ) Traditional ( ) Others (Specify)_____

4. Ethnicity: Yoruba ( ) Igbo ( ) Hausa ( ) Others (specify)_____

5. Place of residence: Rural ( ) Urban ( )

6. Educational level: Primary level ( ) Secondary level ( ) Tertiary level ( ) No formal education ( )

7. Employment status: Unemployed ( ) Employed ( )

8. Monthly income (salary or business): ₦_____

9. Number of children (alive): _____

SECTION B: OBSTETRIC HEALTH CARE CHARACTERISTICS

Kindly fill in, tick **(√)** or mark the option that best represents your opinion in the statements provided.

10. How many times have you been pregnant before (Gravity)? _____

11. How many times have you given Birth (Parity)? _____

12. How many Antenatal Care (ANC) visit have you attended during this current pregnancy? _____

13. How far gone is your pregnancy? 0 – 13 weeks (1st trimester)**( )** 14 – 28 weeks (2nd trimester) **( )** above 28 weeks (3rd trimester) **( )**

14. Do you have any pre-existing maternal medical illness (comorbidities)? Diabetes **( )** High blood pressure **( )** Cancer **( )** Overweight/Obesity **( )** Others (specify):_____

15. Was the tetanus vaccine recommended in this present pregnancy? Yes ( ) No ( )

16. Have you received any vaccine during this pregnancy? Yes ( ) No ( )

17. If "yes" to No 16 above, please state which vaccine(s): _____

18. Have you ever had COVID-19 infection before? Yes ( ) No ( )

SECTION C: COVID-19 VACCINE KNOWLEDGE

Kindly tick (√), fill in or mark the option that best represents your opinion in the statements provided.

19. COVİD-19 vaccine is effective against the infection; Agree ( ) Not sure ( ) Disagree ( )

20. Some COVID-19 vaccines can give you COVID-19 infection; Agree ( ) Not sure ( ) Disagree ( )

21. COVID-19 vaccine is given to pregnant women in Nigeria; Agree ( ) Not sure ( ) Disagree ( )

22. COVİD-19 vaccine is safe during pregnancy; Agree ( ) Not sure ( ) Disagree ( )

23. COVİD-19 vaccine is safe for the unborn baby; Agree ( ) Not sure ( ) Disagree ( )

24. COVID-19 vaccine do not have side effects unlike other vaccines; Agree ( ) Not sure ( ) Disagree ( )

25. Only one (1) shot of COVID-19 vaccine is recommended in Nigeria; Agree ( ) Not sure ( ) Disagree ( )

26. COVID-19 vaccines are administered free of charge in Primary Healthcare Centers (PHCs) across the country; Agree ( ) Not sure ( ) Disagree ( )

27. COVİD-19 vaccine offers protection against COVID-19 infection immediately after receiving the vaccine; Agree ( ) Not sure ( ) Disagree ( )

28. COVID-19 vaccines are stored at room temperature of about 20^{o}C; Agree ( ) Not sure ( )

Disagree **( )**

29. Where did you get the information on COVID-19 vaccine from? Healthcare provider(s) ( ) Friend(s) ( ) Government Agencies ( ) Family member(s) ( ) Social Media ( ) News from Television/Radio ( ) Others (specify) _____

SECTION D: COVID-19 VACCINE RELATED ATTITUDE BASE ON RESEARCH THEORY

Kindly indicate your level of response by ticking **(√)** or marking the box that best describes the level of your response.

Key: SA- Strongly Agree, **A-** Agree**, D-** Disagree **SD-** Strongly Disagree

	Statement	**SA**	**A**	**D**	**SD**
30.	I am concerned about getting COVID-19 infection				
31.	I am concerned about my unborn baby getting COVID-19 infection				
32.	If a pregnant woman gets COVID-19, she is more likely to have severe illness				
33.	If a pregnant woman gets COVID-19, the illness could harm her unborn baby				
34.	COVID-19 vaccine can cause a person to get sick with COVID-19 infection				
35.	COVID-19 vaccine is not an effective way to prevent a pregnant woman from getting COVID-19 infection				
36.	Giving vaccine to a pregnant woman will benefit her fetus and baby				
37.	Getting vaccine during pregnancy is a benefit for the pregnant woman				
38.	If doctors recommended COVID-19 vaccine, I would agree to get vaccinated				

39.	If family members recommended the vaccine, I would agree to get vaccinated				

SECTION E: COVID-19 VACCINE ACCEPTANCE

40. Have you received any shot of COVID-19 vaccine? Yes **( )** No **( )**

41. If "yes" to no. 40 above, how many shots of the vaccine have you received? _____

42. If "yes" to no. 40, your decision to receive the vaccine was driven by?

    a. ( ) Confidence in COVID-19 vaccine potency

    b. ( ) Convinced by healthcare provider

    c. ( ) Convinced by partner (husband)

    d. ( ) Made compulsory by employer

    e. ( ) To avoid likely punishment by government

    Others, specify: _____

43. If "no" to no. 40 above, will you accept the COVID-19 vaccine when offered? Yes **( )** No **( )**

44. If "yes" to no. 43 above, give reason(s) why:

    a. ( ) For the benefit of the baby and others

    b. ( ) To protect myself from COVID-19 infection

    c. ( ) Trust in the government and healthcare system

    Others, specify: _____

45. If "no" to no. 43 above, give reason(s) why:

    a. ( ) Lack of Trust in the Government

    b. ( ) Lack of trust in the vaccine manufacturers

    c. ( ) Reports heard/read on media (television, radio)/on social media

    d. ( ) Fear of the vaccine side effects

    e. ( ) Decision driven by partner (husband)

Others, specify: _____

Bio-data

A. Personal Data

Full Name:	Jatau GAD
Address:	Favour Street, House 13, Emmanuel Estate, Alaja, Ibadan, Oyo State
Email:	gad2nv@gmail.com
Phone Number:	08034501885
Sex:	Male
Date of Birth:	4th October, 1985
Place of Birth:	Lafia, Nasarawa State
State of Origin:	Nasarawa State
Local Government:	Nasarawa Eggon
Ethnicity:	Eggon
Nationality:	Nigerian
Next of Kin:	Mrs Asheolu Gad Jatau
Address of Next of Kin:	Favour Street, House 13, Emmanuel Estate, Alaja, Ibadan, Oyo State

B. Educational Background

Educational institutions Attended with Date and qualification

PTA/NADP Nursery Primary School Lafia **1991 - 1997**

First School Leaving Certificate

Federal Government College Jos, Plateau **1997 – 2003**

West African Senior School Certificate

University Of Jos, Plateau **2005 - 2011**

Bachelor of Pharmacy (B.Pharm) Degree

Nasarawa State University **2014 – 2016**

Postgraduate Diploma in Management (PGDM)

Lead City University, Ibadan, Oyo State **2021 – Current**

Masters of Public Health (MPH)

Professional Qualification

Associate of Pharmacy Council

Member of West African Postgraduate College of Pharmacist (MWAPCP)

Personal Profile

Good personal skill and ability to work effectively in a team being self-disciplined and dependable.

C. Working Experience with Dates

Organization: Federal Medical Center Keffi

Position: Senior Pharmacist (December 2013 – Date)

Responsibilities:

- Ensuring proper and effective storage of all drug commodities at the facility level.
- Drug dispensing, patient counselling, prescription screening, and monitoring of adverse drug reaction and other drug related issues in the course of medication use
- Training of intern Pharmacist and Pharmacy students in the facility and monitoring of Pharmacy activities in the center.
- Providing technical coordination in product selection, quality assurance, receipt of commodities and efficient storage and distribution systems.

- Preparing reporting rates, stock status reports, expiry status reports, stock outs reports and bimonthly state aggregate reports for all supported facilities and sharing with Country Office.
- Ensuring all logistics data from all supported facilities are captured into DHIS.
- Building the capacity of facility staff and and conducting quarterly monitoring and supervisory visits to facilities on logistics activities.

Organization: Nasarawa State Hospital Management Board

Position Held: Pharmacist 1 (February 2012 – November 2013)

Responsibilities:

- Conducting quarterly assessment of both structural and service integration of ART Pharmacy
- Ensuring proper and effective storage of all drug commodities at the facility level.
- Drug dispensing, patient counselling, prescription screening, and monitoring of adverse drug reaction and other drug related issues in the course of medication use
- Assist in facilitating HIV/AIDS commodities bi-monthly review and resupply meeting, development of supply plan and distribution of commodities to supported comprehensive sites.
- Facilitating trainings and capacity building of Pharmacist in the hospital.

Organization:FHI 360 ADHOC

Position Held: Logistics Specialist – NASARAWA STATE (August 2012 – January 2013)

Responsibilities:

- Liaising with the Supply Chain Advisor to provide supply chain management of health commodities in comprehensive ART supported health facilities

- Giving support in coordinating the inventory management in comprehensive ART sites to ensure adequate stock and quality data capture.
- Assist in facilitating HIV/AIDS commodities bi-monthly review and resupply meeting, development of supply plan and distribution of commodities to supported sites.
- Contributing to the health facility upgrades plans in the area of Pharmacy upgrades.
- Facilitating trainings and capacity building of health care personnel across all supported health facilities.

Organization: Federal Medical Center, Keffi (Internship)

Position Held: Intern Pharmacist (2011)

Responsibilities:

- Patient counseling
- Drug Dispensing
- Prescription screening and costing
- Adverse Drug Reaction (ADR) monitoring
- Stock level monitoring
- End of month stock taking and inventory management
- Pharmaceutical care practices
- Weekly clinical presentation and seminars

Organization: Government House Clinic, Makurdi (National Youth Service)

Position Held: Copper Pharmacist (2012)

Responsibilities:

- Patient counseling
- Drug Dispensing
- Prescription screening
- Adverse Drug Reaction (ADR) monitoring
- Stock level monitoring
- End of month stock taking and inventory management
- Pharmaceutical care practices
- Community services/awareness on environmental/ecological conservation

Organization: Jos University Teaching Hospital (SIWES)

Position Held: SIWESS Training (2009)

Responsibilities:

- Prescription screening and costing
- Stock level monitoring

Volunteer – FAHCI

- Registration of HIV positive patients using the PMM data collection tools as appropriate.
- Data collection from the facilities on monthly basis for onward submission to FHI 360/SIDHAS during monthly M&E data feedback sessions.
- Provided assistance during internal and external Data Quality Assurance (DQA) conducted in the facility by FHI 360 M&E regional officer, NACA, and SMILE project.

D. Awards and Fellowships

West African Postgraduate College of Pharmacist (WAPCP). (Fellowship in view).

E. Membership

- Member, Pharmaceutical Society of Nigeria (PSN)

- West African Postgraduate College of Pharmacist (WAPCP).

F. Publications

Nil

G. Major Conferences Attended with Dates

Nil

Trainings and Seminars Attended

- IHVN training on Logistics Management of HIV/AIDS Commodities 2017
- FMOH/SCMS Training on Logistics Management of HIV/AIDS Commodities 2012
- UNICEF Training on Peer Education and HIV Prevention 2011

Computer Proficiency

- Diploma in Data Base Management (Oracle 13G)
- District Health Information System. (DHIS) - Good knowledge.
- Epi-Info – Good Knowledge.
- Microsoft Office Suite: MS Word, MS Excel, MS Power Point, MS Access- Hands-on knowledge
- Adept knowledge of internet/intranet services and major operating system.

Certifications

- **Responsible Conduct of Research**

  CITI Program

- **Conduct of Biomedical Research**

  CITI Program

H. Referees:

Mr James O Umaru
Chief Auditor
Nasarawa State Hospitals Management Board,
Shendam Road, Lafia,
Nasarawa State.
08035938948
umarujames123@yahoo.com

Prof. Noel N. Wannang
Deputy Dean,
Faculty of Pharmaceutical Sciences,
University of Jos.
08037877988
nnwannang1@yahoo.com

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Signature Date

The University Compliance Certification

This is to certify that this thesis by Gad JATAU with the Matriculation Number LCU/PG/002232 in the Department of Public Health, Faculty of Applied and Health Sciences, Lead City University, Ibadan is in full compliance with the approved University format.

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Signature Date