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Equity, Access and Utilization of COVID-19 Vaccine in Ebonyi State, Nigeria

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Abstract

More than a year after vaccine development, COVID-19 vaccine equity remains elusive in the global south. While much is known about vaccine inequity globally, little is known about the in-country situation in Nigeria, and other developing countries, especially after millions of vaccine donations were received from developed countries and international health organizations. This study investigated the equity in the COVID-19 vaccine rollout, the accessibility to the vaccine, the utilization of vaccination services and the social determinants of health informing the uptake of the COVID-19 vaccine in Ebonyi State, Nigeria. An exploratory research design was adopted for this study using a multistage sampling technique to select 338 sample populations. The survey was administered in-person and online (using ArcGIS Survey123). Six In-Depth Interviews (IDI) and three Key Informant Interviews (KII) were conducted between February and March 2022. The qualitative data were analysed using content and thematic analysis, while descriptive statistics and logistic regression were used in analysing the quantitative data. The findings of this study show that there is vaccine inequity in Ebonyi state across geographical (urban-rural) locations and for those with a disability and those with underlying health conditions. Access to vaccines was at a moderate level, with a significant population of the state not receiving the vaccine. The social determinants of health informing the uptake of the COVID-19 vaccine were knowledge of peers/family members who had taken the vaccine (OR = 2.608, B = 0.959, S.E. = 0.242, $p = 0.000$), perceived vaccine effectiveness (OR = 1.433, B = 0.36, S.E. = 0.08, $p = 0.000$), cultural practices (OR = 0.369, B = − 0.998, S.E. = 0.492, $p = 0.042$) and place of residence (OR = 0.514, B = − 0.665, S.E. = 0.291, $p = 0.022$). This study concludes that there is vaccine inequity across all levels, with a rising expiration of donated vaccines amidst poor uptake. It is therefore recommended that Nigeria invests in vaccine manufacturing capacity and/or timely partnerships and treaties for vaccine availability, a holistic and integrated approach to vaccination campaigns with mobile vaccination teams deployed to the rural and hard-to-reach areas. Also, more coordinated grassroot vaccine education and awareness campaign could be implemented to increase vaccine uptake levels.

Keywords Coronavirus · Vaccine · Equity · Pandemic · Vaccination

Introduction

Since late 2019, the world has been grappling with the impact of SARS-Cov-2. A virus with origin in Wuhan city of China has risen to the status of a pandemic with more than 430 million confirmed cases globally including nearly 6 million deaths as of February 25, 2022 (Chapin and Roy 2021; WHO Coronavirus Dashboard 2021). In Nigeria, out of 4,317,621 samples tested for COVID-19, more than 254,000 cases of the disease have been confirmed; this included about 2471 active cases, 248,848 discharged cases and 3142 deaths due to the virus (Nigeria Centre for Disease Control 2022). Within this same period, Ebonyi State had reported more than 2064 confirmed cases which comprised 28 active cases, 2004 discharged cases and 32 deaths from the disease (Nigeria Centre for Disease Control 2022).

Although the use of nonpharmaceutical measures was instrumental in curbing the spread of the disease (Ye et al. 2021), vaccination remains a critical tool in the world's fight against the pandemic. On 11 January 2020, the genetic sequence of SARS-CoV-2, the virus causing the COVID-19,

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was published, triggering what can be seen as the most intense global health research towards the development of a vaccine. By 16 March 2020, the first COVID-19 vaccine candidate initiated human clinical testing, and as early as December 2020 the Pfizer/BioNTech Comirnaty vaccine had been licensed by the World Health Organisation for Emergency Use Listing (Thanh Le et al. 2020). Historically, vaccination is identified as one of the most profitable forms of intervention for the control of infectious diseases. Its wide coverage does not only reduce vaccine preventable disease (VPD) burden and severity, but it also plays a pivotal role in disease eradication as was the case of smallpox in 1978 (Wariri et al. 2019).

As of 25 February 2022, about 34 COVID-19 vaccines have been approved by at least one country for use, out of which ten have been granted emergency use listing (EUL) by the World Health Organisation as well as 5 approved for use by the Africa Regulatory Taskforce (ART), an arm of the Africa Centre for Disease Control and Prevention. Nonetheless, about 146 vaccine candidates are in clinical development, while 195 are in preclinical development. Available data shows that seven (7) COVID-19 vaccines have been approved for use in Nigeria. They included Moderna (Spikevax), Pfizer/BioNTech (Comirnaty), Gamaleya (Sputnik V), Janssen (Johnson & Johnson) Ad26.COV2.S, Oxford/AstraZeneca (Vaxzevria), Covishield (Oxford/ AstraZeneca formulation) and Sinopharm (Covilo) (COVID-19 Vaccine Tracker 2022).

The UK was the first to initiate a mass COVID-19 vaccination campaign as early as December of 2020 with Margaret Keenan, a 91-year-old woman receiving the first official Pfizer COVID-19 jab as part of the UK mass vaccination programme on December 8, 2020 (BBC 2021). None of the COVID-19 vaccines used in Nigeria is produced in the country. All of them are obtained through bilateral agreements with vaccine producing countries, and through other actors in the COVID-19 vaccine economy like the COVID-19 Vaccines Global Access (COVAX), a vaccine pillar of the Access to COVID-19 Tools (ACT) Accelerator. After about three months, Nigeria initiated a mass COVID-19 vaccination programme on 5 March 2021.

As of 28 February 2022, about 62.7% of the global population has received at least one dose of COVID-19 vaccines, and more than 10.7 billion doses have been administered globally. On average, more than 22.83 million vaccine doses are administered daily. According to the New York Times (2022), the vaccination rates across regions of the world show that the USA and Canada had vaccinated 77% of their population with at least a dose of the vaccine, Latin America 75%, Asia Pacific 75%, Europe 68%, Middle East 53% and Africa 16%. In Nigeria, only 2.71% of the country's population has received at least a jab of the vaccines (Johns Hopkins University & Medicine 2022). Out of the 2.71% in Nigeria, about 16,313,712 of the total eligible persons targeted for COVID-19 vaccination were reached with 1st dose, while 6,797,373 of total eligible persons targeted for COVID-19 vaccination were reached with 2nd dose as of 11 February 2022. Ebonyi State makes up one of the least performing states in the COVID-19 mass vaccination campaign in Nigeria. About 6% and 2% of the state residents have been inoculated with first and second doses of the COVID-19 vaccine respectively. Of those who had received two shots of the vaccine, only 172 persons received the booster dose (National Primary Health Care Development Agency 2022a).

According to Katz et al. (2021), rich nations vaccinate at a pace 30 times more than low and middle-income countries, and should this trend persist, most African countries may be achieving herd immunity by the year 2024 or 2025. These among other reasons have resulted in the emergence of more deadly variants of the disease such as the Omicron variant. The Omicron variant (B.1.1.529) was initially reported by the World Health Organisation (WHO) to originate from South Africa on 24 November 2021 and has fast spread to more than 110 countries across all six WHO regions (The Lancet Regional Health 2022). In addressing the issues of COVID-19 vaccine equity and access, countries of the world, as well as other international health agencies, initiated a global partnership by launching the Access to COVID-19 Tools (ACT) Accelerator in April 2020, as a global solution for equitable allocation of COVID-19 vaccines. However, as of December 2021, COVAX the vaccine pillar of ACT-A (COVAX) had shipped over 1 billion doses to 144 countries of the world with few of these countries being of lower-income statuses (GAVI 2021). Amid the poor supply of vaccines to Nigeria, more than a million of the received COVID-19 vaccines had been reported to be out-of-date as of December 2021. Arguably, some of the donated vaccines have a short shelf life and were claimed to be close to expiration at the point of delivery to Nigeria (Mcallister et al. 2021).

The cost of a dose of COVID-19 vaccine ranges from US$2 to $40 with the supply and logistics cost of about US$ 3.70 per person vaccinated with two doses. To vaccinate about 70% of a country's population, rich economies had to only increase their healthcare spending by only 0.8%, whereas low-income countries will have to increase their healthcare spending by 56.6% (Data Futures Platform 2021). Also, secrecy in the prices of COVID-19 vaccines has resulted in some low and middle-income countries paying more for vaccines than the high-income countries. For example, each dose of the AstraZeneca vaccine costs the European Union $2.19, whereas the Philippines pay $5.00 and South Africa $5.25. The Janssen vaccine costs the African Union $10, while other European countries get the vaccine at $8.50 (Kenny 2021). With these realities,

accessing the COVID-19 vaccines will be most difficult for countries like Nigeria that is recovering from recession. The Nigeria 2020 revised Federal Budget (after excluding COVID-19 health-related expenditures) had 3.83% (N414.5 billion) of the total federal budget allocated to health, and in 2021 the allocation increased by 4.18% (N549 billion). Nonetheless, these figures are still below the financial requirement in controlling and vaccinating the Nigerian populace as well as the 15% "Abuja Declaration" annual commitment to the development of health sectors by African countries (Yiaga Africa 2021).

SARS-Cov-2 and other infectious diseases is no respecter of sub-national, national, regional or international borders. According to the United Nations (2020), affordable and non-discriminatory access to COVID-19 vaccination services is a human right and ensuring its actualization should be the interest of all. The Committee on Economic, Social and Cultural Rights (2020) opined that on equal footing, everyone is entitled to enjoy access to scientific progress which is necessary for the attainment of the highest standard of health. Therefore, the COVID-19 vaccine is a global public good, but recent activities of stakeholders even before vaccine approval show strong nationalistic expressions by rich countries of the world. At the national level, Nigeria and most sub-Saharan African countries have had a history of low vaccine coverage and equity gap resulting in inequality in access and utilization of vaccination services. Previous discrimination on vaccines among other reasons has been traced to poverty, low health education and residency in certain disadvantaged (rural and crisis-ridden) regions within the country (Wariri et al. 2019). As such, one cannot but ponder the odds that poor states such as Ebonyi, with relatively low health education and other dimensions of socioeconomic and political disadvantage, will have the COVID-19 vaccines equitably distributed among its units and, where available, how accessible they may become as well as the chances that the masses will utilise the vaccination services.

More so, perceptions on importance formed by the relatively low casualty and severity amid growing noncompliance to safety protocols in Ebonyi State, as well as conspiracy theorists and the growing mistrust of (international and national) stakeholders in the COVID-19 economy, continue to permeate the non-utilization of vaccination services even when they may be equitably distributed and accessible. While much is known about vaccine equity, access and utilization of COVID-19 vaccines at the global, regional and national levels, there is a paucity of knowledge and studies of the phenomenon at the state level. This study, therefore, investigated the equity in the COVID-19 vaccine rollout, the accessibility to the vaccine, the utilization of COVID-19 vaccine and the social determinants of health informing the uptake of the COVID-19 vaccine in Ebonyi State, Nigeria.

What Do We Know About COVID-19 Vaccine Equity, Access and Utilization? A Literature Review

COVID-19 Vaccine Equity

The development of safe and effective COVID-19 vaccines was achieved in record time. However, the virus is identified to be moving faster than the global distribution of vaccines giving rise to emerging variants of concern that possess a great risk to already achieved immunity. In the history of vaccine distribution during public health emergencies, achieving equitable distribution of vaccines has remained a challenge globally. With COVID-19 vaccines developed in late 2020, the WHO and its member states aimed at vaccinating about 40% of each member state's population by the end of 2021. In December 2021, more than 8.6 billion doses were administered globally with marked global inequity. The percentage of the global population fully vaccinated ranged from 90% to below 1%. As has been the case of vaccine roll-out in earlier vaccine-preventable diseases, the high end of the percentage was wealthy nations, while the low end was populated by low and middle-income countries (see Fig. 1).

More than 73% of all vaccines administered in 2021 were in high and upper-middle-income countries. Only 7 African countries attained the 40% vaccine coverage in 2021, and this goes a long way to show the disheartening chances of the world achieving the 70% vaccination goal for all countries in mid-2022 (Georgieva 2022; Houtman et al. 2021). Africa according to the WHO will require more than 900 million vaccine doses to fully vaccinate 40% of its targeted population; however, as of 10 January 2022, it had only received and/or procured only 492 million vaccine doses (The Lancet Infectious Diseases 2022).

At the centre of vaccine equity, discourse is the notion that vaccines must be allocated across all countries of the world based on needs, irrespective of a country's economic status. More so, it is the right of every human to enjoy the highest realizable standard of health without discrimination on the ground of economic, religious, racial, political or any other social conditionality. The global vaccine production rate has accelerated allowing for more than 1.5 billion doses per month production of COVID-19 vaccines, showing that there is enough supply of vaccines for the realization of 40% and 70% global targets if equitably distributed. To Lancet Infectious Disease (2022), about 26 different COVID-19 vaccines were in use globally, and more than 41 billion doses of COVID-19 vaccines were estimated to be available in 2022. These show that the previously accepted reason of limited production capacity as an impediment to global vaccine availability may have

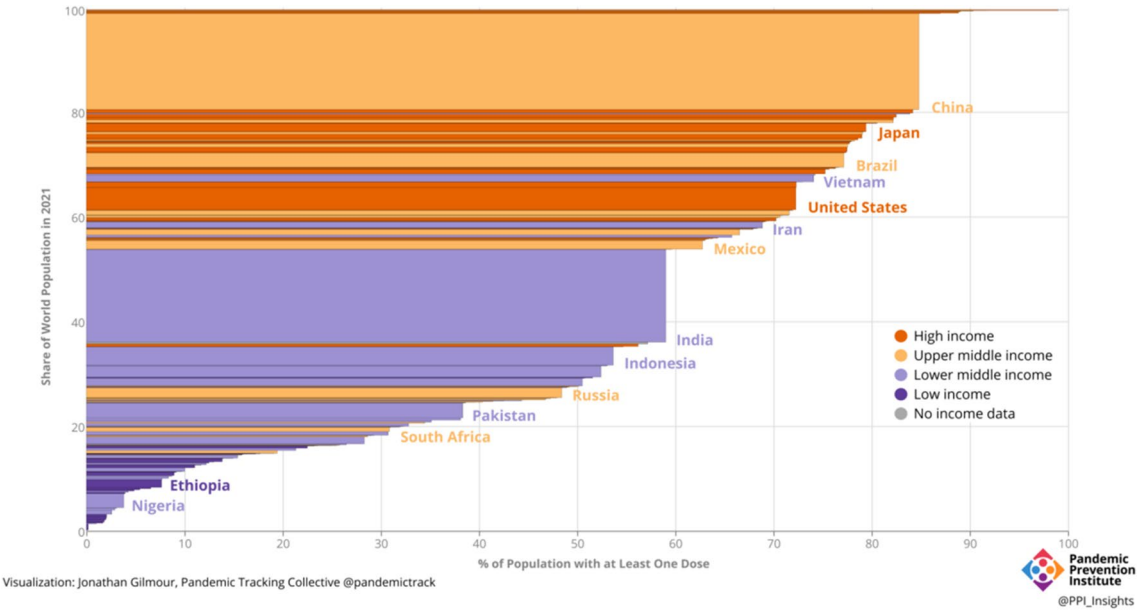

Fig. 1 Share of the world population with at least one dose of COVID-19 vaccine by country income level

been overcome by recent developments, especially in the third year of the pandemic. This also implies that the world is currently having a vaccine allocation problem and not a supply problem. The World Health Organisation (2022) opined that as of the completion of the year 2021, above 40 countries had not attained 10% vaccine coverage, and nearly half of the 194 WHO member states had missed the 40% vaccine coverage target.

The UNDP (2021) posited that globally there exist uneven and inequitable COVID-19 vaccination across and within countries due largely to issues in vaccine manufacturing, supply, logistics, systems and resources. This is mostly experienced in the low and medium human development countries. About 1,581,509,628 vaccine doses were administered as of June 2021; more than 80 percent were in countries of high income. More recent data shows that as of 12 January 2022, about 59.4% of the global population has received at least a dose of the COVID-19 vaccine. Nonetheless, about 76.9% of those vaccinated are from high-income countries, whereas 9.5 are from low-income countries. Beyond global vaccine inequity, this phenomenon also exists at the regional, national and sub-national levels. In America, about 86.6% of the Chilean population had received the full dose of the vaccine, while just 1.08% of the Haitians had received at least a dose of the vaccine (The Lancet Regional Health 2022). In Nigeria, Ebonyi State is one of the states with the least coverage as of January 2022. The state within this period has vaccinated only 90,618 and 35,471 of its estimated population of 2.8 million with the first and second dose of the vaccine (NPHCDA 2022a).

In relation to the share of the global COVID-19 cases, there exist acute disparities across high and low- and middle-income countries. The UN Secretary-General argued further that rich countries vaccinate at a pace more than 30 times the pace of low-income countries, and should this persist, poor countries may be achieving wide vaccination coverage by the year 2024 or 2025 (Katz et al. 2021). This however will result in more pervasive disease vulnerability while allowing the emergence of more deadly variants to emerge and ricochet back across countries of the world (UNDP 2021). The Omicron variant of the virus which was reported as a variant of concern by the WHO in November 2021 has fast spread to more than 110 countries across all six WHO regions. This variant has caused a tsunami of COVID-19 cases (The Lancet Regional Health 2022),

According to Ferranna et al. (2021), the limited supply of vaccine doses in the early phases of the global vaccination campaign has raised the question of how best to distribute vaccines across countries and within sociodemographic groups in a country. Equity frameworks adopted in previous outbreaks like H1N1 influenza and Ebola may not necessarily apply to the current pandemic due largely to variations in sociodemographic susceptibility. For instance, unlike previous respiratory infectious diseases, children have low susceptibility and infection fatality risks to SARS-CoV-2 compared to the older population (Verity et al. 2020; Viner et al. 2021). By implication, the commonly adopted strategies of prioritizing children in vaccine allocation may be suboptimal in the case of COVID-19. Furthermore, the increasing supply of COVID-19 vaccines to African countries as a solution to vaccine inequity is creating another concern.

African countries by 9 January 2022 had only utilized 64% of their procured vaccines amidst high demand. This was because the vaccines donated had a short shelf life, and the continent lacked other key components for successful vaccination like syringes, PPEs and human capacity to implement a wide vaccination campaign (The Lancet Infectious Diseases 2022).

Accessibility to COVID-19 Vaccination Services

The fast spread of the SARS-CoV-2 and its emerging variants have reiterated the notion that "no one is safe until everyone is", resulting in a paradigm shift and call for global equitable access to vaccines. The fast development of safe and effective vaccines remains a celebrated milestone; however, this may be short-lived if individuals, groups and countries do not have early access to them. This led to global deliberations and partnerships that culminated in the launching of the Access to COVID-19 Tools (ACT) Accelerator in April 2020, as a global solution for equitable allocation of COVID-19 vaccines. The ACT-A is made up of four pillars which included diagnostic, therapeutic COVAX (vaccine pillar) and health system strengthening (WHO 2021). The vaccine pillar of ACT-A (COVAX) as of December 2021 had shipped over 1 billion doses to 144 countries of the world with few of these countries being of lower-income statuses (GAVI 2021).

According to the UNDP (2021), developed countries had resumed mass vaccination on average of 2 months before the low-income countries initiated COVID-19 immunization. As of February 2022, about 61.7% of the global population has been inoculated with at least a dose of a COVID-19 vaccine, and on average, 27.51 million vaccine doses are administered daily (Our World in Data 2022). About 2 in 3 people in high-income countries have received at least a dose of the vaccine, whereas nearly 1 in 9 people from low-income countries have been vaccinated with a dose of the vaccine. This implies that access to life-saving vaccines is very low in low-income countries including Nigeria and has among other reasons given rise to unequal vaccination rates. Within this same period, the United Arab Emirates had a record of 96.06% vaccination rate, China 87.88%, Spain 81.51%, France 77.39%, Italy 77.62%, Germany 74.73%, the UK 72.85% and the USA 65.06%. On the other hand, most African countries had a very poor vaccination rate with Burundi with statistics of 0.06%, Ethiopia 1.43%, Cameroon 2.56%, Nigeria 2.71%, Burkina Faso 3.79% and Algeria 13.46% (Johns Hopkins University & Medicine 2022). Out of the 2.71% vaccination rate in Nigeria, about 16,313,712 of the total eligible persons targeted for COVID-19 vaccination were reached with 1st dose, while 6,797,373 of total eligible persons targeted for COVID-19 vaccination were reached with 2nd dose as of February 11, 2022. Ebonyi State makes up one of the least performing states in the COVID-19 mass vaccination campaign in Nigeria. About 6% and 2% of the state residents have been inoculated with first and second doses of the COVID-19 vaccine respectively (National Primary Health Care Development Agency 2022b).

To the WHO (2021), achieving 70% vaccination coverage in high-income countries will only require a 0.8% increase in healthcare spending while low-income countries will be expected to increase the healthcare spending by 56.6% to vaccinate 70% of her population (Data Futures Platform 2021). Available data from the UNICEF and GAVI shows that on average, the cost of a dose of COVID-19 vaccine ranges from US$2 to $40 with the supply and logistics cost of about US$ 3.70 per person vaccinated with two doses. These among other reasons have caused a huge financial burden for governments of low-income countries. Secrecy in the prices of COVID-19 vaccines has resulted in some low and middle-income countries paying more for vaccines than the high-income countries. Kenny (2021) argued that each dose of the AstraZeneca vaccine costs the European Union $2.19, whereas the Philippines pays $5.00 and South Africa $5.25. Furthermore, the Janssen vaccine costs the African Union $10, while other European countries get the vaccine at $8.50. Nonetheless, the acceptance of vaccine-producing countries and manufacturers to see safe and effective vaccines as a global good has remained the saving grace of most low-income countries. Subtly, the ever-increasing vaccine demand and limited supply of vaccines especially to low-income countries have led to a "global catastrophic moral failure" and infringements on human rights despite the supposedly views on vaccines as a global good and its access, a fundamental human right.

According to Manriquez Roa et al. (2021), a mixed methodology study involving exploratory interviews with experts in global access to COVID-19 vaccines and other secondary data revealed that the COVAX facility has provided reasonably global access to the greatest variety of vaccines available to high and low-income countries, fair prices and/or cost-sharing. The study also found the motive for joining COVAX to include access to vaccines, consolidation of the country's foreign health policy and biosecurity. On the global scene, the allocation and prioritization of populations for COVID-19 vaccines are guided by the two frameworks of the World Health Organisation's Strategic Advisory Group of Experts on Immunization (SAGE). The two frameworks included the values framework for the allocation and prioritization of COVID-19 vaccination and the roadmap for prioritizing population groups for vaccines against COVID-19. Both documents provide values and ethical standards as well as public health strategies and target priority groups for COVID-19 vaccination. Other developments of the WHO in ensuring equitable access to vaccines and other treatment supplies included the fair allocation framework. This

framework is part of the Access to COVID-19 Tools (ACT) Accelerator which was a creation of a global partnership in accelerating development, production and equitable access to COVID-19 tests, treatments and vaccines. The framework proposes that as safe and effective vaccines are approved for use, member countries are to take delivery of doses in proportion to their population size to immunize the highest-priority groups. In other phases of the rollout, vaccines may also be deployed for additional coverage according to national priorities.

According to the WHO's Strategic Advisory Group of Experts (SAGE) recommendations, frontline healthcare workers who are at high risk of infection, older population and those at high risk of death due to other underlying health conditions are to be prioritized first in the first phase of the vaccine rollout. Countries are also advised to develop a unified National Deployment and Vaccination Plan (NDVP) for COVID-19 vaccines which will permit a coordinated effort at mass vaccination. The COVID-19 vaccine rollout in Africa is marked by disparities. As of April 2021, eight countries (Burkina Faso, Burundi, Chad, Central African Republic, Eritrea, Madagascar, Tanzania and the Saharawi Republic) had not received supply or initiated vaccination, while other African countries like Seychelles have had more than 60% of its populace fully vaccinated (Loembe' and Nkengasong 2021).

According to Kuppalli et al. (2021), there is also a widening disparity in vaccine access between high-income countries and low-income countries. While countries in North America and Europe are relaxing restrictions, re-opening public spaces and extending vaccination to adolescents, most African countries are still facing the taunting experiences of the virus. Despite the global commitment to equitable distribution and access to vaccines, some countries especially high-income countries have chosen national access over global equity through disproportional direct prepurchase agreements with manufacturers and stockpiling more than enough doses to vaccinate their population, thereby depleting vaccine roll-out to low and middle-income countries (Callaway 2020). Nonetheless, there exists a poor sustainable national investment in domestic vaccine research and development (R&D) in Africa. Nearly all African countries have not had domestic vaccine production as a priority for national disease outbreak preparedness. This among other factors explains Africa's poor access to vaccine-preventable diseases. Painfully, the continent only produces not more than 1% of the vaccine doses in infectious disease treatment despite the growing need for the vaccine (Abiodun et al. 2021). Out of the 277 vaccine candidates under development in April 2021, merely 5 were from Africa, and they comprised four vaccine candidates from Egypt National Research Centre and one at a private firm in Nigeria. However, none of them has progressed beyond the pre-clinical vaccine evaluation phase (Loembe' and Nkengasong 2021; Nkengasong et al. 2020).

A World Bank assessment before the COVAX facility rollout showed that low and middle-income countries will be able to manage small initial consignments (World Bank 2021). This assessment included the ability to develop a national deployment and vaccination plan; initial priority target population; supply chain, and logistics, safety surveillance and monitoring; as well as trained vaccination personnel. However, after receiving the first tranche of the vaccine, the inability to mobilize local communities for vaccine uptake and the management of countrywide logistics remains a huge challenge. As a result, only Morocco (with 9.5 million doses administered) and a few other countries (Nigeria, Ethiopia, Egypt, Ghana, and Kenya) were nearing or surpassing the 1 million COVID-19 dose uptake mark as of April 2021 (Loembe' and Nkengasong 2021).

The Utilization of COVID-19 Vaccination Services

Ending a pandemic like COVID-19 requires a wide vaccination program and high uptake of COVID-19 vaccines and other vaccination services. Globally, as of early February 2022, about 61.9% of the world's population has received at least a dose of the COVID-19 vaccines (Our World in Data 2022). While this figure shows a wide and positive coverage, when disaggregated by country's income status bulk of the vaccines were administered in high-income countries, and only 10.6% of people in low-income countries had received at least a dose of the vaccine in February of 2022.

According to the New York Times (2022), the vaccination rates across regions of the world show that the USA and Canada had vaccinated 77% of their population with at least a dose of the vaccine, Latin America 75%, Asia Pacific 75%, Europe 68%, Middle East 53% and Africa 16%. This shows a great lag in the utilization of COVID-19 vaccines in Africa. More so, of those who had received at least a dose of the vaccines in Africa, some 11.69% are completely vaccinated, and 0.74% have received booster doses. In Nigeria, out of the 48,995,013 vaccines received (which may only cover 15.80% of the country's population), only 22,440,392 vaccines have been administered since the vaccination campaign kick-started on March 5, 2021. These statistics show a wide gap of more than 26 million vaccines non-administered (which may include wastages) (Africa CDC Vaccine Dashboard 2022).

According to Sallam (2021), vaccination campaigns globally have faced some levels of hesitancy. This refers to forms of delay and refusal to accept vaccination even in the presence of available vaccines (Lane et al. 2018). Studies on the utilization of COVID-19 vaccine services are majorly

conducted in high-income countries due largely to insufficient supply across Africa. However, when acquired by African countries, several factors have seen the prolapsing of in-country roll-out and uptake of vaccines. These factors may include the poor healthcare system, limited trained personnel as well as hesitant behaviours towards the vaccine by the continent's population. Nonetheless, Solís Arce et al. (2021) revealed that on average, more than 80% of the African population accepted the COVID-19 vaccines compared with the 64% and 30.4% reported in USA and Russia. This implies that the poor supply of vaccines to the global south to great extent explains the continent's vaccination dilemma.

In Nigeria, Nasarawa, Jigawa, Ogun, Abuja and Kwara states are the top 5 performing states in the country's COVID-19 vaccination campaign. About 72%, 68%, 26%, 25% and 24% have received the first dose of the COVID-19 vaccines in Nasarawa, Jigawa, Ogun, Abuja and Kwara states respectively. More so, about 32%, 16%, 13%, 14% and 11% have received the second dose of the vaccines in Nasarawa, Jigawa, Ogun, Abuja and Kwara states respectively. On the other hand, Ebonyi, Akwa Ibom, Sokoto, Imo, Anambra and Bayelsa states are the least performing states in the COVID-19 vaccination campaign. About 6% in Ebonyi and Akwa Ibom, 5% in Sokoto and 4% in Imo, Anambra, and Bayelsa have been inoculated with at least a dose of the COVID-19 vaccines. Also, only 3% in Akwa Ibom and 2% in Ebonyi, Sokoto, Imo, Anambra and Bayelsa states have received the second dose of the COVID-19 vaccines as of 17 February 2022 (NPHCDA 2022b). Within this same period, all the states of Southeastern Nigeria are still in the league of the 10 low-performing states in the COVID-19 vaccination campaign. It is this under-performing status of Ebonyi State that has informed the researchers' choice of the state to uncover vaccine dynamics informing the poor utilization of the COVID-19 vaccination services.

Methodology

This study was conducted in Ebonyi State, Southeast Nigeria. The choice of Ebonyi State was based on the poor vaccine uptake in the state. An exploratory research design was adopted using both qualitative and quantitative data collection methods. Three local government areas (Abakaliki, Ikwo and Afikpo North) from the three senatorial districts of the state were studied (see Fig. 2). The target population of the study was made up of residents in Abakaliki, Ikwo and Afikpo-North Local Government Areas who are 18 years and above and have lived in the state/LGA for at least 1 year. Cochran's (1977) sample size determination was used to select 384 participants for the study.

A multistage sampling technique was adopted for this study. The first stage of the process involved a random selection of three local government areas across the three senatorial districts of the state. The second stage involved a purposive selection of 2 communities (one with a somewhat urban character and another with a somewhat rural character) in each selected LGA of the state. These included Nkaliki and Amachi (in Abakaliki LGA), Ndufu- Alike and Ndufu-Amagu (in Ikwo LGA), Ozizza and Ugwuegu (in Afikpo North LGA). The respondents were then conveniently selected and recruited for the study from the streets of the selected communities and villages. For the qualitative data, a total of six in-depth interviews (2 in each selected LGA) and three key informant interviews (1 in each selected LGA) were conducted using a purposive selection. The questionnaires were added to ArcGIS Survey123 with links to the questionnaire shared with respondents through emails, WhatsApp and Telegram. More so, in order to reach respondents with little or no internet presence, the questionnaires were also printed and administered physically to the respondents. The Statistical Package for Social Sciences (SPSS) version 20 was used for the analysis of quantitative data. This involved descriptive statistics (frequency distribution and percentage tables) and logistic regression. Qualitative data were transcribed, cleaned and analysed for their content and themes using the predetermined variables. Related and cross-cutting themes were identified and highlighted, based on coding and grouping, and used for qualitative discussions in the study. Respondents were duly informed of the study objectives and methods, whence consent was received before administering both the quantitative and qualitative data. Also, the researchers carefully considered ethical principles of anonymity, non-maleficence and justice/fairness.

Ebonyi State is located in Southeast Nigeria. The state was created in 1996 from parts of Abia State and Enugu State, with Abakaliki as its capital. It has 13 local government areas across three senatorial zones—Ebonyi North, Ebonyi Central and Ebonyi South—in about 5935 square kilometres of land. The state has an estimated population of 2.8 million (Nigeria population and development fact sheet, 2017) and shares borders with Benue State to the North, Enugu State to the west, Imo and Abia States to the south and Cross River State to the east. Its population is mainly Igbo. The state is one of the least-performing states in Nigeria as it concerns COVID-19 vaccination. Only about 6% and 2% of the eligible population of the state have received the first and second doses of the COVID-19 vaccines as of when this study was conducted (NPHCDA 2022a).

Results

A total of 384 copies of the questionnaire were administered; however, 351 responses were received. Of 351 questionnaires received, 338 were correctly filled and were

used for this study and that formed the basis of analysis for the study. This accounts for an 88% response rate.

Table 1 presents the sociodemographic characteristics of the respondents, and the result shows that there was slightly more male (55%) than female (45%) in this study. The mean age of the respondents is 27 years, with the majority being single (75%). The ethnic distribution of the respondents showed that more than 8 out of 10 (85%) of the respondents were Igbo, and about 9% and 3% were Yoruba and Hausa respectively, while 2% of the respondents were from other ethnic groups. Nearly all the respondents (98%) were Christians, while 2% of the respondents were Islam. A greater per cent of the respondents had secondary school (35%) as their highest educational level, followed by undergraduate degrees (30%), NCE/OND/HND (16%), postgraduate degrees (11%) and those with no formal education with the lowest frequency. Most of the respondents earn an average income below N30,000 (47%), while 33% of the respondents on average earn between N31,000 and N100,000 monthly. About 6%, 5% and 3% of the respondents earn on average N151,000–N200,000, N101,000–N150,000 and N201,000–N300,000, respectively.

A higher percentage of the respondents (31%) were employed full-time; 24% were full-time students, while 22%, 21% and 0.6% were employed part-time, unemployed and retired respectively. The majority of the respondents lived in urban areas (72%); 23% were in rural areas, and 4% were undecided about their place of residence. Nearly half (49%) of the respondents lived in Abakaliki LGA, 27% in Afikpo-North and 24% lived in Ikwo LGA. Nearly all the respondents (82%) had no history of chronic disease, while 9.5% had a history of chronic disease. About 8% was however undisclosed in their history of chronic disease.

Qualitatively, nine interviews were conducted. This included six (6) in-depth interviews and 3 key informant interviews with staff of the National Primary Healthcare Centres in the state. The average age of the respondents was 28 years with the youngest being a 23-year postgraduate student. About seven of the respondents were married, while two were single. All the respondents practised Christianity.

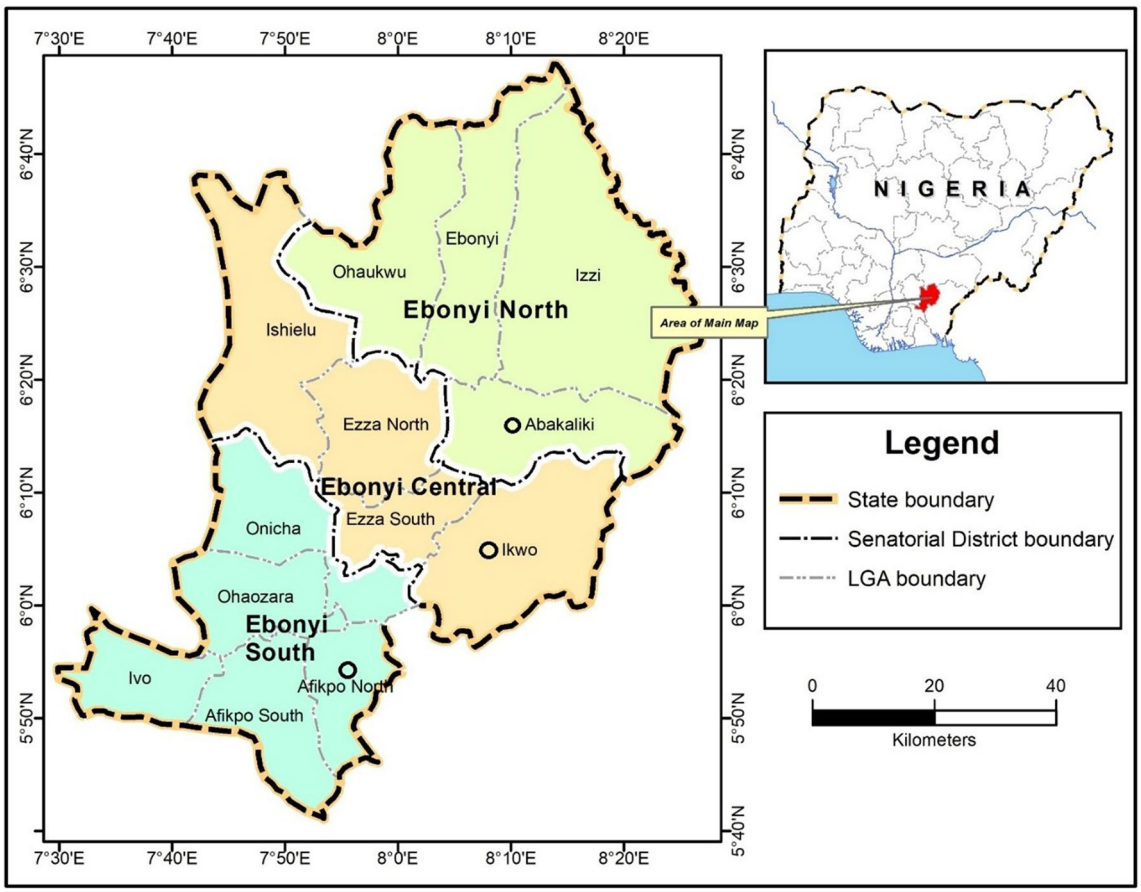

Fig. 2 Map of Ebonyi State showing the study areas

Table 1 Sociodemographic characteristics of respondent ($N = 338$)

Variable	Frequency	Percentage	Mean (SD)
Sex			
Male	187	55.3	
Female	151	44.7	
Age range			
18–24	152	45.0	27.1(7.9)
25–34	134	39.6	
35–44	34	10.1	
45–54	16	4.7	
55–64	2	0.6	
Marital status			
Single	252	74.6	
Married	82	24.3	
Widowed	4	1.2	
Ethnic group			
Igbo	288	85.2	
Hausa	10	3.0	
Yoruba	32	9.5	
Edo	2	0.6	
Engenni	2	0.6	
Urhobo	4	1.2	
Religion			
Christianity	333	98.5	
Islam	5	1.5	
Highest level of education			
No formal education	2	0.6	
Primary education completed	8	2.4	
Secondary completed	119	35.2	
NCE/OND/HND	54	16.0	
University degree holder	103	30.5	
Postgraduate education	37	10.9	
Specialist degree	15	4.4	
Average monthly income			
Below N30,000	161	47.6	
N31,000–N100,000	112	33.1	
N101,000–150,000	20	5.9	
N151,000–N200,000	22	6.5	
N201,000–N300,000	10	3.0	
N301,000–N400,000	7	2.1	
N401,000–N500,000	4	1.2	
Above N500,000	2	0.6	
Employment status			
Unemployed	72	21.3	
Employed parttime	76	22.5	
Employed fulltime	106	31.4	
Retired	2	0.6	
Fulltime student	82	24.3	
Local government area of residence			
Abakaliki	167	49.4	
Ikwo	81	24.0	
Afikpo North	90	26.6	

Vaccine Equity in Ebonyi State, Nigeria

The first objective of this study assessed vaccine equity in Ebonyi state. The results showed that for more than 2.8 million population in the state, only 90,618 (3.2%), 35,471 (1.3%) and 1040 (0.04%) targeted population were reached with the first, second and booster doses of the COVID-19 vaccine. COVID-19 vaccines administered in the state were majorly AstraZeneca, Pfizer, Moderna and Johnson & Johnson.

Figure 3 presents respondents' opinion on equity in the distribution of COVID-19 vaccines. The result shows that there was a slight difference in the respondent's opinion on the fair distribution of COVID-19 vaccines in the state. Majority (51%) of the respondents had a positive opinion, while 49% had a negative opinion. Higher percentage of the respondents (48%) opined that the COVID-19 vaccination campaign in the state "sometimes" considered equally the vulnerabilities, risks and needs of all local governments in the state. Furthermore, 30% showed "often", 16% "never", while 6% suggested that vaccination campaigns in the state considered "every time" the vulnerabilities, risks and needs of all local government areas. Six out of 10 respondents (56%) opined that COVID-19 vaccine prioritization in the state considered sometimes the needs of groups who, because of underlying biomedical factors, are at risk of experiencing greater burdens from the COVID-19 pandemic. About 22%, 18% and 4% suggested often, never and every time respectively.

With regard to considering the needs of the disabled in vaccine prioritization in the state, 56% of the respondents opined "sometimes", 15% of the respondents said "never", while 24% and 4% opined "often" and "every time" respectively. Six out of 10 (60%) respondents showed that COVID-19 vaccine prioritization in the state considered "sometimes", the needs of groups who because of underlying geographic factors (rural areas) are at risk of experiencing greater burdens from the COVID-19 pandemic. About 21% of the respondents showed "never", 16% of the respondents said "often", and 2% expressed that COVID-19 vaccine prioritization in the state considered "every time", the needs of groups who because of underlying geographic factors (rural areas) are at risk of experiencing greater burden from the COVID-19 pandemic.

From the qualitative data, respondents opined that the real issue in the state is vaccine hesitancy and not vaccine

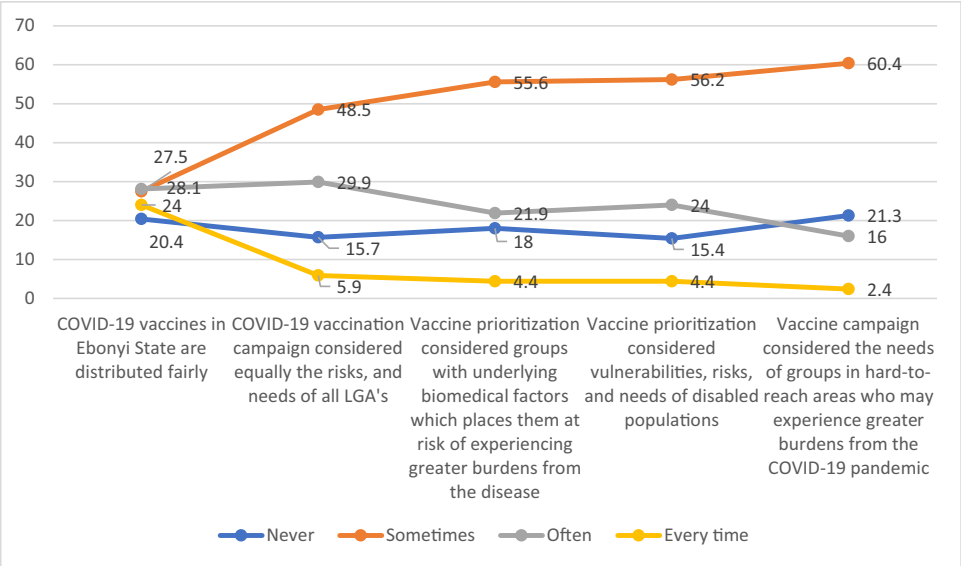

Fig. 3 Respondent's opinion on equity in the distribution of COVID-19 vaccines

inequity, stating that many still believed that COVID-19 is not real. One of the interviewees had this to say:

> Actually, the problem is that of hesitancy, many people do not value it. But as for the allocation, I think they allocate to all the LGA. But as I said earlier, I cannot tell the quantity of the vaccines that they sent to each LGA. (IDI/Ikwo/48 years/Lecturer/March 2022)

Another participant had this to say to buttress the above claim of the previous interviewee:

> What happened is that ….. there is no issues in the distribution, the only thing is that people are still in one way or the other still saying that COVID-19 is not real. (KII/Abakaliki/41 years/Civil Servant/March 2022)

More so, some respondents expressed that despite the hesitancy, vaccines are available at various vaccination points across LGA's. One of the participants stated thus:

> …All the vaccines are available. Yes, we have Astra-Zeneca, Moderna, Pfizer, and Johnson & Johnson. (KII/Abakaliki/41 years/Civil Servant/March 2022)

This assertion by another participant further validates the opinion of the previous respondent:

> There has never been anything as available as COVID 19 vaccine in our state… (IDI/Ikwo/24 years/Student/March 2022)

Similarly, another interviewee opined thus:

> The government has been trying so far to make sure that everyone gets this vaccine. There's this fairness in the distribution. Just that we the masses if we are ready to take the vaccine. (IDI/Afikpo North/40 years/Banker/March 2022)

Contrarily, other respondents posited that there are limited supplies of vaccines to the state. They thus argued:

> …Due to the limited supplies of the available vaccines, it has become difficult for people who are of a poor extraction, who are of lesser socio-economic status to access these vaccines. Also, there's a lot of misrepresentation of the COVID 19 vaccine and mindset of the people and people are saying that it's not safe vaccination, that vaccines are not safe. So, I think it also affects the willingness of people, especially the poor people in the states, to look towards being vaccinated. (IDI/Ikwo/29 years/ Civil servant/March 2022)

Supporting the above claim is the assertion of a graduate student who had this to say:

> I think when you talk about COVID-19 vaccine equity in Ebonyi State I think it has not been fair. It's only people within the urban that have access to this vaccination. (IDI/Ikwo/28 years/Postgraduate Student/March 2022)

To other respondents, the availability or equity of the vaccine does not concern many as there is a high level of disinterestedness in the COVID-19 vaccine. A respondent had this to say:

> …If you go around in the locality or if we go further, you'll find out that people are not ready to allow any member of their family to get vaccinated. On that point, even if there is equity or even if there is disenfranchisement, it's none of their business. It doesn't

concern them in any respect. (IDI/Afikpo North/Public Servant/March 2022)

The implication of these views shared by the participants is that the authorities have been investing efforts in the wrong direction. COVID-19 vaccine to a reasonable extent has been made available in the state, yet a marked negative perception shared by the populace is impacting its efficient use. A reorientation of the masses through vaccine education is needed to correct the wrong perception and bias towards the COVID-19 vaccine.

Access to COVID-19 Vaccines in Ebonyi State

The second research objective assessed the level of access to COVID-19 vaccines in Ebonyi State.

Figure 4 shows that nearly 6 out of 10 (58%) respondents had vaccination sites in their community, 12% of the respondents did not have, while 30% of the respondents do not know if there were COVID-19 vaccination sites in the community. Almost half of the respondents (48%) indicated that they had no difficult transportation need to reach the nearest vaccination site, 27% of the respondents expressed difficult transportation needs, while 25% of the respondents did not know. Furthermore, about 43% of the respondents do not know if COVID-19 vaccination in their area offers a meaningful opportunity to be vaccinated to all individuals and groups who qualify for vaccination. Furthermore, 40% of the respondents suggested yes, while 18% said no. On the availability of COVID-19 vaccines to eligible members of the community at no cost, nearly half of the respondents (49%) said yes, 18% of the respondents said no, and 33% of the respondents said they do not know.

The majority of respondents (41%) reported having a Primary Healthcare Centre as their nearest vaccination site, with 15% indicating a subcentre, and 21% preferring a Community Health Centre. Additionally, 10% mentioned a private hospital/clinic, 5% a community school and 3% cited other locations. Nearly half of the respondents (48.2%) find their nearest vaccination site convenient. However, 22.2% of the respondents do not find it convenient, and 30% are unsure whether their nearest vaccination site is convenient for them.

The majority of respondents (45.3%) are unaware of the availability of COVID-19 vaccines at their nearest vaccination site. On the other hand, 42.3% of the respondents stated that vaccines are indeed available at their nearest vaccination site, while 12.4% suggested otherwise. Among the respondents, 20% reported that their nearest vaccination site is located between 1 and 10 km away, while another 20% mentioned it to be 11 km to 20 km distant. Additionally, 16% said their nearest site was less than 1 km away, and 41% stated it to be over 41 km away. A smaller portion, 13% and 11%, respectively, indicated their nearest COVID-19 vaccination sites to be situated within the ranges of 21 to 30 km and 31 to 40 km. In terms of distance in minutes, 36% of the respondents reported that it took 10–30 min to reach their nearest vaccination site, 32% showed 31–60 min, while 14% each showed less than and more than 1 h to reach their nearest COVID-19 vaccination site. Distributing the respondents on the cost of transportation to the vaccination site, 31% of the respondents opined that it cost between ₦210 and ₦400 to the nearest vaccination site, 27% indicated less than or equal to ₦200, 14% showed ₦410 and ₦600, while 6% each opined that it cost ₦610 and ₦800 and above a thousand naira to reach their nearest vaccination site. However, 10% of the respondents indicated that they do not know how much it costs in naira to reach the nearest vaccination site, while 5% indicated that it cost ₦810–₦1000.

The qualitative data revealed mixed responses from the respondents, some posited limited access, while others

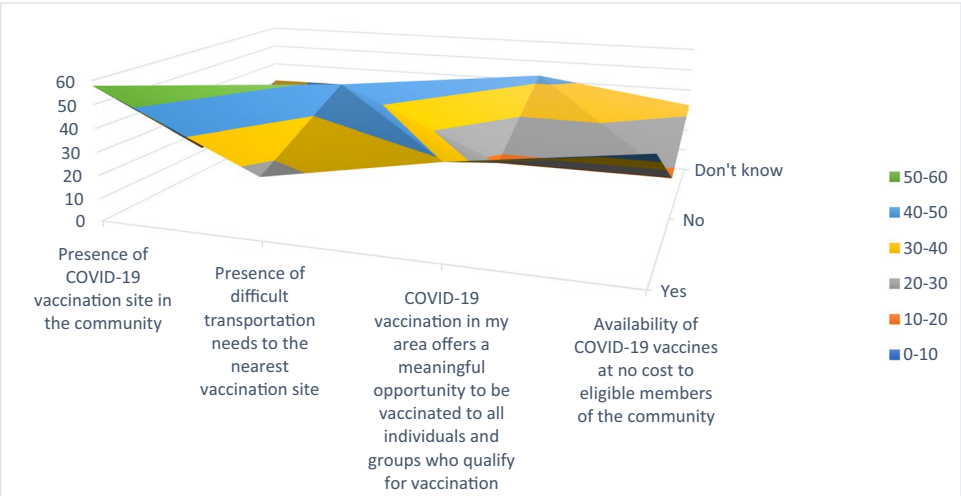

Fig. 4 Access to COVID-19 vaccination

expressed favourable access to the COVID-19 vaccine. Those who expressed limited access to the vaccines, especially in the rural areas and other hard-to-reach areas, stated thus:

> *…Because of the number of the teams or sites created in each LGA, there are some rural areas that are not accessible to this vaccine... (KII/Abakaliki/41 years/ Civil Servant/March 2022)*

Another participant had this to say:

> …Some of the roads in Afikpo especially those of them that live in the rural area of Afikpo-North is not motorable…is not motorable, I think that is one of them. Then…the cost of transportation for them to come out to where they will get these vaccines is high. (IDI/Afikpo North/40 years/Banker/March 2022)

Another participant expressed that he had visited vaccination sites to receive COVID-19 vaccines only to receive a disappointing response that the vaccine is not available. In his words:

> …I was making arrangements to travel, reaching that place. They told me that there's no vaccine. There are a lot of people who came around. Imagine how frustrating that was…a whole government facility there's no vaccination. (IDI/Ikwo/28 years/Graduate Student/ March 2022)

However, other participants suggested that the vaccines are readily available for anybody who wants to get vaccinated. They postulated thus:

> To my own best knowledge… I think the vaccines are there to be accessed. It is now dependent on the individuals going to access the vaccine. (IDI/Ikwo/38 years/Lecturer/March 2022)

> …If anyone needs it, one thing about the distribution is that even here in Ikwo, if you need it today, if you need it tomorrow, there is always a centre where you run to and get it. (IDI/Ikwo/23 years/Student/March 2022)

Population groups such as the disabled were reported to have not been considered in the COVID-19 vaccination campaign. An interviewee posited thus:

> I don't think the vaccination campaign in Ebonyi state has really considered those with vulnerabilities… because people with vulnerabilities especially people who are disabled are often marginalized. They are not actually put into the plans of the state. And when you go to the centres and to the sites where these vaccinations are being given out, you look thoroughly at the crowd that is there. You find out that there are no provisions for people who are disabled. There are no rafts for them to get up to the podium. They have little or no provisions for them. And because of that, you find that people who are disabled are not even may not even be willing to get the vaccination. So, I think that issue of the of increasing access to these vaccines is very formidable. I think that is one of the areas that has been lacking especially in Ebonyi State. (IDI/Afikpo North/30 years/Teacher/March 2022)

Uptake of COVID-19 Vaccine in Ebonyi State

The majority of the respondents (70.7%) are yet to receive COVID-19 vaccine dose. Only 27% of the respondents have received the vaccine, while 2% are unsure if they have received a vaccine dose or not. Of the 27% who had received at least a COVID-19 vaccine dose, 57% of them have been fully vaccinated, 33% of them were partially vaccinated, and 10% cannot exactly say their vaccination status. More so, Moderna (39%), Pfizer/BioNTech (34%), Johnson & Johnson (7%) Oxford/AstraZeneca (13%) and Covishield (Oxford/AstraZeneca formulation) (6%) were the brand of vaccines they had received. Moreover, 32% of the respondent who had received at least a COVID-19 vaccine dose got the jab at a nearby community health centre, 16% each received vaccination at home, at a private hospital/clinic and in a Primary Healthcare Centre, while 5% each also received theirs in the village (through mobile clinics) and a government hospital.

The factors cited by 71% of the respondents who had not received a COVID-19 vaccine dose were fear of vaccine side effects (31%), feeling no need for vaccination (34%) and inconvenience of timing (11%). Some respondents were unaware of vaccination sites (8%) or lacked the time to get vaccinated (7%). Others were discouraged by advice against vaccination (6%), long distances to vaccination sites and extended waiting times (5% each). Additionally, 4% mentioned unavailability of COVID-19 vaccination services when needed, and 3% cited inconvenience of vaccination site locations and vaccine unavailability.

From the qualitative data, all the respondents expressed a poor uptake of the vaccine in the state. Many residents of the state were reported to be discouraged from receiving the vaccine doses. Respondents had this to say:

> The rate of people who are willing to vaccinate may not be up to 50 per cent, Yes. Because even in our own locality I have not seen anybody who said he has received the vaccine. It is only one of my brothers who came down from Abuja who told me that he has been vaccinated because he is a federal civil servant and they made it compulsory that they vaccinate before they can receive their salary. So, the

people receiving it are very low. (IDI/Ikwo/48 years/Lecturer/March 2022)

Another participant opined thus:

I see people receiving the vaccine but out of the population in this state I should say, 30% of the population have taken it. (KII/Abakaliki/41 years/Civil Servant/March 2022)

Some respondents expressed that the few who had received the vaccine were mainly under duress. A participant opined thus:

…We don't believe in...We felt everything is just a prank. We felt the government has some things they never told us. So, no one has really gone to get COVID-19 injection willingly except on duress. (IDI/Ikwo/23 years/Student/March 2022)

Well, I believe maybe because it was mandatory where I work, and they were invited to come and give us the shots…most persons were compared to go to this vaccination centres to go and take it. (IDI/Afikpo North/40 years/Banker/March 2022)

Participants from the National Primary Healthcare argued that massive misinformation and discouraging comments from people in many ways deter people from taking the vaccine. He argued thus:

…Some people are still discouraging people putting fears into them that even somebody that is having the zeal to come if you mention it somewhere. People will ask, what? What do you say? You say you are going to do this, don't. they put fear into the mind. (KII/Abakaliki/41 years/Civil Servant/March 2022)

Concerns about vaccine effectiveness and development within a short period were also found to have influenced people's uptake of the vaccine. A participant expressed thus:

…The uptake of the vaccine is still very poor. A lot of people have not taken the vaccine. A lot of people are not even interested in taking these vaccines. Most of the reasons given often have to do with feelings of fear that are associated with the vaccine. People have this fear that the timeframe for the creation of these vaccines did not meet global standards, that it happened too fast and it's kind of raised a lot of fear among the people about if these vaccines are safe. (IDI/Afikpo North/ 30 years/Teacher/March 2022)

For many who are willing to receive the vaccine, some respondents expressed that the short shelf-life of the vaccine is a considerable concern. A respondent opined thus:

…When I went for my second jab, I was told that the once available had already expired people did not come and take them, so I had to wait for the next batch… (IDI/Ikwo/38 years/Lecturer/March 2022)

It was also identified that many who possess the vaccination card did not necessarily receive the vaccine. A respondent had this to say:

…They threw it away and was giving citizens the card. Identifying that they have taken the injection. Yes, that's what they did in… (IDI/Ikwo/23 years/Student/March 2022)

Table 2 Model summary

Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	266.847[a]	0.146	0.226

[a]Estimation terminated at iteration number 5 because parameter estimates changed by less than 0.001

Table 3 Classification table (the cut value is 0.500)

Observed			Predicted		
			COVID-19 vaccine uptake		Percentage correct
			Yes	No	
Step 1	COVID-19 vaccine uptake	Yes	22	43	33.8
		No	4	233	98.3
	Overall percentage				84.4

The Social Determinants of Health Informing the Uptake of COVID-19 Vaccine in Ebonyi State

The fourth research objective of this study assessed the social determinants of health informing the uptake of the COVID-19 vaccine in Ebonyi State. Logistic regression was used to examine the social determinants of health informing the uptake of the COVID-19 vaccine. The results are as follows:

The model explained 22.6% (Nagelkerke R Square) of the variance in vaccine uptake (see Table 2) and correctly classified 84.4% of cases (see Table 3). Perceived vaccine effectiveness is positive and significant (B = 0.360, S.E. = 0.087, $p = 0.000$) determinant of the probability of vaccine uptake, with odds ratio (OR) indicating that for every one unit increase on this predictor the odds of vaccine uptake change by a factor of 1.433 (meaning the odds are increasing). Also,

knowledge of peers/family members who had taken the vaccine is a positive and significant (B = 0.959, S.E. = 0.242, p = 0.000) determinant of the probability of vaccine uptake, with OR showing that for every one unit increase on this determinant, the odds of vaccine uptake change by a factor of 2.608 (meaning that the odds are increasing). Cultural practices are a negative and significant (B = − 0.998, S.E. = 0.492, p = 0.042) predictor of vaccine uptake. The OR indicates that for every one-unit increment on the predictor, the odds of receiving COVID-19 vaccine increase by a factor of 0.369 (meaning that the odds are decreasing). More so, place of residence is a negative and significant (B = − 0.665, S.E. = 0.291, p = 0.022) determinant of the probability of COVID-19 vaccine uptake with the OR indicating that for every one unit increase on this determinant, the odds of receiving COVID-19 vaccine increases by a factor of 0.514 (meaning that the odds are decreasing). Nonetheless, religious belief (B = − 0.656, S.E. = 0.499, p = 0.189), sex (B = 0.059, S.E. = 0.326, p = 0.856), age (B = 0.023, S.E. = 0.036, p = 0.519), marital status (B = 0.013, S.E. = 0.481, p = 0.979), education (B = − 0.060, S.E. = 0.158, p = 0.705), average monthly income (B = 0.091, S.E. = 0.155, p = 0.559), employment status (B = 0.060, S.E. = 0.123, p = 0.624), occupation (B = − 0.073, S.E. = 0.092, p = 0.429) and history of chronic disease (B = − 0.069, S.E. = 0.408, p = 0.866) were all nonsignificant in the model (see Table 4).

The qualitative data shows that living conditions in the state are below standard and have impacted people's uptake of the COVID-19 vaccine. Respondents had this to say:

> One who does not have money to eat, may not even think of taking the vaccine … Also, if the place you are going to take it is far from where you live, you may find it difficult to pay the T-fare to and from and so that money you can use it to offset other household expenses... (IDI/Ikwo/48 years/Lecturer/March 2022)

Another participant had this to say:

> …Encouraging someone who has not eaten and is looking for what to feed himself and his family to take the vaccine makes them see you like you don't know what you are doing. The first thing is to give him something to eat before you talk of COVID-19. The vaccine is not the main issue to discuss for him. (KII/Abakaliki/41 years/Civil Servant/March 2022)

Another participant identified that it is the virus of hunger that the masses are after its eradication. He argued thus:

> …A lot of people are not really worried about the vaccine. They're not really worried about COVID-19. People are more worried about the virus of hunger. Yes, people are more worried about the virus of hunger, of lack, and of not paying their children's school fees. So, I think it's when people rise above hunger that they would start looking at other areas of their lives. But I think a lot of people here are poor. It impacts the willingness to go for the vaccines. (IDI/Afikpo North/37 years/Civil Servant/March 2022)

Table 4 Variables in the equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Perceived vaccine effectiveness	0.360	0.087	17.025	1	0.000	1.433	1.208	1.701
	Knowledge of peers/family who had taken the vaccine	0.959	0.242	15.709	1	0.000	2.608	1.624	4.190
	Cultural practices	− 0.998	0.492	4.121	1	0.042	0.369	0.141	0.966
	Religious belief system	− 0.656	0.499	1.726	1	0.189	0.519	0.195	1.381
	Sex	0.059	0.326	0.033	1	0.856	1.061	0.560	2.009
	Age	0.023	0.036	0.416	1	0.519	1.024	0.954	1.099
	Marital status	0.013	0.481	0.001	1	0.979	1.013	0.394	2.600
	Education	− 0.060	0.158	0.143	1	0.705	0.942	0.692	1.283
	Average monthly income	0.091	0.155	0.342	1	0.559	1.095	0.808	1.483
	Employment status	0.060	0.123	0.240	1	0.624	1.062	0.835	1.352
	Occupation	− 0.073	0.092	0.627	1	0.429	0.930	0.776	1.114
	Place of residence	− 0.665	0.291	5.218	1	0.022	0.514	0.291	0.910
	History of chronic disease	− 0.069	0.408	0.029	1	0.866	0.933	0.419	2.078
	Constant	1.038	1.519	0.467	1	0.494	2.823		

[a]Variable(s) entered on step 1: perceived vaccine effectiveness, knowledge of peers/family who had taken the vaccine, cultural practices, religious belief system, sex, age, marital status, education, average monthly income, employment status, occupation, place of residence, history of chronic disease

Interestingly, respondents argued that significant others are also determinants of an individual taking the COVID-19 vaccine. They had this to say:

> …When we had that the vaccine is down in the state you could see everybody calling their family members warning seriously against the intake of the vaccine. Even myself, I did it. I called my family. I said no one should take this. Also, I overheard others calling their families. (IDI/Afikpo North/24 years/Trader/March 2022)

This was the assertion of another participant:

> If your parents are compliant or your brothers and sisters as it concerns the intake of the vaccine then it influences one to take the vaccine…But if there is any person who is not willing to take it, I think they go on to urge the person to take it since the other person has taken it. But if you also go to other places, to other homes if the parents are not willing, the elderly ones are not willing, and they feel somehow concerning the intake of the vaccine then it goes a long way to discouraging many other persons in the family from taking it. (IDI/Ikwo/48 years/Lecturer/March 2022)

A trader had this to say:

> A lot of children depend on their parents and if their parents have negative perceptions of the COVID 19 vaccine, it is almost quite likely that the children will not take it. If the parents say that they can't take this vaccine, the children will not take this vaccine. If the husband of a woman says, I'm not taking this vaccine, this vaccine is bad. It is often expected that the wife will not take this vaccine as well. (IDI/Ikwo/40 years/Trader/March 2022)

The opinion of community leaders was also found to determine people's choice and willingness to receive the COVID-19 vaccine. A respondent suggested that:

> Community leaders are saying that nobody should take the vaccine. I have received warnings from the community saying … in short anybody there, any health worker that enters our premises we should hold him and kill that person. You can see that they have put something in the mind of the people and again some of the villagers. If the household, the head of the household said that nobody should take it, they will obey. Yes, they will abide by the directive given to them. (KII/Abakaliki/41 years/Civil Servant/March 2022)

Some respondents also posited that the COVID-19 vaccination campaign is a way of injecting the "666", the church of Satan into people. Some participants had this to say:

> …They're trying to inject 666. And, you know, it just sounds silly and funny, but at the end of the day, it is the reality as we see. So, we have to take it the way we see it. (IDI/Ikwo/53 years/Community Leader/March 2022)

Another interviewee had this to say:

> …Some religious bodies are trying to link it with the end-time prophecy of the scriptures that it is the Mark of the beast they are trying to implant on people… (IDI/Ikwo/23 years/Student/March 2022)

Interestingly, it was reported that many people in the state relied so much on herbal medicines and utilized its juice for treatment of all sorts of diseases which to some extent has influenced the poor utilization of COVID-19 vaccination services in the state. A participant had this to say:

> …An average Ebonyi Man believes in his herb…as funny as they sound, they work for us. We have some herbs that can keep COVID-19 far from us…and people believe more in their traditional drugs. (IDI/Ikwo/23 years/Student/March 2022)

Discussion of Findings

This study was conducted when vaccine-producing countries and international communities through the COVAX created an enabling environment for equitable access to the COVID-19 vaccine in developing countries. The study, therefore, investigated the in-country vaccine equity, access and utilization in Nigeria between February and March 2022. Specifically, it examined equity in the distribution of COVID-19 vaccines, the level of access to COVID-19 vaccines, the extent to which COVID-19 vaccination services are utilised and the social determinants of health informing the utilization of COVID-19 vaccination services in Ebonyi State. The findings of this study show that there is vaccine inequity in Ebonyi State, in terms of geographical location (rural areas and hard-to-reach areas), poor consideration of vulnerabilities, risks and needs of disabled populations and those with underlying biomedical factors which places them at risk of experiencing greater burdens from the disease. The finding conforms with the views of UNDP (2021), The Lancet Regional Health (2022) and Georgieva (2022) stating that there is a marked vaccine inequity both in-country and on the global scene.

The study also found a moderate access level (58%) to the COVID-19 vaccination sites with only 42% indicating the availability of vaccines at the vaccination sites nearest to them. Also, about 74% of the respondents had to cover a distance of more than 10 km to the vaccination site spending an average of N400–N600 on transportation. These findings corroborate the findings of Loembe' and Nkengasong (2021) who reported a poor access level to COVID-19 vaccines

in most African countries. The third objective of the study assessed the utilization/uptake of the COVID-19 vaccine. The study found a poor vaccine uptake with 71% of the respondent indicating not having received the vaccine. Only 15.4% of the respondents were fully vaccinated interestingly, some of those who were fully vaccinated indicated that the decision was out of duress from their employer. However, the majority of those yet to receive the vaccine expressed not feeling the need for vaccination, fear of vaccine side effects and not having time for vaccination as their top three reasons. These findings are contrary to Solís Arce et al. (2021) who in the prevaccine roll-out indicated that 80% of Africans were eager to receive the COVID-19 vaccine.

The fourth objective of this study assesses the social determinants of health informing the uptake of the COVID-19 vaccine. The study found perceived vaccine effectiveness, knowledge of peers/family members who had taken the vaccine and place of residence (urban/rural) to be significant in respondents' likelihood of receiving the COVID-19 vaccine. These findings were not in keeping with Al-Mohaithef and Padhi (2020) who in Saudi Arabia expressed that age, marital status, level of education, employment status and work sector determined the utilization of COVID-19 vaccination. However, the study of Biswas et al. (2021), Ogueji and Okoloba (2022) and Singh et al. (2021) corroborates the findings of this study showing that perceived vaccine effectiveness, awareness of peers who had taken the COVID-19 vaccines and cultural and religious belief systems inform the uptake and utilization of COVID-19 vaccination services. Furthermore, poor economic conditions (poor standard of living) and reliance on herbal juice were also found to have informed the poor uptake of the COVID-19 vaccine in this study. This was supported by Amuzie et al. (2021) who reported income levels and family economic conditions to predict the uptake of COVID-19 vaccines.

Conclusions and Recommendations

Vaccine inequity is widely acknowledged across all levels in Nigeria with a rising expiration of donated vaccines amidst poor uptake levels. Consequently, the following recommendations are made, based on the findings of this research:

1. Developing vaccine manufacturing capacity: The Nigerian government should increase its investment in vaccine research and health systems. The federal government through the Ministry of Health should also develop a unique and workable national plan for pandemic preparedness and institute an active and functional vaccine research centre which would enable the in-country manufacturing of vaccines for vaccine-preventable diseases. Achieving this will stop the "duplication behaviour" of the federal government in future health emergencies as seen during the COVID-19 pandemic.
2. Early partnerships and treaty for vaccine availability: In cases where the country does not have a vaccine for a vaccine-preventable disease (such as it is currently), early partnerships, treaties, and donations of the vaccine should be prioritized by the Federal Ministry of Health through its parastatals like the National Primary Health Care Development Agency (NPHCDA), as well as the Nigeria Centre for Disease Control (NCDC).
3. Building strength in African traditional medicine: The African indigenous herbs and healing practices should be promoted alongside Western medicine. With the right investment and nurturing, African traditional medicines may become an indigenous solution to pandemics and other public health emergencies.
4. A holistic approach to vaccination campaign: Vaccine donation does not promise an effective vaccination campaign. Mass vaccination covers systems and processes such as procurement; cold chain supply chain warehousing; monitoring and surveillance systems; human resource capacity building and deployment; population outreach; and financial management and corporate governance. A multi-ministry partnership/engagement in the vaccination campaign will accelerate the closure of the country-level vaccine deployment and access. Also, the capacity of the national healthcare system must be strengthened through COVID-19 health and social intervention programmes. The vaccination campaign should also be integrated with other immunization services. This will improve vaccine coverage and enable the possible realization of set targets on vaccination rates.
5. Removal of export restrictions and trade barriers on lifesaving COVID-19 vaccines: The defects in global solidarity and structural inequalities in international relations have negatively impacted the procurement and logistics of vaccine roll-out. Moving forward, countries should remove export restrictions and trade barriers which affect the movement of COVID-19 vaccines. These restrictions and barriers not only affect the movement of vaccines but also promotes the hoarding of personal protective equipment needed in controlling and ending the pandemic within the shortest period possible.
6. Building trust in the vaccine: There is significant untrust on the side of the populace regarding the safety and effectiveness of the COVID-19 vaccine. A targeted and personalized vaccine education and awareness programme through citizen and community engagement will increase vaccine uptake among the populace. Influencers and other opinion and community leaders should also be involved in the vaccine education and awareness programme for easy acceptance of the programme.

7. Use of mobile vaccination clinics: In accessing medically underserved populations such as those in rural and other hard-to-reach areas, mobile health clinics should be adopted. The mobile clinic approach will also enable people who may want to avoid in-person vaccination due to fear of contracting the disease in public vaccination sites.
8. Building and sustaining data and tracking systems for COVID-19 vaccine distribution: To achieve equitable access to vaccines, real-time data and digital monitoring tools must be developed. This will provide better data-driven insights into the COVID-19 vaccination campaign. It will also provide a daily track of vaccine coverage, utilization, and wastage from which decision-makers will make timely corrections and better guide implementation bottlenecks in the vaccination campaign.

Study Limitations

The generalizability of the study findings is limited because the findings are from qualitative and quantitative data on COVID-19 vaccine and its uptake from selected local government areas of Ebonyi State. The authors do not suppose that their findings apply to other states of Nigeria and other developing countries.

Declarations

On behalf of the authors, the corresponding author states that the study fulfilled ethical best standards while observing the principles of anonymity, informed consent, freedom from harm, non-maleficence and right of withdrawal.

Ethical Approval This study follows the ethical rules at the University of Ibadan.

Informed Consent On behalf of all authors, the corresponding author states that informed consent was duly received from the participants, and no participant was compelled to take part in the study.

Conflict of Interest The authors declare no competing interests.

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