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Research Article

KNOWLEDGE, ATTITUDES AND PRACTICES OF MOTHERS TOWARDS CHILDHOOD VACCINATION IN LAGOS STATE, NIGERIA

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ABSTRACT

Despite the significant impact of vaccination on reducing child mortality from vaccine-preventable diseases like measles, polio, tuberculosis, and haemophilus influenza, vaccine uptake and coverage remain a challenge, particularly in countries like Nigeria. While the government provides free routine immunization up to age two, many children miss out on essential vaccines beyond this age due to various factors. This study aimed to investigate the awareness, attitudes, and practices of mothers regarding childhood immunization, particularly beyond the age of two, in Alimosho Local Government Area of Lagos, Nigeria. A cross-sectional study was conducted with 291 mothers, collecting data on immunization awareness, attitudes, and practices using a modified, pretested questionnaire administered through an online survey. Descriptive and inferential Chi-square statistics were used to analyze the data. The results revealed that the majority of participants were Yoruba (77.3%), semi-employed (53.6%), and had tertiary education (92.1%). Although 76.6% of the women demonstrated poor knowledge of immunization, a significant majority (79.4%) had positive attitudes towards vaccination. While no significant association was found between socio-demographic variables and knowledge about immunization, ethnicity ($p = 0.026$), employment status ($p = 0.016$), and educational level ($p < 0.001$) were strongly associated with positive attitudes towards immunization. The overall knowledge and attitudes of mothers in Alimosho Local Government Area were found to be lower than reported in other regions of Nigeria. To address these findings, it is recommended that targeted health promotion strategies be developed to improve knowledge and awareness about immunization among mothers in this area. These strategies should leverage various media platforms to reach a wider audience and emphasize the importance of completing the

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full immunization schedule for children. Additionally, efforts should be made to enhance access to immunization services and address socio-demographic disparities that may influence vaccine uptake.

KEYWORDS

Immunization, vaccine hesitancy, vaccine coverage, health attitude, immunization schedule.

INTRODUCTION

The global burden of child mortality, particularly deaths among children under five, has spurred urgent action to reduce preventable neonatal and under-five mortality rates (United Nations Inter-Agency Group for Child Mortality Estimation, 2020). Vaccination has emerged as a highly effective strategy in combating this crisis, significantly contributing to a reduction in child mortality rates (Esposito et al., 2014; Ventola, 2016).

Immunization involves administering live, attenuated, or inactivated microorganisms to stimulate immune responses and prevent diseases (Pollard & Bijker, 2020). The World Health Organization (WHO) prioritizes vaccination as a cost-effective intervention for protecting vulnerable populations from life-threatening infectious diseases (Gilmour et al., 2011). Vaccination has been instrumental in saving over six million lives annually and reducing disability-adjusted life years (Ehreth, 2003). According to the WHO, immunization prevents an estimated four to five million child deaths each year (WHO, 2019), underscoring the importance of continued investment in the Expanded Program on Immunization (EPI) to ensure widespread access to childhood vaccination (WHO, 2017). The EPI targets six vaccine-preventable diseases: tuberculosis, polio, diphtheria, tetanus, measles, and pertussis (WPRO, 2017).

Despite the challenges of achieving the WHO's specified herd immunity threshold of 92-95 percent for vaccine-preventable diseases (VPDs) in low-income countries in 2014, immunization has made significant strides in improving global health outcomes. Over the past two decades, immunization has saved an estimated 20 million lives, with three million lives saved annually (UNICEF, 2020). This remarkable progress is attributed to the widespread implementation of vaccination programs and the development of effective vaccines for a range of infectious diseases.

While the herd immunity threshold remains a challenge in many regions, immunization has been particularly effective in reducing the burden of diseases such as measles, polio, diphtheria, tetanus, pertussis, and pneumonia. In some countries, immunization has led to a near-complete elimination of these diseases, resulting in significant improvements in child health and survival rates.

However, it is important to note that the impact of immunization varies across different regions and populations. Factors such as poverty, access to healthcare, and cultural beliefs can influence vaccine uptake and coverage. Addressing these challenges is essential for ensuring that everyone benefits from the life-saving potential of immunization.

Even with these advancements, Nigeria continues to face a significant burden of child mortality, with 132 deaths per 1000 live births, resulting in more than one in eight children dying before the age of five (National Population Commission and ICF, 2019). This alarming statistic highlights the urgent need for targeted

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interventions to improve immunization coverage and address the underlying factors contributing to high child mortality rates in Nigeria.

Immunization might be either routine or supplementary (also known as immunization campaign) (Chakrabarti et al., 2019). Routine immunization is the nationally scheduled, on-going administration of vaccination doses to new-borns; at specific ages until their first birthday (Intellectual Concept LLC, 2021). The primary goal of routine vaccination is to provide all children and women with an adequate number of doses of strong vaccines in a timely, safe, and efficient manner, hence inducing immunity against certain diseases (Manjunah et al., 2003). For this process to take place, children are taken to the health care facility by their parents or caregivers to obtain antigen dosages appropriate for their age. For cost-effectiveness, most developing countries only do this on specified days of the week to prevent wastage of the multi-dose vaccine delivered vials. Governments, on the other hand, conduct supplemental immunization also known as an immunization campaign, which is occasionally provided for the purpose of catch-up immunization, disease eradication or elimination, and averting epidemics. In the last two decades, immunization programs have grown with wider coverage and impact, and this is evident in the case of polio eradication, which has reduced global polio cases by 99.9% as at 2021 (WHO/UNICEF, 2021).

However, several challenges have been reported to influence the uptake of vaccine by people who most need them which has resulted in low vaccine coverage and worsening of present disease burden (Oyston & Robinson, 2012; Obohwemu, Christie-de-Jong and Ling, 2022). Across the globe, variability exists in immunization coverage due to numerous factors like the demographic profile, political instability, socio-economic characteristics, misconceptions about the safety and efficacy of vaccines, etc. The issue of inadequate, incomplete, or partial immunization has thus been a major research interest in public health domain especially within the African settings, low income and resource-deprived areas of the globe (Jani et al., 2008). According to global statistics, more than 20 million eligible children have been reported to miss the three doses of DTP3 vaccine, 44 percent of which had incomplete immunization of the DPT 3 doses (Negussie et al., 2016). This issue has thus become a threat to public health because it has an impact on the achievement of the millennium developmental goal (MDG) of childhood mortality.

Globally, it is estimated that about two to three million deaths occur yearly because of vaccine Preventable diseases (VPD) with approximately 1.5 million deaths among under-five children (WHO/UNICEF, 2014). WHO established the expanded programmed on immunization (EPI) in 1974, with the goal of ensuring full accessibility of routine immunization vaccines to all children. According to the EPI, a child should receive one dose of Bacillus Calmette Guerin (BCG), three doses of oral polio vaccine (OPV) and Diphtheria Pertussis Tetanus (DPT), and measles vaccines by 12 months of age to ensure maximum protection against VPDs, leading to remarkable global reduction in under-five mortality from vaccine preventable deaths (IGME, 2015).

According to the WHO, UNICEF, World Bank (2009) child immunization is one of the healthcare services of global priority, as planet's survival is dependent on the healthy children population. Several reports have corroborated this, reporting the effectiveness of vaccine as instrumental to the increased continental-wide life expectancy, promotion of over 100 million

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disability-adjusted-life-years globally and estimated human population reaching 10 billion by 2055 (Rodrigues & Plotkin, 2020).

Despite significant gains with routine immunization coverage over the years, millions of children living in developing countries are not fully immunized, exposing them to disabilities or premature death. In 2014, over 60 % of the 18.7 million infants who were not fully vaccinated lived in ten countries including India, Nigeria, Democratic Republic of Congo, Ethiopia, Iraq, Pakistan, Philippines, Indonesia, Uganda, and South Africa (WHO/UNICEF, 2014).

Nigeria is the sixth largest population in the world with the highest population in Africa (Ekoh et al., 2020). Geographically, Nigeria is situated in Sub-Saharan region of Western Africa, and composed of 36 states, which is divided into six geopolitical zones namely northwest, northeast, northcentral, southwest, southeast, and South-South (Eze et al., 2021). According to Yaya et al. (2019), Nigeria records high urban-rural disparity in childhood and under-five mortality, attributable to bio-demographic and socioeconomic factors. In Adedire et al. (2021) report, about 22 percent of childhood and under-five mortality are from VPDs, estimated to over 200,000 deaths per year. The EPI which was aimed to combat this mortality trend was adopted in Nigeria in 1978; initially had a high coverage of about 82 percent with significant impact on reduction of infant mortality and improved child health (Eze et al., 2021). However, myriads of variables like poor government commitment on the EPI policy, religious-based vaccine hesitancy in the north, and federal over-centralization of EPI administrative process, led to collapse in delivery of the EPI services and coverage rapidly nose-dived at about 12 percent in 2003 (Ophori et al., 2014). As a result of this failure in EPI purpose, Nigeria currently ranks first among the ten countries with the most unprotected children in the world, accounting for three million (15.5 percent) of the 19.4 million unvaccinated infants in 2018 (WHO/UNICEF 2020). Since then, several initiatives such as supplemental immunization activities, community-level interventions, global positioning system tracker etc. had been taken to strengthen the routine immunization (Adeloye et al., 2017); however, there still exists low coverage and variability in coverage across Nigeria states. For instance, reports show that less than 30 percent of the eligible children have successfully completed the entire course of their immunization schedule (NPC and ICF International, 2014). Similarly, across Northern states of Nigeria, coverage is reported to vary between 5 and 48 percent (Gunnala et al., 2016).

A key metric or indicator for assessing the effectiveness of implementing routine immunization services in different countries is the DTP3 coverage (United Nations Children Fund, 2020). Unfortunately, Nigeria is among the 10 countries accounting for over 60 percent children without DTP3 vaccine in 2019 (WHO, 2020a, 2020b). Furthermore, in 2017 approximately 20 percent of global infant population with incomplete DTP immunization reside in Nigeria (Obanewa & Newell, 2020). Similarly, out of 8.9 million estimated infant populations by WHO African Region, reported with no measles-containing vaccine in 2015, three million are resident in Nigeria (Masresha et al., 2017). In a bid to resolve and tackle problems associated with vaccine coverage thereby promoting global access to essential vaccine, WHO and UNICEF established the Global Vaccine Action Plan (GVAP) in 2012 (World Health Organization, 2015). In line with GVAP, the Global alliance for vaccines and immunization known as GAVI was initiated and has assisted in subsidizing vaccine cost to poor countries, enabling free access below 2-year EPI coverage while

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other essential children vaccines especially above 2 years become "out-of-pocket" sourced. The impact of this was revealed by 2019 reports of the National Nutrition and Health Survey which indicated the DTP3 coverage had improved to 67 percent (World Health Organization, United Nations Children's Fund, 2020). Similarly, the NPC and ICF report (2019) showed that, between 2008 and 2018 statistics of complete immunization record increased by 8 percent while there was 10 percent decline in percentage of vaccine hesitancy. This data however revealed approximately 30% dropout rate in the number of children aged 12-23 month who completed the dose of DTP-HepB-Hib; similarly, a 27 percent dropout rate was observed for the OPV vaccines. If this is the case with the free vaccine, how bad would it be with the out of –pocket sourced vaccine? Are mothers in Nigeria even aware some vital vaccines should be taken after the government's free EPI vaccines? This research will attempt to investigate and address these pertinent issues towards finding ways of resolving vaccine related public health issues.

Some studies have attempted to delineate determinants, or the factors associated with incomplete vaccination, poor population uptake or vaccine hesitancy in Africa, while others have investigated the perception, practice and awareness of mothers towards immunization (Bangura et al., 2020; Ndwandwe et al., 2021). However, none of these studies has to the best of our knowledge, evaluated mothers' awareness about the need to vaccinate their children up to 10 years of age. This study will thus investigate the knowledge and attitude of mothers on this issue. The findings from this research would provide information on extent and key determinants of vaccine hesitancy among this population group and possible association of vaccine hesitancy with the mortality. This finding would assist in proposing and formulating effective public health intervention to ameliorate the mortality of the not less than 2 years' population. This research aims to investigate the knowledge, attitude and practice of mothers towards the need to vaccinate their children beyond 2 years of age, to gain insight into how best to increase vaccine coverage within this age group.

METHODOLOGY

This research aims to investigate some determinants of vaccine hesitancy among these populations using semi-structured questionnaire that would be administered to participants randomly selected across Alimosho local government area (LGA) in Lagos State, Nigeria.

Research design

A cross-sectional study was conducted using primary data collected from representative mothers with children within the studied vaccination schedule. The demographic data, with information on knowledge and attitude related variables of these mothers were collected. Descriptive analysis of the data was done to determine the prevalence of the mother's experiences while bivariate analysis using Chi square statistics conducted to delineate associations within the measured variables.

Cross-sectional observational study design was adopted for this research because they are useful for understanding determinants of health within a population at a particular time as well as to providing preliminary evidence for future advance studies (Wang & Cheng, 2020).

Quantitative research based on positivist philosophy was chosen for this study because it provides insight on the frequency, magnitude and extent to which the socially influenced variables in the study affects their

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objective realities (Rasinger, 2013; Kaur, 2016). This approach uses a deductive reasoning or logic in separating social experiences of human into variables or empirical components that could be organized into frequencies that helps to explore associations within the variables by statistical methods; and thus, gain insight of human behavior (Rahman, 2017). Also, the benefit of quantitative cross-sectional study is the short data analysis time compared to qualitative data made possible by the statistical software like SPSS (Connolly, 2007); in addition to generalizability of the findings due to utilization of randomly selected samples (Rahman, 2017).

Epistemological approach

Positivism philosophy was used in this research, and it enables the researcher to gain knowledge and derive conclusions from social observations by empirical testing of hypothesis, experimentation, extrapolations, mathematical equations; of which decipher the cause-and-effect relationship in observed variables; and helps provide predictive models based on measurable outcomes of findings (Bryman, 2012; Kivunja & Kuyini, 2017). According to Mohajan (2020), Positivist approach enables researcher to gain understanding of pattern of observations in human behavior, which is embedded in the collected data and how it is influenced by social factors. Contrary, to interpretivism-constructivism approach which is often used in qualitative research to explore subjective realities of participants (Rahman, 2017), Positivist perspective explores objectivity in the pattern of relationship found in social phenomenon or observations, thus providing true knowledge that enables causal relationship in social phenomenon to be established (Houghton, 2011; Ryan, 2018).

Quantitative positivist approach using cross-sectional design was utilized for this research to best explore relationship in factors such as mothers' perceptions, knowledge and social demographics that influence vaccination hesitancy. The information below provides a descriptive overview of the demographics of the study location or setting, sampling and unique context under which the research was conducted.

Study setting

This study was conducted in Alimosho local Government Lagos state, Nigeria. Alimosho Local Government Area (LGA) is one of the densely populated suburbs in Lagos State, Nigeria with estimated population of approximately 1.3 million (based on the 2006 population statistics) residing on a 185.2 sq. kilometer land mass (Ayedun et al., 2020). It is a semi-rural environment; and the largest local governments of the 57 Local Government Area in Lagos (Anetor & Oyekan-Thomas, 2018), with six local administrative zones comprising Egbeda-Akowonjo LCDA, Agbado-Okeodo LCDA, Ayobo-Ipaja LCDA, Egbe-Idimu LCDA, Ikotun-Igando LCDA and Mosan-Okunola LCDA (Ayedun et al., 2020). Alimosho Local government in Lagos is a residential area acclaimed to be home for majority of government workers in the civil service of Lagos state as well as other elite individuals who have easy access to the internet either on their phones, laptop both at home and at work. Alimosho Local Government has proximity to Ikeja, which is the capital of Lagos State where the seat and offices reside. Lagos state is known to be the largest commercial city in Nigeria. The Alimosho residents benefit from a vast provision of healthcare services from government and private providers. In Alimosho LGA, there is the Alimosho General Hospital located at Igando; and 29 primary healthcare facilities distributed across the six LCDAs with approximately 250 healthcare workers that could provide vaccination services (Ogunyemi & Odusanya, 2016). However, this

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LGA is one of those without data on the knowledge, attitude and practice of mothers on childhood immunization process, which makes it suitable for this study.

Study Population

In this study, mothers of children aged 2 years and above were randomly recruited from Alimosho LGA as participants through online networks and social media and groups and platforms like Facebook, Instagram and YouTube. Due to the data collection technique, eligibility for the study only included women whose children met the age requirement, digital literacy and residency in the Alimosho local government area of study. Consent to participate in the research was included with the data collection tool. The demographic data, knowledge of vaccination and essential "out-of-pocket" sourced vaccines is collected using appropriate data collection tool; and subjected to statistical analysis.

Sampling Approach

This study evaluates the knowledge, attitudes, and practices of 369 mothers residing in Alimosho LGA of Lagos regarding the vaccination of their children aged 2 to 10 years. A non-probabilistic purposive sampling was adopted for this study since the intended participants represents a unique population (Ames et al., 2019). Identification of eligible mothers from the area was done and followed up with administration of informed consent forms. The sample size was determined by appropriate calculation before the semi-structured questionnaire was administered to the consenting mothers.

Inclusion Criteria

This study recruited mothers: whose child/children met the age requirement of the children population studied, those who live within the study area (Alimosho local government area), mothers who are digitally literate and Mothers who gave consent to participate in the research.

Exclusion Criteria

Mothers who live within the study area whose children did not meet the age requirement of the children population studied, Mothers whose children meet the age requirement of the children population studied but do not reside in the study location, mothers who are not digitally literate and Mothers who did not give consent to participate in the research.

Sample Size

In order to obtain a sampling that correctly reflects the studied population and allows the findings to be generalizable, Tyrer & Heyman (2016) reported that the confidence level, standard deviation of responses and estimated margin of permissible error must be determined. As such, the appropriate sample size for this study was estimated using the sample size formula of Lemeshow et al., (1993) for cross-sectional study as indicated below.

$n = z^2 p(1-p)/e^2$

where:

n = required sample size

z = standard normal deviate corresponding to 95% confidence level at 1.96

p = prevalence level (according to Adefolalu *et al.*, 2019, the prevalence of mothers with adequate knowledge of immunization for under-five children was 72%)

e = level of error tolerance 5%

Thus, $n = (1.96)^2 (0.72) (1-0.72) / (0.05)^2$

$n = 3.84 \times 0.2016 / 0.0025$

$n = 310$

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To prevent the problem of selection bias in which there is insufficient number of credible data due to incomplete questionnaire fill or non-response that makes the data skewed in unpredictable direction (Tyrer & Heyman, 2016), 10% of the sample size will be added to make approximately a total sample size of 341; this will cater for attrition and non-response.

10% of 310 = 31

Total sample size is 310 + 31 = 341

Sample Recruitment

Mothers of children aged 2 to 10 years living in Alimosho Local Government Area, Lagos State, Nigeria, were purposefully recruited to participate in the study between December 2021 and January 2022. Alimosho local government has social media groups and platforms like Facebook group (Alimosho connect and Alimosho marketplace) and Instagram groups with hashtags (#alimosholocalgovernment, #alimoshomua, #alimosho, #alimoshomumconnect, #alimoshoschools and so on) where the link to the survey and the participants' information form, consent form and questionnaire can be accessed and filled by consenting participants. Google advertisement platform was set up for the study to sensitize and reach out to the participants towards allowing a widespread promotion through social media platforms like Facebook, Twitter, Instagram and YouTube. The google advertisement was paid for (total cost of approximately 35 pounds) and this ran for 3 weeks. This advertisement flier was posted in the Alimosho local government social media platforms like Facebook (Alimosho connect and Alimosho marketplace) and Instagram groups with hashtags (#alimosholocalgovernment, #alimoshomua, #alimosho, #alimoshomumconnect, #alimoshoschools and so on) where eligible mothers were able to view the adverts and mothers who met the inclusion criteria were recruited for the participation in the study.

The advertisement flier was shared widely on all the social media platforms and groups to generate buzz about the research. The participants' information sheet and consent form were communicated online, and consenting mothers clicked on "yes, I agree to participate" before being transferred to the questionnaire, after which the questionnaires were filled. The informed consent form detailing the purpose of the study, duration and instructions for filling the questionnaire, potential risk of participating in the research and assurance of confidentiality of participant's information was made mandatory to be eligible in the research. Instruction on the voluntary participation of the mothers and their right to voluntarily withdraw their participation at any time in the process of the research was also stipulated.

Data Collection Method

The credibility and trustworthiness of this research is dependent on an accurate and systematic collection of the data. In this research, a semi-structured, validated close-ended questionnaire with few open-ended questions which had been used in previous studies was modified and adopted in the survey as the data collection tool for in-depth exploration of the participants' perceptions and knowledge on the research focus (DeJonckheere & Vaughn, 2019). The adopted questionnaire here is a modified standardized widely validated pretested questionnaire that was originally set up by Tadesse et al, (2009) and reused for another study by Negussie et al (2016) which was published in the BMC journal (Appendix E). The questionnaire was slightly remodified to suit the aim and objectives of this research. This questionnaire, which was self-administered online for convenience of the participants (Evans & Mathur, 2005), was executed via the "Qualtrics online software", and comprises of

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24 questions that is sectioned into three phases namely:

1. Socio-demographic and socio-economic information of the mothers composed of 7 questions.

2. Knowledge of mothers towards childhood immunization, constituting 8 questions

3. Attitude of mothers towards childhood immunization, composed of 9 questions using the Likert scales from, 1= strongly disagree to 5= strongly agree

The responses were scored based on predetermined algorithm or codes (Table 1); for instance, "Yes" or "No" questions as "1" or "0" respectively, for multiple choice questions, "correct" answer designated "1" and "incorrect" or "I don't know" as "0". The total number of responses is evaluated against total score; and cut-off are set to designate level of knowledge and attitude respectively. For attitude variable, using a total score of 27, mothers who had 70 percent was assigned as "good" and below 70 percent as "poor". Similarly, for the knowledge variable, using a total score of 32, less than 50 percent was assigned "poor", "50 to 69 percent" described as fair, while 70 percent and above are "good". The data was thereafter transferred to SPSS before the various analysis was conducted.

Table 1: Codebook of Variables

Variable Name	Measurement	Variable type	Coding
Gender	Nominal	Independent	Male=1, Female=2 Prefer not to say=3
Age of mother	Scale	Independent	Number
Age of child	Scale	Independent	Number
Alimosho resident	Nominal	Independent	Yes=1 No=2
ethnicity	Nominal	Independent	Yoruba=1 Igbo=2 Hausa=3 others=4
Employment status	Nominal	Independent	Employed=1 self-employed=2 unemployed=3
Education attained	Nominal	Independent	No formal education=1 Primary education=2 Secondary education (uncompleted)=3 Secondary education (completed)=4 Tertiary Education=4
Vaccine uptake	Nominal	Independent	Yes=1 No=2
Knowledge of mothers on immunization x3	Discrete	Dependent	Multiple values
Attitude of mothers x9	Ordinal	Dependent	1=Strongly disagree 2=somewhat disagree 3=neutral 4=somewhat agree 5=Strongly agree

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Data Analysis

Data analysis for this study was conducted with the IBSM Statistical Package for the Social Sciences (IBSM SPSS) version 28.0 software (IBM Inc., Chicago, USA); and involved both descriptive and inferential statistics to gain full understanding of the research data. Initial raw data containing 369 responses were extracted from Qualtrics unto Microsoft Excel spreadsheet, filtered and cleaned using the inclusion and exclusion criteria giving 291 responses for analysis before computation of the results with SPSS. The demographic details of the mothers were analyzed using descriptive statistics to examine the frequency distribution in immunization awareness within the participants, while the inferential statistics was used to determine the relationship within the data variables. Chi-square test was used as the inferential statistics to analyze the results since the response data are nominal and ordinal which can be coded into numerical variables, and represented as a frequency distribution, which allows the association between knowledge and attitude of mothers towards childhood immunization with respect to their demographic details to be delineated. Working at a statistical significance level of p value less than 0.05 as benchmark, the association within the data was expressed by the Pearson Chi square value; and the strength of association between the variables depicted by the Phi value.

Ethical Consideration

This study was conducted as part of the lead author's Master of Science in Public Health dissertation at the University of Sunderland, supervised by Dr. Obohwemu Kennedy Oberhiri. Ethical approval was obtained from the Sunderland Ethics and Review Committee, ensuring that data collection was based on informed consent from participants and that the research adhered to the principle of non-maleficence, minimizing any potential harm to participants. There was no need to seek approval from the Ministry of Health in Lagos State, Nigeria since the research was strictly through social media platforms and groups. The Ministry of Health Review Board evaluate and approves proposal on human subject research in line with requirement for primary research involving humans (Fleming & Zegwaard, 2018).

A participant information sheet was included with the informed consent form detailing the purpose of the study, duration, and guide on questionnaire, potential risk, and assurance of confidentiality and this was assessed by the potential participants though the links on the adverts and fliers posted on the social media platforms and groups.

The consent form was clicked by participants who met the inclusion criteria before the questionnaire was filled. Information of voluntary withdrawal from the study was also provided. Participation is voluntary and participants can withdraw their participation at any time.

Full anonymity and confidentiality of the participants was ensured from the start of the study, as no personal information was collected. Data collected by the participants will be kept secure be multiple levels of password of the computer system and files and only the study teams will be able to access it. All data was collected using the Qualtrics software to further secure anonymity. Collected data was stored, and pass-worded on a secured hard drive for a minimum of 5 years after which it would be erased.

Data management and statistical analysis

Data obtained from the online Qualtrics was filtered to remove non-compliant responses that did not meet the inclusion or exclusion criteria, coded, scored,

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entered and analyzed in Statistical Package for Social Sciences (SPSS), version 28.0 (IBM, Chicago, USA) as summarized in. "Yes" or "No" questions were scored "1" or "0" respectively, "correct" and "incorrect" answer scored "1" or "0" respectively for the multiple choice and open-ended questions. The knowledge and attitude scores were obtained from quotient of individual score against total scores of 32 and 27 respectively. Knowledge level and attitudinal dispositions were adjudged from designated cut-offs, i.e., for attitude variable, 70 percent "good" while below 70 percent assigned "poor"; for knowledge variable less than 50 percent designated "poor", "50 to 69 percent" described as fair; and 70 percent or greater assigned "good".

Descriptive statistics were such as frequency distribution was computed for categorical variables and mean with standard deviation for continuous or numerical variables. Bivariate analysis was performed using Chi-square test or Fisher's Exact test, as appropriate. A 2-tailed p-value < 0.05 was considered statistically significant.

RESULTS

The findings of the quantitative study on knowledge, attitude and practice of mothers towards childhood vaccination in Lagos, Nigeria is presented in this chapter. The detailed socio-demographic characteristics of the respondents were presented using descriptive statistics expressed as frequency distribution and percentages. The descriptive bar charts were used to address objectives 2 and 3 of the study relating to knowledge and attitudinal disposition of the respondents to vaccination. Objectives 4 and 5 relating to associations between the studied variables were explored with bivariate inferential statistics involving cross tabulations and chi square calculation to delineate evolving patterns in the analyzed data. Based on the outcome of the findings, null hypothesis was mostly upheld while in few cases it was rejected as displayed below:

Null hypothesis: There is no statistically significant relationship or association between the social demographics, knowledge level of respondents, attitude and completion of childhood vaccination beyond 2 years of age.

Alternative hypothesis: There is existing relationship or association, which is statistically significant between the knowledge, attitude and social demographics of the respondents towards vaccine completion in their children beyond 2 years of age.

Respondent Sociodemographic Characteristics

Table 2 below shows summary statistics of the respondents' socio-demographic characteristics. 291 respondents (mothers) were included in the analysis. The mean age of the respondents was 34.5 ± 5.3 years with the youngest being 21 years old and oldest was 58 years, while the mean age of their children was 5.4 ± 2.3 years. In terms of the age distribution, a larger proportion of these respondents 68.7% (n = 200) were aged 31 – 40 years, 23.4% (n = 68) were aged 21 – 30 years while 7.9% aged above 40 years. Similarly, for the respondent's children, 56% (n = 163) were below or of 5 years of age while 44% (n = 128) were over 5 years old. With respect to Ethnicity, majority were of Yoruba decent 77.3% (n = 225), 16.5% were Igbo (n = 48) while 6.2% were Hausa (n = 18). The employment status of the respondents categorized into three groups revealed most (53.6%, n = 156) were semi-employed, 45% (n = 131) were employed and a small fragment, constituting 1.4% (n = 4) were unemployed. Furthermore, the education level revealed that 92.1% (n = 268) of the respondents attained tertiary education level, while 5.8% (n = 17) and

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2.1% (n = 6) attained secondary and primary education respectively.

Table 2: Sociodemographic Characteristics of Respondents

Variables (n=291)	Frequency	Percentage
Age-group (years)		
21-30	68	23.4
31-40	200	68.7
>40	23	7.9
Mean (SD)	34.49 (5.262)	
Child's age (years)		
≤5	163	56.0
>5	128	44.0
Mean (SD)	5.38 (2.333)	
Ethnicity		
Yoruba	225	77.3
Igbo	48	16.5
Hausa	18	6.2
Employment status		
Unemployed	4	1.4
Semi-employed	156	53.6
Employed	131	45.0
Education level		
Primary	6	2.1
Secondary	17	5.8
Tertiary	268	92.1

Assessment of Respondents' Knowledge towards Childhood Vaccination

The participating mothers demonstrated varying levels of knowledge regarding issues related to vaccination as reported in Table 3 below.

Table 3: Prevalence pattern of Mothers' knowledge on Childhood Vaccination (N = 291)

Variable	Count	Total	%
Do you know about immunization?	Yes	275	94.5
	No	16	5.5
List all the immunization vaccine type for children 0-10 years you know	**17 options**		
	0-8: Poor	255	87.6
	9-12: Fair	13	4.5
	≥ 13: Good	23	7.9
Which disease can vaccines prevent?	**9 options**		
	< 5: Poor	176	60.5
	5-6: Fair	67	23.0

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	≥7: Good	48	16.5
Why should a child be given immunization	Correct	253	86.9
	Incorrect	38	13.1
Do you know the schedule for childhood immunization	Yes	235	80.8
	No	56	19.2
Do you know if your child has been completely immunized?	Yes	235	80.8
	No/I don't know	56	19.2
If No, what was the reason for non-completion	Specified	30	53.6*
	Undefined**	8	3.4**
Does immunization have side effects?	Yes	116	39.9
	No/Don't know	175	60.1

• ***Calculated with respect to the total number of incomplete immunizations; **refers to counts of complete immunization that gave reasons for non-completion; and calculated with respect to statistics of total completion of vaccination.***

A larger proportion of the respondents (94.5%, n = 275) knew about immunization; although most (87.6%, n = 255) had poor knowledge about the specific vaccines for use within 0 to 10 years of the child's age. A poor understanding of diseases preventable by vaccines was also shown by most of the respondents (60.5%, n = 176). Of the 291 respondents, only 86.9% (n = 253) knew the specific reason for vaccine use, 80.8% (n = 235) knew the immunization schedule and status of vaccine completion for their children. About half of the respondents who do not know the status of completion of their children (53.6%, n = 30) had provided reasons for their action while 3.4% of those who admitted having completed their children's immunization also gave reasons for their non-completion. Finally, majority of the respondents are not aware of possible side effects of immunization (60.1%, n = 175).

Cumulatively, a dominant proportion of respondents (76.6 %, n = 223) in this study were seen to showcase a low level of knowledge with respect to issues on vaccine and its completion in children beyond 2 years of age as depicted by Figure 1. Fair display of vaccination knowledge was seen in 15.2% (n = 44) of the respondents and 8.2% (n = 24) have substantial good knowledge towards childhood vaccination.

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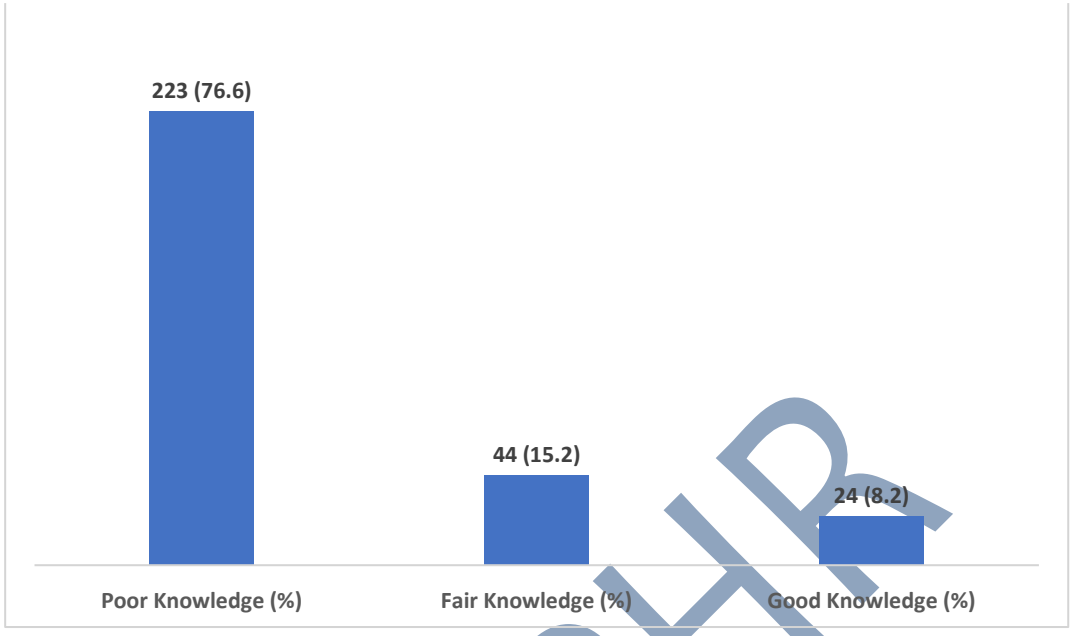

Figure 1: Knowledge of Mothers on Childhood Vaccination

Assessment of Respondents' Attitude towards Issues of Childhood Vaccination

Attitudes of mothers towards childhood immunization and its completion which was measured using the 5point Likert response scale in which 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree; and trichotomized into 3 variables comprising of Agree (Score 3), Neutral (score 2), Disagree (Score 1) to reinforce successive analysis is summarized in Table 5 below. The frequency distribution of the variables associated with respondents' attitude shows that majority (80%, n = 235) agreed to the fact that immunization is necessary for their children, 10% (n = 29) had an indifferent perception while 9.3% (n = 27) disagreed to the importance of childhood immunization. Of the total respondents, a larger proportion believes the immunization schedule must be completed once started, 10.3% had neutral perception and 10 % saw no need to complete childhood immunization. Majority (81.4%) have perceptions that healthy children should take immunization to prevent diseases, 5.8% believes there is no need for healthy children to be vaccinated and 12.7% have indifferent opinion about the issue. A larger proportion (86.9%) believes all immunization services should be free for children, 10% have no decisive opinion on the view but 3.1% expects some level of out-of-pocket payment for immunization. About half (51.9%) of the respondents disagreed that "immunizations are not 100% effective", approximately a quarter (25.8%) and remaining (22.3%) could not support the effectiveness or non-effectiveness of vaccine for their children. In addition, 68.4% reported a positive influence of the healthcare staff at the vaccination centers on their attitude, with 5.5% disagreeing to supportive impact of the vaccination site staffs on their immunization attitude and 26.1% reported indifference attitude to the issue. Similar proportions of the respondents 34.4% and 39.9% agreed and disagreed on determinant role of waiting time on positive attitude to vaccine completion while

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25.8 percent were unperturbed as to impact of waiting time on immunization completion. In addition, most (61.5%) of the respondents disagreed that "availability of the immunization was a problem"; while low proportions constituting 18.6% opine that immunization services are readily available to foster vaccination completion but and 19.9% are neutral on impact of vaccine availability as determinant factor in their attitude towards vaccine completion. Finally, 23% reported access to relevant information on immunization contributed to their poor attitude, with 24.4% indifferent about information access as determinant of vaccine completion and 52.6% disagreeing that this variable influences their attitude towards completion of their children vaccination schedule.

Table 5: Prevalence Pattern of Mothers' Attitude towards Childhood Vaccination (N = 291)

	Frequency (%)		
Variable	**Agree**	**Neutral**	**Disagree**
Immunization for children is very necessary	235 (80.0)	29 (10.0)	27 (9.3)
It is compulsory to complete immunization for children	232 (79.7)	30 (10.3)	29 (10.0)
Immunization should be discontinued if the baby is healthy	17 (5.8)	37 (12.7)	237 (81.4)
All immunization for children should be free	253 (86.9)	29 (10.0)	9 (3.1)
Immunizations are not 100% effective	75 (25.8)	65 (22.3)	151 (51.9)
The staff at the clinic where you got your child's immunization shots was helpful.	199 (68.4)	76 (26.1)	16 (5.5)
The waiting time for immunization discouraged you	100 (34.4)	75 (25.8)	116 (39.9)
Finding enough information about immunization shots that your child received was a problem for you.	67 (23.0)	71 (24.4)	153 (52.6)
Availability of the immunization was a problem	54 (18.6)	58 (19.9)	179 (61.5)

Overall, the respondents" attitude showed two clear patterns of good attitude and bad attitude towards immunization and its completion in their children. 20.6% of the 291-screened mothers exhibited poor attitude towards childhood immunization while 79.4% had good attitude towards issue related to childhood vaccination as shown in Figure 2 below.

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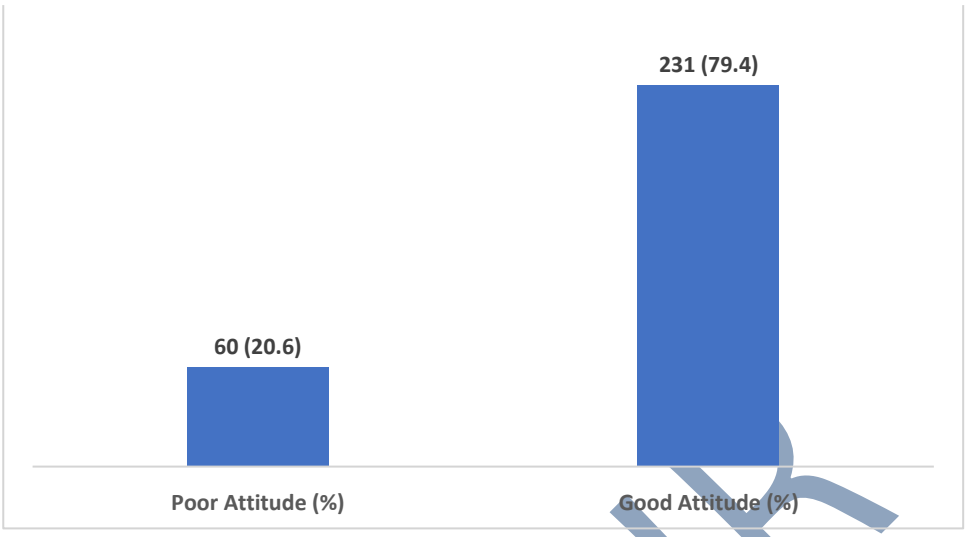

Figure 2: Overall Attitude of Mothers towards Childhood Vaccination

Factors Associated with Respondents' Knowledge of Vaccination

The outcome of bivariate analyses of association between the socio-demographics of the respondents with their knowledge status using cross-tabulation or contingency tables is summarized in Table 6 below. Within the respondent age-group, 17.6% of respondent of 21-30-year age-group had good knowledge towards their children immunization while 82.4% had poor knowledge; 23.5% aged 31-40 had good knowledge and 76.6% had poor knowledge and beyond 40 year of age 39.1% showed good knowledge while 60.9% had poor knowledge. However, high chi-square value of 4.436 with p-value of 0.109 ($p > 0.05$) indicates there is no significant relationship or association between the socio-demographics and knowledge and that the null hypothesis should be accepted with a 95% confidence. In terms of the child's age, 23.9% of respondent with children below 5-years-old had good knowledge of immunization-related issues and 76.1% had poor knowledge while for those with children above 5-years-old, 22.7% had good knowledge and 77.3% had poor knowledge. With a p value of 0.799 ($p > 0.05$), no significant association exists between these continuous variables, and the null hypothesis should be upheld with a level of confidence of 95%. Similarly, 21.8%, 27.1% and 33.3 percent of the Yoruba, Igbo, Hausa respectively had good knowledge of childhood immunization while 78.2%, 72.9% and 66.7% had poor knowledge with a p-value of 0.430; indicating absence of significant relationship between these variables at 95% confidence. Moreover, assessing the association of employment status with the respondents' knowledge shows that 25%, 22.4% and 24.4% of unemployed, semi-employed and employed mothers respectively demonstrated good knowledge towards immunization while 75%, 77.6% and 75.6% of the respondents have poor knowledge. At a p-value of 0.902 ($p > 0.05$), this statistic shows absence of statistically significant association among the cross-tabulated variables. Finally, 0%, 11.8% and 24.6% of the respondents with primary secondary and tertiary levels of education respectively had good immunization knowledge while 100%, 88.2% and 75.4% respondents with primary, secondary and tertiary qualifications respectively had poor knowledge. However, with p-value of 0.276, these variables are largely independent and alternative

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hypothesis should be rejected while null hypothesis should be accepted at 95% confidence level.

Table 6: Association between Sociodemographic Characteristics and Knowledge (N = 291)

	Knowledge			
Variable	**Good (%)**	**Poor (%)**	**χ2**	**p-value**
Age-group (years)				
21-30	12 (17.6)	56 (82.4)	4.436	0.109
31-40	47 (23.5)	153 (76.5)		
>40	9 (39.1)	14 (60.9)		
Child's age (years)				
≤5	39 (23.9)	124 (76.1)	0.065	0.799
>5	29 (22.7)	99 (77.3)		
Ethnicity				
Yoruba	49 (21.8)	176 (78.2)	1.686	0.430
Igbo	13 (27.1)	35 (72.9)		
Hausa	6 (33.3)	12 (66.7)		
Employment status				
Unemployed	1 (25.0)	3 (75.0)	FET**	0.902
Semi-employed	35 (22.4)	121 (77.6)		
Employed	32 (24.4)	99 (75.6)		
Education level				
Primary	0 (0.0)	5 (100.0)	FET**	0.276
Secondary	2 (11.8)	15 (88.2)		
Tertiary	66 (24.6)	202 (75.4)		

***Statistically significant at *p* <0.05, Good Knowledge (Good and fair); **FET: Fisher's Exact Test**

Factors Associated with Respondents' Attitude towards Childhood Vaccination

The result of the bivariate analysis of possible association of attitudinal variable with knowledge and sociodemographic characteristics is presented in Table 7. The output shows that among the women age groups 21-30 years, 31-40 years, above 40 years; 75%, 81.5% and 73.9% respectively had positive attitude towards childhood immunization uptake. However, the p-value associated with this analysis (p = 0.413) is greater than 0.05; indicating absence of significant association between the attitude and respondents' ages, and null hypothesis should be accepted. Likewise, among respondents with children of age-group < 5 years, 76.1% had positive attitude while among those with children above 5 years, 83.6% shows positive attitude towards childhood immunization although the p-value (p = 0.116) which is > 0.05 indicates absence of significant association between variables and the need to reject the alternate hypothesis. The knowledge variable is independent of the attitude of the respondent and shows a non-significant association with it (p = 0.086; p > 0.05). The frequency distribution shows that 13.2% of respondents with good knowledge had positive attitude towards immunization while 22.9% with poor attitude still had good attitudinal qualities of childhood immunization.

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Conversely, ethnicity (p = 0.026) and employment status (p = 0.016) have strong statistically significant association with the attitude and thus, the null hypothesis must be rejected for the alternative hypothesis to be accepted. The frequency distribution among the various ethnicity shows that 82.7% of the Yoruba, 70.8% Igbos and 61.1% Hausa respondents have good attitude towards immunization. Similarly, unemployed residents were more likely to have poor attitude than the employed (75% vs 19.9%; p = 0.016). A highly significant association (p < 0.001) exists between the educational status of the respondents and their attitude implying null hypothesis must be rejected. The frequency distribution shows that the percentage of respondents with poor attitude was significantly higher among women with tertiary education than those with secondary education and below (82.5% vs 43.5%).

Table 7: Association between Socio-demographic Characteristics, Knowledge and Attitude of Respondents (N = 291)

	Attitude			
Variable	**Good (%)**	**Poor (%)**	**χ2**	**p-value**
Age-group (years)				
21-30	51 (75.0)	17 (25.0)	1.766	0.413
31-40	163 (81.5)	37 (18.5)		
>40	17 (73.9)	6 (26.1)		
Child's age (years)				
≤5	124 (76.1)	39 (23.9)	2.477	0.116
>5	107 (83.6)	21 (16.4)		
Ethnicity				
Yoruba	186 (82.7)	39 (17.3)	7.298	0.026*
Igbo	34 (70.8)	14 (29.2)		
Hausa	11 (61.1)	7 (38.9)		
Employment status				
Unemployed	1 (25.0)	3 (75.0)	FET**	0.016*
Employed	230 (80.1)	57 (19.9)		
Education level				
Secondary& below	13 (56.5)	10 (43.5)	FET**	<0.001*
Post-Secondary	47 (17.5)	221 (82.5)		
Knowledge				
Good	9 (13.2)	59 (86.8)	2.955	0.086
Poor	51 (22.9)	172 (77.1)		

***Statistically significant at *p* <0.05, Good Knowledge (Good and Fair)**
****FET: Fisher's Exact**

Summary of Findings

A total of 291 women who satisfied the criteria for participation in this study were of mean age 34.5 ± 5.3 years; their children had a mean age of 5.4 ± 2.3 years; majority were of Yoruba ethnicity (77.3%), most with tertiary education (92.1%). Result shows that a larger percentage of the respondents (76.9%) have poor knowledge (< 50%) knowledge of immunization. However, despite the low level of knowledge a larger proportion (79.4%) showed positive or good attitude. Evaluation of factors associated with immunization knowledge shows that none of the socio-demographic

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characteristics was related to the pattern of distribution of knowledge of immunization within the studied population and null hypothesis of independence should be upheld. The result further showed that attitude of the respondents towards childhood immunization of their children beyond 2 years of age is independent of their age, the children's age or knowledge level ($p > 0.05$) and null hypothesis should be accepted. However, the reported attitudinal disposition is dependent on ethnicity, employment status and level of education of the participants ($p < 0.05$), hence null hypothesis should be rejected, and alternate hypothesis should be accepted.

DISCUSSION

Socio-demographic Characteristics of Respondents

Socio-demographics, or social determinants of health inequality, have significant and peculiar effect on immunization programs, which varies globally (Glatman-Freedman & Nichols, 2012; Mazige *et al.*, 2019; Obohwemu, Christie-de-Jong & Ling, 2022). Boyce et al. (2019) reports that sociodemographic variables are linked with inequality in vaccine uptake and health outcome. In the current study, the demographic profile of the participants varied, with a mean age of 34.49 ± 5.26 years. Most participants were between 31 and 40 years old. In similar studies, different age ranges were dominant: 26 – 35 years (62%) in the study conducted by Abioye & Odeyemi (2013); 26-30 years by Verulava et al. (2019); > 40 years by Asiegbu et al., (2020); 25-29 years (GebreEyesus et al., 2021); and 30-40 years by Mohamed & Al-Zahrani, (2021). Similar with education, 92.1% of our respondent had tertiary degree, which is far higher and different for most studies. In Abioye & Odeyemi study, majority had secondary education at 61%, 64.5% tertiary education (Verulava *et al.*, 2019), 38.1% illiterate (38.1% and 45.2%) dominated studies by Mohammed & Al-Zahrani, (2021) and GebreEyesus et al, (2021) studies. In this study, ethnicity was also considered, and Yoruba women were dominant (77.3%). A notable observation however is that ethnicity was not included as a demographic characteristic in most of the studies, which could narrow strategies at curtailing socio-demographic influence on immunization coverage. According to WHO (2014) document on vaccine hesitancy, focusing on narrow social and cognitive factors in evaluation of socio-determinants of health limits the spectrum of potential interventions to tackle vaccine hesitancy at communal, individual and population level.

Respondents' Knowledge on Childhood Immunization

Although vaccines have been useful public health intervention for combating the menace and preventing the impact of killer diseases in children, statistics shows that approximately 25 million children do not undertake basic routine immunization and thus predisposed to life-threatening diseases and disability (Ramadan *et al.*, 2016). The result of this study shows that low level of knowledge towards children vaccination still exists in our community despite the World Health Organization Immunization Agenda to reduce the proportion of zero-dose children to 50% by 2030 (World Health Organization, 2020b). It was found that 8.2% have good knowledge (Figure 1) of issues related to childhood immunization, which is lower to other studies within and outside Nigeria. Based on the variables accessed, this study reveals that although 94.5% acknowledged they knew about immunization (Table 4) which could be attributed to the fact that most mothers at least deliver in public health facilities nowadays, where they are being informed and encouraged by qualified healthcare workers to present their newborn for immunization services (GebreEyesus *et al.*, 2021). About 13% is unaware that vaccination is

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not for treatment nor prevention of all diseases. Also disappointingly, only 7.9% had good understanding of the relevant vaccines to be taken by their children; and 16.5% have correct awareness of the vaccine preventable deaths despite their high level of tertiary education. This limited knowledge displayed by the women has been corroborated by Samuel (2019) in a cross-sectional study that investigated maternal knowledge and attitude towards immunization in Emohua area of Rivers State Nigeria revealed poor knowledge of the subject. In the study, a higher percentage of the studied population was reported to demonstrate poor knowledge of vaccine-related issues. Ese et al (2020) reported that 20.9% of mothers in a cross-sectional study, carried out in Ibadan North local government of Oyo State Nigeria had good knowledge of the non-routine vaccines often required beyond the routine 2 years of age. Conversely, in similar study conducted by Omomila et al. (2020) in urban centers of Lagos and Adefolalu et al., (2020) in Primary Health centres of Ikorodu Local government, Lagos, Nigeria, the mothers had substantial good knowledge of immunization, 53.9% and 72% respectively.

Studies outside Nigeria also showed similar pattern of poor knowledge of immunization, for instance 31.2% in Egypt (Ramadan *et al,* 2016), 36.3% in Luhuania (Seskute *et al.,* 2018), and 39.5% in Kerala, India (Aslami *et al.*, 2015). However, in a study conducted in Saudi Arabia by Almutairi et al. (2021), 86% of the studied population had good knowledge of vaccination. This shows a level of variability exists in the pattern of knowledge of mothers to vaccination issues globally which is attributed to inherent differences that exist in sample size, socio-demographic characteristics and study settings of the participants (GebreEyesus *et al.,* 2021). Nonetheless, the significance of knowledge in vaccine coverage cannot be overemphasized because poor knowledge, often fuelled by misinformation on safety, risk or benefit of vaccination has been linked to vaccine hesitancy which World Health organization defines as delay in acceptance or a refusal to uptake of vaccine (Macdonald, 2015). Health literacy and hence knowledge has been reported as a critical factor that affect the three "Cs" of vaccine hesitancy which are confidence, complacency and convenience (Dube *et al.*, 2018; Voo *et al.,* 2021). Likewise, based on the Health Belief Model, perception of child vulnerability to vaccine preventable diseases (VPDs) and perceived severity of these VPDs influences vaccination coverage and this perception is greatly influenced by access to good knowledge (Vonasek *et al.,* 2016). This was supported by findings of a qualitative study in Southern Ethiopia, where it was found that poor counselling engendered lack of adequate understanding of immunization schedules with consequent altered perception of vaccine benefits and poor attitude to immunization process (Zewdie et al., 2016). Furthermore, Verulava et al., (2019) reported lack of knowledge accounts for 25.5% incomplete vaccination, which is supported by our study in which good knowledge of immunization schedule by these women led to 80.8% rate of vaccine completion. The major cause of poor knowledge reported by several researchers was lack of access to right information on vaccine. Glanz et al. (2013) reveals lack of adequate information or advocacy often promote acceptance of false myths i.e. incorrect knowledge that could lead to low vaccine uptake and underscores the need for improved health education and promotion to furnish the public especially mothers on relevant information related to vaccines. On the contrary, some studies have also reported association between poor knowledge and improved vaccine compliance; explaining that high knowledge of vaccine often makes some individuals to over-question its necessity and overall safety (Streefland *et al.*, 1999).

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Attitude of Respondents towards Childhood Vaccination

Vaccine uptake and hesitancy has been found not to be solely dependent on availability and access to quality vaccination services but also influenced by knowledge and perceptions or attitude of the service users. Thus, understanding of this duo has been reportedly critical to planning effective interventions to improve dispositions towards routine immunization.

In this study, 79.4% (n = 231) of the respondent showed an overall positive attitude towards vaccine-related issues. This finding is lower to the figure reported in similar cross-sectional study in Kosofe LCDA (Abidoye & Odeyemi, 2013) and Ikorodu LCDA of Lagos State Nigeria (Adefolalu *et al.,* 2019), where 95.5% and 100% of the mothers respectively showed positive attitude to immunization. Reports of studies from other part of Nigeria shows wider variability; 54% positive attitude response was reported in a northern rural setting of Nigeria (Kabir *et al.,* 2005) and over 70% from Atakunmosa-west Local Government of Southwestern Nigeria (Adedire *et al.,* 2021). Studies from researchers outside Nigeria also corroborated this observed variability in attitudes of mothers; Ramadan et al. (2016) reported a 70% prevalence of positive attitude among the studied Egyptian population while Mohammed & Al-Zahrani (2021) reported a 52.3% attitude response in Sudan. The disparity in attitude figure was attributed to higher level of awareness and educational status of the respondents (Abidoye & Odeyemi, 2013). However, although, increased education which fosters understanding of risk disease and benefit of vaccine promotes better attitude (Matta *et al*., 2020), it has been argued that positive attitude does not always translate to improved vaccine uptake or completion (Mapatano *et al.,* 2008; Oladepo *et al.,* 2019).

In terms of the attitude variables, this study finds out that 80% of the respondents considers the necessity of childhood vaccination which is comparable to 96.4% report by Adedire et al, (2021). Adefolalu et al. (2019) also reported 98.8% vaccine necessity prevalence which is similar to the 96% reported in a study conducted in Addis Ababa (Birhanu *et al.,* 2015). Contrarily, in a previous study conducted in India, only 65% of the respondents saw the need for vaccination in disease prevention (Angadi *et al*., 2013). However, the Indian report agrees with the 65% attitudinal disposition reported in Kaduna, Nigeria (Taiwo *et al.,* 2015).

In this study, 79.7% perceives that immunization must be completed which is comparably higher than the 65% reported by Taiwo et al. (2015). However, about 30% respondents in the Indian study agrees to completion of the immunization schedule (Angadi *et al.,* 2013).

With respect to discontinuation of immunization in healthy children, 5.8% of respondent in our study have the opinion that immunization is for the unhealthy children. This statistic is comparable to the 3.6% reported by Adefolalu et al. (2020). Conversely, in the Taiwo et al. (2015), 24% of the respondents restricts vaccination only to sick children. Moreover, findings from our study suggest that immunization services should be free in 86.9% of the respondents; and this is similar to the 92.6% respondent score by (Adedire *et al.,* 2021).

Factors Associated with Respondents' Knowledge on Childhood Vaccination

Although, access to safe quality vaccine is an important factor in improved vaccine coverage (Rodrigues & Plotkin, 2020), knowledge is a critical factor that could influence the decision-making process to accept or refuse uptake. Several social determinants of health

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influence access to quality immunization service, vaccine hesitancy and the knowledge level of the care users. Since there was a low knowledge level of respondents in this study, establishing a relationship with the knowledge would serve a predictive tool for planning effective intervention to improve vaccine uptake.

This study shows that knowledge of childhood vaccination increased with the age of the mothers; with 39.1% of respondents above 40 years of age having good knowledge compared to 17.6% of 21 to 30 years (Table 4). This is corroborated by earlier findings by Borras et al. (2009), who reported improved vaccine uptake that is associated with increased maternal age and higher knowledge. Similarly, Al-Zaharam (2013) identified mother's age as a prominent predictor of childhood vaccination uptake stipulating mothers' age of above 30 years to confer higher knowledge. Comparatively, Siddiqud et al (2017) reported age range 30 to 39 to have higher knowledge of childhood immunization. However, with a high chi-square value of 4.436 and p-value of 0.109 ($p > 0.05$), it indicates that there is no significant relationship or association between these two variables and that the null hypothesis should be accepted with a 95% confidence. This finding conflicts with recent report by Mohammed & Al-Zharani (2021), in which a strong association between mothers age with knowledge ($p = 0.022$) was found.

This study also shows that ethnic differences exist with respect to knowledge of immunization, with the Hausa having better knowledge than the other ethnic groups which could be attributed to their greater interaction with the media services characterized by their news-listening attributes. Conversely, no significant association could be established for this observation ($p = 0.430$). With respect to employment status, unemployed showed higher level of knowledge than semi-employed and employed respectively. This is surprising since the employed is expected to have better socio-economic status that could improve access to information and conflicts other studies where increased income leads to better knowledge from access to quality information (Ahmad *et al.*, 2018; Kara *et al.*, 2018). Adefolalu et al. (2019) reported that formally employed mothers have better understanding of risk-benefit of complete immunization since such job often require a level of education. although, no significant association is established between knowledge and the employment status, our finding is supported by Matta et al. (2020) who also reported similar inverse relationship between employment status and knowledge of vaccination.

Mother's knowledge is related to their educational status (Samuel, 2019) and low literacy often alter knowledge of immunization. In this study, the association between knowledge and educational level was also found to be non-significant (p value = 0.276) as it is greater than 0.05. These variables are largely independent and alternative hypothesis should be rejected while null hypothesis should be accepted at 95% confidence level. Hence, the observation in this study is occurring by chance. This finding conflicts with similar study in Enugu where the educational status of the mothers was significantly related to their knowledge of reasons for immunization acceptance (Tagbo *et al.*, 2012). However closer look at this result shows that knowledge increased with increasing educational level reported at 0%, 11.8% and 24.6% for primary, secondary and tertiary respectively. This finding is supported by previous reports that established association between education and knowledge (Ese *et al.*, 2020). Increased association between knowledge with education has been reported

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by other researchers to promote vaccine uptake (Favin *et al.*, 2012; MohdNor & Bit-Lian, 2019).

Factors associated with Respondents' Attitude towards Childhood Vaccination

As observed with knowledge above, there is no significant association between attitude and sociodemographic variable – age, p = 0.413 (Table 5) and null hypothesis should be accepted; but a closer look reveals a better attitude within the 31 to 40 years of age. Angadi et al. (2013) buttressed this finding stipulating those mothers older than 25 years have higher positive attitude towards complete vaccination. On the contrary, Raji (2013) stipulates those mothers above age of 29 years have better vaccination attitude.

With regard to Ethnicity, this study gave a strong association between mothers' attitude and ethnicity with the Yoruba mothers demonstrating better attitude compared to other ethnic groups (82.7%; p = 0.026); the null hypothesis must be rejected, and alternative hypothesis be accepted. In an earlier study by Wodele et al. (2010), ethnicity was reported to have significant association with good attitude while other studies show that other ethnicity apart from Hausa/Fulani have better positive attitude to complete vaccination (Abdulraheem *et al.*, 2011; Dawria *et al.*, 2017).

This study also reveals a significant association with the employment status of the mothers, with employed mothers showing positive attitude of immunization process (80%; p = 0.016); the null hypothesis must be rejected, and alternative hypothesis be accepted. Our findings are consistent with previous research indicating that the occupation and educational level of mothers are associated with positive attitudes towards vaccination (Adefolalu *et al.*, 2019; Almutairi *et al.*, 2021). However, some researchers have reported negative attitude associated with employment status, which is attributed to complacency and false sense of security associated with higher income which limits the mothers' enquiry of necessary information on immunization (Birnbaum *et al.*, 2013; Matta *et al.*, 2020). Accordingly, unemployed mothers have been reported to have better positive attitude to vaccination compared to employed ones (Singh *et al.*, 2018; Verulava *et al.*, 2019).

Another outcome of this study is a very strong association of attitude with educational level with educational status of secondary and below showing better positive attitude (56.5%; p < 0.001). This implies that null hypothesis will be rejected, and alternate hypothesis be accepted. Our findings, however, slightly contradict reports of Angadi et al. (2013) and Ramadan et al. (2016) who stated that higher positive attitude increases with increased educational status of the mothers with secondary and post-secondary having greater tendency to complete their immunization schedules. In the study by Elbur et al. (2014) and Kmeid et al. (2019), it was found out that increased parental education posits positive attitude due to better understanding of importance of immunization.

Finally, this study shows that no association occurs between attitude and the knowledge variable (p = 0.086) which is greater than 0.05; hence null hypothesis of independence must be retained. Visual observation of the result however shows poor knowledge status (22.9%) had higher attitudinal dispositions. From our study, this could be attributed to lower knowledge or ignorance of possible side effects within the women population (39.9%). This is corroborated by Streetland et al. (1999) who found that parents with limited knowledge about vaccination safety concerns were more likely to have positive

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attitudes towards vaccination. Samuel (2019) made a similar observation, reporting that despite insufficient knowledge, mothers still exhibited positive attitudes towards vaccination. However, other studies (Awosika, 2012; Matta *et al.*, 2020; Al-Zharani, 2021) have found strong associations between knowledge and positive attitudes towards vaccination, leading to improved vaccine uptake. It should, however, be noted that strong positive attitude or attitudinal variable may not be a guarantee or a strong predictor of complete child immunization (Mapatano *et al.*, 2008; Oladepo *et al.*, 2019).

Strengths, Limitations and Lessons Learnt from the Study

The large sample size of 291 participants in this study provides a robust representation of the target population, enhancing the generalizability of the findings and contributing to the reliability and statistical power of the results, ultimately allowing for more confident conclusions.

The inclusion of ethnicity as a demographic characteristic in this study is a significant strength, as it allows for a more nuanced understanding of the socio-demographic factors influencing immunization coverage and the development of targeted strategies to address disparities.

The limitation and restriction in human-interaction dynamics due to COVID-19 protective measures led to the choice of convenience sampling technique using an online platform. However, this sampling technique has an inherent weakness of sample representativeness with regards to the studied population. In addition, since the data collection was only from a single local government in Lagos it is not representative, and the outcome of this research might not be reliably generalizable. Because quantitative research method involves the use of questionnaires, the participants have options of answers that are limited. The response given depends on the response selection made by the researcher, and participants are not allowed to fully express themselves. Qualitative research can also be carried out to harness the perception of mothers towards childhood vaccination within the study population. Participants expressing themselves through interviews and group discussions gives room for understanding the attitude of the participants for example, reading body language. This approach will provide an in-depth intellectual interaction that will be useful towards understanding lived experiences of people and how their experience can influence their behaviour (Qutoshi, 2018).

Furthermore, the online platform provides a bias for only tech-serve participants, which might not adequately represent the studied population, as evident in the larger percentage of the participants having tertiary education. Questionnaires in printed format will be a better way to cover mother with different level of educational background. This will allow the study to have more randomization of the sample and enable a more representative data that could further validate the finding of this study. Another notable limitation in this research is that the modified pretested questionnaire used as the data-collection tool for this study did not have sufficient practice-related questions, which made it difficult to engage the knowledge-attitudes-practices relationship in the study. Moreover, since this is a cross-sectional study, the findings cannot be used to establish a cause-effect relationship. Being a cross-sectional study also made the research vulnerable to attrition, that is, people leaving before the end of the study, and this reduced the overall sample size that was analyzed. Finally, since the research was self-financed, limited funds were

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available to broaden the scope of the research to capture a more robust data.

CONCLUSION

The aim of this study was to evaluate the knowledge, attitudes and practices of mothers towards childhood immunization in Lagos State, Nigeria. Within the context of sociodemographic characteristics, the results show that majority of the women had high educational status which should support their knowledge of risk, benefits and other information about immunization. It was, however, observed that a gross deficiency in knowledge of vaccination exists within this population, and that the mothers' socio-demographic characteristics did not influence their knowledge level. Despite the consensus that knowledge is a key determinant of attitudes and practices, and therefore vaccine hesitancy, our study suggests that positive attitudes towards immunization can exist even among mothers with limited knowledge. Our findings highlight employment, ethnicity, and educational level as key social determinants of vaccine uptake among women in Alimosho. To improve vaccine coverage, targeted health education and promotion campaigns should be implemented to address the knowledge gap and support efforts to enhance employment opportunities within this community.

The findings of this research highlight the need for improved public awareness of immunizations, particularly for children over two years old. To address this, the government should implement targeted health promotion and education programs utilizing social media platforms, which are widely accessible to the public. Additionally, healthcare facilities should provide mothers with user-friendly information about the immunization process, including distributing informative fliers during scheduled immunization days. Furthermore, public health policymakers in Nigeria should ensure that the government's immunization schedule aligns with the WHO's guidelines for developing countries, beyond the age of two. This alignment would enhance the knowledge of healthcare providers and ensure a structured immunization program, ultimately leading to better compliance among mothers.

In a country where health care management is largely out of pocket, treating preventable diseases adds extra financial burden to people. There will be a reduction in financial burden on the populace if the government can make vaccines free of charge for children at least up to the age of 10.

Availability of Data and Materials

The authors declare consent for all available data present in this study.

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Authors' Contributions

The entire study procedure was conducted with the involvement of all writers.

Competing Interests

The authors declare no conflicts of interest.

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