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Community Volunteer-Driven Intervention and Barriers to Childhood Immunization Coverage in Rural Communities of Rivers State, Nigeria

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Abstract: *Immunization is a breakthrough in public health preventing about three million deaths annually in children. This study aimed to determine how effective a community volunteer-driven intervention will reduce barriers to childhood immunization in rural communities of Rivers State, Nigeria. A randomized controlled educational intervention for caregivers of children aged 0 to 6 weeks was used. 368 caregivers were recruited using a multistage sample technique, randomly assigned to intervention and control groups, and followed for 9 months.*

The intervention group received structured immunization education, whereas the control group did not. An interviewer-administered, semi-structured questionnaire was used for data collection, and SPSS version 25 was used for the analysis. Statistical significance was determined using the Chi-Square test, with a level of significance set at $p \leq 0.05$ at a 95% confidence interval.

The intervention group had 153 (83.2%) mothers while the control group had 148 (80.4%) mothers, with mean ages of 30.2 ± 7.9 years and 31.9 ± 10.1 years respectively.

There was a significant reduction in barriers to full immunization of children ($X2=34.19$, $p=0.008$).

Mothers who took decisions to immunize their children significantly increased ($X2=33.91$, $p=0.000$). Structured education on immunization provided by trained community members significantly reduced barriers to childhood immunization.

Keywords: *Barriers, community volunteers, Immunization, Rivers State.*

I. INTRODUCTION

Immunization is a cost-effective public health intervention for child survival that prevents two to three million child deaths from vaccine-preventable diseases each year. The majority of these deaths occur in Sub-Saharan Africa [1].

According to a 2019 World Health Organization (WHO) estimate, 19.4 million infants worldwide would not have received the recommended vaccines. More than 60% of these newborns are born in ten low- and middle-income countries, including Angola, Brazil, the Democratic Republic of the Congo, Ethiopia, India, Indonesia, Myanmar, Nigeria, Pakistan, and the Philippines [2].

Furthermore, an estimated 187 million and 201 million children missed the third dose of diphtheria, tetanus toxoid, pertussis-containing antigens (DTP3), or measles immunization, respectively [3].

Nigeria is home to an estimated 14% of the world's unimmunized children [1]. Not completing recommended routine vaccines, refusal, and non-compliance to the immunization schedule among caregivers of children in Nigeria are some of the reasons for the country's low immunization coverage, with over 3.2 million unimmunized children aged 12 months, resulting in outbreaks of Vaccine-Preventable Diseases [4].

Since the Alma-Ata Declaration, more emphasis has been placed on involving the community in the delivery of primary healthcare services, particularly in maternal and child health services like family planning, guinea worm eradication programs, general health education, malaria control programs, etc. This includes using community volunteers, traditional leaders, religious leaders, village health workers, and other community-oriented resource persons [5].

There are several significant barriers to childhood immunization, according to various studies. According to the National Immunization Cluster Survey (NICS) of 2006, the main obstacles to achieving universal immunization in Nigeria were mothers' misinformation, inadequate service delivery, and healthcare personnel's lack of motivation [6]. About 60 to 80% of the reasons why mothers fail to immunize their infants are due to these significant barriers [6].

In Nigeria's six geopolitical regions, 60% of mothers' vaccination refusals were due to their ignorance of the immunization schedule, time, and place of immunization, while 80% were due to problems with the delivery of immunization services, such as a lack of vaccines or immunization service providers, a long distance to a health center, hostile attitudes of health workers, and long waiting times [6]

Barriers to immunization can be classified as parental/caregiver barriers, health system barriers, and provider barriers which affect the provision of childhood immunization services in sub-Saharan Africa [7].

Anything that prevents mothers and caregivers from getting their children to be vaccinated and accessing those vaccination services is considered a parental or caregiver barrier [7].

Many studies have shown that parents' attitudes toward vaccination services influenced their decision to vaccinate their children [8-12].

Barriers for parents or caregivers might be classified as modifiable or unmodifiable [7]. Modifiable barriers are barriers that can be changed or adjusted. Parents' knowledge of immunization, misconceptions about immunization, lack of trust in the immunization service provider, home delivery, long wait times for immunization sessions, providers' hostility toward parents, parents' forgetfulness of their children's immunization schedule, the timing of immunization services, language barrier, and being too busy to attend immunization services are just a few examples [7].

Non-modifiable barriers include one's employment, religion, ethnicity, financial status, mother or caregiver place of residence, support of a spouse, family size, migration, seasonal farm work, feeling ashamed of poverty-related causes, and being a single mother [7].

Misconceptions regarding childhood immunization are also a substantial parental obstacle to effective immunization service utilization [10,11,13,14].

Some parents believe that vaccine-induced immunity is inferior to natural sickness immunity, and as a result, they would prefer to have the disease rather than the vaccination [15].

According to several studies, caregivers prefer traditional healers to orthodox health practitioners, and as a result, they do not trust vaccines and believe traditional remedies work just as well as immunizations [14].

Some parents are said to have declined immunization services because they believe the vaccines are "harmful," "expired," and could cause physical disabilities or even death in their children [12,15,16].

Long wait times at health facilities frequently and regularly impede childhood immunization [14,17].

Parents may forget the date of their next immunization visit and, as a result, fail to vaccinate their children [18].

Other studies found that the location and schedule of immunization were unknown [19], and having to get immunized at inconvenient times, such as on weekends or holidays, were reported as barriers [20, 21].

Language is another obstacle to childhood immunization [22], and the role of male partners in decision-making about childhood vaccinations have also been documented in other studies [12,15,16,22].

Male spouses were regularly reported to be against vaccinating their children. Vaccination decisions are frequently made jointly by the child's mother and father. However, women are responsible for transporting their children to the healthcare facility for vaccination, and occasionally husbands oppose vaccinations and prevent their wives from taking their children for vaccination by denying them the necessary social and financial assistance [12,15,22].

Several studies have identified mothers' insufficient financial resources as a key obstacle to children's immunization [8,11,12,15,18,19].

Poor mothers were frequently ridiculed and bullied by other women and health personnel if they did not dress appropriately [15].

The distance of mothers' residence from a health care facility was identified as a barrier in determining whether a child completed all of the recommended vaccinations [9,23,24].

Information on the effectiveness of a community volunteer-driven intervention in reducing parental barriers to childhood immunization in rural communities of Rivers State that are at high risk for not seeking immunization services for their children is limited.

This study was therefore aimed at assessing the effectiveness of a community volunteer-driven intervention in reducing parental barriers to basic childhood immunization in rural communities of Rivers State.

II. METHODS

The study was carried out in the Rivers East senatorial district at Emohua and Etche Local Government Areas of Rivers State. Rivers State is one of the thirty-six (36) states of the Federal Republic of Nigeria, located in the country's south-south geopolitical zone.

2.1 Study Design. A randomized controlled study was conducted among caregivers with children aged 0 to 6 weeks in rural communities of Rivers State.

2.2 Study population

The participants were parents of infants aged 0 to 6 weeks. The 6-week time frame was set in place to guarantee that the intervention would be implemented on or before the first dose of the pentavalent vaccine.

2.2.1 Inclusion criteria

(1) All caregivers must be residents of the two LGAs and have children aged 0 to 6 weeks. (2). All caregivers must reside in the two LGAs for the duration of the study. (3) Caregivers must have consented to participate in the study

2.2.2 Exclusion criteria

(1) Parents or caregivers with children who have significant co-morbidity such as Sickle Cell Disease or other life-threatening conditions including pneumonia, measles, otitis media, etc. (2) Caregivers who are unable to respond to the questionnaires due to physical or mental disabilities [25].

2.3 Sample Size Determination

2.3.1 Caregivers

The formula for comparing two proportions was used to determine the minimum sample size "n" for the study [26]. The minimum sample size calculated for each group was 181, but 184 were used to give a total of 368 caregivers for the intervention and control groups. This was done using a pre-intervention coverage of 53%, [27] to detect a change of 15% (68% of fully vaccinated children at post-intervention), at a power of 80%, 5% significant level, and a non-response rate of 10%.

2.3.2 Selection of Community Volunteers

There were eight (8) community volunteers chosen for each study group, totaling sixteen (16) volunteers for the two groups. The selection of the eight (8) volunteers was based on a malaria study [25].

2.4 Sampling Method

A multi-stage sampling method was used to select caregivers. The first stage was the selection of the Rivers East senatorial district and the selection of Emohua and Etche LGAs by simple random sampling by balloting.

The second stage involved choosing 4 Primary Health Care (PHC) facilities from each LGA using a purposive sample method with the assistance of the Medical Officers of Health in charge of the LGAs.

The third stage involved randomly selecting 46 caregivers from the immunization register of each health facility as it was easier to choose the children aged 0 to 6 weeks from the register.

In the fourth stage, the list of caregivers was given to the trained community volunteers who visited the caregivers in their households to ensure that they met the inclusion criteria.

2.5 Randomization

2.5.1 Caregivers

A total of 837 caregivers were assessed for eligibility. 469 of these caregivers were excluded because 348 did not meet the inclusion criteria and 121 did not give their consent to participate. A simple 1:1 allocation was used to randomly allocate the remaining 368 caregivers to either the intervention group or the control group. The WinPepi (Windows Programme for the Epidemiologist) version 11.65 statistic program was used to generate the allocation sequence for the caregivers who were numbered from 1 to 368. There was allocation concealment as the caregivers did not know which group they belonged to until after the allocation.

2.5.2 Community volunteers

Each PHC facility screened and selected ten (10) volunteers from its catchment communities from which two (2) volunteers were selected randomly through balloting to give a total of sixteen (16) community volunteers. The sixteen community volunteers were randomly allocated to either the intervention or control group by balloting.

There was no blinding of the caregivers and the community volunteers since the intervention was educational. The investigators were however blinded to the exposure status of the caregivers.

2.6 Data collection instrument.

An open-ended and closed-ended, pre-tested, semi-structured questionnaire adapted from another study, and administered by an interviewer was used to collect the data [28].

The questionnaire had four (4) sections. Section 1 was on the sociodemographic profile of the caregivers and their children.

Section 2 was on the knowledge of caregivers on immunization/vaccination.

Section 3 was on barriers to routine immunization services which included distance of house and health facility, some reasons why children are not fully vaccinated, and who decided to take the child for immunization/vaccination.

Section 4 was on the practice of immunization.

The same questionnaires were used post-intervention.

2.7 Study Procedure

The researcher and eight trained research assistants conducted the study. The assistants received two days of training in interviewing procedures and record keeping to improve the validity of the data they collect. The assistants were able to communicate in the local languages. To better understand the caregivers, interviews were conducted with them in their homes in both English and, when necessary, their native language or Nigeria Pidgin English, also known as Nigeria creole.

The research team received assistance in each community from a community guide. The study was conducted in three phases namely pre-intervention, intervention, and post-intervention phases over ten months (15th of March 2021 to the 21st of January 2022).

The intervention was a 3-day structured health education training on immunization given by the research team to eight (8) community volunteers in the intervention group. The selected caregivers were later trained by the trained volunteers.

The training for the eight (8) community volunteers and caregivers in the control group focused on general health promotion, including oral rehydration therapy and growth monitoring as contained in the child health card.

The post-intervention was the assessment of the intervention when each child became 9 months old. The community volunteers for the two groups had a list of the caregivers with the ages of the children at baseline, and they were able to determine when the children would be 9 months old. The assessment was done for the intervention and control groups using the same questionnaires for the baseline survey. The outcome measure of the study was the effectiveness of the community volunteers in reducing the barriers to routine childhood immunization.

2.8 Data Management

The data from the baseline and post-intervention surveys were manually sorted and validated by checking the data daily for inaccuracies and inconsistencies by the research team and asking questions in more than one way.

The data were then entered into Microsoft Excel 2019 (Microsoft, Redmond, Washington, DC, USA), cleaned, and transferred to IBM SPSS Version 25.0 (IBM, Armonk, New York, USA). The data set was revalidated using the inbuilt validation functions of the IBM SPSS Version 25 and immediately backed up with an external drive.

The data generated from the study were analyzed with the IBM SPSS statistics Version 25. Univariate analysis was performed, and the data were presented as frequency tables. Categorical variables were expressed in percentages while continuous variables were expressed as mean and standard deviation. Comparisons between groups pre-and post-intervention were performed with a Student t-test of independent sample means for continuous variables and Pearson Chi-square ($\chi 2$) test for statistical significance. A p-value less than or equal to 0.05 was considered statistically significant at a 95% Confidence Interval.

2.9 Ethical approval

Ethical approval was obtained from the Ethics Committee of the University of Port Harcourt.

Permission was obtained from the Medical Officers of Health in charge of Emohua and Etche local government areas. Informed consent was obtained from heads of households, community volunteers, and caregivers with children 0 to 6 weeks old. Verbal consent was obtained where written consent was not possible.

III. RESULTS

3.1 Response rate

368 caregivers were recruited for the study, 184 each for the intervention group and the control group. 339 caregivers completed the study; 173 (94.0%) in the intervention group and 166 (90.2%) in the control group giving an attrition rate of 6.0% for the intervention group and 9.8 % for the control group. All the community volunteers completed the study.

3.2 Sociodemographic characteristics of the respondents and their children at pre-intervention

Table 1: Sociodemographic characteristics of the respondents and their children at pre-intervention

Characteristics	**Intervention group n_1=184**		**Control group n_2=184**		χ^2 ***(p-value)***
	Freq (n)	**Percent (%)**	**Freq (n)**	**Percent (%)**	
Relationship of the respondent to the child					0.46 (0.499)
Father	31	16.85	36	19.57	
Mother	153	83.15	148	80.43	
Age of caregiver (years)					8.03 (0.091) α
≤20	13	7.07	16	8.70	
21-30	100	54.35	95	51.63	
31-40	54	29.35	42	22.83	
41-50	13	7.07	17	9.24	
≥51	4	2.17	14	7.61	
Mean (SD)	30.20 ± 7.90		31.92 ± 10.10		1.82 (0.072) μ
Sex of caregiver					0.29 (0.589)
Female	153	83.15	148	80.43	
Male	31	16.85	36	19.57	
Age of child (days)					4.21 (0.379) α
0-10	12	6.52	12	6.52	
11-20	72	39.13	69	37.50	
21-30	61	33.15	71	38.59	
31-40	35	19.02	24	13.04	

41-50	4	2.17	8	4.35	
Mean (SD)	22.62 ± 9.27		22.23 ± 8.61		0.42 (0.675) $^{\mu}$
Sex of child					1.54 (0.215)
Female	51	27.72	63	34.24	
Male	133	72.28	121	65.76	
Religion					1.91 (0.384)
Christian	154	83.70	160	86.96	
Muslim	17	9.24	17	9.24	
Traditional	13	7.07	7	3.80	
Marital status					9.82 (0.080) α
Married	101	54.89	80	43.48	
Single	38	20.65	41	22.28	
Co-Habiting	26	14.13	32	17.39	
Separated	10	5.43	19	10.33	
Widowed	4	2.17	10	5.43	
Divorced	5	2.72	2	1.09	

χ^2=Chi-Square; **μ**=Student t-test; **α**=Fishers Exact p.

Table 1 shows the sociodemographic data of the caregivers and their children pre-intervention.
Most caregivers were mothers (83.2% intervention group: 80.4% control group) with a mean age of 30.2±7.9 years (intervention group) and 31.9±10.1 years (control group).
The majority of the children were males (72.3% intervention group: 65.8% control group) with a mean age of 22.6± 9.3 days (intervention group) and 22.2± 8.6 days (control group).
Most caregivers were Christians (83.7% intervention group: 87.0% control group) and were married (54.9% intervention group: 37.0% control group).

3.3 Barriers to routine childhood immunization services at pre-intervention

Table 2: Barriers to routine childhood immunization services at pre-intervention

Characteristics	**Intervention group** n_1**=184**		**Control group** n_2**=184**		χ^2 ***(p-value)***
	Freq (n)	**Percent (%)**	**Freq (n)**	**Percent (%)**	
Distance of house and health facility					5.903 (0.116)
Very near	61	33.15	56	30.43	
Near	59	32.07	51	27.72	
Far	39	21.20	34	18.48	
Very far	25	13.59	43	23.37	
**Why unvaccinated? [*Multiple response*					16.559

(n1=557; n2=525)					(0.485)
Fees are charged for immunization	73	13.11	81	15.43	
No money	60	10.77	52	9.90	
Long waiting time	34	6.10	36	6.86	
The attitude of health workers	31	5.57	29	5.52	
Fear of side effects	63	11.31	67	12.76	
Not aware of multiple doses	32	5.75	21	4.00	
Lack of interest	26	4.67	20	3.81	
Too busy	15	2.69	23	4.38	
Partner refused	19	3.41	21	4.00	
Absence of health workers	8	1.44	6	1.14	
Child was sick	13	2.33	11	2.10	
No vaccine	7	1.26	9	1.70	
Time of immunization inconvenient	33	5.92	35	6.67	
Immunization may kill the child	46	8.26	38	7.24	
It's against my religion	42	7.54	21	4.00	
Prefer traditional medicine to vaccines	14	2.51	7	1.33	
Forgot to follow up	29	5.21	34	6.48	
Language barrier	12	2.15	14	2.67	
Decision for vaccination					5.688 (0.128) **α**
Father	44	23.91	40	21.74	
Mother	96	52.17	93	50.54	
Both parents	41	22.28	39	21.20	
Grandparents	3	1.63	12	6.52	

χ^2=Chi-Square; **α**=Fishers Exact

The distance of houses of caregivers from the health facility was not statistically significant (X2=5.90, p=0.12) as in table 2. The majority of caregivers, 61 (33.2%) resided very near a health facility and 25 (13.6%) resided very far from a health facility in the intervention group. For the control group, 56 (30.4%) resided very near a health facility and 43 (23.4%) resided very far from a health facility.

High fee for immunization was the frequently mentioned barrier for children not fully immunized and this accounted for 73 (13.1%) in the intervention group and 81 (15.4%) in the control group. The other barriers to immunization are shown in table 2. The reasons were given by caregivers for not fully vaccinating their children were not statistically significant (X2=16.56, p=0.49).

In making decisions for childhood immunization, mothers were the major decision makers. In the intervention group, mothers accounted for 96 (52.2%) and 93 (50.5%) in the control group.

Fathers taking decisions for childhood immunization were responsible for 44 (23.9%) in the intervention group and 40 (21.7%) in the control group. There was no statistically significant difference in decision-making between the intervention and control groups (X2=5.69, p= 0.13).

3.4 Barriers to routine childhood immunization at post-intervention

Table 3: Barriers to routine childhood immunization services at post-intervention

Characteristics	**Intervention group**		**Control group**		χ^2
	n_1=173		**n_2=166**		***(p-value)***
	Freq (n)	**Percent (%)**	**Freq (n)**	**Percent (%)**	
Distance of house and health facility					7.773 (0.051)
Very near	60	34.68	52	31.33	
Near	56	32.37	47	28.31	
Far	37	21.39	29	17.47	
Very far	20	11.56	38	22.89	
Why unvaccinated? [*Multiple response* (n1=357; n2=492)					34.193 **(0.008) α***
Fees are charged for immunization	67	18.77	65	12.45	
No money	52	14.57	56	10.73	
Long waiting time	32	8.96	34	6.51	

The attitude of health workers	29	8.12	31	5.94	
Fear of side effects	41	11.48	59	11.99	
Not aware of multiple doses	12	3.36	24	4.60	
Lack of interest	21	5.88	28	5.36	
Too busy	13	3.64	15	3.05	
Partner refused	11	3.08	23	4.41	
Absence of health workers	7	1.96	5	0.96	
Child was sick	5	1.40	7	1.34	
No vaccine	0	0.00	3	0.57	
Time of immunization inconvenient	27	7.56	38	7.28	
Immunization may kill the child	8	2.24	36	6.90	
It's against my religion	12	3.36	18	3.45	
Prefer traditional medicine to vaccines	9	2.52	11	2.11	
Forgot to follow up	5	1.40	27	5.49	
Language barrier	6	1.68	12	2.30	
Decision for vaccination					33.906 **(0.000) α***
Father	23	13.29	61	36.75	
Mother	116	67.05	72	43.37	
Both parents	33	19.08	25	15.06	
Grandparents	1	0.58	8	4.82	

χ^2=Chi-Square; **α**=Fishers Exact

The distance of houses of caregivers from a health facility was not statistically significant (X2=7.77, p=0.05) as in table 3. The majority of caregivers, 60 (34.7%) resided very near a health facility and 20 (11.6%) resided very far from a health facility in the intervention group. For the control group, 52 (31.3%) resided very near a health facility and 38 (22.9%) resided very far from a health facility.

Providers' barriers included fees charged for immunization, long waiting times, the attitude of health workers, the absence of health workers, and the time of immunization inconvenient for caregivers.

The health system barrier though modifiable but not within the scope of this study was no vaccine and this was reported only in the control group, 3 (0.6%).

Parental/caregivers barriers that were reduced by the intervention were no money by caregivers, fear of side effects, not being aware of multiple doses of childhood immunization, lack of interest in childhood immunization, too busy to attend immunization sessions, partners' refusal to take the child for immunization, the child was sick, immunization may kill the child, it's against my religion, preferred traditional medicine to vaccines, forgot to follow up immunization series, and language barrier.

The intervention had a statistically significant reduction in the barriers to full immunization of children in the intervention group compared to the control group ($X2=34.19$, $p=0.008$).

In making decisions for immunization, more mothers decided to immunize their children in the intervention group, 116 (67.1%) compared to 72 (43.4%) in the control group and this was statistically significant ($X2=33.91$, $p=0.000$).

IV. DISCUSSIONS

The intervention did not affect the distance of caregivers' residence from a healthcare facility because the distance is not a barrier that can be modified. In both groups, the majority of caregivers resided near healthcare facilities. These findings are consistent with those reported by other researchers. A study reported that mothers who reside near a health facility that provides routine immunization services within a one-kilometer radius of their residence are more likely to fully immunize their children than mothers living in areas that are not close to health facilities providing routine immunization services [29].

The same study also reported that the distance of residence from a health facility was an important obstacle to full immunization as it is relevant in accessing the health facilities where immunization services are offered and that an additional distance of 1 km to the nearest health facility reduces the likelihood that a child receives a vaccine by about 5% [29].

Long walking distances to immunization centers are some of the main reasons contributing to poor compliance with routine immunization regimens, according to a study [30].

Caregivers who live close to health facilities are 18 times more likely to have their children fully immunized than caregivers who must travel more than an hour to a health facility for immunization services [11]. Distance to health facilities was also associated with failure to complete the recommended vaccination series [11].

Delivery of infant immunizations in distant communities has reportedly been hindered by the distance to healthcare facilities [11,31]. This may be related to socioeconomic circumstances and the expense of mothers' transportation to each immunization appointment, especially when the healthcare facilities are far away [11,31].

Caregivers who travel long distances to reach immunization centers would find it difficult to complete immunization series [8,11-14, 22].

A study reported that "the longer the distance from the vaccination site, the lower the chances of vaccination by the seventh day of the life of a child" [32].

A family whose home was at least an hour from the vaccination site was less likely to be fully vaccinated (56% immunization coverage) than a family whose home was between 30 and 59 minutes away (67% immunization coverage) [19].

According to a study, children who live in places where the distance from their home to a health facility is not a big problem have a 42% higher chance of receiving all of their recommended vaccinations than children who live in areas where the distance to a health facility is a big problem [33].

Fees charged by healthcare providers for childhood immunization were the most frequently reported reasons for children not being fully immunized in this study as was also reported by another similar study [34].

Not having money as reported in this study is a non-modifiable parental barrier to childhood immunization as the caregivers in both groups were mainly peasant farmers and had to cater to other needs apart from health including immunization. This observation agrees with the findings of several studies that cited the financial limitations of mothers as a major hindrance to childhood immunization [8,11,12,15,18,19, 29].

Long waiting time as another reason for incomplete immunization in this study is another provider barrier to full immunization of children although this study was not aimed at mitigating it. Long waiting times during immunization sessions as a barrier to full immunization of children were also reported in other studies [14,17,34].

Time of immunization such as on weekends/public holidays, going to the farm during the daytime, etc was inconvenient for some caregivers in this study. The inconvenient time of immunization is a modifiable health system barrier that is not within the scope of this study. The caregivers were however encouraged to take the children for immunization during the daytime since the immunization is done once a week and the farming and other engagements on the remaining days of the week. Inconvenient time of immunization as a reason for incomplete immunization was reported in similar studies [20,21].

There was a higher reduction in the language barrier in the intervention group, from 12 (2.2%) in pre-intervention to 6 (1.7%) in post-intervention. This is an indication that the intervention was effective as the caregivers in the intervention group were given health education on immunization in the local language, and so, had a better understanding of immunization than the control group. The few caregivers in the intervention group who still reported language as a barrier at post-intervention were probably not natives of the communities but met the inclusion criteria to participate in the study. A similar study also reported language as a barrier to childhood immunization [22].

There was also a higher reduction in religious beliefs on immunization in the intervention group, 42 (7.5%) in pre-intervention to 12 (3.4%) in post-intervention. Other studies had noted that sociocultural factors and religion harm the utilization of immunization services [16,17,23, 32,34].

Another barrier to immunization that was reported by caregivers was no vaccine. No vaccine is a health system barrier that is not within the scope of this study. However, post-intervention, none reported no vaccine as a barrier in the intervention group and 3 (0.6%) reported no vaccine in the control group. The availability of vaccines is not due to the intervention but may be due to the several immunization campaigns such as the Maternal Newborn Child health week (MNCHW), Integrated measles campaigns, and Immunization plus days (IPDs) that were carried out during the study period.

The attitude of health workers is also a health system barrier and a major barrier to immunization services. It is also not within the scope of this study. In pre-intervention, 31(5.6%) (intervention group) and 21 (5.5%) (control group) while in post-intervention, 29 (8.1%) (intervention group) and 31 (5.9%) (control group) complained about the bad attitudes of the health workers towards caregivers that attended immunization sessions. Other studies also reported hostility and rude attitudes of healthcare providers toward mothers as barriers to childhood immunization [14,18].

A study also reported negative attitudes of health workers toward mothers and recommended training and retraining of immunization staff on clinical ethics [34].

The caregiver was too busy to attend immunization sessions was another hindrance as was also reported by another study [35]. The mother/caregiver too busy to take the child for vaccination is because vaccination is considered to be the responsibility of the mother who is also looking for ways to support her husband/spouse in the maintenance of the family financially [35].

The misconception of immunization such as immunization might kill the child was reported as a barrier and was greatly reduced in the intervention group from 46 (8.3%) in pre-intervention to 8 (2.2%) in post-intervention. This shows the effectiveness of the intervention in improving the knowledge of caregivers on misconceptions about immunization as was also reported by other studies [35,36].

There was an improvement in the awareness of multiple doses of vaccines by caregivers in the intervention group as was observed in a similar study [36]. Also, there was an improvement in the interest of caregivers in immunization in the intervention group as was also reported in a similar study [36].

The absence of health workers to provide immunization services is also a health system barrier that is not within the scope of this study. Another study also reported the absence of healthcare providers as a barrier to childhood immunization [36].

Refusal of a partner for the child to be taken for immunization was slightly reduced from 19 (3.4%) in pre-intervention to 11 (3.1%) in post-intervention in the intervention group. The refusal may be due to misconceptions of caregivers on immunization, poor knowledge of caregivers on immunization, and bad attitudes of health care providers towards caregivers. The reduction of this barrier in the intervention group is an indication that the intervention was effective in educating caregivers on the importance of childhood immunization. Misconceptions about childhood immunization have been reported as a major hindrance to the effective utilization of immunization services [10,11,13,14].

The child being sick was reported as a barrier although a child being sick is a false contraindication for immunization. The intervention did reduce this false contraindication to immunization in the intervention group even though it was not eliminated. Children who are sick are often denied immunization by health workers because the health workers do not have the knowledge of the indications and contraindications for vaccinations and also lack counseling skills.

Also, parents would very often not allow the sick child to be vaccinated even though the child is already receiving injections to treat the current illness. This is often due to the mother's belief that vaccination will be inconveniencing the child, affect the effectiveness of the injections for treating the current illness of the child, and also an expression of ignorance of the need for vaccination [18,22].

The refusal to receive vaccinations was cited as a deterrent by some caregivers. However, the intervention had no positive impact on this. According to certain research, parents do not trust vaccines but do feel that traditional remedies work as an alternative to immunization, so they seek treatment from traditional healers [14].

There was an improvement in the follow-up of the immunization series in the intervention group, and this is also an indication of the effectiveness of the intervention as reported in a similar study [28].

There was a significant improvement in the number of mothers who took decisions in vaccinating the children in the intervention group. Several similar studies reported improvement in childhood vaccination when mothers are responsible for decision-making in the immunization of children. There is a need to remove all cultural impediments that prevent women from immunization by empowering them with decision-making at home [37].

Children of women who lack autonomy in making decisions are less likely to receive the full series of childhood vaccinations [38].

A study on women's autonomy and the nutritional and immunization status of their children reported that the welfare of children depends on the consciousness and awareness of the mother [39].

Another study reported that community-level women's autonomy is associated with an increased number of children's immunizations above and beyond that of individual-level women's autonomy [40]. These results indicate that empowering women within households is not only an important mechanism through which improvements in children's health can be achieved, but also serves as a way to improve the lives of other children within the community [40].

Communication is very important to improve awareness among parents to reduce the barriers to immunization. There is a need to improve the communication skills of the health workers especially those at the Primary Health Care facilities as they are the first point of contact for parents and encourage them to make the most of any opportunity when parents are in contact with healthcare services to increase awareness about vaccination and recommend vaccines to other people, especially the mothers.

V. CONCLUSION

Structured immunization education administered by community members to caregivers, significantly reduced barriers to routine childhood immunization services in rural communities. The finding is important for improving immunization coverage in rural communities of Rivers State.

To bridge the gap in the shortage of healthcare workers, the government should consider the training of community volunteers and engage them in the provision of basic health services including immunization in rural communities.

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REFERENCES

[1] World Health Organization. Children: reducing mortality [Internet]. 2013 [cited 2021 August 25]. Available from: http://www.who.int/mediacentre/factsheets/fs178/en/

[2] World Health Organization. Immunization Coverage Key facts [Internet] 2022 [cited 2022 Jan 09]. Available from: https://www.who.int/news-room/fact-sheets/detail/immunization-coverage

[3] World Health Organization. Immunization, Vaccines and Biologicals, Immunization Coverage. Geneva: World Health Organization; 2019. https://www.who.int/immunization/monitoring_surveillance/routine/coverage/en/index1.html

[4] World Health Organization. Global Vaccine Action Plan 2011-2020. Geneva: World Health Organization; 2013.

[5] Federal Ministry of Health. National strategies and guidelines for home and community management of malaria. Abuja: Nigeria. Federal Ministry of Health; 2010.

[6] National Immunisation Coverage Survey (NICS). Federal Government of Nigeria. Immunization coverage survey 2006: Akinsville B.P Abuja, Nigeria. 2006; 10-38.

[7] Bangura JB, Xiao S, Qiu D, Ouyang F, Chen L. (2020). Barriers to childhood immunization in sub-Saharan Africa: A systematic review. *BMC Public Health*. 2020; 20:1108. https://doi.org/10.1186/s12889-020-09169-4

[8] Adedokun ST, Uthman OA, Adekanmbi VT, Wiysonge CS. Incomplete childhood immunization in Nigeria: a multilevel analysis of individual and contextual factors. BMC *Public Health*. 2017; 17:236. https://dx.doi.org/10. 1186%2Fs12889-017-4137-7

[9] Chidiebere OD, Uchenna E, & Kenechi OS. Maternal socio-demographic factors that influence full child immunization uptake in Nigeria. *S Afr J Child Health*. 2014; 8(4):138–42. DOI: 10.7196/sajch.661.

[10] Cockcroft A, Usman MU, Nymucherera OF, Emori H, Duke B, Umar NI, Andersson N. Why children are not vaccinated against measles a cross-sectional study in two Nigerian states. *Arch Public Health*. 2014; 72: 48. http://www.archpublichealth.com/content/72/1/48

[11] Kiptoo E, Esilaba M, Kobia G, Raphael N. Factors influencing low immunization coverage among children between 12 - 23 months in East Pokot, Baringo country, Kenya. *Int J Vaccines*. 2015; 1(2): 58–62. DOI: 10.15406/ijvv.2015.01.00012.

[12] Legesse E, Dechasa W. An assessment of child immunization coverage and its determinants in Sinana District, Southeast Ethiopia. *BMC Pediatr*. 2015; 15:31. DOI: 10.1186/s12887-015-0345-4. PMID: 25886255; PMCID: PMC4438454.

[13] Obasoha PE, Mustapha MA, Makada A, Obasohan DN. Evaluating the reasons for partial and non-immunization of children in Wushishi local government area, Niger state, Nigeria: methodological comparison. *Afr J Reprod Health*. 2018; 22:113. https://doi.org/10.29063/ajrh2018/v22i4.12

[14] Tobin-West CI, Alex-Hart BA. Identifying barriers and sustainable solution to childhood immunization in Khana local government area of Rivers state, Nigeria. *Int Q Community Health Educ 2011-2012*. 2012; 32:149–158. http://dx.doi.org/https://doi.org/10.2190/IQ.32.2.e

[15] Babirye JN, Rutebemberwa E, Kiguli J, Wamani H, Nuwaha F, Engebretsen IMS. More support for mothers: a qualitative study on factors affecting immunisation behaviour in Kampala Uganda. *BMC Public Health*. 2011; 11:723. https://doi.org/10.1186/1471-2458-11-723

[16] Babalola S. Maternal reasons for non-immunisation and partial immunisation in northern Nigeria. *J Paediatr Child Health*. 2011; 47:276. https://doi.org/10.1111/j.1440-1754.2010.01956.x

[17] Porth JM, Wagner AL, Teklie H, Abeje Y, Moges B, Boulton ML. Vaccine nonreceipt and refusal in Ethiopia. The expanded program on immunization coverage survey, 2012. *Vaccine*. 2019; 37: 2106. https://doi.org/10.1016/j.vaccine.2019.02.045

[18] Mekonnen AG, Bayleyegn AD, Ayele ET. Immunization coverage of 12-23 months old children and its associated factors in Minjar-Shenkora district, Ethiopia: a community-based study. *BMC Pediatr*. 2019; 19(1):198. https://doi.org/10.1186/s12887-019-1575-7

[19] Tefera AY, Wagner AL, Mekonen BE, Carlson FB, Boulton LM. Predictors and barriers to full vaccination among children in Ethiopia. *Vaccines*. 2018; 6:22. https://doi.org/10.3390/vaccines6020022

[20] Tadesse T, Getachew K, Assefa T, Ababu Y, Simireta T, Birhanu Z, Hailemichael Y. Factors and misperceptions of routine childhood immunization service uptake in Ethiopia: findings from a nationwide qualitative study. *Pan Afr Med J*. 2017; 5:28. https://dx.doi.org/10.11604%2Fpamj.2017.28.290.14133

[21] Ibraheem R, Abdulkadir M, Akintola M, Adeboye M. Determinants of timely presentation for birth dose vaccination at an immunization Centre in North Central Nigeria. *Ann Glob Health*. 2019; 85(1):20. https://doi.org/10.5334/aogh.725

[22] Malande OO, Munube D, Afaayo RN, Annet K, Bodo B, Bakainaga A, et al. Barriers to effective uptake and provision of immunization in a rural district in Uganda. *PloS one*. 2019; 14(2): e0212270. https://doi.org/10.1371/journal.pone.0212270

[23] Landoh DE, Ouro-Kavalah F, Yaya I, Kahn AL, Wasswa P, Lacle A, et al. Predictors of incomplete immunization coverage among one to five years old children in Togo. *BMC Public Health*. 2016; 16: 968. https://dx.doi.org/10.1186%2Fs12889-016-3625-5

[24] Wemakor A, Helegbe GK, Abdul-Mumin A, Amedoe S, Zoku JA, Dufie AI. Prevalence and factors associated with incomplete immunization of children (12-23 months) in Kwabre East District, Ashanti region, Ghana. *Arch Public Health*. 2018; 76:67. https://dx.doi.org/10.1186%2Fs13690-018-0315-z

[25] Tobin-West CI, Briggs NCT. Effectiveness of trained community volunteers in improving knowledge and management of childhood malaria in a rural area of Rivers State, Nigeria. *Nigerian Journal of Clinical Practice*. 2015; 18 (5):651-658.

[26] Wang H, Chow SC. Sample Size Calculation for Comparing Proportions. 2007. https://doi.org/10.1002/9781118445112.stat07091

[27] UNICEF: Progress report 2017. Common thing to child survival. A promise renewed. Prepared by UNICEF Division of Policy and Strategy, New York, USA, September 2017.

[28] Adenike OB, Adejumoke J, Olufunmi O, Ridwan O. Maternal characteristics and immunization status of children in North Central of Nigeria. *Pan African Medical Journal*. 2017; 1937- 8688. Available at www.panafrican-med-journal.com Accessed (2022 Jan 19).

[29] Sato R. Differential determinants and reasons for the non- and partial vaccination of children among Nigerian caregivers. *Vaccine*. 2019; 38(1): 63–9. https://doi.org/10.1016/j.vaccine.2019.09.097
[30] Abdulraheem S, Onajole AT, Jimoh AAG, Oladipo AR. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology*. 2011; 3(4):194-203.
[31] Adebayo B, Oladokun R, Akinbami F. Immunization Coverage in A Rural Community in Southwestern Nigeria. *J Vaccines*. 2012; Vaccin 3143; 3:143.
[32] Miyahara R, Jasseh M, Gomez P, Shimakawa Y, Greenwood B, Keita K, et al. Barriers to timely administration of birth dose vaccines in The Gambia, West Africa. *Vaccine*. 2016; 34(29):3335. https://doi.org/10.1016/j.vaccine.2016.05.017
[33] Fenta MS, Biresaw HB, Fentaw KD, Gebremichae SG. (2021). Determinants of full childhood immunization among children aged 12–23 months in sub-Saharan Africa: a multilevel analysis using Demographic and Health Survey Data. Tropical Medicine and Health. 2021; 49: 29. https://doi.org/10.1186/s41182-021-00319-x
[34] Rahji FR, Ndikom CM. Factors influencing compliance with immunization regimen among mothers in Ibadan, Nigeria. *IOSR J Nursing Health Sci*. 2013; 2(2): 1–9. DOI: 10.9790/1959-0220109.
[35] Singh S, Sahu D, Agrawal A, Vashi MD. Barriers and opportunities for improving childhood immunization coverage in slums: A qualitative study. *Preventive medicine reports*. 2019; 14:100858. https://doi.org/10.1016/j.pmedr.2019.100858
[36] Tijjani U. Determinants of Childhood Routine Immunization Coverage in Sokoto State, North West Nigeria. *Scientific Research Journal*. 2020.
[37] Bello K, Daniel AD. Knowledge and Attitude of Mothers towards Childhood Immunization in Bauchi Local Government, Bauchi State – Nigeria. *International Journal of Innovative Research in Social Sciences & Strategic Management Techniques*. 2017; 4:2.
[38] Antai D. Gender inequities, relationship power, and childhood immunization uptake in Nigeria: a population-based cross-sectional study, *International Journal of Infectious Diseases.* 2012; 16(2): e136-e145. https://doi.org/10.1016/j.ijid.2011.11.004
[39] Bharati P. Women Autonomy, Nutritional and Immunization Status of their Children. *Anthropology*. 2014; 02(02) DOI: 10.4172/2332-0915.1000118.
[40] Ebot JO. Place Matters: Community Level Effects of Women's Autonomy on Ethiopian Children's Immunization Status. *African Population Studies*. 2014;28 (2) Supplement. http://aps.journals.ac.za 1202