

SPECIES COMPOSITION AND MORPHOLOGICAL DIFFERENTIATION OF THE SIMULIUM DAMNOSUM COMPLEX IN AGBA, EBONYI STATE

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Abstract: Background; Many reasons have been given for low immunization coverage in Kaduna State and among these are ignorance, service delivery issues, mistrust, fears and family issues. The main objective of this study is to Identify some other factors that predict caregiver's utilization of routine immunization services.

Methodology: This was a retrospective observational study that analyzed previously collected exit interview data conducted during routine supervision of immunization sessions using a standard structured questionnaire on mobile phones via the 'open data kit' software.

Results: The study revealed that 97.5% of caregivers were aware of the importance of routine immunization, while good knowledge of vaccine administered constitutes 92.3%, awareness of days for follow up visit was 97.4% and satisfaction of routine immunization services was 99.2%. However, among the caregivers 22% had reported experience of an adverse events following immunization. Awareness of caregivers of the importance of routine immunization was found to be associated with caregiver's awareness of vaccine administered (odds ratio: 0.079; 95% CI: 0.063-0.098 ; $p < 0.0001$), awareness of next date for follow up (odds ratio: 0.168; 95%CI: 0.120-0.235; $p < 0.0001$) and whether caregivers are satisfied with routine immunization services (odds ratio: 0.117; 95%CI: 0.071-0.92; $p < 0.0001$). Also, Traditional leaders, field volunteers, religious leaders, mothers, fathers, grandparents and both- parents are significantly associated with awareness of caregivers of the importance of routine immunization.

Conclusion: These results suggest very high awareness of routine immunization, high level of satisfaction among caregivers for routine immunization services and with reports of adverse event after immunization very common.

Keywords: Caregivers, Immunization, Coverage, Kaduna

INTRODUCTION

Satisfactory progress has not been made as regards routine immunization in Nigeria during the 'decade of vaccine in Africa.' Nigeria has the highest number of unimmunized children in the world, with over 4.3 million unimmunized children in 2017, contributing to more than a quarter of all unimmunized children globally.¹ World Health Organization (WHO)/United children's fund (UNICEF) joint estimate of routine immunization coverage stood at 65% from 2017 to 2019. Survey data showed the following immunization coverage in the country with 38% in 2013² 54% in 2014³ 49% in 2015⁴ and 33% in 2016/2017.⁵

Due to the low immunization coverage, the country considered routine immunization as a public health emergency in 2017 with the formation of coordination centers at the national, state, and local government area (LGA) levels to address this.¹ Reasons for incomplete vaccination in Nigeria are lack of education (36%), service delivery issues 21%, Mistrust, or fears -21% family issues- 15% others -7%.⁵

Immunization coverage is dismally low in Kaduna state based on findings from the 2016 Multi-Indicator cluster Survey/National Immunization Cluster Survey (MICS/NICS)⁵ with the number of fully immunized children at

30%, which was below the national average of 33%.⁵ National Nutrition and Health Survey also proved inadequate immunization coverage for the state with penta-3 coverage of 29% and measles coverage of 36%.⁶ For 2016 and the year 2017, it was 53% in the country.⁷ This has led to the declaration of a state of emergency in routine immunization in the country. Routine immunization Programme assessment for performance management action lot quality assurance sampling survey conducted in Kaduna state showed a gradual increase in coverage from 45% in quarter 4 of 2017 to 73% in quarter 4 of 2018.⁸

Nigeria routine immunization strategies used to reach out to children in the state are mainly through fixed and outreach services as recommended by the WHO African region reaching every district (a ward in Nigeria) strategy.⁹ However, strategic interventions to reduce missed opportunity for vaccination that are being implemented in the country are optimized routine immunization supportive supervision, optimized integrated routine immunization services (OIRIS). Others are periodic intensification of routine immunization (local immunization days, maternal and child health week, hard to reach areas projects, routine immunization intensification projects) reducing equity gaps and to boost immunization coverage in poorperforming areas.¹ These strategies are all being implemented in Kaduna state.

Several factors have been shown to influence healthcare-seeking behavior in some studies which include deeply rooted cultural beliefs and practices, levels of education and health knowledge, service accessibility, gender roles, and out-of-pocket expenses for clients, level of patients satisfaction^{10,11} yet literature search has shown a dearth of studies conducted in Kaduna state on such factors. Knowledge and attitudes on childhood vaccinations were shown to be important in planning tailored intervention programs aimed to increase both vaccination coverage and timeliness.^{12,13} A study in Kaduna state has demonstrated that the mother's educational status, family setting, knowledge, perception, and practices about immunization are essential factors that influence access to information's on routine immunization.¹⁴

It has been shown that caregiver's satisfaction is one factor that affects the quality of health care and to improve the utilization of primary health care services, and this needs to be a focus.¹⁵ Outreach services have led to meaningful client experience and satisfaction, and this can be used in improving the delivery of preventive services.¹⁶ It is worthy to note that simple access to immunization services does not necessarily translate into uptake of services.¹⁰ It becomes relevant to look at factors like perception, motivators, decision making, caregivers' knowledge, and caregivers' satisfaction that predict utilization of routine immunization services in Kaduna state. It is known that the education of caregivers and health workers could contribute to reducing the high prevalence of missed opportunities for vaccination; hence, improving coverage.¹⁷

The study aimed to assess caregivers' perception to good immunization coverage in the state, with the objectives of describing caregivers' knowledge and experiences that contribute to the uptake of routine immunization across the three senatorial zones Kaduna state, determine association with caregiver's awareness of the importance of routine immunization and the study might provide tailored recommendations to improve the quality of routine immunization services in the state.

METHODS

This is a descriptive observational study. It was a review of previously collected anonymous (de-identified) exit interview data conducted during routine supervision of immunization sessions by a combination of personnel from the Government and partners using a standard structured questionnaire on mobile phones using the 'open data kit' software approved by the Government of Nigeria.¹⁸ The data is sent after the immunization sessions to

the Government's National Primary Health Care Development Agency (NPHCDA) server¹⁸ hosted by WHO Nigeria as part of routine immunization supervision protocol. Kaduna state, located in North-western Nigeria has a projected year 2020 population of 9,176,219 with under 1-year population of 367,048 and women of childbearing age of 2,018,768 as projected from 2006 National Census.¹⁹

Randomly conducted exit interviews records for the period between May 22, 2017, and January 2019 were downloaded (retrieved) from the government's (NPHCDA) routine immunization supervision server.¹⁸ Records with incomplete responses were excluded from the analysis. The data obtained were analyzed for the following thematic areas: awareness of the importance of routine immunization; Source of mobilization for attending routine immunization sessions; who makes the decision in the family on whether the child receives routine immunization/vaccines or not, awareness of caregivers on vaccine administered, knowledge of next date for follow up by caregivers, whether caregivers are satisfied with routine immunization services, the experience of adverse effect after routine immunization.

Data Analysis

The data was exported from NPHCDA routine immunization supportive supervision server to Microsoft excel 2010. The statistical software IBM SPSS version 25²⁰ was used for data analysis. The data were expressed as absolute numbers, percentages, p-values, odds ratio, and 95% CIs values. Data were subjected to binary logistic regression to determine the association between variables with $p < 0.05$ considered significant.

The study was done according to Helsinki's declaration and National Code of Health Research Ethics (2006),²¹ Federal Ministry of Health, Nigeria, with approval given by Kaduna state ministry of Health ethical committee with approval number NHREC/17/03/2018/ MOH/ADM/744/VOL1/933 dated September 13, 2019.

RESULTS

A total of 13701 exit interview records from 3975 immunization sessions were included in the analysis, with 165 (1%) records of tertiary health facilities, 831 (6%) of secondary health facilities, and 12705 (93%) records of primary health facilities. Local Government areas from the northern senatorial zone had 5635 records, while 6028 were records from LGAs of Central senatorial zone, and 2038 were records from southern senatorial zone LGAs. Records from public health facilities constitute 95% of analyzed data, while only 5% of records were from private health facilities. Thirteen records representing 0.09% were excluded from the analysis due to incomplete responses of the questions asked; hence, there is an inclusion rate of 99.91% downloaded data.

Questions were asked on seven thematic areas, which include: i. are the caregivers' aware of the importance of routine immunization? ii. who mobilizes caregivers to take their children for routine immunization? iii. who decides whether the child receives RI/vaccines in the family? iv. are the caregivers' aware of vaccine administered? v. are the caregivers' aware of next date for follow up? vi. Are the caregivers satisfied with routine immunization services? and vii. What are the experiences of adverse events after routine immunization. There is an option of a single choice of answers for all questions asked except for questions on who mobilizes caregivers to bring their children for immunization where more than one choice is allowed.

Caregivers' awareness of the importance of routine immunization (Table 1) in the state is 97.5%, with values for the different senatorial zones greater than 96% (table 2).

Table 2 showed that fathers were the significant decision-makers on whether a child should be brought for routine immunization in all the three zones ranging from 70.5% in the more homogenous Zone 1 LGAs to 60.3% in the

more heterogeneous Zone 2 LGAs and 44.7% in another different more homogenous zone 3 LGAs based on varied culture. The influence of mothers was 39% in zone 3 LGAs, 16% in Zone 2 LGAs, and 19% in Zone 1 LGAs. Another critical factor is the influence of both parents, which is highest in Zone 2 LGAs (19%) followed by zone 3 LGAs (15%) and lastly, zone 1 LGAs (9%). However, still in table 1, when it comes to overall decision making in the state, fathers make the most decision when it comes to allowing their children to receive routine immunization (62%) followed by mothers (20.8%), both parents (14.7%) with other reasons less than 2% each.

Table 1: Responses of caregivers on their awareness, experience, and satisfaction on routine

immunization in Kaduna state

Total response	Yes	No	Frequency (%)	
Awareness of caregivers of the importance of immunization	13701	13353 (97.5)	48 (2.5)	of routine
Caregivers awareness of the vaccine administered	13701	12645 (92.3)	1056 (7.7)	
Awareness of caregivers of the next day for follow up	13701	13339 (97.4)	362 (2.6)	
Caregivers that are satisfied with routine immunization	13701	13586 (99.2)	115 (0.8)	service
Caregivers that have reported experience of adverse events after routine immunization	13701	3021 (22.0)	9974	NA (78)

Source of mobilization of caregivers for routine immunization

Total response	16804
Traditional leader	2141 (12.7)
Voluntary community Mobilizer	4171 (24.8)
Health worker	6773 (40.3)
Supplemental immunization campaign teams	771 (4.6)
Field volunteers	1109 (6.6)
Religious leaders	468 (2.8)
Community based organization	90 (0.5)
Traditional birth attendants	378 (2.2)
Others	462 (2.7)
None	441 (2.6)

Decision -makers on whether a child receives routine immunization in the family

Total response	13701
Mother	2849 (20.8)
Father	8515 (62.1)
Grand-parents	243 (1.8)
Relatives	47(0.3)
Both Parents	2015 (14.7)
Others	32 (0.2)

Table 2 shows 'knowledge of what vaccine was administered' which was found to be 97.5% (highest) in was revealed in Table 2. This was high for all the the southern (zone 3) senatorial LGAs followed by the three senatorial zones with 97.1% in Zone 1 central (zone 2) senatorial LGAs (93.8%) and lowest LGAs, 97.3% in zone 2 LGAs, and 99.2% for was in the northern (zone 1) senatorial LGAs (88.7%). zone 3 LGAs.

The overall level of awareness of the vaccine administered in the state was discovered to be high which 92.3% with a positive response is.

Table 2: Responses of caregivers on their awareness, experience, and satisfaction on Routine immunization in Kaduna state by senatorial zone

Frequency (%)						
Zone 1 LGAs			Zone 2 LGAs		Zone 3 LGAs	
Awareness of caregivers of the importance of routine immunization	Yes	No	Yes	No	Yes	No
Caregivers awareness of the vaccine administered	5454(96.8)	181(3.2)	5881(97.6)	147(2.4)	2018(99.0)	20(1.0)
Awareness of caregivers of the next day for follow up	5472(97.1)	163(2.9)	5864(97.3)	164(2.7)	1988(97.5)	50(2.5)
Caregivers that are satisfied with 2025(99.2) 13(0.8) routine immunization service			5605(99.5)	30(0.5)	5956(98.8)	72(1.2)

Total response	N= 5635	N= 6028	N= 2038(5)
Mother	1093(19.4)	975(16.2)	781(38.3)
Father	3971 (70.5)	3633(60.3)	911(44.7)
Grand-parents	52(0.9)	163(2.7)	28(1.4)
Relatives	17(0.3)	24(0.4)	6(0.3)
Both Parents	494 (8.8)	1217 (20.2)	304(14.9)
Others	8 (0.1)	16 (0.3%)	8 (0.4)

shows that 'caregiver satisfaction with routine immunization service' (Tables 1 &2) is high for all the three zones with 99.5%,98.8% and 99.4% for Zone 1, 2 and 3 LGAs respectively and the overall value for the state found to be 99.2%.

Yes	No	NA	Yes	No	NA	Yes	No	NA
Caregivers that have reported experience of adverse events after routine immunization	1291(22.9)	1377(22.8)	353(17.3)	1546(82.7)	139(6.8)	4077(72.4)	267(4.7)	4351(77.2)

Sour ce of mobilization of caregivers for routine immunization

Total response	N= 6685	N= 7573	N=2546
Traditional leader	982 (14.7)	611(8.1)	548 (21.5)
Voluntary community Mobilizer	1652 (24.7)	2367(31.3)	152 (6.0)
Health worker	2786(41.7)	2742 (36.2)	1245 (48.9)
Supplemental immunization campaign	305(4.6) teams	386(5.1)	80(3.1)
Field volunteers	396(5.9)	423(5.6)	290 (11.4)
Religious leaders	95(1.4)	263(3.5)	110 (4.3)
Community based organization	14(0.2)	66(0.9)	10 (0.4)
Traditional birth attendants	169(2.5)	170(2.2)	39(1.5)
Others	165(2.5)	243(3.2)	54(2.1)
None	12(1.8)	302 (4.0)	18 (0.7)

Table 3: Association between the different variables

Dependent variable	Independent variable	P-value	Odds ratio	95% CI
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Awareness and satisfaction on Routine immunization

Caregivers awareness of the importance of routine immunization $p<0.000^*$ 0.079 0.063-0.098 of the

Aw areness of caregivers Awareness of caregivers $p<0.0001$ * 0.168 0.12-0.235 of the
next day for follow up of the importance of routine immunization

Caregivers that are satisfied with routine immunization service Awareness of caregivers $p<0.0001^*$ 0.117 0.071 -0.92 with Routine immunization of the importance of routine immunization

Source of mobilization of caregivers for routine immunization

Awareness of caregivers Traditional leader $p=0.000^*$ 2.386 1.79-3.148
of the importance of

routine immunization

Voluntary community Mobilizer $p=0.482$ 1.108 0.833 -1.474

Health worker $p=0.335$ 1.14 0.873 -1.489

Supplemental immunization $p=0.724$ 1.095 0.663 -1.807

campaign teams

Field volunteers $p=0.007^*$ 0.394 0.200-0.778

Religious leaders $p=0.005^*$ 0.056 0.008-0.413

Community Based Organization $p=0.205$ 1.942 0.695 -5.428

01.3 6 0.662 -2.579

$p=0.441$

Others $p=0.000^*$ 4.117 2.711-6.253

None $p=0.382$ 0.686 0.294-1.599

Decision-makers on whether a child receives routine immunization in the family

Awareness of caregiver Mother of $p=0.000^*$ 16.553 5.981-45.812
the importance of routine immunization

Father $p=0.000^*$ 6.375 2.421 -16.786

Grand-parents $p=0.006^*$ 5.200 1.616 -16.728

Relatives $p=0.085$ 4.500 0.813-24.969

Both Parents $p=0.000^*$ 10.692 3.880 -29.466

Others $p=0.000^*$ 7.816 2.974 -20.541

Statistical significance at $p < 0.05$ (2-tailed)

The data on 'experience of adverse events after routine immunization' was similar for all the three senatorial zones as well as in the whole state (Tables 1 and 2) with 22.9% in zone 1, 22.4% in zone 2 and lowest was in zone 3 LGAs with 17.3% as well as an average of 22% for the entire state.

Awareness of caregivers about the importance of routine immunization (Table 3) was found to be a factor that was associated with caregiver's awareness of vaccine administered (p-value: $p < 0.0001$; odds ratio: 0.079; 95%CI: 0.063-0.098), awareness of next date for follow up was (p-value: $p < 0.0001$; odds ratio: 0.168 ; 95%CI: 0.12-0.235) and whether caregivers are satisfied with routine immunization services (p-value: $p < 0.0001$; odds ratio: 0.117; 95%CI: 0.071-0.92).

Some source of mobilization of caregivers for routine immunization was found to be associated with higher odds in awareness of caregiver of the importance of routine immunization while some are associated with lower odds, as seen in Table 3.

The decision-makers on whether a child receives routine immunization in the family (Table 3) are associated with higher odds of awareness of the importance of routine immunization.

DISCUSSION

Our study used exit interview data, and though apprehension about the reliability of responses in such surveys is not misplaced since 'courtesy bias's may lead respondents to give approving responses, especially if interviewed in the premises of the institution; exit surveys are still considered essential tools for ascertaining quality and demand for healthcare services²². Hence, we deem it appropriate to get useful information to help improve routine immunization studies in Kaduna state. Most of our data, about 95% were observed to have been generated from public facilities. Generally, it has been reported that public sectors primary healthcare centers were preferentially used by more impoverished populations where there are important providers.²³ Findings suggest that patient views could vary with subject recruitment site.²⁴

Many studies have been conducted showing reasons for low immunization coverage from various countries.^{10,12,24} Factors such as inadequate immunization services, poor parental knowledge and attitudes of health workers, limited access to services, poor health staff attitudes and practices, the unreliability of services, false contraindications, fears of side effects, conflicting priorities, and parental beliefs were all identified.¹⁰ A study revealed that one of the most potent predictors for client satisfaction with government services was provider behavior, especially respect and politeness.²⁵ Likewise, another study¹² confirmed that attitude was significant in mothers' decision to avail their children of vaccines offered to them. Other critical determinants of the success of vaccination efforts are health workers' attitudes, the manner in which patients were treated, aspects of a service organization, adequate supply of vaccines, and caregivers' basic knowledge about immunization.¹⁰ Moreover, it has been revealed that these factors contribute to missed opportunities for immunization, which was one of the important causes of poor immunization coverage that should be prevented.²⁶ Furthermore, our study focused on knowledge as well as, mobilization of caregivers, decision making for routine immunization, the satisfaction of routine immunization services rendered, and experience of an adverse event after routine immunization.

It has been documented that good access to health facilities or services does not necessarily translate to the uptake of services. This was true for immunization as for any other preventive services.¹⁰ Also, caregivers' actions were also crucial in accessing of healthcare for the under-fives²⁷, hence, the focus on caregivers became important.

Awareness of the importance of routine immunization by caregivers was very high in the state (averaging 97%) and in the three senatorial zones with little or no differences between them. This high level of awareness might be due to the various immunization activities (supplemental immunization campaigns as well as routine immunization outreaches) being conducted all year round with its attendant's community mobilization and

sensitization activities. It is worthy to note that Kaduna state has 'volunteer community mobilizers system' and 'community engagement program in place across all the Local Government Areas, and these have a primary role of creating awareness about the importance of routine immunization and mobilization for routine immunization services.

While health workers are a major source of mobilization of caregivers for routine immunization in the three senatorial zones, volunteer community mobilizers also play a very important role as the second next important factor for zone 1 and zone 2 senatorial LGAs. In contrast to Zone 3, senatorial LGAs, traditional leaders were the next highest Source of mobilization of the community for routine immunization, and this might be due to the fact that while all LGAs in zone 1 and 2 senatorial LGAs have the presence of volunteer community mobilizers, only 3 out of the 8 LGAs in zone 3 has a sparse presence of volunteer community mobilizers. Though not statistically significant ($p>0.05$), voluntary community mobilizers, health workers, supplemental immunization campaign teams, community-based organization, traditional birth attendants and 'others' were associated with higher odds of a high level of awareness of the importance of routine immunization while field volunteers and religious leaders were associated with lower odds of awareness of the importance of routine immunization ($p<0.05$). This should call for more engagement of the religious leaders and field volunteers so as to ensure that their messages are tailored towards increasing awareness of routine immunization. The term 'others' has not been defined nor categorized in the question asked.

'Who makes the decision on whether a child receives immunization' was a predominant factor that affects the success of immunization. This will be important to any planned interventions towards behavioral change in this regard. Fathers as heads of households are seen as the primary decision-makers on whether a child receives immunization or not in the three senatorial zones in the State. In this study, we observed that fathers play a much greater role in the northern senatorial zone (70.5%), followed by the central senatorial zone (60.3%) with the lowest (44.7%) in the southern senatorial (zone 3) LGAs. The converse was also true for the role of mothers on decision making for routine immunization with the highest percentage score in the southern senatorial zone (38%), the central senatorial zone (16.2%), and 19.4% in the LGAs of the northern senatorial zone. These differences can be explained in terms of cultural differences in the three zones. Decision-makers on whether a child receives routine immunization were all associated with higher odds ($p<0.05$) about the awareness of the importance of routine immunization by caregiver though this was not significant for relatives ($p>0.05$). Moreover, in some settings, grandmothers were seen to be critical decision-makers in families supportive of immunization.^{10,26}

'Caregivers awareness of vaccine administered' and caregiver awareness of the next date for follow up gave information about knowledge on immunization by caregivers. Knowing what vaccine was administered and for what purpose was expected to be a motivator for further visits to the facility for routine immunization services. Awareness for vaccines administered was found to be highest for the southern senatorial zone LGAs (97.5%), followed by the central senatorial zone (93.8%) and 88.7% which is the lowest was seen in the northern senatorial zone. Knowing the dates for follow up visits is also very high for all the LGAs (>96%). These two factors might be indicative of the quality of health talks conducted during immunization services.

In this study, the question on 'caregivers' satisfaction with routine immunization service' was not graded. The question was asked in general terms without specifications on areas of satisfaction; hence answers might be

relative being either a yes or No. However, results obtained showed a high-level satisfaction (99.2%) among caregivers in the state. A study¹⁹ found that 63.2% of the participants were satisfied with the healthcare service they received. Patients attending the private facilities had the highest level of satisfaction having 73%) and patients attending the primary care facilities had the lowest level of satisfaction with 52%. A particular study showed that client satisfaction was an essential measure about the quality of health care and needs to be addressed in order to improve the utilization of primary health care services in urban areas.¹⁵ Reports showed that the level of satisfaction with the health services was quite high¹⁵. By and large, the satisfaction with the behavior of health professionals is seen to improve if the respondents have availed benefits of services provided.²² A study showed that there was no statistically significant ($p>0.05$) association between maternal satisfaction with childhood immunization services and knowledge score,²⁸ and since client needs are changing, and priorities from client's perspectives were also changing,²⁹ ongoing monitoring of client satisfaction becomes important.

Another study showed overall satisfaction with services at the facility at 62.6%. The satisfaction level was found to be higher among illiterate patients, who had no costs for transportation and those who had high expectations while coming to the hospital²⁹ between levels of satisfaction and gender.³⁰ These findings suggest that major improvements in the quality of vaccination and service organization will be needed to increase client satisfaction and service utilization.³¹

MICS/NICS survey 2016/2017⁵ showed that adverse events after routine immunization' affect the quality of immunization service by contributing to fear and mistrust. It has been found that people who distrust public health services are less likely to use them.³² Over 20% of respondents had reported experience of an adverse event after routine immunization. The frequency of occurrence is thus very common being greater than 10% based on WHO AEFI frequency classification³³. This poses a great concern for the immunization system in the state.

Limitations of the studies

The target group is biased to caregivers who actually access the services, hence, a limitation of the study. This may explain the disconnect between high level of awareness & satisfaction in routine services among caretakers and the low immunization performance coverage earlier stated in the background. The Source of information for immunization and demographic variables was not part of the study. Bias may have been introduced in the study as data collection was carried out by health staff across the sectors. Suggested answers to questions on satisfaction was either yes or no and not graded; hence may not be a true reflection of the level of satisfaction. A stratified sample of all records was not used but all records for the said period. Data used for analysis are mostly from fixed sites with few from outreach sites, and caregivers' views on immunization services in both sites may differ.

Strength of the study

Use of extensive data set with a statewide representation from all the LGAs.

Recommendations

Continuous training of health service providers to improve the quality of Routine immunization services in the light of reported high AEFI by caregivers and lack of knowledge of vaccine administered by some.

Segmented community dialogues and sensitization meetings of caregivers to improve their knowledge of routine immunization, ensuring implementation of optimized routine immunization supportive supervision as recommended by the Government. Subsequently, prospective studies should be done to include

sociodemographic and other variables that will give more information on the practice of routine immunization in the state. Further studies need to be carried out to assess the effect of adverse events following immunization on a missed opportunity for vaccination in the state.

CONCLUSION

There is a very high awareness of the importance of routine immunization, good knowledge of vaccine administered, knowledge of the next date for follow up, as well as a high level of satisfaction among caregivers for routine immunization services. However, there is a need to further train and re-train health workers on the adverse event after immunization and supply of tools to report adverse events following immunization in view of the high proportion of caregivers reporting experience of an adverse event after immunization.

Data availability/data sharing statement

Data used for analysis is publicly available on <https://whonghub.org/partners/31/merged-dataset/1085>; and a password for the data can be requested from the national primary healthcare development agency, Nigeria.

Competing interests

No conflict of interest to report. For this study and publication, no funding was received.

Authors Contributions

SGI, GU, BA, MD conceptualized the paper, reviewed the data, and analyzed them. SGI, GU, BA wrote the draft of the manuscript. SGI, GU, BA, AO, FB, MD HI, NI, SMY, AAS, LHS, AT, JOO, KSN and SKP, interpreted the data and reviewed the manuscript for intellectual content. All authors read and made input to the final draft.

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