

Pneumococcal vaccine awareness, acceptance, and hesitancy among caregivers of children with sickle cell anaemia attending a tertiary hospital in north-eastern NigeriaAyuba Zakar¹, Falmata Mustapha Grema², Tsuung Ason Benjamin³¹Department of Haematology and Blood Transfusion, Yobe State University Damaturu-Nigeria²Department of Haematology and Blood Transfusion, Abubakar Tafawa Balewa University Bauchi, Nigeria³Department of Family Medicine, Yobe State University Damaturu-Nigeria**Corresponding author: Ayuba Zakar, Email: ayubanet@yahoo.com**<https://dx.doi.org/10.4314/yomj.v2i2.8>**Received: 03-Jun-2026****Accepted: 18-Aug-2026****Published: 31-Aug-2026****ABSTRACT**

Background: Children with sickle cell anaemia (SCA) are at increased risk of invasive pneumococcal disease (IPD) due to functional asplenia and impaired immunity. Although the pneumococcal vaccine (PCV) effectively prevents IPD, caregivers' awareness, acceptance, and hesitancy strongly influence vaccine uptake.

Methods: We conducted a cross-sectional study among caregivers of children with SCA who attended the Yobe State Specialist Hospital in Potiskum from April to June 2026. We collected data using interviewer-administered questionnaires and analysed them using descriptive and inferential statistics. We assessed associations between categorical variables using Chi-square and Fisher's exact tests, with significance set at $p < 0.05$.

Results: Of the 126 caregivers who participated in the study, 88.9% had heard of PCV, with healthcare workers as the primary source of information (82.5%). Furthermore, 72.2% correctly identified the disease prevented by PCV, and 73.0% knew it is recommended for children with SCA; 85.7% of children had received the vaccine, with 76.2% completion of the recommended doses. Vaccine acceptance was largely driven by protection from severe illness (58.3%) and healthcare provider recommendations (25.0%). Conversely, fear of side effects (27.8%) and vaccine unavailability (27.8%) were the main reasons for hesitancy. Information source was significantly associated with vaccine uptake ($\chi^2 = 49.723$, $p < 0.001$).

Conclusion: Caregivers showed high PCV awareness and acceptance, with healthcare providers as the primary information source. Addressing vaccine safety concerns, improving availability, and strengthening caregiver education may further reduce hesitancy and improve uptake among children with SCA.

Keywords: Sickle Cell Anaemia; Pneumococcal vaccine; Vaccine awareness; Vaccine acceptance; Vaccine hesitancy; North-Eastern Nigeria

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INTRODUCTION

Sickle Cell Anaemia (SCA) is the homozygous inheritance of the haemoglobin S gene. In its classical form, the disease is characterised by chronic haemolysis, episodic bone pain, chronic organ deterioration, and an overall reduction in quality of life [1]. A painful episode, the so-called vaso-occlusive crisis, occurs when sickled red cells obstruct blood flow, leading to tissue ischaemia. Repeated vaso-occlusion of the splenic vessels may lead to splenic infarction, reducing the spleen's size and function. In extreme cases, the spleen may be undetectable on ultrasonography, a condition known as auto-splenectomy [2]. Functional asplenia refers to the global impairment of splenic function, predisposing SCA patients to infection with encapsulated organisms such as *Neisseria meningitidis*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Salmonella* [3].

According to the World Health Organisation, pneumonia accounted for 14% of all deaths among children under 5 years, killing about 740,180 children in 2019 [4]. Standard protocols for preventing *S. pneumoniae* infection in children with SCA include oral penicillin V prophylaxis for the first 5 years and vaccination [5]. The conjugate pneumococcal vaccine (PCV) reduced the incidence of invasive pneumococcal disease (IPD) by 90.8% in children < 2 years and by 93.4% in those > 5 years [6]. A crude analysis estimated the effectiveness of a single dose of PCV at 84.5% among Sick Cell Disease (SCD) patients aged <10 years [7]. Nigeria, through the Global Vaccine Initiative (GAVI), introduced the 10-valent PCV in 2014 as part of the routine childhood immunisation schedule, administered at 6, 10, and 14 weeks, expected to save 35,000 infant lives annually [8].

Although advances in preventive care have improved health outcomes in high-income countries, children with SCA in middle- and low-income countries (LMICs) still experience preventable complications due to delayed diagnosis, limited access to comprehensive care, and suboptimal vaccine uptake. Vaccine hesitancy has emerged as a major threat to immunisation programs in LMICs, and the WHO has identified it as one of the top ten threats to global health [9,10]. However, vaccine hesitancy is a complex, multifactorial phenomenon

influenced by cultural and religious beliefs, socioeconomic factors, confidence in the health system and providers, and misinformation. In LMICs, these challenges are compounded by vaccine stock-outs, poor transportation networks, and inadequate health education [11,12].

About 150,000 babies are born with SCD annually in Nigeria [13]. These children are at risk of IPD, making accelerated vaccine coverage a strategic necessity, especially in North-Eastern Nigeria, which sits at the intersection of a high SCA burden, historical vaccine distrust, and low education. Despite the well-established benefits of PCV, evidence on caregivers' awareness, acceptance, and hesitancy toward pneumococcal vaccination for children with SCA remains limited in Nigeria, especially in the North-East. Understanding caregivers' knowledge, attitudes, and vaccine-related concerns is essential to identify barriers to PCV uptake and inform targeted interventions to improve coverage among this high-risk population. Our study therefore aimed to assess awareness, acceptance, and hesitancy among caregivers of children with SCA attending a tertiary health facility in North-Eastern Nigeria, providing practical insight into barriers to vaccine uptake and suggesting ways to overcome them. It will also contribute to the limited body of literature on PCV uptake in North-Eastern Nigeria.

METHODOLOGY

1. Study design and setting.

This hospital-based, descriptive, cross-sectional study was conducted among caregivers of children with SCA who attended the Sick Cell Clinic of the Yobe State Specialist Hospital, Potiskum (YSSHP), a 300-bed tertiary health facility, from April to June 2026. Potiskum is the commercial centre of Yobe State in North-Eastern Nigeria. Yobe has one of the highest burdens of SCD in Nigeria. The clinic provides comprehensive care for patients with SCA, including routine follow-up, immunisation counselling, and treatment of acute and chronic complications.

2. Ethical Considerations

Ethical approval was obtained from the Ethics and Research Committee of the Yobe State Ministry of Health (REF: YB/HREC/APRIL/26/010). The study followed the principles of the Declaration of Helsinki

governing research involving human subjects. We obtained written informed consent from participating caregivers after explaining the study objectives, procedures, and expected benefits for children with SCA. Participation was voluntary, and caregivers were informed of their right to withdraw at any time without affecting the health services provided to their patients. We maintained confidentiality by anonymising the questionnaires.

3. Study population

The study population comprised caregivers of children with SCA aged 0-18 years who attended the Sickle Cell clinic at YSSHP during the study period. Caregivers were parents, guardians, or adult family members responsible for the child's health needs for at least 6 months prior to the study.

4. Data Collection

Data were collected using questionnaires covering caregivers' socio-demographic characteristics and those of their children, as well as awareness of PCV, acceptance and hesitancy. It also examined factors influencing awareness, acceptance and hesitancy, including accessibility, cost, healthcare provider recommendations, and perceived vaccine safety. Researchers and their trained assistants collected data. Interviews were conducted in English or Hausa, depending on the respondent's preference.

5. Statistical analysis

Data were entered into Microsoft Excel, cleaned, and exported to the Statistical Package for the Social Sciences (SPSS) version 22 (IBM Corp., Armonk, NY, USA) for analysis. We summarised categorical variables using frequencies and percentages. We described awareness, acceptance, and hesitancy towards pneumococcal vaccination using proportions with corresponding 95% confidence intervals where appropriate. We assessed associations between caregiver characteristics and awareness, acceptance, or hesitancy using the Chi-square test and Fisher's exact test. Results were presented in tables and charts. Statistical significance was set at a two-tailed p-value of less than 0.05 ($p < 0.05$).

RESULTS

Table 1: Socio-demographic Characteristics of the Caregivers of Children with SCA attending the sickle cell clinic of YSSHP from April to June 2026 (n=126).

Socio-demographic Characteristics	Frequency	Percent
Age (years)		
≤5	53	42.1
6-11	36	28.6
12-17	31	24.6
18	6	4.8
Sex		
Male	46	36.5
Female	80	63.5
Age of caregiver (years)		
<20	2	1.6
20-29	19	15.1
30-39	37	29.4
40-49	50	39.7
>50	18	14.3
Sex of caregiver		
Male	22	17.5
Female	104	82.5
Relationship with patient		
Mother	95	75.4
Father	18	14.3
Guardian	12	9.5
Sister	1	.8
Marital status		
Single	4	3.2
Married	116	92.1
Widowed	3	2.4
Divorced/Separated	3	2.4
Educational level		
No formal education	48	38.1
Primary	18	14.3
Secondary	28	22.2
Tertiary	32	25.4
Occupation		
Business	24	19.0

Civil servant	16	12.7
Driver	2	1.6
Farmer	6	4.8
Housewife	68	54.0
Retired civil servant	1	.8
Self-employed	2	1.6
Student	3	2.4
Teacher	3	2.4
Trader	1	.8

No of Children in the family

1-5	58	46.0
6-10	55	43.7
11-15	13	10.3

No. of children with SCA

1	68	54.0
2	40	31.7
3	11	8.7
4	7	5.6

Income (₦)

<50,000	71	56.3
50,000-100,000	41	32.5
101,000-200,000	14	11.1

*SCA: Sickle Cell Anaemia***Table 2: Awareness of Pneumococcal Vaccine among the Caregivers of Children with SCA (n= 126)**

Awareness of Pneumococcal Vaccine	Frequency	Percent
Heard of the pneumococcal vaccine before		
Yes	112	88.9
No	14	11.1
Source of Information		
Health worker	104	82.5
Media (TV/Radio/social media)	6	4.8
Family/friends	2	1.6
Nil	14	11.1

Knew what the pneumococcal vaccine prevents

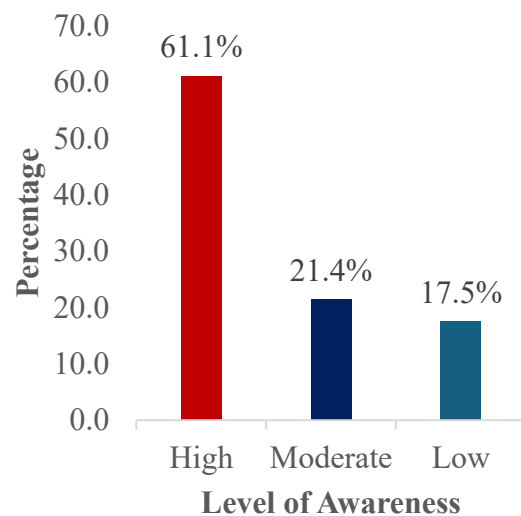
Yes	91	72.2
No	18	14.3
Not Sure	17	13.5

Aware of high-risk infection in children with SCA

Yes	91	72.2
No	35	27.8

Aware of pneumococcal vaccine recommended for SCA patients

Yes	92	73.0
No	34	27.0

SCA: Sickle Cell Anaemia**Figure 1: Level of Awareness of Pneumococcal Vaccine among the Caregivers of Children with SCA (n=126).****Table 3: Acceptance of Pneumococcal Vaccine among Caregivers of Children with SCA (n=126)**

Acceptance of Pneumococcal Vaccine	Frequency	Percent
The child/ward was vaccinated		
Yes	108	85.7
No	11	8.7
Not sure	7	5.6
Doses administered to the child/ward		
1 Dose	3	2.4
2 Doses	9	7.1
Full recommended doses	96	76.2
Not sure	7	5.6
None	11	8.7

SCA: Sickle Cell Anaemia

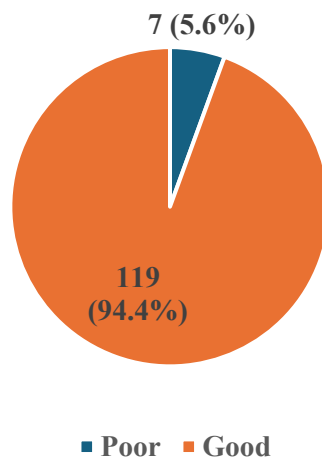


Figure 2: Level of Acceptance of Pneumococcal Vaccine among Caregivers of Children with SCA (n=126)

Table 4: Reasons for Hesitancy Towards Pneumococcal Vaccine among Caregivers of Children with SCA

Hesitancy towards pneumococcal vaccine	Frequency	Percent
Reason for being hesitant or not vaccinating your child/ward (n=18)		
Lack of Awareness	2	11.1
High cost of vaccine	2	11.1
Fear of side effects	5	27.8
Lack of trust in vaccines	3	16.7
Vaccine not available	5	27.8
Religious or Cultural reasons	1	5.6

Encouragement from health workers will motivate me to vaccinate my child/ward (n=18)

Yes	15	83.3
Not sure	3	16.7

Believe in vaccine safety for children (n=126)

Yes	116	92.1
No	2	1.6
Not sure	8	6.3

Vaccines should be free for SCA patients (n=126)

Yes	114	90.5
No	12	9.5

Ways to improve pneumococcal vaccine uptake for SCA patients (n=126)

Government Should Create more Awareness	72	57.1
Government Should Provide free vaccines	3	2.4
Government Should Improve the vaccine	4	3.2
No response	47	37.3

SCA: Sickle Cell Anaemia

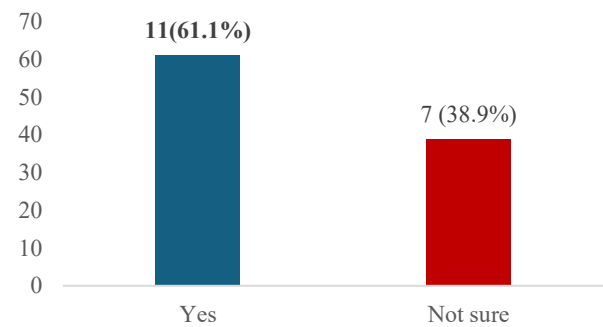


Figure 3: Assessment of Willingness to Take Up Vaccination among Caregivers of Unvaccinated Children/Ward (n=18)

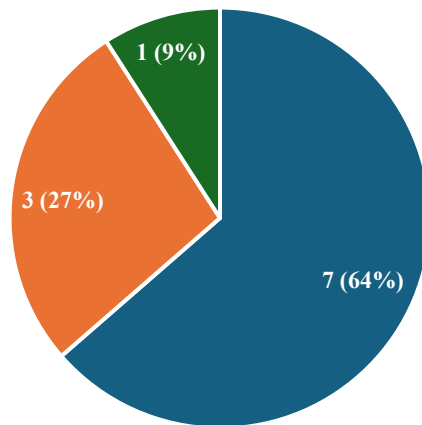


Figure 4: Motivation if willing to allow child/ward to be vaccinated (n=11).

Table 5: Association Between Socio-demographic Characteristics and Acceptance of Pneumococcal Vaccination among Caregivers of Children with SCA Not Vaccinated (n=18)

Socio-demographic Characteristics	Acceptance of Pneumococcal Vaccine			Test Statistics	Df	p-value	Tertiary value
	Good	Poor	Total				
Age (years)							
≤5	5 (27.8%)	1 (5.5%)	6 (33.3%)	F.E = - 4.530	-	0.814	
6-11	4 (22.2%)	3 (16.7%)	7 (38.9%)				
12-17	3 (16.7%)	0 (0.0%)	3 (16.7%)				
18	2 (11.1%)	0 (0.0%)	2 (11.1%)				
Sex							
Male	8 (44.4%)	2 (11.1%)	10 (55.6%)	X ² = 1 0.524	1	0.807	
Female	6 (33.3%)	2 (11.1%)	8 (44.4%)				
Age of caregiver (years)							
<20	0 (0.0%)	0 (0.0%)	0 (0.0%)	F.E = - 11.399	-	0.137	
20-29	5 (27.8%)	1 (5.5%)	6 (33.3%)				
30-39	5 (27.8%)	1 (5.5%)	6 (33.3%)				
40-49	3 (16.7%)	1 (5.5%)	4 (22.2%)				
>50	1 (5.5%)	1 (5.5%)	2 (11.1%)				
Sex of caregiver							
Male	3 (16.7%)	2 (11.1%)	5 (27.8%)	X ² = 1 0.272	1	0.873	
Female	11 (61.1%)	2 (11.1%)	13 (72.2%)				
Relationship with patient							
Mother	9 (50.0%)	2 (11.1%)	11 (61.1%)	F.E = - 11.451	-	0.045	
Father	2 (11.1%)	1 (5.5%)	3 (16.7%)				
Guardian	2 (11.1%)	1 (5.5%)	3 (16.7%)				
Sister	1 (5.5%)	0 (0.0%)	1 (5.5%)				
Marital status							
Single	1 (5.5%)	0 (0.0%)	1 (5.5%)	F.E = - 14.488	-	0.007	
Married	12 (66.7%)	4 (22.2%)	16 (88.9%)				
Widowed	0 (0.0%)	0 (0.0%)	0 (0.0%)				
Divorced/Separated	1 (5.5%)	0 (0.0%)	1 (5.5%)				
Educational level							
No formal education	4 (22.2%)	1 (5.5%)	5 (27.8%)	X ² = 3 15.416	3	0.016	
Primary	2 (11.1%)	1 (5.5%)	3 (16.7%)				
Secondary	4 (22.2%)	1 (5.5%)	5 (27.8%)				
Tertiary	4 (22.2%)	1 (5.5%)	5 (27.8%)				
Occupation							
Business	3 (16.7%)	1 (5.5%)	4 (22.2%)	F.E = - 35.396	-	0.001	
Civil servant	1 (5.5%)	1 (5.5%)	2 (11.1%)				
Driver	0 (0.0%)	0 (0.0%)	0 (0.0%)				
Farmer	1 (5.5%)	0 (0.0%)	1 (5.5%)				
Housewife	7 (38.9%)	2 (11.1%)	9 (50.0%)				
Retired civil servant	0 (0.0%)	0 (0.0%)	0 (0.0%)				
Self-employed	1 (5.5%)	0 (0.0%)	1 (5.5%)				
Student	1 (5.5%)	0 (0.0%)	1 (5.5%)				
Teacher	0 (0.0%)	0 (0.0%)	0 (0.0%)				
Trader	0 (0.0%)	0 (0.0%)	0 (0.0%)				
No. of children in the family							
1-5	7 (38.9%)	2 (11.1%)	9 (50.0%)	F.E = - 18.081	-	0.023	
6-10	6 (33.3%)	1 (5.5%)	7 (38.9%)				
11-15	1 (5.5%)	1 (5.5%)	2 (11.1%)				
No. of children with SCA							
1	7 (38.9%)	2 (11.1%)	9 (50.0%)	F.E = - 18.081	-	0.023	

2	5 (27.8%)	1 (5.5%)	6 (33.3%)	
3	2 (11.1%)	1 (5.5%)	3 (16.7%)	
4	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Income (₦)				
<50,000	7 (38.9%)	2 (11.1%)	9 (50.0%)	$\chi^2 = 20.629$
50,000-100,000	5 (27.8%)	1 (5.5%)	6 (33.3%)	10.620
101,000-200,000	2 (11.1%)	1 (5.5%)	3 (16.7%)	

SCA: Sickle Cell Anaemia; χ^2 : Chi-square; F.E: Fisher's Exact Test; df: degree of freedom; $p \leq 0.05$ is considered statistically significant

Table 6: Association Between Source of Information and Pneumococcal Vaccine Uptake Among Caregivers of Children with SCA (n=126)

Source of Information	The child/ward was vaccinated		Not sure	Total
	Yes	No		
Health worker	98 (77.8%)	4 (3.2%)	2 (1.6%)	104 (82.5%)
Media (TV/Radio/social media)	5 (4.0%)	0 (0.0%)	1 (0.8%)	6 (4.8%)
Family/friends	1 (0.8%)	1 (0.8%)	0 (0.0%)	2 (1.6%)
Nil	4 (3.2%)	6 (4.8%)	4 (3.2%)	14 (11.1%)

$\chi^2 = 49.723$; df = 3; p-value <0.001

χ^2 : Chi-square; df: degree of freedom; $p \leq 0.05$ is considered statistically significant

DISCUSSION

Our study provides the first localised insight into PCV awareness, acceptance, and hesitancy among caregivers of children with SCA in a tertiary health setting in North-Eastern Nigeria. In a resource-limited health system weakened by almost a decade and a half of insurgency, optimising vaccine coverage is cost-effective and strategically necessary to protect highly susceptible populations against vaccine-preventable infections. While our study found a high level of awareness and acceptance of the

PCV, residual gaps remain that must be addressed to ensure comprehensive protection of all children with SCA against IPD.

Most (82.5%) caregivers of children with SCA in this study were female, with the highest proportion (75.4%) being the children's biological mothers. This finding reflects traditional practices in Africa, where women care for children and manage the household, while men seek jobs to bring income to the family. The role of men is necessary, as most of the household's income in this study is below 50,000 naira (<36\$) per month or <1.2\$ per day, a figure grossly insufficient to care for patients with chronic conditions such as SCA. This aligns with the Nigerian Economic Summit Group 2021 report, which revealed that 63% of Nigerians are multidimensionally poor, with the North-East disproportionately affected [14]. Our study further demonstrates the extent of women's educational and economic disempowerment in our society, as evidenced by the high number of women without formal education who were housewives, which suggests unemployment. This calls for urgent policy intervention to address this gender inequality in our setting.

Regarding PCV awareness among respondents, the majority (88.9%) were aware of the vaccine, and 72.9% knew what PCV prevents. Most caregivers (61.1%) demonstrated a high level of awareness. This contrasts with findings from Ghana, where only 4% of caregivers had heard of PCV, and with a study in Benin City, Nigeria, where only 32.3% knew what the vaccine prevents and only 20% demonstrated overall knowledge [15,16]. In the Ghanaian study, caregivers preferred vaccines to tablets, indicating a strong willingness to vaccinate despite poor baseline knowledge. Together, these studies strongly suggest that barriers to PCV uptake are not outright refusal but inadequate caregiver education, suboptimal provider counselling, and low awareness of pneumococcal disease prevention. The primary source of PCV awareness for most caregivers in our study was healthcare workers. The high level of awareness among predominantly uneducated caregivers highlights the important role healthcare workers play in promoting vaccine uptake. Social and

electronic media did not play a significant role in raising PCV awareness among our respondents. The lack of formal education among most caregivers may have limited their participation in and understanding of social and electronic media content. However, this residual gap can be bridged by engaging with healthcare workers to discuss vaccines and their benefits in the dialect most widely understood by the population, via radio, television, and social media.

Our study demonstrated a high level of acceptance of PCV by the caregivers, where the majority (85.7%) of them have vaccinated their children, with 72.6% of them achieving full-dose vaccination of their children. The primary motivation for acceptance is protecting their children from severe illness, followed by the doctor's recommendation. Among caregivers who did not vaccinate their children, acceptance of PCV was associated with several socio-demographic factors, including the caregiver's relationship with the patient, marital status, educational level, occupation, number of children in the family, number of children with SCA, and monthly income ($p < 0.05$).

The significant association between the caregiver's relationship with the patient and acceptance of the PCV may reflect involvement in decision-making about the child's health needs, with the patient's biological parents having greater freedom to decide whether to vaccinate their child than extended family members. This finding underscores the need for targeted vaccine education to all caregivers, especially those responsible for healthcare decision-making.

Marital status showed a statistically significant association with vaccine acceptance. Married caregivers may benefit from more emotional, financial, and social support, which can positively influence the family's joint healthcare decision-making process and compliance with vaccine schedules. Studies have demonstrated that household stability and spousal support positively influence vaccine uptake in children [17,18]. Caregivers who are divorced, widowed, or single may be deprived of the expected spousal support, and if faced with additional financial

pressures, can negatively impact timely vaccine uptake.

Educational attainment was an important determinant of vaccine acceptance by caregivers. Those with higher education are more likely to appreciate the susceptibility of SCA children to IPD, the benefit PCV offers, and are best placed to counter vaccine misinformation. The relationship between education and vaccine acceptance has not always been uniformly positive [19]. Therefore, tailoring information for caregivers with no formal education will help bridge the remaining gap in vaccine acceptance.

Caregivers' occupation and monthly income play important roles in PCV acceptance. Caregivers with better jobs and higher incomes can cover transport costs to immunisation clinics and other immunisation-related expenses. Those with unstable jobs and low household incomes face financial pressure to meet competing household demands, diverting caregivers' attention from their children's health needs, even when they understand the benefits of vaccination. These findings support calls to make vaccines more accessible and fully integrate them into the routine care of SCA patients.

Family size and the number of children with SCA were also significantly associated with PCV acceptance. On the one hand, a large family size may increase competition for available resources among several family members, which may limit the caregiver's ability to access preventive services consistently. On the other hand, an increased number of children with SCA in the family can increase the number of contacts with healthcare providers who can provide them with the right information on vaccines. Also, previous complications in other SCA family members place caregivers in a position to make informed choices about vaccines.

Reasons for vaccine hesitancy among caregivers who did not vaccinate their children include fear of side effects, vaccine unavailability, and lack of trust in vaccines. Only 5.6% of caregivers cited cultural and religious barriers. This contrasts with the past, when cultural and religious barriers were major impediments to vaccine uptake in northern

Nigeria, allowing vaccine-preventable diseases such as poliomyelitis to spread in the region [20]. Lack of trust in the vaccine was cited by 16.7% of hesitant caregivers, suggesting residual mistrust in this region of Nigeria. It is encouraging that most hesitant caregivers believe encouragement from healthcare workers will motivate them to vaccinate their children. This again highlights the critical role healthcare workers can play in eliminating residual barriers to accelerated vaccine coverage.

CONCLUSION

While PCV awareness is high among caregivers of children with SCA in North-Eastern Nigeria, our findings demonstrate that acceptance is heavily dependent on socioeconomic factors and healthcare provider communication. Bridging the gap between awareness and actual vaccine uptake requires a multifaceted approach that addresses socioeconomic factors and health provider-caregiver communication. Implementing these strategies is essential to improve vaccination rates and reduce the burden of IPD among children with SCA.

LIMITATIONS

This single tertiary hospital-based study may have limited generalisability, as respondents likely had greater exposure to health education and healthcare specialists than those attending primary or secondary care, where more children with SCA are found. Therefore, our findings cannot be generalised to caregivers of SCA in North-Eastern Nigeria. In addition, we assessed vaccination status through caregiver self-reports rather than immunisation records. This inability to independently verify vaccination status may have resulted in misclassification of vaccine uptake.

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CONFLICT OF INTEREST

None declared.

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