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ORIGINAL RESEARCH

Determinants of Access to the Pentavalent 3 Vaccine Among Children Aged 0-23 months in Cameroon Based on the Demographic and Health Survey 2018

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Purpose: Vaccination is one of the most effective and efficient health interventions for reducing morbidity and mortality from infectious diseases, particularly in sub-Saharan Africa. Understanding the determinants of access to vaccines can help improve immunization coverage and control vaccine-preventable diseases. The aim of this study was to explore the contribution of certain determinants to access to pentavalent 3 in children aged 0–23 months in Cameroon via demographic and health survey data.

Materials and Methods: This was a cross-sectional nested case–control study in which children aged 0–23 months were selected via cluster random sampling in households in the 10 regions of Cameroon. Secondary data from the Demographic and Health Survey, which was conducted in Cameroon from 2017–2018, were used. Univariate and multivariate logistic models were used to analyze the determinants of access to the pentavalent 3 vaccine.

Results: The vaccination coverage of the pentavalent 3 vaccine (P3V) among children aged 0–23 months was 69.5%. The access to the P3V with Christian religion, compared with non-Christian experienced 63% of P3V (adjusted Odds ratio (AOR)=1.63, 95% CI, [1.22–2.17], p=0.001). Compared with those living in other regions in Cameron, those living in the northern regions of Cameroon were observed 37% less likely to have access to P3V (AOR=AOR=0.63, 95% CI, [0.44–0.87], p=0.006), while mother's marital status (married) compared with unmarried mothers were 37% more likely to experience access to P3V (AOR=1.37, 95% CI, [1.04–1.81], p=0.024). Relative to subjects with less education, those with at least secondary or higher education were 92% more likely to have access to P3V, (AOR=1.92, 95% CI [1.47–2.51], p<0.001), while those with cell phone experienced 44% increased access to P3V, (AOR=1.44, 95% CI, [1.17–1.78], p=0.001).

Conclusion: Access to the pentavalent 3 vaccine in Cameroon does not meet national targets and is affected by various socio-demographic factors, including region of residence, religion, educational attainment, maternal marital status, and cell phone ownership.

Keywords: determinants, access to vaccination, pentavalent vaccine, children, Cameroon

Introduction

Since its discovery, vaccination has been documented to be one of the most effective interventions for reducing morbidity and mortality worldwide, particularly in sub-Saharan Africa.[1,2] For several decades, immunization programs have taken remarkable steps to improve the success of and access to vaccination through routine vaccination and supplementation

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activities.[3,4] Despite these efforts, immunization coverage remains below the target, especially in sub-Saharan African countries, where millions of children have limited or no access to vaccination.[4–7]

At its seventy-third General Assembly in 2020, the World Health Organization established a program for immunization by 2030. One of the goals of this program is to ensure that every child is protected by full immunization, regardless of geographical location, age, socioeconomic status or gender. This calls for immunization programs to improve access to vaccination through a series of actions.[8,9]

In Cameroon, child immunization activities are governed by the Ministry of Health through the Expanded Program on Immunization (EPI).[10] This program manages national immunization policy, coordinates immunization activities at all levels of the health pyramid (central, intermediate and peripheral), draws up and implements procedures, ensures the acquisition and deployment of material resources and immunization equipment, and supervises and trains immunization personnel at all levels of the health system.[1,11] Under the supervision of the health district management team and the support of the regional public health delegation, the health area (a geographical entity covering a population of 5000–30,000 inhabitants) is the entity that implements vaccination activities. Vaccination activity reports are sent monthly from health centers (at the health area level) to the Ministry of Health (including the national vaccination program).[10]

Remarkable efforts have been made to improve vaccination coverage throughout the country through the Ministry of Public Health's Expanded Program on Immunization.[10] These efforts include immunization campaigns, improved immunization logistics, and supervised training to build the capacity of health workers involved in immunization activities.[10,12]

Despite the many actions implemented for improvement, there are still discrepancies between national coverage and the situation in the community; there are also difficulties in achieving national immunization targets for certain specific antigens, and there are decreasing trends in immunization.[12,13] The pentavalent vaccine, introduced into Cameroon's Expanded Program on Immunization (EPI) in 2009, offers protection against five diseases: diphtheria, tetanus, pertussis, hepatitis B, and Haemophilus influenzae type b (Hib). Three doses are administered to infants at four-week intervals: the initial dose at six weeks, the second dose at ten weeks, and the third dose at fourteen weeks.[14,15] The third pentavalent dose coverage is one of the indicators used to monitor the performance of routine vaccination.[16]

Much of the research carried out in Cameroon on vaccine coverage has focused on specific areas (health districts, regions, etc), without considering national vaccine coverage. Overall, these studies revealed that vaccine coverage was well below the national coverage for most antigens.[17–21] Those studies exploring the determinants of access to routine immunization have been limited to the district level.

The DHS is a survey conducted every five years by the National Institute of Statistics via a methodology that allows the results to be extrapolated to the national level. The national coverage of pentavalent 3 is one of the results generated by this survey, as well as a number of variables that can explain the status of children with regard to this vaccination.[22]

The present study explores the contribution of certain determinants to access to pentavalent 3 in children aged 0–23 months. This study is expected to generate evidence to guide the choice of interventions and targets to improve vaccine performance.

Methodology

Study Design

This was a cross-sectional study with a nested case–control study in which children aged 0–23 months were selected via cluster random sampling in households in the 10 regions of Cameroon. The cases were children aged 0–23 months who received the third dose of the pentavalent vaccine, and the controls were children aged 0–23 months who did not receive the third dose of the pentavalent vaccine. Exposure is defined by sociodemographic characteristics such as the living environment, parental or household head characteristics, and household economic level. This study uses data from the 2018 Cameroon Demographic and Health Survey. This survey was conducted by the National Institute of Statistics (NIS) in collaboration with the Ministry of Public Health, the United States Agency for International Development (USAID), and other national and international organizations. The DHS was implemented via two-stage cluster random sampling on

the basis of air enumeration and household samples. In the first stage, 470 enumeration areas (EAs) or clusters were drawn systematically with probability proportional to their household size, and in the second stage, a sample of 28 households per cluster was drawn systematically with equal probability. In the households, men and women aged 15–49 years and children aged 0–59 months were eligible, depending on the health indicators sought. In this study, the population consisted of children aged 0 to 23 months. This age group was selected because it is directly affected by the pentavalent vaccine.[22]

Study Site

Cameroon is a country located in Central Africa, bordered to the northeast by Chad, to the south by the Republic of the Congo, Gabon, and Equatorial Guinea, to the west by Nigeria, and to the east by the Central African Republic. It has a total surface area of 475,650 square kilometers and is divided into 10 regions, 58 departments, 14 urban communities, and 360 rural communities. According to demographic projections from the National Institute of Statistics (NIS) database, Cameroon's population is estimated to be approximately 26,153,961, with women comprising 50.6% of the total population and an estimated growth rate of 2.6%.[22]

Cameroon's healthcare system is organized according to a three-tier pyramid structure based on the Lusaka (1985) framework: central, intermediate, and peripheral levels. The central level, which includes the Ministry of Public Health, is responsible for administration as well as the development of health system policies and strategies. The intermediate level is represented by the ten regional public health delegations, which provide technical support to the peripheral level, specifically the health districts. The peripheral level consists of health districts, which are socioeconomic entities that align with the administrative boundaries of one or more communes. Within these districts, essential health services and care are provided to the population by service structures that may be either public or private, coordinated by district health services. As of 2020, there were 190 health districts, 1813 health areas, 292 district hospitals and similar facilities, 433 district medical centers, and 5382 health centers.[2,23,24] Cameroon's health system confronts several communicable diseases, including HIV/AIDS, malaria, and tuberculosis, which collectively account for approximately 23.7% of the total disease burden and 25% of deaths. In terms of maternal and child health, the infant and child mortality rates decreased from 144 per 1000 live births to 103 per 1000 live births between 2004 and 2014. However, maternal mortality rates increased from 430 to 782 maternal deaths per 100,000 live births between 2004 and 2011. Diseases with epidemic potential, such as cholera, cerebrospinal meningitis caused by meningococcus, yellow fever, and measles, have intermittently contributed to the morbidity and mortality of the population, although some of these diseases saw a decline from 2011 to 2015.[25]

The pentavalent vaccine was introduced into Cameroon's Expanded Program on Immunization (EPI) in 2009, replacing the DTC (diphtheria, tetanus, and pertussis) vaccine. This vaccine offers protection against five diseases: diphtheria, tetanus, pertussis, hepatitis B, and Haemophilus influenzae type b (Hib). Three doses are administered to infants at four-week intervals: the initial dose at six weeks, the second dose at ten weeks, and the third dose at fourteen weeks.[14,15]

Variables

The primary outcome of this study was access to the pentavalent 3 vaccination. The third dose of the pentavalent vaccine was classified as access to the pentavalent 3 vaccine. This variable was coded as 1 if the child had received the third dose of the pentavalent vaccine and 0 if they had not. Vaccination status was documented on the vaccination card or reported by the child's mother or guardian. Individuals whose information was not recorded on the immunization card or declared by the child's mother or guardian were considered as not vaccinated. We analyzed access to the third dose of the pentavalent vaccine and its determinants for children aged at least 4 months, since this dose is given at 14 weeks of age.

The main independent variables in this study included the age and sex (male or female) of the household head, living environment (rural or urban), and region (the Adamawa, North, and Far North regions were classified as "northern regions" and the Centre, Littoral, South, Southwest, Northwest, West, and East regions were categorized as "other regions"); marital status of the mother (single or married/living with a partner), the education level of the mother (no

formal education, primary, secondary, or higher), and the wealth index (grouped into two categories: low wealth [poorest, poorer] and high wealth [middle, richer, richest]) were also considered.

Data Analysis

Descriptive statistics were presented as frequencies and proportions. Bivariate analysis was conducted using simple logistic regression. Variables with a p-value of less than 0.05 were considered for inclusion in the multiple logistic regression analysis. Multivariate analysis was performed using multiple logistic regression to assess the factors associated with access to the third dose of the pentavalent vaccine. The adjusted odds ratio (AOR) and crude odds ratio (COR), along with their 95% confidence intervals (CI), were reported with a p-value of less than 0.05 in the multivariate logistic regression to indicate the statistical association between access to the third dose of the pentavalent vaccine and various determinants. Stata version 17 (Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC) software was used to analyze the data.

Results

Of the 3195 children aged 4 to 23 months included in the analysis, 2221 had received the third dose of the pentavalent vaccine. Consequently, the coverage rate for the third dose of the pentavalent vaccine was 69.5%. In terms of vaccination documentation, 1886 children out of 3195 (59.0%) possessed a vaccination card, which accounted for 84.9% of the vaccinated children. Among the 335 children (10.5%) whose proof of vaccination was based on the declaration of their mother or caregiver, all 335 were vaccinated, representing 100.0% of the vaccinated children. Figure 1 and Table 1 show pentavalent 3 vaccination coverage and proof of vaccination, respectively.

The Table 1 presents the distribution of access to the Pentavalent 3 vaccine according to the sociodemographic characteristics of the children aged 0–23 months. Among 3195 children, 1777 (55.6%) resided in rural areas. Regions outside the northern areas (Adamawa, North, and Far North) were the most represented, accounting for 60.2% of the total. In most cases, men served as the heads of households (81.3%). Cell phones were available in the households of 1862 participants (58.3%). A total of 3143 participants (98.4%) did not have health insurance coverage. Regarding the ages of the children, more than half were between 12 and 23 months old. The majority of participants identified as Christians (66.8%). Approximately 1808 children (56.6%) had

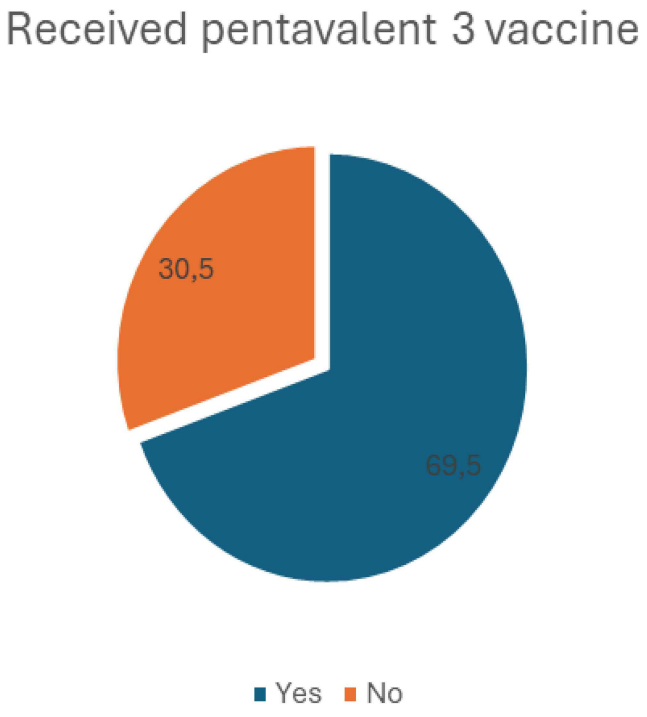

Figure 1 Pentavalent 3 vaccine coverage among children aged 0–23 months in Cameroon.

Table 1 Distribution of Access to the Pentavalent Dose 3 Vaccine by Sociodemographic Characteristics

Variables	Received Pentavalent 3 Vaccine						P value
	No		Yes		Total		
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Proof of vaccination							
Vaccination card	0	0.0	1886	84.9	1886	59.0	
Mother/guardian declaration	0	0.0	335	15.1	335	10.5	
Not reported	974	100.0	0	0.0	974	30.5	
Place of residence							<0.001
Urban	274	19,4	1144	51.5	1418	44.4	
Rural	700	39,4	1077	48.5	1777	55.6	
Sex of household head							0.061
Male	811	83.3	1787	80.5	2598	81.3	
Female	163	16.7	434	19.5	597	18.7	
Owns a mobile telephone							<0.001
No	569	58.4	764	34.4	1333	41.7	
Yes	405	41.6	1457	65.6	1862	58.3	
Covered by health insurance							<0.001
No	970	99.6	2173	97.8	3143	98.4	
Yes	4	0.4	48	2.2	52	1.6	
Sex of child							0.612
Male	507	52.1	1135	51.1	1642	51.4	
Female	467	47.9	1086	48.9	1553	48.6	
Current age of child							<0.001
12 to 23 months	525	53.9	1374	61.9	1899	59.4	
Less than 12 months	449	46.1	847	38.1	1296	40.6	
Religion							<0.001
Muslims and other	468	48.0	594	26.7	1062	33.2	
Christians	506	52.0	1627	73.3	2133	66.8	
Highest Education level							<0.001
Primary and less	753	77.3	1055	47.5	1808	56.6	
Secondary and above	221	22.7	1166	52.5	1387	43.4	
Current marital status of mother							0.007
Single	141	14.5	409	18.4	550	17.2	
Married/living with partner	833	85.5	1812	81.6	2645	82.8	

(*Continued*)

Table 1 (Continued).

Variables	Received Pentavalent 3 Vaccine						P value
	No		Yes		Total		
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Region							<0.001
Other regions	395	40.6	1527	68.8	1922	60.2	
Northern regions	579	59.4	694	31.2	1273	39.8	
Respondent's current age							0.636
Less than 30	627	64.4	1449	65.2	2076	65.0	
30 and more	347	35.6	772	34.8	1119	35.0	
Age of household head							0.059
Less than 30	175	18.0	340	15.3	515	16.1	
30 and more	799	82.0	1881	84.7	2680	83.9	
Wealth index combined							<0.001
Poor and very poor	611	62.7	825	37.1	1436	44.9	
Middle and more	363	37.3	1396	62.9	1759	55.1	

mothers who had not completed their secondary education. There were more children whose mothers were either married or in a relationship (82.8%), and the majority of these children came from middle-income households or higher (55.1%).

Table 2 presents the results on the determinants of access to pentavalent 3 vaccination among children aged 0–23 months. We note that children residing in rural areas were 35% less likely to have access to the pentavalent 3 vaccine compared to those living in urban areas (Adjusted Odds Ratio (AOR)=0.65, 95% Confidence Interval (CI) [0.46–0.91], p=0.012). The access to the P3V with Christian religion, compared with non-Christian experienced 63% of pentavalent 3 vaccine (AOR=1.63, 95% CI, [1.22–2.17], p=0.001). Compared with those living in other regions in Cameron, those living in the northern regions of Cameroon were observed 37% less likely to have access to pentavalent 3 vaccine

Table 2 Determinants of Having Access to Pentavalent Dose 3

Variables	Crude OR. 95% CI	p value	Adjusted OR. 95% CI	p value
Place of residence				
Urban	Ref		Ref	
Rural	0.37 [0.28–0.48]	<0.001	0.65 [0.46–0.91]	0.012
Religion				
Muslim and other	Ref		Ref	
Christian	2.53[1.94–3.29]	<0.001	1.63 [1.22–2.17]	0.001
Region of residence				
Other regions	Ref		Ref	
Northern regions	0.31 [0.23–0.41]	<0.001	0.63 [0.44–0.87]	0.006

(*Continued*)

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Table 2 (Continued).

Variables	Crude OR. 95% CI	p value	Adjusted OR. 95% CI	p value
Marital Status of Mother				
Never in union	Ref		Ref	
Married/live with partner	0.75 [0.57–0.98]	0.041	1.37 [1.04–1.81]	0.024
Sex of household head				
Male	Ref		Ref	
Female	1.20 [0.94–1.54]	0.139	–	–
Educational level of the mother				
No education	Ref		Ref	
Secondary and above	3.75 [2.99–4.71]	<0.001	1.92 [1.47–2.51]	<0.001
Having a telephone				
No	Ref		Ref	
Yes	2.68 [2.21–3.25]	<0.001	1.44 [1.17–1.78]	0.001
Age of household head				
Less than 30 years	Ref		Ref	
30 years and more	1.21 [0.95–1.54]	0.121	–	–
Have a health insurance				
Yes	Ref		Ref	
No	4.84 [1.81–12.90]	0.002	1.92 [0.78–4.72]	0.154
Economic status				
Poor	Ref		Ref	
Middle and above	2.84 [2.28–3.55]	<0.000	1.10 [0.83–1.45]	0.512

Abbreviations: OR, Odds ratio; Ref, Reference; 95% CI, 95% Confidence Interval.

(AOR=AOR=0.63, 95% CI [0.44–0.87], p=0.006), while mother's marital status (married) compared with unmarried mothers were 37% more likely to experience access to pentavalent 3 vaccine (AOR=1.37, 95% CI, [1.04–1.81], p=0.024). Relative to subjects with less education, those with at least secondary or higher education were 92% more likely to have access to pentavalent 3 vaccine, (AOR=1.92, 95% CI [1.47–2.51], p<0.001), while those with cell phone experienced 44% increased access to pentavalent 3 vaccine, (AOR=1.44, 95% CI [1.17–1.78], p=0.001).

Discussion

The aim of this study was to explore the contribution of certain determinants to the pentavalent 3 vaccine among children aged 0 to 23 months in Cameroon.

Pentavalent 3 coverage among children aged 0–23 months was 69.5%. The determinants of pentavalent 3 vaccine coverage in children aged 0–23 months in Cameroon were investigated. Households in the Christian faith had greater odds of having access to the pentavalent 3 vaccine (Adjusted Odds ratio (AOR) =1.63, 95% Confidence Interval (CI) [1.22–2.17]) than those of other faiths (Muslims and others) in terms of religion. Children living in the northern regions of Cameroon had lower odds of accessing the pentavalent 3 vaccine (AOR = 0.63, 95% CI [0.44–0.87]) compared to

those in other regions of Cameroon. Additionally, children residing in rural areas were less likely to have access to the pentavalent 3 vaccine than those living in urban areas (AOR = 0.65, 95% CI [0.46–0.91], p = 0.012). The marital status of the child's mother was significantly associated with access to the vaccine. Specifically, children whose mothers were married or cohabiting were more likely to have access to the pentavalent 3 vaccine (AOR = 1.37, 95% CI [1.04–1.81]) compared to those whose mothers were single. Additionally, mothers who had completed at least secondary education had higher odds of their children accessing the pentavalent 3 vaccine (AOR = 1.92, 95% CI [1.47–2.51]). Furthermore, households with mobile telephones were more likely to have improved access to the pentavalent 3 vaccine (AOR =1.44, 95% CI [1.17–1.78]) than those without mobile phones.

Vaccine coverage is one of the key indicators of the success of an immunization activity at both the local and national levels. One of the objectives of the World Health Organization's (WHO) Regional Strategic Plan for Immunization (2014–2020) for the African Region was to achieve 90% immunization coverage by 2020 for DTP and to introduce the hepatitis B vaccine.[2]

One of the key indicators for evaluating the effectiveness of a childhood immunization program is the access to the third dose of the pentavalent (pentavalent 3) vaccine. This dose serves as a measure of the completeness of a child's immunization schedule. Consequently, the Global Vaccine Action Plan established dual targets for pentavalent vaccines: 90% national coverage and 80% coverage for other administrative units.[22,23]

This study revealed a pentavalent 3 vaccine coverage rate of 69.5% among children aged 0–23 months in Cameroon. This is well below the targets set by the Global Vaccine Action Plan for 2020.[26]

Several factors contribute to children's access to vaccination. These include aspects related to the vaccine and health system, communication and information dissemination, family dynamics, parental attitudes and knowledge, as well as the living environment.[27–29]

This study identified an association between the living environment and access to the third dose of the pentavalent vaccine. Specifically, it found that children living in regions outside of the northern regions (including Adamawa, North and Far North) were significantly more likely to have access to the pentavalent 3 vaccine. Furthermore, children residing in rural areas were less likely to have access to the pentavalent 3 vaccine compared to their urban counterparts. Previous research, including studies conducted in Senegal by Abdou Salam Mbengue, has also demonstrated a correlation between access to vaccination and geographical factors.[6] In Cameroon, as in most sub-Saharan African countries, health care provision is poorly distributed between urban and rural areas. This poor distribution of healthcare provisions could partly explain these results. There is also access to information but also the presence of conflict zones that can compromise vaccine activities in certain regions of the country notably the Great North regions of Cameroon. It is important for the necessary resources to be allocated where they are most needed.

With regard to factors related to children's parents, the study revealed an association between parents' religion and vaccine coverage. The likelihood of receiving the pentavalent 3 vaccine was higher in households led by Christians compared to those of other religions. However, some studies conducted in different contexts have reported no association between religion and access to vaccination.[26,29,30]

This situation can be attributed to the fact that Christians constitute the largest demographic in Cameroon. Consequently, healthcare, particularly vaccination, is least accessible in predominantly Muslim regions such as Adamawa, North, and Far North. Efforts to enhance access to vaccination should be intensified in the northern regions, with the active involvement of religious leaders.

The findings indicate that children whose mothers were married or in a relationship were more likely to have access to the Pentavalent 3 vaccine compared to those whose mothers lived alone. Several studies have demonstrated the impact of mothers' marital status on children's access to vaccination.[20,31–33] These results underscore the critical role of couples in enhancing access to healthcare for children, as well as the challenges that single mothers encounter in addressing their children's needs. Interventions designed to improve access to childhood immunization should consider the unique circumstances of parenthood, particularly through awareness-raising campaigns aimed at single mothers.

The study revealed that households led by individuals who had at least completed secondary education were more likely to achieve good coverage of the pentavalent 3 vaccine compared to those whose heads had never attended

secondary school. Additionally, other studies conducted in different contexts have found an association between educational attainment, household economic factors, and vaccine coverage.[1,6,30,34–36]

Education plays a crucial role in shaping individuals' behaviors. Regarding vaccines, households are more likely to adopt health-promoting practices, particularly concerning immunization, if the primary caregiver or household members have received an education. This observation elucidates the associations identified in the results. Health authorities should prioritize enhancing communication efforts aimed at all segments of the population to improve access to the pentavalent 3 vaccine. Additionally, awareness-raising initiatives should be intensified within disadvantaged groups.

There was a significant association between the presence of a mobile phone in the household and access to the pentavalent 3 vaccine. Children from households with a mobile phone were more likely to have access to the pentavalent 3 vaccine compared to those without one. Other studies conducted in various settings have demonstrated the positive impact of mobile phones on enhancing access to immunization.[37–39] These findings may be attributed to the fact that households with mobile phones can swiftly access information regarding immunization activities. Additionally, they can receive messages, calls, or reminders from health workers or other households, which can enhance their access to these services. Furthermore, in certain circumstances, mobile phone ownership may correlate with socioeconomic status, which, in turn, is linked to access to health services.[40–42]

Study Limitations

This study has several limitations. First, the information on vaccine coverage did not include individuals who lacked a vaccination card or who did not report their vaccination status. Relying on coverage reported by the children's mothers may introduce memory bias. Second, the determinants considered in this study were limited to those for which data were available. Additionally, these determinants were collected concurrently with the vaccine coverage data, which could introduce bias. This potential bias was mitigated through adjustments made in the logistic regression analysis. Furthermore, the study only included living children and those whose mothers consented to participate in the survey, which may affect the generalizability of the results. However, the measures implemented in the Demographic and Health Survey were designed to address this issue.

Conclusion

Access to the third dose of the pentavalent vaccine remains below national targets, with approximately seven out of ten children aged 0 to 23 months having received this dose. The findings indicate that access to the pentavalent 3 vaccine for children is influenced by various factors related to parents, household characteristics, and the geographical environment. Key determinants include the region of residence, the mother's marital status, her level of education, the parents' religion, and the availability of a mobile phone. To improve access to the third dose of the pentavalent vaccine, it is essential for health systems to consider these factors when planning and implementing immunization activities and interventions.

Data Sharing Statement

DHS datasets, including the dataset used for this study, are available upon request to the MEASURE DHS (url: https://dhsprogram.com/data/available-datasets.cfm).

Ethics Statement

The data used in this study were obtained from the Cameroon Demographic and Health Survey (2017–2018). Household members who participated in this study gave informed consent and were informed about the objectives of the survey. The use of the dataset for this study was approved by the DHS program. The procedures and standards of the Demographic and Health Surveys (DHS) were reviewed and approved by the National Ethics Committee for Human Health Research (CNERSH) of Cameroon and the ICF Ethics Committee.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest in this work.

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