

Socioeconomic and Geographic Inequalities in Second-Year-of-Life (2YL) Vaccination Coverage among Children Aged 18-59 Months in Ghana: Evidence from the 2022 Ghana Demographic and Health Survey (GDHS)

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Abstract

Background

Despite progress in childhood immunization, inequalities in 2YL vaccination remain a barrier to achieving equitable coverage in Ghana. Evidence of socioeconomic and geographic disparities in 2YL vaccination is limited in the country. Understanding the magnitude and direction of socioeconomic and geographic inequalities is imperative for guiding equity-focused public health policy. Therefore, this study assessed inequalities in 2YL vaccination coverage among children aged 18–59 months using the 2022 GDHS.

Methods

A cross-sectional inequality analysis was conducted using data from the 2022 GDHS. The study included 1,367 children aged 18–59 months with complete vaccination information. Inequality was assessed using the absolute difference (AD), relative ratio (RR), and Erreyger Concentration Index (CI) across wealth index, maternal education levels, and place of residence (urban-rural). A concentration curve was used to illustrate the distribution across maternal education gradients. The outcomes assessed included the measles-containing vaccine second dose, MenA, and complete 2YL vaccination coverage (children who received both MenA and Measles 2).

Results

Pro-rich inequality was observed in 2YL vaccination coverage in Ghana. Comparing the richest to the poorest households, absolute differences were 0.08–0.12, relative ratios were 1.13–1.16, and concentration indices were positive (0.04–0.06), indicating higher coverage among the wealthiest households. Stronger inequalities were observed by maternal education, with children of highly educated mothers showing higher coverage (AD: 0.22–0.27, RR: 1.31–1.40, CI: 0.14), demonstrating pronounced pro-education inequality. In contrast, rural-urban differences were minimal (AD: 0.01–0.02, RR: 0.97–1.08, CI: 0.01–0.02), suggesting weak geographic inequality in 2YL vaccination coverage.

Conclusion

The 2YL vaccination coverage in Ghana is characterized by significant socioeconomic inequality driven mainly by household wealth and maternal education, whereas geographic disparities are minimal. Equity-focused immunization strategies targeting disadvantaged socioeconomic groups are needed to improve coverage and reduce inequalities.

Introduction

Childhood immunization remains one of the most cost-effective public health interventions for reducing child morbidity and mortality worldwide (Meleko, Geremew, and Birhanu 2017; Nandi and Shet 2020; Zhou et al. 2024; UNICEF 2025). Over the past decades, substantial progress has been made in expanding access to vaccines, contributing significantly to the decline in deaths from vaccine-preventable diseases (Funari et al., 2025; WHO/UNICEF, 2025). Despite these gains, global immunization coverage has stagnated in recent years, and millions of children continue to miss essential vaccines, particularly in low-and middle-income countries (WHO, 2025). Consequently, there has been an increase in outbreaks of vaccine-preventable diseases such as measles, meningitis, and yellow fever worldwide, putting children's lives at risk and increasing healthcare costs associated with treatment and outbreak response (WHO/UNICEF, 2025). Therefore, ensuring equitable access to vaccination services is critical to achieving global health targets, including the Immunization Agenda 2030 and Sustainable Development Goal 3, which aim to ensure healthy lives and promote well-being for all (WHO, 2025).

In sub-Saharan Africa, although routine immunization has made progress, significant challenges remain (Okesanya et al., 2024). Nevertheless, substantial disparities persist both across and within countries (Nguyen et al., 2025). These disparities are primarily driven by socioeconomic factors, including household wealth, parental education, and access to healthcare services (Budu et al., 2022, 2023; Abdi et al., 2025). In particular, maternal education has been consistently identified as a key determinant of child health service utilization, influencing health-seeking behavior, vaccination knowledge, and the ability to navigate healthcare systems (Meghwal and Kumar, 2025; Yeboah, Engmann, and Jakperik, 2025). Similarly, children from wealthier households tend to have access to preventive health services compared with those from poorer households, reflecting broader structural inequities (Shad and Doris, 2024).

In Ghana, the Expanded Program on Immunization (EPI) has achieved notable success, with relatively high coverage of several basic childhood vaccines (Akanpaabadai et al., 2024). Ghana launched its EPI in 1978, following the 1974 World Health Assembly initiative, initially targeting children under 12 months with six vaccines, and later expanding to include additional vaccines (Kokutse 2024). Ghana has made progress in vaccine adoption and expansion of the immunization program, resulting in a significant reduction in vaccine-preventable deaths in children (Walana et al., 2024). However, despite these achievements, gaps in immunization coverage persist, particularly among disadvantaged populations. Attention has increasingly shifted toward vaccines administered in the second year of life (2YL), such as the second dose of the measles-containing vaccine and the Meningococcal A conjugate vaccine (MenA), which are critical for sustaining immunity against measles and meningitis. In line with this, Ghana introduced a combined measles-rubella vaccine into its routine immunization program in 2013 as part of efforts to strengthen protection against measles in children (Dongdem et al., 2021). As a result, children receive two doses of the measles-rubella vaccine to ensure full protection, administered at 9 and 18 months of age. Additionally, MenA was introduced into routine immunization in 2016 to prevent meningitis in children (Fall et al., 2018).

Evidence indicates that children scheduled for 2YL vaccines are at a higher risk of missing doses or dropping out of the immunization schedule. Despite these national efforts, inequalities in vaccine coverage remain a persistent challenge, particularly concerning socioeconomic status and maternal education. These disparities not only put individual children at risk of vaccine-preventable diseases but also threaten the broader public health goals of the country. While routine immunization programmes have largely focused on children under one year, there is limited evidence on how socioeconomic and maternal education inequalities affect 2YL vaccination coverage in Ghana, particularly in the context of recent expansions in the vaccination schedule. Addressing this gap is essential for informing policies and programs aimed at reducing disparities and improving 2YL vaccination coverage among children aged 18–59 months. Understanding the extent and drivers of these inequalities is essential for designing targeted interventions that promote equitable access and improve overall health coverage.

Therefore, this study aimed to assess socioeconomic and maternal education inequalities in 2YL vaccination coverage among children aged 18–59 months in Ghana using data from the 2022 GDHS dataset. The findings will provide critical insights for policymakers and program planners to strengthen immunization strategies and ensure that all children, regardless of their background, have access to life-saving vaccines in Ghana.

Materials and Methods

Study design and data source

This study employed a cross-sectional design using secondary data from the 2022 GDHS. The GDHS used a stratified two-stage cluster sampling procedure to ensure nationally representative results for both urban and rural areas across 16 regions. In the first stage, 32 strata, 618 clusters, and 586 Primary Sampling Units (PSU) were selected from the sampling frame using probability proportional to size (PPS) for urban and rural areas in each region. The target number of clusters was then selected using equal probability. In the first phase, systematic random sampling was used for each region's urban and rural areas. In the second stage, after the selection of the clusters, a household listing and map updating operation was carried out in all the selected clusters to develop a list of all households in the cluster. This list served as a sampling frame for the selection of household samples (Ghana Statistical Service (GSS) and ICF, 2024).

Study area

This study covered the entire country of Ghana in West Africa. Ghana is located along the Gulf of Guinea and the Atlantic Ocean to the south. Ghana shares its boundaries with Burkina Faso to the north, Côte d'Ivoire to the west, and Togo to the east. Ghana is located at 8°00'N and 2°00'W, covering a total area of approximately 238,533 sq km. According to reports from the 2021PHC carried out by the GSS, Ghana's population stands at 30.8 million, with an inter-census annual growth rate of 2.1. Approximately 56.7% of

the population resides in urban settings. Administratively, Ghana has 16 regions, which are further divided into 261 districts. Ghana's major ethnic groups include Akan, Mole Dagbani, Ewe, and Ga-Dangme. Ghana is well endowed with natural resources, and its major economic activities include agriculture (particularly cocoa and other crops), mining (especially gold and oil), manufacturing, and a significant service sector.

Study sample

This study utilized data from the 2022 GDHS, a nationally representative survey conducted in Ghana. The analysis focused on children aged 18–59 months, as this age group is appropriate for assessing the completion of the 2YL vaccination. The study included children aged 18–59 months born to women aged 15–49 years who participated in the survey. Only available and complete vaccination information from vaccination cards or maternal recall was included in the analysis. Overall, 1,367 children aged 18–59 months with complete vaccination data were included in the study.

Study Variables

Outcome Variable

The main outcome variable was the second year-of-life vaccination coverage among children aged 18–59 months. This was defined based on whether a child received the recommended vaccines administered in the 2YL, specifically the measles-rubella second dose and Meningococcal A vaccine. Complete 2YL vaccination was defined as a child who received both the second dose of measles and MenA.

Inequality Variables

Socioeconomic status was measured using the wealth index provided in the 2022 GDHS and categorized into: (poorest, poorer, middle, richer, and richest). Maternal educational attainment was categorized (no formal education, primary, secondary, and higher). Place of residence was categorized (urban or rural).

Other Demographic Variables

Selected demographic characteristics, such as maternal age, marital status, maternal religious affiliation, employment, region of residence, child's age, and sex, were included to describe the study population and vaccination coverage.

Data analysis

The study variables extracted from the 2022 GDHS dataset underwent data cleaning and recording to ensure accuracy, completeness, and consistency of the analysis. The results were summarized and presented using descriptive statistics, including frequencies and percentages. The study accounted for the complex survey design of the data by applying sampling weights, clustering, and stratification using the 'svyset' function in Stata/SE version 16.0. All statistical analyses were performed using Stata and Microsoft Excel 2020. This study assessed socioeconomic, educational, and residential inequalities in 2YL vaccination coverage. Absolute and relative inequalities were employed. Absolute inequality was measured using the difference (D), defined as the difference in coverage between the most advantaged and most disadvantaged groups. Relative inequality was assessed using the ratio, calculated as the ratio of coverage between these groups. In addition, the concentration index (CI) was used to quantify socioeconomic-related inequality in 2YL vaccination coverage. The CI ranges from -1 to +1, where 0 indicates no inequality, positive values indicate pro-rich inequality, and negative values indicate pro-poor inequality. A concentration curve was plotted to visually assess the distribution of 2YL vaccination coverage across the wealth quintiles. A curve below the line of equality indicates pro-rich inequality, whereas a curve above the line indicates pro-poor inequality. All statistical tests were conducted at a 5% significance level.

Results

Socio-Demographic characteristics of respondents

A total of 1,367 mothers with children aged 18–59 months were included in the study. The distribution of respondents by age, wealth index, educational attainment, and place of residence is shown in Table 1. The largest share of respondents was aged 30–34 years (25.7%), with the smallest share among women aged 45–49 years (2.2%). Regarding household wealth status, 32.7% of respondents were from the poorest households, representing the largest proportion of respondents. Most respondents (45.4%) completed secondary education, making it the most common education level. Regarding residence, approximately 60% of respondents lived in rural areas. Most mothers were married, and over 60% identified as Christians. Over 80% of the mothers were employed. Slightly more than half of the children were male, and the majority were aged 25–59 months.

Table 1
Socio-Demographic characteristics of respondents

Variable	Frequency (N = 1,367)	Percentage (%)
Age Group		
15–19	35	2.6
20–24	235	17.2
25–29	347	25.4
30–34	351	25.7
35–39	241	17.6
40–44	128	9.4
45–49	30	2.2
Wealth Index		
poorest	447	32.7
poorer	325	23.8
middle	243	17.8
richer	201	14.7
richest	151	11.1
Maternal Educational Attainment		
No education	443	32.4
Primary	208	15.2
Secondary	620	45.4
Higher	96	7
Residential area		
urban	550	40.2
rural	817	59.8
Marital Status of Mothers		
Never married	96	7.0
Married	992	72.6
Cohabitation	225	16.5

Variable	Frequency (N = 1,367)	Percentage (%)
Age Group		
No longer with a spouse	54	4.0
Mother's Religion		
Traditionalist	74	5.4
Muslim	439	32.1
Christian	854	62.5
Mother's Employment Status		
No	251	18.4
Yes	1116	81.6
Sex of Child		
Male	695	50.8
Female	672	49.2
Child Age in Months		
18–24	608	44.5
25–59	759	55.5

Vaccination coverage and socioeconomic inequalities

Figures 1 and 2 present the national picture and regional distribution of coverage for MenA, Measles2, and complete second year-of-life vaccination (SYLV) in Ghana. The findings indicate relatively moderate vaccination coverage for second year-of-life vaccines, below the national 85% threshold recommended for herd immunity against measles and meningitis. Vaccination coverage varied considerably across the regions. For MenA vaccination, coverage ranged from 42.3% in the Northern region, which recorded the lowest coverage, to 83.9% in the Upper West region, which had the highest coverage. A similar pattern was observed for measles2 vaccination and those who received both MenA and measles2 vaccines in the country. Table 2 presents inequalities in MenA, measles2, and complete second year of life vaccination by wealth index, maternal education, and place of residence using absolute difference (AD), relative ratio (RR), and concentrated index (CI). The results indicate pro-rich inequality in vaccination coverage across wealth groups. For MenA vaccination, the absolute difference was 0.12(95% CI: 0.02–0.22) and the relative ratio was 1.16 (95% CI: 1.03–1.32), indicating that children from the richest households were 16% more likely to receive the MenA vaccine than those from the poorest households. The concentration index (CI = 0.06) was positive and statistically significant, confirming that MenA vaccination coverage was concentrated among the richest households. Similarly, the absolute difference and related ratio indicated that there were gaps in the vaccination coverage for measles2 and the

complete second year of life. For instance, children from the richest households were 16% more likely to receive both MenA and measles vaccines than those from the poorest households. The positive concentration index of 0.06 further confirmed the pro-rich inequality in complete vaccination coverage. Overall, the three measures consistently show that vaccination coverage is higher among children from the richest households. Furthermore, maternal education demonstrated the strongest and most consistent association with vaccination coverage, with children of highly educated mothers being substantially more likely to receive all vaccines than those whose mothers had no formal education.

Figure 3 presents the concentration curve for complete second year-of-life vaccination by maternal educational attainment. The concentration curve lies below the line of equality, indicating that vaccination coverage is disproportionately concentrated among children from highly educated households. This suggests the presence of pro-education inequality in the vaccination coverage. The graphical result is consistent with the positive concentration index obtained in the analysis, confirming that children from highly educated households were more likely to receive the second year-of-life vaccination compared to those from non-educated households.

Table 2
Socioeconomic Inequality in Second Year of Life Vaccination

Variable	Absolute Difference	Relative Ratio	Concentration Index (CI)
Wealth Index (Richest vs Poorest)			
MenA	0.12(0.02–0.22) *	1.16(1.03–1.32) *	0.06 *
Measles 2	0.08(-0.02–0.18)	1.13(1.00–1.27) *	0.04
Complete 2YLV	0.12(0.01–0.22) *	1.16(1.03–1.33) *	0.06
Maternal Educational Level (Higher education vs No education)			
MenA	0.27(0.17–0.37) *	1.40(1.24–1.59) *	0.14 *
Measles 2	0.22(0.11–0.33) *	1.31(1.15–1.49) *	0.14 *
Complete 2YLV	0.25(0.14–0.36) *	1.38(1.19–1.59) *	0.14 *
Residence (Rural vs Urban)			
MenA	0.01(-0.06–0.07)	1.06(0.97–1.15)	0.01
Measles 2	0.02(-0.04–0.09)	1.05(0.97–1.14)	0.02
Complete 2YLV	0.02(-0.05–0.08)	1.08(0.99–1.18)	0.02

Discussion

This study assessed socioeconomic inequalities in second year-of-life vaccination in Ghana using multiple inequality measures, including absolute differences, relative ratios, and concentration indices.

The study revealed moderate vaccination coverage for MenA and Measles2 vaccines, with coverage levels below the WHO-recommended threshold of 90–95% required for optimal population immunity. The proportions observed in this study were 64% for MenA, 67% for measles 2, and 61% for those who received both MenA and Measles 2 vaccines. This suggests that a substantial proportion of children remain vulnerable to vaccine-preventable diseases, particularly measles and meningitis, which continue to pose a public health risk in Ghana. One possible explanation could be that many caregivers perceive vaccination as primarily an activity for infants, leading to reduced health facility visits after the first year. In addition, health systems in many settings place a stronger emphasis on vaccines administered within the first year, which may contribute to lower awareness and uptake of vaccines scheduled later in childhood.

The study found evidence of wealth-related inequalities in vaccination coverage. The positive concentration indices for MenA, measles 2, and complete second year of life vaccination suggest that the vaccination proportion is disproportionately concentrated among children from the wealthiest households. Similarly, the relative ratios indicate that children from the richest households were approximately 13%–16% more likely to receive these vaccines than those from the poorest households. Wealthiest households may have better access to transportation, greater health literacy, and an improved ability to cover indirect costs associated with seeking healthcare services, such as transportation and opportunity costs. These findings are consistent with the existing literature, which shows that socioeconomic status remains an important determinant of child health service utilization (Acharya et al., 2022; Budu et al., 2022, 2023; Singh and Khatri, 2024; Lam et al., 2025; Mendez-Lopez et al., 2025). However, some studies have reported pro-poor inequality in childhood vaccination coverage, where children from the poorest households exhibit higher vaccination uptake than those from wealthier households (Cata-Preta et al., 2021). Despite Ghana's national immunization program providing vaccines free of charge, financial and structural barriers may still affect vaccine uptake among poorer households. For example, indirect costs, such as transportation to health facilities, long waiting times, and competing livelihood demands, may discourage caregivers from completing vaccination schedules. In addition, the poorest households may have limited exposure to health information, which may reduce awareness of the importance of completing the second year of life vaccinations. These findings align with those of previous studies (Abbas, Sajid and Dao, 2024; Li, 2025; Richman et al., 2025).

More importantly, maternal education emerged as the strongest determinant of inequality in all the vaccination indicators. Children born to mothers with higher education levels were significantly more likely to receive MenA and Measles 2 vaccines. This finding aligns with the existing literature, suggesting that educated mothers are more likely to have better health literacy, improved awareness of immunization schedules, and greater autonomy in making healthcare decisions (Hatijar, Rahmadani and Akib, 2025; Meghwal and Kumar, 2025; Poku et al., 2025; Yeboah, Engmann and Jakperik, 2025). The relatively high concentration index values for education further highlight the magnitude of this inequality, suggesting that interventions targeting maternal knowledge and awareness may improve vaccination uptake in the future.

The study found no significant rural-urban differences in vaccination coverage. This suggests that Ghana's immunization programs may have achieved relatively equitable geographic access to vaccination services, possibly due to the expansion of community-based health planning and services (CHPS) and outreach immunization strategies (UNICEF, 2022; Harvey et al., 2025). However, while geographic access appears equitable, the persistence of socioeconomic and educational inequalities indicates that access alone is insufficient and that demand-side barriers remain critical.

Policy implication

The findings of this study have important policy implications for Ghana's Expanded Program on Immunization (EPI). Addressing socioeconomic and maternal educational barriers to vaccination is critical for achieving equitable vaccination coverage and meeting national and global immunization targets. Ensuring that vaccination programs reach children from disadvantaged households is essential for reducing preventable childhood diseases and improving child survival outcomes.

Strengths and limitations of the study

This study had several strengths and limitations. It utilized data from the 2022 GDHS, which is nationally representative and based on a rigorous multistage stratified sampling design, enhancing the reliability and generalizability of the findings for assessing inequalities in 2YL vaccination coverage. The large sample size further improved the precision of the inequality estimates. However, the cross-sectional design limits the ability to establish causal relationships between socioeconomic factors and vaccination outcomes, and reliance on self-reported data may introduce recall bias.

Conclusion

Ghana appears to have made progress in reducing disparities in geographical access to vaccination services; however, maternal education and wealth-related inequalities remain a concern for Ghana's second year-of-life vaccination coverage. Future interventions should focus on reducing maternal education and wealth-related inequalities to ensure that all children, regardless of socioeconomic status, have equal access to life-saving vaccines.

Declarations

Competing Interest:

None declared

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination of this study.

Ethical considerations

The 2022 GDHS protocol was reviewed and approved by the Institutional Review Board of the ICF and the Ghana Health Service Ethical Committee. Access to the 2022 GDHS dataset for analysis was requested through the Demographic and Health Survey (DHS) program, and permission was granted to download the data for analysis.

Consent for publication:

Not required.

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Author Contribution

Author's Contribution: SN conceived and designed the study and was responsible for cleaning and validating data. SN and DN performed data analysis and interpretation. SN, AS, and JB have drafted the manuscript. JN, AS, CBD, and BB critically reviewed the manuscript. JN, CBD, AS, and BB supervised and proofread the manuscript. All authors have read through subsequent versions of the manuscript and approved the final version.

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Data Availability

The data can be accessed online upon request via <https://dhsprogram.com>.

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Figures

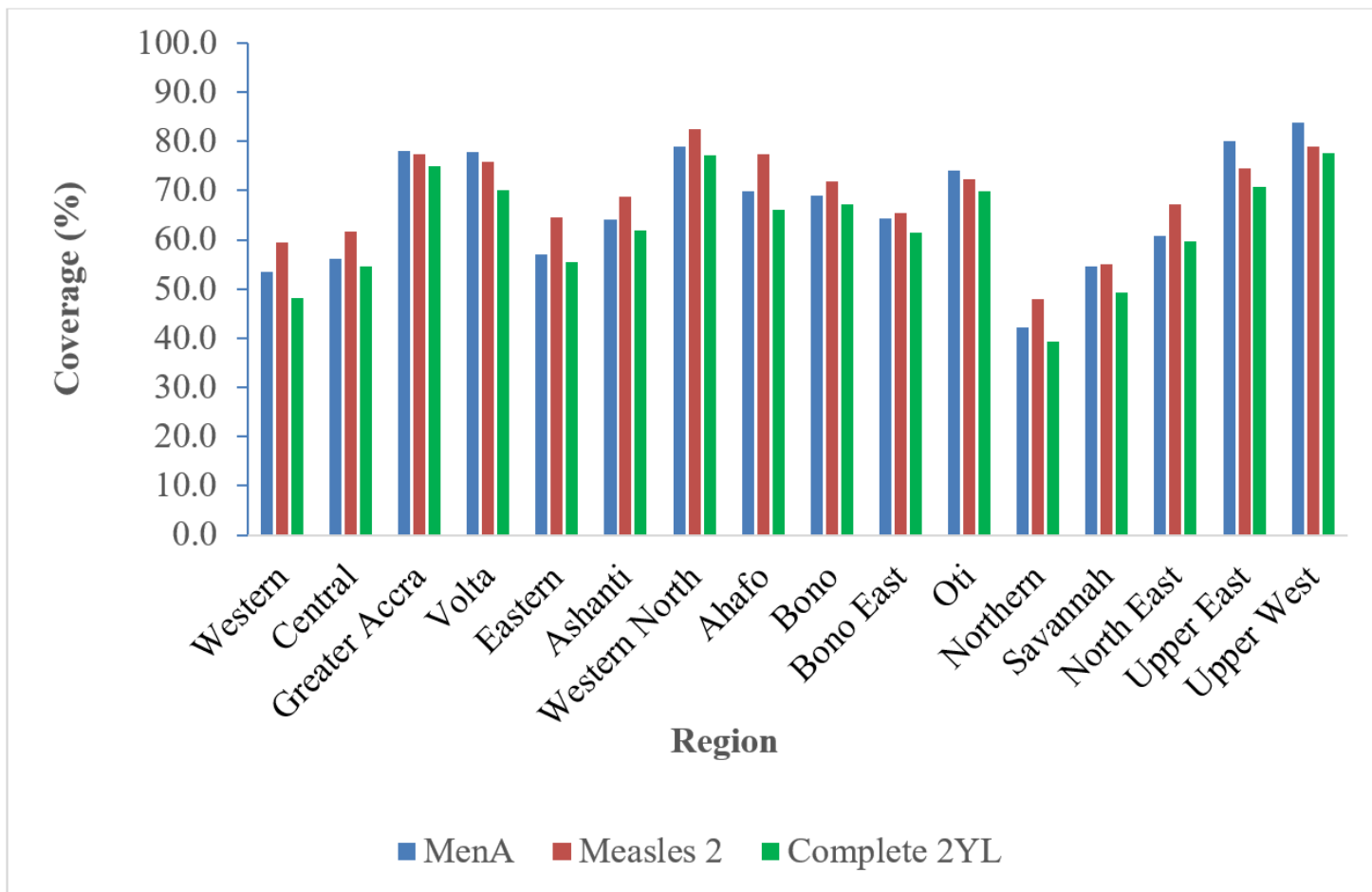


Figure 1

Regional Distribution of Second Year of Life Vaccination among Children in Ghana

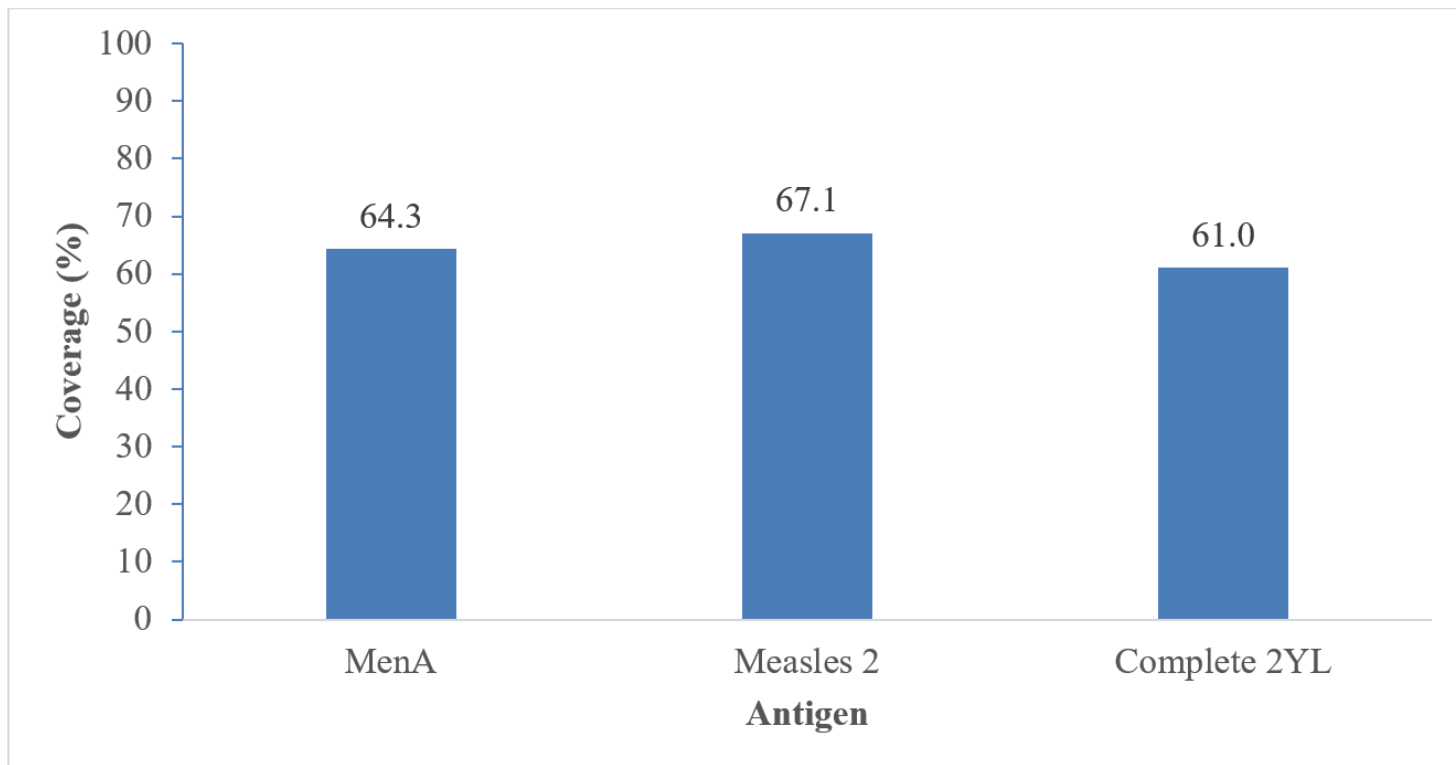


Figure 2

Second Year of Life Vaccination among Children 18-59 Years in Ghana

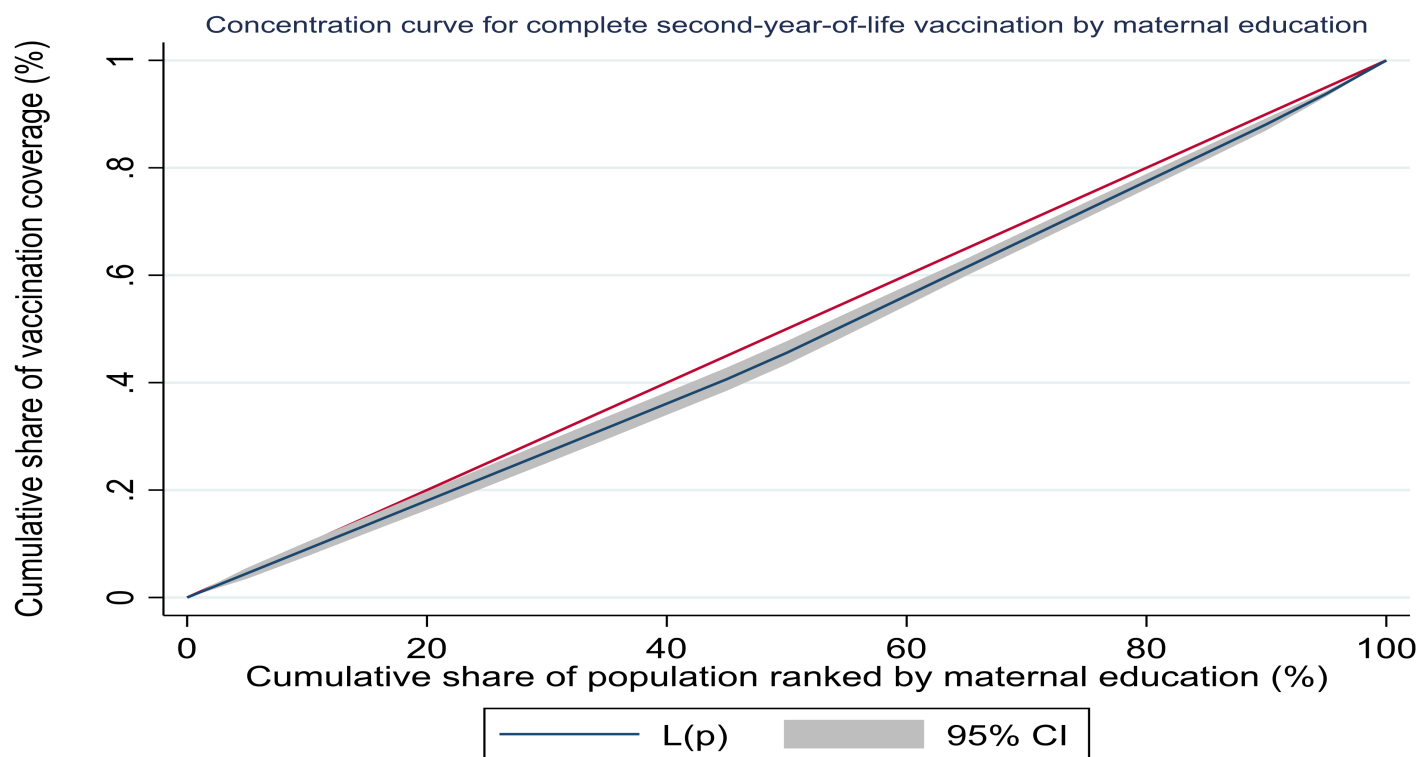


Figure 3

Concentration curve for the complete second year of life vaccination