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Research Article

Analysis of Trends in Immunization Coverage Inequalities Among Children Aged 12–23 Months in Guinea: Data from Demographic and Health Surveys in 2005, 2012, and 2018

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Abstract

Background: The aim of this study was to describe trends in inequalities in full immunization of children aged 12 to 23 months and to identify associated socioeconomic factors. Methods: A secondary analysis was carried out using data from three Demographic and Health Surveys (DHS) conducted in 2005, 2012 and 2018 in the Republic of Guinea. The concentration, or Lorenz curve, and associated index were used to measure inequalities over time. Multivariate logistic regression was employed to identify socioeconomic factors associated with full vaccination of children aged 12 to 23 months. Results: The study found a strongly positive overall concentration index (CI > 0.5) for complete vaccination of children aged 12 to 23 months, indicating inequalities in favor of wealthier households. This inequality decreased in 2012 but increased again in 2018. Children from wealthy families were nearly twice as likely to be fully vaccinated compared to children from very poor families (adjusted OR 1.79, 95% CI: 1.38 - 2.32). Conclusion: This study revealed significant inequalities favoring wealthy families in the use of immunization services by children aged 12 to 23 months in Guinea. It also underscores the need for planning and

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implementing strategies to reduce these inequalities in access to and use of immunization services.

Keywords

Full Immunization, Inequality, Trend, Children 12-23 Months, Guinea

1. Introduction

Vaccination is a safe and effective way to protect against diseases by training your immune system to produce antibodies. It strengthens the body's defenses by using inactive or weakened forms of viruses or bacteria, enabling your immune system to respond without causing illness or exposing you to the disease's risks, ensuring protection before exposure [1]. Each year, vaccination prevents 3.5 to 5 million deaths from diseases such as polio, tetanus, whooping cough, influenza, measles, yellow fever, and more [1].

Thus, in 2012, the World Health Organization (WHO) recommended that all countries achieve 90% vaccination coverage at the national level and 80% in every health district for all vaccines in the national immunization program by the end of 2020, so that everyone could benefit from the advantages of vaccination [2].

Unfortunately, most African countries are far from reaching these goals [2]. In the West African sub-region, the percentages of children aged 12 to 23 months who are fully vaccinated vary from one country to another. For instance, this percentage was 35.5% in 2021 in Côte d'Ivoire [3], 44.6% in Mali in 2018 [4], 51.0% in Liberia in 2021 [5], 64.0% in 2023 in Senegal [6], 75.0% in 2022 in Ghana [7] and 79.3% in 2021 in Burkina Faso [8]. In Guinea, the Demographic and Health Surveys (DHS) report that the proportion of children aged 12 to 23 months who were fully vaccinated was 24% in 2018, compared to 37% in 2012 [9, 10].

In most low- and middle-income countries, there are inequalities favoring wealthy and urban populations regarding the full vaccination of children aged 12 to 23 months. These inequalities are not visible when only considering national averages [11]. A study based on data from the Demographic and Health Surveys (DHS) of Ghana, Kenya, and Ivory Coast concludes that inequality in vaccination coverage in these three countries persists over time and favors wealthier households [12]. However, the 2011-2020 Global Action Plan of the World Health Organization placed particular emphasis on equitable access to vaccination, a key component of the right to health [2].

In Guinea, some previous studies, notably those by Alfred Douba et al. [13] and Diallo M.D. [14], analyzed the sociodemographic factors associated with full vaccination of children aged 12 to 23 months, respectively in six West African countries and in Guinea. However, in these studies, the concentration curve and the associated index (Gini index) were not used.

The Lorenz curve, developed by Max Otto Lorenz in 1905 to describe income inequalities, is now used in public health to assess the level of inequalities in the provision of health services based on population income [15].

To our knowledge, there are few studies that have examined trends in vaccination coverage inequalities using socioeconomic analyses (concentration curves and indices). This is what motivated the undertaking of this study, whose main objective is to evaluate the trends and variations in inequalities in full vaccination of children aged 12 to 23 months in Guinea, from 2005 to 2018. More specifically, this study describes the trends in inequalities in full vaccination of children and identifies, on one hand, the socioeconomic factors associated with these inequalities and, on the other hand, the factors influencing full vaccination.

The results of this study could help authorities identify disadvantaged groups in terms of access to vaccination services and the causes of these disparities, in order to develop policies aimed at improving equity in the provision of vaccination services and achieving universal health coverage, in line with the Sustainable Development Goals in Guinea.

2. Methods

2.1. Study Setting

The Republic of Guinea is a coastal country located in West Africa, halfway between the equator and the Tropic of Cancer. It stretches between 7 °and 12 °north latitude and 8 °and 15 °west longitude. It shares its borders to the east with Côte d'Ivoire and Mali, to the west with Guinea-Bissau and the Atlantic Ocean, to the north with Senegal and Mali, and to the south with Liberia and Sierra Leone. Its total area is 245,857 square kilometers, with an estimated population of 12,907,395 inhabitants, resulting in an average density of 52.49 inhabitants per square kilometer. The country is divided into eight administrative regions and 33 prefectures [10, 16].

Guinea is characterized by a high birth rate and strong fertility, with frequent pregnancies occurring both early and late in life, as well as a significant proportion of women of childbearing age. The crude birth rate is estimated at 36.1 per 1,000 inhabitants, and the total fertility rate is 4.5 children per woman [17]. The Guinean healthcare system is largely structured according to the

country's administrative divisions [16].

2.2. Data Sources

This study utilized data from the Guinea Demographic and Health Surveys (DHS) conducted in 2005, 2012, and 2018, allowing for the use of comparable and representative samples of children aged 12 to 23 months.

The DHS data were obtained through a two-stage stratified random sampling method. Clusters or enumeration zones (EZ) were selected from the complete list of census areas based on the most recent General Population and Housing Census for the first stage. If necessary, updates were made to the list of census districts. For the second stage, a systematic random sampling method was employed within each previously selected cluster, where households were chosen based on equal probability, considering the type of residence (urban or rural [10].

Before submission to the National Ethics Committee for approval, the survey protocol and questionnaires were pre-tested and validated by the survey steering committee. They received endorsement from the Ethics Committee (International Review Board) of ICF. Investigators were recruited and trained for data collection, using questionnaires for households, men, women, and biomarkers. To gather information regarding child vaccination, the individual women's questionnaire was utilized, which included relevant sociodemographic characteristics of the respondents [10].

2.3. Study Variables

Dependent variable

The dependent variable in this study was the complete vaccination coverage of children aged 12 to 23 months. Two sources were used to collect information on this vaccination coverage: vaccination cards and verbal responses from mothers. According to national guidelines, a child is considered fully vaccinated if they have received: one dose of BCG, three doses of pentavalent vaccine, three doses of oral poliovirus vaccine (OPV), and one dose of measles vaccine. This principle was applied to recode the variable "fully vaccinated child" in this study. Questions regarding specific vaccines were recoded as follows: "Yes" = 1 and "No" = 0. Complete vaccination coverage was determined by creating a composite variable that included all administered vaccines. For this composite variable, responses (yes and no) were recoded as follows: "complete" = 1 and "incomplete" = 0, thus resulting in a binary variable.

Independent Variables

The independent variables in this study included age, wealth index, place of residence, marital status of the mother, ethnicity, region, level of education, respondent's occupation, and access to media, including radio, television, and magazines, as well as maternal parity.

The age of respondents was classified into three age groups: 15-24 years, 25-34 years, and 35 years and older. The wealth index was categorized into three classes: very poor, poor, and rich. The place of residence was recoded as rural and urban. The marital status of the respondent was divided into two categories: single and married. The ethnic variable was defined as follows: Soussou, Peulh, Malinké, Kissi, Guerzé, and others. Parity, defined by the number of children born, was recoded as: no births, one birth, two births, three births, four births, and more. Regions were established according to the administrative divisions, totaling eight regions: Bokè, Kindia, Conakry, Faranah, Kankan, Labé, Mamou, and N'Nzérékoré. The level of education was classified into four categories: no education, primary, secondary, and higher education. The respondent's occupation was categorized into two classes: unemployed and employed. Access to media was assessed based on the frequency of reading newspapers, listening to the radio, and watching television.

2.4. Statistical Analysis

Descriptive data analysis

For the descriptive analysis, percentages were used to summarize the study covariates. The Chi-square test was employed to compare proportions among the various rounds of the Demographic and Health Surveys in Guinea (2005, 2012, and 2018).

Trends in inequalities in full vaccination of children aged 12 to 23 months.

To assess inequalities in the complete vaccination of children aged 12 to 23 months over a given period, the concentration curve and the Gini index were used. This curve represents the cumulative proportion of fully vaccinated children on the vertical axis, according to the percentage of children ranked by their household wealth on the horizontal axis, ranging from the poorest households to the wealthiest. The line of equality crosses the figure diagonally when all children, regardless of their parents' economic status, have the same access to full vaccination, meaning that the values on the x-axis are equal to those on the y-axis.

When the curve lies below the line of equality, it indicates that full vaccination is more common among wealthier households. Conversely, if the curve is above the line of equality, it reveals inequality favoring poorer households.

Concentration indices, such as the Gini coefficient, have been used to assess the extent and evolution of inequalities. The Gini coefficient ranges from -1 to +1: negative values indicate that full vaccination among children aged 12 to 23 months is concentrated in poorer households, while positive values reflect a concentration among wealthier households. A value of 0 indicates the absence of inequality related to household wealth.

Following this initial analysis measuring absolute inequality in full vaccination, additional analyses were conducted to compare the estimates of inequality indices and test the null hypothesis. The null hypothesis (H0) states that the index is

identical within a socio-economic group. Using the homogeneity test, a comparison of concentration indices within socio-economic groups (age, place of residence, marital status, education level, occupation, media access, ethnicity, administrative regions) was carried out.

Socioeconomic factors associated with inequalities in full vaccination of children aged 12 to 23 months

To identify the socioeconomic factors associated with the full vaccination of children aged 12 to 23 months, a multivariable logistic regression was used to calculate the Adjusted Odds Ratio. Model selection was performed using a stepwise approach, controlling for and checking the presence of confounding factors at each stage. The Akaike Information Criterion (AIC) was used to compare regression models. Results with a p-value ≤ 0.05 were considered statistically significant. The data analysis was conducted using R Studio software.

3. Results

The data from the 2005 Demographic and Health Survey (DHS) reveal that 213 children (39.6%) out of 573 aged 12 to 23 months had received all required vaccine doses. The proportion of fully vaccinated children was significantly higher in urban areas than in rural areas ($p < 0.01$). Mothers with higher education levels were more likely to have fully vaccinated children ($p < 0.01$), and this complete vaccination coverage was also more common in wealthier households ($p < 0.01$). Additionally, children of mothers with access to media were more likely to be fully vaccinated, especially those who listened to the radio and read magazines. The difference between mothers with media access and those without was statistically significant ($p < 0.05$). Finally, the minority ethnic group Guerzé had the highest proportion of fully vaccinated children ($p < 0.05$).

In 2012, the DHS reported that 475 children (36.4%) out of 1,302 were fully vaccinated. Again, the proportion was higher in urban areas than in rural areas, a statistically significant difference ($p < 0.05$). Mothers with higher education levels also had more fully vaccinated children ($p < 0.05$). The wealthiest households were the most represented among those with fully vaccinated children ($p < 0.05$). Access to media also played an important role, with mothers exposed to media having a higher proportion of vaccinated children, showing a statistically significant difference compared to those without access ($p < 0.05$). It is also noteworthy that single mothers had a higher proportion of fully vaccinated children ($p < 0.05$).

In 2018, the vaccination coverage for children aged 12 to 23 months was 24% (176 out of 740). This proportion remained higher in urban areas compared to rural areas, with a statistically significant difference ($p < 0.05$). Among mothers with higher education levels, the complete vaccination coverage was higher ($p < 0.05$), and children from wealthy households were once again overrepresented among fully vaccinated children ($p < 0.05$). Access to media was also associated with greater vaccination coverage, and this difference was statistically significant ($p < 0.05$). Finally, single mothers made up the majority of respondents with fully vaccinated children ($p < 0.05$).

Table 1. *Characteristics of respondents and fully vaccinated children, DHS 2005, 2012 and 2018.*

Characteristics	DHS 2005			DHS 2012			DHS 2018		
	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*
Age (year)									
15-25	70(41.2)	100(58.8)		183(41.3)	260(58.7)		52(24.1)	164(75.9)	
26-36	18(40.9)	26(59.1)	0.08	38(33.9)	74(66.1)	0.008	7(10.9)	57(89.1)	0.27
37-49	125(34.8)	234(65.2)		254(34.0)	493(66.0)		117(25.4)	344(74.6)	
Place of residence									
Urban	53(46.5)	61(53.5)	0.015	169(45.3)	204(54.7)	0.00	57(27.1)	153(72.9)	0.01
Rural	160(34.9)	299(65.1)		306(32.9)	623(67.1)		119(22.4)	412(77.6)	
Marital status									
Married	193(36.7)	333(63.3)	0.25	435(35.8)	779(64.2)	0.04	157(23.0)	526(77.0)	0.06
Not married	20(42.6)	27(57.4)		40(45.5)	48(54.5)		19(32.8)	39(67.2)	
Level of study									
Not attended school	176(35.0)	327(65.0)	0.01	326(32.4)	679(67.6)	0.00	121(22.1)	426(77.9)	0.01
Primary	20(58.8)	14(41.2)		59(47.2)	66(52.8)		14(23.0)	47(77.0)	

Characteristics	DHS 2005			DHS 2012			DHS 2018		
	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*
Secondary	14(43.7)	18(56.2)		70(51.1)	67(48.9)		25(24.8)	76(75.2)	
Univerisity	3(75.0)	1(25)		20(57.1)	15(42.9)		16(50.0)	16(50.0)	
Mother's parity									
1	40(41.2)	57(58.8)		114(42.5)	154(57.5)		31(24.6)	95(75.4)	
2	36(37.9)	59(62.1)	0.14	91(39.1)	142(60.9)	0.00	41(27.9)	106(72.1)	0.10
3	31(39.2)	48(60.8)		71(39.2)	110(60.8)		35(25.0)	105(75.0)	
4 and more	106(35.1)	196(64.9)		199(32.1)	421(67.9)		69(21.0)	259(79.0)	
Wealth Index									
Very poor	41(28.3)	104(71.7)		76(25.9)	218(74.1)		35(19.9)	141(80.1)	
Poor	86(34.3)	165(65.7)	0.000	196(35.4)	357(64.6)	0.00	69(22.3)	240(77.7)	0.02
Rich	86(48.6)	91(51.4)		203(44.6)	252(55.4)		72(28.1)	184(71.9)	
Occupation									
Not employed	198(36.9)	338(63.1)	0.39	418(35.9)	746(64.1)	0.12	133(23.2)	440(76.8)	0.29
Employee	15(40.5)	22(59.5)		57(41.3)	81(58.7)		43(25.6)	125(74.4)	
Newspapers									
No access	201(36.4)	351(63.6)	0.04	431(35.0)	802(65.0)	0.00	161(22.9)	543(77.1)	0.01
Access	12(57.1)	9(42.9)		44(63.8)	25(36.2)		15(40.5)	22(59.5)	
Radio									
No access	201(36.4)	351(63.6)	0.04	165(32.5)	343(67.5)	0.01	50(17.5)	236(82.5	0.00
Access	12(57.1)	9(42.9)		310(39.0)	484(61.0)		126(27.7)	329(72.3)	
Television									
No access	168(35.7)	303(64.3)	0.07	277(33.3)	554(66.7)	0.00	88(19.9)	354(80.1)	0.00
Access	45(44.1)	57(55.9)		198(42.0)	273(58.0)		88(29.4)	211(70.6)	
Ethnicity									
Sousou	39(41.5)	55(58.5)		92(47.7)	101(52.3)		34(26.2)	96(73.8)	
Fulani	66(28.6)	165(71.4)		125(24.1)	393(75.9)		52(17.0)	254(83.0)	
Malinke	71(41.5)	100(58.5)		179(41.7)	250(58.3)		55(24.6)	169(75.4)	
Kissi	15(46.9)	17(53.1)	0.01	40(55.6)	32(44.4)	0.42	11(28.9)	27(71.1)	0.44
Toma	8(50.0)	8(50.0)		3(37.5)	5(62.5)		2(33.3)	4(66.7)	
Guerze	14(53.8)	12(46.2)		24(49.0)	25(51.0)		22(64.7)	12(35.3)	
Others				12(36.4)	21(63.6)		0(0,0)	3(100)	
Regions									
Bok é	21(28.8)	52(71.2)		57(41.3)	81(58.7)		28(23.9)	89(76.1)	
Conakry	15(45.5)	18(54.5)		66(46.5)	76(53.5)		23(33.3)	46(66.7)	
Faranah	34(39.1)	53(60.9)	0.20	64(32.7)	132(67.3)	0.00	27(29.0)	66(71.0)	0.48
Kankan	41(42.7)	55(57.3)		89(44.3)	112(55.7)		20(17.2)	96(82.8)	
Kindia	26(27.8)	54(67.5)		60(36.1)	106(63.9)		16(18.6)	70(81.4)	

Characteristics	DHS 2005			DHS 2012			DHS 2018		
	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*	Yes (%)	No (%)	p -value*
Labe	15(27.8)	39(72.2)		40(27.0)	108(73.0)		17(16.2)	88(83.8)	
Mamou	19(31.1)	42(68.9)		34(21.9)	121(78.1)		12(16.9)	59(83.1)	
Nzerekore	42(47.2)	47(52.8)		65(41.7)	91(58.3)		33(23.8)	51(76.2)	

Figure 1 shows that the inequalities regarding fully vaccinated children favored the wealthiest households. This inequality decreased in 2012 but increased again in 2018. The table indicates that the concentration index is significantly positive (CI > 0.5) for the complete vaccination of children, illustrating the inequalities in favor of affluent households during these periods

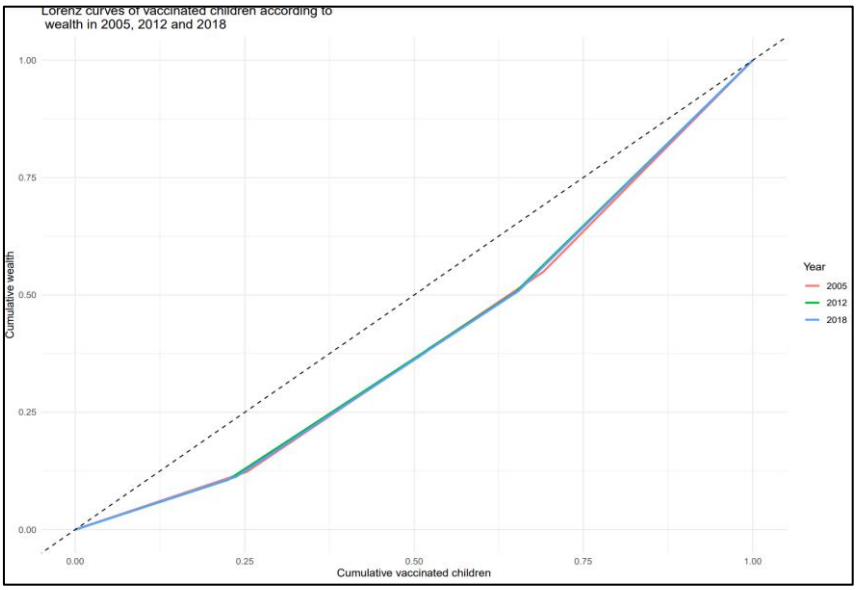

Figure 1. *Curve of full vaccination coverage for children aged 12 to 23 based on household income from the 2005, 2012, and 2018 DHS.*

Table 2. *Concentration indices of full vaccination coverage for children aged 12 to 23.*

Variable	Concentration index		
	DHS 2005	DHS 2012	DHS 2018
Fully vaccinated children	0,91*	0,82**	0,94*

**p<0.01 *p<0.05

The concentration indices related to socioeconomic characteristics show that inequalities in full immunization coverage among children favored the wealthiest households between 2005 and 2018, with a slight reduction observed in 2012. This trend is statistically significant for most of the covariates studied. Inequalities were particularly pronounced in rural areas, among single parents, households without access to radio, and in the regions of Kankan, Bok é, and Lab é In the majority of cases, the concentration indices for the selected covariates did not show a significant reduction between 2005 and 2018. However, a slight decrease was noted in 2012 for the following characteristics: married mother, urban area, and non-educated mothers (Table 3).

Table 3. *Concentration indices from the three Demographic and Health Survey series based on respondents' characteristics.*

Characteristics	Concentration indices		
	DHS 2005	DHS 2012	DHS 2018
Age (year)			
15-25	0.97*	0.93*	0.98*
26-36	0.99*	0.98*	0.99*
37-49	0.94*	0.90*	0.96**
Place of residence			
Urban	0.93*	0.88*	0.96*
Rural	0.97**	0.93*	0.98*
Marital status			
Married	0.92**	0.83*	0.95*
Not married	0.99*	0.98*	0.99*
Level of study			
Not attended school	0.92*	0.87*	0.96*
Primary	0.99*	0.97*	0.99*
Secondary	0.99*	0.97*	0.99*
Univerisity	0.99*	0.99*	0.99*
Newspapers			
No access	0.99	0.98*	0.95
Access	0.92*	0.84*	0.99*
Radio			
No access	0.99*	0.93*	0.99*
Access	0.92**	0.88**	0.96*
Television			
No access	0.93	0.89	0.98*
Access	0.98*	0.92	0.97*
Regions			
Bok é	0.99*	0.98*	0.99*
Conakry	0.99	0.97	0.99
Faranah	0.98	0.97	0.99
Kankan	0.98*	0.96**	0.99*
Kindia	0.99*	0.97	0.99
Lab é	0.99*	0.98*	0.99**
Mamou	0.99	0.99	0.99
Nzerekore	0.98	0.97	0.98

**p<0.01 *p<0.05

The likelihood of a child with a mother who has a university education being fully vaccinated was about twice as high

compared to a child with a mother who has no formal education (AOR=1.87, 95% CI: 1.02-3.43). Similarly, children from wealthier households had nearly twice the chance of being fully vaccinated compared to those from poorer households (AOR=1.79, 95% CI: 1.38-2.32). Additionally, children whose mothers listened to the radio were more likely to receive all their vaccines than those whose mothers did not, with an AOR of 1.27 (95% CI: 1.30-1.57) (Table 4).

Table 4. *Facteurs socio économiques associés aux inégalités dans la vaccination complète des enfants âgés de 12 à 23 mois.*

Characteristics	Children aged 12–23 months fully vaccinated		
	AOR[1]	95% CI[1]	p-value
Level of education of respondents			
No schooling	—	—	
Primary	1.39	1.01-1.89	0.040
Secondary	1.11	0.79 -1.54	0.5
University	1.87	1.02 - 3.43	0.042
Wealth index			
Very poor	—	—	
Poor	1.29	1.02 - 1.64	0.038
Rich	1.79	1.38 - 2.32	<0.001
Survey year			
2005	—	—	
2012	0.70	0.55 - 0.89	0.005
2018	0.28	0.21- 0.38	<0.001
Ethnicity			
Soussou	—	—	
Peulh	0.48	0.37- 0.63	<0.001
Malinké	0.98	0.76 - 1.27	0.9
Kissi	1.61	1.07- 2.42	0.022
Toma	1.20	0.54 - 2.59	0.6
Guerzé	2.06	1.32 - 3.25	0.002
Others	0.79	0.36 - 1.66	0.5
Frequency of magazine reading			
No access	—	—	
Access	1.51	0.94 - 2.43	0.091
Radio listening frequency			
No access	—	—	
Access	1.27	1,03 - 1,57	0,028
Parents' occupation			
Not employed	—	—	
Employed	0.80	0,61 - 1,05	0.12
Mother's parity			
1 birth	—	—	

Characteristics	Children aged 12–23 months fully vaccinated		
	AOR[1]	95% CI[1]	p-value
2 births	0.99	0,75 - 1.31	>0.9
3 births	1.05	0,77 -1.41	0.8
4 and more births	0.86	0,68 - 1.10	0.2

[1] AOR = Ajusted Odds Ratio, CI = Confidence Interval

4. Discussion

This study explored the trends in inequalities in full vaccination coverage among children aged 12 to 23 months between 2005 and 2018, while identifying the associated socioeconomic factors. Our findings reveal a significant decline in the proportion of fully vaccinated children during this period. In fact, this proportion decreased from 37.2% in 2005 to 36.5% in 2012, and then dropped to 24% in 2018. These rates fall well below the World Health Organization (WHO) recommendations, which, in 2012, called for 90% national vaccination coverage and 80% coverage in each health district for all vaccines in the national program by the end of 2020 [2]. The observed decline, particularly between 2012 and 2018, could be attributed to the Ebola epidemic that struck the country, leading to an economic crisis and a reduction in both the supply and demand for vaccination services in health facilities.

Our analysis shows that full vaccination coverage among children was mainly concentrated in wealthier households in 2005, 2012, and 2018. Although this inequality slightly decreased in 2012, it increased again in 2018, with Gini indices of [0.91; 0.82; 0.94], respectively. These figures highlight disparities in the implementation of vaccination strategies across the country, which can be explained by various sociodemographic and governance factors. Unlike the findings of Hoang-Long Vo et al. [18] and Brian Wahl et al. [19], our results align with those reported by Alfred Douba et al. [20]. It is important to note that vaccination in Guinea is free, but several other factors, particularly related to human resources, logistics, and management, contribute to this poor performance.

The results of this study shed light on the influence of several maternal factors on full vaccination coverage among children in Guinea. Children whose parents had a higher level of education were more likely to receive all the vaccines recommended by the Expanded Program on Immunization during this period. These findings are consistent with the work of M. Dil é Diallo [14] and Alfred Douba et al. [13] Communication channels also play a key role in vaccination activities, particularly through awareness and promotion. Our study shows that the likelihood of full vaccination was higher among children whose mothers regularly listened to the radio, compared to those whose mothers did not have access to or did not listen to the radio. This result is similar to that observed in Ethiopia by Ayal Debie [21]. Vaccination equity remains a constant concern for vaccination program managers and their technical and financial partners. Despite the efforts made, our study shows that inequality in favor of wealthier households persists over time, with a strongly positive Gini index. These findings contrast with those reported by Innocent A. Semali [22] and Eugene Budu [23].

Due to the cross-sectional nature of demographic and health surveys, this study was able to identify associations, but it is important to note that this does not allow conclusions to be drawn about causal relationships. However, these limitations are not significant enough to call into question the validity of the results. To our knowledge, this is the first study to examine the evolution of inequalities in full immunization coverage among children in Guinea.

5. Conclusion

Our study, based on data from the last three Demographic and Health Surveys, highlights a decline in vaccination coverage among children aged 12 to 23 months who have received all their vaccines. Over the years, inequalities in vaccination coverage have persisted, with concentration indices showing positive friction. However, a slight improvement in these inequalities was observed in 2012. Mother-related factors, such as education level, household wealth, media access and ethnicity, were significantly associated with completeness of childhood immunization schedule.

Overall, these results underline the importance of reviewing National Immunization Program strategies, considering maternal determinants, in order to improve immunization coverage and reduce related disparities.

Abbreviations

AIC Akaike Information Criterion
BCG Bacillus Calmette-Guerin Vaccine
CI Confidence Interval

DHS	Demographic and Health Surveys
EZ	Enumeration Zones
OPV	Poliovirus Vaccine
OR	Odds Ratio
WHO	Word Health Organization

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Ethical Considerations

The Demographic and Health Surveys (DHS) were approved by the Guinean government and adhered to ethical standards, including obtaining informed consent from participants and ensuring the confidentiality of the information collected.

Access to the data was granted after submitting an official request through an account on the DHS Program website (https://dhisprogram.com), with a detailed description of the project. Once the request was approved and access authorized, the data was downloaded for processing and analysis. The use of DHS data was conducted with strict respect for participant anonymity. Therefore, the secondary analysis of the DHS data from Guinea for our study was exempt from ethical review.

Author Contributions

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Data Availability Statement

The datasets for this article are not publicly available due to concerns regarding participant/patient anonymity. Requests to access the datasets should be directed to the corresponding author.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Word Health Oraganization (WHO). Vaccines and immunization: What is vaccination? [Internet]. WHO Headquarters (HQ). 2024 [cited 2024 Sep 12]. Available from: https://www.who.int/news-room/questions-and-answers/item/vaccines-and-immunization-what-is-vaccination

[2] Organisation mondiale de la Sant é. Plan d'Action Mondial pour les Vaccins 2011-2020. In Gen ève: Biblioth èque de l'OMS ; 2013. p. 148 p. Available from: http://www.who.int/about/licensing/copyright_form/en/index.html

[3] Institut National de la Statistique Abidjan C ôte d'Ivoire TDPIRMU. C ôte d'Ivoire: Enqu ête D émographique et de Sant é, Indicateurs Cl és [Internet]. Abidjan; 2021 [cited 2024 Sep 28]. Available from: https://dhsprogram.com/pubs/pdf/PR140/PR140.pdf

[4] Institut National de la Statistique (INSTAT) TDPIRMU. R épublique du Mali : Sixi ème Enqu ête D émographique et de Sant é au Mali (EDSM-VI) 2018, Indicateurs cl és. [Internet]. Bamako; 2019. Available from: www.DHSprogram.com

[5] Liberia Institute of Statistics and Geo-Information Services (LISGIS) M of HMLTDPIRMU. Liberia Demographic and Health Survey [Internet]. Monrovia; 2019 [cited 2024 Sep 28]. Available from: https://www.lisgis.gov.lr/admin_area/surveys/pdf/20240625406838220 19-20%20FR362.pdf

[6] Agence Nationale de la Statistique et de la D émographie (ANSD) Dakar S én égal TDPIRMU. S én égal: Enqu ête D émographique et de Sant é Continue (EDS-Continue) 2023. Dakar; 2024.

[7] Ghana Statistical Service Accra Ghana TDPIRMU. Ghana Demographic and Health Survey 2022 [Internet]. Accra; 2024 [cited 2024 Sep 28]. Available from: https://dhsprogram.com/pubs/pdf/FR387/FR387.pdf

[8] Institut National de la Statistique et de la Démographie Ouagadougou BFTDPIRMU. Burkina Faso Enquête Démographique et de Santé 2021: Indicateurs Clés [Internet]. Ouagadougou; 2022 [cited 2024 Sep 28]. Available from: https://dhsprogram.com/pubs/pdf/PR139/PR139.pdf

[9] Institut National de la Statistique Ministère du Plan Conakry GMDIICMUSA. Guinée Enquête Démographique et de Santé et à Indicateurs Multiples (EDS-MICS) 2012 [Internet]. 2013 [cited 2024 Sep 28]. Available from: https://dhsprogram.com/pubs/pdf/FR280/FR280.pdf

[10] Institut National de la Statistique du Ministère du Plan et du Développement Economique de Guinée, The DHS Program, ICF. Enquête de Démographie et de Santé de Guinée, 2018. 2019 juill.

[11] M. C. Restrepo-Méndez et al., « Inequalities in full immunization coverage: trends in low- and middle-income countries », Bull. World Health Organ., vol. 94, no 11, p. 794-805A, nov. 2016, https://doi.org/10.2471/BLT.15.162172

[12] H. P. P. Donfouet, G. Agesa, et M. K. Mutua, « Trends of inequalities in childhood immunization coverage among children aged 12-23 months in Kenya, Ghana, and Côte d'Ivoire», BMC Public Health, vol. 19, no 1, p. 988, juill. 2019, https://doi.org/10.1186/s12889-019-7309-9

[13] A. Douba, B. N. A. Lepri, H. A. Y. Gnissan, Z.-A. Péronille, C. A. Bangaman, et K. N'Guessan, « Facteurs sociodémographiques associés à la vaccination incomplète des enfants de 12 à 59 mois dans six pays d'Afrique de l'ouest | », CAIRN.INFO, vol. 27, no 2015/4, p. 575-584, nov. 2015, https://doi.org/10.3917/spub.154.0575

[14] M. D. Diallo, « Facteurs Associés à la Vaccination Complète chez les Enfants de 12 à 23 Mois en Guinée », European Scientific Journal, ESJ, vol. 17, no 17, p. 80, mai 2021, https://doi.org/10.19044/esj.2021

[15] K. Blesch, O. P. Hauser, et J. M. Jachimowicz, « Measuring inequality beyond the Gini coefficient may clarify conflicting findings », Nat Hum Behav, vol. 6, no 11, p. 1525-1536, août 2022, https://doi.org/10.1038/s41562-022-01430-7

[16] Ministère de la Santé Guinée. Plan National de Développement Sanitaire (PNDS) de la Guinée 2015 - 2024. 2015.

[17] Institut National de la Statistique de la Guinée. Des statistiques fiables pour la prise de décision [Internet]. [cité 30 nov 2022]. Disponible sur : https://www.stat-guinee.org/

[18] H.-L. Vo et al., « Trends in Socioeconomic Inequalities in Full Vaccination Coverage among Vietnamese Children Aged 12–23 Months, 2000–2014: Evidence for Mitigating Disparities in Vaccination », Vaccines, vol. 7, no 4, Art. no 4, déc. 2019, https://doi.org/10.3390/vaccines7040188

[19] B. Wahl et al., « Change in full immunization inequalities in Indian children 12-23 months: an analysis of household survey data », BMC Public Health, vol. 21, no 1, p. 841, mai 2021, https://doi.org/10.1186/s12889-021-10849-y

[20] A. Douba, B. N. A. Lepri, H. A. Y. Gnissan, Z.-A. Péronille, C. A. Bangaman, et K. N'Guessan, « Facteurs sociodémographiques associés à la vaccination incomplète des enfants de 12 à 59 mois dans six pays d'Afrique de l'ouest | », CAIRN.INFO, vol. 27, no 2015/4, p. 575-584, nov. 2015, https://doi.org/10.3917/spub.154.0575

[21] D. Ayal, M. L. Ayenew, S. T. Koku, A. Getasew, et A. T. Getayeneh, « Complete vaccination service utilization inequalities among children aged 12–23 months in Ethiopia: a multivariate decomposition analyses - PMC », J Equity Health, vol. 19, no 1, p. 65, mai 2020, https://doi.org/10.1186/s12939-020-01166-8

[22] I. A. Semali, « Trends in Immunization Completion and Disparities in the Context of Health Reforms: The case study of Tanzania », BMC Health Serv Res, vol. 10, no 1, p. 299, déc. 2010, https://doi.org/10.1186/1472-6963-10-299

[23] E. Budu, E. K. M. Darteh, B. O. Ahinkorah, A.-A. Seidu, et K. S. Dickson, « Trend and determinants of complete vaccination coverage among children aged 12-23 months in Ghana: Analysis of data from the 1998 to 2014 Ghana Demographic and Health Surveys », PLOS ONE, vol. 15, no 10, p. e0239754, oct. 2020, https://doi.org/10.1371/journal.pone.0239754