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Predictors of perinatal mortality in Liberia's post-civil unrest: A comparative analysis of the 2013 and 2019–2020 Liberia Demographic and Health Surveys

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ABSTRACT

Introduction Perinatal mortality remains a pressing concern, especially in lower and middle-income nations. Globally, 1 in 72 babies are stillborn. Despite advancements, the 2030 targets are challenging, notably in sub-Saharan Africa. Post-war Liberia saw a 14% spike in perinatal mortality between 2013 and 2020, indicating the urgency for in-depth study.

Objective The study aims to investigate the predictors of perinatal mortality in Liberia using 2013 and 2019–2020 Liberia Demographic and Health Survey datasets.

Methods In a two-stage cluster design from the Liberia Demographic and Health Survey, 6572 and 5285 respondents were analysed for 2013 and 2019–2020, respectively. Data included women aged 15–49 with pregnancy histories. Descriptive statistics was used to analyse the sociodemographic characteristics, the exposure to media and the maternal health services. Bivariate and multivariate logistic regressions were used to examine the predictors of perinatal mortality at a significance level of p value ≤0.05 and 95% CI. The data analysis was conducted in STATA V.14.

Results Perinatal mortality rates increased from 30.23 per 1000 births in 2013 to 42.05 in 2019–2020. In 2013, increasing age of respondents showed a reduced risk of perinatal mortality rate. In both years, having one to three children significantly reduced mortality risk (2013: adjusted OR (aOR) 0.30, 95% CI 0.14 to 0.64; 2019: aOR 0.24, 95% CI 0.11 to 0.54), compared with not having a child. Weekly radio listenership increased mortality risk (2013: aOR 1.36, 95% CI 0.99 to 1.89; 2019: aOR 1.86, 95% CI 1.35 to 2.57) compared with not listening at all. Longer pregnancy intervals (p<0.0001) and receiving 2+ tetanus injections (p=0.019) were protective across both periods. However, iron supplementation showed varied effects, reducing risk in 2013 (aOR 0.90, 95% CI 0.48 to 1.68) but increasing it in 2019 (aOR 2.10, 95% CI 0.90 to 4.92).

Conclusion The study reports an alarming increase in Liberia's perinatal mortality from 2013 to 2019–2020. The findings show dynamic risk factors necessitating adaptable healthcare approaches, particularly during antenatal care. These adaptable approaches are crucial for refining health strategies in line with the Sustainable Development Goals, with emphasis on the integration of health, education, gender equality, sustainable livelihoods and global partnerships for effective health outcomes.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study used a nationally representative data from the Liberia Demographic and Health Survey, which enhances the generalisability of the findings.
- ⇒ Comparing the data across two survey periods facilitates the understanding of the impact of evolving healthcare policies and human behaviours.
- ⇒ Employed rigorous scrutiny of the regression models to ensure the validity and the reliability of the study analysis.
- ⇒ The study design uses a cross-sectional approach, making it difficult to establish causal relationships.
- ⇒ There is also a potential for recall bias since the data collected required participant to remember past events.

INTRODUCTION

The moment of birth stands as one of the most interesting points for every family, particularly the mother. Yet, for some mothers, this moment of joy is abruptly halted before life truly begins. Perinatal mortality, which includes both stillbirth and early neonatal deaths within the first week of life, remains one of the most heartbreaking challenges in public health. Stillbirth refers to the loss of the fetus after 28 weeks of gestation before birth and early neonatal mortality is the death of an infant within the first 7 days of life.[1 2] This is particularly common in lower and middle-income countries, although some families in high-income countries still have their share of this heart-wrenching moments.[3]

Globally, stillbirths and neonatal deaths remain a significant challenge. It is estimated that each year 1 in every 72 babies are stillborn around the worldwide.[4 5] From 1990 to 2019, there has been 18% decline in stillbirths, decreasing from 2.9 million to 2 million in 2019.[5] Concurrently, neonatal mortality also saw a 35% reduction during the same period.[4 5] However, the majority of perinatal mortality, accounting for approximately 84%, occurs in lower income and middle income, particularly in sub-Saharan Africa (SSA).[4] The risk of stillbirth and neonatal death is 7.6 and 9 times higher, respectively, in low-income countries compared with high-income countries.[4 5] Even though there has been a 35% decrease worldwide since 2000, the pace of this reduction falls short of expectations. This implies that the aspirational global target of 12/1000 live births by 2030, a key objective set forth in the Sustainable Development Goals (SDGs), particularly Goal 3, remains a distant goal,[4–6] particularly for countries in SSA region.

Perinatal mortality ranges from 34.7 to 42.95 per 1000 live births in countries within the SSA region.[7 8] Within this context, Liberia, a country emerging from a 14-year civil war in 2003, faces unique healthcare challenges. This conflict severely damaged the nation's healthcare infrastructure, leading to some of the poorest health outcomes. Successive governments have focused on revitalising the healthcare system with special attention to maternal and child health.[9] Available reports indicate that key maternal healthcare utilisation indicators, such as antenatal care (ANC), facility-based delivery and postnatal care, which affects perinatal health outcome, have registered improvements in the country.[9–11] Despite these efforts and the improvements in maternal healthcare utilisation, perinatal mortality in Liberia has increased by 14% from 2013 to 2020.[10 11]

While there is substantial research on factors influencing perinatal mortality in SSA, including sex of the neonate,[12] birth weight,[13 14] place of residence,[15 16] wealth index status, mother's education level, mother's age, number of births[12 17 18] and history of terminated pregnancy,[17] there is a notable gap in literature specifically addressing these factors in the unique post-conflict context of Liberia. This study aims to fill this significant gap by providing a comprehensive analysis of perinatal mortality in Liberia using two rounds, 2013 and 2019 (2020) of Liberia Demographic and Health Survey (LDHS), a nationally representative population-based data.

This study seeks to understand the trends and the determinants of perinatal mortality in Liberia, and it aims to contextualise these findings within the broader regional patterns of perinatal mortality in SSA, thus contributing to a refined understanding of perinatal health in post-conflict settings.

Study objectives

The study specifically seeks to:

- Assess and compare the perinatal mortality rates (PMR) in Liberia using the 2013 and 2019 (2020) LDHS datasets.
- Identify and compare the predictors of perinatal mortality in Liberia using the 2013 and 2019 (2020) LDHS datasets.

METHODS

Study setting

Liberia, situated along the Atlantic seaboard in Western Africa, spans an area of about 43 000 square miles. The nation is neighboured by Sierra Leone on its northwest, Guinea on its north and Côte d'Ivoire on its eastern side. The land is abundant with various natural resources, such as iron ore, timber, diamonds and gold, and is also conducive for the cultivation of rubber trees.

The territorial division of Liberia includes 15 counties, and each of these regions roughly corresponds to the territories claimed by different Liberian ethnic groups. The country has a population of about 4.5 million people (in 2015). Liberia is partitioned into 15 counties that are organised into five distinct geographical regions. Each of these regions comprised three counties. The territorial demarcation of each county is characterised by a hierarchical division into smaller units, namely districts and clans. During the 2008 National Population and Housing Census each clan was further divided into enumeration areas (EAs). An EA refers to a designated geographical region that is assigned to an enumerator with the objective of conducting a census count. As per the Liberian census frame, an EA comprised approximately 100 households.

Data source and study design

The data used for this study were obtained from the 2013 and 2019 (2020) LDHS, a nationally representative cross-sectional survey conducted across all the counties in the country. It is mainly conducted by the Liberia Institute of Statistics and Geo-Information Services and the Ministry of Health of Liberia, with technical support from the Demographic Health Program since 1986. It provides comprehensive national population-based data, covering all facets of public health, particularly maternal and child health. The data for this study was obtained online at: https://www.dhsprogram.com/data/available-datasets.cfm.[19 20]

Both 2013 and 2019 (2020) surveys employed a stratified two-stage cluster design to obtain representative samples. In the first stage, sample points (clusters) consisting of EAs were drawn. These EAs were selected based on proportionate probability according to their size within each of the sampling stratum. In using this strategy, a total of 322 and 325 clusters were obtained for 2013 and 2019–2020, respectively.

In the second stage, a systematic sampling of households was performed. Household listing was conducted in all the selected clusters. A fixed number of 30 households were selected in both years, with an equal probability systematic selection process. A total sample size of

9677 and 9745 households was obtained for 2013 and 2019–2020, respectively.

Sample size

This study's population comprised females aged 15–49 who were either permanent residents or temporary visitors who spent the previous night in the selected households. A total of 9462 and 8364 eligible women were identified for the interview in 2013 and 2019 (2020), respectively. However, this study only included women aged 15–49 who had terminated pregnancy or delivery after the seventh month of pregnancy. Therefore, the sample size for this study is 7690 for 2013 and 5742 for 2019 (2020).

The samples acquired through this meticulous approach are anticipated to offer a representative snapshot of Liberia's demographic landscape, spanning national, urban (including Greater Monrovia and other urban locales) and rural strata across all five geographical regions. The comprehensiveness of this sampling strategy enhances the robustness of the study, ensuring the findings provide insightful reflections of the diverse population subsets within the country.

Data collection instrument

In the Demographic and Health Surveys (DHS) programme, individuals eligible for interview included females aged 15–49 and males aged 15–59 who were either permanent residents of the designated households or temporary guests who had spent the previous night in said households. The questionnaires for collecting data for the 2013 and 2019 (2020) were seven. However, for the purpose of this study only the Woman's Questionnaire has been considered (https://dhsprogram.com/Methodology/Survey-Types/DHS-Questionnaires.cfm#CP_JUMP_16179).

The Woman's Questionnaire contained questions on several topics including, but not limited to, background characteristics (age, education, religion, ethnicity, occupation, etc), reproduction and child mortality, prenatal, place of delivery and postnatal care, and husband/partner's background characteristics. Direct question on whether a female was circumcised and the use of internet were only available in the 2019–2020 questionnaire.

Variables

Outcome variable

The dependent variable for this study is perinatal mortality. Perinatal mortality is the death of a baby between 28 weeks of gestation onwards and before the first 7 days of life.[3] Perinatal death includes stillbirths and early neonatal deaths. Data on perinatal death, stillbirths and early neonatal death are not directly collected using the Woman's Questionnaire. However, questions regarding the number of children who have died, either before or after birth, whether a woman had miscarriage, aborted or stillbirths, and the duration of pregnancy before termination are indicated in the questionnaire. Also, the total number of births by a respondent is also present in the questionnaire. Perinatal mortality was therefore calculated using the response of these questions from the women. The process of creating the perinatal death from the DHS dataset for both 2013 and 2019–2020 is described in the DHS GitHub code share (https://github.com/DHSProgram/DHS-Indicators-Stata/tree/master/Chap09_RH). The perinatal death was coded as 0 'not perinatal death' or 1 'perinatal death'.

Independent variables

The independent variables for this study were grouped into three categories: sociodemographic, exposure to media and maternal health indicators. The sociodemographic characteristics include age of respondents, marital status, number of children ever born, weight category, religion, educational status, occupation, wealth index, place of residence and county.[14 21 22] The variables under the exposure to media include frequency of reading newspaper/magazine, frequency of listening to radio and frequency of watching television. The maternal health variables are pregnancy interval, gestational age at ANC registration,[23 24] number of ANC visits, person providing assistance during ANC, receiving 2+ tetanus injections during pregnancy,[25] taking iron and folic acid during pregnancy,[26] taking antimalarials during pregnancy (sulfadoxine pyrimethamine (SP)/Fansidar)[27] and maternal age at delivery.[28] The variable representing the number of children ever born was recategorised for analytical clarity into five distinct groups: no child—'1', 1–3 children—'2', 4–6 children—'3', 7–9 children—'4' and 10 or more children—'5'. Furthermore, each respondent's weight category was meticulously classified based on their body mass index (BMI), calculated using the recorded height and weight data in the dataset. The classifications were as follows: underweight (BMI <18.5 kg/m²)—'1', normal weight (BMI 18.5–24.9 kg/m²)—'2', overweight (BMI 25.0–29.9 kg/m²)—'3' and obese (BMI ≥30 kg/m²)—'4'.

Patient and public involvement

No patient or the public were involved in the study.

Data analysis

Data for the 2013 and 2019–2020 surveys were obtained from the DHS website in STATA file format and analysed using STATA V.14 (StataCorp, College Station, Texas, USA). A design-based analysis approach incorporating weighting was employed to adjust for the unequal probabilities instituted by the DHS, aiming to enhance case representation while minimising sample variability for specific areas or subpopulations.[29]

The first phase of the analysis employed descriptive statistics and χ^2 test to analyse the sociodemographic characteristics, the exposure to media, and the maternal health variables and their association with perinatal death. PMR, defined as the number of perinatal deaths per 1000 births (both stillbirths and live births within the first 7 days of life),[3] was manually calculated in Microsoft Excel sheet. The PMRs, together with spatial data on the administrative demarcation of the counties in Liberia, were inputted into ArcMap V.10.5 to create a thematic map of perinatal mortality distribution in Liberia.

In the second phase of the analysis, independent variables which were significantly associated with perinatal mortality at p≤0.25 in a bivariate analysis were examined in a multiple logistic regression model, controlling for potential confounders for all survey years. A backward stepwise logistic regression was used to identify possible predictors of perinatal mortality among all the independent variables of the study.[30] At each step, variables with p value >0.25 were eliminated until all independent variables were significant at p≤0.25. The crude and adjusted ORs (aOR) and their respective 95% CIs of the final variables in 2013 and 2019 (2020) were reported in a table.

To examine the variability of the predictors of perinatal mortality in 2013 and 2019 (2020), a final multiple logistic regression model was built. The model assessed if predictor variable significant in 2013 was still significant in 2019 (2020). Factors that were associated with perinatal mortality at p≤0.25 in the bivariate analysis were included in the multiple logistic regression model.[31] A p value <0.05 was considered statistically significant in model 3.[32]

Model diagnostics

To ensure model validity, multicollinearity among the independent variables was assessed using the variance inflation factor (VIF) test. The goodness of fit for the models was evaluated through the likelihood ratio test (LRT) and Hosmer-Lemeshow tests, providing a robust framework for interpreting the reliability of the results.

RESULTS

Table 1 describes the sociodemographic characteristics and the association with perinatal mortality. In 2013, many of the respondents (51.5%) were in the age group of 20–29 years, with perinatal death rate of 1.9%. The difference in perinatal death rates across the age groups was statistically significant (p<0.01) in 2013. However, in 2019 (2020), although similar age distribution was shown, there was no statistical significance in the difference of their perinatal death rates (p=0.172). A significant association was also found between marital status and perinatal death in 2013 (p<0.01), with married respondents having a 0.8% perinatal death rate, while the perinatal death rate was 1.2% among those cohabiting. A marginal significance level (p=0.051) was observed in 2019 (2020) in the perinatal death rates across marital statuses. The rate of perinatal death was found to be highly significant (p<0.0001) with the number of children a woman had in both survey rounds. The perinatal death rate decreased with the number of children in both rounds from 1.6% for one to three children to 0.1% for those with more than 10 children in 2013 and a similar trend in 2019 (2020). The weight category was not significantly associated with perinatal death in 2013 (p=0.277). However, in the 2019 (2020) round, there was a significant association (p=0.018). Women who were underweight experienced a higher perinatal death rate (3.6%) compared with the other categories in 2019 (2020).

Table 2 shows the exposure to media and the association with perinatal mortality. It is observed that in both survey rounds, there was no statistical significance (p>0.05) in relation to frequency of reading newspaper/magazine and its association with perinatal mortality. For frequency of listening to radio, 32.2% of respondents did not listen to radio in 2013, with a perinatal death rate of 0.9%. In contrast, a significant association (p<0.001) was observed between frequency of listening to radio in 2019 (2020) survey years. Non-listeners constituted 44.7% with perinatal death rate of 1.0% in 2019 (2020). Also, for frequency of watching television, majority (69.6% and 69.9% in 2013 and 2019 (2020), respectively) of respondents did not watch television at all with higher perinatal death rates of 2.3% and 2.9%, respectively. However, there was no significant association observed between the frequency of watching television and perinatal death in both survey rounds.

Prevalence of PMR

The data reveal a general upward trend in PMR between the two survey periods, increasing from 30.23 per 1000 births in 2013 to 42.05 per 1000 births in 2019–2020. This upward trend is also reflected at the county level in some instances. For example, Grand Bassa County saw an increase in PMR from 20.61 per 1000 births in 2013 to 55.99 per 1000 births in the 2019–2020 LDHS. Similarly, Sinoe County experienced a significant rise from 10.97 per 1000 births in 2013 to 65.52 per 1000 births in 2019–2020. However, a few counties bucked this trend. Notably, Bomi County saw a decrease in PMR from 52.33 per 1000 births in 2013 to 25.46 per 1000 births in the 2019–2020 survey period. This is presented in online supplemental figure 1.

Table 3 shows the ANC services and their association with perinatal death rates for the survey rounds. First pregnancies accounted for 23.4% of the sample, with a perinatal death rate of 0.9%. Similarly, in 2019 (2020) round, first pregnancy accounted for 24.7% and a perinatal death rate of 1.0%. A statistically significant difference (p=0.049 and p=0.044 for 2013 and 2019 (2020), respectively) was observed in the perinatal deaths across the different pregnancy intervals in both survey rounds. A highly significant association (p<0.0001) was found between gestational age at ANC registration and perinatal mortality in both survey rounds. In both survey rounds, majority (2013=66.9% and 2019 (2020)=70.4%) of the respondents registered for ANC before 4 months of gestation. The perinatal death rate for this category (<4 months) of respondents was 1.8% in 2013 compared with 2.6% in 2019 (2020). Person providing assistance during ANC was significantly associated (p<0.0001) with perinatal deaths in both rounds. In 2013, care provided by a doctor

Table 1 Sociodemographic characteristics of respondents and perinatal deaths, Liberia, 2013 (N=7690) and 2019 (2020) (N=5742)

Sociodemographic characteristics	2013 round (weighted)			2019 (2020) round (weighted)		
	Frequency N (%)	Perinatal death n (%)	P value	Frequency N (%)	Perinatal death n (%)	P value
Age of respondent			**<0.01**			0.172
<20	612 (9.3)	21 (0.3)		467 (8.8)	16 (0.3)	
20–29	3385 (51.5)	123 (1.9)		2690 (50.9)	106 (2.0)	
30–39	2032 (30.9)	37 (0.6)		1631 (30.8)	66 (1.3)	
40–49	543 (8.3)	17 (0.3)		497 (9.4)	33 (0.6)	
Marital status			**<0.01**			0.051
Married	2184 (33.2)	52 (0.8)		1651 (31.2)	79 (1.5)	
Cohabitation	2774 (42.2)	81 (1.2)		1943 (36.8)	89 (1.7)	
Widowed	87.36 (1.3)	1 (0.01)		56 (1.1)	1 (0.0)	
Divorced/separated	476.7 (7.3)	18 (0.3)		383 (7.2)	23 (0.4)	
Never in union	1050 (16.0)	47 (0.7)		1252 (23.7)	31 (0.6)	
Number of children ever born			**<0.0001**			**<0.0001**
No child	13 (0.2)	13 (0.2)		9 (0.2)	9 (0.2)	
1–3	3641 (55.4)	103 (1.6)		3036 (57.4)	98 (1.9)	
4–6	2021 (30.7)	6 (0.9)		1632 (30.9)	76 (1.5)	
7–9	727 (11.1)	19 (0.2)		525 (9.9)	32 (0.6)	
10+	170 (2.6)	8 (0.1)		84 (1.6)	6 (0.1)	
Weight category (BMI)			0.277			**0.0179**
Underweight	226 (3.4)	4 (0.06)		286 (5.4)	191 (3.6)	
Normal weight	5511 (83.9)	166 (2.5)		4130 (78.2)	5 (0.1)	
Overweight	611 (9.3)	15 (0.2)		599 (11.3)	11 (0.2)	
Obese	224 (3.4)	14 (0.2)		270 (5.1)	15 (0.3)	
Religion			0.907			0.7167
Christian	5539 (84.2)	167 (2.5)		4350 (82.3)	192 (3.6)	
Muslim	760 (11.6)	26 (0.4)		810 (15.3)	26 (0.5)	
Traditionalist	37.57 (0.6)	1 (0.07)		33 (0.6)	2 (0.003)	
No religion	224 (3.4)	5 (0.07)		88 (1.7)	3 (0.005)	
Other	11 (0.2)	1 (0.008)		5 (0.1)	0	
Educational status			0.087			0.4204
No formal education	2729 (41.6)	62 (1.0)		1888 (35.7)	83 (0.2)	
Primary	2011 (30.6)	79 (1.2)		1355 (25.7)	50 (0.09)	
Secondary	1645 (25.0)	48 (0.7)		1841 (34.8)	86 (1.6)	
Tertiary/higher	187 (2.8)	9 (0.1)		208 (3.8)	3 (0.006)	
Occupation			0.8989			0.7259
Unemployed	2652 (40.4)	77 (1.0)		1609 (30.1)	66 (1.3)	
Professional/technical/managerial	60 (0.9)	3 (0)		111 (2.1)	1 (0.0)	
Clerical	22 (0.3)	1 (0)		8 (0.2)	0 (0.0)	
Sales	1590 (24.2)	54 (1.0)		880 (16.7)	45 (0.9)	
Agriculture	1989 (30.3)	58 (1.0)		1757 (33.3)	68 (1.3)	
Household/domestic services	104 (1.6)	1 (0)		839 (15.9)	40 (0.8)	
Skilled/unskilled manual work	125 (1.9)	4 (0)		73 (1.4)	2 (0.0)	
Other	30 (0.5)	2 (0)		7 (0.1)	0 (0.0)	

Continued

Table 1 Continued

Sociodemographic characteristics	2013 round (weighted) Frequency N (%)	Perinatal death n (%)	P value	2019 (2020) round (weighted) Frequency N (%)	Perinatal death n (%)	P value
Wealth index			0.0905			0.0652
Poorest	1596 (24.3)	56 (1.0)		1269 (24.1)	47 (0.9)	
Poorer	1466 (22.3)	28 (0)		1164 (22.0)	58 (1.1)	
Middle	1384 (21.1)	44 (1.0)		994 (18.8)	30 (0.6)	
Richer	1248 (19.0)	51 (1.0)		1011 (19.1)	63 (1.2)	
Richest	878 (13.3)	20 (0)		847 (16.0)	24 (0.5)	
Place of residence			0.588			0.9974
Urban	3278 (49.9)	105 (1.6)		2814 (53.2)	118 (2.2)	
Rural	3293 (50.1)	94 (1.4)		2471 (46.8)	104 (2.0)	
Region			0.997			
South-central	5002 (42.1)	186 (1.6)				0.31
North-western	1202 (10.1)	43 (0.36)		2305 (43.6)	109 (2.1)	
South-eastern a	831 (7.0)	28 (0.23)		465 (8.8)	16 (0.3)	
South-eastern b	828 (6.9)	47 (0.4)		337 (6.4)	17 (0.33)	
North-central	3993 (34.7)	117 (1.0)		295 (5.6)	19 (0.36)	

The percentage in the cells represents row percentage of each subgroup.
P-value indicate level of significance
BMI, Body Mass Index; BMI, body mass index; n, subsample; N, total sample.

was associated with 0.4% perinatal death rate, while 2.0% rate was associated with care provided by nurse/midwife. Similarly in 2019 (2020), perinatal death rate was 0.6% among respondents cared for by doctors compared with 3.0% for respondents provided care by nurse/midwife. A statistical significance (p<0.001) was found between respondents who received 2+ tetanus injections, took iron tablet/syrup or took SP/Fansidar during pregnancy and perinatal deaths in both survey years.

Logistic regression models

In regression analysis, VIF values exceeding 5 or 10 are largely considered as indicating multicollinearity.[33–35] In this study, the cut-off point for collinearity was narrowed

Table 2 Exposure to media and perinatal deaths, Liberia, 2013 (N=7690) and 2019 (2020) (N=5742)

Exposure to media	2013 round (weighted) Frequency N (%)	Perinatal death n (%)	P value	2019 (2020) round (weighted) Frequency N (%)	Perinatal death n (%)	P value
Frequency of reading newspaper/ magazine			0.7492			0.562
Not at all	5625 (85.6)	172 (2.6)		4813 (91.0)	199 (4.0)	
Less than once a week	585 (8.9)	19 (0.3)		418 (8.0)	22 (0.0)	
At least once a week	362 (5.5)	8 (0.1)		54 (1.0)	1 (0.0)	
Frequency of listening to radio			0.1736			**<0.001**
Not at all	2117 (32.2)	57 (0.9)		2363 (44.7)	75 (1.0)	
Less than once a week	2144 (32.6)	56 (0.9)		1649 (31.2)	57 (1.0)	
At least once a week	2311 (35.2)	85 (1.3)		1273 (24.1)	91 (2.0)	
Frequency of watching television			0.1539			0.963
Not at all	4574 (69.6)	154 (2.3)		3695 (69.9)	152 (2.9)	
Less than once a week	1115 (17.0)	24 (0.4)		944 (17.8)	41 (0.8)	
At least once a week	883 (13.4)	21 (0.3)		646 (12.3)	29 (0.5)	

Table 3 Antenatal services and perinatal deaths, Liberia, 2013 (N=7690) and 2019 (2020) (N=5742)

Antenatal services	2013 round (weighted) Frequency N (%)	Perinatal death n (%)	P value	2019 (2020) round (weighted) Frequency N (%)	Perinatal death n (%)	P value
Pregnancy interval (months)			0.049			0.044
First pregnancy	1536 (23.4)	57 (0.9)		1305 (24.7)	53 (1.0)	
<15	699 (10.6)	28 (0.4)		530 (10.0)	41 (0.8)	
15–26	1327 (20.2)	36 (0.5)		990 (18.7)	45 (0.9)	
27–38	1101 (16.8)	28 (0.4)		691 (13.1)	27 (0.5)	
≥39	1910 (29.1)	50 (0.8)		1769 (33.5)	56 (1.1)	
Gestational age at ANC registration (months)			<0.0001			<0.0001
No ANC	206 (3.1)	38 (0.6)		128 (2.1)	34 (0.7)	
<4	4347 (66.1)	117 (1.8)		3719 (70.4)	138 (2.6)	
4–5	1530 (23.3)	20 (0.5)		1117 (21.1)	40 (0.8)	
6–7	399 (6.2)	13 (0.2)		244 (4.6)	7 (0.1)	
8+	56 (0.9)	1 (0.0)		61 (1.1)	0.1 (0.0)	
Don't know	34 (1.4)	0 (0.0)		16 (0.3)	3 (0.7)	
Number of ANC visits			<0.0001			<0.0001
No ANC	206 (3.1)	38 (0.6)		98 (1.9)	5 (0.1)	
<4	1134 (17.3)	35 (0.5)		509 (9.6)	21 (0.4)	
4–8	4106 (62.5)	94 (1.4)		3886 (73.5)	141 (2.7)	
≥9	907 (13.8)	25 (0.4)		663 (12.6)	22 (0.4)	
Don't know	219 (3.3)	7 (0.1)		129 (2.4)	33 (0.6)	
Person providing assistance during ANC			<0.0001			<0.0001
Doctor	1137 (17.3)	23 (0.4)		953 (18.0)	30 (0.6)	
Nurse/midwife	5001 (76.1)	133 (2.0)		4137 (78.2)	158 (3.0)	
Other health worker	111 (1.7)	2 (0.0)		40 (0.8)	0 (0.0)	
TBA/other/relative	117 (1.8)	2.3 (0.0)		57 (1.1)	29 (0.6)	
No ANC	206 (3.1)	38 (0.6)		98 (1.9)	5.4 (0.1)	
Received 2+ tetanus injections during pregnancy			<0.0001			<0.001
No	1107 (16.9)	65 (1.0)	16.9	1128 (21.3)	84 (1.6)	
Yes	5465 (83.1)	134 (2.0)	83.1	4157 (78.7)	135 (2.6)	
Took iron tablet/syrup during pregnancy			<0.0001			<0.0001
No	251 (3.8)	7.6 (0.1)		332 (6.2)	3.9 (0.1)	
Yes	6289 (95.7)	160 (2.4)		4903 (92.8)	188 (3.6)	
Don't know	31 (0.5)	31 (0.5)		50 (1.0)	31 (0.6)	
Took SP/Fansidar during pregnancy			<0.0001			<0.0001
No	2257 (34.3)	57 (0.9)	34.3	576 (10.9)	31 (0.6)	10.9
Yes	4283 (65.2)	110 (1.7)	65.2	4680 (88.5)	162 (3.1)	88.5
Don't know	31 (0.5)	31 (0.5)	0.5	29 (0.55)	29 (0.6)	0.55

ANC, antenatal care; SP, sulfadoxine pyrimethamine; TBA, Traditional Birth Assistant.

to 5 as the rule of thumb.[35] No evidence of collinearity was observed (mean VIF for the independent variables for 2013 was 1.65 (min=1.15 and max=2.31) and mean VIF for the independent variables for 2019 (2020) was 1.61 (min=1.13 and max=2.24)).

The LRT gives a χ^2 value of 267.74 (df=14, p<0.0001), which indicates good fit for the model used in the 2013 data analysis. On the other hand, the LRT for the 2019 (2020) data gave a χ^2 value of 300.00 (df=13, p<0.0001), which also shows a good fit for the model. Regarding the Hosmer-Lemeshow test for the 2013 data, the observed data are better explained by the model (χ^2=3.70, with 8 df and p=0.883). Similarly, the Hosmer-Lemeshow test for the 2019–2020 data was also better explained by the model, with χ^2 value of 10.94 (df=8 and p=0.205).

Predictors of perinatal mortality in 2013 and 2019 (2020)

In 2013, after controlling for weight category, religion, occupation, place of residence, region and frequency of reading newspaper/magazine, predictors such as age of respondent, marital status, number of children, educational status, wealth index, frequency of listening to radio, frequency of watching television, person providing ANC, pregnancy interval, number of ANC visits, gestational age at ANC registration, receiving 2+ tetanus injections and taking iron supplements were associated with perinatal mortality, and thus were included in the initial model for 2013.

For 2019 (2020), the initial predictors of perinatal mortality that included age, marital status, number of children, BMI, wealth index, frequency of listening to radio, pregnancy interval, gestational age at ANC registration, number of ANC visits, person providing assistance during ANC, receiving 2+ tetanus injections, taking iron tablet/syrup and taking SP/Fansidar during pregnancy were included in the model, after controlling for religion, educational status, occupation, place of residence, region, frequency of reading newspaper/magazine and frequency of watching television. However, after the backward stepwise procedure, only significant factors (p≤0.25) were included in the final logistic regression models used in table 4.

Table 4 shows the predictors of perinatal mortality for both 2013 and 2019 (2020). In 2013, the age of respondents showed varied risks for perinatal mortality, with those aged 30–39 years showing a lower risk (aOR 0.65; 95% CI 0.33 to 1.27), although not reaching statistical significance across intra-age groups. Marital status also emerged as a significant factor; those never in union had increased odds of perinatal mortality (aOR 1.53; 95% CI 0.96 to 2.44). The risk of perinatal mortality decreased with an increasing number of children ever born. For instance, respondents with one to three children had a significantly lower risk (aOR 0.30; 95% CI 0.14 to 0.64) compared with those with no child. Additionally, the frequency of listening to the radio was associated with increased perinatal mortality risk, especially for those who listened at least once a week (aOR 1.36; 95% CI 0.99 to 1.89) compared with those who did not listen to radio at all. Pregnancy interval was also found to be a significant predictor of perinatal mortality with interval of 15–26 months showing a reduced likelihood of perinatal mortality (aOR 0.80; 95% CI 0.49 to 1.31) in 2013. Person providing assistance during ANC was noteworthy in 2013 (p=0.015), indicating a varying impact on perinatal mortality based on the type of healthcare provider. Respondents who took 2+ tetanus injections during pregnancy also showed reduced risk of perinatal mortality (aOR 0.87; 95% CI 0.61 to 1.22).

In 2019 (2020) data, the significance of the number of children ever born was maintained in 2019 (2020) (p<0.0001), with respondents with four to six children having 56% lower odds for perinatal mortality (aOR 0.44; 95% CI 0.23 to 0.83). Radio listenership's association with increased risk of perinatal mortality remained significant (aOR 1.72; 95% CI 1.24 to 2.39). Pregnancy intervals continued to be a protective factor against perinatal mortality, with longer intervals showing significant association with lower risk, with 15–26 months of interval showing 50% less risk (aOR 0.50; 95% CI 0.30 to 0.83) and 39 or more months of interval showing 64% reduced risk (aOR 0.36; 95% CI 0.22 to 0.58).

Receiving 2+ tetanus injections and taking iron tablet/syrup during pregnancy were found to reduce the risk of perinatal mortality (aOR 0.84; 95% CI 0.58 to 1.22). Taking iron supplements and taking SP/Fansidar (antimalarial) were predictors of perinatal morality (p<0.0001) in 2019 (2020).

Comparison of predictors of perinatal mortality in 2013 and 2019 (2020)

The 2013 and 2019 (2020) survey rounds were compared to identify the change in the predictors of perinatal mortality in Liberia over the period under study in table 5. A multiple logistic regression model (model 2) was constructed using independent variables which were associated with perinatal mortality in 2013 (age, marital status, number of children ever born, frequency of listening to radio, pregnancy interval, person providing assistance during ANC, receiving 2+ tetanus injections during pregnancy, taking iron tablet/syrup during pregnancy) and were analysed using 2019 (2020) data.

The risk of perinatal mortality for respondents with one to three children remained consistently lower across both survey rounds, showing a 70% reduction in 2013 (aOR 0.30; 95% CI 0.14 to 0.64) and 76% reduction in 2019 (2020) (aOR 0.24; 95% CI 0.11 to 0.54), compared with respondents with no children. Radio listenership at least once a week, in contrast to not listening at all, indicated a higher risk of perinatal mortality, with a 36% increase in 2013 (aOR 1.36; 95% CI 0.99 to 1.89) and 86% increase in 2019 (2020) (aOR 1.86; 95% CI 1.35 to 2.57).

The findings further showed a diminishing risk of perinatal mortality with increasing pregnancy interval when compared with first pregnancy. For example, a pregnancy interval of 27–28 months was associated with 12%

Table 4 Predictors of perinatal mortality in Liberia in 2013 and 2019 (2020)

Independent variables	2013 cOR (95% CI)	2013 aOR (95% CI)	2019 (2020) cOR (95% CI)	2019 (2020) aOR (95% CI)
Age of respondent	P=0.022	P=0.068		
<20	1	1		
20–29	0.96 (0.63 to 1.46)	1.23 (0.73 to 2.07)		
30–39	0.55 (0.35 to 0.88)*	0.65 (0.33 to 1.27)		
40–49	0.87 (0.50 to 1.51)	0.62 (0.26 to 1.49)		
Marital status	P=0.006	P=0.112		
Married	1	1		
Cohabitation	1.23 (0.82 to 1.85)	1.16 (0.83 to 1.62)		
Widowed	0.36 (0.04 to 2.74)	0.50 (0.67 to 3.66)		
Divorced/separated	1.60 (0.85 to 3.03)	1.55 (0.92 to 2.62)		
Never in union	1.89 (1.13 to 3.16)*	1.53 (0.96 to 2.44)		
Number of children ever born	P=0.131	P=0.011	P=0.032	P<0.0001
No child	1	1	1	1
1–3	0.55 (0.32 to 0.95)*	0.30 (0.14 to 0.64)**	0.34 (0.19 to 0.63)**	0.211 (0.11 to 0.42)***
4–6	0.50 (0.27 to 0.87)*	0.39 (0.19 to 0.78)**	0.43 (0.23 to 0.79)**	0.44 (0.23 to 0.83)*
7–9	0.48 (0.26 to 0.90)*	0.43 (0.21 to 0.88)*	0.59 (0.31 to 1.11)	0.59 (0.30 to 1.14)
10+	1	1	1	1
Frequency of listening to radio	P=0.058	P=0.086	P<0.0001	P=0.001
Not at all	1	1	1	1
Less than once a week	1.02 (0.74 to 1.41)	1.03 (0.72 to 1.47)	1.21 (0.89 to 1.63)	1.03 (0.73 to 1.44)
At least once a week	1.33 (0.99 to 1.79)	1.36 (0.99 to 1.89)	1.82 (1.35 to 2.46)***	1.72 (1.24 to 2.39)**
Pregnancy interval (months)	P<0.0001	P=0.01	P<0.001	P<0.0001
First pregnancy	1	1	1	1
<15	1.20 (0.83 to 1.76)	1.53 (0.94 to 2.51)	1.55 (1.07 to 2.24)*	1.12 (0.69 to 1.82)
15–26	0.57 (0.39 to 0.85)**	0.80 (0.49 to 1.31)	0.70 (0.47 to 1.05)	0.50 (0.30 to 0.83)**
27–38	0.67 (0.45 to 1.00)*	0.88 (0.52 to 1.48)	0.67 (0.43 to 1.04)	0.46 (0.26 to 0.80)**
≥39	0.56 (0.39 to 0.81)**	0.65 (0.39 to 1.08)	0.71 (0.50 to 0.99)*	0.36 (0.22 to 0.58)***
Person providing assistance during ANC	P<0.0001	P=0.015		
Doctor		1		
Nurse/midwife	1.08 (0.74 to 1.58)	1.07 (0.73 to 1.58)		
Other health worker	1.16 (0.45 to 3.02)	1.12 (0.43 to 2.93)		
TBA/other/relative	0.82 (0.29 to 2.34)	0.84 (0.29 to 2.44)		
No ANC	6.42 (4.04 to 10.18)***	1.46 (0.67 to 3.17)		
Received 2+ tetanus injections during pregnancy	P<0.0001	P=0.165	P<0.0001	P=0.069
No	1.0	1	1	1
Yes	0.49 (0.38 to 0.64)***	0.87 (0.61 to 1.22)	0.50 (0.38 to 0.64)***	0.84 (0.58 to 1.22)
Took iron tablet/syrup during pregnancy	P<0.0001	P<0.0001	P<0.0001	P=0.002
No	1	1	1	1
Yes	0.70 (0.42 to 1.17)	0.90 (0.48 to 1.68)	1.82 (0.85 to 3.89)	0.88 (0.44 to 1.59)
Don't know	1	1	85.35 (34.17 to 213.18)***	1
Took SP/Fansidar during pregnancy			P<000.1	P<0.0001
No			1	1

Continued

Table 4 Continued

	2013		2019 (2020)	
Independent variables	cOR (95% CI)	aOR (95% CI)	cOR (95% CI)	aOR (95% CI)
Yes			0.66 (0.45 to 0.97)*	0.98 (0.72 to 1.33)
Don't know			1	1

*P≤0.05, **p<0.001, ***p<0.00001.
ANC, antenatal care; aOR, adjusted OR; cOR, crude OR; SP, sulfadoxine pyrimethamine.

reduction in risk in 2013 (aOR 0.88; 95% CI 0.52 to 1.48) and a 58% reduction in 2019 (2020) (aOR 0.42; 95% CI 0.24 to 0.75). Receiving 2+ tetanus injections was also beneficial, demonstrating a 13% reduction in perinatal mortality risk (aOR 0.87; 95% CI 0.61 to 1.22) in 2013, compared with 25% reduced risk in 2019 (2020) (aOR 0.75; 95% CI 0.55 to 1.02).

Notably, iron supplementation presented mixed results. In 2013, taking iron tablets was associated with a 10% reduction in perinatal mortality risk (aOR 0.90; 95% CI 0.48 to 1.68), while in 2019 (2020), it was linked to a significant increased risk (aOR 2.10; 95% CI 0.90 to 4.92).

In the final model (model 3), the number of children ever born (p<0.0001), frequency of listening to radio (p<0.0001), pregnancy interval (p<0.0001) and receiving 2+ tetanus injections during pregnancy (p<0.01) consistently emerged as significant predictors of perinatal mortality, indicating the persistent influence of these factors over the entire period under study.

DISCUSSION

The findings of the study offer a fine understanding of the prevalence of PMR in Liberia. The results demonstrate an alarming rise of PMR over the study periods, increasing from 30.23 per 1000 births in 2013 to 42.05 per 1000 births in 2019–2020. The increasing PMR directly impacts the SDG target of 3.2 which aims to end preventable deaths of newborns and children under 5 years of age. The rising PMR in Liberia, as evident in this study, indicates a setback in this target. This trajectory is a cause for concern and warrants immediate attention from the public health officials of Liberia, policy-makers and healthcare providers. A study by Jena *et al* conversely reported a reduction in PMR in Ethiopia from 1997 to 2019.[2]

A deeper interrogation of the data showed disparities of perinatal mortality across the different counties in Liberia. Grand Bassa County and Sinoe County are particularly worrisome, with perinatal mortality escalating from 20.61 to 55.99 and 10.97 to 65.52 per 1000 births, respectively. These findings could imply that interventions that may have been effective in the past are now insufficient. Also, the findings could suggest that new risk factors have emerged that are exacerbating perinatal mortality in these areas.

The overall increase in PMR signifies that Liberia faces a significant challenge in maternal and child health that need urgent addressing. Rising PMR could be indicative of broader systemic issues, including lack of access to quality healthcare, limited prenatal and postnatal care or socioeconomic factors that hinder healthcare utilisation. The difference in trends of PMR at the county level emphasises the importance of localised public health interventions. These interventions should be tailor made to address the specific needs and challenges of each county, as a 'one-size-fits-all' approach is unlikely to be effective.

The study further unearthed a tapestry of predictors affecting perinatal mortality in both survey periods. The age of mothers emerged as a significant predictor of perinatal mortality in 2013. Mothers aged 30–39 years exhibited a lower risk of perinatal mortality in 2013, a trend which was not observed in the 2019–2020 rounds. This disparity raised a question of underlying age-related risk variations. There could have been changes in healthcare access and quality, particularly for women in age group of 30–39 years. Also, a shift in the demographic composition of the 30–39 years age group in Liberia, such as occupation, parity, birth intervals and ANC attendance, could affect perinatal mortality risk. Conversely, other studies pointed to increased age of mother (35 years and above) to be a high-risk factor for perinatal mortality.[28 36] It is also important to explore further to discern on the other mechanisms at play in Liberia.

The increased number of previously born children was observed to be a protective factor of perinatal mortality in both rounds, showing almost the same reduced risk levels (70% in 2013 and 76% in 2019 (2020)). Similarly, Dheresa *et al* reported a reduced risk of perinatal mortality among mothers with multiparity in their study.[15] This highlights the importance of maternal experience and the potential role of enhanced maternal care and knowledge in subsequent pregnancies.

Interestingly, there was a consistent association between frequent radio listening and increased perinatal mortality risk in both survey rounds. This disparity could be explained by the type of healthcare content broadcasted on the radio changing over the years. After the civil unrest in the country, there may have been an introduction of programmes or advertisements that promote harmful health behaviours, misinformation or stress that

Table 5 Comparison of predictors of perinatal mortality in 2013 and 2019 (2020)			
	2013	**2019 (2020)**	
	Model 1	**Model 2**	**Model 3**
Independent variables	**aOR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Age of respondent	**P=0.068**	P=0.623	NS
<20	1	1	
20–29	1.23 (0.73 to 2.07)	1.30 (0.74 to 2.28)	
30–39	0.65 (0.33 to 1.27)	1.32 (0.67 to 2.59)	
40–49	0.62 (0.26 to 1.49)	1.10 (0.49 to 2.43)	
Marital status	**P=0.112**	P=0.981	NS
Married	1	1	
Cohabitation	1.16 (0.83 to 1.62)	0.79 (0.57 to 1.09)	
Widowed	0.50 (0.67 to 3.66)	0.28 (0.04 to 2.13)	
Divorced/separated	1.55 (0.92 to 2.62)	1.19 (0.74 to 1.91)	
Never in union	1.53 (0.96 to 2.44)	0.93 (0.57 to 1.43)	
Number of children ever born	**P=0.011**	**P<0.0001**	**P<0.0001**
No child	1	1	1
1–3	0.30 (0.14 to 0.64)**	0.24 (0.11 to 0.54)**	0.25 (0.13 to 0.48)***
4–6	0.39 (0.19 to 0.78)**	0.43 (0.21 to 0.88)*	0.42 (0.23 to 0.80)**
7–9	0.43 (0.21 to 0.88)*	0.59 (0.29 to 1.19)	0.57 (0.30 to 1.11)
10+	1	1	1
Frequency of listening to radio	**P=0.086**	**P<0.0001**	**P<0.0001**
Not at all	1	1	1
Less than once a week	1.03 (0.72 to 1.47)	1.13 (0.81 to 1.57)	1.21 (0.88 to 1.67)
At least once a week	1.36 (0.99 to 1.89)	1.86 (1.35 to 2.57)***	1.90 (1.38 to 2.62)***
Pregnancy interval (months)	**P=0.01**	**P<0.0001**	**P<0.0001**
First pregnancy	1	1	1
<15	1.53 (0.94 to 2.51)	0.99 (0.59 to 1.65)	1.11 (0.69 to 1.78)
15–26	0.80 (0.49 to 1.31)	0.44 (0.26 to 0.75)**	0.48 (0.29 to 0.79)**
27–38	0.88 (0.52 to 1.48)	0.42 (0.24 to 0.75)**	0.47 (0.27 to 0.81)**
≥39	0.65 (0.39 to 1.08)	0.40 (0.24 to 0.66)**	0.46 (0.29 to 0.72)**
Person providing assistance during ANC	**P=0.015**	P=0.568	NS
Doctor	1	1	
Nurse/midwife	1.07 (0.73 to 1.58)	0.87 (0.600 to 1.24)	
Other health worker	1.12 (0.43 to 2.93)	1	
TBA/other/relative	0.84 (0.29 to 2.44)	3.69 (1.68 to 8.10)	
No ANC	1.46 (0.67 to 3.17)	0.68 (0.22 to 2.17)	
Received 2+ tetanus injections during pregnancy	**P=0.165**	**P=0.019**	P<0.01
No	1	1	1
Yes	0.87 (0.61 to 1.22)	0.75 (0.55 to 1.02)	0.69 (0.51 to 0.93)*
Took iron tablet/syrup during pregnancy	**P<0.0001**	**P<0.0001**	**P<0.0001**
No	1	1	1
Yes	0.90 (0.48 to 1.68)	2.10 (0.90 to 4.92)	2.11 (0.97 to 4.60)
Don't know	1	41.47 (14.12 to 121.75)	78.51 (29.71 to 207.50)

*P≤0.05, **p<0.001, ***p<0.00001.
ANC, antenatal care; aOR, adjusted OR; NS, not significant.

could potentially have a negative impact on maternal outcome. In contrast, a similar study reported increased risk of perinatal mortality among mothers with less exposure to media, including radio.[17] It is critical for the health ministry and the government of Liberia to take a keen look at the contents of radio, particularly in relation to healthcare service and health products.

This study further elucidates the critical role of optimal pregnancy intervals, a finding that has been consistent for both survey years. The increased risk associated with short pregnancy intervals and the protective effect of longer intervals promotes the significance of family planning and spacing of pregnancies. This finding directly contributes to the achievement of the SDG 3. Therefore, emphasising the significance of family planning and spacing of pregnancy supports SDG 3's target of reducing maternal mortality and ending preventable deaths of newborns and children. Effective implementation of family planning strategies can thus be a crucial step towards the global health objective under SDG 3. This finding corresponds with that of the study by Jena *et al*,[2] where pregnancy interval less than 15 months was found to be a risk factor of perinatal mortality.

The study also showed a consistent protective effect of mothers receiving two or more tetanus injections against perinatal mortality for both study periods. Also, although not observed in the 2013 period, the use of SP/Fansidar (antimalarial) in the 2019–2020 survey round showed a protective effect of perinatal mortality. Both maternal tetanus injection and the uptake of SP/Fansidar are found to be protective factors of perinatal mortality in other studies.[23 25 27 37] These findings advocate for the sustained promotion and accessibility of such interventions to optimise maternal and neonatal outcomes.

Strength and limitations

The study employed a nationally representative dataset from the LDHS. Findings obtained from such datasets are considered to be appropriate for generalisation. In addition, the study compared two different survey periods, accounting for the changing landscape of governmental healthcare policies and the dynamic human behaviour. The regression models derived from the datasets were put to critical scrutiny to ensure their validity and reliability for regression analysis.

The study, however, shares some limitations with cross-sectional study in that it is not possible to establish the causal relationships between the predictors and outcomes. There is also a high possibility of recall bias, like maternal recall of previous pregnancies and their outcomes, birth intervals, and time of ANC registration and number of ANC attendance. This can affect the accuracy of the findings of the study. Another limitation is that the original datasets did not provide an exact indicator for perinatal mortality. The perinatal mortalities were obtained by merging different data groups, that is, the women data group (individual recode) and the birth data group (birth recode). This method might either miss out on or inaccurately represent some critical variables related to perinatal mortalities.

CONCLUSION

This comparative exploration of the 2013 and 2019–2020 LDHS datasets reveals a critical increase in perinatal mortality in Liberia, indicating a critical need for targeted and county-specific interventions. The study also identified an evolving and varied risk factors which include dynamic roles of maternal age, marital status and person providing ANC assistance. These factors underscore the importance of adaptive healthcare policies and continued research in the country. The consistent protective impact of the optimal pregnancy intervals, comprehensive ANC and specific medical interventions such as prevention of maternal and neonatal tetanus and prevention of malaria in pregnancy, in both survey periods, highlights enduring avenues for reducing perinatal mortality in Liberia. The insights obtained from the study are pivotal for informing maternal and perinatal health policies and implementing strategic interventions towards reducing the burden of perinatal mortality in a post-conflict recovery phase and gearing towards achieving SDG, particularly Goal 3's targets. In the same vein, the study findings are important in shaping future research in maternal and reproductive healthcare in Liberia.

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