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High-risk fertility behaviour and childhood anaemia in sub-Saharan Africa

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ABSTRACT

Objective This study sought to examine the association between high-risk fertility behaviour and childhood anaemia in sub-Saharan Africa .

Design An analytical study was conducted using cross-sectional data from mothers with children under age 5 (n=64 512) from 28 sub-Saharan African countries. Multilevel logistic regression models were fitted to examine the association between high-risk fertility behaviour and childhood anaemia. The results were presented using adjusted odds ratios (aORs) with 95% confidence interval (CI).

Setting Twenty-eight sub-Saharan African countries.

Outcome measure Childhood anaemia.

Results The percentage of children with anaemia in the 28 countries was 66.7%. We found that age more than 34 at delivery and short birth interval had significant associations with childhood anaemia. Children of mothers whose most recent delivery occurred after 34 years were less likely to be anaemic compared with those whose most recent delivery occurred before age 34 (aOR=0.89; 95% CI 0.83 to 0.95). We found that children born to mothers with short birth intervals were more likely to be anaemic, compared with those with long birth intervals (aOR=1.08; 95% CI 1.01 to 1.16).

Conclusions We, therefore, draw the attention of policy makers and programme implementers to invest in policies and programmes aimed at combating childhood anaemia in sub-Saharan Africa to focus on the population at risk, that is, women whose most recent delivery occurred at younger ages and those with short birth intervals. Encouraging contraceptive use and creating awareness about the importance of birth spacing among reproductive-age women would be more helpful.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study used a nationally representative data set of 28 countries in sub-Saharan Africa, hence making our findings generalisable to the countries included in the present study.
⇒ Demographic and Health Survey (DHS) data have been used and validated in several instances, which ensures the validity and reliability of our findings.
⇒ Being a cross-sectional study, data from DHS cannot assess causality between high-risk fertility behaviour (HRFB) and childhood anaemia.
⇒ Since the study was based on secondary data, cultural factors that reinforce the association between HRFB and childhood anaemia could not be measured.

INTRODUCTION

Over the years, there have been concerted efforts to drastically reduce anaemia among children through deworming programmes, iron supplementation, and the distribution of insecticide-treated bed nets.[1] Notwithstanding, childhood anaemia remains a serious public health concern worldwide, especially in low- and middle-income countries in sub-Saharan Africa (SSA).[2] A child is said to be anaemic when blood haemoglobin (Hb) level is <11.0 g/L.[3] Globally, 273 million children under age 5, constituting 43% of under-five children, suffer from anaemia, with more than 53% of this prevalence reported in SSA.[4]

Anaemia among children can have deleterious consequences on the physical growth, as well as the cognitive/mental development and social behaviours of children.[5 6] In severe cases of childhood anaemia, the risks of lower aerobic exercise capacity and heart failure are increased exponentially, and this can lead to childhood mortality.[7] The current modalities for treating anaemia among children include iron supplementation, erythropoietin-stimulating agents and blood transfusions.[8]

The literature indicates that there is a myriad of factors accountable for anaemia among children. Iron deficiency is recognised as the most common cause of anaemia among children.[9] Hookworm infestation has also been identified as another common cause of asymptomatic anaemia through blood loss.[9] Also, there are child (ie, younger age, sex of the child), maternal (ie, maternal age, maternal anaemia and

maternal education) and household (wealth index) factors that account for childhood anaemia.[10–12] Apart from these factors, other studies have recognised the absence of deworming, malnutrition and recent infections or diseases like diarrhoea to significantly increase the odds of childhood anaemia.[10 13]

Beyond these factors, there is a growing interest in the association between high-risk fertility behaviour (HRFB) and child health outcomes.[11] HRFB is manifested in terms of too-early or too-late maternal age at delivery, shorter birth interval and a higher number of live births.[14] Available evidence indicates that HRFB is associated with both neonatal and under-five deaths in low- and middle-income countries and regions like SSA.[15] However, little scholarship has been given to the association between HRFB and childhood anaemia in SSA. This presents a gap in the existing scholarship on HRFB and childhood anaemia in SSA, hence, the need for this study which aims to examine the association between HRFB and childhood anaemia in SSA. It is expected that the findings of this study will contribute to expediting SSA's quest to achieve the Sustainable Development Goal 3, target 3.2.[16]

METHODS

Study design

The study used cross-sectional data from the most recent Demographic and Health Surveys (DHSs) of 28 sub-Saharan African countries. DHS is a nationally representative survey which collects data on health indicators using stratified multistage sampling. The first stage of the sampling procedure involves the selection of clusters, also called enumeration areas (EA). This is followed by the selection of households in each EA in the second stage. These surveys are implemented every 5 years in more than 90 low-income and middle-income countries across the world. The programme uses standardised protocols including sampling techniques, instruments, data management and analyses procedures in all these countries to provide for cross-national comparisons. The use of the multistaged sampling technique, the standardised instrument use and the rigorous data management techniques ensured the reliability of the survey data. The data were also collected by experienced and trained researchers and this also enhanced the reliability of the data. The primary focus of the programme is child and maternal health, with women and men of ages 15–49 years at the households as target groups for interviews. Details of the data collection procedure have been published elsewhere.[17] In this study, data from mothers with children under age 5 before the most recent survey (n=64 512) were extracted for the analyses.[18] Table 1 shows a description of the study sample.

Table 1 Description of the study sample

Countries	Year of survey	Weighted n	Weighted %
1. Angola	2015–2016	2624	4.07
2. Burkina Faso	2010	3419	5.30
3. Benin	2018	2968	4.60
4. Burundi	2016–2017	2987	4.63
5. DR Congo	2013–2014	3555	5.51
6. Congo	2011–2012	1893	2.93
7. Cote d'Ivoire	2011–2012	1554	2.41
8. Cameroon	2018	2069	3.21
9. Ethiopia	2016	4113	6.38
10. Gabon	2012	1394	2.16
11. Ghana	2014	1356	2.10
12. Gambia	2013	541	0.84
13. Guinea	2018	1691	2.62
14. Lesotho	2014	765	1.19
15. Mali	2018	1918	2.97
16. Malawi	2015–2016	3014	4.67
17. Nigeria	2018	5470	8.48
18. Niger	2012	1839	2.85
19. Namibia	2013	678	1.05
20. Rwanda	2014–2015	1011	1.57
21. Sierra Leone	2019	1893	2.93
22. Senegal	2010–2011	1300	2.01
23. Togo	2013–2014	1628	2.52
24. Tanzania	2015–2016	4680	7.25
25. Uganda	2016	1962	3.04
26. South Africa	2016	554	0.86
27. Zambia	2018	4796	7.43
28. Zimbabwe	2015	2840	4.42
All countries		64 512	100.00

Variables

Outcome variable

Anaemia status of children was the outcome variable considered in this study. For each DHS, anaemia status of living children within the age bracket of 0–4 years before the survey night was taken. It has its responses classified into four categories according to the World Health Organisation (WHO) recommendation: (1) 'Not anaemic' for children with Hb count (g/L) measuring above 11 g/L; (2) 'Mild anaemia' for Hb count of 10–10.9 g/L; (3) 'Moderate anaemia' for Hb count between 7.0 and 9.9 g/L; and (4) 'Severe anaemia' for Hb count less than 7.0 g/L.[19] Children with no observations for anaemia count (not tested) and those whose mothers were not listed in the household questionnaire were excluded. Observations under mild, moderate and severe were combined and recoded as 'Anaemic (Yes)' and observations under not anaemic were recoded as 'Not anaemic

(No)'. The anaemia status of children was represented as a dichotomous variable with '0' representing 'No' and 1 representing 'Yes'.[10–12 20]

Key explanatory variable

The key explanatory variable considered in this study was HRFB among women aged 15–49 years. Four parameters were used as indicators of HRFB based on previous studies.[21 22] These were mother aged <18 years at the time of delivery, mother aged >34 years at the time of delivery, mother of a child born after a short birth interval (<24 months) and mother of high parity (>3 children).

Covariates

Nineteen covariates consisting of child, mother, household and community factors were considered as covariates in this study.[10–12] The child factors were sex of the child (male and female), age of the child (0, 1, 2 and 4), birth order of child (1, 2, and 3 and above) and perceived size at birth (small, average and large). The mother factors were maternal age (recoded into two categories of '15–19' years and '20–49' years), educational level (no formal education, primary, secondary and higher), employment status (yes and no), antenatal visits during pregnancy (yes and no), postnatal check within 2 months (yes and no), place of delivery (home, health facility, other), marital status (single and married) and exposure to media (yes, no). Source of drinking water (recoded as 'improved' and 'unimproved'), type of toilet facility (recoded into 'improved' and 'unimproved'), household size (recoded as 'small', 'medium' and 'large'), type of cooking fuel (recoded as 'clean' and 'unclean') and wealth status were considered as household factors. Place of residence (rural and urban) and geographical subregions were the community factors.

Data analyses

Stata SE V.14.2 was used for data analyses. We first performed descriptive statistics using frequencies and percentages (weighted) to examine the distributions of the variables and underlying characteristics for each country. Next, χ^2 test of independence was used to determine the associations between the outcome variable and each of the explanatory variables. This was followed by multicollinearity diagnoses of the explanatory variables considered in the study. The results of the multicollinearity test showed that the minimum, maximum and mean variance inflation factors were 1.00, 5.02 and 1.69, respectively. Hence, there was no evidence of multicollinearity among the study variables. Finally, a multivariable multilevel logistic regression analysis was carried out to examine the association between HRFB and childhood anaemia using three models. The first model (model 0) was fitted to include only the outcome variable (anaemia) to demonstrate the variation in anaemia among children attributed to the clustering by the primary sampling units. Model I examined the association between the key explanatory variables and anaemia among children. The final model (model II) was fitted to control for the covariates. The results were presented using adjusted odds ratios (aOR) with the respective 95% confidence intervals (CIs). Model fitness and comparison were checked using the Akaike's information criterion (AIC). The last model with the least AIC was selected as the best fitted model for the study. Statistical significance was set at $p<0.05$. All frequency distributions were weighted to adjust for oversampling or undersampling and the survey data declaration command 'svyset' was executed to allow for adjustment of differences as a result of the multistaged sampling design.

Patient and public involvement

Patients and the public were not involved in the design and conduct of this research.

RESULTS

Descriptive results

The percentage of anaemic children in the 28 countries was 66.7%, with the highest (90.5%) and lowest (38.9%) prevalence of childhood anaemia in Burkina Faso and Rwanda, respectively (table 2). In terms of HRFB, 4.0% of the mothers had their their most recent delivery below 18 years, 19.2% had their most recent delivery after 34 years, 12.7% had a short birth interval and 45.4% had more than three children. In terms of the association between the explanatory variables and childhood anaemia, we found significant associations between the key explanatory variable and the covariates and childhood anaemia, except the size of the child at birth, postnatal care (PNC), and drinking water source (table 3).

Multilevel regression results on the association between HRFB and childhood anaemia

Table 4 shows the results from the multilevel logistic regression analysis on the association between HRFB and childhood anaemia. The last model, which had all the explanatory variables and the covariates, was chosen as the best fit model because it had the highest log-likelihood ratio (−37 392.375) and the lowest AIC (74 854.75). The model indicates the association between HRFB and childhood anaemia, while controlling for child characteristics, mother's characteristics, household characteristics and contextual factors. In terms of the effect of HRFB on childhood anaemia, we found that only age more than 34 at birth and short birth interval had associations with childhood anaemia. In terms of the effect of age more than 34 at birth and childhood anaemia, we found that children of mothers whose most recent delivery occurred after 34 years were less likely to be anaemic compared with those whose most recent delivery occurred before 34 years (this includes most recent delivery at age less than 18) (aOR=0.89; 95% CI 0.83 to 0.95). With short birth interval, we found that children born to mothers with short birth interval were more likely to be anaemic,

Table 2 Prevalence of childhood anaemia and high-risk fertility behaviour

Countries	Anaemia (%)	Age less than 18 at most recent delivery (%)	Age more than 34 at most recent delivery (%)	Short birth interval (%)	High parity (%)
1. Angola	69.1	6.7	18.6	17.5	45.6
2. Burkina Faso	90.5	2.6	20.4	8.7	51.2
3. Benin	75.2	3.1	19.9	11.5	45.8
4. Burundi	62.5	1.1	23.1	13.1	49.9
5. DR Congo	62.6	4.0	20.6	20.9	53.1
6. Congo	69.2	5.4	19.0	10.5	37.8
7. Cote d'Ivoire	76.9	6.7	17.4	9.6	43.8
8. Cameroon	61.3	4.7	16.2	17.5	45.6
9. Ethiopia	58.5	2.4	19.4	14.4	51.9
10. Gabon	63.1	8.1	17.8	10.3	36.4
11. Ghana	68.0	1.5	23.7	8.0	42.2
12. Gambia	81.6	2.7	18.3	10.8	53.2
13. Guinea	77.4	8.2	19.8	12.4	45.2
14. Lesotho	53.9	3.4	14.6	7.2	22.8
15. Mali	85.7	5.0	19.6	16.6	54.9
16. Malawi	65.5	4.7	13.0	8.1	37.9
17. Nigeria	70.9	3.2	21.1	16.6	50.0
18. Niger	81.1	4.6	19.8	17.8	61.6
19. Namibia	53.0	3.4	17.8	8.7	27.2
20. Rwanda	38.9	1.2	20.5	8.9	35.1
21. Sierra Leone	68.6	4.4	18.1	9.0	41.2
22. Senegal	78.3	3.8	20.5	13.3	47.9
23. Togo	74.0	2.5	20.7	8.9	42.4
24. Tanzania	61.6	3.8	21.1	12.5	43.8
25. Uganda	55.2	2.8	19.1	18.3	49.7
26. South Africa	61.2	5.7	13.2	7.1	15.7
27. Zambia	61.8	5.3	18.0	9.4	43.2
28. Zimbabwe	40.3	3.5	15.1	7.8	32.2
All countries	66.7	4.0	19.2	12.7	45.4

compared with those with long birth interval (aOR=1.08; 95% CI 1.01 to 1.16).

DISCUSSION

Younger or older maternal age, high parity, and shorter birth intervals describe what is known as HRFB. Studies have shown that HRFB is detrimental to the health of both mothers and their children.[23] However, in the present study, we examined the relationship between HRFB and childhood anaemia in SSA. Our findings indicate that SSA has a high burden of childhood anaemia, with about 67 out of 100 children born in the countries included in this study being anaemic. This result corroborates other studies that have found childhood anaemia to be high in SSA.[11 24] The observed prevalence of childhood anaemia (66.7%) is higher than the global prevalence of childhood anaemia (43%).[4] Our observed prevalence of childhood anaemia is further higher than the prevalence in Latin America and Caribbean countries such as Chile (4.0%), Costa Rica (4.0%), Argentina (7.6%) and Mexico (19.9%).[25] This high prevalence of childhood anaemia raises a lot of concerns about SSA's readiness to achieve the global nutrition target of 50% reduction in anaemia by 2025.[26] We also found some intercountry variations pertaining to the prevalence of anaemia in SSA, with a very high prevalence recorded in Burkina Faso, whereas Zimbabwe recorded the lowest prevalence. This finding corroborates related studies that have also reported the highest prevalence of childhood anaemia in Burkina Faso[11 27] and very low prevalence for

Table 3 Distribution of childhood anaemia across high-risk fertility behaviour and covariates

Variables	Weighted n	Weighted %	Anaemia (%)	P value
Age less than 18 at most recent delivery				<0.001
No	61 938	96.0	66.5	
Yes	2574	4.0	71.7	
Age more than 34 at most recent delivery				<0.001
No	52 147	80.8	67.3	
Yes	12 365	19.2	64.4	
Short birth interval				0.001
No	56 307	87.3	66.4	
Yes	8205	12.7	68.8	
High parity				<0.001
No	35 252	54.6	65.8	
Yes	29 260	45.4	67.9	
Sex of child				<0.001
Male	33 427	51.8	67.9	
Female	31 085	48.2	65.5	
Age of child				<0.001
0	11 256	17.5	78.5	
1	21 640	33.5	74.5	
2	15 476	24.0	64.4	
3	9773	15.1	53.6	
4	6367	9.9	45.3	
Birth order				0.001
First	12 370	19.2	66.4	
2–4	31 415	48.7	66.4	
5+	20 727	32.1	68.0	
Size of child at birth				0.398
Large	9113	14.1	67.0	
Average	17 272	26.8	66.2	
Smaller	38 127	59.1	66.9	
Mother's age				<0.001
15–19	3685	5.7	76.7	
20–49	60 827	94.3	66.1	
Maternal educational level				<0.001
No education	23 484	36.4	75.6	
Primary	21 601	33.4	63.4	
Secondary	17 259	26.8	60.8	
Higher	2168	3.4	61.4	
Current employment status				0.001
No	22 078	34.2	67.9	
Yes	42 434	65.8	66.1	
Antenatal Care				<0.001
No	5705	8.8	72.4	
Yes	58 807	91.2	66.2	
Place of delivery				<0.001

Continued

Table 3 Continued

Variables	Weighted n	Weighted %	Anaemia (%)	P value
Home	18331	28.4	71.3	
Health facility	45380	70.3	64.9	
Other	801	1.2	63.8	
Postnatal Care				0.752
No	36090	55.9	66.7	
Yes	28422	44.1	66.8	
Marital status				<0.001
Single	8862	13.7	63.6	
Married	55650	86.3	67.2	
Drinking water source				0.204
Improved	42167	65.4	66.5	
Unimproved	22345	34.6	67.2	
Toilet facility				<0.001
Improved	30470	47.2	63.0	
Unimproved	34042	52.8	70.1	
Household size				<0.001
Small	28489	44.2	64.2	
Medium	28511	44.2	66.9	
Large	7512	11.6	75.7	
Mass media exposure				<0.001
No	22096	34.3	69.4	
Yes	42416	65.7	65.4	
Cooking fuel				<0.001
Unclean	57176	88.6	67.7	
Clean	7336	11.4	59.2	
Wealth index				<0.001
Poorest	13415	20.8	72.1	
Poorer	13463	20.9	69.0	
Middle	12956	20.1	67.9	
Richer	13073	20.2	64.8	
Richest	11605	18.0	58.8	
Place of residence				<0.001
Urban	21668	33.6	63.0	
Rural	42844	66.4	68.6	

P values obtained from χ^2 test.

Zimbabwe.[28] Soares Magalhães and Clements[27] posit that the high prevalence of childhood anaemia in West Africa, particularly in Burkina Faso where it is most prevalent, could be explained by the pervasiveness of two important haematological conditions (haemoglobinopathies and thalassemias) which are hereditary.

Overall, the results of this study suggest that HRFB (older maternal age and shorter birth intervals) is significantly associated with childhood anaemia. Concerning older maternal age, our findings revealed that children born to women who were older than 34 years had lower odds of becoming anaemic compared with those who had childbirth before age 34 (this includes most recent delivery at age less than 18). Thus, younger maternal age was a significant risk factor while older maternal age was protective for childhood anaemia. This finding is supported by Moschovis *et al*[11] who showed that younger age was significantly associated with higher anaemia among children. A similar finding was reported in Armenia, where younger maternal age was found to be significantly associated with increased odds of childhood anaemia.[18] The result could possibly be due to the

Table 4 Multilevel regression modelling of association between high-risk fertility behaviour and childhood anaemia

Variables	Model 0	Model I aOR (95% CI)	Model II aOR (95% CI)
Fixed effects			
Key explanatory variables			
Age less than 18 at birth			
No		1 (1.00 to 1.00)	1 (1.00 to 1.00)
Yes		1.34*** (1.20 to 1.50)	0.99 (0.84 to 1.18)
Age more than 34 at birth			
No		1 (1.00 to 1.00)	1 (1.00 to 1.00)
Yes		0.80*** (0.76 to 0.85)	0.89*** (0.83 to 0.95)
Short birth interval			
No		1 (1.00 to 1.00)	1 (1.00 to 1.00)
Yes		1.09* (1.02 to 1.17)	1.08* (1.01 to 1.16)
High parity			
No		1 (1.00 to 1.00)	1 (1.00 to 1.00)
Yes		1.21*** (1.15 to 1.27)	1.06 (0.98 to 1.14)
Random effects			
PSU variance (95% CI)	0.067 (0.051 to 0.088)	0.067 (0.051 to 0.087)	0.076 (0.058 to 0.100)
ICC	0.0199881	0.0198841	0.0226424
Wald χ^2	Reference	100.69 (<0.001)	3844.34 (<0.001)
Model fitness			
Log-likelihood	−40668.23	−40581.826	−37392.375
AIC	81340.46	81175.65	74854.75
n	64512	64512	64512
Clusters (n)	1375	1375	1375

Exponentiated coefficients; 95% CIs in brackets. *P<0.05; **p<0.01; ***p<0.001. 1=Reference category .
Model 0: empty model with no explanatory variables.
Model I: contained only the key explanatory variables.
Model II: contained the key explanatory variables and covariates.
AIC, Akaike's information criterion; aOR, adjusted OR; ICC, intraclass correlation; PSU, primary sampling unit.

experience of younger women who become mothers as well as the limited resources at their disposal, which makes it difficult for them to meet the nutritional requirements for their children, eventually exacerbating nutritional deficiencies that consequently affect childhood development and risk of anaemia.[23 29–31] Therefore, to reduce the likelihood of childhood anaemia, it is imperative to strengthen the efforts to minimise childbirth before age 18. This can be achieved by accelerating actions to improve modern contraceptive use among young women (18 years and below).

Several studies have shown the significant positive effects of increasing birth intervals on the child health outcomes.[15 32 33] Our findings align with these previous studies by showing that shorter birth intervals exacerbate the risk of childhood anaemia. Thus, when women have birth intervals less than the optimal interval between 36 and 60 months,[32] then their children stand a high likelihood of developing anaemia. Hence, this emphasises the need for women in SSA to maintain optimal birth interval in order to reduce the probability of the children becoming anaemic. This could be achieved by encouraging family planning uptake by women as it has the potential to optimal spacing between births and contribute towards reducing the risk of anaemia among children. It also calls on the government to improve access to family planning commodities. Apart from this, our study highlights the significant association between household size and childhood anaemia, with large household sizes increasing the likelihood of childhood anaemia 1.21-fold.

A primary limitation of the study is the use of secondary data which limited our analyses to variables within the data set. Also, given that the DHS employs a cross-sectional research design, we are unable to establish causality between HRFB and childhood anaemia. In the future, longitudinal studies may be appropriate in establishing causal inferences between HRFB and childhood anaemia.

CONCLUSION

The study concludes that HRFB (older maternal age at childbirth and shorter birth intervals) is significantly associated with childhood anaemia. Hence, there is the need for policies and programmes aimed at combating childhood anaemia in SSA to focus on the population at risk (ie, children born to younger mothers, children with short birth intervals). Encouraging contraceptive use and creating awareness about the importance of birth spacing among reproductive-age women would be more helpful.

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Contributors JO is the guarantor of this study and accept full responsibility for the work. JO, BOA, A-AS and SY conceptualised the study. RGA, BOA and A-AS conducted the data analysis with inputs from EB. JO, RGA, BOA, A-AS, EKA, EB, BZ and SY contributed to the draft and reviewed and approved the final version. All the authors have read and approved the final version for publication.

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Patient consent for publication Not required.

Ethics approval Ethical approval was not sought for the present study since the data is available in the public domain. Permission was first sought from the MEASURE DHS before using the data for the current study. Detailed ethical guidelines and standards can be found at http://goo.gl/ny8T6X.

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Data availability statement Data are available in a public, open access repository. The data set analysed is publicly available via https://dhsprogram.com/data/available-datasets.cfm.

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