BMJ Open

Under-5 mortality in sub-Saharan Africa: is maternal age at first childbirth below 20 years a risk factor?

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To cite: Ahinkorah BO. Under-5 mortality in sub-Saharan Africa: is maternal age at first childbirth below 20 years a risk factor? *BMJ Open* 2021;**11**:e049337. doi:10.1136/bmjopen-2021-049337

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-049337).

Received 26 January 2021
Accepted 06 September 2021

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ABSTRACT

Objectives This study aimed at examining the association between young maternal age at first childbirth and under-5 mortality in sub-Saharan Africa (SSA).

Design and setting This cross-sectional study pooled nationally-representative data from the most recent Demographic and Health Surveys conducted in 30 countries in SSA from 2010 to 2019.

Participants 116 379 mothers of children under 5.

Results The prevalence of adolescent childbirth and death in children under 5 in SSA were 57.36% (95% CI 53.73% to 60.99%) and 4.10% (95% CI 3.65% to 4.54%), respectively. Children born to mothers whose first childbirth occurred at <20 years were 11% more likely to die before the age of 5 compared with those whose mothers' first childbirth occurred at age ≥20 years (adjusted odds ratio (aOR) 1.11; 95% CI 1.05 to 1.18). In terms of the covariates, the likelihood of under-5 mortality was higher among children born to single (aOR 1.54; 95% CI 1.41 to 1.67) and cohabiting mothers (aOR 1.10; 95% CI 1.01 to 1.21) compared with married mothers. Children born to mothers who were obese were more likely to die before the age of 5 compared with those born to mothers with normal body weight (aOR 1.17; 95% CI 1.09 to 1.26). The odds of under-5 mortality were higher among children whose weight at birth was <2500 g compared with those whose weight was ≥2500 g at birth (aOR 1.83; 95% CI 1.64 to 2.03).

Conclusions The findings call for the need to enhance policies aimed at reducing under-5 mortality in SSA by reducing adolescent pregnancy and childbirth through family planning, comprehensive sexuality education, and the elimination of child marriage. Again, Since under-5 mortality among adolescent mothers is linked with their poor socio-economic status, there is the need for government and non-governmental organisations in SSA to introduce poverty alleviation programmes and improve access to both formal and informal education as a way of enhancing the socioeconomic status of adolescent mothers. Public health education, through continuous advocacy programmes should be done to encourage adolescent mothers to access antenatal care and health facility deliveries as a way of enhancing the survival status of their children. These interventions should be implemented, taking into consideration other characteristics of mothers such marital status and BMI and child's characteristics such as child's weight, which were found to be associated with high under-5 mortality.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The use of large nationally representative datasets of 30 countries in sub-Saharan Africa is a major strength of this study.
⇒ Again, the large sample size made it possible to use high level statistical analyses that confirm the accuracy of the findings.
⇒ In terms of limitations, the design employed in the Demographic and Health Surveys is cross-sectional and hence, causal interpretations of the findings cannot be established.
⇒ Age at first childbirth was self-reported, and as a result, there is the possibility of under-reporting and over-reporting of data.

INTRODUCTION

Death of children under 5 is a significant health indicator and a key development index for nations worldwide.[1] Between 1990 and 2018, the global under-5 mortality rate reduced by 52% from 93 deaths per 1000 live births to 39 deaths per 1000 live births.[2] This decline has not been experienced in all regions as the chances of a child's survival from birth to 59 months have differed from one region to another.[3–5] Globally, sub-Saharan Africa (SSA) has been considered as the region with the highest under-5 mortality rate.[6–9] For instance, in 2018, SSA recorded an under-5 mortality rate of 78 deaths per 1000 live births, compared with 39 deaths per 1000 live births globally and this translated to 1 death for every 13 live births, compared with 1 death for every 199 live births in high-income countries.[2]

The Sustainable Development Goal-3 aims to reduce under-5 mortality rate to at least 25 per 1000 live births by 2030.[10] In line with this, WHO[11] has recommended strategies such as access to nutrition and micronutrients, exclusive breastfeeding, skilled antenatal care (ANC) and birth attendance, and postnatal care as means of improving the health status of children and enhancing their chances of survival. However, evidence has shown that

most of these strategies are beyond the reach of a number of sub-Saharan African countries, due to the absence of empirical data on the causes of under-5 mortality in most of the countries in SSA.[12–15]

In SSA, the major causes of under-5 deaths include pregnancy-related complications, pneumonia, diarrhoea, neonatal sepsis and malaria.[16] Apart from these causes, studies have found several maternal and child factors such as maternal age, place of residence, level of education, wealth quintile, sex of the child, birth rank, size of the child at birth, place of delivery, assistance during delivery, and number of ANC attendance as factors associated with deaths of children under 5 in SSA.[6 7 9 17 18]

Other studies have shown that maternal age at first birth is associated with adverse birth outcomes such as neonatal mortality,[19] low birth weight, pre-eclampsia/eclampsia, preterm birth, and maternal and perinatal mortality in SSA.[20] This has been found to occur because women who give birth at young age are more likely to be less wealthy and have received less education[21 22] and may make less use of maternal and child healthcare services.[23 24] Moreover, since such births are more likely to be their first birth, they carry increased risks.[25]

Globally, several studies have found that children born to mothers whose first childbirth occurred during adolescence are more likely to die before age 5 compared with those born to mothers whose first childbirth occurred in adulthood.[26–29] In SSA, there are studies that have shown that adolescent pregnancy and childbirth do not only have short-term and medium-term negative effects on the adolescent girl but established long-term effects as well.[30 31] These studies explained that most adolescents in SSA who have experienced adolescent pregnancy or childbirth are likely to be socioeconomically disadvantaged even after several years due to school drop-outs, unemployment, and abandonment by parents.[31 32] Others may also experience long-term psychological problems such as anxiety and depression due to stigmatisation.[33–35] These negative situations may affect the health status of their subsequent children who are even born when they are adults.

Considering that SSA has the highest prevalence of under-5 mortality[6–9] and adolescent childbearing globally,[36 37] understanding the association between young maternal age at first childbirth and under-5 mortality in SSA is critical for policy and public health interventions. However, the only available evidence on the association between young maternal age at first childbirth and under-5 mortality in SSA have been done only in specific countries such as Nigeria[38] and South Sudan.[39] To the best of the author's knowledge, there has not been any study that has used pooled data accross a number of countries in SSA to examine the association between young maternal age at first childbirth and under-5 mortality. Again, considering the long-term effects of adolescent childbearing in SSA, it is important to understand its negative health effect not only for the firstborn children of adolescent mothers but their subsequent children as well, including those who were born when they were adults. The current study seeks to fill the gap in dearth of evidence by examining the association between young maternal age at first birth and under-5 mortality in SSA using data from the Demographic and Health Surveys (DHS) of 30 countries.

In this study, it is hypothesised that children of mothers whose first childbirth occurred when they were adolescents (less than 20 years) are more likely to die before the age of 5 compared with those whose mothers' first childbirth occurred at age 20 years and above. Findings from the study will be useful to government and non-governmental organisations of these countries in implementing and strengthening existing childhood healthcare programmes that can help improve child survival and reduce the high under-5 mortality rate in SSA.

METHODS

Study design

The birth recode files of the DHS of 30 countries in SSA, which contain data on the full birth history of all women interviewed and information on health indicators as well as fertility and mortality rates were used. Data for the DHS are mostly gathered every 5 years. However, this period can be longer in some countries due to specific country conditions. Data for each survey are obtained by sampling respondents using a two-stage sampling technique. The two stage sampling process begins with the selection of clusters usually called enumeration areas. This is followed by the selection of households for the survey. Details on the sampling methodology and data collection used by the DHS are published elsewhere.[40] In this study, the inclusion criteria were countries whose datasets were published between 2010 and 2019 and had information on age at first birth, child mortality and all other variables that were considered essential in this study. In all, 116 379 mothers of children under 5 were included in this study. The countries included in this study and their samples are shown in table 1. The manuscript was prepared in line with the Strengthening Reporting of Observational studies in Epidemiology reporting guidelines[41] as found in online supplemental table S1.

Study variables

Outcome variable

The outcome variable for this study was under-5 mortality, which has been defined as the death of children under-5 years.[1 42] This variable was recoded as a binary variable (0=no and 1=yes).[9 17]

Key explanatory variable

The main explanatory variable of the study was 'age at first childbirth'. This variable was derived from the question, 'how old were you when you first gave birth?' The responses to this question were in single years. For the purpose of this study, respondents who mentioned <20 years as their ages at the time of their first childbirth were considered as those who had 'adolescent

Table 1 Sample distribution by country

Survey countries	Survey year	Weighted sample	Percentage
Benin	2018	4584	3.94
Burkina Faso	2010	5339	4.59
Burundi	2017	4299	3.69
Cameroon	2018	3503	3.01
Chad	2015	7201	6.19
Comoros	2012	2056	1.77
Congo	2011–2012	3142	2.70
Congo DR	2013–2014	5557	4.77
Cote D'Ivoire	2011–2012	2538	2.18
Ethiopia	2016	7330	6.30
Gabon	2012	2518	2.16
Gambia	2013	2530	2.17
Ghana	2014	2128	1.83
Guinea	2018	2799	2.40
Kenya	2014	6767	5.81
Lesotho	2014	1329	1.14
Liberia	2013	2490	2.14
Malawi	2016	4478	3.85
Mali	2018	3262	2.80
Namibia	2013	1813	1.56
Niger	2012	3848	3.31
Nigeria	2018	8418	7.23
Rwanda	2015	2952	2.54
Senegal	2010–2011	3044	2.62
Sierra Leone	2019	3675	3.16
South Africa	2016	1226	1.05
Tanzania	2016	6965	5.98
Togo	2013–2014	2473	2.13
Uganda	2016	3339	2.87
Zimbabwe	2015	4776	4.10
All countries		116 379	100.00

childbirth' while those whose first childbirth occurred at ≥20 years were considered as those who gave birth as adults (adult childbirth).

Covariates

Based on the findings of previous studies on factors associated with under-5 mortality,[9 17 42 43] eleven variables, made up of nine individual-level factors (marital status, pregnancy intention, mother's education level, mother's body mass index (BMI), sex of child, child's weight, number of ANC visits, place of delivery, and assistant during delivery) and two contextual factors (wealth quintile and place of residence) were considered as the main covariates. Marital status was coded as married, cohabiting and single (never married, widowed, divorced, and separated). Pregnancy intention was coded as intended, mistimed and unwanted while mother's educational level was coded as no education, primary, and secondary/higher. Mother's BMI was coded as thin (<18.5kg/m2), normal (18.5–24.9kg/m2), and obese (>25kg/m2). Sex of the child was coded as male and female and child's birth weight was coded as ≥2500 g and <2500 g. The number of ANC visits was coded as less than four visits and four or more visits. Place of delivery was coded as home and health facility while assistant during delivery was coded as Traditional Birth Attendant (TBA)/others and Skilled Birth Attendant (SBA)/health professional. Wealth index was coded as poorest, poorer, middle, richer, and richest. Place of residence was coded as urban and rural. Apart from these, subregions (Central, West, East and Southern Africa) and survey years were also considered as additional covariates. The countries were categorised into subregions based on their specific location within Africa as defined by the United Nations.[44] These are West Africa (Burkina Faso, Benin, Cote D'Ivoire, Ghana, Gambia, Guinea, Liberia, Mali, Nigeria, Niger, Sierra Leone, Senegal, and Togo), East Africa (Burundi, Ethiopia, Kenya, Comoros, Malawi, Rwanda, Tanzania, and Uganda), Central Africa (Congo DR, Congo, Cameroon, Gabon, and Chad) and South Africa (Lesotho, Namibia, South Africa, and Zimbabwe).

Statistical analysis

Data analyses were carried out using Stata V.14.0. First, the prevalence of adolescent childbirth and under-5 mortality were presented using forest plots, with their associated 95% confidencen intervals (CI) and weights. Next, the weighted frequencies and percentages for the covariates and their distribution across age at first childbirth and under-5 death were presented, followed by a χ^2 test of independence. Finally, multilevel logistic regression models were used to show the association between age at first childbirth and under-5 mortality while controlling for the covariates. Model 0 showed the variance in under-5 mortality attributed to the clustering of the primary sampling units without the explanatory variables. Model I and model II contained the key explanatory variable (age at first childbirth) and the individual-level factors, respectively. The final model (model III) had the key explanatory variable and all the covariates. The Stata command 'melogit' was used in fitting these models. The Akaike's information criterion (AIC) tests were used for model comparison. The results were presented as crude odds ratios (cORs) and adjusted odds ratios (aORs), at 95% CIs. Sampling weights were applied to cater for under-sampling and over-sampling.[45] Finally, the survey command in Stata was used to adjust for the complex sampling structure of the data in the regression analyses.

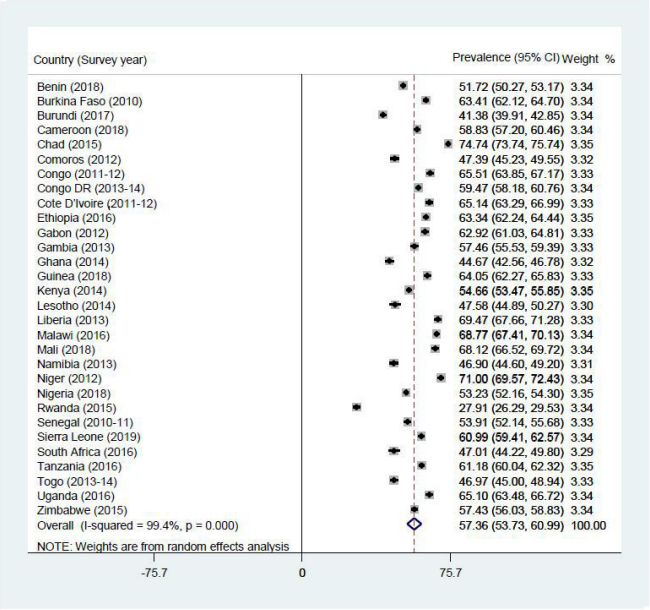

Figure 1 Forest plot showing prevalence of adolescent childbirth in sub-Saharan Africa by country.

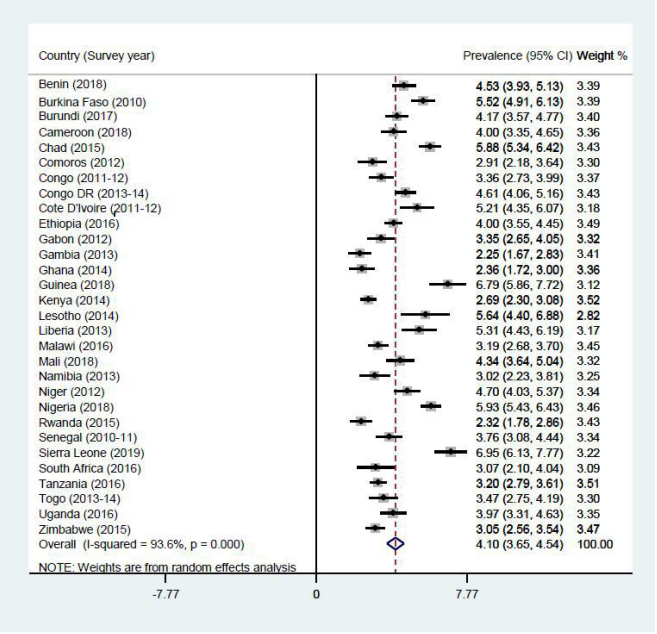

Figure 2 Forest plot showing prevalence of under-5 mortality in sub-Saharan Africa by country.

Patient and public involvement

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

RESULTS

Prevalence of adolescent childbirth in SSA

In the 30 countries in SSA, the prevalence of adolescent childbirth was 57.36% (95% CI 53.73% to 60.99), ranging from as high as 74.74% (95% CI 73.74% to75.74%) in Chad to as low as 27.91% in Rwanda (95% CI 26.29% 29.53%) (figure 1).

Prevalence of under-5 mortality in SSA

The prevalence of death among children under 5 in the 30 countries in SSA was 4.10% (95% CI 3.65% to 4.54%). The highest prevalence of 6.95% (95% CI 6.13% to 7.77%) was in Sierra Leone while the lowest prevalence of 2.25% (95% CI 1.67% to 2.83%) was in Gambia (figure 2).

Distribution of sociodemographic characteristics across age at first childbirth and death of children under 5

Table 2 shows results of the distribution of the sociodemographic characteristics of mothers across adolescent mothers versus older mothers and under-5 deaths versus no deaths. The results showed statistically significant difference between all the sociodemographic characteristics and age at first childbirth, except sex of the child. Statistically significant difference was also observed between the sociodemographic characteristics of mothers and under-5 mortality, except mother's BMI.

In terms of adolescent childbirth, the prevalence was higher among cohabiting mothers (60.62%), compared with married mothers (58.46%); mothers whose pregnancies were unwanted (62.84%), compared with those whose pregnancies were intended (57.70%); and mothers with no formal education (65.11%), compared with those with secondary/higher education (44.37%). Mother's with normal body weight had higher prevalence of adolescent childbirth (61.45%), compared with those whose body weight was obese (51.09%). Adolescent childbirth was higher among mothers whose children were ≥2500 g (59.05%), compared with those whose children were <2500 g (54.69%). Higher prevalence of adolescent childbirth was observed among mothers who had less than four ANC visits (63.83%), those who delivered at home (68.54%), and those who were assisted by TBA/others during delivery (67.62%), compared with those who had four or more ANC visits (54.75%), those who delivered at the health facility (54.09), and those whose deliveries were assisted by SBA/health professional (55.40%), respectively. Adolescent childbirth was higher among poorest mothers (65.45%), compared with richest mothers (42.81%) and mothers who lived in rural areas (62.92%) compared with those who lived in urban areas (50.20%). Mothers who lived in Central Africa had the highest prevalence of adolescent childbirth in terms of subregion (65.64%).

With under-5 mortality, children born to single mothers had a higher prevalence of under-5 mortality (5.07%), compared with those who were cohabiting (3.99%). Children of mothers whose pregnancies were intended had a higher prevalence of under-5 mortality (4.47%), compared with those whose pregnancies were mistimed (3.50%). The highest prevalence of under-5 mortality was found among children of mothers who lived in rural areas (4.46%), those with no formal education (5.09%)

Table 2 Cross-tabulation of sociodemographic characteristics and death of children under 5

Variables	Weighted sample (N)	Weighted column percentage (%)	Age at first childbirth				P values	Death of child under 5				P values
			<20 years		≥20 years			No		Yes		
			N	Row %	N	Row %	<0.001	N	Row %	N	Row %	<0.001
Marital status												
Married	83 355	71.62	48 726	58.46	34 628	41.54		79 906	95.86	3449	4.14	
Cohabiting	16 585	14.25	10 055	60.62	6531	39.38		15 923	96.01	662	3.99	
Single	16 439	14.13	9660	58.76	6779	41.24		15 605	94.93	834	5.07	
Pregnancy intention							<0.001					<0.001
Intended	84 043	72.21	48 495	57.70	35 548	42.30		80 283	95.53	3760	4.47	
Mistimed	24 732	21.25	15 168	61.33	9564	38.67		23 865	96.50	867	3.50	
Unwanted	7605	6.53	4778	62.84	2826	37.16		7285	95.80	319	4.20	
Mother's education level							<0.001					<0.001
No education	45 914	39.45	29 895	65.11	16 019	34.89		43 576	94.91	2339	5.09	
Primary	37 105	31.88	23 745	63.99	13 360	36.01		35 600	95.94	1505	4.06	
Secondary/higher	33 359	28.66	14 801	44.37	18 557	55.63		32 258	96.70	1102	3.30	
Mother's body mass index							<0.001					0.974
Normal	76 299	65.56	6739	61.45	4229	38.55		10 501	95.68	467	4.32	
Thin	10 968	9.42	46 828	61.37	29 472	38.63		73 005	95.74	3295	4.26	
Obese	29 112	25.01	14 875	51.09	14 237	48.91		27 928	95.93	1184	4.07	
Sex of child							0.772					<0.001
Male	59 212	50.88	34 830	58.82	24 383	41.18		56 509	95.43	2703	4.57	
Female	57 176	49.12	33 612	58.80	23 555	41.20		54 924	96.08	2242	3.92	
Child's weight							<0.001					<0.001
≥2500 g	109 868	94.41	64 881	59.05	44 988	40.95		105 354	95.89	4514	4.11	
<2500 g	6511	5.59	3561	54.69	2950	45.31		6079	93.37	431	6.63	
No of ANC visits							<0.001					<0.001
Less than four visits	51 985	44.67	33 183	63.83	18 802	36.17		49 924	95.07	2561	4.93	
Four or more visits	64 393	55.33	35 258	54.75	29 136	45.25		62 009	96.30	2385	3.70	
Place of delivery							<0.001					<0.001
Home	38 011	32.66	26 054	68.54	11 957	31.46		36 068	94.89	1943	5.11	
Health facility	78 368	67.34	42 387	54.09	35 981	45.91		75 366	96.17	3002	3.83	
Assistant during delivery							<0.001					<0.001
TBA/others	32 451	27.88	21 944	67.62	10 507	32.38		30 876	95.15	1574	4.85	

Continued

Table 2 Continued

Variables	Weighted sample (N)	Weighted column percentage (%)	Age at first childbirth				P values	Death of child under 5				P values
			<20 years		≥20 years			No		Yes		
			N	Row %	N	Row %	<0.001	N	Row %	N	Row %	<0.001
SBA/health professional	83 928	72.12	46 498	55.40	37 431	44.60		80 557	95.98	3371	4.02	
Wealth quintile							<0.001					<0.001
Poorest	24 473	21.03	16 018	65.45	8454	34.55		23 299	95.20	1174	4.80	
Poorer	24 339	20.91	15 907	65.36	8432	34.64		23 269	95.60	1070	4.40	
Middle	23 295	20.02	14 342	61.57	8953	38.43		22 257	95.54	1039	4.46	
Richer	23 335	20.05	13 212	56.62	10 123	43.38		22 358	95.81	977	4.19	
Richest	20 937	17.99	8963	42.81	11 975	57.19		20 251	96.72	686	3.28	
Place of residence							<0.001					<0.001
Urban	37 760	32.45	18 956	50.20	18 804	49.80		36 320	96.19	1440	3.81	
Rural	78 620	67.55	49 486	62.94	29 133	37.06		75 114	95.54	3506	4.46	
Subregion							<0.001					<0.001
Central Africa	21 920	18.84	14 390	65.64	7531	34.36		20 911	95.40	1009	4.60	
West Africa	47 128	40.50	27 816	59.02	19 312	40.98		44 786	95.03	2342	3.97	
East Africa	38 186	32.81	21 434	56.13	16 753	43.87		36 905	96.64	1282	3.36	
Southern Africa	9145	7.86	4802	52.51	4342	47.49		8832	96.58	313	3.42	

ANC, antenatal care; SBA, skilled birth attendant; TBA, traditional birth attendant.

and those of the poorest wealth quintile (4.80%). The highest deaths of under-5 children were also observed among male children (4.57%), children whose weight was <2500 g (6.63%), children whose mothers had less than four ANC visits (4.93%), those who were delivered at home (4.93%) and mothers who were assisted by TBA/Others during delivery (4.85%). Finally, under-5 mortality was highest in West Africa (3.97%) in terms of subregion.

Association between adolescent childbirth and under-5 mortality

Model III of table 3 shows the results of the association between age at first childbirth under-5 mortality, while controlling for all the covariates. The results indicate that children born to mothers whose first childbirth occurred at <20 years were 11% more likely to die before the age of 5 compared with those whose mothers' first childbirth occurred at age ≥20 years (aOR 1.11; 95% CI 1.05 to 1.18).

In terms of the covariates, the likelihood of under-5 mortality was higher among single (aOR 1.54; 95% CI 1.41 to 1.67) and cohabiting mothers (aOR 1.10; 95% CI 1.01 to 1.21) compared with married mothers. Children born to mothers who were obese were more likely to die before the age of 5 compared with those born to mothers with normal body weight (aOR 1.17; 95% CI 1.09 to 1.26). The odds of under-5 mortality were higher among children whose weight at birth was <2500 g compared with those whose weight was ≥2500 g at birth (aOR 1.83; 95% CI 1.64 to 2.03). On the contrary, the likelihood of under-5 mortality was lower among children born to mothers with secondary/higher education, female children, children whose mothers had four or more ANC visits and delivered at the health facility, children born to richest women, and children whose mothers lived in East and Southern Africa (see model III of table 3).

DISCUSSION

The aim of this study was to examine the association between adolescent childbirth and under-5 mortality in SSA. It was revealed that children born to mothers whose first childbirth occurred at <20 years were more likely to die compared with those born to mothers whose first childbirth occurred at age ≥20 years. In terms of the higher odds of under-5 mortality among adolescent mothers, the finding is consistent with the findings of previous studies in sub-Saharan African countries like Nigeria[38] and South Sudan.[39] Apart from these country-specific studies, other studies in low-income and middle-income countries, including SSA and others outside the subregion, have also found that young maternal age at first birth increases the risk of death of children under 5.[26 27 46] Several physiological, sociocultural, and socioeconomic factors may account for the higher odds of under-5 mortality among children born to adolescent mothers compared with those born to mothers aged 20 years and above. Physiologically, the younger the body of the mother the higher the likelihood of pregnancy and childbirth complications, which increase the risk of under-5 mortality.[47 48] Socioculturally, adolescent mothers are more likely to be stigmatised and face barriers accessing maternal and child healthcare services, predisposing children born to them to mortality.[21–24] Socioeconomically, compared with adult mothers, adolescent mothers are more likely to have low level of education and low wealth status, which have been considered as predictors of under-5 mortality.[9 17 42 49 50] Considering that some of the women whose first childbirth occurred when they were adolescents may not be adolescents at the time of the survey, the results on the association between adolescent childbearing and under-5 mortality provides an indication that the negative effects of adolescent childbearing on under-5 mortality may extend over several years. Therefore, it is useful to mention that the problem is even more profound than we imagine and is not only short term or medium term but long term as well.

In this study, the likelihood of under-5 mortality was higher among single and cohabiting mothers compared with married mothers. Similar findings have been obtained in studies that have been conducted in SSA[6 51 52] and other low-income countries.[53 54] Most of these studies have cited lack of spousal support as the major reason for the high prevalence of under-5 mortality among children born to single and cohabiting women.[6 51 52] Other studies have also attributed the higher likelihood of under-5 mortality among children born to single and cohabiting mothers compared with married mothers to poor nutritional status, which manifest in stunting, wasting, and underweight and threaten the survival of children.[55 56]

Children born to mothers who were obese were more likely to die before the age of 5 compared with those born to mothers with normal body weight. Consistent with the findings of the current study, excessive maternal BMI has been found to be associated with high risk of under-5 mortality in previous studies[57 58] Associations between maternal obesity and under-5 mortality could be attributed to pregnancy complications which are more common among obese mothers. For instance, obese mothers are more likely to deliver through caesarean section due to increased risks of obesity-related pregnancy complications and are also at higher risk of spontaneous extremely preterm delivery (<28 weeks).[59 60] Relatedly, preterm infants are often affected by serious neonatal morbidities, which can threaten their survival.[61 62] Consistent with the findings of previous studies,[7 63–65] it was found in this study that the odds of under-5 mortality were higher among children whose weight at birth was <2500 g compared with those whose weight was ≥2500 g at birth. Studies have shown that the higher odds of mortality among children with low birth weight compared with those with normal body weight is attributed to poor health and disability often common among children with low birth weight.[66–68]

Strengths and weaknesses

The use of large nationally representative datasets of 30 countries in SSA in examining the association between

Table 3 Multilevel logistic regression analysis on the association between adolescent childbirth and under-5 mortality

Variables	Model 0	Model I cOR (95% CI)	Model II aOR (95% CI)	Model III aOR (95% CI)
Fixed effects				
Age at first childbirth				
< 20 years		1.21 (1.14 to 1.28)	1.15 (1.07 to 1.22)	1.11 (1.05 to 1.18)
≥20 years		Ref	Ref	Ref
Marital status				
Married			Ref	Ref
Cohabiting			1.06 (0.97 to 1.16)	1.10 (1.01 to 1.21)
Single			1.50 (1.38 to 1.63)	1.54 (1.41 to 1.67)
Pregnancy intention				
Intended			Ref	Ref
Mistimed			0.79 (0.74 to 0.86)	0.84 (0.77 to 0.91)
Unwanted			0.91 (0.81 to 1.03)	1.00 (0.88 to 1.12)
Mother's education level				
No education			Ref	Ref
Primary			0.82 (0.76 to 0.88)	0.95 (0.88 to 1.02)
Secondary/higher			0.71 (0.65 to 0.77)	0.78 (0.71 to 0.86)
Mother's body mass index				
Normal			Ref	Ref
Thin			0.92 (0.84 to 1.02)	0.95 (0.86 to 1.05)
Obese			1.12 (1.05 to 1.21)	1.17 (1.09 to 1.26)
Sex of child				
Male			Ref	Ref
Female			0.83 (0.79 to 0.88)	0.83 (0.78 to 0.88)
Child's weight				
≥2500 g			Ref	Ref
<2500 g			1.78 (1.60 to 1.98)	1.83 (1.64 to 2.03)
No of ANC visits				
Less than four visits			Ref	Ref
Four or more visits			0.85 (0.80 to 0.90)	0.83 (0.78 to 0.88)
Place of delivery				
Home			Ref	Ref
Health facility			0.76 (0.70 to 0.83)	0.82 (0.75 to 0.90)
Assistant during delivery				
TBA/others			Ref	Ref
SBA/health professional			1.11 (1.02 to 1.21)	1.01 (0.93 to 1.10)
Wealth quintile				
Poorest				Ref
Poorer				0.97 (0.89 to 1.06)
Middle				1.03 (0.94 to 1.12)
Richer				0.97 (0.88 to 1.07)
Richest				0.81 (0.72 to 0.92)
Place of residence				
Urban				Ref
Rural				1.01 (0.93 to 1.10)

Continued

Table 3 Continued

Variables	Model 0	Model I cOR (95% CI)	Model II aOR (95% CI)	Model III aOR (95% CI)
Sub-region				
Central Africa				Ref
West Africa				1.05 (0.94 to 1.16)
East Africa				0.62 (0.55 to 0.71)
Southern Africa				0.81 (0.69 to 0.93)
Year of survey				
2010				Ref
2011				0.84 (0.66 to 1.05)
2012				0.89 (0.75 to 1.06)
2013				0.85 (0.70 to 1.03)
2014				1.02 (0.85 to 1.22)
2015				1.10 (0.90 to 1.34)
2016				1.26 (1.02 to 1.56)
2017				1.56 (1.21 to 2.02)
2018				1.21 (1.04 to 1.42)
2019				1.71 (1.40 to 2.08)
Random effects				
PSU variance (95% CI)	0.02 (0.01 to 0.05)	0.02 (0.01 to 0.05)	0.02 (0.01 to 0.05)	0.02 (0.01 to 0.05)
ICC	0.006	0.006	0.006	0.005
LR test	χ^2=5.67, p=0.009	χ^2=5.48, p=0.010	χ^2=5.19, p<0.011	χ^2=4.91, p=0.013
Wald χ^2	Reference	38.90, p<0.011	471.05, p<0.011	717.97, p<0.011
Model fitness				
Log-likelihood	−20207.49	−20187.76	−19972.82	−19842.40
AIC	40 418.99	40 381.52	39 977.63	39 750.80
Sample size	116 379	116 379	116 379	116 379

1=Reference category.
Source: Demographic and Health Surveys.
AIC, Akaike's information criterion; aOR, adjusted OR; cOR, crude OR; ICC, intraclass correlation; LR, likelihood ratio; PSU, primary sampling unit; SBA, skilled birth attendant; TBA, traditional birth attendant.

adolescent childbirth and under-5 mortality is a major strength of this study. Again, the large sample size made it possible to use high level statistical analyses that confirm the accuracy of the findings. Despite these strengths, there are some limitations inherent in this study. First, the design employed in the DHS is cross-sectional and hence, causal interpretations of the findings cannot be established. Second, age at first childbirth was self -reported, and as a result, there is the possibility of under-reporting and over-reporting of data.[69–71] Since reporting under-5 mortality may bring about unpleasant moments, some mothers may under-report its occurrence. Finally, considering that some of the respondents in this study whose first birth occurred when they were adolescents were not adolescents at the time of the survey, under-5 mortality reported by those people could be due to other factors and not necessarily because their first childbirth occurred when they were adolescents.

CONCLUSION

This study has established an association between adolescent childbirth and death of children under 5 in SSA. The findings have significant policy and public health implications. From the policy perspective, the findings call for the need to enhance policies aimed at reducing under-5 mortality in SSA by reducing adolescent pregnancy and childbirth through family planning, comprehensive sexuality education, and the elimination of child marriage. Again, there is the need for government and non-governmental organisations in SSA to introduce poverty alleviation programmes and improve access to both formal and informal education as a way of enhancing the socioeconomic status of adolescent mothers. Public health education should also be enhanced through continuous advocacy programmes as a way of helping adolescent mothers to access ANC and health facility deliveries. These interventions should be implemented,

taking into consideration other characteristics of mothers such marital status and BMI and child's characteristics such as child's weight, which were found to be associated with high under-5 mortality.

Contributors BOA contributed to the study design and conceptualisation. BOA reviewed the literature performed the analysis and drafted the first draft of this manuscript. BOA provided technical support and critically reviewed the manuscript for its intellectual content. BOA had final responsibility to submit for publication. The author read and amended drafts of the paper and approved the final version.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data for this study were sourced from Demographic and Health surveys (DHS) and available here: http://dhsprogram.com/data/available-datasets.cfm.

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REFERENCES

1 Adebowale AS, Fagbamigbe AF, Morakinyo O, *et al*. Parental educational homogamy and under-five mortality in sub-Saharan Africa: Clarifying the association's intricacy. *Sci Afr* 2020;7:e00255.
2 UNICEF. *Levels & trends in child mortality: estimates developed by the UN inter-agency group for child mortality estimation*. New York: Estimation UIGfCM, 2019.
3 Chao F, You D, Pedersen J, *et al*. National and regional under-5 mortality rate by economic status for low-income and middle-income countries: a systematic assessment. *Lancet Glob Health* 2018;6:e535–47.
4 Cha S, Jin Y. Have inequalities in all-cause and cause-specific child mortality between countries declined across the world? *Int J Equity Health* 2020;19:1–13.
5 Roser M, Ritchie H, Dadonaite B. *Child & Infant Mortality. Our World in Data*, 2013.
6 Yaya S, Bishwajit G, Okonofua F, *et al*. Under five mortality patterns and associated maternal risk factors in sub-Saharan Africa: a multi-country analysis. *PLoS One* 2018;13:e0205977.
7 Yaya S, Uthman OA, Okonofua F, *et al*. Decomposing the rural-urban gap in the factors of under-five mortality in sub-Saharan Africa? Evidence from 35 countries. *BMC Public Health* 2019;19:616.
8 Acheampong M, Ejiofor C, Salinas-Miranda A, *et al*. Priority setting towards achieving under-five mortality target in Africa in context of sustainable development goals: an ordinary least squares (OLS) analysis. *Glob Health Res Policy* 2019;4:3.
9 Ahinkorah BO, Seidu A-A, Budu E, *et al*. Proximate, intermediate, and distal predictors of under-five mortality in Chad: analysis of the 2014–15 Chad demographic and health survey data. *BMC Public Health* 2020;20:1–12.
10 United Nations. *Sustainable development goals*. New York: United Nations, 2015.
11 WHO. *Causes of child mortality*, 2017.
12 Kyei-Nimakoh M, Carolan-Olah M, McCann TV. Access barriers to obstetric care at health facilities in sub-Saharan Africa-a systematic review. *Syst Rev* 2017;6:110.
13 Wong KLM, Benova L, Campbell OMR. A look back on how far to walk: systematic review and meta-analysis of physical access to skilled care for childbirth in sub-Saharan Africa. *PLoS One* 2017;12:e0184432.
14 Geleto A, Chojenta C, Musa A, *et al*. Barriers to access and utilization of emergency obstetric care at health facilities in sub-Saharan Africa: a systematic review of literature. *Syst Rev* 2018;7:183.
15 Brown J, Cairncross S, Ensink JHJ. Water, sanitation, hygiene and enteric infections in children. *Arch Dis Child* 2013;98:629–34.
16 Liu L, Hill K, Oza S. Levels and causes of mortality under age five years. In: *Reproductive, maternal, newborn, and child health*, 2016: 71.
17 Yaya S, Ahinkorah BO, Ameyaw EK, *et al*. Proximate and socio-economic determinants of under-five mortality in Benin, 2017/2018. *BMJ Glob Health* 2020;5:e002761.
18 Bado AR, Appunni SS. Decomposing wealth-based inequalities in under-five mortality in West Africa. *Iran J Public Health* 2015;44:920.
19 Neal S, Channon AA, Chintsanya J. The impact of young maternal age at birth on neonatal mortality: evidence from 45 low and middle income countries. *PLoS One* 2018;13:e0195731.
20 Grønvik T, Fossgard Sandøy I, Sandøy F I. Complications associated with adolescent childbearing in sub-Saharan Africa: a systematic literature review and meta-analysis. *PLoS One* 2018;13:e0204327.
21 Rani M, Lule E. Exploring the socioeconomic dimension of adolescent reproductive health: a multicountry analysis. *Int Fam Plan Perspect* 2004;30:110–7.
22 Chirwa GC, Mazalale J, Likupe G, *et al*. An evolution of socioeconomic related inequality in teenage pregnancy and childbearing in Malawi. *PLoS One* 2019;14:e0225374.
23 Reynolds HW, Wong EL, Tucker H. Adolescents' use of maternal and child health services in developing countries. *Int Fam Plan Perspect* 2006;32:6–16.
24 Atuyambe L, Mirembe F, Tumwesigye NM, *et al*. Adolescent and adult first time mothers' health seeking practices during pregnancy and early motherhood in Wakiso district, central Uganda. *Reprod Health* 2008;5:13.
25 Mahy M. Childhood mortality in the developing world: a review of evidence from the demographic and health surveys: measure DHS+, ORC macro 2003.
26 Finlay JE, Özaltin E, Canning D. The association of maternal age with infant mortality, child anthropometric failure, diarrhoea and anaemia for first births: evidence from 55 low- and middle-income countries. *BMJ Open* 2011;1:e000226.
27 Sinha S, Aggarwal AR, Osmond C, *et al*. Maternal age at childbirth and perinatal and under five mortality in a prospective birth cohort from Delhi. *Indian Pediatr* 2016;53:871–7.
28 Kim Y-N, Choi D-W, Kim DS, *et al*. Maternal age and risk of early neonatal mortality: a national cohort study. *Sci Rep* 2021;11:814.
29 Restrepo-Méndez MC, Victora CG. Maternal mortality by age: who is most at risk? *Lancet Glob Health* 2014;2:e120–1.
30 Psaki SR, Soler-Hampejsek E, Saha J, *et al*. The effects of adolescent childbearing on literacy and Numeracy in Bangladesh, Malawi, and Zambia. *Demography* 2019;56:1899–929.
31 Assini-Meytin LC, Green KM. Long-Term consequences of adolescent parenthood among African-American urban youth: a propensity score matching approach. *J Adolesc Health* 2015;56:529–35.
32 Grant MJ, Hallman KK. Pregnancy-Related school dropout and prior school performance in KwaZulu-Natal, South Africa. *Stud Fam Plann* 2008;39:369–82.
33 Osok J, Kigamwa P, Stoep AV, *et al*. Depression and its psychosocial risk factors in pregnant Kenyan adolescents: a cross-sectional study in a community health centre of Nairobi. *BMC Psychiatry* 2018;18:136.
34 Govender D, Naidoo S, Taylor M. Antenatal and postpartum depression: prevalence and associated risk factors among adolescents' in KwaZulu-Natal, South Africa. *Depress Res Treat* 2020;2020:5364521.
35 Ayamolowo SJ, Olajubu AO, Akintola FE. Perceived social support and depression among pregnant and child-rearing teenagers in Ile-Ife, Southwest Nigeria. *Afr J Midwifery Womens Health* 2019;13:1–9.
36 Ahinkorah BO, Kang M, Perry L, *et al*. Prevalence of first adolescent pregnancy and its associated factors in sub-Saharan Africa: a multi-country analysis. *PLoS One* 2021;16:e0246308.
37 Neal S, Channon AA, Chandra-Mouli V, *et al*. Trends in adolescent first births in sub-Saharan Africa: a tale of increasing inequity? *Int J Equity Health* 2020;19:1–11.

38 Ayotunde T, Mary O, Melvin AO, *et al*. Maternal age at birth and under-5 mortality in Nigeria. *East Afr J Public Health* 2009;6:11–14.
39 Mugo NS, Agho KE, Zwi AB, *et al*. Determinants of neonatal, infant and under-five mortality in a war-affected country: analysis of the 2010 household health survey in South Sudan. *BMJ Glob Health* 2018;3:e000510.
40 Corsi DJ, Neuman M, Finlay JE, *et al*. Demographic and health surveys: a profile. *Int J Epidemiol* 2012;41:1602–13.
41 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Int J Surg* 2014;12:1495–9.
42 Van Malderen C, Amouzou A, Barros AJD, *et al*. Socioeconomic factors contributing to under-five mortality in sub-Saharan Africa: a decomposition analysis. *BMC Public Health* 2019;19:760.
43 Sisay W, Tesema GA, Worku MG. *Trend and factors associated with under-five mortality in Ethiopia further analysis of 2000-2016 Ethiopian demographic and health survey: a multivariate decomposition analysis*, 2020.
44 United Nations. Standard Country or Area Codes for Statistics Use, 1999 (Revision 4), 1999. Available: https://unstats.un.org/unsd/publications/catalogue?selectID=109 [Accessed 23 May 2020].
45 ICF International. *Demographic and health survey sampling and household listing manual*. MEASURE DHS, Calverton, Maryland, U.S.A: ICF International, 2012.
46 Gibbs CM, Wendt A, Peters S, *et al*. The impact of early age at first childbirth on maternal and infant health. *Paediatr Perinat Epidemiol* 2012;26 Suppl 1:259–84.
47 WHO. *Maternal mortality*, 2019.
48 Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, *et al*. Maternal age and risk of labor and delivery complications. *Matern Child Health J* 2015;19:1202–11.
49 Nattey C, Masanja H, Klipstein-Grobusch K. Relationship between household socio-economic status and under-five mortality in Rufiji DSS, Tanzania. *Glob Health Action* 2013;6:19278.
50 Chowdhury AH, Hanifi SMA, Mia MN, *et al*. Socioeconomic inequalities in under-five mortality in rural Bangladesh: evidence from seven national surveys spreading over 20 years. *Int J Equity Health* 2017;16:197.
51 Ekholuenetale M, Wegbom AI, Tudeme G, *et al*. Household factors associated with infant and under-five mortality in sub-Saharan Africa countries. *International Journal of Child Care and Education Policy* 2020;14:10.
52 Van Malderen C, Amouzou A, Barros AJD, *et al*. Socioeconomic factors contributing to under-five mortality in sub-Saharan Africa: a decomposition analysis. *BMC Public Health* 2019;19:1–19.
53 Dendup T, Zhao Y, Dema D. Factors associated with under-five mortality in Bhutan: an analysis of the Bhutan National health survey 2012. *BMC Public Health* 2018;18:1–15.
54 Mugo NS, Mya KS, Raynes-Greenow C. Exploring causal pathways for factors associated with neonatal, infant and under-five mortality, analysis of 2015-2016 Myanmar demographic health survey. *J Glob Health Rep* 2019;3:e2019015.
55 Ntoimo LFC, Odimegwu CO. Health effects of single motherhood on children in sub-Saharan Africa: a cross-sectional study. *BMC Public Health* 2014;14:1–13.
56 Amadu I, Seidu A-A, Duku E, *et al*. The joint effect of maternal marital status and type of household cooking fuel on child nutritional status in sub-Saharan Africa: analysis of cross-sectional surveys on children from 31 countries. *Nutrients* 2021;13:1541.
57 Johansson S, Villamor E, Altman M, *et al*. Maternal overweight and obesity in early pregnancy and risk of infant mortality: a population based cohort study in Sweden. *BMJ* 2014;349:g6572.
58 Cresswell JA, Campbell OMR, De Silva MJ, *et al*. Effect of maternal obesity on neonatal death in sub-Saharan Africa: multivariable analysis of 27 national datasets. *Lancet* 2012;380:1325–30.
59 Guelinckx I, Devlieger R, Beckers K, *et al*. Maternal obesity: pregnancy complications, gestational weight gain and nutrition. *Obes Rev* 2008;9:140–50.
60 Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: a population-based study. *Lancet* 2006;368:1164–70.
61 Ambalavanan N, Carlo WA, Tyson JE, *et al*. Outcome trajectories in extremely preterm infants. *Pediatrics* 2012;130:e115–25.
62 Soll RF. Early versus delayed selective surfactant treatment for neonatal respiratory distress syndrome. *Neonatology* 2013;104:124–6.
63 Budu E, Ahinkorah BO, Ameyaw EK, *et al*. Does birth interval matter in Under-Five mortality? Evidence from demographic and health surveys from eight countries in West Africa. *Biomed Res Int* 2021;2021:1–10.
64 Vilanova CS, Hirakata VN, de Souza Buriol VC, *et al*. The relationship between the different low birth weight strata of newborns with infant mortality and the influence of the main health determinants in the extreme South of Brazil. *Popul Health Metr* 2019;17:1–12.
65 Mayor S. Low birth weight is associated with increased deaths in infancy and adolescence, shows study. *BMJ* 2016;353:i2682.
66 Goldenberg RL, Culhane JF. Low birth weight in the United States. *Am J Clin Nutr* 2007;85:584S–90.
67 Horbar JD, Badger GJ, Carpenter JH, *et al*. Trends in mortality and morbidity for very low birth weight infants, 1991-1999. *Pediatrics* 2002;110:143–51.
68 Kusuda S, Fujimura M, Sakuma I, *et al*. Morbidity and mortality of infants with very low birth weight in Japan: center variation. *Pediatrics* 2006;118:e1130–8.
69 Ahinkorah BO. Individual and contextual factors associated with mistimed and unwanted pregnancies among adolescent girls and young women in selected high fertility countries in sub-Saharan Africa: a multilevel mixed effects analysis. *PLoS One* 2020;15:e0241050.
70 Ahinkorah BO. Predictors of unmet need for contraception among adolescent girls and young women in selected high fertility countries in sub-Saharan Africa: a multilevel mixed effects analysis. *PLoS One* 2020;15:e0236352.
71 Ahinkorah BO. Predictors of modern contraceptive use among adolescent girls and young women in sub-Saharan Africa: a mixed effects multilevel analysis of data from 29 demographic and health surveys. *Contracept Reprod Med* 2020;5:32.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9

		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Ahinkorah BO. *BMJ Open* 2021; 11:e049337. doi: 10.1136/bmjopen-2021-049337