Received: 26 February 2022 | Revised: 7 August 2022 | Accepted: 10 August 2022

DOI: 10.1111/mcn.13426

ORIGINAL ARTICLE

Maternal & Child Nutrition WILEY

Association of women's empowerment with anaemia and haemoglobin concentration in children in sub-Saharan Africa: A multilevel analysis

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Abstract

We assessed the associations between women's empowerment and anaemia and haemoglobin concentration among children (6–59 months) in 31 sub-Saharan African (SSA) countries. We included 72,032 mother–child pairs from Demographic and Health Surveys conducted between 2006 and 2019. A three-dimensional women's empowerment index (attitude towards violence, decision making and social independence) was constructed using principal components analysis, and associations between the index and any anaemia and Hb concentration were assessed using multilevel regression. The mean (standard deviation) haemoglobin concentration was 102.3 (16.0 g/L) and 65.8% of the children were anaemic. The odds of anaemia reduced with increasing empowerment in the dimensions of attitude towards violence [quintile (Q5) versus Q1, OR 0.77; 95% confidence interval [CI] 0.65–0.89, $p_{trend} = 0.006$], decision making (Q5 vs. Q1, OR 0.72; 95% CI 0.61–0.84, $p_{trend} < 0.001$) and social independence (Q5 vs. Q1, OR 0.86; 95% CI 0.76–0.97, $p_{trend} = 0.015$). The mean Hb concentration increased with increasing women's empowerment in the dimensions of attitude towards violence (Q5 vs. Q1, mean difference [MD] 1.40 g/L; 95% CI 0.63–2.17, $p_{trend} < 0.001$) and social independence (Q5 vs. Q1, MD 1.32 g/L; 95% CI 0.36–2.28, $p_{trend} = 0.001$). There was no evidence for a linear trend in the association between decision making and haemoglobin concentration ($p_{trend} = 0.051$). Women's empowerment was associated with reduced odds of any anaemia and higher haemoglobin concentration in children. The promotion of women's empowerment may play a role in reducing the burden of childhood anaemia in SSA.

KEYWORDS

anaemia, child nutrition, haemoglobin, iron deficiency anaemia, malnutrition, women's empowerment

1 | INTRODUCTION

Childhood anaemia is an intractable public health problem affecting 42% of children aged between 6 and 59 months worldwide (World Bank, 2016). Sub-Saharan Africa (SSA) has one of the highest prevalence in the world. In 2016, 60% of children in SSA were anaemic (World Bank, 2016). Anaemia is an established risk factor for maternal and child mortality in low- and middle-income countries, and its detrimental consequences on development and human potential have long been recognised (Victora et al., 2008; Walker et al., 2007). To effectively prevent anaemia, a better understanding of its social determinants is required.

The underlying causes of anaemia include diseases, such as hookworm infestation, sickle cell disorders, thalassemias, schistosomiasis and malaria (Crawley, 2004; Kassebaum et al., 2014) and inadequate nutrient intake, which leads to micronutrient deficiencies such as iron deficiency. These underlying causes can be attributed to poor child care and nutrition practices, which are linked to lack of maternal education, large family sizes and lack of autonomy, all of which are aspects of women's empowerment—defined as 'the process of increasing women's access to control over the strategic life choices that affect them and access to the opportunities that allow them fully to realise their capacities' (Chen & Tanaka, 2014).

Women's empowerment may reduce maternal and child undernutrition, specifically wasting, stunting and Vitamin A deficiency (Carlson et al., 2015; Pratley, 2016; Saaka, 2020; Silva-Barbeau et al., 2005), but a lack of a standardised measure and definition of this multidimensional concept makes comparison and interpretation of study findings difficult (Carlson et al., 2015). Moreover, whereas several studies have assessed the association between women's empowerment and wasting or stunting in children (Santoso et al., 2019; van den Bold et al., 2013; Yaya et al., 2020), only a few have comprehensively assessed the association between women's empowerment and childhood anaemia or haemoglobin (Hb) concentration in SSA (Basu & Koolwal, 2005; Jones et al., 2019). This is despite all these forms of undernutrition sharing common potential pathways, that is, women's empowerment impacts household's access to resources, allocation of the resources towards children's health and nutrition, and dependence on the household (Santoso et al., 2019).

To mitigate the problem of measuring women's empowerment and to allow for comparisons across studies, a Survey-based Women's emPowERment index (the SWPER index) was developed and validated using data from the Demographic and Health Survey (DHS) from 34 African countries (Ewerling et al., 2017), opening opportunities to explore the association of women's empowerment with a range of health and nutritional indicators in women and children using a standardised measure. We aimed to assess the association between women's empowerment—based on the SWPER index—and any anaemia among children aged between 6 and 59 months in SSA.

Key messages

- Few studies have comprehensively assessed the association between different dimensions of women's empowerment and childhood anaemia or haemoglobin concentration in SSA.
- We used the Survey-based Women's emPowERment index (the SWPER index) to measure women's empowerment in a standardised manner across 31 sub-Saharan African countries and assess the associations of different dimensions of women's empowerment with anaemia and haemoglobin concentration among children.
- Children of women who were empowered in the attitude towards domestic violence, decision making and social independence dimensions had higher haemoglobin concentrations and were less likely to be anaemic than those of less empowered women.
- Empowerment in decision making seemed to have the strongest association with anaemia.
- Promotion of women's empowerment in attitude towards violence, decision making, and social independence dimensions may play a role in reducing the burden of anaemia among children in SSA.

2 | METHODS

2.1 | Data source and study population

This study utilised pooled data from the most recent DHS conducted between 2006 and 2019 in 31 countries in SSA. All countries with data on Hb measurement were included (Supporting Information: Table 1). The detailed methodology of DHS is available elsewhere (ICF Macro, 2011). In brief, DHS is a cross-sectional nationally representative household survey conducted in low- and middle-income countries to provide data for a wide range of population, health and nutrition indicators. Standard DHS has sample sizes usually between 5000 and 30,000 households and is typically conducted about every 5 years. Households are selected through a stratified multistage cluster sampling method and sociodemographic, health and nutrition data are collected mainly from women aged 15–49 years using interviewer-administered questionnaires. Blood samples are collected from women and children in all households or a random subset of selected households based on considerations, such as the required sample size and financial costs.

The study population for the current analysis is women and their singleton children aged 6–59 months. We restricted the analysis to the youngest child and to singletons to avoid clustering of children at the household level. The initial pooled data set contained 323,505 children and their mothers. From this number, we excluded the following: children from households not selected for Hb measurement, nonusual residents, children with missing Hb

data, not youngest child, twins, unmarried women and children with missing data to compute the empowerment index (Supporting Information: Figure 2).

2.2 | Variables

The outcome variables were standardised measures of child Hb concentration, adjusted for altitude and any anaemia (Sharman, 2000b). Any anaemia was defined as Hb concentration <110 g/L (g/L) (WHO, 2011). Hb measurement involved the collection of blood samples from children aged 6–59 months using a microcuvette from a drop of capillary blood taken from a finger prick (for children aged 6 months or older) or heel prick (for children younger than 6 months) (Sharman, 2000b). Hb analysis was conducted on-site using a portable HemoCue® analyser (HemoCue AB), a simple and cheaper system that has been accepted as a standard method for Hb measurement by the International Committee for Standardisation in Haematology (Sharman, 2000a). The DHS program uses either the HemoCue 201+ or the 301+ system (Pullum et al., 2017), which have been shown to measure anaemia prevalence comparably (Rappaport et al., 2017).

The exposure was the SWPER index for women's empowerment. We constructed a SWPER index on the pooled data set as previously described (Ewerling et al., 2017). This involved identifying the indicators of women's empowerment available across the surveys and recoding them as shown in Supporting Information: Table 2. Next, we performed a principal component analysis of the selected indicators and generated a scree plot to determine the number of components to retain. Using the conventional Eigenvalue of >1 and in keeping with the SWPER index, we retained the first three components that loaded well on variables related to attitude towards domestic violence (beating justified if wife neglects children, refuses to have sex with husband and burns food), decision making (decision on health care and purchase of household goods) and social independence (worked in the past 12 months, age at cohabitation, age at first birth and the age difference between woman and husband) (Supporting Information: Figure 2 and Table 3). The three components accounted for 50.0% of the total variation in the empowerment index. Women were then ranked into empowerment quintiles based on the factor scores of each of the retained components, with the lowest quintile representing the least empowered and the highest quintile representing the most empowered.

Based on a review of the literature (Khulu & Ramroop, 2020; Moschovis et al., 2018), information available in the DHS data set and the use of a directed acyclic graph, we considered the following as potential confounders: year of the survey, wealth index quintile, place of residence (urban, rural), living with a partner (yes, no) and woman's age (continuous). Conceptually, potential confounders were associated with both women's empowerment and anaemia but not on the causal pathway between these two variables. Child's age (continuous) and child's sex were "forced-in" variables (Greenland, 1989) as they are unlikely to influence women's empowerment but are strongly associated with anaemia. We reconstructed the wealth index on the combined data set using principal component analysis of several proxy wealth index indicators, including the type of housing material, asset ownership and access to utilities (The DHS Program, 2016).

2.3 | Statistical analysis

Our analysis was based on a pooled data set of all the included countries. We used descriptive statistics to summarise participants' characteristics and women's empowerment variables. We then ran three-level mixed-effects logistic and linear regression models to assess the associations of women's empowerment with child anaemia and Hb concentration. We quantified the associations using odds ratios (OR, for anaemia) and mean differences (MDs, for Hb) with 95% confidence intervals (CIs). In the multilevel analyses, households were nested within clusters and clusters were nested within countries. The analysis accounted for the survey design and sample weights. Because multilevel analysis of survey data requires specification of weights at different levels, we generated country-level weights by dividing the population of the respective county at the time of the survey by the sample size of each country (Elkasabi et al., 2020). For the cluster-level weights, we used the survey weight variable (which is a product of the household-level weight and the cluster-level weight) supplied in the DHS datasets. We performed both unadjusted and adjusted analyses. In adjusted analyses, the associations of dimensions of women's empowerment with anaemia and Hb concentration were adjusted for the covariates above. We assessed for linear trends by including the empowerment variable as a continuous variable in the models. There was no evidence of multicollinearity based on variance inflation factors (VIFs): VIFs ranged from 1.01 to 1.93, with a mean of 1.64. All analyses were performed using Stata 15 and $p < 0.05$ were considered statistically significant.

3 | RESULTS

This study included 72,032 (unweighted) mother–child dyads. Of the included children, 48, 653 (65.8%, weighted) were anaemic and the mean (standard deviation [SD]) Hb concentration was 102.3 (16.0) g/L. The mean age of the mothers was 29.7 (SD 7.1) years and 34.8% had a parity of 1–2 while 23.6% had a parity of >6 (Table 1). Most of the women were from rural areas (67.7%) and married (74.9%). The mean age of children was 24.9 (SD 13.8) months and 49.4% of them were female.

Table 2 summarises the distribution of study subjects according to indicators of women's empowerment. Among women, the following reasons justified wife beating: going out without telling husband (28.2%), neglecting children (32.2%), arguing with husband (29.3%), refusing to have sex with husband (22.9%) and burning food (14.9%). About 40% of the women were from households where the husband/partner or other person was the sole decision maker on

TABLE 1 Distribution of study participants from 31 SSA countries by selected sociodemographic characteristics and anaemia status.

Characteristic	Child not anaemic (*N* = 23,379)	Child anaemic (*N* = 48,653)	Total (*N* = 72,032)
Place of residence			
Urban	36.4	30.1	32.3
Rural	63.6	69.9	67.7
Woman's age, mean (SD)	30.4 (6.9)	29.3 (7.2)	29.7 (7.1)
Parity			
1–2	35.0	34.7	34.8
3–4	17.0	16.5	16.6
5–6	24.3	25.4	25.0
>6	23.8	23.5	23.6
Wealth index quintile			
Poorest	17.7	21.8	20.4
Poorer	19.2	21.1	20.5
Middle	20.0	20.9	20.6
Richer	19.7	19.9	19.2
Richest	23.4	17.1	19.2
Missing data	0.1	0.2	0.2
Year of interview			
2006–2008	2.9	1.8	2.1
2009–2011	12.3	17.1	15.4
2012–2014	23.8	27.2	26.0
2015–2017	36.0	27.8	30.6
2018–2019	25.0	26.2	25.8
Marital status			
Married	73.1	75.8	74.9
Living with partner	26.9	24.2	22.1
Sex of household head			
Male	85.3	86.1	85.8
Female	14.7	13.9	14.2
Child's sex			
Male	48.7	51.6	50.6
Female	51.3	48.4	49.4
Child's age, mean (SD)	29.4 (14.1)	22.5 (13.0)	24.9 (13.8)

Abbreviation: SSA, sub-Saharan African.

their health care, while 43.7% reported that their husband/partner was the usual decision maker on large household purchases (Table 2). Most of the women (83.4%) never read newspapers and 69.5% were currently working, a majority of them (47.6%) being self-employed in the agricultural sector. The women's mean age at first cohabitation was 18.4 (SD 4.2) years and the mean age at first birth was 19.2 (SD 3.7) years. Compared to their partners, on average, the women were 7.4 (SD 7.1) years younger and had schooled for 1.5 (SD 3.7) fewer years. Overall, the proportions of women who felt wife beating was justified for any of the mentioned reasons or whose husband/partner or other person was the main decision maker were significantly higher among the anaemic than the nonanaemic children. Woman's age at first cohabitation and age at first birth were significantly lower among the anaemic than nonanaemic children, while the age

TABLE 2 Percent distribution of women in 31 SSA countries according to indicators of women's empowerment by anaemia status

Empowerment indicator	Total[a] (*N* = 72 032)	Child anaemic[a] No (*N* = 23 379)	Child anaemic[a] Yes (*N* = 48 653)	*p* Value
Beating justified if				
Wife goes out without telling husband				<0.001
Yes	28.2	25.8	29.5	
Don't know	0.9	0.7	1.0	
No	70.9	73.5	69.5	
Wife neglects children				<0.001
Yes	32.2	30.4	33.1	
Don't know	0.6	0.5	0.7	
No	67.2	69.1	66.2	
Wife argues with husband				<0.001
Yes	29.3	25.9	31.0	
Don't know	0.7	0.7	0.8	
No	70.0	73.4	68.2	
Wife refuses to have sex with husband				<0.001
Yes	22.9	20.6	24.0	
Don't know	0.9	1.0	0.8	
No	76.3	78.4	75.2	
Wife burns food				0.001
Yes	14.9	13.1	15.8	
Don't know	0.6	0.5	0.7	
No	84.5	86.4	83.5	
Who usually decides on the respondent's health care				<0.001
Husband/partner or other alone	39.6	33.8	42.7	
Respondent and husband/partner	42.2	45.5	40.5	
Respondent alone	18.1	20.8	16.8	
Who usually decides on large household purchases				<0.001
Husband/partner or other alone	43.7	38.4	46.5	
Respondent and husband/partner	43.7	47.9	41.4	
Respondent alone	12.6	13.7	12.0	
Who usually decides on visits to family/relatives				<0.001
Husband/partner or other alone	33.8	29.7	36.0	
Respondent and husband/partner	48.8	52.9	46.7	
Respondent alone	17.4	17.4	17.3	
Age at first cohabitation	18.4 (4.1)	18.7 (4.1)	18.2 (4.1)	<0.001
Age at first birth	19.2 (3.7)	19.4 (3.7)	19.1 (3.7)	<0.001
Woman's minus husband's age	−7.4 (7.1)	−7.1 (6.5)	−7.6 (7.4)	<0.001
Years of schooling				<0.001
None	30.5	23.2	34.3	

(Continues)

TABLE 2 (Continued)

Empowerment indicator	Total[a] (*N* = 72 032)	Child anaemic[a] No (*N* = 23 379)	Child anaemic[a] Yes (*N* = 48 653)	*p* Value
1–4	16.9	16.0	17.4	
5–8	31.8	34.5	30.3	
≥8	20.8	26.3	17.9	
Woman's minus husband's years of schooling	−1.5 (3.7)	−1.4 (3.7)	−1.5 (3.7)	0.062
Frequency of reading newspaper				<0.001
Not at all	83.4	79.1	85.6	
Less than once a week	9.6	11.7	8.5	
At least once a week	7.1	9.2	5.9	
Worked in the past 12 months				<0.001
No	25.9	23.3	27.3	
In the past year	4.6	4.1	4.9	
Currently working	69.5	72.6	67.9	

Abbreviation: SSA, sub-Saharan African.

[a]Values are expressed as percent or mean (SD).

difference with husband was higher among the anaemic than nonanaemic children. The proportion of women who read a newspaper at least once a week or were currently working was significantly lower among the anaemic than the nonanaemic children (Table 2).

The prevalence of anaemia was highest among the least empowered and lowest among the most empowered women across all three dimensions of empowerment (Table 3). The highest prevalence (73.6%) was observed among those least empowered in the decision-making dimension and the lowest prevalence was among those most empowered in the domain of attitude towards violence (60.8%). Unadjusted regression results showed that the odds of anaemia reduced linearly with an increasing level of empowerment. Similarly, the mean Hb concentration generally increased with an increasing level of empowerment across all three dimensions of empowerment (Table 3).

The results of multivariable analysis (Table 4) show that the odds of anaemia reduced with increasing empowerment in the dimensions of attitude towards violence (Q5 vs. Q1, OR 0.77; 95% CI 0.65–0.89, $p_{trend} = 0.006$), decision making (Q5 vs. Q1, OR 0.72; 95% CI 0.61–0.84, $p_{trend} < 0.001$) and social independence (Q5 vs. Q1, OR 0.86; 95% CI 0.76–0.97, $p_{trend} = 0.015$). The mean Hb concentration increased with increasing women's empowerment in the dimensions of attitude towards violence (Q5 vs. Q1, MD 1.40g/L; 95% CI 0.63–2.17, $p_{trend} < 0.001$) and social independence (Q5 vs. Q1, MD 1.65 g/L; 95% CI 0.99–2.31, $p_{trend} < 0.001$). Although children with mothers in the fourth quintile of empowerment in the decision making dimension had a higher Hb concentration than those in the first quintile (MD 1.50 g/L; 95% CI 0.99–2.01), there was no evidence for a linear trend ($p_{trend} = 0.051$).

4 | DISCUSSION

This study examined the association between women's empowerment and childhood anaemia in SSA. We found that women who were empowered in the attitude towards domestic violence, decision making and social independence domains were less likely to have anaemic children.

Our study findings are consistent with the existing literature on the role of women's empowerment in child nutrition in SSA (Abreha et al., 2020; Abreha & Zereyesus, 2021; Salawu et al., 2020; Yaya et al., 2020). However, studies on women's empowerment and child nutrition in this region have focused mainly on anthropometrical indicators, particularly stunting and underweight (Abreha & Zereyesus, 2020), with only a few looking at anaemia (Abreha et al., 2020; Jones et al., 2019). One study, whose aim was to explore pathways by which women's empowerment influences child nutritional status (Jones et al., 2019), was based on DHS data from five East African countries and found significant and direct positive associations between women's decision making and child Hb concentration (Jones et al., 2019). However, the study did not find a direct link between attitude towards violence with anaemia (Jones et al., 2019). The study also found a significant positive association, both direct and mediated through decision making, between assets (social empowerment) and anaemia (Jones et al., 2019). Our findings are consistent with those of a study in India, which found that a mother's ability to make decisions about her health care, contribution to the family income, newspaper reading or negative attitude towards domestic violence increased the odds that her child will not have anaemia (Basu & Koolwal, 2005). Associations between poor iron status and women's empowerment in agriculture have also been reported (Gupta et al., 2019).

TABLE 3 Unadjusted associations of dimensions of women's empowerment with any anaemia and haemoglobin concentration in children from 31 SSA countries

	Any anaemia			Haemoglobin concentration (g/L)		
Empowerment index quintile (Q)	Percent	OR (95% CI)	*p* Value	Mean (SD)	MD (95% CI)	*p* Value
Attitude towards violence						
Q1	70.2	1 (ref.)		100.6 (18.3)	1 (ref.)	
Q2	66.5	0.88 (0.78–0.99)	0.031	101.6 (15.8)	0.64 (0.09–1.19)	0.022
Q3	67.6	0.89 (0.75–1.06)	0.178	101.8 (16.8)	1.56 (0.73–2.39)	<0.001
Q4	63.4	0.76 (0.62–0.94)	0.012	103.2 (14.4)	2.20 (1.53–2.87)	<0.001
Q5	60.8	0.68 (0.56–0.83)	<0.001	104.2 (14.1)	3.25 (2.09–4.41)	<0.001
p_{trend}		0.005			<0.001	
Decision making						
Q1	73.6	1 (ref.)		99.4 (18.1)	1 (ref.)	
Q2	69.2	0.80 (0.74–0.87)	<0.001	100.8 (16.2)	0.87 (0.36–1.39)	0.001
Q3	64.3	0.66 (0.59–0.75)	<0.001	102.7 (15.9)	1.83 (1.05–2.61)	<0.001
Q4	60.2	0.57 (0.50–0.66)	<0.001	104.5 (13.9)	2.88 (2.17–3.59)	<0.001
Q5	61.1	0.58 (0.50–0.68)	<0.001	104.0 (14.9)	2.39 (1.37–3.41)	<0.001
p_{trend}		<0.001			<0.001	
Social independence						
Q1	69.3	1 (ref.)		100.5 (17.5)	1 (ref.)	
Q2	68.6	0.99 (0.87–1.12)	0.862	101.1 (16.1)	0.10 (−0.67 to 0.88)	0.796
Q3	65.0	0.85 (0.79–0.92)	<0.001	102.5 (15.4)	1.20 (0.59–1.81)	<0.001
Q4	64.5	0.85 (0.72–1.01)	0.067	103.0 (15.2)	1.56 (0.52–2.60)	0.003
Q5	61.1	0.73 (0.66–0.82)	0.005	104.4 (15.3)	3.03 (2.02–4.03)	<0.001
p_{trend}		0.008			<0.001	

Note: Women in Q1 are the least empowered while those in Q5 are the most empowered.

Abbreviations: CI, confidence interval; MD, mean difference; OR, odds ratio; SSA, sub-Saharan African.

Women's empowerment may influence child malnutrition including anaemia through complex pathways as illustrated in a proposed conceptual framework based on UNICEF's framework for child nutrition (Santoso et al., 2019). First, women's empowerment may determine whether a household can access various resources that might improve child nutrition. Second, women's empowerment could determine whether those resources are allocated towards children's health and nutrition. For instance, women's decision-making power in material resource allocation may lead to more resources being allocated to child health and nutrition (Porter, 2016). Moreover, women's decision making about child care and child health may influence health-seeking behaviours for the prevention and treatment of their children's illnesses (Pratley, 2016). Women's decision making on their health care and material resources could improve their nutritional status, resulting in better nutritional status for their children. In a study in Ethiopia, higher women's empowerment in household decision making was associated with reduced anaemia in children (Abreha et al., 2020). In a study in Ghana, women's participation in decision-making regarding household purchases was associated with improved dietary diversity (Amugsi et al., 2016), which may influence maternal (Jin et al., 2022) and, eventually, child anaemia status.

This is the first time the association between the SWPER index and anaemia and Hb concentration in children in SSA has been assessed. The findings from this study, therefore, add to the growing evidence of the importance of women's empowerment in promoting nutrition in children. The strengths of this study include a large sample size, hence high power to detect significant differences, and the inclusion of data from a large number of countries from SSA, which increases the generalisability of our findings. Despite these strengths, this being a cross-sectional study, we cannot infer causation or establish a temporal relationship between the indicators of empowerment and the study outcomes. Moreover, our assessment of women's empowerment was limited by the variables measured across all the included countries.

In conclusion, women's empowerment was associated with reduced odds of anaemia and higher Hb concentration in children.

TABLE 4 Adjusted associations of dimensions of women's empowerment with any anaemia and haemoglobin concentration in children from 31 SSA countries

Empowerment index quintile (Q)	Any anaemia OR (95% CI)	*p* Value	Haemoglobin concentration (g/L) MD (95% CI)	*p* Value
Attitude towards violence				
Q1	1 (ref.)		1 (ref.)	
Q2	0.88 (0.80–0.96)	0.008	0.29 (−0.28 to 0.87)	0.317
Q3	0.88 (0.74–1.04)	0.122	1.16 (0.39–1.92)	0.003
Q4	0.81 (0.68–0.97)	0.025	1.23 (0.56–1.90)	<0.001
Q5	0.77 (0.65–0.89)	0.001	1.40 (0.63–2.17)	<0.001
p_{trend}	0.006		<0.001	
Random effects variance				
Country, estimate (SE)	<0.01 (<0.01)		20.86 (6.38)	
Cluster, estimate (SE)	0.52 (0.07)		<0.01 (<0.01)	
Decision making				
Q1	1 (ref.)		1 (ref.)	
Q2	0.84 (0.76–0.94)	0.003	0.33 (−0.09 to 0.75)	0.123
Q3	0.73 (0.65–0.82)	<0.001	0.82 (0.21–1.44)	0.009
Q4	0.67 (0.59–0.78)	<0.001	1.50 (0.99–2.01)	<0.001
Q5	0.72 (0.61–0.84)	<0.001	0.56 (−0.36 to 1.47)	0.234
p_{trend}	<0.001		0.051	
Random effects variance				
Country, estimate (SE)	<0.01 (<0.01)		20.46 (6.20)	
Cluster, estimate (SE)	0.49 (0.07)		<0.001 (<0.01)	
Social independence				
Q1	1 (ref.)		1 (ref.)	
Q2	1.02 (0.89–1.17)	0.789	−0.05 (−0.66 to 0.56)	0.871
Q3	0.89 (0.84–0.94)	<0.001	0.89 (0.37–1.41)	0.001
Q4	0.93 (0.79–1.10)	0.383	0.73 (−0.02 to 1.48)	0.057
Q5	0.86 (0.76–0.97)	0.018	1.32 (0.36–2.28)	0.007
p_{trend}	0.015		0.001	
Random effects variance				
Country, estimate (SE)	<0.01 (<0.01)		21.02 (163.09)	
Cluster, estimate (SE)	0.52 (0.08)		<0.01 (<0.01)	

Note: Women in Q1 are the least empowered while those in Q5 are the most empowered. Adjusted for survey year, wealth index, place or residence, living with partner, interview year, woman's age, child's age and child's sex.

Abbreviations: CI, confidence interval; MD, mean difference; OR, odds ratio; SSA, sub-Saharan African.

Promotion of women's empowerment in attitude towards violence, decision making and social independence dimensions may play a role in reducing the burden of anaemia among children in SSA. Further research to understand the association of women empowerment and anaemia in other contexts and to explore the potential pathways for this association is needed.

AUTHOR CONTRIBUTIONS

Calistus Wilunda and Risa Takahashi contributed to the study design and conceptualisation. Calistus Wilunda performed the analysis. Calistus Wilunda, Milkah Wanjohi and Antonina Mutoro drafted the initial draft. Elizabeth Kimani-Murage and Risa Takahashi critically reviewed the manuscript for its intellectual content. All authors read

and amended drafts of the paper and approved the final version. Calistus Wilunda had the final responsibility to submit for publication.

ACKNOWLEDGEMENT

This study did not receive any specific funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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.

ETHICS STATEMENT

Country-specific DHS protocols were approved by relevant ethics committees in each country and respondents provided informed consent. DHS data were accessed with permission from the DHS Program. Ethical review was not required for this study because deidentified open-access datasets were used in the analysis.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Wilunda, C., Wanjohi, M., Takahashi, R., Kimani-Murage, E., & Mutoro, A. (2023). Association of women's empowerment with anaemia and haemoglobin concentration in children in sub-Saharan Africa: A multilevel analysis. *Maternal & Child Nutrition*, 19, e13426. https://doi.org/10.1111/mcn.13426