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Research Article

DETERMINANTS OF PREVALENCE OF ANAEMIA IN CHILDREN AGED 6-59 MONTHS IN ZAMBIA: MULTIVARIATE ANALYSIS OF 2018 DHS

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A B S T R A C T

Untreated anaemia in children can pose serious effects on growth and health of a child. Children with untreated anaemia may develop mental and health problems that can lead to poor reading ability and consequently lead to poor academic performance in early childhood education. In Zambia, 58% of children aged 6-59 months had anaemia in 2018 as evidenced by the national wide Demographic and Health Survey. This study aimed at establishing the determinants of prevalence of anaemia in children aged 6-59 months in Zambia. The 2018 Zambia Demographic and Health Survey collected information on the children at household level. A sample of 7,755 children were tested for anaemia. Binary logistic regression was performed to determine the relative risk of anaemia in children by selected characteristics of their mothers.

Prevalence of anaemia is reported higher in children aged 9-11 months and 12-17 months compared with those aged 48-59 months. Children born from young mothers have a higher prevalence of anaemia compared with children born to older mothers. Age of both the child and the mother are significant contributing factors of prevalence of anaemia in children in Zambia. It is recommended that the government and stakeholders should consider interventions such as health facility routine screening and early treatment plans directly targeting children age 9-17 months.

INTRODUCTION

Anaemia in children 6-59 months is a public health problem in many developing countries, Zambia included. The World Health Organisation (WHO) in 2015 estimated that globally, 42% of children below 5 years were anaemic with many of these children found in developing countries [22]. In 2014, WHO defined anaemia as "a condition in which the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around a human body." According to the WHO thresholds, a child has anaemia if the haemoglobin (hb) level is below 11.0 grams per decilitre (g/dl) [24].

It is now a public health concern to address the problem of anaenia in children as its health, social and economic consequences are not only short term but also long term [24]. The effects of anaemia in childhood may include impaired cognitive and physical development, poor learning outcomes/ performance in school and increased risk of mortality [1, 12, 21 & 23].

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Furthermore, effects of anaemia in adulthood can lead to low work productivity and physical activity, as well as long-term implications on the economic development of a country such as reduced gross domestic product [8, 15, 18, 21& 25]

Studies have established that the causes of anaemia in children under five are many, among of them include: biological factors such as nutrient deficiencies especially iron, sex, age; disease such as malaria, HIV etc., which lower blood hb concentrations; social, environmental and cultural factors [25]. In a study conducted by Gaston *et al*, in 2018 to investigate factors associated with anaemia among children under five years in Lesotho using the country's 2009 and 2014 DHS data. It was established that in 2009, nutritional status (specifically stunting) of a child, child's age, and mother's anaemia status are the main risk factors. On the other hand, in another study conducted in 2014, Gaston *et al* established that nutritional status of a child, fever or no fever in the two weeks prior to the survey, child's age, and mother's body mass index were the risk factors associated with anaemia in children.

Nambiema *et al*, in 2109 analysed Togo's demographic and health survey data and established that mother's anaemic status and prevalence of malaria in children were risk factors of anaemia in children 6 to 59 months. Children's age and mother's level education were associated with anaemia [13].

Duttaa *et al* in 2020 investigated the prevalence and risk factors of anaemia in children 6-59 months in India using data from the 2005-06 National Family Health Survey. The study established that the risk factors of anaemia were children's age, sex of child and presence of diarrhoea in children. Children born from young mothers, children whose mothers had low exposure to mass-media and whose mothers had high parity were more at risk of being anaemic [4]. Most studies have revealed that whilst some factors associated with prevalence of anaemia in children 6-59 months are the same, there are also others that are different from country to country.

The 2018 Zambia Demographic and Health Survey (ZDHS) survey reports that 58 percent of children 6-59 months in Zambia have anaemia. This prevalence is high and a severe public health problem as classified by WHO a prevalence of 40% or more should be taken a public concern. [21]. The Ministry of Health has since 2000 implemented the biannual child health week, where supplements of essential micronutrients and deworming medication provided to children as part of interventions meant to improve child health and nutrition 6-59 months [5, 17, 26]. Additionally, since most children are not fed appropriately, supplementation of micronutrients such as iron and Vitamin A to children 6-59 months during child health week are aimed at preventing iron and vitamin A deficiencies, which are leading causes of anaemia [16, 26].

Pregnant women are at higher risk of anaemia due to increase in blood volume and severe anaemia can contributes to low birth weight in children. Pregnant women during their antenatal care visits are advised to take iron folate supplements, eat iron-rich foods, and prevent intestinal worms [19, 26]. Nonetheless, because of limited access to diverse foods and diets to enable consumption of the needed micronutrients, pregnant women receive iron supplements and deworming medication during their antenatal care visits. In spite of all these interventions, a question remains as to why prevalence of anaemia in children aged 6-59 months in Zambia is still high.

Studies have been conducted in Zambia to determine factors associated with prevalence of anaemia among children. The focus of these studies have varied in terms of target age of children, at subnational level and others using hospital/ clinic record. Daly *et al*, in 2017 investigated factors associated with anaemia status and haemoglobin concentrations in children 6-11 months in Mbala district of Northern province of the Zambia. Nkhoma *et al*, in 2020 studied types and severity of anaemia in patients aged 1-14 years at the Children's Hospital of the University Teaching Hospitals in Zambia. This study is based on a nationally representative household survey aimed at identifying the factors associated with prevalence of anaemiain children aged 6-59 months in Zambia.

Study objective

The primary purpose of this study was to establish the determinants of prevalence of anaemia in children age 6-59 months in Zambia. In-depth multivariate data analysis based was conducted on secondary datasets from the 2018 Zambia Demographic and Health Survey. Results from this study will be useful to the Ministry of Health and relevant stakeholders to inform decision making for strengthening interventions aimed at improving child nutrition and health.

Conceptual Framework

In order to establish the determinants associated with prevalence of anaemia in children 6-59 months in Zambia, the researchers developed the conceptual framework (shown in Figure 1) based on the literature reviewed. The likely determinants of prevalence of anemia in children 6-59 months in Zambia are categorized into three; background characteristics (residence and region), characteristics of children (age, sex, birth weight, birth order, and stunting) which in this study are viewed as proximate determinants to whether a child has anemia. On the other hand, mother's characteristics included (age, marital status, education level, employment status, wealth status) which an indirect influence on prevalence of anemia in children by affecting child's characteristics (birth weight, birth order and stunting). There are also background characteristics are expected to influence characteristics of children and mothers respectively, thus determine prevalence of anemia in children 6-59 months in Zambia [2].

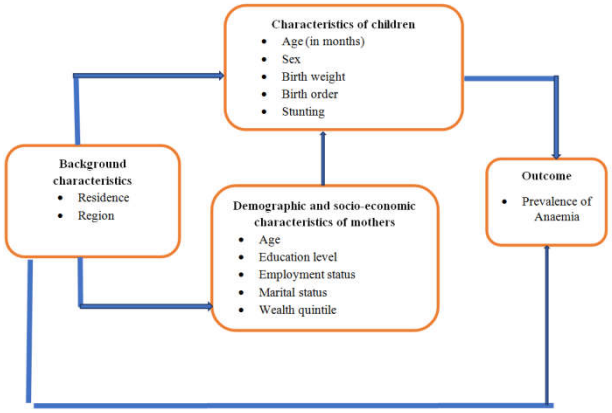

Figure 1 Conceptual framework showing determinants of prevalence of anaemia in children

Source: Developed by Authors based on review of literature

DATA AND METHODS

The analysis used secondary data from the sixth Zambia Demographic and Health Survey (ZDHS) conducted in 2018. The ZDHS is a nationally representative survey conducted every after five years since 1992. The 2018 ZDHS was designed to provide estimates at national, provincial as well as by residence (rural/ urban). It collected information, which included demographic and socio-economic characteristics, child health and nutrition such as anaemia testing, anthropometry, and up take of essential drugs in the 6 months prior to the survey. In this analysis, data used is the household recode (ZMPR71FL), which shows selected characteristics of usual members of households and child recode (ZMKR71FL), which shows characteristics of children under 5 years files. The two datasets were merged in order to have all variables needed for analysis in one file. Only records that successfully merged were kept in the file for analysis.

In the 2018 ZDHS, all children 6-59 months were eligible for anaemia testing and a weighted 8, 623 children had blood tested for haemoglobin levels. The target population in this analysis is children 6-59 months captured in all selected households in Zambia and tested for anaemia, these children stayed in the selected households on the night before the survey and whose mothers were interviewed. Therefore, the final sample for this study was 7,755 under-5 children.

Data analysis

Stata version 14 statistical software was used for analysis, which involved univariate and inferential analysis. During analysis, the data was weighted to account for the non-proportional allocation of the sample to different provinces and their urban and rural areas and differences in response rates. Univariate analysis was performed to frequency and percentage distribution of the sample by selected characteristics. Bivariate and multivariate binary logistic regression was performed to determine the odds ratios of anaemia by selected characteristics of children and their mothers.

The outcome variable – anaemia was generated from variable hc57 which has four categories of anaemia levels- severe, moderate mild and no anaemia). These four categories were collapsed into two categories; 0 "No" (if child had no anaemia, haemoglobin (hb) level 11.0 or higher grams per decilitre (g/dl)) and 1 "Yes" (if child had hb level below g/dl. The data was weighted in order to allow for generalization of the results. The independent variables were categorised in to three; child characteristics (birth weight, sex of the child, age of the child, birth order and the nutrition status of a child), mother's characteristics (age, education level, employment status, marital status, wealth index, residence and region). Chi-square test for independence was performed to assess the influence of the independent variables on the outcome variable.

RESULTS

Sample description and prevalence of anaemia in children

Table 1 describes the background characteristics of the children. About 22% of the children were aged 24-35 months while those aged 6-8 months accounted for 6 percent. Half of these children were females (51%). Over 90% of the children weighed more than 2.5kg at birth. Nearly 35% of the children were of birth order range 2 to 3 while the least sample (12%) were those of birth order 7th or above. Findings shows that in Zambia, stunting is still a problem as 36% of the children were stunted. The results also show that 6 out 10 children had anaemia.

Table 1 Percentage distribution of children age 6-59 months by background characteristics, 2018 DHS, Zambia

Background Characteristic	Percent	Number of children
Age in months		
6-8	5.7	445
9-11	6.0	466
12-17	12.0	931
18-23	11.6	897
24-35	22.7	1,764
36-47	21.9	1,698
48-59	20.0	1,554
Sex		
Male	49.9	3,868
Female	50.1	3,887
Birth Weight		
<2.5kg	8.2	508
>=2.5kg	91.8	5,694
Birth order		
1	23.7	1,840
2-3	34.5	2,678
4-6	29.7	2,302
7+	12.0	934
Child stunted		
Yes	36.5	2,829
No	63.5	4,926
Presence of Anaemia		
Yes	59.1	4,579
No	40.9	3,176
Total	100	7,755

*Analysis is based on successfully merged records in ZMPR71FL andZMCR71FL datasets

Prevalence of anaemia by selected background characteristics of the children and mother

Table 2 show the bivariate analysis of characteristics of the child and the mother and prevalence of anaemia. Results in table 2 reveal that over 59% of children in Zambia had anaemia. At least seven out of ten of children in the age range 6-23 months had anaemia, with the highest prevalence being 77% among children aged 9-11 months. Findings also show that male children in Zambia (61%) are more likely to be anemic compared to females (57%) as observed in the DHS. Birth weight does not seem to have a bearing on anaemia levels in children though the results show that 63% of children born with low birth weight (less than 2.5kg) had anaemia compare to 59% of those born with a weight of 2.5kg or more. Similarly, prevalence of anaemia in children does not depend on the birth order of a child. It is evident that nutrition status of a child is significantly associated with anaemia such that stunted children are more likely to be anaemic than those who are not (65% vs 56%).

Table 2 Prevalence of anaemia in children aged 6-59 months by background characteristics, 2018 DHS, Zambia

Background characteristic	Percent	CI	P-value
Age			0.000*
6-8	72.8	[67.7,77.4]	
9-11	77.6	[73.1,81.6]	
12-17	76.5	[73.0,79.6]	
18-23	71.9	[68.1,75.4]	
24-35	59.4	[56.3,62.4]	
36-47	49.8	[46.3,53.2]	
48-59	41.4	[38.6,44.3]	
Sex			0.032*
Male	60.8	[58.6,63.0]	
Female	57.3	[55.1,59.5]	
Birth weight			
<2.5kg	63.4	[58.3,68.2]	0.081
>=2.5kg	58.8	[57.0,60.5]	
Birth order			
1	59.2	[56.2,62.1]	0.947
2-3	59.1	[56.8,61.3]	
4-6	58.5	[56.0,61.1]	
7+	59.9	[56.1,63.5]	
Child nutrition status			
Stunted	64.8	[62.3,67.2]	0.000*
Not stunted	55.7	[54.0,57.5]	
Total	59.1	[57.5,60.6]	

Table 3 shows bivariate analysis of the influence of mothers' characteristics on prevalence of anaemia in children. The results show that children born from young mothers of age group (15-19) have the highest prevalence of anaemia (67%) than those born from mothers in older age categories. The lowest percent is among children born from mothers in the age range 40-44. Results also show that there is no statistical difference in the prevalence of anaemia between children in living rural areas and those living in urban areas. Region is significantly associated with prevalence of anaemia. Luapula province has the highest percent of children with anaemia (72%) while Central province has the lowest prevalence at (50%). Education level of mother is highly associated prevalence of stunting. Children born from mothers who attained tertiary level of education have a lower prevalence of anaemia (53%) compared to other categories, with the highest prevalence being among those born from mothers with no

formal education (64%). It is also observed that slightly more children from a poor wealth index, compared to those from a middle and rich wealth index category were anaemic, though there is no association between wealth index and prevalence of anaemia in children. Similarly, there difference in prevalence of anaemia in children in terms of mother's occupation is statistically insignificant. It is interesting to note that children whose mothers are either separated, divorced or widowed are least likely to be anaemic compared to those whose mothers were reported married or never married.

Table 3 Percentage of anaemia in children aged 6-59 months by Mother's background characteristics, 2018 DHS, Zambia

	%	CI	P value
Mothers age			
15-19	67.4	[62.5,72.0]	0.012*
20-24	60.5	[57.3,63.6]	
25-29	57.5	[54.6,60.3]	
30-34	59.1	[56.2,62.0]	
35-39	57.8	[54.1,61.4]	
40-44	54.0	[49.0,58.9]	
45-49	58.6	[50.0,66.7]	
Residence			0.992
Urban	59.1	[56.2,61.9]	
Rural	59.0	[57.3,60.8]	
Province			0.000*
Central	50.2	[45.3,55.2]	
Copperbelt	57.5	[54.1,60.8]	
Eastern	57.2	[53.3,61.0]	
Luapula	71.6	[66.9,75.8]	
Lusaka	59.0	[53.9,63.9]	
Muchinga	54.2	[48.1,60.2]	
Northern	61.1	[56.2,65.8]	
North western	62.7	[58.8,66.4]	
Southern	57.1	[52.5,61.7]	
Western	62.7	[57.8,67.3]	
Education level			
No education	64.1	[60.2,67.9]	0.003*
Primary	57.7	[55.7,59.7]	
Secondary	60.3	[57.8,62.6]	
Higher	52.7	[46.8,58.7]	
Wealth index			0.463
Poor	60.0	[58.0,62.0]	
Middle	58.2	[54.8,61.4]	
Rich	58.2	[55.5,60.9]	
Occupation			0.296
Unemployed	59.8	[57.6,61.9]	
Employed	58.3	[56.4,60.2]	
Marital status			0.001*
Never married	65.8	[61.8,69.6]	
Married/ living with partner	58.7	[57.0,60.3]	
Separate & divorced/widowed	55.6	[51.6,59.5]	
Total	59.1	[56.8,63.1]	

Multivariate Binary Logistic Regression

Inferential analysis was performed using multivariate binary logistic regression. The analysis was to predict the odds of anaemia ("0" if the child didn't have anaemia and "1" if the child had anaemia) in children based on various explanatory variables. This analysis allowed for the assessment of the impact of multiple independent variables (selected characteristics of both the mother and of the child) on the dependent variable (anaemia) at the same time. The results are presented in the tables 4a and 4b.

The logistic regression results show that age of a child is a very strong determinant of anaemia. Younger children aged 9-11 months were about 6 times more likely to be anaemic compared to children aged 48-59. The odds are similar among those aged 12-17 months (AOR: 5.01). Children who are not stunted are about 29 percent less likely to be anaemic compared to those that are stunted. Sex of a child, birth weight and birth order do not seem to be associated with anaemic levels in children as they are all statistically insignificant.

Table 4a Logistic regression results of prevalence of anaemia by demographic and socio-economic characteristics of children, 2018 DHS, Zambia

Background characteristics	AOR	CI
Age of child (months)		
48-59	RC	RC
6-8	4.24***	3.06 - 5.88
9-11	5.71***	4.20 - 7.77
12-17	5.01***	3.96 - 6.33
18-23	3.74***	2.92 - 4.80
24-35	2.14***	1.74 - 2.63
36-47	1.41**	1.15 - 1.74
Sex of child		
Male	RC	RC
Female	0.85	0.73 - 1.00
Birth order		
1	RC	RC
2-3	1.02	0.83 - 1.26
4-6	0.97	0.74 - 1.27
7+	1.05	0.73 - 1.53
Birth weight		
<2.5 kg	RC	RC
>=2.5 kg	0.87	0.69 - 1.09
Stunting		
Yes	RC	RC
No	0.71***	0.61 - 0.81

*** p<0.001, ** p<0.01, * p<0.05

Findings in table 4b show association of mothers' background characteristics and prevalence of anaemia in children. Results indicate that age of the mother has no bearing on the prevalence of anaemia in children. Similarly, rural-urban differential does not have an effect on anaemia levels in children.

Table 4b Logistic regression results of prevalence of amaemia on selected demographic and socio-economic characteristics of mothers, 2018 DHS, Zambia

Background characteristics of mothers	AOR	CI
Age of mother		
15-19	1.00	
20-24	1.06	0.79 - 1.42
25-29	1.11	0.80 - 1.54
30-34	1.18	0.83 - 1.67
35-39	1.13	0.76 - 1.69
40-44	1.02	0.64 - 1.62
45-49	1.49	0.78 - 2.84
Residence		
Urban	1.00	
Rural	0.91	0.73 - 1.14
Province		
Central	1.00	
Copperbelt	1.43**	1.10 - 1.86
Eastern	1.26	0.95 - 1.67
Luapula	2.60***	1.89 - 3.56
Lusaka	1.41*	1.04 - 1.93
Muchinga	0.99	0.70 - 1.41
Northern	1.36*	1.01 - 1.84
North western	1.61**	1.18 - 2.18
Southern	1.34	0.99 - 1.81
Western	1.73***	1.26 - 2.38
Education status		
No education	1.00	
Primary	0.73*	0.56 - 0.95
Secondary	0.83	0.61 - 1.13
Higher	0.63*	0.42 - 0.95
Wealth index		
Poor	1.00	
Middle	1.00	0.83 - 1.21
Rich	0.96	0.75 - 1.24
Employment status		
Unemployed	1.00	
Employed	0.91	0.80 - 1.04
Marital status		

Single	1.00	
Married/partner	0.91	0.71 - 1.15
Separate	0.76	0.57 - 1.03
Constant	1.06	0.60 - 1.88

*** p<0.001, ** p<0.01, * p<0.05

However, region is significantly associated with anaemia, with Luapula Province having the highest odds (AOR) when compared with Central Province. Education of the mother is also a significant determinant of prevalence of anaemia in children. It is worth noting however, that the prevalence is lowest in children born from mothers with tertiary education as they are 37% less likely to be anemic (AOR: 0.63) when compare with children born from mothers without education. Wealth index and marital status are not significantly associated with anaemia in children.

DISCUSSION

Prevalence of anaemia in children is relatively high in Zambia. This study was aimed at determining factors associated with prevalence of anaemia in children age 6-59 months. Detailed analysis of selected socio-economic and demographic characteristics of both the mother and the child have been conducted and results presented in this paper. Based on the sample used in this analysis, the prevalence of anaemia in children was found to be way higher than the global prevalence. Results from this study showed that age of a child is significantly associated with the prevalence of anaemia. Younger children in the age range 6-23 months have a higher risk of anaemia (OR= >3.0) than older children aged 48-59 months. The findings are in line with those from other studies [7]. One study conducted in Ethiopia found that children in the age ranges 6–11 and 12–23 months were 4.5 times (AOR = 4.52; 95% CI: 1.67–12.34) and 2.8 times (AOR = 2.79; 95% CI: 1.04–7.51) more likely to be anemic respectively than children in the age range of 48–59 months [7].

Another significant contributing factor to prevalence of anaemia in children is the nutrition status of a child. This study has also found that children that were stunted were at a higher risk of being anaemic than those that were not. There is a likelihood that malnutrition in children causes iron deficiency which increases the chances of being anaemic. In support of this finding, a study conducted in Nepal in 2017 found that malnutrition in children was associated with a higher prevalence of anemia compared (APR [95% CI]: 1.19 [1.08–1.30]) [10].

Evidence show that education of the mother is a significant determinant of prevalence of anaemia in children [3, 4, 10]. This study has established that the prevalence of anaemia in children reduces with increase in mother's education. This is possibly because mothers with secondary or higher levels of education are expected to be knowledgeable about appropriate nutrition required for proper growth of the child. Further, mothers with higher education are more likely to be economically able to buy their children nutritious foods that are rich in iron compared to those with low or no education.

It is however, surprising that household wealth index has no influence on prevalence of anaemia in children. This could probably be due to the fact that household wealth encompasses all household assets and therefore does not necessarily reflect disposable income that would be available to be spent on food. However, other studies have found a relationship between wealth and prevalence of anaemia. For example, a study conducted in Pakistan established that children from the lower wealth quintiles were more likely to be anaemic compared with children from the rich wealth quintile (poorer: 1.09 [1.03–1.16] and poorest: 1.10 [1.04–1.17]) [10].

The findings suggest insignificant rural-urban differentials in terms of prevalence of anaemia in children in Zambia. Analysis by province show that some provinces have higher odds of anaemic prevalence in children. For example, Luapula province have the highest prevalence of anaemia (2.60 [1.89 - 3.56]) compared to other regions.

The findings reported in this study have implications for both policy formulation and public health improvement. The lower anaemic prevalence among children whose mothers have higher education suggests that improving education system can have long term impact on health of children. In addition, the introduction of nutrition education talks at maternal and child care clinics especially in rural areas is vital for providing necessary and appropriate information to mothers improve feeding practices for under five children.

CONCLUSION

The findings of this study show that prevalence of anaemia in children in Zambia is too high at (59%). It is evident that children's characteristics such age and nutrition status are contributing factors to prevalence of anaemia. These findings are consistent with findings from similar studies conducted within Zambia and outside. The study has also established that in Zambia, background characteristics that relate to the mother are significantly associated with prevalence of anaemia in children. Also, important to note in this study is that education of a mother is significant in determining the health status of children. In most society mothers with fair level of education are highly likely to be knowledgeable about basic nutrition prescribed for children. The findings suggest the need for target interventions to improve children nutrition to address the challenges of affecting sector in the country.

Based on the findings of the study, the following recommendations are being proposed;

- Given that, the prevalence is highest among young children in the ages 6-24 months, it is important that government comes up with child health programmess aimed at addressing anaemia in this age range. This is especially so because in this age group, whilst most children are still being breastfed, complimentary foods are also introduced of which some parents may tend to neglect one type of feeding (breastfeeding/complimentary foods) and concentrate on the other. Therefore, parents should be adequately taught during child health week programmes to ensure that children are both breastfed and right foods are introduced, without neglecting the other.
- In line with the above, the issue of stunting needs to be addressed by providing mothers with right feeding practices.
- There is need to include measurement for haemoglobin level as a health care component during under five clinics. This will help to know which children are anemic and administer appropriate measures to reduce the prevalence.
- Health facilities should include child health programmes that also aim at educating mothers on child

nutrition especially targeting women living in rural areas.

Abbreviations

AOR: Adjusted odds ratio
OR: Odds ratio
CI: Confidence Interval
CPH: Census of Population and Housing
DHS: Demographic and Health Survey
HIV: Human deficiency virus
ZDHS: Zambia Demographic and Health Survey
ZMPR: Zambia Population Recode File
WHO: World Health Organization

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The authors declare that they have no competing interests

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