

studies in Bangladesh, Brazil, India, Indonesia, and Uganda that reported evidence of low mother's education as a risk factor regarding childhood anaemia.^{18,28,29,33} For child health and feeding practices, the mother's education level is believed to be a key influencer as mothers are the primary caregivers.³⁹ Thus, we acknowledge that the mother's education might play an important role in reducing the prevalence of anaemia, even if our study is not giving such indication.

Despite vitamin A deficiency and intestinal parasitic diseases being key determinants of the onset of anaemia, we found no association between their corresponding indicators and childhood anaemia. The lack of association with intestinal parasite medication differs from a similar study in Rwanda, which reported a low likelihood of anaemia amongst medicine recipients¹¹. Even if our study shows no evidence of these medicines being related to the existence of anaemia; considering the key role vitamin A plays in iron deficiency and parasitic diseases related to high risk of anaemia, we encourage interventions to be maintained.^{11,23,30}

We could not give evidence of an association between anaemia and the nutritional factors stunting, underweight and wasting. Our results are in line with some other studies.^{30,31} In most studies, however, there is evidence of an association between anaemia and at least one of the nutritional factors.^{20,21,23,29,33,40} The fact that anaemia is a malnutrition deficit, a co-existent and increased risk of anaemia is mostly assumed among malnourished children.^{20,21,41} However, our results indicate that this might not be the case for Namibian children. On the other hand, Namibia has high rates of malnutrition among children under the age of five and thus attention must be paid to these factors. Resolving malnutrition can surely play a vital role in curbing the high prevalence of anaemia. Lastly, we found no association between place of residence (urban, rural) and onset of childhood anaemia. Our results are similar to those of a previous study in Nigeria.²⁶

Our analysis has some key strengths and limitations. A key strength is that we used a large national representative sample to provide empirical evidence related to determinants of anaemia among children in Namibia. The fact that our analyses were restricted only to children whose mothers were present to be interviewed might have led to a selection bias. However, our complimentary analyses with the entire sample of children aged 6–59 months gave a similar result, showing that such a bias likely is low, if it exists at all. Malaria information for the children would likely have strengthened our study with, as it has been shown in previous studies that it increases the risk of becoming anaemic,^{9,11} and malaria is prevalent in Namibia in some of the densely populated areas.⁴²

Childhood anaemia is a major public health concern in Namibia, and from our study data, a prevalence of 47.5% has previously been reported.¹⁷ Our study gives valuable evidence of age, sex and household wealth status being the key determining factors for the onset of anaemia among children aged 6–59 months in Namibia. Targeting poverty reduction in the population can enhance the likelihood of reducing childhood anaemia through improved access to nutritious food. Special attention must be paid to younger children of less than 2 years, as they carry the most prevalence and highest likelihood of anaemia. One group that we consider extra important to keep an eye on is boys whose parents are poor, as this group had a high risk of anaemia in comparison with the richest households. We recommend that current interventions be maintained, and amendments can be made accordingly, related to the current knowledge of determinants of anaemia.

Conclusions

In conclusion, our study shows that the youngest children, boys and households with a poor wealth status have an increased risk of having anaemia among children of the age of 5 years. However, the prevalence of anaemia is in most groups considered to be on too high a level despite a lower risk in these groups. We highlight the persistent challenges anaemia poses to

public health and poverty as a social determinant of health. Our study can help with priorities for public health policymaker, so that they can plan for preventions and control programmes to prevent anaemia among children. Cost-effective measures such as nutrition education and food fortification must be explored adequately to achieve significant reduction in anaemia prevalence. Future research is encouraged in order to further understand the specific determinants of childhood anaemia. The inclusion of biomarker data on haemolysis diseases (malaria, intestinal helminths, HIV/AIDS etc.) will also be vital to future research.

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Table 1: Study characteristics and anaemia prevalence's for groups of individuals.

Group	All		Anaemia	
	<i>n</i>	%	<i>n</i>	Weighted ^a % [95% CI]
All	1537		785	49.6 [46.5-52.6]
Age				
6-11 months	224	14.6	144	62.8 [55.0-70.0]
12-23 months	395	25.7	264	64.2 [58.7-69.4]
24-35 months	341	22.2	173	49.5 [43.4-55.6]
36-47 months	304	19.8	118	38.8 [32.6-45.3]
48-59 months	273	17.8	86	30.1 [24.2-26.7]
Sex				
Boys	751	49.0	406	52.7 [48.5-57.0]
Girls	786	51.0	379	46.5 [42.5-50.7]
Place of residence				
Urban	633	43.2	313	48.0 [43.2-53.0]
Rural	904	56.8	472	50.8 [46.9-54.6]
Household wealth status				
Richest	180	12.6	70	38.3 [31.7-45.4]
Richer	324	20.9	155	47.7 [40.5-55.1]
Middle	331	19.6	174	51.9 [45.2-58.6]
Poor	328	21.1	189	55.0 [48.6-61.2]
Poorest	374	25.8	197	50.4 [44.7-56.2]
Mother education level				
Higher	60	5.2	508	68.7 [64.4-72.7]
Secondary	964	64.3	483	50.0 [46.2-53.8]
Primary	385	24.1	210	25.4 [21.7-29.5]
No education	128	6.4	67	5.9 [4.4-7.9]
Using vitamin A supplement^b				
Yes	1319	86.4	669	49.5 [46.1-52.9]
No	183	11.8	99	50.8 [42.5-59.0]
Don't know	25	1.7	12	41.8 [21.9-64.8]
Using deworming medicine^b				
Yes	672	43.5	347	51.0 [46.3-55.7]
No	792	52.3	402	48.7 [44.6-52.8]
Don't know	66	4.2	34	48.4 [33.8-63.2]

Stunting^c				
No	1,119	77.1	562	48.4 [45.1-51.9]
Yes	352	22.9	191	52.3 [46.1-58.4]
Underweight^c				
No	1,263	85.9	649	49.3 [46.0-52.5]
Yes	208	14.1	104	49.6 [41.4-57.8]
Wasting^c				
No	1,355	92.3	682	48.5 [45.3-51.8]
Yes	116	7.7	71	58.9 [48.4-68.6]

^a Using sampling weights from the Namibia Demographic and Health Survey.

^b There were missing data for ten persons for “Using vitamin A supplement” and seven persons for “Using deworming medicine”.

^c There were missing data for weight and/or height, and also values outside plausible limits for stunting, underweight and wasting.

Table 2: Factors associated with anaemia among children aged 6-59 months in Namibia.

Variables	All participants			
	Univariable ^w	Multivariable ^w	Multivariable ^{nw}	Multivariable ^{wc}
	OR[95%CI]	OR[95%CI]	OR[95%CI]	OR[95%CI]
Age (in months)				
6 - 11 (n=224)	1	1	1	1
12 - 23 (n=395)	1.06 [0.72-1.57]	0.86 [0.57-1.31]	0.89 [0.60-1.31]	0.97 [0.68-1.38]
24 - 35 (n=341)	0.58 [0.40-0.84]	0.49 [0.32-0.76]	0.47 [0.31-0.70]	0.54 [0.38-0.77]
36 - 47 (n=304)	0.37 [0.25-0.55]	0.29 [0.19-0.45]	0.27 [0.18-0.41]	0.33 [0.23-0.48]
48 - 59 (n=273)	0.25 [0.16-0.39]	0.21 [0.13-0.35]	0.20 [0.13-0.31]	0.27 [0.18-0.40]
Sex				
Boys (n=751)	1	1	1	1
Girls (n=786)	0.78 [0.62-0.98]	0.73 [0.56-0.95]	0.75 [0.60-0.94]	0.83 [0.68-1.01]
Place of Residence				
Urban (n=633)	1	1	1	1
Rural (n=904)	1.11 [0.87-1.43]	0.79 [0.56-1.10]	0.76 [0.57-1.01]	0.87 [0.64-1.18]
Wealth quintile				
Richest (n=180)	1	1	1	1
Richer (n=324)	1.47 [0.98-2.20]	1.32 [0.82-2.13]	1.65 [1.06-2.55]	1.15 [0.78-1.67]
Middle (n=331)	1.74 [1.17-2.58]	1.66 [1.01-2.72]	2.06 [1.28-3.31]	1.38 [0.91-2.10]
Poor (n=328)	1.97 [1.33-2.91]	2.22 [1.28-3.84]	2.77 [1.70-4.53]	1.58 [1.02-2.46]
Poorest (n=374)	1.64 [1.13-2.38]	1.75 [0.98-3.14]	2.19 [1.30-3.68]	1.47 [0.93-2.34]
Mother's education				
Secondary (n=964)	1	1	1	1
Higher (n=60)	0.59 [0.34-1.03]	0.81 [0.43-1.52]	1.06 [0.57-1.96]	-
Primary (n=385)	1.09 [0.83-1.44]	1.05 [0.8-1.44]	1.18 [0.89-1.56]	-
No education (n=128)	0.84 [0.55-1.29]	0.99 [0.61-1.60]	1.19 [0.77-1.86]	-
Vitamin A				
Yes (n=1319)	1	1	1	-
No (n=183)	1.05 [0.73-1.52]	1.20 [0.78-1.83]	1.23 [0.86-1.76]	-
Deworming				
Yes (n=672)	1	1	1	-
No (n=792)	0.91 [0.71-1.18]	0.79 [0.59-1.07]	0.87 [0.69-1.10]	-
Stunting				
No	1	1	1	1

Yes	1.17 [0.88-1.54]	1.08 [0.75-1.55]	1.17 [0.87-1.59]	1.15 [0.90-1.47]
Underweight				
No	1	1	1	1
Yes	1.01 [0.71-1.44]	0.98 [0.61-1.56]	0.85 [0.58-1.26]	1.03 [0.73-1.45]
Wasting				
No	1	1	1	1
Yes	1.52 [0.97-2.37]	0.88 [0.52-1.47]	0.99 [0.62-1.58]	1.10 [0.72-1.68]

^w Sample weights from the Namibia Demographic and Health Survey 2013 applied to analyses (n=1383).

^{nw} Sample weights not applied for analyses (n=1383).

^{wc} Sample weights were applied with complimentary analyses that included all children who had been evaluated for anaemia. Mother's education, use of Vitamin A medication and use of deworming medication were excluded from analyses (n=2208).

Statistical significances ($p < 0.05$) are noted in bold.

Rural (n=904)	1.23 [0.87-1.74]	0.72 [0.45-1.15]	0.61 [0.40-0.92]	0.70 [0.47-1.05]	1.02 [0.73-1.44]	0.88 [0.57-1.35]	0.93 [0.63-1.37]	1.05 [0.71-1.58]
Wealth quintile								
Richest (n=180)	1	1	1	1	1	1	1	1
Richer (n=324)	1.88 [1.04-3.40]	1.65 [0.86-3.17]	2.15 [1.17-3.95]	1.21 [0.72-2.04]	1.15 [0.63-2.11]	1.06 [0.48-2.34]	1.22 [0.64-2.33]	1.06 [0.57-1.96]
Middle (n=331)	2.02 [1.14-3.58]	1.86 [0.91-3.79]	2.44 [1.28-4.66]	1.51 [0.82-2.79]	1.49 [0.79-2.79]	1.49 [0.66-3.36]	1.71 [0.85-3.45]	1.28 [0.68-2.39]
Poor (n=328)	2.94 [1.57-5.49]	3.20 [1.46-7.05]	3.92 [1.95-7.89]	1.88 [0.99-3.57]	1.41 [0.77-2.55]	1.60 [0.68-3.76]	1.95 [0.96-3.93]	1.36 [0.70-2.64]
Poorest (n=374)	2.42 [1.33-4.38]	2.56 [1.15-5.73]	3.55 [1.70-7.40]	1.84 [0.97-3.52]	1.10 [0.62-1.94]	1.14 [0.46-2.80]	1.30 [0.61-2.77]	1.19 [0.59-2.40]
Mother education								
Secondary (n=964)	1	1	1	1	1	1	1	1
Higher (n=60)	0.32 [0.14-0.76]	0.56 [0.24-1.34]	0.84 [0.36-1.96]	-	1.06 [0.47-2.41]	1.24 [0.50-3.11]	1.26 [0.51-3.13]	-
Primary (n=385)	1.05 [0.71-1.56]	0.94 [0.61-1.45]	1.14 [0.76-1.71]	-	1.12 [0.76-1.67]	1.18 [0.76-1.85]	1.24 [0.84-1.83]	-

Yes	1.66 [0.97-2.82]	1.04 [0.56-1.92]	1.23 [0.68-2.29]	1.28 [0.76-2.15]	1.08 [0.54-2.15]	0.74 [0.33-1.60]	0.76 [0.35-1.64]	0.85 [0.43-1.66]
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^w Sample weights from the Namibia Demographic and Health Survey 2013 applied to analyses (n=1383).

^{nw} Sample weights not applied for analyses (n=1383).

^{wc} Sample weights were applied with complimentary analyses that included all children who had been evaluated for anaemia. Mother's education, use of Vitamin A medication and use of deworming medication were excluded from analyses (n=2208).

n/a Analysis not applicable due to missing standard errors because of stratum with single sampling unit.

Statistical significances ($p < 0.05$) are noted in bold.