

# Anemia in young children living in the Surinamese interior: the influence of age, nutritional status and ethnicity

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**Purpose:** This study investigates the prevalence of anemia in young children living in the interior of Suriname and the influence of the associated factors age, nutritional status and ethnicity.

**Patients and methods:** In this cross-sectional observational study, 606 children aged 1–5 years from three different regions of Suriname's interior were included, and hemoglobin levels and anthropometric measurements were collected. Logistic regression models were computed to examine independent associations between anemic and nonanemic groups and to measure the influence of age, nutritional status and ethnicity.

**Results:** A total of 606 children were included, of whom 330 (55%) were aged 1–3 years and 276 were aged 4–5 years. The overall prevalence of anemia was 63%. Younger age was associated with anemia (odds ratio [OR]=1.78; 95% confidence interval [CI]: 1.27–2.51). Anemia was less prevalent in Amerindian than in Maroon children (OR=0.51; 95% CI: 0.34–0.76). Hemoglobin level was not influenced by nutritional status nor by sex.

**Conclusion:** The prevalence of anemia in children aged 1–5 years living in Suriname's interior is high (63%) compared to that in similar aged children in Latin America and the Caribbean (4–45%). Children aged 1–3 years were more affected than those aged 4–5 years as were Maroon children compared to Amerindian children. Nutritional status and sex were not of influence.

**Keywords:** Maroon, Amerindian, hemoglobin, malnutrition, stunting, younger age

## Introduction

Anemia is the world's second leading cause of disability and affects 43% of all children worldwide.<sup>1</sup> Childhood anemia is often multicausal, with age, nutritional status, inflammation, infections and ethnicity – related to inherited conditions such as sickle cell disease and thalassemia – being significant contributors. Age is widely recognized as an important determining factor of anemia affecting primarily children under 2 years of age<sup>2</sup> and almost half of preschool children.<sup>3</sup> Nutritional deficiencies play an important role in childhood anemia, iron deficiency being the most common cause.<sup>4</sup> Children suffering from iron-deficiency anemia during their first 2 years of life have slower cognitive development and poorer school performance and work capacity later in life.<sup>5</sup>

The Republic of Suriname, situated on the north-eastern coast of South America, has a highly diverse society consisting of Hindustanis, Maroons, Creoles, Javanese, indigenous Amerindians, Brazilians, Chinese and individuals from mixed ethnicity. The majority of its half million inhabitants live in the northern coastal plain. The far greater part of the country's interior is covered by tropical rainforest and is inhabited primarily by Maroons and Amerindians. The World Bank reports an overall 39% prevalence rate

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of anemia among children aged under 5 years in Suriname;<sup>6</sup> however, little information is available on the prevalence of anemia in young children living in the interior. The Medical Mission Primary Health Care Suriname is responsible for health care in Suriname's interior and documents information on demographic and other factors of the interior population, e.g., age, sex, ethnicity, nutritional status and hemoglobin level. The prevalence rates of anemia and associated factors may vary in the different regions in Suriname's interior due to ethnic differences and nutritional and cultural habits.

The primary aim of this study is to determine the prevalence of anemia in children aged 1–5 years living in three different interior regions of Suriname. The secondary aim is to gain more insight into the relationship between the prevalence of anemia and the associated factors age, nutritional status and ethnicity. The outcome of this study may support adaptation of anemia prevention and control programs in young children in Suriname and in particular those of the Medical Mission.

## Patients and methods

In this cross-sectional observational study, 606 children aged 1–5 years from three different regions of Suriname's interior were included in the period September–October 2015. Eligible study participants between 12 and 71 months of age who lived in or near the selected villages were invited to come to the local Medical Mission health post and included in the study by convenience sampling on a first-come, first-served basis. To facilitate parents who were unable to visit the health post, two trained investigators went into the villages under guidance of the Medical Mission staff to include children. Verbal assent was obtained from each child, and written informed consent was obtained from each child's parent or guardian after they were fully informed about the study in a language they could understand. The selection of these villages was based on urbanization, i.e., they were classified as urban or rural based on accessibility by road, availability of electricity and/or tap water, access to food stores and ethnicity: Brokopondo and Brownsweeg are located in an urban area with a mainly Maroon population; Pikin Sleen and Hekununu are remote rural villages far upstream only accessible by boat, and their population consists entirely of Maroons; and the urban Amerindian villages Apoera and Washabo are in West-Suriname.

Age, sex and ethnicity were recorded; weight and length were measured using a portable weight scale (HealthO-Meter®; Seca, Chino, CA, USA) and a body length measurement instrument (Road Rod®, Hopkins, Caledonia, MI,

USA), respectively. Anthropometric variables were computed using the World Health Organization (WHO) Child Growth Standards SPSS Syntax File for children 0–5 years of age and WHO Anthro (version 3.2.2, January 2011) and macros for SPSS and Igrowup for children 5–19 years of age (standard deviation, SD).<sup>7,8</sup> Malnutrition was defined according to WHO standards as body mass index (BMI)  $\leq 2SD$ , and stunting was defined as height-for-age *z*-score  $\leq 2SD$ . Hemoglobin levels were drawn from every participant by a single finger prick and measured with a mobile device (Stat-Site®MHgb, Stanbio Laboratory, Boerne, TX, USA). For the 12–59 months age group, a blood hemoglobin level lower than the recommended WHO threshold of 11.0 g/dL (6.83 mmol/L) was used as cut off point to identify anemia, and a cut off of 11.5 g/dL (7.14 mmol/L) was used for children older than 59 months.<sup>9</sup>

Subjects were excluded in case of critical physical condition: children with severe anemia and unstable vital signs would immediately be referred for admission, treatment and diagnostic work-up to the Diakonessenhuis hospital in Paramaribo, the capital of Suriname. Children aged 12–47 months (1–3 years) were classified as very young children, and children aged 48–71 months (4–5 years) were classified as older children.

For statistical analysis and power calculation, the Medical Mission-owned database was used, which contains information on all children living in the selected villages. A sample size of 603 was calculated to reach a power of 80%, a 95% confidence interval (CI), with a 5% margin of error. Descriptive, bi- and multivariable logistic regression analyses were applied to test differences in sex, age, ethnicity and nutritional status between the anemic and nonanemic groups. A *p*-value  $< 0.05$  was considered statistically significant. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). The study was approved by the Commission of Human Subjects Research of Suriname's Ministry of Health (VG 019-15).

## Results

A total of 606 children were included, of whom 330 (55%) were very young (1–3 years) and 276 were older (4–5 years) children, 315 (52%) were males and 291 were females, and 471 (77.7%), 131 (21.6%) and 4 (0.7%) were of Maroon, Amerindian and Mixed descent, respectively (Table 1).

Table 2 shows the population characteristics stratified for anemia and nonanemia. A total of 63% ( $n=381$ ) were anemic, of which the majority (60.1%,  $n=229$ ) were in the 1–3 years

**Table 1** Study population demographics and characteristics

Demographics and characteristics	n=606	% (95% CI)
Sex		
Male	315	52.0 (48.0–55.9)
Female	291	48.0 (44.0–52.0)
Ethnicity		
Maroon	471	77.7 (74.2–80.9)
Amerindian	131	21.6 (18.5–25.1)
Mixed and others	4	0.7 (0.3–1.7)
Region		
Urban	226	37.3 (33.5–41.2)
Rural	380	62.7 (58.8–66.5)
Age (months)*	43.7 (46.5; 29.6–57.8)	
Hemoglobin (mmol/L)*	6.6 (6.6; 6.0–7.3)	
Length (cm)*	96.9 (99.0; 86.9–107.0)	
Weight (kg)*	14.4 (14.5; 11.7–17.0)	

**Note:** \*Data reported as mean (median; interquartile range).

**Abbreviation:** CI, confidence interval.

**Table 2** Population characteristics stratified for anemia and nonanemia; OR with 95% CI.

Population characteristics#	Non-anemia, n=225 (%)	Anemia,* n=381 (%)	Bivariate, OR (95% CI)	P-value
Sex				0.73
Male	119 (37.8)	196 (62.2)	1	
Female	106 (36.4)	185 (63.6)	1.06 (0.76–1.47)	
Age group				<0.001
1–3 years	101 (30.6)	229 (69.4)	1.85 (1.33–2.58)	
4–5 years	124 (44.9)	152 (55.1)	1	
Ethnic group				<0.001
Maroon	157 (33.3)	314 (66.7)	1	
Amerindian	66 (50.4)	65 (49.6)	0.49 (0.33–0.73)	
BMI** for age z-score ≤2SD				0.11
No	198 (36.1)	350 (63.9)	1	
Yes	26 (47.3)	29 (52.7)	0.63 (0.36–1.10)	
Height for age z-score ≤2SD				0.05
No	210 (38.5)	336 (61.5)	1	
Yes	15 (25.4)	44 (74.6)	1.83 (1.00–3.38)	
Region				0.23
Urban	77 (34.1)	149 (65.9)	1	
Rural	148 (38.9)	232 (61.1)	0.81 (0.57–1.14)	

**Notes:** \*Hemoglobin cutoff values for anemia according to WHO standards: children <5 years: <6.83 mmol/L (<11.0 g/dL), 5–12 years old: <7.14 mmol/L (11.5 g/dL).

#Numbers do not add up to the column total due to missing data; percentages do add up to 100%. Missing ethnic group n=4, BMI n=3, height for age n=1.

\*\*Body mass index according to WHO standards.

**Abbreviations:** BMI, body mass index; CI, confidence interval; OR, odds ratio; SD, standard deviation; WHO, World Health Organization.

age group. Girls had a slightly higher anemia prevalence (63.6%) compared to boys (62.2%). A total of 9.8% of the children were stunted (height for age z-score ≤2SD).

In bivariable analysis, younger age and Maroon ethnicity were statistically significantly associated with anemia,

$p < 0.001$  and  $p = 0.001$ , respectively; stunting (chronic malnutrition) was borderline significant,  $p = 0.05$ . In multivariable analysis, the association between anemia and younger age remained significant, with very young children being more often anemic than older children (odds ratio [OR]=1.78; 95% CI: 1.27–2.51). Anemia was less prevalent in Amerindian than in Maroon children (OR=0.51; 95% CI: 0.34–0.76). Hemoglobin level was not influenced by nutritional status, including BMI ≤2SD (OR=0.63; 95% CI: 0.36–1.10) and chronic malnutrition, height for age z-score ≤2SD (OR=1.83 95% CI 1.00–3.38), nor by sex (OR=1.06; 95% CI: 0.76–1.47 for females compared to males). Within the Maroon community, urbanization had no significant effect on hemoglobin level  $p = 0.85$  (OR=0.96; 95% CI 0.66–1.41).

## Discussion

The prevalence rate of anemia in children aged 1–5 years living in the three studied interior regions of Suriname is high (63%) and exceeds the rates of similarly aged children in other Latin American countries and the Caribbean (range 4–45%).<sup>10</sup>

Anemia was more prevalent in children 1–3 years of age, indicating that age is an important determinant for anemia. The high anemia prevalence in these very young children is alarming because of its expected negative impact on their ability to combat infections, whereas in the long term it could result in short stature, poor school performance and a lower capacity for physical work.<sup>11</sup> Potential contributing factors could be the high prevalence of iron deficiency observed in pregnant women (Medical Mission, unpublished data, 2016), which may affect the development of limited fetal iron stores.<sup>12,13</sup> Second, children in the interior are often solely breastfed and the amount of iron secreted in breast milk may not be sufficient to cover the infant's daily iron requirements. Third, weaning foods used during the transition period to the readily used diet in Suriname's interior are often low caloric and lack multiple micronutrients, especially iron.<sup>14</sup>

Maroon children were more affected compared to Amerindian children indicating that ethnic differences play a role in the occurrence of anemia in children living in Suriname's interior. These differences may partly be the result of genetic predisposition, but cultural differences and feeding practices may also be of influence.<sup>15,16</sup>

The prevalence of anemia was not influenced by BMI nor by chronic malnutrition. Anthropometric measurements to assess growth and development are the most widely used indicators of nutritional status, particularly in young children. However, anthropometric measurements are not sufficient to

define nutritional status because dietary intake in children may meet daily caloric requirements but can be specifically deficient in micronutrients. This was also reflected in our study where over half of the normal and overweight children were anemic.

## Conclusion

The prevalence of anemia in children aged 1–5 years living in the Suriname's interior is high, and younger children and children of Maroon descent are more often affected. Nutritional status, sex and region were not of influence on hemoglobin level. Further studies are necessary to investigate underlying causes in order to adapt anemia prevention and control programs reaching women of childbearing age and implement targeted interventions for young children.

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## Disclosure

The authors report no conflicts of interest in this work.

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