Anaemia Prevalence, Severity and Associated Risk Factors Among Indigenous Temiar Orang Asli Community in Kelantan, Peninsular Malaysia

Mohd Amirul Fitri A. Rahim

National University of Malaysia

Mohd Bakhtiar Munajat

National University of Malaysia

Wathiqah Wahid

National University of Malaysia

Nor Diyana Dian

National University of Malaysia

Mohd Ikhwan Mukmin Seri Rakna

District Health Office of Gua Musang

Nuraffini Ghazali

National University of Malaysia

Noor Wanie Hassan

National University of Malaysia

Paul C. S. Divis

Universiti Malaysia Sarawak

Inke Nadia D. Lubis

University of North Sumatra

Sriwipa Chuangchaiya

Kasetsart University

Mohd Rafiq Mohd Kasri

District Health Office of Gua Musang

Zulkarnain Md Idris (✉ zulkamain.mdidris@ukm.edu.my)

National University of Malaysia

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Abstract

Anaemia continues to be a major public health challenge in developing countries. An important and often unreported group at risk for anaemia is indigenous communities. This study aimed to assess the prevalence of anaemia and to identify its determinants in the indigenous Temiar Orang Asli community in Peninsular Malaysia. A community-based cross-sectional study was conducted in 2019. Six hundred and forty participants aged one and older were enrolled and personal characteristic data were collected. Anaemia status was determined using haemoglobin level (Hb) according to the World Health Organization (WHO) Hb cut-off. The overall anaemia prevalence was 44.7% (286/640) and the prevalence rates of mild, moderate and severe anaemia were 42.7%, 50.7% and 6.6%, respectively. Anaemia-specific prevalence varied significantly by age groups ($P < 0.001$) and was highest in the 6–17 group for mild anaemia (39.3%, 95% CI: 30.6–48.6), followed by ≤ 5 group for both moderate anaemia (43.4%; 95%CI: 35.2–51.9) and severe anaemia (42.1%; 95%CI: 20.3–66.5). In the multivariate logistic regression, anaemia was associated in age groups of ≤ 5 (adjusted odds ratio [aOR] 5.6 [95%CI: 3.3–9.4], $P < 0.001$) and 6–17 (aOR 2.1 [95%CI: 1.4–3.2], $P < 0.001$) as well in those living in Lambok (aOR 2.7 [95%CI: 1.3–5.5], $P = 0.006$). This study has highlighted the high prevalence of anaemia among indigenous Orang Asli in Peninsular Malaysia and revealed that younger children were positively associated with childhood anaemia. Effective interventions and special attention for this indigenous population need to be implemented to reduce the risk of anaemia.

Background

Anaemia has been recognised as one of the serious global public health problems as it affects more than two billion people, which corresponds to 24.8% of the world's population¹. Anaemia is defined as the amount of red blood cells or the concentration of haemoglobin (Hb) inside the blood cells is lower than that required by the human body^{2,3}. Haemoglobin is needed to carry oxygen and the blood's ability to carry oxygen to the body's tissues will be reduced if someone has too few or abnormal amounts of red blood cells or not enough Hb. This may result in general symptoms such as frequent vagueness, fatigue, shortness of breath and poor concentration⁴.

Anaemia has multiple precipitating factors and may result from a multifactorial deficiency of micronutrients (e.g. iron, folic acid, vitamin A and B12), infectious diseases (e.g. malaria and helminth) and inherited disorders (e.g. sickle cell disease and thalassemia)^{5,6}. Almost all of the age population groups are affected by anaemia, ranging from newborn to older age. However, women of childbearing age are at higher risk of developing a condition due to blood loss from menstruation⁷. Infants between 1 and 2 years of age also are at risk for anemia, if they did not get enough iron in their diets⁸. According to the world health organization (WHO), 42% of children less than 5 years old of age and 40% of pregnant women worldwide are estimated to be anaemic⁹. Furthermore, people that live in the less developed areas of the country and among hard-to-reach populations are more susceptible to anaemia because of poor quality diet, social-emotional and exposure to parasitic infections¹⁰.

An important and often unreported group at risk of anaemia is the indigenous population¹¹. In most cases, anaemia is a mild problem among indigenous people living in developed countries, and it has reached a serious level in the poorer regions of the world¹¹. As minorities, indigenous communities often experience significant and persistent differences in the social determinants of health, including access to healthcare services, education, employment, housing and food security¹². This is related to the aetiology of anaemia, which includes insufficient diet and poor living conditions as well as an association with infectious diseases including malaria and intestinal parasites^{5,6}.

In Malaysia, the indigenous minority people known as Orang Asli represent 0.6% of the total population of Malaysians¹³. The Orang Asli in Peninsular Malaysia are divided into three main tribes (i.e. Negrito, Senoi and Proto-Malay), with the Senoi tribe being the largest ethnic group constituting 55% of the total Orang Asli population with a large majority from the Temiar sub-tribe (Malaysia Department of Orang Asli). Approximately 37% of 869 Orang Asli villages throughout the country are still located in remote and forested areas¹⁴. Poverty and remote settlements have previously reported contributing many health problems related to malnourishment and high incidence of infectious diseases in these communities^{15,16,17,18,19,20,21,22}. Although several studies have been conducted to assess the prevalence of anaemia in Malaysia, there is a dearth of information on anaemia status among the Orang Asli population in the country. In response, this study aimed to determine the prevalence and associated risk factors of anaemia among indigenous Orang Asli communities in Peninsular Malaysia. Results from this study would be useful for informing national prevention strategies and could be used by several already existing national agencies dedicated to improving morbidity and mortality among indigenous peoples.

Methods

Ethics statement

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Medical Ethics Committee of the National University of Malaysia (UKM) (Reference No. UKM PPI/111/8/JEP-2019-148) and the Department of Orang Asli Development, Ministry of Rural and Regional Development Malaysia. Participants were sensitized to the study objectives and procedures by the local health district personnel for the study participation.

Study area and population

The study was conducted in Pos Kuala Betis (latitude 4°53'22"N; longitude 101°45'30"E), a clustered rural resettlement (RPS) of five villages (i.e. Angkek, Betak, Galas, Lambok and Podek) located at the Gua Musang district, Kelantan State, Peninsular Malaysia (Fig. 1). The Temiar sub-tribe of the Senoi was known to be the main indigenous Orang Asli in these villages. Located approximately 40km from Gua Musang town, the typical climate of the study area is tropical monsoon with temperature ranged between 20°C to 32°C and average annual rainfall between 2,000 mm to 4,000 mm. While the main economic activity was centred on agriculture such as palm oil plantation, the livelihood of the villagers mainly

depended on rubber-tapping, labourers, farmers and gathering and selling forest products²³. Previous studies have shown that this locality experienced high intestinal parasitic infections^{24,25} as well as recurrent malaria outbreaks, which possibly related to autochthonous outbreaks of vivax malaria in the neighbouring state²⁰.

Study design and sampling techniques

A community-based cross-sectional survey was carried out between June and July 2019²³. All indigenous Temiar Orang Asli of both sexes, residing in the study villages and aged one and older were invited to take part in the study. Participants were explained about the study protocol and informed consent was documented. For the illiterate participant, informed consent was obtained in the presence of an independent literate witness. For children and adolescents below 18 years old, informed consent was obtained from parents or legal guardians. District healthcare providers and community leaders were purposely involved in the study to facilitate participation and cooperation among the community²³. Participants were divided into four groups following age stratification practices in Malaysia namely infants and children (≤ 5 years), school-going children and adolescents (6–17 years), young adults (18–40 years) and older adults (>40 years).

Data collection

Gender, age and location were recorded for each participant. A blood sample was obtained by finger prick and Hb level was measured with the HemoCue Hb 201 Analyzer (HemoCue, Sweden), and was expressed as g/L. Anaemia was classified as mild, moderate or severe based on the concentrations of Hb in the blood. According to WHO criteria²⁶, for children aged 6–59 months and pregnant women, anaemia is defined at Hb <110 g/L (100–109, 70–99, and <70 g/L correspond to mild, moderate and severe anemia, respectively). For children aged 5–11 years old, anemia is defined as Hb <115 g/L, in which 110–114, 80–109, and <80 g/L correspond to mild, moderate and severe anemia, respectively. While for children 12–14 years old and non-pregnant women (15 years of age and above) anaemia is defined as Hb <120 g/L (110–119, 80–109, <80 g/L refer to mild, moderate and severe anaemia, respectively). Lastly, in men (15 years of age and above), anaemia is defined as Hb <130 g/L, in which 110–129, 80–109, <80 g/L correlate to mild, moderate and severe anaemia, reciprocally²⁶.

Statistical analysis

All survey data were double entered into Microsoft Excel spreadsheets and cross-checked for errors. Data were processed and analysed using STATA/SE 13.1 statistical software package (StataCorp, USA). Differences in proportions were tested using the Chi-squared test or Fisher's exact test. 95% confidence intervals (95% CI) were estimated to provide uncertainty surrounding the point estimates. Logistic regression was used to identify factors associated with anaemia in the community. Gender, age group and village were considered as explanatory variables in the univariate analyses. All variables with a P -value of <0.10 from the likelihood ratio test in the univariate analyses were included in the multivariate

logistic regression model and stepwise backward elimination was used to identify the main risk factors for anaemia²⁷. A $P < 0.05$ was considered statistically significant.

Results

Characteristic of the participants

A total of 640 individuals from Pos Kuala Betis (representing 68% of the combined population in the five villages) participated in this study (Table 1). The surveillance coverage varied among villages from 50 to 90%, being mostly females (58%; 95% CI: 54.1–61.8) and the age of participants ranged between 1 to 88 years old (mean [standard deviation; SD] age of 22.6 [17.8] years). A slight majority of the participants were school-age children and adolescents in the 6–17 age group (34.1%; 95% CI: 30.4–37.9).

Table 1
Demographic characteristic and anemia status of indigenous Temiar Orang Asli population in five villages of Pos Kuala Betis, Kelantan, Malaysia

Characteristic	Overall	Angkek	Betak	Lambok	Podek	Galas	<i>P</i> -value ^a
Total population ^b , N	941	154	100	198	281	208	
Total number of respondents, n (%)	640 (68)	138 (89.6)	50 (50)	150 (75.8)	186 (66.2)	116 (55.8)	
Gender, n (%)							
Male	269 (42)	71 (51.5)	17 (34)	56 (37.3)	77 (41.4)	48 (42.4)	0.101
Female	371 (58)	67 (48.5)	33 (66)	94 (62.7)	109 (58.6)	68 (58.6)	
Age, mean (SD), years	22.6 ± 17.8	21.6 ± 16.8	24.9 ± 19.3	24.4 ± 19	20.5 ± 17.2	23.9 ± 17.8	0.206
Age group, n (%), years							
≤ 5	104 (16.3)	27 (19.6)	8 (16)	18 (12)	35 (18.8)	16 (13.8)	0.607
6–17	218 (34.1)	43 (31.2)	17 (34)	53 (35.3)	68 (36.6)	37 (31.9)	
18–40	214 (33.3)	50 (36.2)	14 (28)	54 (36)	57 (30.6)	39 (33.6)	
> 40	104 (16.3)	18 (13)	11 (22)	25 (16.7)	26 (14)	24 (20.7)	
Hb level, mean (SD), g/dL	12.1 ± 2	12.2 ± 2	12.4 ± 1.3	12 ± 1.8	12 ± 2.3	12.3 ± 1.9	0.321
Anemia ^c , n (%)							
No	354 (55.3)	78 (56.5)	35 (70)	72 (48)	102 (54.8)	67 (57.8)	0.092
Yes	286 (44.7)	60 (43.5)	15 (30)	78 (52)	84 (45.2)	49 (42.2)	
SD, standard deviation							
^a Comparison between the five villages							
^b Census from the Demographic Surveillance System of District Health Office of Gua Musang							
^c WHO classification of anaemia on the basis of blood haemoglobin level (WHO 2011)							

Anaemia-specific prevalence

Of all participants, the overall prevalence of anaemia was 44.7% (95% CI: 40.8–48.6) and not significantly different between villages ($P=0.092$) (Table 1). The anaemia-specific prevalence among participants in Pos Kuala Betis is shown in Table 2. The prevalence of mild, moderate and severe anaemia was 42.7% (95% CI: 36.9–48.6), 50.7% (95% CI: 44.7–56.6) and 6.6% (95% CI: 4.1–10.2), respectively. Although the prevalence of anaemia was highest among females (57%; 95% CI: 51.0–62.8), no significant difference was observed between the three anaemia severity classifications ($P=0.691$). Nevertheless, the prevalence of anaemia varied significantly by age groups ($P<0.001$) and was highest in the 6–17 age group for mild anaemia (39.3%, 95% CI: 30.6–48.6), followed by ≤ 5 age group for both moderate anaemia (43.4%; 95%CI: 35.2–51.9) and severe anaemia (42.1%; 95%CI: 20.3–66.5).

Table 2
Specific prevalence of anemia among indigenous Temiar Orang Asli communities in Pos Kuala Betis, Kelantan, Malaysia

Category	Anemia	Mild	Moderate	Severe	<i>P</i> -value
Overall, n (%)	286 (100)	122 (42.7)	145 (50.7)	19 (6.6)	
Gender, n (%)					
Male	123 (43)	56 (45.9)	59 (40.7)	8 (42.1)	0.691
Female	163 (57)	66 (54.1)	86 (59.3)	11 (57.9)	
Age group, n (%), years					
≤ 5	74 (25.9)	3 (2.5)	63 (43.4)	8 (42.1)	< 0.001
6–17	106 (37.1)	48 (39.3)	52 (35.9)	6 (31.6)	
18–40	66 (23.1)	44 (36.1)	20 (13.8)	2 (10.5)	
> 40	40 (13.9)	27 (22.1)	10 (6.9)	3 (15.8)	
Village, n (%)					
Angkek	60 (21)	27 (22.1)	28 (19.3)	5 (26.3)	0.109
Betak	15 (5.2)	11 (9)	4 (2.8)	0 (0)	
Lambok	78 (27.3)	35 (28.7)	40 (27.6)	3 (15.8)	
Podok	84 (29.4)	27 (22.2)	48 (33.1)	9 (47.4)	
Galas	49 (17.1)	22 (18)	25 (17.2)	2 (10.5)	

Factor associated with anaemia

Comprehensive results for all significant co-variables associated with anaemia in univariate analysis ($P<0.05$) are provided in Table 3, and these variables were further used to build multivariate models with

stepwise forward selection. The final model in multivariate logistic regression showed that age groups of ≤ 5 (adjusted odds ratio [aOR] 5.6 [95%CI: 3.3–9.4], $P < 0.001$) and 6–17 (aOR 2.1 [95%CI: 1.4–3.2], $P < 0.001$) were significantly associated with higher odds of anaemia in the population. Moreover, respondents living in Lambok was found to be significantly associated with anaemia (aOR 2.7 [95%CI: 1.3–5.5], $P = 0.006$) compared to other villages.

Table 3
Factors associated with anaemia among indigenous Temiar Orang Asli in Pos Kuala Betis, Kelantan, Malaysia

Risk factor	Category	N	Anemia rate, % (95% CI)	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Gender	Male	269	45.7 (39.7–51.9)	1.07 (0.78–1.47)	0.653	0.98 (0.71–1.37)	0.935
	Female	371	43.9 (38.8–49.2)	1.00		1.00	
Age group	≤ 5	104	71.2 (61.4–79.6)	5.53 (3.31–9.25)	< 0.001	5.60 (3.34–9.40)	< 0.001
	6–17	218	48.6 (41.8–55.5)	2.12 (1.43–3.15)	< 0.001	2.13 (1.43–3.15)	< 0.001
	18–40	214	30.8 (24.7–37.5)	1.00		1.00	
	> 40	104	38.5 (29.1–48.5)	1.40 (0.86–2.29)	0.177	1.39 (0.86–2.29)	0.180
Village	Angkek	138	43.5 (35.1–52.2)	1.79 (0.89–3.59)	0.098	1.74 (0.85–3.56)	0.127
	Betak	50	30 (17.9–44.6)	1.00		1.00	
	Lambok	150	52 (43.7–60.2)	2.53 (1.27–5.01)	0.008	2.70 (1.34–5.47)	0.006
	Podek	186	45.2 (37.9–52.6)	1.92 (0.98–3.76)	0.056	1.84 (0.92–3.67)	0.083
	Sri Galas	116	42.2 (33.1–51.8)	1.71 (0.84–3.46)	0.139	1.82 (0.88–3.77)	0.108
CI, confident interval; OR, odd ratio							

Discussion

In this study, the current status and risk factors of anaemia among the indigenous Temiar Orang Asli in Peninsular Malaysia were determined. Overall, this study has shown a high anaemia prevalence of 44.7% particularly among children and adolescent, and considered a severe level (i.e. $>40\%$) based on the ranges of anaemia among indigenous populations globally¹¹. Although this figure was two folds higher than the anaemia incidence among the general Malaysian population i.e. 24.2%²⁸, the prevalence of anaemia

among the Temiar Orang Asli was within similar ranges reported in other indigenous tribes in Malaysia i.e. the Senoi and Semai in Peninsular Malaysia, and Penan and Iban in Malaysian Borneo^{15,16,29,30}. However, these findings were contrary to a recent study conducted among the present-day hunter-gatherer of indigenous Negritos Orang Asli with an overall anaemia prevalence of 68.4%²². The fact that a high prevalence of anaemia among indigenous populations is widely distributed in Malaysia, suggests that common disparities in health among these diverse groups of people are attributing to a higher risk of anaemia.

The finding of this study demonstrated that the prevalence of anaemia was significantly higher in children and adolescents (i.e. ≤ 17 years, 55.9%) compared to adults (i.e. ≥ 18 years, 33.3%). This is consistent with the findings of earlier local studies conducted among Orang Asli in Peninsular Malaysia^{16,18}. The variation in prevalence and severity of anaemia tends to be convex with age, increasing in childhood and decreasing in adulthood³⁰. This may be because the child's exposure to be anaemic rises as he or she gets older. It is common for children to be more active, curious, and eager to learn new things in their surroundings. However, many of them are still unaware of personal and appropriate hygiene practices and the consequence of exposing themselves to infectious organisms due to their early age. Meanwhile, as in agreement with a previous study by Muslim et al²², gender stratification in this study showed no difference between the prevalence of anaemia between the females and males although it is well acknowledged that females tend to be more anaemic as a result of physiological differences^{7,31}.

The present study also revealed that anaemia-specific prevalence of both moderate and severe anemia was highest in children age less than 5 years old with 43.4% and 42%, respectively. Besides, the odds of anaemia were almost six times higher for the ≤ 5 group when compared to those in 18–40 group in the population. These scenarios are in agreement with previous reports^{18,22,32}, whereby the younger children from the indigenous population in Malaysia had a higher prevalence of anaemia compared to older children. In the Orang Asli community, older children are usually enrolled in boarding schools provided by the government. It is postulated that a feeding intervention that had been implemented in the boarding school could reflect the lower prevalence of anaemia among older children. Previous studies have shown that the contributing factors of anaemia among children of the indigenous population in Malaysia are largely due to poor dietary intake of iron, recurrent infections and low socioeconomic status^{32,33}. Furthermore, preschoolers depend on their caregivers to provide food for most part of the day. Because of that, a caregiver with a lack of knowledge of proper nutrition, low socioeconomic status, unemployed and low level of education attributed to childhood malnutrition. This issue deserves attention because chronic anaemia during childhood has been shown associated with retardation in physical development and cognition, while severe anaemia is responsible for more than half of the deaths in children under 5 years of age³⁴.

Other than micronutrient deficiencies, anaemia can also occur when excessive amounts of blood are lost due to gastrointestinal infections associated with diarrhoea. Thus, infections related to hygiene,

sanitation, safe water and water management are significant contributors to anaemia³⁵. Recurrent infections especially due to soil-transmitted helminth (STH) often significantly associated with anaemia among Orang Asli communities^{15,16,17,18,19,21,22}. Infections with heavy loads of the helminth *Trichuris trichiura* were reported having the most significant correlation with anaemia as well as a strong predictor of iron deficiency anaemia and growth stunting in the Orang Asli population^{15,21,22}. In the high-risk groups of anaemia, for example, children aged under 5 years; multifactorial that coexist to affect the risk of anaemia due to the combined effect of growth and physiological state in this vulnerable group³⁶. As a vicious cycle of malnutrition and infection, children with the weak immune systems due to malnutrition are more likely to have a higher risk of developing severe anemia causing increase susceptibility to infection while their childhood environment has high exposure to infections which may also cause malnutrition³⁷.

Local variation in anaemia prevalence was also observed among communities on the same clustered rural settlement. The present study showed that anaemia prevalence in the five villages in Pos Kuala Betis ranged from 30–52%. Further findings showed that living in Lambok was found to be significantly associated with anaemia compared to other villages. Although these villages belong to the same cluster resettlement, they differ greatly in their location and access to the general population. For an instant, the Lambok community lives the furthest in a forested area with impoverished agriculture and incomplete basic infrastructure amenities. In contrast, the Betak community is in a fertile plain with easy access to a nearby town. Thus, micronutrient deficiencies (i.e. anaemia) in the Lambok community are likely the result of inadequate diets and parasitic infections from food and water contamination. The heterogeneity in anaemia prevalence within indigenous communities due to the different in location and access to food has also been reported in other setting³⁸. Like many other indigenous communities globally¹¹, Orang Asli communities in Malaysia are often located in deeply remote areas with a lack of basic amenities such as piped water supply, electricity, toilet facility, garbage disposal service as well as limited access to government health programs^{17,39}. Tackling these issues could ultimately lead to a greater reduction of intestinal parasitic transmission, subsequently lower the prevalence of anemia in Orang Asli communities.

A number of caveats should be considered in this study. First, although the cross-sectional nature of the research design was efficient and cost-effective, it has an inherent selection bias and does not allow causality to be established. Second, the lack of data on micronutrient deficiencies, infectious diseases and genetic predispositions is important for understanding the causes of anaemia in the study population. Hence their confounding influence could not be ascertained. Third, the use of capillary blood instead of venous samples can also constitute a source of bias. At the moment when the surveyor pricks the skin and collects blood drops, the Hb can be diluted with extracellular fluid through manipulation of the subject's finger⁴⁰. Nonetheless, this technique offers many practical advantages and does not affect the quality of diagnosis at the population level⁴¹. Fourth, the nature of the logistic regression model developed with a limited number of variables are also the additional limitation of this study.

Conclusion

In conclusion, anaemia constitutes a major health problem particularly among the school-age children of the indigenous Temiar Orang Asli community in Peninsular Malaysia. The magnitude of anemia in this study carries public health importance, particularly in planning programs for community health and could help develop intervention strategies and target high-risk subpopulations in this vulnerable population group. This speaks to the aetiology of anaemia, which includes inadequate diet and poor living conditions as well as an association with malaria and intestinal parasites. Further research needs to be done to ascertain the exact cause of anaemia in this community.

Declarations

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Authors' contributions

Z.M.I., M.R.K.M.K., P.C.S.D., I.N.D.L. and S.C. conceived and designed the study. M.A.F.A.R., M.B.M., W.W., N.D.D., M.I.M.S.R., N.G., N.W.H. and Z.M.I. performed the fieldwork. M.A.F.A.R., M.B.M. and Z.M.I. performed data cleaning and analysed the data. M.A.F.A.R., M.B.M., W.W., N.D.D. and Z.M.I. interpreted the data and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

Map of study setting. (a) Map of Malaysia showing the location of Kelantan State (dark red). (b) Map of Gua Musang district (light red) in Kelantan State showing the location of Pos Kuala Betis. The study in Pos Kuala Betis is located approximately 40 km from Gua Musang town. The map was created with ArcGIS software, version 10.4, <http://www.esri.com>.