

Association between Anaemia, Iron Deficiency Anaemia, Neglected Parasitic Infections and Socioeconomic Factors in Rural Children of West Malaysia

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Abstract

Background: Given that micronutrient deficiency, neglected intestinal parasitic infections (IPIs) and poor socioeconomic status are closely linked, we conducted a cross-sectional study to assess the relationship between IPIs and nutritional status of children living in remote and rural areas in West Malaysia.

Methods/Findings: A total of 550 children participated, comprising 520 (94.5%) school children aged 7 to 12 years old, 30 (5.5%) young children aged 1 to 6 years old, 254 (46.2%) boys and 296 (53.8%) girls. Of the 550 children, 26.2% were anaemic, 54.9% iron deficient and 16.9% had iron deficiency anaemia (IDA). The overall prevalence of helminths was 76.5% comprising *Trichuris trichiura* (71.5%), *Ascaris lumbricoides* (41.6%) and hookworm infection (13.5%). It was observed that iron deficiency was significantly higher in girls ($p=0.032$) compared to boys. Univariate analysis demonstrated that low level of mother's education (OR=2.52; 95% CI=1.38–4.60; $p=0.002$), non working parents (OR=2.18; 95% CI=2.06–2.31; $p=0.013$), low household income (OR=2.02; 95% CI=1.14–3.59; $p=0.015$), *T. trichiura* (OR=2.15; 95% CI=1.21–3.81; $p=0.008$) and *A. lumbricoides* infections (OR=1.63; 95% CI=1.04–2.55; $p=0.032$) were significantly associated with the high prevalence of IDA. Multivariate analysis confirmed that low level of mother's education (OR=1.48; 95% CI=1.33–2.58; $p<0.001$) was a significant predictor for IDA in these children.

Conclusion: It is crucial that a comprehensive primary health care programme for these communities that includes periodic de-worming, nutrition supplement, improved household economy, education, sanitation status and personal hygiene are taken into consideration to improve the nutritional status of these children.

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Introduction

Anaemia is a specific condition where red blood cells are not providing adequate oxygen to the body tissues. It is usually caused by iron deficiency, which is the commonest micronutrient deficiency in both developing and developed countries [1,2]. Generally, it takes at least several weeks after iron store has depleted before anaemia develops. When iron deficient occurs, haemoglobin concentrations are reduced to below optimal levels and therefore, iron deficiency anemia (IDA) is considered to be present. However, because anaemia is the most common indicator used to screen for iron deficiency, the terms anaemia, iron deficiency, and IDA are sometimes used interchangeably and synonymously [2].

Group most affected include pregnant women, pre-school and school-age children, low birth weight infants and women of child-bearing age [1,3]. The World Health Organization (WHO) estimates that more than two billion people are affected by iron deficiency and anaemia, which corresponds to 24.8% of the

world's population [1]. Most are in the Western Pacific and South-East Asia. Despite its increasing prevalence in South-East Asia, anaemia is the most neglected nutritional deficiency disorder in the region today [4]. Iron deficiency anaemia (IDA) has severe nutritional and health consequences, including inadequate growth and mental development in children [5], high maternal mortality and incidence of low birth weight infants and low productivity in adults [5,6]. Poor school performance among school children and adolescent has also been associated with IDA [7,8].

Micronutrient deficiency causes are multifactorial ranging from micronutrient deficiency such as iron, folate and vitamin B₁₂, insufficient dietary intake, malabsorption and infectious diseases in particular parasitic infections [9]. The latter is well documented and soil-transmitted helminth (STH) infections are prevalent in areas where anaemia and IDA is widespread [10]. Accumulating evidence from a number of studies has shown that micronutrient deficiency and STH infections are intertwined and co-exist among low-income population [11,12]. Other determinants such as demographic factors such as age, gender and larger family size