Anemia in low-income and middle-income countries.

Balarajan Y, Ramakrishnan U, Ozaltin E, Shankar AH, Subramanian SV. Lancet ePub ahead of print: DOI:10.1016/S0140-6736(10)62304-5, 2011.

Mapping the risk of anemia in preschool-age children: the contribution of malnutrition, malaria, and helminth infections in West Africa.

Soares Magalhaes RJ, Clements ACA. PLoS Medicine 8:e1000438, 2011.

Introduction

In October 2008, Nutrition News for Africa (NNA) presented a summary of the worldwide prevalence of anemia based on the WHO Vitamin and Mineral Nutrition Information System (http://www.who.int/vmnis/en/), which emphasized the high prevalence of anemia among young children and women of reproductive age in sub-Saharan Africa. In the current issue of NNA, we review two related papers: 1) an updated assessment of anemia prevalence in low-income and middle-income countries, with an overview of its epidemiology, causes and consequences; and 2) a study using a geographical information system to assess the spatial distribution of anemia, undernutrition, malaria and other parasitic infections in three countries in West Africa to allow for better targeting of anemia-control interventions.

Anemia is defined as low hemoglobin (Hb) concentration, red blood cell (RBC) count, or packed-cell volume, which results from reduced production or excess loss of RBCs, or both.

Methods

The article by Balarajan *et al* summarizes the latest figures on anemia prevalence worldwide, based on a review of the published literature and data from Demographic and Health Surveys (DHS) conducted in 32 selected middle- and low-income countries. For the analysis of DHS data, they used surveys that examined for anemia among women aged 15-49 years (anemia defined as Hb<120 g/L , adjusted for altitude, or <110g/L among pregnant women) and children aged 1-5 years (Hb<110 g/L). The authors explored possible risk factors for anemia, including women's age, education, household wealth, and residence location (urban or rural). They considered the same risk factors for children, as well as their mother's age and the presence of maternal anemia. The authors also provide a useful and concise overview of the main nutritional, infectious and genetic causes of anemia and current prevention and control strategies.

The study by Soares Magalhaes and Clements uses Hb data from DHS conducted from 2003-2006 among 7147 children aged 1-4 years in Mali, Burkina Faso and Ghana. The authors used geographical positioning data collected during the DHS to predict the spatial distribution of anemia. They also examined anthropometric information on child malnutrition from the DHS, malaria rates from the Malaria Atlas Project, and parasitological survey data regarding hookworm and S. haematobium infections for the same three countries to estimate the number of cases of anemia attributable to different types of malnutrition and infection.

Results and Conclusions

The authors of the first paper concluded that anemia remains a major public health problem globally, with an average prevalence of 43% in lower income countries. High-risk groups are children and women of reproductive age, with Africa and Asia accounting for more than 85% of the anemia burden in these groups. In their analysis of DHS data, the authors found considerable heterogeneity in the prevalence of anemia, and they concluded that anemia is more common in women with little or no formal education, and in those from poorer households. They found that residence in an urban vs a rural setting had little or no effect on the risk of anemia. The same factors, along with maternal anemia, were associated with anemia in children.

Soares Magalhaes and Clements found that the prevalence of anemia among 1-4 year old children ranged from 87-91% in Mali, Burkina Faso and Ghana, indicating that ~6.7 million children in these three countries were anemic in 2011. Risk factors for anemia in their study included child age, rural residence, undernutrition (defined anthropometrically) and parasitic infections. The mean hemoglobin concentration increased in relation to children's age; and the prevalence of anemia decreased, accordingly, by ~15 percentage points over the age range of the children included in the study. The authors estimated that 37% of the anemia cases (~2.5 million cases) were attributable to malnutrition (i.e., in children with the combination of wasting, stunting, and underweight), 15% (~1.0 million) to malaria, 3.7% (~250,000) to isolated S. haematobium infection, 4.2% (~285,000) to hookworm infection, and 0.9% (~61,000) to co-infection with S. haematobium and hookworm. The maps that were produced by using geographic information system analysis demonstrated a large spatial clustering of low mean Hb and a high risk of malaria in children across the Burkina Faso-Mali border. The areas with higher prevalence of anemia also overlapped the zones with more severe anemia, suggesting that these areas should be prioritized for programmatic interventions.

Program and Policy Implications*

In observational studies, maternal anemia is associated with elevated maternal perinatal mortality and child anemia is associated with impaired cognitive development. Furthermore, studies in adult workers indicate that anemia results in decreased work productivity and its adverse economic consequences. Thus, efforts are needed to prevent and treat anemia, especially in sub-Saharan Africa where the prevalence is particularly high among young children and women. The foregoing articles underscore the fact that there are multiple causes of anemia. Iron deficiency is believed to be the most common nutritional cause of anemia, but deficiencies of vitamin A, vitamin B_{12}, folate and other nutrients may also be involved. Unfortunately, the current studies did not provide information on the specific nutritional deficiencies that were associated with anemia, and the population attributable fractions of these causes of anemia remain uncertain. Several infections are also associated with anemia, including malaria, helminth infections, and schistosomiasis. Malaria and schistosomiasis are of particular relevance to Africa, because most of the global disease burden occurs in this region. Genetic causes of anemia, such as sickle-cell disorders and thalassemias, also contribute to the anemia burden in Africa, although the attributable risk of these conditions is not known. This heterogeneity in the causes of anemia and their geographical distribution implies that programs aiming to control anemia need to be designed according to the specific contributing factors in particular areas. Thus, descriptive surveys are desirable to determine the prevalence and severity of anemia and likely causal factors in representative samples of the target populations.

Geographic information system analysis, such as the analysis described in the paper by Soares Magalhaes and Clements, can help program managers direct their resources most efficiently to the areas with greatest disease burden and target the major risk factors prevalent in those areas.

*These comments have been added by the editorial team and are not part of the cited publication.

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Christian Fares
Managing Editor, Nutrition News for Africa
Helen Keller International (HKI)
cfares@hki.org