Students are given medication for intestinal parasitises, Boloso Sore Woreda, Ethiopia

Non-nutrition interventions to prevent anaemia in school-age children and adolescents

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Background

About one in four school-age children globally are anaemic (WHO, 2008), a condition that affects their growth, learning capacity and physical fitness. A recent analysis of Demographic and Health Survey data from 65 low-income and 22 middle-income countries collected between 2000 and 2017 found that anaemia is a severe public health problem in almost half of these countries, affecting over 40% of non-pregnant adolescent girls (Rukundo et al, 2018). Iron deficiency is commonly assumed to cause a half of all cases of anaemia (WHO, 2002a), with the other causes including malaria, helminth infections, chronic inflammation and other micronutrient deficiencies. However, a recent systematic review found that the proportion of anaemia associated with iron deficiency may be much lower, especially in countries where infectious diseases are common and the prevalence of anaemia exceeds 40% (Petry et al, 2016). This short review discusses the potential impact of both nutritional and non-nutritional interventions to prevent anaemia in school-age children and adolescents.

Nutrition interventions

To prevent anaemia and iron deficiency, the World Health Organization recommends giving iron supplements intermittently (meaning once, twice or three times a week on non-consecutive days), to school-age children where the prevalence of anaemia is ≥20% (WHO, 2011) and, where the prevalence of anaemia is ≥40%, to increase this to daily iron supplements to adolescent girls (WHO, 2016). In regions where malaria is endemic, iron supplements should only be given in conjunction with adequate measures to prevent, diagnose and treat malaria (WHO, 2011). Systematic reviews of intermittent and daily iron supplements given to school-age children have clearly shown that giving iron effectively prevents anaemia (De-Regil LM et al, 2011), even if malaria is endemic (Neuberger et al, 2016).

Other nutrition interventions that have the potential to increase micronutrient intakes (such as vitamin A supplementation, multiple micronutrient supplements, food supplementation, or food fortification), and those that can improve diet diversity and quality, including school feeding, can also be effective means to prevent anaemia in school-age children and adolescents (da Siva Lopes et al, 2021). However, giving iron and micronutrients alone may not be sufficient.

Non-nutrition interventions

Worm control

While nutrients are essential to manufacture haemoglobin and treat anaemia, addressing underlying infections that cause blood loss is an important first step. For example, in places where infections with hookworms and schistosomes are common, periodic mass treatment with single doses of effective anthelmintics such as albendazole and praziquantel is highly cost-effective (WHO, 2002b) and reduces the risk of anaemia, especially if combined with micronutrient supplements after treatment (Hall et al, 2008). Good sanitation and careful personal hygiene are then essential to prevent reinfection and reduce transmission.

Malaria control

Malaria is a major cause of anaemia, especially in sub–Saharan Africa where the prevalence of any species of *Plasmodium* in school-age children often exceeds 50% (Brooker et al, 2017). When school-age children and adolescents have developed partial immunity, nearly all infections are asymptomatic, so they go undetected and untreated, yet the parasites still destroy red blood corpuscles and contribute to anaemia (White et al, 2018). These asymptomatic infections are also associated with poor health, poor cognitive function and lower educational achievement.

A meta-analysis of the effect in sub-Saharan Africa of presumptively treating asymptomatic school-aged children (5-15 years) for malaria

Box 1 Case study in Mali: impact on anaemia of iron supplements vs. anti-malaria treatment

Two cluster randomised trials conducted in primary schools in the same area of Sikasso region in Southern Mali – an iron supplementation study (Hall et al, 2002) and an anti-malarial intervention conducted 10 years later (Clarke et al, 2017) – provide an interesting case study on the relative impact of iron supplements versus intermittent clearance of malaria parasites on anaemia in school children. Sikasso region has a high prevalence of malnutrition (including iron deficiency) and endemic but seasonal malaria. Therefore, both interventions would be expected to have a substantial impact on anaemia. The iron supplements study, conducted in 2000-2001, reported an initial 56% prevalence of anaemia (62% in boys and 50% in girls) and the anti-malarial trial, conducted in 2011-12, reported an initial prevalence of 63%, indicating little progress in preventing anaemia in this age group over this period. The malaria study also found that 80% of children were infected with *P. falciparum*,[2] mostly asymptomatically.

The iron supplements trial was carried out in 60 primary schools. Children in all schools, intervention and control, were treated with an anthelmintic drug and vitamin A at the start of the school year but children in 30 randomly selected schools were additionally given a weekly iron supplement by their teachers for 10 weeks. The endline survey was conducted between 14 and 16 weeks after the baseline survey and about two weeks after iron supplementation had finished. The prevalence of anaemia fell by 8.2% (from 58% to 50%) and rose by 9.4% (from 54% to 63%) in the intervention and control groups respectively. The overall difference between the groups was therefore 18% (p<0.001).

The intermittent preventive treatment of malaria trial was conducted 10 years later in 80 randomly selected primary schools, 40 intervention and 40 control schools. It evaluated a single presumptive mass treatment for malaria[3] given by teachers at the end of the malaria transmission season in December 2011 to all children in the 40 intervention schools. Two months later the prevalence of anaemia was lower in both groups, but with a greater reduction in the treated group (from 54% to 35% versus 54% to 45% in the control group), an overall difference between the groups of 10% (p=0.001). Six months later, the prevalence of infection with *Plasmodium spp* in the intervention group was still only 9% compared with 75% in the control schools, while 36% of children were anaemic compared with 49% in the control group.

In both studies, the interventions were administered by teachers with supportive training and supervision, showing that teachers in rural Africa can give treatment for malaria as well as micronutrient supplements.

found that treatment with antimalarials was associated with a 23% lower prevalence of anaemia, 72% lower prevalence of infection with *Plasmodium falciparum*[1] and, in some cases, better cognitive function (Cohee et al, 2020). Preventing malaria by sleeping under insecticide-treated nets is also important, especially amongst school-age children and adolescents who are the least likely of any population group to have access to a mosquito net.

An analysis of two cluster randomised trials in Mali conducted ten years apart (see Box 1), provides useful insight into the relative impact of malaria and nutrition interventions on the prevalence of anaemia in school-aged children. These two treatments given once a year (combined with deworming) could have a significant effect on reducing the prevalence of anaemia in school children, including school-going adolescents. They are relatively cheap, since they can be administered by teachers through the education system.

Conclusion

There is an understandable tendency for nutritionists to focus on nutritional interventions to treat nutritional problems. But in places where parasitic worms cause chronic blood loss or asymptomatic malaria infections cause haemolysis, treating these infections and preventing reinfection will be an important means to help prevent anaemia and its consequences for school-age and adolescent children during an important period of growth, development and learning.

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1 Malaria is caused by *Plasmodium* parasites. *Plasmodium falciparum* is the species most likely to pogress to severe potentially fatal forms of malaria, including severe anemia
2 In Mali, *P. falciparum* is the predominant species. Study in Sikasso showed that it represented 92.6% of all four species of Plasmodium (Ouologuem et al, 2017).
3 Children were treated with artesunate and sulfadoxine-pyrimethamine.

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