

In Response

Dear Sir:

We thank Muhsen and Cohen¹ for their informative letter to the editor in connection with our findings reported in the September 2012 issue of the *American Journal of Tropical Medicine and Hygiene*.² In response, three points are offered for discussion.

First, the aim of our work was to deepen the understanding of the etiology of anemia in a typical rural setting of West Africa. Taking into consideration general reviews^{3,4} and prior research conducted in different parts of Côte d'Ivoire,^{5,6} emphasis was placed on parasitic infections (i.e., *Plasmodium falciparum* and helminths), inflammation, and micronutrient deficiencies (i.e., iron, riboflavin, and vitamin A). Available financial, technical, and human resources were constrained, which is often the case while conducting research in the humid tropics. Three cohorts (i.e., infants, school-aged children, and women of childbearing age) were followed prospectively over a 14-month period.^{7,8} These cohorts were selected, because they are at high risk of parasitic infection and vulnerable to anemia. At the baseline cross-sectional survey, we found that anemia was significantly and positively associated with *P. falciparum* infection in infants, cellular iron deficiency (ID) in school-aged children and women of childbearing age, and chronic inflammation in school-aged children.² As the subjects grew older, these associations altered.⁷

Second, Muhsen and Cohen¹ emphasize that *Helicobacter pylori*, a Gram-negative spiral-shaped bacterium that the World Health Organization classifies as a carcinogen of class I, is associated with increased odds of ID anemia (IDA) and that anti-*H. pylori* therapy reduces the risk of IDA. The evidence derives from a systematic review and meta-analysis,⁹ and it is further supported by intervention studies among children and adults in middle- and high-income countries.^{10–13} However, other studies did not find any association between iron stores and *H. pylori* infection,¹⁴ and the causal mechanisms of *H. pylori* infection and IDA remain to be fully characterized. In addition to an increased requirement for iron needed to support bacterial growth and the gastric mucosal damage that can decrease gastric acid production, *H. pylori* induces inflammation—polarized to a T-helper 1 response¹⁵—and chronic bleeding, both of which might lead to anemia.

Third, while reviewing the literature, we could not identify any studies that investigated *H. pylori* infection in community surveys in Côte d'Ivoire. However, data derived from two hospital-based studies indicate that *H. pylori* infection does occur in Côte d'Ivoire among both children and adults, particularly among patients who present with abdominal pain.^{16,17} Overall, the epidemiology of *H. pylori* is poorly characterized in sub-Saharan Africa.^{18,19} Hence, considering the paucity of published data, it is difficult to appreciate whether and to what extent *H. pylori* infection might have contributed to the high level of anemia among infants, children, and women of childbearing age observed in a rural part of south-central Côte d'Ivoire.

Taken together, the study of *H. pylori* in sub-Saharan Africa deserves more attention. We, thus, agree with the proposal made by Muhsen and Cohen¹ that future epidemiologic

studies investigating the etiology of anemia in tropical settings should include appraisal of *H. pylori*, and therefore, the relationship between this bacterial infection and anemia can be further elucidated. Several direct and indirect techniques are available for the diagnosis of *H. pylori*. Gastric mucosal biopsy is a costly and invasive diagnostic method, whereas bacteria culture requires specific technical skills and is expensive. Hence, these two techniques are not suitable for large-scale epidemiologic studies in resources-constrained settings. However, a simple stool antigen assay and the [¹³C] urea breath test hold promise for community-based surveys in low-income countries.^{20,21} The stool antigen assay is particularly suitable for studies where fecal samples are collected for the diagnosis of helminth and intestinal protozoa infections. Should *H. pylori* infection emerge as an important contributor to the burden of anemia in sub-Saharan Africa, this information would further support the urgent need of implementing basic public health measures, such as improving access to clean water, sanitation, and hygiene.

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