Viewpoint

Rethinking anaemia surveillance

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Iron-deficiency anaemia affects about 1·3 billion people[1] and is the most common form of malnutrition in the world. In the past few years, there have been renewed efforts to control iron-deficiency anaemia. At the 1990 World Summit for Children, leaders from more than 159 countries agreed to try to reduce the prevalence of iron-deficiency anaemia by a third by the turn of the century.[2,3] In 1993, the World Bank[4] ranked anaemia as the eighth leading cause of disease in girls and women in developing countries, and concluded that iron-deficiency anaemia could be effectively controlled with existing cost-effective interventions.

Surveillance systems for anaemia are fundamental to public-health decision-making and for monitoring the progress of national and worldwide goals to control anaemia.[5] Effective anaemia surveillance is essential to identify which populations are most in need of intervention and to assess whether programmes are working. As the World Declaration and Plan of Action for Nutrition[6] states, the international community should "strengthen micronutrient surveillance capabilities and activities by devising indicators to monitor . . . strategies for achieving national goals". There is a need for simple indicator cut-offs that enable progress to be tracked and compared across regions, and for criteria on prevalence that identify the most severely affected populations. Such surveillance activities differ from population assessments of the underlying causes or interventions and from the clinical assessments of individuals, for which other methods are recommended.[7–9] Haemoglobin concentration is the key indicator of iron-deficiency anaemia for surveillance purposes, especially since the advent of the HemoCue system (HemoCue, AB, Angelholm, Sweden) which measures haemoglobin concentration within seconds from a drop of whole blood without need of electricity.[10] The current criteria for the assessment of the severity and magnitude of iron-deficiency anaemia in populations are the prevalence of any anaemia and severe anaemia (table 1).

Little progress seems to have been made against iron-deficiency anaemia. Based on surveillance data from 1975 to 1990, the United Nations reported that the prevalence of anaemia worldwide had not declined.[11] Similarly, in sub-Saharan Africa, a region challenged by war and economic instability, and in Southeast Asia, a region characterised by economic emergence and declining rates of other forms of malnutrition, the prevalence of iron-deficiency anaemia has not fallen. A midterm report of the objectives of the World Summit for Children warns that the goal to reduce anaemia by 2000 is "unlikely to be met without a significant acceleration of effort over the next 6 years".[3]

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Is it true that efforts to control iron-deficiency anaemia are failing, despite substantial health and economic improvements in some parts of the world? Table 2 shows haemoglobin concentrations for different populations of women. Although all the women are from less developed countries, they were not selected purposively. These data are from studies conducted since 1990 at the Center for Human Nutrition, Johns Hopkins University, Baltimore, USA; none of the studies should be interpreted as nationally representative. The Nepal data were collected in a continuing community-based study[12] in the Terai region, which is representative of the northern Gangetic flood plain of India and southern Nepal. Protein-energy malnutrition, vitamin A deficiency, and hookworm infection[14] are common in women from this region, but there is no programme to provide iron supplements to these women. The Zanzibar data were collected from a rural community-based survey on Pemba Island (Chwaya HM, unpublished observations), where acute malnutrition is common in children, and hookworms and *Schistosoma haematobium* and *Plasmodium falciparum* are endemic.[15] Iron supplements are provided to pregnant women by the Zanzibar Ministry of Health, but coverage is low because of limited tablet supply. The other three areas represent populations where malnutrition is declining and public-health infrastructures are reasonably good. In Peru and Indonesia, iron supplementation for pregnant women has been a long-standing health policy, and tablets are widely available. The Peru data were collected from women who attended antenatal clinics in low-altitude urban areas (Zavaleta N, Fukomoto M, unpublished observations), and the Indonesia data are from a rural community-based study in Central Java.[16] The Shanghai population comprised women who received antenatal care at urban public hospitals.[17] Although this population is poor, acute malnutrition is rare and antenatal care is very good; iron supplements are available but are used by less than 10% of pregnant women.[17]

From all we know about these populations—eg, their dietary adequacy, burdens of infectious diseases, and availability of health services—we would expect to find striking differences in the prevalence and severity of iron-deficiency anaemia. A good indicator should be able to separate these populations according to different degrees

Criterion	Population prevalence category (%)		
	High	Moderate	Low
Any anaemia*	>40	10–39	1–9
Severe anaemia†	>10	1–9	<0·1–0·9

*Haemoglobin concentration <110 g/L in pregnant women or young children, <120 g/L in schoolchildren or non-pregnant women, <130 g/L in adult men.
†Haemoglobin concentrations <70 g/L.

Table 1: **Epidemiological criteria for assessment of severity and magnitude of iron-deficiency anaemia**

Population	No	% of population with haemoglobin concentrations (g/L)				
		Below anaemia cut-off*	<100	<90	<80	<70
Nepal, 3 months post partum	613	81·4	28·4	13·6	6·3	2·4
Central Java, 3 months post partum	146	71·9	15·1	2·7	2·1	2·1
Zanzibar, not pregnant	583	71·7	26·2	13·0	8·9	5·3
Nepal, pregnant	1052	69·8	40·5	20·8	9·5	4·9
Shanghai, pregnant	829	66·2	25·3	5·5	0·8	0·2
Peru, pregnant	670	44·3	14·5	4·3	<0·1	<0·1

*Anaemia defined as haemoglobin concentrations <110 g/L in pregnant women or <120 g/L in non-pregnant women.

Table 2: **Haemoglobin concentrations in different populations of women**

of risk of iron-deficiency anaemia. However, based on the current criteria for any anaemia, all the populations would be classified as areas with a high prevalence of iron-deficiency anaemia. By contrast, based on the prevalence of severe anaemia, none of the populations would have high rates of anaemia. But this opposition simply does not make sense. Either iron-supplementation programmes and general health indicators have no bearing on the prevalence of iron-deficiency anaemia, or the current criteria do not provide the information needed for the population burden of iron-deficiency anaemia to be assessed accurately. The answer lies in the lower end of the distribution of haemoglobin concentrations. The cumulative distributions in table 2 show the expected differences between the populations. There is only a 1·8-fold difference in the prevalence of anaemia between the populations; however, if haemoglobin concentrations below 90 g/L (moderate-to-severe anaemia) are used as the indicator, there is a 7·7-fold difference between populations. Some comparisons are illuminating. The prevalence of anaemia is similar among non-pregnant women in Central Java and Zanzibar. However, the prevalence of moderate-to-severe anaemia is five times higher in Zanzibar than in Java. The rate of anaemia in pregnant women is similar in rural Nepal and Shanghai, but the prevalence of moderate-to-severe anaemia is 2·5 times higher among Nepalese women than among women from Shanghai.

Severe anaemia (haemoglobin concentration <70 g/L) is closely linked to risk of mortality, but is difficult to monitor because the prevalence rarely exceeds 5–7%, even in populations with a high prevalence of iron-deficiency anaemia. Furthermore, this indicator does not always distinguish between populations with very different haemoglobin distributions—eg, Nepalese and Central Javanese women in the post-partum period (table 2). Changing the cut-off for haemoglobin concentration in anaemia surveillance is such a simple idea that it seems unimportant, but it is not. Let us return to two key objectives of anaemia surveillance: to identify population groups in greatest need of intervention and to monitor progress in anaemia control. The first objective enables donors and governments to use scarce health resources wisely and the second enables them to set goals and see if they are met. How would public-health decision-making be influenced by surveillance of moderate-to-severe anaemia—ie, a haemoglobin cut-off of 90 g/L?

First, public-health resources for anaemia control would be allocated differently. The prevalence of all anaemia or moderate-to-severe anaemia give different indications of the severity of anaemia in the population groups (table 3). The current perception is that anaemia is widespread in all countries. Fund donors, who need to address health issues that are well-defined and amenable to solution, find it difficult to focus their programme efforts on anaemia. Governments of developing countries are overwhelmed with health problems, and may not feel compelled to tackle anaemia when their better-off neighbours report similar rates of anaemia. But, table 3 shows that there are differences in the prevalence of iron-deficiency anaemia between countries and regions, and highlights the need for action in Nepal and Zanzibar.

Second, in developing countries, the prevalence of moderate-to-severe anaemia is more likely to indicate progress in anaemia control if other health improvements are being made. The prevalence of all anaemia in Indonesian women has remained above 50% during the past 30 years, even though progress has been made in most other health indicators, especially nutrition. It would be interesting to know whether the prevalence of moderate-to-severe anaemia has declined or whether it has always been low. I suspect it has declined greatly. Indeed, the lower end of the distribution of a homoeostatically controlled indicator, such as haemoglobin concentration, would be likely to change more rapidly than the upper end. If a successful programme for anaemia control were implemented in Nepal or Zanzibar, the distribution of haemoglobin concentrations might first shift to become like Indonesia—ie, with high prevalence of all anaemia but low prevalence of moderate-to-severe anaemia. This distribution would represent substantial progress, but would not be revealed with surveillance that relied on the prevalence of all anaemia.

If we begin to use the prevalence of moderate-to-severe anaemia for surveillance purposes, it is important not to lose sight of the prevalence of mild anaemia. A survey of haemoglobin concentrations provides data on both mild and moderate-to-severe anaemia. For countries where the prevalence of mild or all anaemia has already fallen below 50%, such as Latin America, the Middle East, and North Africa, the prevalence of all anaemia will measure the lower end of the haemoglobin distribution and is the best indicator for monitoring progress in the control of iron-deficiency anaemia. A suggestion to monitor the prevalence of moderate-to-severe anaemia in regions where the prevalence of iron-deficiency anaemia is high does not imply that there are no health risks associated with mild anaemia. Mild iron-deficiency anaemia affects cognitive capacity in children,[18] increases the risk of preterm delivery in pregnant women,[17,19] and reduces work output in all individuals.[20] Public-health interventions to

Population	No	Prevalence of iron-deficiency anaemia (%)	
		Defined by prevalence of all anaemia*	Defined by prevalence of moderate-to-severe anaemia (haemoglobin <90 g/L)
Nepal, 3 months post partum	613	81	14
Central Java, 3 months post partum	146	72	3
Zanzibar, not pregnant	583	72	13
Nepal, pregnant	1052	70	21
Shanghai, pregnant	829	66	6
Peru, pregnant	670	44	4

*Haemoglobin concentrations <110 g/L in pregnant women, <120 g/L in women who are not pregnant.

Table 3: **Iron-deficiency anaemia in different populations by prevalence of all anaemia and prevalence of moderate-to-severe anaemia**

control iron-deficiency anaemia are needed in all the populations listed in table 2. But the addition of a lower haemoglobin cut-off for surveillance purposes is important because the health risks associated with moderate-to-severe anaemia are substantially greater; it is within this range that anaemia contributes directly to mortality among women and children.

A helpful analogy is the use of the prevalence of moderate-to-severe stunting or wasting (more than 2 SD below the reference mean) to monitor protein-energy malnutrition worldwide, even though many children who are 1 SD below the reference are malnourished and experience adverse health risks.[21] Similarly, use of low birthweight defined as below 2500 g to monitor rates of low birthweight does not mean that the risk of mortality for a baby who weighs 2600 g is the same as that for a 3300 g baby.[22] Surveillance indicators are chosen because they serve the purposes of surveillance, not because they indicate the point of minimum risk. Despite effective interventions, control of iron-deficiency anaemia has not proved to be easy. We need to intensify our surveillance of anaemia so that the progress we make can be assessed, especially in those countries with a high prevelence of anaemia. A simple change in the haemoglobin cut-offs used for anaemia surveillance would sharpen our focus.

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