An epidemic of scurvy in Afghanistan: Assessment and response

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Editorial note

The following article describing an epidemic of scurvy in mountainous Afghanistan emphasizes the contemporary risk of this ancient deficiency disease, especially in settings of complex emergencies and social-agricultural disruption. Such a setting is, sadly, all too common for serious nutritional emergencies. We intend to give greater emphasis in this journal to assessment and interventions in complex and extended emergencies related to drought, conflict, and cultural disasters.

Abstract

In March 2002, there were reports of a hemorrhagic fever outbreak in western Afghanistan. It was later confirmed that the hemorrhagic symptoms and increased mortality were actually due to scurvy. Most aid workers did not include scurvy in the initial differential diagnosis because it is uncommon throughout the world and has mainly been reported in refugee populations in recent times. A rapid assessment confirmed the cases clinically, estimated a prevalence rate of 6.3% (a severe public health problem), and determined that the attack rates peaked each year in January and February (the end of the winter). Many Afghans have limited dietary diversity due to isolated locations, lengthy winters, the continuing drought of the last four years, asset depletion, and loss of livelihood. After numerous food and fortification options to prevent future outbreaks had been considered, vitamin C tablet supplementation was selected because of the relatively rapid response time as compared with other prevention methods. A three-month course of vitamin C tablets was distributed to 827 villages in at-risk areas. The tablets were acceptable and compliance was good. No cases of scurvy were reported for the winter of 2002–03. The case study from Afghanistan demonstrates that scurvy can occur in nonrefugee or nondisplaced populations; vitamin C supplementation can be an effective prevention strategy; there is an urgent need to develop field-friendly techniques to diagnose micronutrient-deficiency diseases; food-security tools should be used to assess and predict risks of nutritional deficiencies; and the humanitarian community should address prevention of scurvy in outbreak-prone areas.

Key words: Afghanistan, emergencies, micronutrient deficiency, scurvy, vitamin C

Scurvy is caused by insufficient consumption of vitamin C. The normal human body stores of vitamin C last two to three months [1, 2], and scurvy can appear when these stores become depleted, as it did during the six-month winter period in Afghanistan. The typical Afghan diet is limited and monotonous, consisting of wheat bread and tea, occasionally supplemented with dairy products and wild green leaves. In remote, mountainous areas, there is little or no consumption of fresh fruits and vegetables during the winter, which has been compounded by the four-year drought and armed conflict that have depleted assets and limited the variety of possible livelihood strategies. Early signs of scurvy include lassitude, weakness, irritability, dull pains in the muscles or joints of the legs and feet, and weight loss. The main function of vitamin C is to maintain collagen formation and wound healing, so the main clinical symptoms of scurvy are follicular hyperkeratosis, hemorrhagic manifestations, swollen

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joints, swollen bleeding gums, and peripheral edema [3]. Concurrent anemia may occur more frequently in emergency situations due to the effect of vitamin C on blood formation, folic acid metabolism, undernutrition, and concurrent infections. Older persons are at increased risk of scurvy if diet diversity is limited, as are people who do physically demanding work and women of reproductive age, especially during pregnancy due to increased needs for fetal development [4]. Scurvy can be prevented by meeting the recommended daily requirement of 30 mg of vitamin C [5]; however, lower doses of 6.5 to 10 mg per day have been found to prevent scurvy [1, 3, 6, 7].

There are three main criteria for the diagnosis of scurvy: dietary history, clinical manifestations, and biochemical indices. The serum level of ascorbic acid, which has a linear relationship with vitamin C intake [8], appears to be the most sensitive indicator of current diet. According to the World Health Organization (WHO), the presence of a single clinical case of scurvy constitutes a public health problem (table 1).

Scurvy has been historically associated with lengthy sea voyages, when sailors did not have access to fresh sources of vitamin C. In recent times, the only documented outbreaks have been in refugee populations in the Horn of Africa that were dependent for extended periods on limited food rations or had limited access to fresh food (Ethiopia [11], Kenya [12], Somalia [11, 13] and Sudan [10, 14]). Recently, scurvy was found outside of Africa among Bhutanese refugees in Nepal [15]. Refugee populations that are completely dependent on general rations for months or longer are at risk, given that a typical daily ration does not contain sufficient vitamin C. Effective, feasible, and affordable interventions to address scurvy outbreaks have been difficult to identify. The World Food Programme (WFP) and the Office of the United Nations High Commissioner for Refugees (UNHCR) have provided fortified blended foods [14] or increased the ration size to allow for the exchange of staple foods for fresh fruits and vegetables in the ration [16]. Outbreaks of scurvy are less commonly reported among nonrefugee populations; however, scurvy has been reported in the general population in rural parts of Afghanistan since 2001.

The complex emergency in Afghanistan, consisting of devastation from armed conflict, sudden political and economic changes, and natural disasters, has had severe consequences for food security, with a serious impact on nutrition. Numerous nutrition surveys in Afghanistan have found prevalence rates for stunting of 40% to 60% (height-for-age Z-score <–2), prevalence rates for wasting of 6% to 12% (weight-for-height Z-score <–2), and a high prevalence of micronutrient deficiencies (iodine, vitamin A, iron, and vitamin C). In addition, some studies have reported rates of mortality in children less than five years of age as high as 2.51 to 5.9 per 10,000 per day [17]. A main underlying cause of malnutrition in Afghanistan is chronic food insecurity leading to lack of dietary diversity, which has an effect on micronutrient status, acute malnutrition, chronic malnutrition, and mortality among children under five years of age [18].

The capacity of populations to diversify their diet in Afghanistan is affected by four significant factors to varying degrees, depending on the area:

» Location. Many areas are isolated due to the mountainous terrain and lack of roads. The snow in winter makes many areas completely inaccessible at times, even by helicopter. This affects opportunities for trade, access to markets, and access of the international community to provide aid.
» Climate. The winter can last up to six months, with cold weather and significant snowfall inhibiting most fruit and vegetable cultivation for half the year.
» Loss of productive capacity due to drought. The four-year drought has resulted in a reduction of cultivable land and thus agricultural production, with the main staple, wheat, being prioritized over diversified food production. Moreover, the drought has also significantly reduced fruit trees, nuts, and other vegetation that families customarily used to preserve for the lengthy winters.
» Loss of livelihoods and asset depletion. Drought and conflict have resulted in loss of assets, which decreases household purchasing power and ability to diversify the diet. In addition, the reduction in livestock, such as goats, sheep, and camels, has decreased available animal labor to cultivate land and also dairy and meat consumption.

Scurvy is believed to be widespread in Afghani-

TABLE 1. WHO provisional criteria for the severity of the public health problem of vitamin C deficiency

Indicator	Mild	Moderate	Severe
Clinical	1 clinical case; < 1% of population in age group concerned	1%–4% of population in age group concerned	≥ 5% of population in age group concerned
Biochemical/serum ascorbic acid (mg/100ml)			
< 0.2	10%–29%	30%–49%	≥ 50%
< 0.3	30%–49%	50%–69%	≥ 70%

Source: refs. 9, 10.

stan and was first documented in Kohistan District in April 2001. This outbreak affected at least 10% of the population [19], demonstrating that scurvy may also exist unreported in other areas of Afghanistan. This under-reporting was later further supported by the WFP Vulnerability Assessment Mapping (VAM) (see fig. 1) and the UNICEF Nutrition Survey Database for Afghanistan (table 2), both tools revealing that scurvy can be found across the country, being endemic in some areas, especially in northwest Afghanistan. Scurvy may have gone unnoticed because there was no functioning health system with a surveillance system prior to September 11, 2001.

Assessment and investigation of the outbreak

Taiwara District in Ghor Province of western Afghanistan has a population of 79,000. Taiwara is a one-day car journey from the nearest town and hospital, has few functioning health facilities, and is usually completely inaccessible throughout the six-month winter period.

In early March 2002, Action Contre la Faim (ACF) reported 20 deaths and 47 cases of scurvy in Taiwara, all with similar symptoms, consisting of pain in the joints leading to inability to walk, bleeding gums and loss of teeth, swollen joints, edema of the lower limbs, and ecchimosis (bruising) on the legs. Because of the hemorrhagic symptoms and sudden deaths, a hemorrhagic fever outbreak was suspected and reported by the media [21, 22]. Expatriates were evacuated and an investigation team from ACF, the Ministry of Health, and WHO arrived to confirm the outbreak.

Scurvy was diagnosed through dietary histories and clinical confirmation. Biochemical testing was not feasible because of the fragility of the samples needed for ascorbic acid testing. In addition, because of the lack of health and nutrition infrastructure and services before September 11, 2001, there was no health and nutrition sentinel surveillance system and no vital registration in most of Afghanistan, especially in remote areas. The only available records were through interviews with key informants such as village chiefs, heads of households, and national health staff, who provided information about a regularly occurring disease called *sialengi* or "black legs," characterized by bleeding gums and death. Because of the lack of an existing case definition, that used by the investigating team consisted of the presence of one of three clinical criteria: painful legs and/

FIG. 1. Distribution of scurvy during winter/spring 2002 based on reported cases in Afghanistan [20]

TABLE 2. Nutrition surveys of vitamin C status in Afghan populations, extracted from UNICEF's Nutrition Survey Database for Afghanistan

Title	Sampling method	Sample population	Scurvy findings	Organization
Malnutrition and Mortality in Kohistan District, Afghanistan, April 2001	2-stage, 30-cluster survey	3,165 people in 278 households	6.5% (7/108) death due to scurvy	Save the Children US, CDC
Report Number 2, GOAL Samangan Province, Nutrition Survey, May 29–June 24, 2002	2-stage, 30-cluster survey	Total, 1,493: 676 children 0-59 mo, 817 women 15–49 yr	0.1% of children 0–59 mo had signs of deficiency	GOAL
Nutrition and Health Survey, Badghis Province, Afghanistan, February–March 2001	2-stage, 30-cluster survey	Total, 1,100: 545 children < 5 yr, 555 women 15–49 yr	3.1% of children < 5 yr had at least 1 sign of deficiency	UNICEF, CDC
Report Number 1, GOAL Jawzjan Province, Nutrition Survey, April 9–24, 2002	2-stage, 30-cluster survey	Total, 1,627: 717 children 0-59 mo, 910 women 15–49 yr	0.6% children 0–59 mo had at least 1 sign of deficiency	GOAL
Vulnerability survey in Northern Afghanistan (Faryab Province and IDP camps), January 2001	Clinic population and nearby inhabitants only	813	8.7% reported cases of scurvy	MSF Belgium
Nutritional Survey Report, Kohistan, Faryab Province, April 4–10, 2001	2-stage, 30-cluster survey	708 children 6–59 mo	250 cases of scurvy found and treated	Save the Children US
Nutrition and Health Survey, Maslakh IDPs Camp, Herat, Afghanistan, April 2002	Systematic random sampling	Total, 379: 178 children < 5 yr, 201 women 15–49 yr	4.5% of children < 5 yr had at least 1 sign of deficiency	UNICEF

CDC, US Centers for Disease Control and Prevention; GOAL; MSF, Médecins sans frontières. The development of the vitamin C map and inclusion of vitamin C status in nutrition surveys were propagated and supported after a widely publicized outbreak in Taiwara District, Ghor Province, in March 2002.

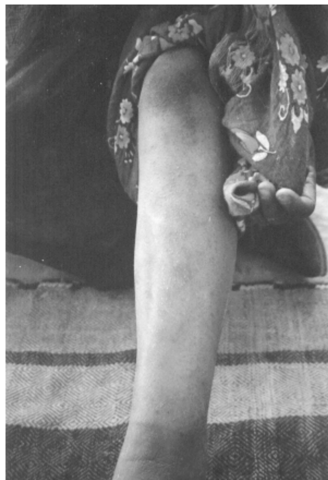

FIG. 2. Close-up of perifollicular hemorrhaging on the legs of an Afghan woman

FIG. 3. Bleeding gums, a sign of scurvy, on an Afghan boy

or joints, hemorrhagic gingivitis (bleeding gums), and ecchimosis on the legs. (See figs. 2 and 3.)

After determining the case definition, the investigation team provided scurvy education to 25 village health workers, including signs and symptoms, treatment protocols, and morbidity and mortality data collection. The investigations were based on counting of recent deaths at graveyards, verbal autopsy for recent deaths, search for cases and collection of case histories, clinical examinations, and interviews with patients and their families and village inhabitants and elders. The recall period for investigating mortality was for the previous three months beginning after *Eid* (the period from December 16, 2001, to March 16, 2002). Because there was limited secondary source material, data were collected primarily through focus groups and key informants. Community health workers then used a questionnaire to collect data in order to calculate

prevalence and fatality rates.

During the investigation period, the team found 18 suspected cases of scurvy in Zarbid Village, Taiwara District; 8 patients (44%) were male and 10 (56%) were female. The median age was 35 years. Twelve of the suspected cases were clinically confirmed by the team, and 10 of these 12 (83%) had first developed signs two months before, in January and February 2002 [23]. In addition, four children between three and five years old were observed who could not stand up because of pain in their joints. It was also reported that six deaths in January and February were attributed to scurvy. The range of time between the onset of symptoms and death was 6 to 31 days. All persons with scurvy who were over 50 years old died. In Taiwara District, over a period of three months, the scurvy attack rate was 6.3% (4,588 cases in a population of 72,835), which, according to WHO standards, constitutes a severe health problem (table 1). Among those with scurvy, a 7% case fatality rate (323 deaths among 4,588 scurvy cases) was reported. Overall, during this period, 20% of all deaths (323 of 1,615) were due to scurvy [23]. By early March, the prevalence of scurvy had decreased to 3.9%. None of the people in Zarbid Village in Taiwara District who died had eaten *seech* (a local wild food, one of the few vegetables that becomes available in March, the beginning of spring), but 50% of survivors reported that they had consumed this green plant [23]. Key informants reported that *sialengi* regularly occurred in the area in previous years; however, *sialengi* had afflicted more people with increased severity that year.

In bordering Chaghcharan District, hundreds of cases of scurvy were also reported during the same period [23]. WHO and Médecins du Monde investigated the Chaghcharan outbreak and found that the prevalence of scurvy began to decline when the end of winter was near, and that the availability of various wild plants and some vegetables and fruits may have prevented new scurvy cases.

In March 2002, it was confirmed clinically that the outbreak was not hemorrhagic fever but scurvy. In addition to the presence of contributing factors for scurvy, the signs and symptoms according to the case definition were apparent in reported and clinically confirmed cases. The distribution of cases also followed vulnerable group patterns, as described by WHO, affecting more women than men and more older people. Scurvy also responded to treatment with vitamin C.

Intervention: design and approach

As an immediate short-term intervention, UNICEF, in partnership with ACF, treated 5,000 people for scurvy by distributing 252,000 vitamin C tablets in Taiwara and neighboring Passaband [24]. The curative treatment regime used was 200 mg/day for two weeks for children and 1 g/day for two weeks for adults. The symptoms began to subside after the vitamin C tablets were consumed. Unfortunately, the scurvy outbreak and findings were identified too late for timely prevention. The first cases were reported locally in November 2001, and the epidemic peaked around January and February 2002. In addition, standardized protocols and photographs of cases were developed and distributed to assist in searching for cases.

Food options were investigated for medium- and long-term interventions to prevent future winter outbreaks. Distributing fresh foods was not feasible, because some areas are inaccessible during the six-month winter season. Germination of pulses was also considered, but the acceptability and understanding of germination in Afghan populations had not been tested, raising the risk of a repeated outbreak of scurvy. ACF analyzed canned tomato paste and found that the vitamin C content was significantly less than that reported on the label. In addition, cooking and taste preferences had not been investigated, and moving canned goods to large populations was expected to be difficult and expensive. Home gardening was not an option because of the significant amount of time required to implement a program, the lack of water resulting from the four-year drought, and the long, cold winters. Fortification was also considered, but no suitable vehicle was found that would protect vitamin C from being oxidized in the presence of heat or light [25]. The inclusion of fortified cereals in all rations was advised but was practiced only in selected areas. Thus, after more sustainable options of preventing scurvy had been investigated and ruled out, supplementation with vitamin C remained the only option. Even here, compliance was clearly a problem because of the need for regular doses [10]. In other emergency situations, distribution of vitamin C tablets has had limited success because of problems with logistics and compliance [10].

After investigating the above intervention options as part of a national prevention campaign targeting over 1 million people in high-risk areas, UNICEF and ACF decided to provide blanket distribution of vitamin C tablets and health education to all children and adults in 827 villages (168,598 adults and 42,952 children, for a total population of 211,550) in Taiwara and Passaband Districts in Ghor Province. Adults received 10 tablets (1 tablet per week), each containing 250 mg of vitamin C; children under five years of age received 20 tablets (2 tablets per week), each containing 50 mg of vitamin C. The tablets were sufficient to prevent scurvy for two and a half months. The risk of toxicity was considered to be extremely low [26, 27]. In addition, to increase the micronutrient content of the regular ration of wheat, lentils, vegetable oil, and iodized salt, children under five received fortified blended food (10

kg of UNIMIX and 2.5 kg of vegetable oil) distributed by ACF and other organizations. Unfortunately, the vitamin C content of fortified blended food such as UNIMIX or CSB (corn soy blend) (40 mg/100 g) can be reduced by 50% to 82% after cooking losses [28]. Moreover, the amount of vitamin C actually ingested by the intended beneficiary would then be further reduced even more due to normal intrahousehold sharing.

Making use of the existing community networks, one representative of each village, accompanied by a few villagers, came to the distribution spot to receive the one-time food distribution, the 3-month supply of vitamin C, and nutrition and hygiene education, along with specific information on vitamin C dosing (the quantities per week for adults and children). Each representative was in charge of redistributing the items among the heads of families in his village and instructing them about the frequencies and quantities of vitamin C dosing.

Because of the need to identify outbreaks early, the need for project monitoring, and the inaccessibility of Taiwara and Passaband by road during the winter months, UNICEF, ACF, and the Ministry of Health undertook a helicopter mission to Ghor Province in February 2003. The monitoring team designed a two-page questionnaire to assess the presence of scurvy, the use and acceptability of vitamin C tablets, access to vitamin C–rich foods, and knowledge of scurvy. The team was divided into two pairs of women and one group of three men, and each group conducted same-gender focus-group discussions in different areas of each village. The men on the monitoring team led a focus-group discussion with the village leaders, and the women led a discussion with the available women in each village. A total of 15 focus-group discussions were conducted, and information was cross-checked for analysis. A major constraint was that the areas visited were determined by the flying conditions, and the focus groups could run for only approximately 20 minutes because of poor weather and visibility for the helicopter (see fig. 4).

According to the focus groups, there were no cases of scurvy reported that winter, but there had been an outbreak in the previous winter during March 2002. Most of those interviewed said that scurvy was "there every year" in the winter; however, this was the first year that there were no scurvy cases in their villages (box 1). Most reported that they felt better the past winter than in previous winters.

All those interviewed stated that vitamin C tablets were received at the household level during December 2002 or January 2003. Most of the focus groups reported that children received 100 mg and adults received 250 mg of vitamin C per week, according to protocols. No tablets were reported to have been sold or traded. Although some higher intakes were reported (300 mg/week for children and 750 mg/week for adults), they were still at nontoxic levels. Some reported that they did not receive enough vitamin C to last through the winter because of this increased rate of consumption. Only one person out of the more than 120 participants in the focus-group discussions presented large quantities of vitamin C when the participants were asked to show their remaining household doses. All of those interviewed found that vitamin C tablets were acceptable with regard to taste and dosing schedule, even for children.

With regard to food sources of vitamin C, most discussants had access to a few fruits and vegetables (cultivated or wild) during all seasons except winter, with their last consumption of fresh fruits or vegetables around October. Only one focus group reported that there were fruits and vegetables in a nearby bazaar (brought in from Herat); however, these were considered to be unaffordable. Because vitamin C is water-soluble and heat-labile, raw fruits and vegetables are

FIG. 4. Due to winter isolation, flying in by helicopter was the only method of reaching beneficiaries in most villages in Taiwara and Passaband Districts of Ghor Province

BOX 1. Reports of local people of prevalence of *sialengi*

"*Sialengi* has been here since the adults were children, but not this winter."

Woman from Yegin Village, Taiwara District

"Except for this year, there is *sialengi* here each year at the end of winter."

Man from Tourma Village, Passaband District

"This is the first year without *sialengi*."

Woman from Chesma Khoni Village, Taiwara District

"I feel less body pains and no more leg pains. Older people and children have not had *sialengi*."

Man from Kali Khon Bula Village, Passaband District

higher in vitamin C; however, only fruits, onions, tomatoes, and carrots were consumed raw. Wild vegetables with possible high vitamin C content were reported to be inedible when eaten raw because of their bad taste (*seech*, a small green and white plant; *sertak* and *hushein*, green plants; and *sheresh*, a wild plant prepared as tea and used topically to treat scurvy).

Nutrition education was planned and conducted in many areas but was not provided in the villages visited because of poor accessibility. Consequently, most of the participants in the focus groups did not know that scurvy (*sialengi*) was caused by lack of vitamin C due to inadequate consumption of fresh fruits and vegetables. Most people said that *sialengi* was caused by cold weather, and some thought that it was contagious. The participants in the focus groups knew that there was a relationship between *sialengi* and vitamin C. They knew that *sialengi* could be treated with vitamin C, but they did not know that vitamin C could also be used preventively. The majority also did not know that vitamin C could be obtained from fruits and vegetables as well as from tablets.

The prevention of scurvy during this past year may be attributable to the distribution of vitamin C tablets. The cost of the tablets required to prevent scurvy in one person for one month was US$0.003 (about one-third of one cent). Addition of the cost of experienced staff and transportation to deliver supplements and fortified food to such remote areas increased the cost to US$1.28 per person per month.

Conclusions and recommendations

Afghanistan has chronic nutrition problems, including micronutrient-deficiency diseases such as scurvy, demonstrating that scurvy is not confined to Africa or to refugee populations. Drought, conflict, geography, and climate are contributing factors to the lack of dietary diversity. Thus, sustainable long-term strategies to address scurvy in large, nonrefugee populations need to be developed. There is also a need for more documentation on micronutrient-deficiency diseases in emergencies, despite possible methodological constraints. Organizations and aid workers should be aware that regions of Afghanistan are prone to micronutrient-deficiency diseases, and scurvy outbreaks have occurred annually in parts of Afghanistan from December through February. Food and nutrition projects should be prepared to address micronutrient needs.

Distribution of vitamin C tablets successfully prevented scurvy in an area where a winter outbreak typically occurs. There were no reported outbreaks of scurvy this past winter in western Afghanistan. Using tablets as a prevention strategy is clearly not a sustainable solution. However, because this was an urgent situation, it was determined that it would be more ethically correct to implement an immediate prevention strategy rather than to wait to use a more sustainable strategy for delivering vitamin C. Noncompliance, which is typically a major problem, was not apparent in this case, possibly because of health education provided at the time of distribution and/or lack of access to a marketplace to sell the tablets. Another problem often associated with vitamin C supplements is the need for at least weekly distribution, which was not applicable here because sufficient amounts for three months were distributed to the villages, along with education on dosing, and because there were reliable community distribution structures. Thus, during the three-month target period, concerns about low cost effectiveness due to poor coverage and compliance were not apparent, because proper distribution was ensured through the established community networks and village leaders. The use of National Immunization Days to deliver vitamin C to remote areas with no other distribution mechanism should also be considered for the future.

The establishment of surveillance systems to detect micronutrient-deficiency diseases is essential for their control [29]. However, food and nutrition surveillance systems take a lot of time to become established and usually require a functioning health and nutrition structure to be in place first. An early-warning system in high-risk areas, using clear definitions, should be coordinated at the district, provincial, regional, and national levels and should be adaptable to regions with few or no health facilities. Regular food-security assessments would also be useful to predict outbreaks of micronutrient-deficiency diseases. In addition, nutrition education and training on feasible methods of preventing scurvy in future winters should be provided to all at-risk populations. Although scurvy was prevented in this population in this particular season, people should receive nutrition education so that they can make the wisest possible choices for themselves and their families on the basis of knowledge of what exactly causes scurvy and how it can be prevented through food choices, production of durable food sources of vitamin C that can be saved and consumed during long winters, and vitamin C–saving preparation and cooking techniques.

The situation in Afghanistan supports previous findings [14] that if scurvy is present, there are likely to be other micronutrient-deficiency diseases, and any sustainable response needs to take this into account. Iron deficiency is a widespread problem globally. Vitamin C can increase the bioavailability and absorption of nonheme and heme iron in a meal by 200% to 600% [30], demonstrating the synergistic benefits of multi-micronutrient strategies. Although it is important to provide fortified blended food in rations, this may be inadequate for meeting vitamin C requirements, and therefore supplementation may also be needed. Multiple micronutrient supplementation would help address

the many micronutrient diseases in Afghanistan, but it is unsustainable in the long term. Multimicronutrient fortification of a food for more sustainable prevention of scurvy and other deficiency diseases is being considered and investigated. In the meantime, attempts to improve the quality of food aid rations should continue, since some Afghan populations are dependent on food aid during the winter and have little opportunity to vary their diet with fruits, vegetables, and fortified foods that contain vitamin C.

The case of Afghanistan demonstrates the need to develop sustainable vitamin C strategies for scurvy-prone areas. Scurvy in refugee camps has been addressed, and guidelines exist for the prevention and management of scurvy in such settings [16]. There is now a need to develop strategies to address micronutrient-deficiency diseases in large, geographically remote regions. Clearly this is much more difficult and complex, and the humanitarian community will need to go beyond some of the interventions that work well in camps. Home gardening has low feasibility during the long winter months unless it is done in plastic greenhouses. Germinated wheat, a good source of vitamin C, is familiar to Afghans, but it is usually consumed cooked as *samanak*; investigations are needed to see whether people are willing to consume it raw.

Although rapid assessments can be used to identify high-risk areas for targeting, field-friendly methods of confirming micronutrient-deficiency diseases are also urgently needed. There is a need to validate a standard clinical case definition and to include it in surveillance of endemic or outbreak-prone areas. The clinical case definition and treatment protocol was found to be useful and effective, but both need further testing in future outbreaks, and the sensitivity and specificity of case definitions need to be evaluated by comparing them with the gold-standard laboratory definition. Biochemical tests require sanitary conditions in a controlled environment, which is difficult when taking samples in the field, transporting samples within a country, and sending samples to internationally specialized laboratories for analysis. Moreover, the time required to do all this can affect the sample results. Biochemical analysis and diagnosis requires laboratory skills and knowledge of laboratory methods that are uncommon in emergencies. There is also a need to introduce and mainstream the clinical assessment and diagnosis of micronutrient deficiencies into common assessment tools, such as nutrition surveys, possibly by training field survey staff to identify micronutrient-deficiency diseases. There is a great need for field-friendly methods and protocols to detect micronutrient-deficiency diseases in emergency situations where there is no existing health structure. This often makes it difficult to predict outbreaks and plan for biochemical analysis. Micronutrient-deficiency diseases can also be addressed or prevented by training surveyors, field staff, and clinical staff about how to identify micronutrient deficiencies and how to actively seek cases. In addition, there need to be good food-security assessments of food diversity to assist in predicting potential outbreaks of micronutrient-deficiency diseases in emergencies.

There were many significant limitations in the attempts to address scurvy in Afghanistan. An important limitation is the difficulty of doing biochemical testing of scurvy in the field. Although clinical diagnosis and key informant interviews with village leaders and local clinical staff demonstrated scurvy, biochemical confirmation would have strengthened the evidence. Another limitation posed by geography and climate was the restricted time available to implement and conduct monitoring of the project. Because of the limitations of time and geography, we could not employ population-based methods. However, the success of the project is supported by the fact that there have not been any reports of scurvy this past winter. Another major issue was the lack of nutrition information and surveillance systems, which strongly impeded the provision of adequate and timely services and assistance to the people of Afghanistan.

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