7 Small-animal Revolving Funds: An Innovative Programming Model to Increase Access to and Consumption of Animal-source Foods by Rural Households in Malawi

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Abstract

Increased intake of animal-source foods is a key means to improve nutritional status in populations with high levels of nutrient deficiencies. However, there are few examples of programming models that have successfully improved both access to and consumption of animal products in resource-poor settings. This chapter presents a case study of a community-based intervention to increase household access to and consumption of animal-source foods, implemented as part of a comprehensive, 9-year nutrition and health programme in Malawi.

A community-managed revolving fund scheme was used to distribute small animals to rural households, accompanied by training on animal husbandry and intensive nutrition education to promote consumption of the animal products. This was integrated into a broader anaemia control strategy, which included iron supplementation and malaria control. Cross-sectional surveys were used to evaluate programme effectiveness, including comparison of beneficiary communities with non-programme areas.

Household rearing of all small animals increased from 43% to 65% in programme areas. Significantly more households in the programme area both raised and consumed the target animals at the final evaluation. Anaemia prevalence in pregnant women decreased from 59% to 48% in the programme area, but increased to 68% in the comparison group. In pre-school children, anaemia prevalence decreased similarly in both groups.

The revolving fund scheme successfully increased access to and consumption of small animals in programme communities. Anaemia prevalence decreased in women, but the specific contribution of the animals to this cannot be separated from the combined impact of the integrated programme.

Keywords: animal-source foods, anaemia, revolving fund

Introduction

The nutritional benefits of animal-source foods are well documented, as is the lack of these foods in the diets of many populations suffering from high levels of nutritional deficiencies (1). However, the identification of effective strategies to increase access to and consumption of animal-source foods by vulnerable populations has proven challenging.

 Combating Micronutrient Deficiencies: Food-based Approaches (eds B. Thompson and L. Amoroso)

Many projects which promote livestock-raising are oriented towards improving household income rather than nutritional status, and therefore fail to promote consumption of the animals or to measure changes in dietary patterns of beneficiaries (2). There are few published examples of interventions that have both successfully increased household access to animal-source foods and demonstrated an impact on specific nutritional deficiencies. Strengthening knowledge and experience in this area therefore remains a priority for the international nutrition community.

This chapter presents a case study from Malawi, where an intervention to increase households' raising and consumption of small animals through a revolving loan distribution scheme accompanied by intensive nutrition intervention was implemented as part of a comprehensive micronutrient and health programme. Although animal-source foods have multiple nutritional benefits, a major emphasis of the overall programme was on prevention and control of iron deficiency, and therefore anaemia prevalence was used as the outcome indicator.

Iron-deficiency anaemia is the most common nutritional disorder in the world, disproportionately affecting a significant percentage of women and children in developing countries (3). Often subtle in manifestation, anaemia exacts a tremendous burden in terms of lost earnings, premature death and poor health outcomes. Lack of dietary iron is the primary causal factor in approximately half of anaemia cases worldwide (3). The iron sources with greatest bioavailability (i.e. most readily absorbed and utilized by the body) are animal products, which contain haem iron. However, typical diets in many developing countries provide very little iron or iron that is poorly absorbed by the body. Rural families in Malawi, for example, tend to consume a maize-based diet that is high in phytate, a strong inhibitor of iron absorption, and very low in haem iron and other enhancers of iron absorption. Anaemia prevalence has been assessed as 73% in children under 5 years old, with 82% of their mothers also anaemic (4). An analysis of the iron intake of pregnant women in rural Malawian communities found that 89% of dietary iron was non-haem, and that the intake of bioavailable iron was significantly associated with iron status (5). Interventions to improve dietary intake of bioavailable iron, particularly through animal-source foods, are urgently needed in such settings to combat the high levels of iron deficiency and anaemia. Such interventions have the added advantage of reaching the whole population and providing a variety of nutritional benefits, including high-quality protein and multiple micronutrients (6).

However, among the limited published reports of studies aiming to increase iron intake through animal-source foods, few have effectively paired the dietary interventions with improved nutritional status. In Vietnam, iron intake in children increased following an intervention that included home gardens, fishponds and animal husbandry, but iron status was not assessed (7). Iron status (serum ferritin) of schoolgirls in Thailand improved following a similar multidimensional food-based intervention, but concurrent interventions (iron supplementation and an improved school meal programme) prevented attribution of the biochemical results directly to household dietary changes (8). In some cases, food-based interventions have resulted in improved family income but no changes in diet quality of target beneficiaries (9). Other intervention studies have demonstrated an increase in household food security and consumption of animal-source foods by women and children, but did not measure changes in nutritional status (10,11). Thus there remains a critical need for well-designed and evaluated interventions to increase access to haem iron sources in populations where anaemia is highly prevalent.

An important lesson from these previously published reports is that effective strategies to increase intake of iron-rich animal-source foods require significant effort to integrate nutrition education with activities to increase access to appropriate animal products (12). Interventions need to be oriented towards household consumption of the animals raised, as opposed to a primary focus on income generation through livestock sales (2). Additionally, the animals must be able to reproduce frequently enough to provide a regular source of meat and must be culturally

acceptable and able to thrive in the local environment. Incorporating an understanding of cultural factors affecting preferential food allocation within the household is also key in many settings, as these issues may play a role in limiting the intake of animal- source foods by children and women (13).

Food-based interventions to address anaemia must also be delivered in combination with essential primary health care measures. Although iron deficiency is the most common cause of anaemia, other factors also contribute to and exacerbate anaemia status (14). These include infectious diseases, particularly malaria and hookworm infection; other micronutrient deficiencies, such as folate, vitamin B_{12} and vitamin A; blood losses during menstruation and childbirth; and inherited conditions such as sickle cell disease. The aetiology of anaemia in Malawi includes both iron deficiency, due to the dietary limitations discussed earlier, and malaria and parasitic infections. The 2001 Malawi Micronutrient Survey found malaria prevalence to be extremely high, ranging from 17% in non-pregnant women to 60% in children aged 6–36 months (15).

Methods

World Vision, an international non-governmental organization, initiated the MICronutrient And Health (MICAH) programme in Malawi in 1996, with funding from the Canadian International Development Agency and World Vision Canada. The programme goal was to improve the nutrition and health status of women and children, specifically focusing on iron and iodine deficiencies. MICAH was implemented from 1996 to 2005 in 16 project sites throughout Malawi, covering 14 of the 26 districts in the country, primarily in rural areas.

The raising of small animals was identified as the focal intervention of MICAH's dietary diversification strategy due to the high bioavailability of key micronutrients such as iron and zinc in animal-source foods. A revolving fund scheme was developed as the implementation strategy for this intervention.

MICAH's small-animal revolving fund scheme (SARF) employed a distribution method whereby the programme provided initial animal stock to a number of individuals who were selected according to criteria determined by the community. These individuals were then required to give the first offspring from their animals to others in the community, and so on until full distribution throughout the community was achieved. Prior to receiving any animals, the beneficiaries were required to construct a shelter to house them, according to training provided by staff from the Ministry of Agriculture's Department of Veterinary Services. Where the community identified beneficiaries (such as the elderly or adults with chronic illnesses) who were unable to construct the required shelter, a committee would be formed to assist that household. The type of shelter constructed varied throughout the country according to the local environment. The animals distributed included goats (initially), rabbits, chickens and guinea fowl. The accompanying nutrition education promoted the consumption of all animal-source foods.

Significant resource investments were made from the very onset of the programme to engage the community, so that MICAH's SARF was developed as a collaboration between village health committees; Ministry of Agriculture, Irrigation and Food Security (MoA) veterinary extensionists; MICAH staff; local implementing partners; and community members. Preliminary capacity-building initiatives included a five-day training session led in partnership with MICAH staff and representatives from the MoA and the Ministry of Health (MOH). In addition to education on the other programme activities, these sessions focused on animal husbandry techniques. Trainings were developed by MICAH partners to address regional differences and were based on the expertise of the local veterinary extensionist and his/her MoA resources. In many cases a community 'expert', such as a successful farmer in that locale, was asked to assist with MICAH training to share their knowledge and lessons learned. Workshop participants, comprising four or five men and women from each village, left the training sessions to act as trainers of trainers to initiate

promotion and peer education activities within their own communities. Building upon these health promotion initiatives, community members were surveyed regarding their interest in participating in the SARF. Interested households were then provided with education on animal husbandry, including the construction of the animal enclosures.

Initially the programme focused on goats, by providing an improved variety of male goats for breeding with traditional local female goats to produce offspring with better meat and milk production potential. However, a mid-term evaluation revealed that because goats are relatively large and important animals within the community setting, they were not being consumed on a regular basis by households and were not under the control of the women, who provided meals for the household. Rather, they would be used for ceremonial purposes such as a chief's wedding, a funeral or major religious events. At these events, it was usually the men who would consume the meat and women would often only receive a small portion, if any at all. It was thus concluded that although the goats were valued as an input by the communities, the intervention was not directly contributing to an increase in consumption of animal-source foods by women and children, the key target groups of the programme.

Through collaboration and discussion with the MoA, MOH and MICAH implementing partners, the promotion of rabbits was identified as a possible means of improving the quality of dietary intake within the target area, as an alternative to goats. Rabbits are small and therefore not as highly valued as the larger goats. Also, rabbits reproduce quickly, unlike the one goat kid per year, and were thus more likely to be used by women for family meals. The lower perceived value of the rabbits also enabled the women to have decision-making control over the use of the rabbits, whereas the goats were under the control of the male household head.

Since the consumption of rabbit meat was new to most project communities, significant effort was required in introducing the concept. Cooking demonstrations and taste tests involving influential members of the communities, particularly religious leaders, proved an effective means of overcoming initial hesitation regarding the rabbits. The staff also assessed each community to decide on the committee that would take up the responsibility of the rabbit revolving funds and identification of initial beneficiaries. In some cases, the initial beneficiary was the chief's household, or another influential member of the community. This was due to the fact that once these influential people adopted the new practice of rabbit-rearing, it would be deemed acceptable by the others. In other cases, especially needy families would be identified as primary beneficiaries so that the community would be able to see the difference made in the diet and lives of people with few resources. In this way, the programme adapted to the unique characteristics of each community in order to maximize the acceptance and coverage of the intervention.

The SARF was managed by local village health committees, which were responsible for overseeing and monitoring the intervention. While MICAH suggested that animal offspring benefit at least three other households, it was ultimately the responsibility of the local community to define the payback plan for their village. A sub-committee was responsible for gathering village-level statistics. The sub-committee secretary maintained a master registry of village households, SARF animals distributed and their related statistics, including births, deaths, probable cause of death, vaccination status and dates of mass vaccinations.[1] MICAH staff then used these data to address any issues that needed to be resolved; however, beneficiaries were encouraged and empow- ered to resolve problems at the community level. The local veterinary extensionist was also required to submit reports on small- animal husbandry activities (including MICAH SARF) to the MoA.

[1] While MICAH recommended that the community collect certain information, each SARF subcommittee established its own registry format with data collection based on local needs.

Within each village, MICAH also established a small-animal revolving drug fund. SARF training included the identification and treatment protocols for common animal illnesses that beneficiaries might encounter. Animal owners were encouraged to purchase the appropriate medicine from the revolving drug fund when an animal was ill. This revolving fund was also administered by the village health committee, which had a designated treasurer in charge of finances. Medicines were sold for a small profit to cover the cost of transportation (for restocking) and inflation. Although the initial animals introduced in the community were pre-vaccinated, it was the responsibility of the local veterinary extensionist and animal owner to follow up on immunizations for future offspring. The local veterinary extensionist also organized periodic mass immunization campaigns with vaccines provided by the government via the existing MoA system.

In addition to the small animals, MICAH Malawi promoted and supported the establishment of household and communal gardens, in close collaboration with the MoA. The emphasis was on cultivation of fruits that enhance iron absorption through vitamin C (such as citrus fruits) or that are rich in vitamin A (mango, papaya), and indigenous varieties of dark green leafy vegetables. Solar driers were introduced as a best practice in preservation of fruits and vegetables, to provide a year-round source of micronutrients. The SARF intervention was also integrated into MICAH's overall anaemia prevention and control strategy, which included the following activities: iron supplementation (weekly to women of childbearing age and children under 5 years old, daily to pregnant women); fortification of staple foods with iron, zinc, vitamin A, B vitamins and folate; malaria prevention and treatment; hookworm control; latrine construction; and capacity building and advocacy for improved anaemia programmes at all government levels.

Programme evaluation

Effectiveness of the MICAH programme in Malawi was evaluated through cross-sectional surveys, a baseline in 1996 and final evaluation in 2004. Two-stage cluster sampling was employed, using proportionality to population in the selection of clusters and households. Key indicators were assessed through semi-structured interviews with a standardized questionnaire and by collection of biochemical, clinical and anthropometric data (16). At the final evaluation in 2004, a sample of communities outside the programme areas (hereafter referred to as the non-MICAH group) was also included as a means to evaluate the MICAH programme effectiveness through comparison with similar communities which received the usual government interventions, but not the additional anaemia control package delivered by MICAH.

Mobile laboratories were set up in the participating communities to collect data on haemoglobin, malaria and parasite infection. Haemoglobin was measured onsite from finger-prick blood samples using a portable haemoglobinometer (HemoCue AB, Angelholm, Sweden). Malaria parasites were also examined onsite by thick blood smears using Field's A and B staining technique (17). A direct microscopy technique was used for stool examination to look for ova, cysts and parasites. All laboratory procedures were conducted by qualified technicians from selected health facilities in Malawi.

Data were entered and analysed using standard statistical packages (e.g. EpiInfo, SPSS). Significance testing for differences from baseline to follow-up, and between MICAH and non-MICAH groups in the final evaluation, was done by chi-square tests for categorical variables and *t* tests for continuous variables. A wealth index (18) was applied to confirm the similarity of the MICAH and non-MICAH communities.

The MICAH programme, including the evaluation design, received ethics clearance from the Ministry of Health in Malawi. At the community level, the surveys were conducted after verbal consent from traditional authorities in the participating clusters, and from the sampled household heads and respondents, on behalf of their children.

Results

The MICAH programme was implemented in 16 project sites, directly reaching 272,400 people in 45,400 households throughout Malawi. General characteristics of the target population are described in Table 7.1. There were improvements in women's literacy, household access to water and sanitation facilities, and child growth in both MICAH and non-MICAH areas over the 8-year period between the baseline and final surveys. However, the improvements in access to clean water and prevalence of childhood underweight were markedly greater in the MICAH programme areas.

The findings of the wealth ranking analysis are not presented here, but there was no material, nor statistically significant, difference in median household wealth score by MICAH versus non-MICAH village.

Ownership and utilization of small animals

The MICAH SARF intervention provided 40,000 small animals as initial inputs to communities. At the close of the programme, 15,000 offspring had been distributed through the revolving loan system. The resulting increase in small-animal ownership in MICAH households is reflected in the 2004 evaluation data (Table 7.2).

An important element of the SARF intervention was educating the target population to view their animals as a food source, not primarily as an income-generating activity. To this end, an extensive nutrition education effort accompanied the distribution of animals and training on their care and breeding. Table 7.3 presents evaluation data indicating that household consumption of animal products did increase over the programme lifetime and in 2004 was significantly greater in MICAH compared with non-MICAH households for chicken, goat and rabbit meat.

In the 2004 survey only, 24-hour recall data were collected to determine food consumption patterns among children aged 6–59 months using a 7-point scale. Approximately 25% of the children (n = 408) reported consuming meat the previous day. However, the questionnaire did not assess either the specific types of meat or the quantity consumed.

Prevalence of anaemia

The ultimate purpose of the SARF intervention, as one component of the broader integrated strategy of the MICAH programme, was to reduce anaemia in vulnerable groups through increased household access to a

Table 7.1. General characteristics of the study population.

Indicator	1996 (n)	2004 MICAH (n)	2004 non-MICAH (n)
Illiteracy among women ≥14 years old (%)	55 (1682)	27[a] (4322)	31 (2210)
Households with access to a clean water source (%)	55 (1269)	81[a,b] (1932)	73 (981)
Households with access to sanitary facilities (%)	49 (1269)	94[a,b] (1935)	90 (988)
Stunting in children aged 6–59 months (% with HAZ < –2)	56 (504)	40[a] (1387)	39 (651)
Underweight in children aged 6–59 months (% with WAZ < –2)	29 (504)	13[a,b] (1387)	23 (651)
Wasting in children aged 6–59 months (% with WHZ < –2)	8 (504)	2[a] (1387)	2 (651)

MICAH, MICronutrient And Health (programme); HAZ, height-for-age Z score; WAZ, weight-for-age Z score; WHZ, weight-for-height Z score.

[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).

[b]Statistically significant difference compared with 2004 non-MICAH group ($P < 0{\cdot}05$).

Table 7.2. Household ownership of animals.

Indicator	1996 (n = 1272)	2004 MICAH (n = 1930)	2004 non-MICAH (n = 988)
Households with any small animals (goat, chicken, rabbit, guinea fowl, duck, pigeon) (%)	43	65[a,b]	50
Households with goats (%)	32	27[a]	26
Households with chickens (%)	40	59[a,b]	47
Households with rabbits (%)	1	17[a,b]	3
Households with guinea fowl (%)	<1	8[a,b]	3
Households with ducks (%)	3	6[a]	6
Households with pigeons (%)	4	5[a]	4

MICAH, MICronutrient And Health (programme).
[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).
[b]Statistically significant difference compared with 2004 non-MICAH group ($P < 0{\cdot}05$).

Table 7.3. Household consumption of animal products.

	Households with various small animals reporting consumption as main use (%)		
Product	1996	2004 MICAH	2004 non-MICAH
Chicken eggs	28	52[a]	47
Chicken meat	33	58[a,b]	42
Goat meat	13	26[a,b]	17
Rabbit meat	0	65[b]	39
Guinea fowl meat	0	63	52

MICAH, MICronutrient And Health (programme).
[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).
[b]Statistically significant difference compared with 2004 non-MICAH group ($P < 0{\cdot}05$).

highly bioavailable source of iron and other key micronutrients. The changes in anaemia observed from baseline to final evaluation are presented in Table 7.4.

Significant reductions in anaemia prevalence were observed in MICAH areas for both pregnant women and children under 5 years old, whereas a similar improvement occurred only in children in the non-MICAH area. No baseline data were collected for non-pregnant women of childbearing age, but, in 2004, women in the MICAH area had a significantly lower prevalence of anaemia compared with those in the non-MICAH communities.

While iron deficiency is the major cause of anaemia worldwide, it is not the only relevant cause in Malawi. Table 7.5 presents the prevalence of malaria and hookworm, major contributors to anaemia, in MICAH and non-MICAH areas. However, it is not possible to determine the relative contribution of each causative factor to the high rates of anaemia with the level of data collected in the MICAH surveys.

The coverage of other essential anaemia control interventions, implemented in conjunction with the SARF, is described in Table 7.6.

The comprehensive anaemia control strategy implemented by MICAH Malawi prevents determination of the specific contribution of the SARF intervention to the observed reductions in anaemia. However, statistical analysis of data collected from women in 2000 (not presented here) and 2004 found a positive association between several key interventions and higher mean haemoglobin levels (19). For both pregnant and non-pregnant women these included absence of malaria infection, consumption of iron supplements and presence of a household latrine. The presence of small animals at the household was positively associated with haemoglobin for non-pregnant women.

On the other hand, further analysis of 2004 data from pre-school children found that neither consumption of meat in the past 24 h nor household ownership of livestock was protective for anaemia. Associations with being non-anaemic were consuming dairy products in the past 24 h (odds ratio (OR) = 0.40, 95%

Table 7.4. Prevalence of anaemia in vulnerable groups.

Target group	1996 (*n*)	2004 MICAH (*n*)	2004 non-MICAH (*n*)
Children under 5 years old (% with Hb < 11 g/dl)	86 (637)	60[a] (1337)	63 (729)
Pregnant women (% with Hb < 11 g/dl)	59 (392)	48[a,b] (203)	68 (85)
Women 15–49 years old (% with Hb<12 g/dl)	N/A	39[b] (1518)	53 (787)

MICAH, MICronutrient And Health (programme); Hb, haemoglobin; N/A, data not available.
[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).
[b]Statistically significant difference compared with 2004 non-MICAH group ($P < 0{\cdot}05$).

Table 7.5. Prevalence of malaria and hookworm.

Indicator	1996 (*n*)	2004 MICAH (*n*)	2004 non-MICAH (*n*)
Malaria in children under 5 years old (%)	33 (648)	13[a] (1284)	13 (694)
Malaria in pregnant women (%)	24 (392)	7[a] (199)	6 (82)
Hookworm in school-age children (%)	18 (690)	0[a] (1019)	0.3 (506)

MICAH, MICronutrient And Health (programme).
[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).

Table 7.6. Coverage of anaemia control interventions.

Indicator	1996 (*n*)	2004 MICAH (*n*)	2004 non-MICAH (*n*)
Daily iron supplementation to pregnant women (%)	49 (168)	51[a,b] (465)	46 (238)
Weekly iron supplementation to women aged 15–49 years (%)	N/A	72[b] (299)	8 (147)
Weekly iron supplementation to children under 5 years old (%)	N/A	68[b] (1061)	6 (577)
Households consuming fortified maize flour (%)	N/A	12[b]	2
Children under 5 years old sleeping under an insecticide-treated bednet (%)	N/A	87[b]	75
Pregnant women sleeping under an insecticide-treated bednet (%)	N/A	78[b]	60

MICAH, MICronutrient And Health (programme); N/A, data not available.
[a]Statistically significant difference compared with results for 1996 ($P < 0{\cdot}05$).
[b]Statistically significant difference compared with 2004 non-MICAH group ($P < 0{\cdot}05$).

confidence interval (CI) 0.19, 0.85); living within 4 km of a health facility (OR = 0.60,
95% CI 0.45, 0.78); and ownership of cultivated land (OR = 0.15, 95% CI 0.03, 0.71). De-worming, after adjustment for confounders, had no or negative associations with anaemia.[2]

However, there was an apparent impact of household small-animal ownership on child growth. Normal weight-for-age was positively associated with belonging to a household producing dairy products or eggs for home consumption (OR = 0.72, 95% CI 0.57, 0.92), iron supplementation (OR = 0.58, 95% CI 0.46, 0.75), preserving fruit or vegetables (OR = 0.63, 95% CI 0.43, 0.91) and access to a village health committee (OR = 0.72, 95% CI 0.52, 1.00[3]). Improved height-for-age was positively associated with consumption of two forms of protein in the previous 24 h (OR = 0.59, 95% CI 0.38, 0.91), proximity to

[2] Rose, G., Main, B. and Namarika, R. (2007) Health and nutrition practices associated with child growth and anemia in rural Malawi: findings from an integrated Micronutrient and Health Program. Unpublished paper.

health facility (OR = 0.75, 95% CI 0.60, 0.93) and weekly iron supplementation (OR = 0.79, 95% CI 0.64, 0.99).[4]

Discussion

Small-animal ownership and consumption

The SARF intervention of MICAH Malawi was successfully implemented on a large scale, and resulted in a significant increase in both small-animal husbandry and consumption of animal foods at the household level (Tables 7.2 and 7.3). However, the survey did not assess the number of animals owned by individual households, such that a household with one chicken was weighted the same in the analysis of animal ownership as a household with several animals of different species. This additional detail would have provided a stronger picture of the differences between MICAH and non-MICAH areas in terms of animal husbandry, as well as clarifying the potential extent of animal food consumption by the beneficiary households.

It is not surprising that the small animals promoted by the programme (particularly rabbits and guinea fowl) were found in a higher proportion of MICAH households compared with the non-MICAH group in 2004, which points to the specific contribution of the programme to increased animal husbandry at the household level. However, it is noteworthy that some non-MICAH households were also raising these animals, which previously were uncommon in the rural areas targeted by the programme. This likely reflects the strong integration of the MICAH SARF intervention within the MoA, such that it was adopted as a core MoA strategy and began to reach into non-MICAH areas through MoA staff and support. In addition, in 2001, the SARF methodology was incorporated into several other development programmes in Malawi. Through advocacy from the Malawi National Micronutrient Coordinator (a position within the MOH but supported by MICAH), MICAH's success with small animals was shared with the World Health Organization (WHO) and Malawi Red Cross Society, resulting in SARF expansion in non-MICAH areas. United States Peace Corps Volunteers also received training in SARF programming, allowing further expansion due to the wide coverage of the Peace Corps' operational areas in Malawi. This replication of MICAH's SARF outside the programme areas likely led to dilution of the impact of MICAH on small-animal ownership in the evaluation data, although a significant difference was still observed between programme and non-MICAH households. However the adoption of this intervention by various development initiatives is a strong indication of the high degree of acceptability of the SARF model, as well as its perceived value and effectiveness as a means to sustainably improve the dietary quality of rural households in Malawi.

During the intervention period, a major drought in Malawi took place in the 2001/02 maize-growing season. In order to cope with the severe food shortage, households were forced to sell valuable resources in order to find food. This included the small animals distributed as part of the MICAH programme, which were either sold for money to buy maize or were consumed. In normal circumstances, at least a breeding pair would be kept, but in such a time of severe food shortage, hunger and malnutrition, all resources available were used in order to survive. Although the MICAH programme did not collect nutrition data during the drought period, it is assumed that levels of malnutrition of all types, including anaemia, either did not improve or deteriorated during this crisis and that recovery and nutritional repletion afterwards would require a significant period of time, as well as inputs from external programmes such as MICAH. In response, the MICAH programme launched an intensive animal restocking programme in 2002–2003, and by the final programme survey in 2004, 72% of households in the programme area had small animals. This coverage might have been even higher without the major losses of the drought period.

[4] Note: rounding error, upper confidence limit <1.0, $P = 0.049$.

Formal qualitative analysis of the critical factors for success of the SARF intervention was not conducted. However, ongoing analysis of monitoring data and reflective discussions between staff, implementing partners and beneficiaries of the programme resulted in common agreements. The following key components of the SARF intervention are believed to have led to its success in increasing household access to and consumption of animal-source foods: (i) community management of the entire process and ongoing responsibility for the revolving fund scheme; (ii) promotion of animals over which women have primary control; (iii) strong integration and partnership with relevant government ministries; (iv) intensive nutrition education to promote consumption of the small animals; and (v) locally developed strategies to increase acceptability and adapt the care and housing of animals to the environment and available resources.

Anaemia prevalence

Anaemia prevalence decreased significantly in pregnant women in MICAH areas compared with non-MICAH, and was significantly lower in non-pregnant women in MICAH areas in 2004. In pre-school children, a similar dramatic decrease from baseline to 2004 was observed in both MICAH and non-MICAH areas (Table 7.4). It was beyond the scope of the programme evaluation to assess the prevalence of iron deficiency or the relative contribution of various causes of anaemia in the study population. Therefore, the following discussion of probable explanations for the difference in results between women and pre-school children when comparing MICAH and non-MICAH communities is based on reasonable interpretation of available data.

The positive results for anaemia in women in MICAH areas are likely a reflection of the impact of the integrated, comprehensive anaemia control strategy implemented by the programme. The small animals were a key component of this, as a means to improve dietary intake of a highly bioavailable source of iron and other key micronutrients. However, it is not possible to determine the specific contribution of the SARF intervention to the improvements in anaemia, as individual consumption data are not available, nor can the contribution of animal-source foods be separated from the role of other essential anaemia control interventions.

The MICAH programme established a community-based delivery system for weekly iron supplementation to women of childbearing age and pre-school children, resulting in high (over 65%) coverage of these target groups (Table 7.6). In contrast, less than 10% of non-pregnant women and pre-school children in non- MICAH areas reported taking regular iron supplements. In addition, MICAH initiated fortification of maize with multiple micronu- trients (including iron) at the village level. This intervention was expanded to include 19 mills in six partner project sites by the end of the programme. Coverage of insecticide- treated bednets for malaria prevention was higher in MICAH areas, but malaria preva- lence declined significantly from baseline to similar levels in both MICAH and non-MICAH areas by 2004 (Table 7.5). This can be attributed to national-level efforts to address the high prevalence of malaria, which MICAH also supported in its operational areas (including distribution of nearly 97,000 insecticide-treated bednets). Furthermore, hookworm prevalence in school-age children was virtually eliminated in both MICAH and non-MICAH areas by 2004 (Table 7.5), again due to efforts broader than the MICAH interventions alone.

The anaemia control interventions unique to the MICAH areas were the small-scale fortification, routine community-based iron supplementation and promotion of small-animal husbandry for household consumption of bioavailable iron. Fortification was not implemented on a wide enough scale to be the main contributor to improved anaemia levels in women, as only 12% of households were consuming the fortified maize at the final evaluation (Table 7.6). Both iron supplementation and small-animal husbandry reached high (65% or greater) coverage levels, but it is not possible to determine the exact contribution of each to the successful reductions in anaemia prevalence.

It may be that the observed reduction in anaemia among pre-school children in both MICAH and non-MICAH areas was primarily a response to improved malaria control interventions. Mid-term data collected in 2000 (not presented here) indicated that anaemia prevalence in pre-school children had been reduced but remained critically high despite MICAH's emphasis on iron interventions for this age group. This led programme staff to conclude that malaria prevention played a greater role in anaemia of young children than previously anticipated. Malaria prevention efforts were therefore greatly expanded in the remaining years of the programme, in conjunction with the national malaria campaign, and, in 2004, anaemia levels in pre-school children had further declined in both MICAH and non- MICAH areas, both of which benefited from high coverage of malaria control interventions.

It is noteworthy that, despite iron deficiency being a major cause of anaemia worldwide, neither the higher coverage of iron supplementation nor the increased availability of small animals at the household level appears to have resulted in greater improvements in anaemia among children in MICAH areas. Furthermore, analysis of the available food consumption data failed to find a protective effect on anaemia of meat consumption in the previous 24 h. However, no data were collected on portion size or frequency of meat intake. It may be that the quantities consumed were insufficient to impact anaemia prevalence. More detailed analysis of intake patterns would be helpful to strengthen the benefit of the SARF intervention for the youngest children, a group in which anaemia prevalence remains unacceptably high. At the same time, it is important to recognize the benefits of consumption of animal foods beyond the potential for a specific impact on anaemia. It has been well documented that the high-quality protein and multiple bioavailable micronutrients contained in animal-source foods have an important impact on optimal child growth and cognitive development (20). Therefore, the lack of an apparent impact on anaemia in young children does not imply that the SARF intervention was not effective for this age group. Indeed, regression analysis of the MICAH 2004 24-hour recall data indicated a positive association between household small-animal ownership and production of dairy products and eggs and weight-for-age in young children.

Limitations of the evaluation

The MICAH Malawi programme design followed the WHO/United Nations Children's Fund recommendation that an integrated approach to the management of iron deficiency anaemia is needed for maximum effectiveness (14). The SARF intervention was therefore one component of a multipronged anaemia control strategy, which also included iron supplementation to women and children; fortification of staple foods with multiple micronutrients; malaria control; and prevention and treatment of parasitic infections. This integrated approach is a strong point of the programme in terms of its ability to address the multidimensional aetiology of anaemia, but prevents the determination of the specific contribution of the food-based intervention to the observed reductions in anaemia.

In addition, the effectiveness of the SARF intervention in terms of improvements in intake of dietary iron cannot be established, due to the lack of individual-level consumption data. Dietary intake data are difficult to collect with accuracy, particularly in large household surveys. As the purpose of the MICAH surveys was to measure the overall effectiveness of the programme, not to conduct detailed research on specific interventions, it was beyond the scope of the evaluation to assess individual food intake patterns. Thus, while reported consumption of animals at the household level increased in MICAH programme areas, intra-household allocation is unknown. Therefore, no conclusions can be drawn as to the extent key target groups benefited from the increased availa- bility of animal-source foods. It is known that, in some contexts, intra-household dis- tribution of animal-source foods does not favour the most nutritionally vulnerable

family members (13). MICAH did address such issues in the decision to promote rabbits rather than goats, once it was identified that goats were not likely to be consumed by the target beneficiaries. However, further study on individual consumption patterns and related underlying issues would strengthen the case for the SARF's potential as an anaemia control intervention, as well as providing valuable information to enhance the intervention design for future replication in similar settings.

Conclusions

The SARF intervention implemented by MICAH Malawi resulted in increased access to animal-source foods for MICAH households. In addition, household consumption of animal-source foods in all categories was higher among MICAH households compared with those in the non-MICAH areas in the 2004 evaluation. This experience provides a model for a food-based approach with strong potential for replication in other similar contexts. Critical factors leading to the success of the intervention include community management and ownership; integration with government ministries; promotion of animals over which women have primary control; and development of locally adapted methods to promote acceptability and to care for the animals.

The positive evaluation findings for reduced anaemia prevalence among women in MICAH areas are attributed to the combined effect of multiple anaemia control interventions, particularly those aimed at increasing iron intake. While it cannot be proven from the available data, it is likely that the increased access to animal-source foods contributed to the results observed. MICAH Malawi's experience demonstrates that food-based interventions can be successfully implemented at the community level, and when integrated with other essential nutrition and health interventions, contribute to improvements in nutritional status, including reductions in iron deficiency and anaemia.

Acknowledgements

The authors express their appreciation to Melani Fellows for her support in the preparation of this chapter and to Kendra Siekmans for reviewing the chapter and providing helpful insights. MICAH Malawi was funded by the Canadian International Development Agency and World Vision Canada. A.C.M. led the implementation and evaluation design of the multi-country MICAH programme. B.J.M. and A.M.M. provided management and technical support from World Vision Canada to MICAH Malawi. R.H.N. and M.E.Y. led the design and implementation of the SARF intervention in Malawi and supervised the evaluation. B.J.M. conducted additional analysis on the evaluation data and A.M.M. was the lead writer of this chapter, with M.E.Y. contributing the intervention description.

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