

Treatment and prevention of malnutrition among infants and young children in Birbhum District, West Bengal, India

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Malnutrition is a severe problem in India. As it impairs health, implementation of preventive measures is of high importance. Lack of knowledge and money were found to be important predictors for malnutrition in the study population in Birbhum District, West Bengal, India. Therefore, these aspects were addressed in the study. Two types of cooking workshops were conducted with rural mothers. First, the impact of increased nutritional education was assessed by combining nutritional training and practical realization during cooking. Second, a newly developed nutrient-rich meal was implemented and its acceptance was evaluated. The combination of cooking and education improved the nutritional value of the prepared meals. The newly implemented dish contained even higher amounts of micronutrients and was well accepted. However, more improvement is still necessary to meet the dietary requirements. Therefore, nutrition education should be combined with other measures to address all aspects of malnutrition including affordability of food.

Keywords: malnutrition, prevention, children, nutrition education.

1 Introduction

In India there is a high prevalence of malnutrition in infants and young children. Many children below the age of five suffer from wasting (low weight-for-height, 19.8%), stunting (low height-for-age, 48.0%), and underweight (low weight-for-age, 42.5%) (IIPS & Macro International 2007, UNICEF 2014). Besides that, micronutrient deficiencies play an important role: 69.5% of the children aged 6-59 months were anemic (IIPS & Macro International 2007) and 57% of children below 6 years suffered from sub-clinical vitamin A deficiency (VAD) (UNICEF & MI 2004).

Macro- and micronutrient deficiencies can be detrimental to human health. For instance, motor and cognitive development in young children may be impaired by iron deficiency, and the social-emotional behavior may be influenced negatively (Lozoff & Georgieff 2006, Lozoff et al. 2008, Shafir et al. 2008). VAD can cause xerophthalmia, an eye disease, which can lead to blindness, and also increases the risk of infectious diseases and mortality (West 2003). However, negative consequences for health can occur even without clinical symptoms of a deficiency (Allen et al. 2006, Biesalski 2013). Therefore, treatment and prevention of malnutrition are of utmost importance.

This Master's thesis (Beitze 2016) was carried out to evaluate treatment and preventive approaches in order to identify suitable measures to combat malnutrition among the Santal children (a scheduled tribe) in Birbhum District, West Bengal, India. This article focuses on the relevant and important aspects of the preventive measures.



2 Methods

The preventive approaches were conducted between May and June 2015, at “St. Mary’s Child and Mother Health Care Center” in Makarampur, Birbhum District, West Bengal, India, and within the surrounding villages. The state West Bengal, located in the East of India, has a population density of 1029/km² (Census Commission of India 2011). In 2001, 5.5 % of the state’s population belonged to scheduled tribes of which 51.8 % were Santals (Census Commission of India 2001). The observed study population lives in mud houses; cooking takes place outside the houses in mud ovens.

The health care center is run by the NGO Shining Eyes e.V., social workers or a nurse assistant facilitated the study program to foster a close relationship with the Santal tribes and translate between English, Bengali, and Santali languages.

2.1 Interviews and focus group discussions with mothers

Over a period of two years, a nurse assistant had interviewed mothers of admitted malnourished children regarding their dietary habits using a structured questionnaire. During the study period, these interviews were accompanied and extended to include more details. Furthermore, within the scope of nutritional training sessions for the mothers of admitted children, focus group discussions were conducted to gain background information about their nutritional knowledge and identify possible reasons for malnutrition.

2.2 Cooking workshops

Two cooking programs, presented in the following, were organized in Monedanga, Bankajole, and Baganpara, villages around the health care center.

Free cooking with nutritional training

This program was carried out with three women participants in Monedanga and with two in Bankajole. According to the number of participants, the program lasted three days in Monedanga and two days in Bankajole. In each group, on the first day, one woman received sufficient funding to purchase food items she considered to need for a healthy meal. Each time, all women in the group then collaboratively prepared the meal and afterwards received a lesson about healthy nutrition. These steps were repeated with the second (and third) women in the following day(s) in order to identify any changes in knowledge and cooking behavior among the participants. The developed recipes were recorded.

Introduction of a previously developed recipe: acceptance study

In this program, a nutrient-rich recipe, developed by a German Master student (Haas 2015) and adjusted to local habits, was introduced in Bankajole and Baganpara as example for a balanced diet. In Bankajole, the dish was cooked with one family from the first cooking workshop, in Baganpara three women participated. The acceptance of the recipe was investigated in semi-structured interviews about the ingredients, taste, and cooking process. Acceptance (taste) by the villages’ children aged 7 months to 7 years was observed



and asked from their mothers. In focus group discussions, variations were discussed to improve the recipe and make it more appropriate for the local eating habits.

2.3 Statistical and nutritional analysis

Statistical analyses have been conducted by means of IBM Statistics SPSS 22 and 23 (IBM Corp. Released 2013 (2015). IBM SPSS Statistics for Windows, Version 22.0 (23.0). Armonk, NY: IBM Corp.) and Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA, USA). Nutritional data were analyzed using NutriSurvey 2007 (Dr. Jürgen Erhardt, SEAMEO-TROPMED RCCN-University of Indonesia). The information about the nutrient content of food items was taken from the “Food Composition Table for Bangladesh” (Shaheen et al. 2013). Comparable food items replaced ingredients which were not covered by the table. Because the Food Composition Table did not provide any data on vitamin B12 and iodine, these nutrients were excluded from the analysis. Salt and spices were not included in the analysis due to the usage of varying amounts. Changes in nutrient and water content through the cooking process were considered by using a specific “boiled-function” in NutriSurvey. Standard portion sizes were used for different age groups. In this publication, the recipes are presented for children aged 24-35.9 months (portion size 200 g). Fulfillment of nutrient requirements was calculated in comparison with the Indian Recommended Dietary Allowances (RDAs) from the National Institute of Nutrition (2009). When the values were not available, Dietary Reference Intakes (DRIs) of the Institute of Medicine were used (Otten et al., 2006).

3 Results

3.1 Interviews and focus group discussions with mothers

The interviews and focus group discussions revealed that there was a high consumption of staple foods (e.g. rice). Consumption of animal products was rare. Vegetables were mentioned frequently, however, portion sizes could not be determined.

It was found that nutritional knowledge was poor. For instance, several women could not mention any healthy foods. However, their knowledge was improved slightly by the nutritional trainings. Furthermore, lack of money was stated as a main reason for low consumption of vegetables or animal products. Less than half of the families grew their own vegetables in kitchen gardens.

3.2 Cooking workshops

Free cooking with nutritional training

The meals prepared by the participants consisted of rice, potatoes, plantain, lentils, soya chunks, vegetables, eggs, mustard oil, and some condimental ingredients in varying combinations and amounts. On the third day in Monedanga, substitution of a little amount of the meal (15 %) with mango was proposed to the women so as to introduce vitamin C as an important promoter of iron absorption (WHO et al., 2001).



It was found that the training sessions enhanced the diversity of the food items used. In Monedanga, even animal products (eggs) were used on the second and third day. Consequently, the contents of some nutrients increased over time as the workshop progressed (see Table 1 and Figure 1).

Energy & Nutrients	Fulfillment of requirements [%]					
	Monedanga				Bankajole	
	Day 1	Day 2	Day 3	Day 3 + Mango	Day 1	Day 2
Energy [kcal]	22.9	18.6	22.8	21.4	19.1	22.3
Protein [g]	43.7	34.7	41.9	37.1	27.5	38.9
Fat [g]	11.1	13.0	26.7	23.3	15.9	9.6
Carbohydrates [g]	34.2	25.9	27.0	26.3	26.5	34.3
Vitamin A [μ g]	0.9	38.9	35.9	52.4	1.1	2.2
Vitamin E (α -tocopherol) [mg]	1.7	11.7	6.7	11.7	3.3	1.7
Vitamin B1 [mg]	20.0	20.0	20.0	20.0	20.0	40.0
Vitamin B2 [mg]	16.7	16.7	33.3	33.3	16.7	16.7
Niacin (eq.) [mg]	46.3	37.5	37.5	35.0	32.5	40.0
Vitamin B6 [mg]	11.1	11.1	22.2	22.2	11.1	22.2
Total Folic Acid [μ g]	54.0	44.8	45.9	65.6	20.0	26.0
Vitamin C [mg]	8.5	25.0	39.8	60.0	14.8	24.3
Vitamin D [μ g]	0.0	4.0	4.0	4.0	0.0	0.0
Calcium [mg]	9.5	6.7	8.6	8.0	4.4	5.6
Magnesium [mg]	107.8	75.6	142.6	130.2	63.4	88.6
Phosphorus [mg]	27.4	21.0	22.4	20.4	16.6	23.3
Iron [mg]	21.1	16.7	18.9	17.8	11.1	17.8
Zinc [mg]	24.0	22.0	24.0	26.0	18.0	24.0

Table 1: Nutrient intake per standard portion of the meals prepared in Monedanga and Bankajole for children 24-35.9 months (200 g)



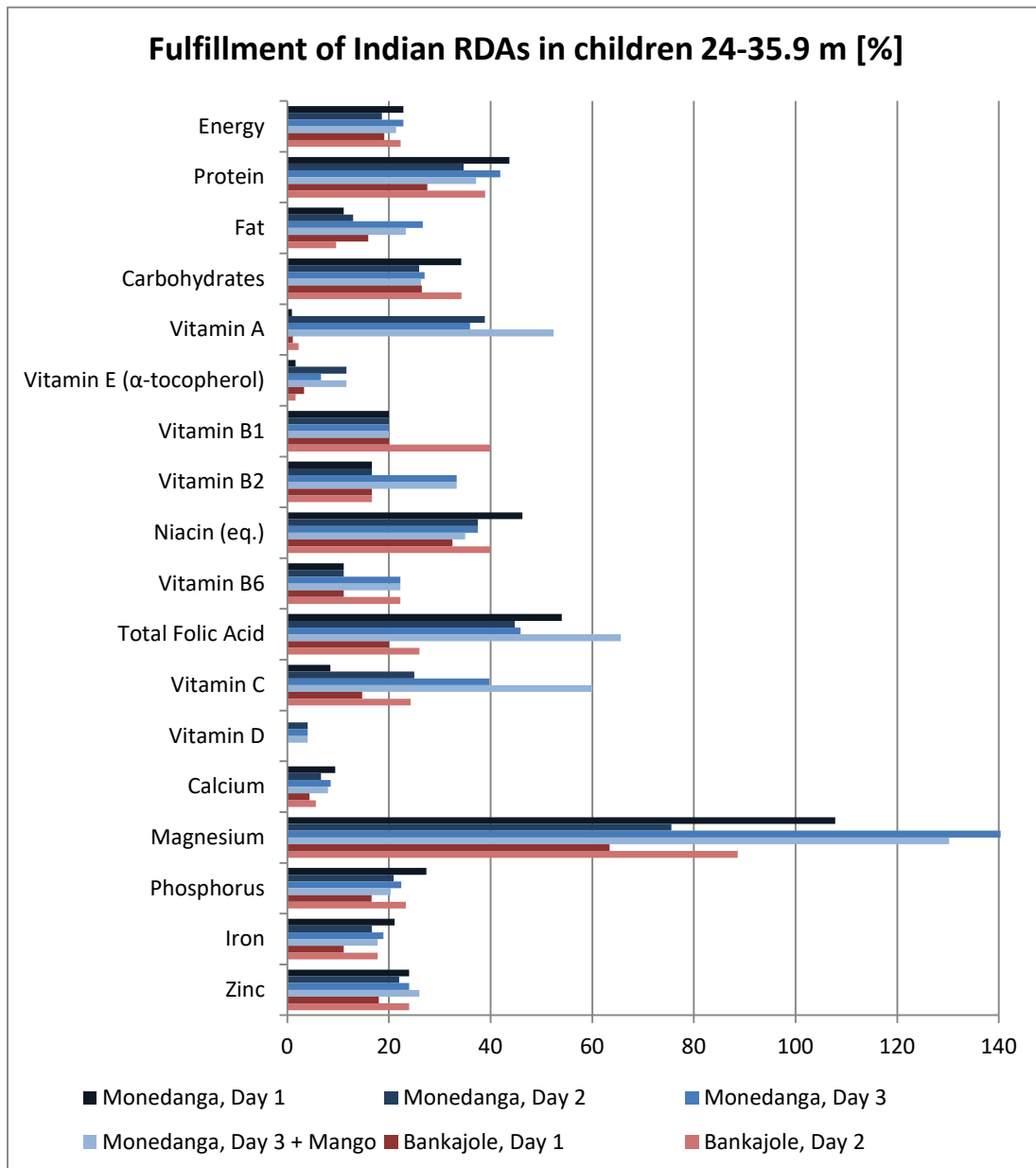


Figure 1: Nutrient intake per standard portion of the meals prepared in Monedanga and Bankajole for children 24-35.9 months (200 g)

A comparison of the two villages revealed differences. Especially for vitamin A, a large improvement was observed during the training phase in Monedanga (> 30 % of requirements, > 50 % if mango was included) but not in Bankajole (1.1 %). B-vitamins were in a similar range for the two villages. Only folic acid was nearly twice as high in Monedanga as in Bankajole. Vitamin C content increased over the days of training in both villages. However, higher amounts were achieved in Monedanga. Iron and zinc content per portion was approximately 20 % of the requirements or even below in both villages, whereas, calcium intake remained below 10 %.



Introduction of a previously developed recipe: acceptance study

The recommended meal, a so-called *kichuri*, consisted of rice, lentils, soya chunks, pumpkin, spinach, *moringa* leaves, garlic, eggs, and a sauce made of poppy seeds, sesame seeds, chickpea flour, and water. One portion accounted for 40 % of daily requirements of vitamin A, iron, and zinc, about 30 % of calcium, and almost 50 % of vitamin C. By replacing 15 % of the dish with mango, the vitamin A and C content was enhanced, however, the contents of some other micronutrients were decreased (see Table 2 and Figure 2).

Energy & Nutrients	Fulfillment of requirements [%]	
	Kichuri	Kichuri + mango
Energy [kcal]	27.1	25.0
Protein [g]	78.4	68.3
Fat [g]	39.6	34.4
Carbohydrates [g]	24.8	24.5
Vitamin A [μ g]	41.9	57.5
Vitamin E (α -tocopherol) [mg]	8.3	13.3
Vitamin B1 [mg]	40.0	40.0
Vitamin B2 [mg]	33.3	33.3
Niacin (eq.) [mg]	53.8	47.5
Vitamin B6 [mg]	33.3	33.3
Total Folic Acid [μ g]	75.4	90.6
Vitamin C [mg]	47.5	66.5
Vitamin D [μ g]	6.0	4.0
Calcium [mg]	30.1	26.3
Magnesium [mg]	187.8	168.6
Phosphorus [mg]	48.3	42.4
Iron [mg]	42.2	36.7
Zinc [mg]	42.0	40.0

Table 2: Nutrient intake per standard portion of the *kichuri* without and with additional mango for children 24-35.9 months



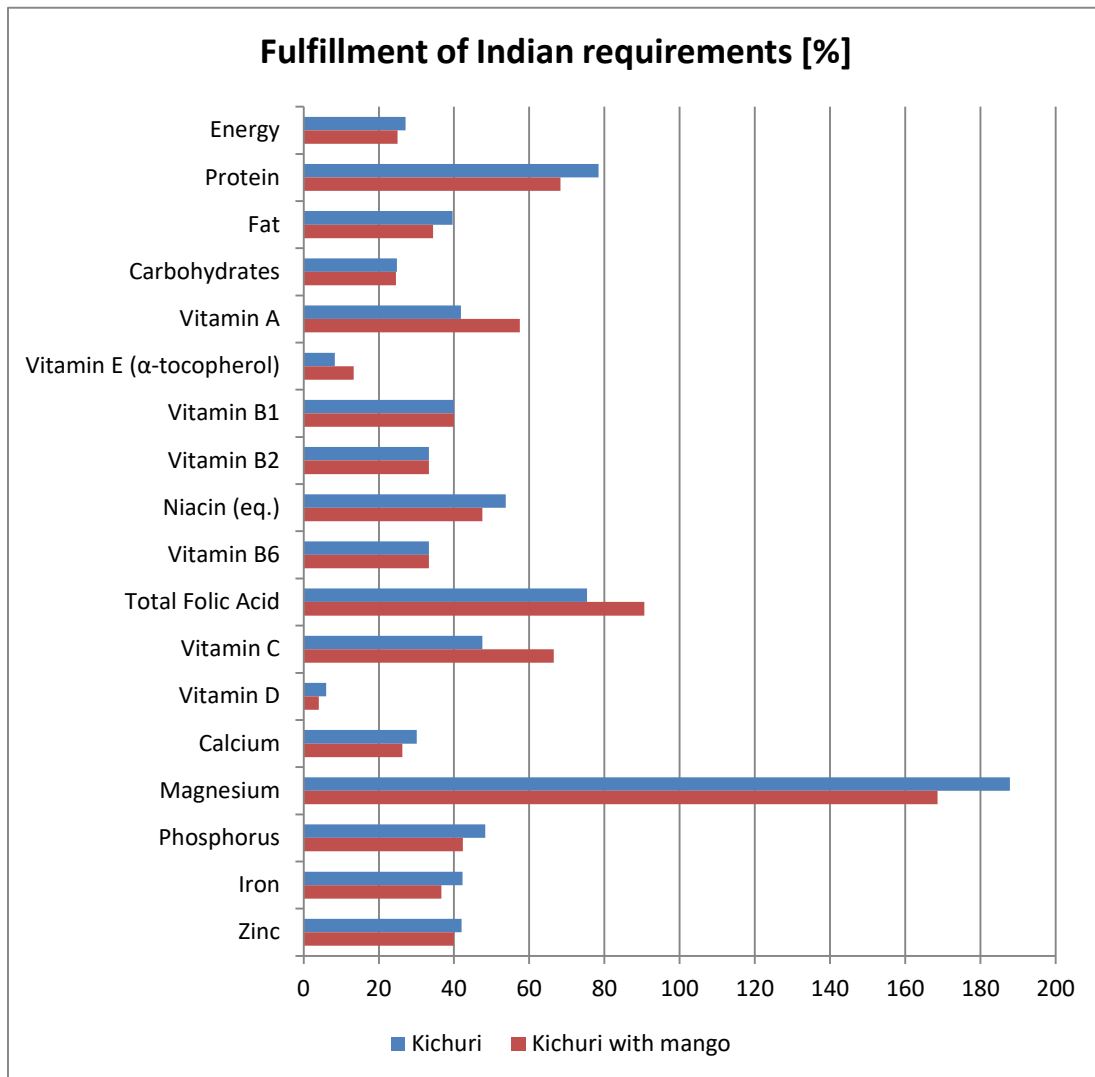


Figure 2: Nutrient intake per standard portion of the kichuri without and with additional mango for children 24-35.9 months

The meal was well accepted by mothers and children. However, the price was reported to be too high to prepare it daily. Therefore, ideas were developed by the participants on how to replace costly ingredients with cheaper alternatives.

4 Discussion

4.1 Interviews and focus group discussions with mothers

Although there was no exact measurement of the diet, the interviews and focus group discussions revealed that the local population might have insufficient diet. This is consistent with Piroth (2014) who examined the diet of young children in villages around the health care center. Constraints in money and knowledge were frequently identified during the focus group discussions. Therefore, these two factors need to be addressed in the study area. The nutritional trainings conducted in the health care center successfully in-



creased the knowledge of mothers on a small scale. Anyhow, this required many repetitions; hence, frequent training is needed to achieve sustainable improvement in knowledge and behavior change.

4.2 Cooking workshops

Free cooking with training

The cooking workshop, combined with nutritional training, resulted in an improvement in the nutrient composition of the prepared meals. It was conspicuous that the increase in nutrient content was higher in Monedanga than in Bankajole. This could be explained by the fact that the participants in Monedanga had had contact with the health care center before and had received nutritional education, which may have been intensified during the workshop. Furthermore, the workshop in Monedanga lasted a day longer, which gave the possibility to repeat and deepen the knowledge. Therefore, increasing the number of educational sessions seems to increase nutritional knowledge more than a single training and, consequently, improves dietary quality.

Since only a single meal was analyzed instead of a whole day's meals, the recommendations for daily requirements did not have to be completely fulfilled. To develop nutrient-rich dishes, Haas (2015) used a cut-off of 40 % of daily requirements to ensure a sufficient intake. This cut-off was rarely achieved by the meals prepared by the participants.

Vitamin A content surged in Monedanga after the first day, which can be explained by the inclusion of animal products (eggs), orange vegetables (pumpkin), and spinach which are rich in vitamin A (Shaheen et al., 2013). Even though the inclusion of these food items increased the content of vitamin A, the 40 % threshold was exceeded only by adding mango. This shows the importance of using local fruits to overcome micronutrient deficiencies. Moreover, β -carotene (a provitamin) has a better bioavailability in fruit than in green leafy vegetables (West & Castenmiller, 1998, Platel & Srinivasan, 2015), which makes their contribution to fulfill the vitamin A requirements even more notable. The content of iron, zinc, and calcium was low, even after nutritional trainings. One reason for this may be that animal products, which are the main dietary sources for these nutrients (Shaheen et al., 2013), are expensive and rarely used in the study area. In addition, there is insufficient knowledge about alternative food sources for these nutrients and increasing their bioavailability. Fruit was missing in the meals despite the explanations about their importance for iron absorption. This supports the hypothesis that continuous trainings are necessary to substantially increase knowledge and to change cooking behavior of mothers in the study area.

The results on B-vitamins vary. In some days, vitamin B₁, niacin, or folic acid could exceed the 40 % cut-off, however, most of the meals contained lower amounts of most of the B-vitamins. The content of vitamin E was low. Since oil from germs and seeds is a rich source of vitamin E (Biesalski & Grimm, 2007), it can be an important dietary source. The traditionally used mustard oil is declared to contain no vitamin E according to the Bangladesh Food Composition Table (Shaheen et al., 2013). However, the seeds contain the nutrient (Shaheen et al., 2013); hence a contribution of the oil to daily intake may be conceivable. Furthermore, there are no data on vitamin E content for some of the vegetables



used in the meals. Therefore, some of them and the mustard oil could possibly contribute to the vitamin E supply. Vitamin D was contained in low amounts or even not at all. However, vitamin D can be synthesized in the skin under the influence of sunlight (Combs, 2012). Therefore, considering only the dietary intake, no conclusion can be drawn about vitamin D status.

The results are limited due to small sample size. Furthermore, accompanying them in their daily routine may have influenced the participants' behavior. Moreover, the calculations with NutriSurvey have to be rated as estimations as the calculated values are rounded values and the nutrient changes by cooking are approximations.

In conclusion, there is an improvement in the nutrient content of the meals as a result of nutritional training and cooking sessions. Longer education time with several repetitions is beneficial and should be preferred to a single training session.

Introduction of a previously developed recipe: acceptance study

In one portion of the newly introduced *kichuri* with and without mango, 40 % of requirements could be achieved in almost all nutrients. The fact that vitamin E and D were still below 40% might be due to the above-mentioned reasons. The calcium content was increased in comparison with the meals prepared by the participants but was still below the cut-off. A reason for this is that dietary sources (e.g. dairy products, poppy seeds) are costly. Therefore, their content in the recipe was not enhanced in order not to restrain the households to consume the dish frequently. Drinking water can be a source of calcium and other minerals but the content varies by region (WHO, 2009). Thus, water could help to cover the calcium needs but this would have to be confirmed with data on the calcium content of the water in the area. Adding mango increased the content of some vitamins but decreased the iron content to below 40 %. However, the bioavailability of iron, which is enhanced by vitamin C, could counteract the decreased amount (WHO et al., 2001).

The participants proposed the use of other vegetables as possible alternatives. This could be a good possibility to ensure adequate nutrient intake in different seasons as long as quantity and diversity are similar to the originally proposed vegetables. Furthermore, sauces based on tomato or mango were proposed. However, poppy seeds and sesame seeds, which were used in the original recipe, are important calcium sources (Shaheen et al., 2013). If they are replaced with other ingredients, alternatives for sufficient calcium intake must be sought.

The recipe could be recommended especially as a supplementary meal in addition to the usual family diet to increase the dietary intake of micronutrients. The nutritionally enhanced recipe was well accepted by mothers and children. However, as 40 % of daily requirements are not covered for all nutrients, more dietary sources have to be included in the diet to ensure an adequate supply in the long run.

In general, nutrition education and the combination with practical realization can be recommended as a tool to improve the local diet. In Bangladesh, intensive nutrition education including demonstrating the preparation of a nutritious dish improved the nutritional status of moderately malnourished children significantly in comparison to a group receiving less frequent, non-intensive nutrition education (Roy et al., 2005). In Indonesia, Inayati et al. (2012) were able to demonstrate the effectiveness of an intensive nutrition



education designed in an interactive way. The use of pictures produced by a local artist, the conduction of facilitated group discussions, and demonstrating the preparation of a balanced meal led to a higher increase in knowledge and practice compared to education without interactive elements. In this way, the superiority of an intensive training was shown. Similarly, Palwala et al. (2009) detected an improvement of the quality and quantity of complementary foods after educational group sessions for Indian mothers in urban slums. Additionally, further improvements were achieved through follow-up visits during which measures were repeatedly explained to single mothers. The authors concluded that periodic repetitions were helpful in modifying the practices of the mothers.

These studies support the suggestion that nutrition education in an interactive way – via practical demonstration of nutritious meals and several repetitions – may be beneficial in increasing knowledge and nutritional quality.

5 Conclusion

Preventive measures are important to combat malnutrition before severe symptoms occur. Lack of knowledge was found to be a main reason for malnutrition in the study area. Nutrition education, especially in the combination of theoretical lessons and practical trainings, could play an important role to enhance knowledge and influence cooking behavior. However, this should be combined with other measures to address all facets of malnutrition. For instance, promoting kitchen gardens could increase dietary diversity in families with limited budget. Poverty, as another important predictor of malnutrition, has to be combated to effectively prevent malnutrition. Further research is needed in order to improve the current measures and combat malnutrition successfully.

6 Acknowledgements

The financial support for this work by the Foundation fiat panis is gratefully acknowledged. Thanks deserves also the organization Shining Eyes e.V., which made the research stay in India possible and supported me throughout the work there. Moreover, I am obliged to all women and children for their willingness to participate in the study program.



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