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Assessment of Micronutrient Deficiency through Dietary Intake, Food Consumption Practices and Nutritional Status Amongst Women of Reproductive Age in Kongowea, Mombasa County

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Abstract

Micronutrient deficiencies are a public health concern among women of reproductive age (WRA) and children aged below five years in low and middle-income countries. Random sampling in a cross-sectional study was used to assess the nutritional status and dietary diversity of 184 women of reproductive age (15-49 years), estimated by data obtained on food frequency, 24-hour recall and dietary diversity using a structured, validated questionnaire. The data was analyzed using Nutri-survey software and transferred to SPSS version 20 and was analysed using descriptive statistics. The BMI status indicated that 47.6% were normal, 42.9% were overweight and 9.5% were obese. The mean energy intake was 2132.6±626.7, protein 49.6±10.2, iron 12.5±2.02 and zinc 9.13±2.14. The results indicate that the respondents in this study were below optimum in the intake of some vitamins and minerals. The vitamins consumed below the RDA included vitamin A (15.8%), vitamin B_2 (49.4% and 31.4%), vitamin C (13.3% and 27.7%) and vitamin D (87.0% and 77.8%). The minerals consumed below the RDA in both age categories were sodium (55.1% and 42.4%), potassium (36.5% and 38.8%), calcium (68.8% and 67.8%) and iron (16.7% and 3.9%). The most consumed foods were starch cereals and the least consumed were meat and fish. There is need for nutrition education aimed at improving proper nutrition and increased micronutrient intake among women of reproductive age.

More Information

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Micronutrients,
women of reproductive age,
nutrition status,
dietary intake,
recommended daily allowance.

Introduction

Malnutrition is directly or indirectly linked to the major causes of death and disability worldwide. Over 2 billion people are estimated to be deficient in one or more vitamins and minerals, particularly iron, zinc and vitamin A [25]. Micronutrients, commonly known as vitamins and minerals are essential in small quantities for proper growth and development. Their deficiencies in diet can lead to impaired physiological development and socio-economic achievement [9]. Micronutrient deficiencies are a serious public health concern among women of reproductive age (WRA) in low- and middle-income countries [6]. The most common deficiencies include vitamin A, (under 5, 84.4%), iron deficiency anaemia (6 – 72 months old 69% and pregnant women 55.1%), iodine deficiency disorders (36.8%) and zinc deficiency (mothers 52% and children under age 5, 51%) [13].

In Kenya, Iron, Vitamin A, Iodine, Folate, Cobalamin and Zinc are the micronutrients known to be of public health importance. Significant progress is being made in reducing the prevalence of micronutrient

deficiencies, except for zinc deficiency [14]. Zinc is a vital trace element with many health benefits and its deficiency in children can lead to growth impediments as well as increased risk of infection.

Micronutrient deficiency is a public health concern in Mombasa County. According to the demographic health surveys conducted between 1998 and 2014, the county has constantly been having poorer indicators than the national indicators on stunting, wasting and underweight. During pregnancy, micronutrient requirements are known to increase and this can aggravate the existing insufficiencies thereby resulting in adverse maternal outcomes [2]. The main causes of micronutrient deficiencies are attributed to insufficient intake and low bioavailability of some micronutrients [16].

Most research has focused on rural populations, with few studies in urban settings. Investigations have mainly focused on pregnant women and few have studied pre-conceptional women of reproductive age or compared intakes of adults and adolescents against the respective recommended intakes. The study aimed to provide a unique insight into food and micronutrient consumption of women of reproductive age living in Kongowea, Mombasa County, to describe micronutrient intakes amongst these women, assess the adequacy of these intakes against references and identify important dietary sources of these micronutrients.

Materials and Methods

Study site

The study was conducted in *Kongowea* sub location, Nyali Constituency, Mombasa County. There are approximately 25 villages and over 2,000 households in an area of 8.35 km^2 with a population density of 7,659 [13]. The residents experience social and economic disadvantages which have a well- established link to child malnutrition.

Research Design and Sampling

The research was a cross sectional study and sampling was done purposively. The sample size was 10% of the accessible population of 2000 households [10]. The study targeted women of reproductive age (15-49 years) and children aged below 5 years. A total of 184 respondents were interviewed between May 2022 and August 2022 for their nutritional status and dietary diversity. Data on food consumption frequency and 24-hour dietary recall was collected using a structured questionnaire.

Solid and liquid food items were estimated by asking the respondents to depict the actual amount of food consumed in household measures. These quantities were then converted to volumes using water and measuring cylinders.

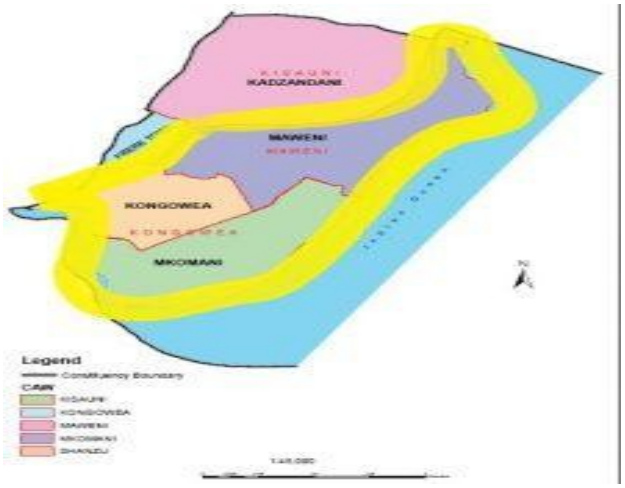

Figure 1: Map of Nyali Constituency Incorporating Kongowea Ward (yellow indicates Kongowea location boundary and its administrative divisions)

Food frequency determination

Dietary habits were assessed by collecting information on the frequency of consumption of various food groups using a food frequency questionnaire (FFQ). The questionnaire captured all foods/beverages typically consumed, including traditional foods not available in stores and those available seasonally. Data was collected on the number of days in the 7 days a participant ate specific food items and the various foods were then grouped into eight food groups. This information was used to calculate the food frequency for each of the eight food items consumed in the last 7 days for each participant and for the study population.

24-hour dietary recall

The total quantities of food consumed by each respondent for one full day were computed to obtain the nutrient quantities of these foods (iron, zinc, proteins, calories etc.). The nutrients ofinterest are zinc and iron, but since energy and protein are important basic nutrients, their intake was also analyzed. The adequacy of zinc and iron for the respondents was determined by comparing the amount consumed with the recommended daily allowance (RDA) and the total nutrient intake calculated.

Nutrition status

The weight of the respondents was recorded to the nearest whole number using an electronic balance. Height was measured with the Harpenden Stadiometer in meters, rounded off to the nearest two decimal places. The body Mass Index (BMI) was calculated by the formula BMI= Weight (kg)/Height (m^2) and expressed as kg/m^2. The BMI (body mass index) was categorized as summarized according to the International Classification of adult underweight, overweight and obesity.

Statistical analysis

The data was analyzed using statistical package for social sciences (SPSS version 20) in which descriptive statistics and correlations conducted to identify any associations within the variables. Data on dietary intake obtained from the 24-hour dietary recall was entered into the Nutrisurvey software. This professional nutrition software contains a food database and provides nutrient analysis and nutrient requirements for individuals.

Results and Discussion

24-hour recall results

The mean energy intake for women aged 19–24 years was 2132.57 Kcal while the recommended energy for the same category was 2420.00 Kcal. The mean energy intake for the women aged 25-50 years was 2139.65 Kcal while the recommended energy for the women was 2427.00 Kcal. The mean protein intake for women aged 19–24 years was 49.57g against the recommended daily allowance for the same being 71.00g. The mean protein intake for the women aged 25-50 years was 69.48g while the recommended daily allowance of protein for the same category is 72.00g. The mean for the carbohydrate in the category of women between 19-24 years is 425.94 g against a recommended daily allowance for the same category of 345.00 g. The mean carbohydrate intake for women aged between 25-50 years is 388.17 g whereas the recommended daily allowance for the same age group is 347.00 g. The mean fat intake in the category of women between 19-24 years was 21.88 g while the recommended daily intake is 82.00 g. The recommended fat intake for the category of 25-50 years was 31.02 g against a recommended fat intake for the same category of 82.00 g. The mean intake of dietary fibre in the category of women between 19-24 years was 33.49 g versus the recommended daily intake of 30.00 g. The mean for the dietary fibre in the category of women between 25 to 50 years is 34.52g while the recommended daily allowance of dietary fibre intake for the same category is 30.00g.

Table 1: 24-Hour Dietary Recall Macronutrient Results

Age	Freq (N)	Mean±SD	RDA	Min	Max
Energy (kcal)					
19 – 24 Yrs.	19	2132.57±626.75	2420.00	1289.26	3255.32
25 – 50 Yrs.	165	2139.65±745.84	2427.00	701.35	5268.28
Protein (g)					
19 – 24 Yrs.	19	49.57±10.21	71.00	32.73	74.02
25 – 50 Yrs.	165	69.48±32.39	72.00	10.63	194.84
Carbohydrate (g)					
19 – 24 Yrs.	19	425.94±155.40	345.00	268.44	721.86
25 – 50 Yrs.	165	388.17±160.37	347.00	102.11	984.36
Fat (g)					
19 – 24 Yrs.	19	21.88±20.51	82.00	4.51	82.30
25 – 50 Yrs.	165	31.02±27.45	82.00	3.58	202.42
Fiber (g)					
19 – 24 Yrs.	19	33.49±7.03	30.00	23.73	49.57
25 – 50 Yrs.	165	34.52±15.94	30.00	8.04	127.56

Table 2: 24-Hour Dietary Recall Vitamin Results

Age	Freq (N)	Mean	RDA	Min	Max
Vitamin A					
19 - 24 Yrs.	19	836.74±889.70	800.0 µg	180.00	3577.64
25 - 50 Yrs.	165	672.94±641.07	800.0 µg	13.13	4605.17
Vitamin B_1					
19 - 24 Yrs.	19	0.9271±0.32	1.0 mg	0.53	1.8
25 - 50 Yrs.	165	1.1326±0.59	1.0 mg	0.29	3.7
Vitamin B_2					
19 - 24 Yrs.	19	0.6081±0.20	1.2 mg	0.34	1.14
25 - 50 Yrs.	165	0.8228±0.38	1.2 mg	0.22	2.56
Vitamin B_6					
19 - 24 Yrs.	19	1.891±1.04	1.2 mg	0.91	4.67

25 - 50 Yrs.	165	1.7948±0.84	1.2 mg	0.62	5.19
Vitamin C					
19 - 24 Yrs.	19	86.7229±38.94	100.0 mg	36.57	173.1
25 - 50 Yrs.	165	72.3556±46.06	100.0 mg	0	276.31
Vitamin D					
19 - 24 Yrs.	19	0.65±1.31	5.0 µg	0	3.75
25 - 50 Yrs.	165	1.1186±1.61	5.0 µg	0	7.68
Vitamin Equivalency					
19 - 24 Yrs.	19	5.0414±3.30	-	2.08	14.7
25 - 50 Yrs.	165	6.1797±4.96	-	0.96	33.72

Micronutrients

The mean vitamin A intake of the age categories 19-24 years and 25-50 years are 836.74 µg and 672.94 µg respectively whereas the mean recommended daily allowance is 800 µg. The mean Vitamin B_1 intake for women aged 19–24 years was 0.9271 mg against the recommended daily allowance for the same being 1.00 mg. The mean Vitamin B_1 intake for the women aged 25-50 years was 1.1326 mg while the recommended daily allowance of protein for the same category is 1.00 mg. The mean vitamin B_2 intake of the age categories 19-24 years and 25-50 years are 0.6081 mg and 0.8228 mg respectively whereas the mean recommended daily allowance is 1.2 mg. The mean intake of vitamin B_6 for the age categories 19-24 years and 25-50 years are 1.891 mg and 1.7948 mg respectively whereas the mean recommended daily allowance is 1.2 mg. The mean vitamin C intake for 19–24 years was 86.7229 mg while that of those aged 25-50 years was 72.3556 mg. The mean recommended daily allowance for vitamin C is 100 mg. The mean vitamin D intake of the age categories 19-24 years and 25-50 years are 0.65 µg and 1.1186 µg respectively whereas the mean recommended daily allowance is 5.0 µg.

Table 3: 24-Hour Dietary Recall Mineral Results

Age	Freq (N)	Mean	RDA (mg)	Min	Max
Sodium					
19 - 24 Yrs.	19	897.03±1210.98	2000.0	33.00	4155.67
25 - 50 Yrs.	165	1152.29±1113.84	2000.0	22.00	5893.73
Potassium					
19 - 24 Yrs.	19	2223.92±1415.40	3500.0	953.50	6193.11
25 - 50 Yrs.	165	2143.06±1104.81	3500.0	632.61	6822.56
Calcium					
19 - 24 Yrs.	19	312.02±87.55	1000.0	150.50	516.01
25 - 50 Yrs.	165	322.19±125.12	1000.0	52.50	823.42
Magnesium					
19 - 24 Yrs.	19	303.31±131.95	300.0	157.92	605.78
25 - 50 Yrs.	165	318.80±212.23	300.0	82.00	1678.04
Phosphorous					
19 - 24 Yrs.	19	793.30±236.37	700.0	423.08	1389.93
25 - 50 Yrs.	165	1059.84±538.65	700.0	316.17	4410.68
Iron					
19 - 24 Yrs.	19	12.50±2.02	15.0	9.83	16.41
25 - 50 Yrs.	165	14.41±5.64	15.0	5.89	49.50
Zinc					
19 - 24 Yrs.	19	9.13±2.14	7.0	5.44	13.04
25 - 50 Yrs.	165	12.90±6.63	7.0	3.84	48.63

Minerals Analysis

The respondents in this study were deficient in the minerals Sodium, Potassium, Calcium and Iron. The mean magnesium intake of the age categories 19-24 years and 25-50 years are 303.31 mg and 318.80 mg respectively whereas the mean recommended daily allowance is 300 mg. The mean Phosphorous intake for 19–24 years was 793.30 mg while that of those aged 25-50 years was 1059.84 mg. The mean recommended daily allowance for phosphorous is 700 mg. The mean zinc intake of the age categories 19-24 years and 25-50 years are 9.13 mg and 12.90 mg respectively whereas the mean recommended daily allowance is 7.0 mg.

Body Mass Index (BMI)

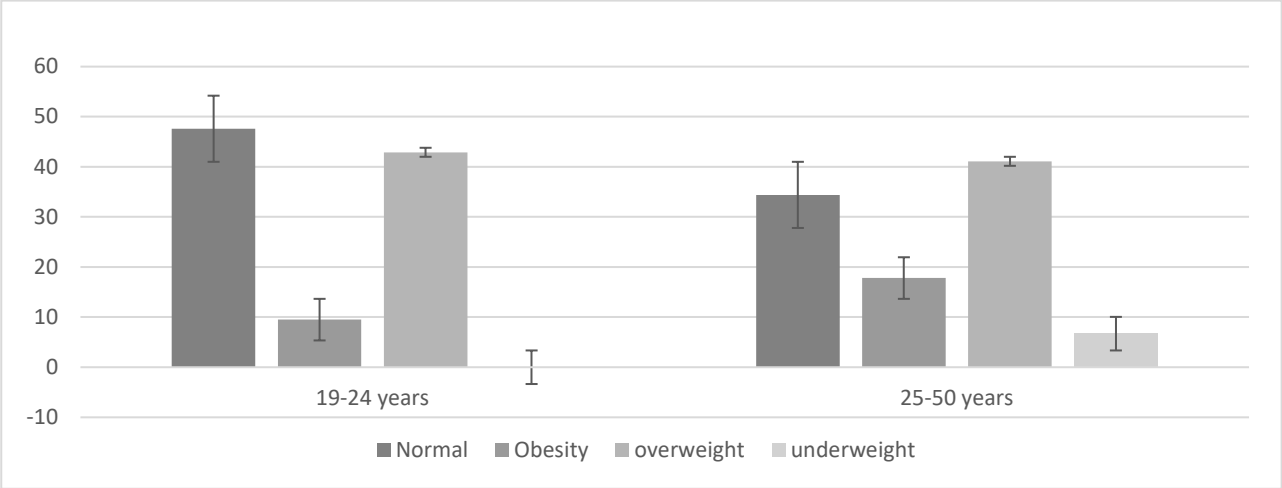

Figure 2. Graph of Body Mass Index Classification

The BMI status for the 19-24 years age category indicated that 47.6% were normal, 42.9% were overweight and 9.5% were obese. There were no respondents who were underweight. In the 25-50 years age category, the highest percentage (41.1%) were overweight followed by those who were normal (34.4%). The obese were at 17.8% and 6.7% of the respondents were underweight.

Food frequency

Table 4: Food Frequency

Food Frequency							
Food group	**Specified food**	**Frequency**					
		Daily	**3-6 times a week**	**1-2 times a week**	**Once per month**	**Once per three months**	**Once after a long time**
Starch (cereals)	Maize, rice, wheat and oats	173	9	2			
Starch (non-cereals)	Cassava, sweet potatoes, irish potatoes, yams	13	71	95	4		1
Legumes & nuts	Beans, green grams, *mbaazi*, groundnuts	26	125	32	1		
Vegetables	Kales, spinach, m*chicha* and cowpeas	172	8	3	1		
Fruits	Oranges, bananas mangoes and avocado	40	84	55	4		
Eggs	Chicken and eggs	11	57	94	11	2	7
Meat and fish	Beef, chicken, fish and mutton	9	32	74	62	1	4
Milk	Fresh milk and mala	110	47	17	4		6

The most frequently consumed foods daily were starch cereals (maize, rice, wheat and Oats) followed by vegetables (kales spinach, *mchicha*, cowpeas) and milk (fresh and fermented). The least consumed foods were meat and fish, eggs and non-starch cereals (cassava, sweet potatoes, irish potatoes and yams).

Discussion

Energy

The results indicate that both categories of women aged between 19-24 years and 25-50 years were unable to meet their recommended daily energy intake by 11.9% and 11.8% respectively. Contrary to the hypothesized association, there is a significant relationship between the dietary intake and micronutrient deficiency. The data contributes a clear understanding of the impact of diet on nutritional status. A study on assessing nutritional status and dietary intake among women of reproductive age cited that 78.7% of the women of child bearing age surveyed had a low caloric intake and 11.8% had a low protein intake compared with the recommended dietary allowance (RDA) [8]. A similar which was conducted indicated that women aged 19–24 years were unable to meet their recommended energy intake [19]. Starchy cereals are the staple foods of *Kongowea* households and are consumed in the large quantities (according to food frequency) and this explains the high contribution of carbohydrates to total energy intake. In this study, starchy cereals (maize, rice, wheat and oats) were the food group consumed by nearly all the population (94.0%) probably due to food habit and its low cost and high satiety value. These foods are capable of satisfying hunger at a cheaper price compared to protein sources and vegetables that are more costly and difficult to afford by respondents of low-income. This finding is similar to the study carried out by (Gomez *et al.,* 2020) who reported that 99.4% consumed starchy foods and lower than (Yeneabat *et al.,* 2016) [24] who reported starchy food intake of 64.7%. Energy requirements in women of reproductive age are determined by biological as well as sociocultural factors and, therefore, are population specific [4]. The reliability of these data is impacted by the lack of assessment of the level of physical activity of each woman surveyed, which would have allowed for a calculation of their individual energy needs for comparison with energy intakes.

Protein

The study demonstrates that women aged between 19-24 years and 25-50 years did not meet their recommended daily protein intake by 30.2% and 3.5% respectively. However, the women aged between 25-50 years took more protein as opposed to their counterparts in the 19-24 years. In the study, the least frequently consumed category of foods were meat and fish (4.9%) and chicken and eggs (5.9%), all of which are protein dense foods. This could be due to the fact that protein sources are more costly and difficult to afford especially by respondents of low-income. The predominance of the women aged between 25-50 years could be attributed to the fact that they are more economically empowered at household level than the category aged between 19-24 years.

Fat

The results indicate that the respondents between 19-24 years and 25-50 years did not meet their recommended daily fat intake by 73.3% and 62.1% respectively. These results might suggest that there was a low-fat intake based on the food frequency in which meat and fish (4.9%) as well as chicken and eggs (5.9%) were the least frequently consumed foods. However, based on the findings of similar studies, a more plausible explanation is that food groups such as nuts and seeds which are good sources of fats were not included in the study hence impacting on the reliability of this data. These results build on the existing evidence of Shrestha *et al.,* 2021 [22] who reported nuts and seeds intake of 3.1% and an intake of less than 45% for eggs.

Vitamins and minerals

The micronutrient results indicate that both categories of the respondents in this study were below optimum in the intake of some vitamins and minerals. The vitamins that were consumed below the RDA included vitamin A (15.8%), vitamin B_2 (49.4% and 31.4%), vitamin C (13.3% and 27.7%) and vitamin D (87.0% and 77.8%). The minerals consumed below the RDA in both age categories were sodium (55.1% and 42.4%), potassium (36.5% and 38.8%), calcium (68.8% and 67.8%) and iron (16.7% and 3.9%). Contrary to the hypothesized association between dietary intake and micronutrient deficiency, the results suggest that inadequate intake of micronutrients can indeed result in a deficiency. The inability to meet the RDA could be attributed to inadequate intake of fruits (21.7%) as well as meat and fish (4.9%) as indicated by the food frequency.

The data contributes a clear understanding of how inadequate intake of vitamins and minerals can result in micronutrient deficiency. These results build on the existing evidence of a study conducted by Onyeji *et al.,* 2022 [20] in which despite a diverse diet, 88.3% some of the micronutrient intake of the women respondents had less than optimal especially for Magnesium, Sodium, Potassium, and Vitamin C where more than 75% of the respondents scored lower than of their RDA but adequate for Iron (94.6%), Zinc (72.7%) and Phosphorus (51.4%). Over 95 % had inadequate intake of Calcium and Potassium. The generalizability of the results is limited by the varieties of foods that are

essential towards providing micronutrients to the diet such as seeds and nuts.

Micronutrients play an important role in both physical and mental wellbeing of the human population. Despite the dietary diversity of the women in this study being wide, the actual consumption showed inadequate consumption of some of the micronutrients. This insufficient nutrient intake of subjects poses problems for women's health both in terms of increased risk of unfavourable maternal and birth outcomes as well as of long-term consequences related to overall health and wellbeing [23]. The findings suggest that there is need to establish healthy eating patterns and improve micronutrient intake among all WRA.

Food frequency

These results indicate that the most frequently consumed foods were starch cereals (maize, rice, wheat, oats) green leafy vegetables, milk and milk products. These foods were consumed on a daily basis and are the major staple foods in Kenya. Consumption of whole grain cereal products is associated with higher diet quality and nutrient-dense foods delivering protein, lipids, B vitamins (including thiamin, niacin, riboflavin), vitamin E, and minerals (calcium, magnesium, potassium, phosphorus, iron, and sodium) [21].

Green leafy vegetables contain considerable amounts of essential micronutrients in addition to the presence of high amounts of vitamin C and therefore a high intake of GLVs could provide nutritional requirements necessary for the normal growth thus giving adequate protection against diseases arising from malnutrition [1]. The main minerals present in milk are sodium, magnesium, phosphorous, potassium, calcium, iron, copper and iodine [13]. The least consumed foods were meat, fish and chicken, which are good sources of fat-soluble vitamins, iron, zinc as well as other minerals.

Iron is one of the trace minerals that play a vital role in the body, that contains about 4g of iron, of which three-fourth is found in association with the protein, haemoglobin. In foods, iron occurs in two forms ferrous and ferric but the absorption form of iron is only in the ferrous state. Iron is involved in the synthesis of other compounds in the body and is therefore important in reactions involving energy release in the body (oxidation and reduction reactions). Iron deficiency anaemia is the most common micronutrient problem in the world as it affects more than 2 billion people globally [3].

On the cellular level, the function of zinc is catalytical, structural and regulatory. Many different enzymes depend on zinc for their ability to catalyze vital chemical reactions. Zinc plays an important role in the structure of proteins and cell membrane and therefore loss of zinc from biological membranes increases their susceptibility to oxidative damage and impairs their functions. Zinc finger proteins have been found to regulate gene expression by acting as transcription factors and plays a role in cell signalling thus influencing hormone release and nerves impulse transmission [9].

Conclusions and Recommendations

It was evident in this study that many women of reproductive age had low micronutrient intake and if continued in the long term, these women would be at a risk of developing micronutrient deficiencies. Nutrition education aimed at improving proper nutrition and increased micro-nutrient intake among women of reproductive age is recommended in *Kongowea* ward of *Nyali* constituency.

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