To assess the food consumption practices, dietary intake and nutritional status of lactating mothers in the house hold after intervention in Mwanamukia-Nairobi

Nkirigacha, E. M.[1*], Imungi, J. K.[2] , Okoth, M.W[3]

[1*]Nkirigacha Evayline Muthoni
PhD Student University of Nairobi, Faculty of Agriculture, Department of Food Science, Nutrition and Technology, University of Nairobi, P.O Box 30197-00100, Nairobi, Kenya
E-mail: evlynemuthoni@gmail.com

[2]Imungi Jasper Kathenya
Department of Food Science, Nutrition and Technology, University of Nairobi,
P. O Box 30197-00100, Nairobi, Kenya
E-mail: imungijk@yahoo.com

[3]Okoth Micheal Wandanyi
Department of Food Science, Nutrition and Technology,University of Nairobi,
P. O Box 30197-00100, Nairobi, Kenya
E-mail: Okothwa@yahoo.com

***Corresponding Author**

Abstract
Diet is the cornerstone for maintaining health in lactating mothers populations. The aim of this study was to determine the dietary intake and nutrition status of the mothers after intervention with a sub-sample size of 50 using a cross-sectional study in Mwanamukia, Nairobi Kenya. A structured, validated and pre-tested questionnaire obtain information on food frequency, nutrition status and dietary diversity. 24 hour recall data was entered into nutrisurvey, transferred to SPSS version 20 and analyzed using descriptive statistics and Pearson correlation coefficient determined associations. The mean energy intake 1896.7-2105.4 Kcal. The mean protein intake 70.1 - 72.2g. Women were deficient in Vitamin A, Vitamin B12, Vitamin D, calcium and iron. The highest BMI (36%) and obese 8%. Most consumed foods were grains, least consumed were tomatoes. Conclusion from the study is most respondents had a normal BMI, they consumed more plant origin foods and they deficient of most micronutrients.

Key words: lactating mothers, food practices, nutritional status, dietary intake

Introduction

Diet is the cornerstone for maintaining health and also for the management and prevention of a wide range of medical conditions (WHO, 2011; WHO, 2007). Pregnant and lactating women are especially at high risk of deficiencies due to inadequate dietary intakes, physiological changes involved and various socio-demographic factors (Diallo, 2009). Nutrient requirements are considerably elevated during lactation than in any other stage of a woman‛s reproductive life (Doran et al., 1997). Nutrition is vitally important during the postnatal (immediately after birth) period (Silveira et al., 2007). The requirements are greater than during the pregnancy period, since breast milk has to supply an adequate amount of all the nutrients for an infant‛s needs for growth and development. The milk secreted in one month of breastfeeding represents more energy than the total cost of a pregnancy (Guthrie and Mary, 1995).

Nutrition of the lactating woman affects milk composition and production plus the health of the offspring in adulthood (Silveira et al., 2007). The dietary intake of lactating women is a major determinant of nutritional status and depletion of nutrient stores during lactation poses a risk of malnutrition to the mother whereas inadequate amounts of breast milk can be a source of malnutrition for the infant (Mackey, 1998). Good nutritional intake supports the stamina, patience and self-confidence that nursing an infant demands. The high energy cost of lactation as well as the nutritional and health risk it could pose for the woman emphasizes the need for continuous monitoring of their nutritional status and dietary intake in poor resource countries (Buff and King, 2005). Helping women achieve appropriate nutritional status to optimize breastfeeding is important and requires consideration of energy and nutrient needs (Brown, 2008).

One of the strategies of meeting increased nutrient needs is through utilization of locally available foods including fruits and vegetables which most of the time are produced for sale (Wardlow, 2005). Monotony in diet is considered the hallmark of poverty and poor nutrition. These diets supply inadequate amounts of nutrients and have poor organoleptic qualities that further diminish appetites already suppressed by physiological nutrient deficiencies (Christine *et al,2013*). The need for variety is imposed by the body's physiological requirements. Poor diets deficient in nutrients reinforce the malnutrition–infection cycle and contribute to overall poor health and sub-optimal growth (Barkoukis.H, 2007).

Dietary diversity, assessed as the number of foods consumed across and within food groups over a reference period, is widely recognized as being a key dimension of diet quality and is reflected in food-based dietary guidelines (WHO, 1998; FAO, 2010). Dietary diversity is a simple count of food items or food groups used in households or by individuals over a certain time period. It has been considered a potential 'proxy' indicator to reflect nutrient adequacy (Ruel, 2002). The count serves as an indicator of the nutritional adequacy of diet in relation to growth and other health outcomes (Barkoukis.H, 2007). Dietary diversity indicators have been proposed as potential proxy indicators for diet quality (Ruel, 2003). Under ideal conditions of food access and availability, food diversity should satisfy micronutrient and energy needs of the general population. Unfortunately, for many people in the world, access to a variety of micronutrient-rich foods is not possible (FAO, 2001). Dietary diversity may be limited by access and affordability of higher quality foods (Stewart et al., 2013)**.**

Individual dietary diversity scores aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. Dietary diversity scores have been validated for several age/sex groups as proxy measures for macro and/or micronutrient adequacy of the diet. Scores have been positively correlated with adequate micronutrient density of complementary foods for infants and young children (FANTA, 2006). If properly promoted, urban agriculture can play a crucial a role in Africa's quest for food security, including food availability, enhancement of nutrition for residents, and dietary diversity *(Arku et al.,* **2012)**. Nine food groups are proposed for the WDDS.

Food frequency questionnaire (FFQ) are the most efficient, cost-effective and practical method for the large-scale measurement of dietary intake, which also includes the measurement of micronutrients (Lucas, 1998; Piers, 1995). Dietary intakes typically obtained from FFQ or 24 h recall data have been used to calculate a diet quality score or index that provides an evaluation of the consistency of food intakes with dietary guidelines rather than comparing with nutrient reference values (Spurr et al., 2002; Dufour et al., 1997). One of the requirements for reliable dietary intake data is high-quality food composition data. Local data is preferred because of variations in growing conditions, transportation and food preparation methods, local data is preferred (Scrimshaw, 1997).

2. Materials and methods

The study targeted lactating mothers. It was carried out in two phases. The first phase was a baseline survey with a sample size of 260 respondents. The second phase was an intervention with a sub-sample of 50 respondents. The 50 respondents were among the 260 respondents in the baseline survey. The intervention started on April 2015. Respondents were trained on farming methods to be involved. Training on vegetable production methods was conducted by the researcher and Ministry of Agriculture staff. After the training, in May 2015, each participant was assisted with planting materials and equipment to facilitate the planting process in their households.

The 50 respondents planted amaranthus, black nightshade and cowpeas. The vegetables were planted in multistory gardens, organoponics, and open field depending on the respondent's situation. In July 2015, the vegetables were ready for consumption and the respondents consumed them for one month. They were then evaluated using a structured questionnaire, 24 hour dietary recall and a food frequency questionnaire.
In August, interviewing of lactating mothers commenced. A food frequency questionnaire and a 24-hour dietary recall were administered. The principal researcher ensured that the 50 lactating mothers who were interviewed were at the one-three months postpartum, free from any chronic disease, not fasting and not on any medication during the interview period. Their nutritional status and dietary diversity were assessed. Data on food consumption frequency, and 24-hour dietary recall was collected using a structured questionnaire.

2.1 Analytical methods

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

2.2 Data analysis

2.2.1Food frequency

Data was extracted from the food frequency questionnaire. The types of foods consumed and their frequency was identified. The most frequently consumed foods were ascertained and presented.

2.2.2 Dietary diversity

Questions on dietary diversity were compiled to generate information on the variety of the diet consumed by the respondents.

2.2.3 Nutrition status

Respondent information on weight and height was compiled to obtain BMI. This was then categorized into underweight, normal, overweight. This was presented. Associations between nutrition status and intake were made.

2.2.4 Nutrition knowledge and dietary intake

Diet quality scores were done to investigate the relationship between nutrition knowledge and dietary intake.

2.2.5 Statistical analysis

To facilitate data entry, questionnaires were coded. Data was then entered and cleaned using statistical packages for social sciences (SPSS version 20).The data was then analyzed. The variables for each objective were defined and coded for ease of data analysis. Frequencies mean, standard deviations, percentages were determined. Correlations were conducted to identify associations. Where the associations existed, chi-square was used to test their strength. Data on dietary intake obtained from the 24 hour recall questionnaire was entered into the Nutrisurvey software. This professional nutrition software contains a food database and provides nutrient analysis and nutrient requirements for individuals. Two food composition tables were used. The analysis obtained from the Nutrisurvey software was then exported to Word as a report.

3. Results

3.1 24 hour recall results

Table 1: 24 hour recall results

Energy (kcal)	Mean	Std deviation	RDA	Minimum	Maximum
19 – 24 years **N=13**	1896.6846	759.80219	2036.635	527.80	3601.40
25-50 years **N=40**	2105.3975	796.99426	2035.8	420.30	5518.30
Protein (g)					
19 – 24 years **N=13**	70.1231	40.33995		11.10	175.40
25-50 years **N=40**	72.2125	32.85778	60.14	8.60	186.50
Carbohydrate (g) N=13					
19 – 24 years **N=13**	294.8308	104.35164		81.70	458.20
25-50 years **N=40**	332.4775	115.97573	290.6 g	74.00	717.40
Fat					
19 – 24 years **N=13**	48.8846	43.98333		.00	182.20
25-50 years **N=40**	56.8300	36.97480	69.2g	7.30	240.00
Fiber					
19 – 24 years **N=13**	32.6077	12.28830		6.30	53.20
25-50 years **N=40**	34.5700	17.83543	29.9 g	3.40	86.40

The mean energy intake for women aged **19 – 24 years was** 1896.7 Kcal while the recommended energy for the same women was 2036.635 Kcal. The mean energy intake for the women aged **25-50 years wa**s 2105.4 Kcal while the recommended energy for the women was 2035.8 Kcal. The mean protein intake for women aged **19 – 24 years wa**s 72.2g while the recommended protein for the same women is 60.14g. The mean protein intake for the women aged **25-50 years was** 70.1g while the recommended energy for the same women is 60.14g.

The average mean for the carbohydrate in the category of women between 19 to 24 years is 294.8 g. The recommended carbohydrate intake for the category of 25 to 50 years is approximately 290.6 g. The average mean for the carbohydrate in the category of women between 25 to 50 years is 332.5 g. The recommended carbohydrate intake for the category of 25 to 50 years is approximately 290.6 g. The average mean for the fat in the category of women between 19 to 24 years is 48.9 g (data from 24HR). The recommended fat intake for the category of 25 to 50 years is approximately 69.2g. The average mean for the fat in the category of women between 19 to 24 years is 56.8 g. The recommended fat intake for the category of 25 to 50 years is approximately 69.2 g.

The average mean for the dietary fiber in the category of women between 19 to 24 years is 32.6 g. The recommended dietary fiber intake for the category of 25 to 50 years is approximately 29.9 g. The average mean for the dietary fiber in the category of women between 19 to 24 years is 34.6 g. The recommended dietary fiber intake for the category of 25 to 50 years is approximately 29.9 g.

3.2 Vitamins

Table 2: vitamins analysis according to age

Vitamins

Vit_A	N	Minimum	Maximum	Mean	Std. Deviation	RDA
19 to 24 years	13	28.40	3562.70	972.9385	1055.04083	3000µg
25 to 50 years	40	50.80	2975.90	727.6425	614.33580	3000µg
Vit_B1						
19 to 24 years	13	.40	1.90	1.1462	.35500	1.1mg
25 to 50 years	40	.20	2.60	1.2900	.51976	1.1mg
Vit_B2						
19 to 24 years	13	.40	3.10	1.2538	.72297	1.15mg
25 to 50 years	40	.20	2.80	1.3575	.55326	1.15mg
Vit_B6						
19 to 24 years	13	.60	3.90	1.7769	.85260	1.3mg
25 to 50 years	40	.30	8.30	1.6700	1.22604	1.3mg
Vit_B12						
19 to 24 years	13	.00	8.00	1.5769	3.02769	2.4µg
25 to 50 years	40	.00	17.10	1.8925	3.27065	2.4µg
Vit_C						
19 to 24 years	13	32.90	175.80	77.9154	42.93289	75mg
25 to 50 years	40	6.90	269.90	71.0625	45.60668	75mg
Vit_D						
19 to 24 years	13	.00	1.90	.3385	.68134	15µg
25 to 50 years	40	.00	6.10	1.0900	1.28358	15µg
Vit_Eeq						
19 to 24 years	13	1.50	11.20	5.2615	3.05028	15mg
25 to 50 years	40	1.80	19.00	5.4725	3.27367	15mg

The women in this study were deficient in Vitamin A, Vitamin B12, Vitamin D, Vitamin E eq. the most affected was Vitamin D

3.3 Minerals

Table 3: minerals analysis according to age

Minerals

	N	Minimum	Maximum	Mean	Std. Deviation	RDA
Sodium						
19 to 24 years	13	216.50	6450.60	2398.5923	1551.40689	1500 mg
25 to 50 years	40	105.60	123000.0	5999.2225	19017.52444	1500mg
Potassium						
19 to 24 years	13	1406.10	4922.80	2802.6231	1077.87388	4700mg
25 to 50 years	40	540.60	8885.60	2884.7225	1437.51811	4700 mg
Calcium						
19 to 24 years	13	202.10	1412.80	579.9923	369.74799	1000 mg
25 to 50 years	40	243.80	1597.10	792.7050	383.20653	1000 mg
Magnesium						
19 to 24 years	13	215.40	851.50	450.1154	162.13040	310
25 to 50 years	40	72.10	1047.50	511.1825	191.59047	
Phosphorus						
19 to 24 years	13	343.40	2694.00	1174.8769	583.75224	700 mg
25 to 50 years	40	249.00	2155.30	1392.5100	476.50332	700 mg
Iron						
19 to 24 years	13	6.90	25.90	15.9538	4.59304	18 mg
25 to 50 years	40	1.60	32.00	16.9700	6.59441	18 mg
Zinc						
19 to 24 years	13	3.40	18.30	10.7077	4.38529	8 mg
25 to 50 years						8 mg/day
	40	1.90	31.90	11.3375	5.22738	

The women in this study were deficient in potassium, calcium and iron. The most deficient mineral was calcium. Their intake for the other nutrients was sufficient.

3.4 Nutrition status

Nutrition status

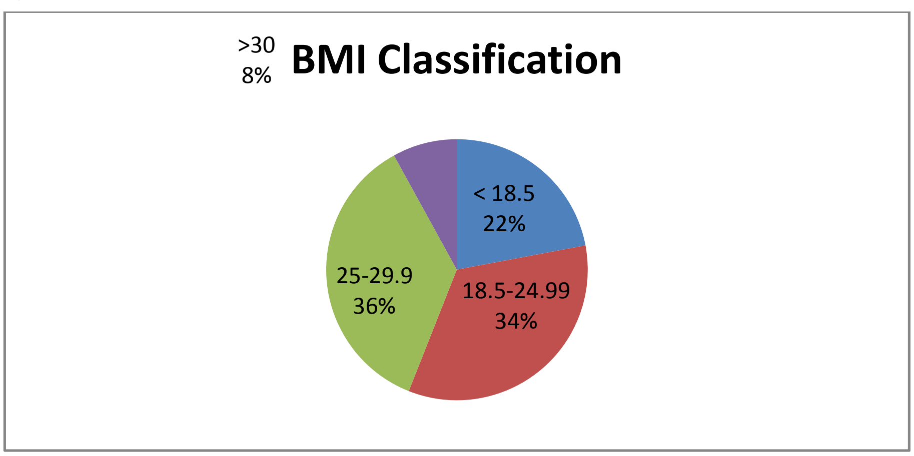

Figure 1: nutrition status

The highest percentage (36%) of the respondents had a normal BMI. The least number of respondents were obese (8%)

3.5 Frequency

Table 4: food frequency

Frequency

Food item	**Frequency**			
	Daily	**3-6 times a week**	**1-2 times a week**	**Once a month**
Grains				
Wheat	**10**	**6**	**2**	
Maize and rice	**14**			
Maize	**5**	**9**	**2**	
Rice	**5**	**5**	**6**	
Starch (non cereals)				
Irish potatoes	**6**	**9**	**4**	
Sweet potatoes	**6**	**4**	**8**	**2**
arrow roots	**6**	**3**	**4**	**6**
Cassava	**0**	**0**	**6**	**2**
Legumes				
French beans	**3**	**4**	**11**	**3**
Green peas	**5**	**1**	**9**	**12**
Green grams	**10**	**5**	**12**	**2**
Ground nuts	**1**	**5**	**5**	**5**
Vegetables				
Dark green leafy vegetables	**29**	**24**	**24**	**12**
Carrots	**16**	**4**	**2**	**2**
Tomatoes	**6**	**1**	**1**	**1**
Meats				
Goat, beef, pork, rabbit, lamb, chicken, fish	**26**	**15**	**25**	**17**
Eggs	**22**	**17**	**5 1**	
whole grains	**22**	**9**	**7**	

The most frequently consumed foods were whole grains, wheat, maize and rice, green grams, carrots, dark green leafy vegetables, meats and eggs. These were consumed on a daily basis. The least consumed foods were tomatoes, sweet potatoes, cassava, groundnuts.

4.0 Discussion

4.1 24 hour recall data

4.1.1 Energy

The women aged 19 – 24 years were unable to meet their recommended energy intake. The women aged 25-50 years met and exceeded their recommended energy intake by 3.4%. The DRIs for normal-weight lactating women assume that the energy spent for milk production is 500 cal per day in the first 6 months and 400 cal afterward (Food and Nutrition Board, 2002). A study of energetics in exclusively breastfeeding women cited a total energy cost of approximately 623 cal per day assuming 750 grams of milk produced at 0.67 kcal/g and 80% efficiency. With mobilization of approximately 170 kcal per day, net energy needs were estimated at approximately 450 kcal per day (Brown, J. E. et al., 2011). As stated by Whitney and Rolfes (2016), most women need at least 1800 kcalories a day to receive all the nutrients required for successful lactation. Severe energy restriction may hinder milk production. The women with the lowest energy intakes in this study took 1896.7kcal. This means they were within the recommended range.

The respondents' distribution of total calories from carbohydrate ranged from 57.7% to 65.2%. For protein it was 13.7% - 14.1% while it was 21.6% -25.1% for fat. According to WHO (1995),

The recommended level of energy distribution is 55-65% for carbohydrate, 12-16% for protein and 15-30% for fat. Following this, the respondents in this study were within acceptable levels in their carbohydrate, fat and protein intake.

4.1.2 Protein

The mean energy intake for women aged 19 – 24 years was 72.2g while for the women aged 25-50 years was 70.1g. The recommended energy intake for women in both categories is approximately 60.14g (Nutrisurvey, 2007). The women in this study took more protein than recommended. WHO/FAO/UNU (2007) recommends that macronutrients contribute the following to total energy; Fat 25-35, carbohydrates 45-65 % and proteins 10-35 %. In this study, proteins provided 13-14% of the total energy recommendations. This is in line with the recommended intakes. Chen H et al., (2012) indicate that lactating women require dietary protein intake for synthesis of the protein in breast milk, and for the growth, maintenance and repair of cells.

4.1.3 Vitamin and mineral intakes

The women in this study were deficient in Vit_A, Vit_B12, Vit_D, Vit_Eeq, potassium, calcium and iron. They attained 24-32% of Vitamin A RDA, 67-79% Vitamin B12 RDA, 2.3-7.3% Vitamin D RDA, 36% Vitamin E eq, 60- 61.4% potassium RDA, 58-79% calcium RDA and 89-94% iron RDA. From this, it appears the worst deficiency was in Vitamin D. Others were Vitamin A and Vitamin E. These results concur with a study done in Indonesia by Marginal *et* al, (2000)which had 50% of lactating mothers deficient of iron, 25% deficient in zinc and 18% deficient of vitamin A. These deficiencies identified are also in agreement with the Food and Nutrition Board, Institute of Medicine which states that, vitamin and mineral intakes that do not meet recommended levels (of folate, thiamin, vitamin A, calcium, iron, and zinc) have been reported for lactating women (Food and Nutrition Board, 2001; Food and Nutrition Board, 1999; Food and Nutrition Board, 1998). Ten percent of lactating women have thiamin intakes below the recommended levels (Food and Nutrition Board, 1998).

Intakes of 200-500mg calcium per day is typical in African and Asian countries where the consumption of animal milk is low, while average calcium consumption in Northern Europe, Northern America and Australia is in excess of 1000mg|d (Prentice et al., 1994; and Zapata et al., 2004). This partially agrees with the current study where the Minimum calcium intake was 202mg while the average was 687mg. In this study, milk was rarely consumed. When it was consumed, it was in small quantities either as part of beverages mainly tea. Insufficient calcium intake has also been reported among lactating women in Italy and Spain (Savino et al., 2001; Sanchez et al., 2008)
According to Whitney and Rolfes (2016), factors that contribute to vitamin D deficiency include dark skin, breastfeeding without supplementation, lack of sunlight, and not using fortified milk.
Sanusi and Adebiyi (2009) reported that the diets of populations in tropical countries rarely contain large amounts of milk, eggs and liver which are rich sources of preformed vitamin A. This thus makes people depend on carotenoids particularly from leafy vegetables and palm oil as sources of vitamin A. This is in agreement with the current study in that the best sources of Vitamin A came from dark green leafy vegetables. However, contrary to Sanusi and Adebiyi (2009) the respondents in this study took eggs.

Whitney and Rolfes (2016) state that dark green, deep orange vegetables and fruits and fortified foods such as milk contribute large quantities of vitamin A. Some foods are rich enough in vitamin A to provide the RDA and more in a single serving. Carrots and sweet potatoes are two of the best sources per kcalorie which the respondents took almost every day. The deficiency may have been because they were not taking enough of Vitamin A rich foods to cater for the demand of both mother and baby. Much of the vitamin E in the diet comes from vegetable oils and products made from them, such as margarine and salad dressings. Wheat germ oil is especially rich in vitamin E. Because vitamin E is readily destroyed by heat and oxidation, fresh foods are preferable sources (Whitney and Rolfes, 2016). The fact that the respondents had a deficiency might have been because they were not consuming Vit E rich products and where they did, they probably exposed the products to heat such that the vitamin was destroyed.

Whitney and Rolfes (2016) indicate that, women can produce milk with adequate protein, carbohydrate, fat, and most minerals, even when their own supplies are limited. For these nutrients and for the vitamin folate as well, milk quality is maintained at the expense of maternal stores. This is most evident in the case of calcium: dietary calcium has no effect on the calcium concentration of breast milk, but maternal bones lose some density during lactation if calcium intakes are inadequate. The nutrients in breast milk that are most likely to decline in response to prolonged inadequate intakes are the vitamins—especially vitamins B6, B12, A, and D.

4.2 Frequency

The most frequently consumed foods were whole grains, wheat, maize and rice, green grams, carrots, dark green leafy vegetables and eggs. These were consumed on a daily basis. Most of these foods symbolize the major staples in Kenya. It was therefore not unexpected to find that the lactating women had a high carbohydrate intake. According to Whitney and Rolfes (2016), wheat is rich in calcium, iron, sodium, folate and niacin. Maize is rich in iron, folate and niacin. Carrots are rich in potassium and vitamin A. Dark green leafy vegetables are rich in calcium, potassium, vitamin A and folate. Despite the respondents frequent, however they were not deficient of other nutrients found in frequently consumed foods. The least consumed foods were sweet potatoes, cassava and groundnuts. Sweet potatoes are rich in Vitamin A and potassium, cassava is rich in potassium while groundnuts are rich in potassium, sodium, vitamin E and niacin. Because these foods were consumed less frequently, the respondents were likely to be deficient in the nutrients. Our findings also suggest that fruits were eaten less frequently.

Vitamin A is important in promoting vision, participating in protein synthesis and cell differentiation and regulating growth and development. Vitamin E is an antioxidant essential in defending against the adverse effects of free radicals. Its main action is to stop the chain reaction of free radicals from producing more free radicals. Sodium helps maintain acid-base balance and is essential to nerve impulse transmission and muscle contraction. Iron serves as a **cofactor** to enzymes involved in oxidation-reduction reactions that occur in all cells. Enzymes involved in making amino acids, collagen, hormones, and neurotransmitters all require iron (**Whitney and Rolfes,** 2016)

Calcium is an integral part of bone structure, providing a rigid frame that holds the body upright and serves as attachment points for muscles, making motion possible. It also serves as a calcium bank, offering a readily available source of calcium to the body fluids. Niacin is part of coenzymes NAD and NADP used in energy metabolism. It is useful in maintenance of skin and tongue, improving circulation and maintaining the health of the digestive track. Potassium plays a major role in maintaining fluid and electrolyte balance and cell integrity. Folate is part of coenzymes THF and DHF used in DNA synthesis and important in new cell formation. It converts vitamin B-12 to coenzyme form and along with B12 and B6, may decrease risk for heart disease and birth defects (**Whitney and Rolfes,** 2016)

Their sources of protein were mainly plant based (cereals and legumes). The most frequently consumed legumes were green grams. The consumption of beans and other legumes was low as majority of the mothers rarely consumed them, at all. The digestibility of most animal proteins is high (90 to 99 percent); plant proteins are less digestible (70 to 90 percent for most, but more than 90 percent for soy and legumes). Plant based foods have also been noted to contain micronutrients with low bioavailability (Neumann et al., 2003). This means that a little of the legumes consumed was lost and did not get absorbed.

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