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STUDY OF FOOD AND NUTRIENT CONSUMPTION PATTERN AMONG CHILDREN OF 6-59 MONTHS OF AGE, WITH PARTICULAR REFERENCE TO PEARL MILLET (PENNISETUM TYPHOIDES) IN NAGAUR, A DESERT DISTRICT OF RAJASTHAN

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Objective: Study of food and nutrient consumption pattern among children of 6-59 months of age, w.r.t. Pearl Millet. Method: A cross sectional study implemented for estimating average intake pattern of food and nutrients among children between 6 to 59 months. 30 cluster sampling approach adopted in dietary survey. Results: Analysis revealed that mean intake of energy in 6-23 months age group was 447.5 Kcal indicating 63.9% deficit in comparison to RDA (ICMR) whereas in 24-59 months age group, mean was 895.8 Kcal showing deficit of 47% w.r.t. RDA, ICMR. Children in 6-23 months age group showed deficit to extant of 15% in proteins, 19.2% in fat, 69.2% in iron, 85.5% in Zinc, 84.5% in Vitamin C, 50% in thiamine, Niacin, vitamin B12, vitamin A, and beta carotene 82.7% w.r.t RDA, ICMR. In case of 24-59 months of age group, deficit was observed in iron (44.4%), zinc (66.4%), vitamin C (58.5%), Thiamine (33.3%), Niacin (70.9%) w.r.t RDA, (ICMR) whereas adequate consumption of proteins, fat, calcium, and folate. Conclusion: Strong need for formulating nutritional intervention packages for this region by introducing adequate bioavailability of iron and vitamin A etc. in their local diets, which can be improved by altering meal pattern.

Keywords: Children, Iron, Pearl millet, Nutrition, Dietary intake

INTRODUCTION

Micronutrient malnutrition is one of the burning problems in developing countries, and deficiency of one or more of the three micronutrients iron, iodine and vitamin A are of major public health significance. WHO (1992 and 1996) and UNICEF (1992) together urged the establishment of micronutrient monitoring and evaluation system capable of assessing the magnitude and distribution of iodine, vitamin A and iron deficiency disorders. In iron-deficiency anaemia, it is now recognized that even without anemia, mild to moderate iron deficiency occurs and has adverse functional consequences. It adversely affects cognitive performance, behaviour and physical growth of infants and preschool children, the immune status, morbidity from infections and also work performance. During pregnancy, it increases the perinatal risks for mothers and neonates and increases overall infant mortality. Vitamin A deficiency, subclinical, is defined as tissue concentrations of vitamin A low enough to have adverse health consequences, although there is no evidence of clinical xerophthalmia. Worldwide, iodine deficiency is the single most important preventable cause of brain damage. During pregnancy, it increases the risk of abortions, stillbirths and congenital anomalies. Increased perinatal and infant mortality along with mental deficiency and psychomotor defects are associated with this. The magnitude and extent of these three micronutrients

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deficiency disorders are not known for this area. Assessment of the situation for this area requires baseline prevalence of these three micronutrient deficiency disorders, i.e., anaemia, vitamin A deficiency and iodine deficiency disorder, which will help to uplift their nutritional status in the community by developing a nutritional package for this region where conditions are very harsh, demanding heavy nature of work. Thus this work aimed to study of food and nutrient consumption pattern among children of 6-59 months of age, with particular reference to Pearl Millet in Nagaur, a desert district of Rajasthan.

Zinc is also an essential micronutrient for healthy functioning of the human body. Though present in tiny amounts, it is critical to life and its deficiency can have a variety of adverse consequences. Zinc deficiency may occur due to diets inadequate in bio-available zinc, certain diseases like diarrhea, loss of zinc in processed foods, and soil deprived of zinc, which can reduce the zinc content in agricultural products. Zinc deficiency in children results in stunting, underweight, and increased risk of infections like diarrhea and pneumonia.

Also sub clinical deficiencies of other micronutrients can reduce the positive effect of a single micronutrient, even when it is not limiting. Multi-centric studies carried out by ICMR (1989), NNMB (1999) and NFHS-3 (2000) Singh *et al.,* show that the prevalence of anemia, vitamin A deficiency and iodine deficiency disorders continues to be high, though there is a small decline in IDD in India. In study[10] of Jodhpur district, Pregnant and lactating women suffered higher from anemia (81%) in comparison to other studies (Singh *et al.*, 2009), i.e., NIN (MND) (76.5%) (NIN, 2003) and NFHS III (2005) (NFHS, 2000) (61.2 % in Rajasthan and 57.9% in India) and 52.0% in Non industrialized countries and 22.7% in industrialized countries according to WHO (2001). Iron deficiency caused an estimated 0.8 million deaths (2.4% of global DALYs), with one-third of the burden in South-East Asia. Zinc deficiency (Fotedar *et al.*, 2002) accounted for a similar number of deaths, but a much higher share (2.9%) of global disease burden was in South-East Asia. Zinc deficiency affects about one-third of the world's population. Collectively, this cluster of under nutrition and micronutrient deficiencies caused about 6 million deaths in 2000 (11% of the global total) and about 17% of the entire global burden of disease. Much of this disease burden occurs among children. Indeed, these estimates suggest that at least half of all child deaths each year could be prevented if under nutrition and associated micronutrient disorders could be addressed.

METHODOLOGY

A cross sectional study has been implemented for estimating the average intake pattern of food and nutrients among women of child bearing age (15-45 years) and children between 6 to 59 months of age with special emphasis on consumption of Pearl Millet and iron. This is a part of big study on Pearl Millet funded by HarvestPlus, Washington (Singh *et al.*, 2015). In this paper, part of the study on children is being given in this paper.

Study Area

Study has been carried out in Nagaur, a desert district of Rajasthan in India. Nagaur district has ten tehsils/blocks as per Govt. of India census 2001 (ICMR Task Force Study, 1989). The study was carried out in all ten tehsils/blocks of Nagaur district.

Study Subjects

Women in the child bearing (15-45 years) age and children under five years of age (6-59 months) were subjects for this study.

Study Design

30 cluster sampling approach (as propagated by WHO) was adopted in dietary survey keeping in view the operational feasibility. The Sampling unit was kept at household level as in each house, mother and child were available. The Sample size was calculated on the basis of prevalence of iron deficiency in diet of women in desert area as reported in scientific literature (WHO, 2001; and Singh *et al.*, 2009) as 20%, level of confidence of 95% relative precision of 20% and design effect of 2 Using formula $(Z\alpha)^2 Q/(L^2) P$, sample size worked out to be 768, adjusted for a 20 percent non response. The sample size was rounded of to 900 from Nagaur district of Rajasthan or 900/30 = 30 households per cluster and 3 house hold per cluster were repeated only for dietary intake.

Selection of Villages

In Nagaur, geographically, a cluster consisted of a village. These 30 clusters/villages were selected from 10 tehsils (Sub-districts) of Nagaur district by means of simple random sampling using the Indian census 2001. In each cluster/ village, 30 household were selected on the basis of simple random sampling technique using a complete list of all households in each village.

Inclusion Criteria: Only those households were selected which had women of child bearing age (15-45 years) and children of age between 6 to 59 months.

Exclusion Criteria: If in one household, women of child bearing age had two or more children with age of 6 to 59 months, then only one child at that household was considered for the study.

The study has been done in two parts, i.e., collection of data from the eligible women of child bearing (15-45 years) and a child between 6-59 months of age from the selected household and the biochemical analysis of the food collected from the field.

Random Selection of the Households

In selected villages a random walk method starting from a central place (usually a temple) in the village and proceeding in at least four different directions was adopted. A household was selected only if eligible women of child bearing (15-45 years) and a child between 6-59 months of age were among the members of the family.

At each household level, information on the demographic and socio-economic aspects were collected. At each household level, women, were interviewed for the dietary pattern using 24 hour recall method (Data was collected by the standard technique as followed by NIN (ICMR), Hyderabad) along with Roseland Gibson/harvest manual for 24 hour recall. Dietary intake details were collected for women of child bearing age, i.e. (15-45 years) and children between 6-59 months at each household (HHs) level for the day prior to the interview. HHs were shown dietary cups regarding portion sizes (actual foods and cooked items) and a small percentage of the HHs include direct weighing of portions to validate the measuring instruments provided to the field workers. Information for Food Frequency Questionnaire (FFQ) was also collected from women at each HHs level.

RESULTS

Daily Pearl Millet intake by children of the target population of nagaur district of Rajasthan shown in Table 1. In 6-23 months, mean consumption was 82.2 g/day. Mean intake in 23-59 months age group was 132.4 g/day. Overall in children of 6-59 months of age, mean consumption was 118.8 g/day and 48.6% were consumers.

Table 2 shows the energy and nutrient intakes per day of only 790 children of 6-59 months age groups as 110 children were exclusively breastfed. Analysis revealed that Mean of energy in 6-23 months age group was 447.5 Kcal indicating 63.9% deficit in comparison to Recommended Dietary Allowances (RDA) ICMR whereas in 24-59 months age group, mean was 895.8 Kcal showing deficit of 47% with reference to RDA, ICMR. Children in 6-23 months age group showed deficit to the extant of 15% in proteins, 19.2% in fat, 69.2% in iron, 85.5% in Zinc, 84.5% in Vitamin C, 50% in thiamine, Niacin, vitamin B12, vitamin A, and beat carotene 82.7% with reference to RDA, ICMR. In case of 24-59 months of age group, deficit was observed in iron (44.4%), zinc (66.4%), vitamin C (58.5%), Thiamine (33.3%), Niacin (70.9%) with reference to RDA, ICMR whereas adequate consumption of proteins, fat, calcium, and folate. The values for iron intakes are extremely low but this may be consistent with the very high levels of anemia found in the different surveys. Also it does not account for the fact that some children are getting iron from breast milk.

Figure 1 shows that in case children of 6-59 months of age groups, milk was the main dietary source of energy (45.6%) followed by pearl millet 20.6%, fat and oils (17.8%) and roots and tubers (8.34%).

Figure 2 shows dietary sources of iron by food group among the children of the studied population of Nagaur district, Rajasthan. In case of children of 6-59 months of age groups, main dietary source of iron was observed to

Table 1: Daily Pearl Millet Intake (Gram/Day) by Children by Age Group

Food	6-23 Months			23-59 Months			All Children		
	Mean All N=334	Mean Consumers N=35	% Consumers	Mean All N=566	Mean Consumers N=403	% Consumers	Mean All N=900	Mean Consumers N=438	% Consumers
Pearl millet grains/Flour (pearl-millet flour raw roasted	8.6	82.2	10.5	94.3	132.4	71.2	57.8	118.8	48.6
	(105.1)	(28.8)		(727.1)	(37.6)		(711.4)	(36.0)	

Note: Data is presented in mean (SD). "Mean all" presents the mean intake for all individuals in the sample, including all those who have 0 intake. "Mean consumers" presents the mean intake only among those who consumed pearl millet on the day of the 24-hour recall. % consumers present the proportion of individuals who consumed pearl millet on the 24-hour recall day.

Table 2: Energy and Nutrient Intakes per Day by Children by Age Group

Nutrient	RDA		6-23 Months N=230		24-59 Months N=560		All N=790	
	EAR	ICMR[3]	Mean	Median (25th, 75th)	Mean	Median (25th, 75th)	Mean	Median (25th, 75th)
Energy, Kcal	-	12401690	447.5	390 (22.8,608)	895.8	723 (489, 964.5)	763.1	622.5 (392, 885)
Protein, g	-	22/30	18.7	16.3 (9.7, 24.9)	35	27.7 (18.3,37.7)	30.2	23.6 (14.9,35.5)
Lipid (Fat), g	-	25	20.2	17.3 (9.6, 27.7)	36.1	24.2 (14.2, 36.9)	31.4	22.3 (12.7, 33.9)
Calcium, mg	500	400	558	445 (250, 749)	882.7	571.5 (304, 940)	786.3	531.5 (281, 878)
Iron, mg	Low: 10.8/14.8 Mod: 5.4/ 7.4	12/18	3.7	1.7 (0.7, 5.4)	10	7.7 (5.1, 12.1)	8.1	6.5 (2.6, 10.3)
Zinc, mg	WHO: 6.9/8.7 IZiNCG: 2/4	-	1	0 (0, 1.6)	2.9	2.5 (1.4, 4)	2.4	2.1 (0.4, 3.5)
Vitamin C, mg	13/22	40	6.2	4.5 (2.2, 7.5)	16.6	8.5 (3.7, 15.5)	13.4	6.8 (3.1, 12.6)
Thiamine, mg	0.4/0.5	0.6/0.9	0.3	0.3 (0.1, 0.4)	0.6	0.4 (0.3, 0.6)	0.5	0.4 (0.2, 0.6)
Riboflavin, mg	0.4/0.5	0.7/1	0.9	0.7 (0.4, 1.2)	1.4	1 (0.5, 1.5)	1.3	0.9 (0.5, 1.4)
Niacin, mg	5/6	8/11	1.3	0.7 (0.3, 1.9)	3.2	2.7 (1.8, 3.9)	2.7	2.2 (1.0, 3.5)
Folate, µg DFE[2]	120/160	30/40	46.3	41 (22, 61)	86.6	66.5 (44.5, 94.5)	74.7	58 (37, 87)
Vitamin B 12, g	0.7/1.0	0.2-1.0	0	0 (0,0)	0.1	0 (0, 0.6)	0.09	0 (0, 0.6)
Beta-carotene, g	-	1600	277.5	237 (133, 372)	596.3	373.5 (223, 559.5)	502.6	317.5 (190, 499)

Note: [1]EARs are shown for children 1-3 years of age/4-5 years of age for comparison to dietary intakes. For iron, EARs are given for low (5%) and moderate (10%) iron bioavailability. For zinc, EARs are given for WHO/FAO (2005) and for IZiNCG (2004) corresponding to low bioavailability. [2]Folate DFE, Dietary Folate Equivalents; Vitamin A RAE, Retinol Activity Equivalents. Indian Council of Medical Research[3] (ICMR) (1989).

Figure 1: Dietary Sources of Energy by Food Group Among Children (6-59 Months)

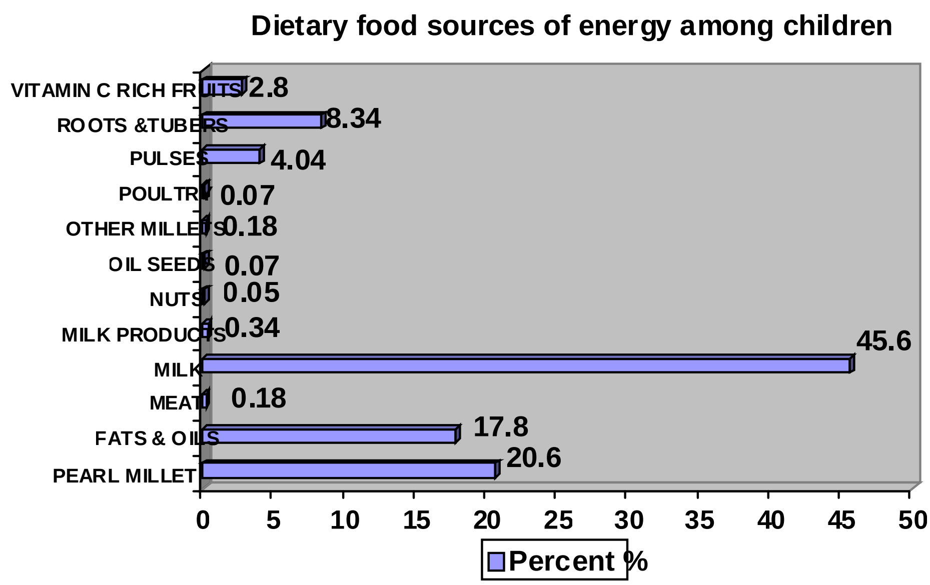
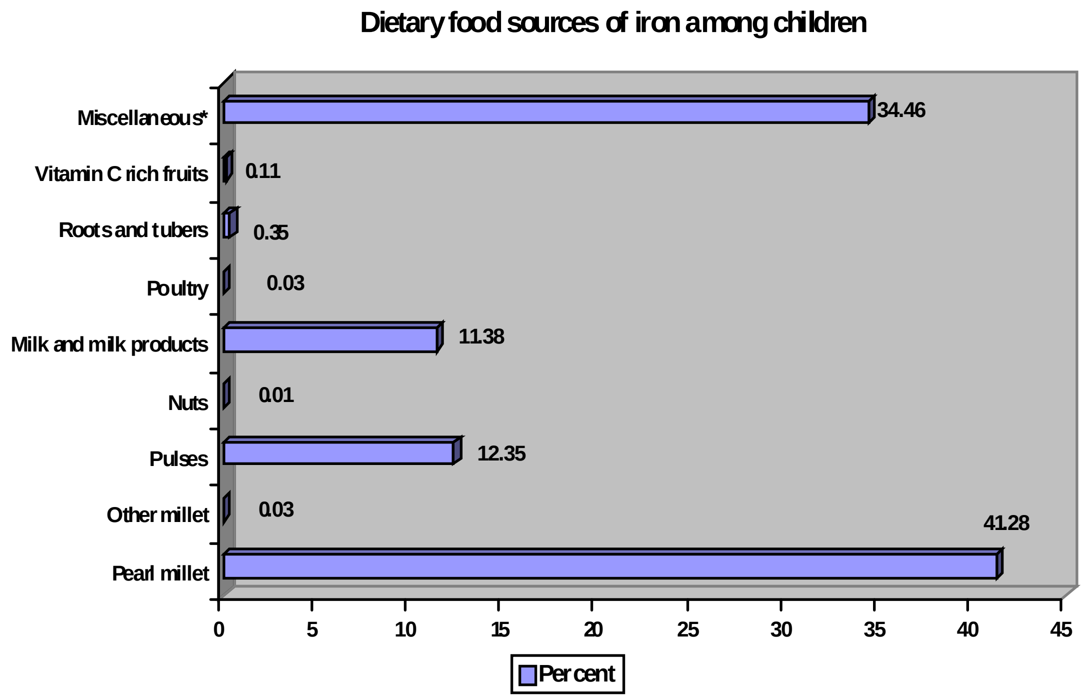


Figure 2: Dietary Sources of Iron by Food Group Among Children



Note: Miscellaneous * Tea with milk, sugar, spices, condiments, etc.

be pearl millet, i.e., 41.28% and 34.46% from another food items.

DISCUSSION

Nutritionally pearl millet is comparable and even superior to major cereals with respect of energy value, proteins, fat and minerals. It makes an important contribution to human diet due to high levels of calcium, iron, zinc, lipids and high quality proteins. Besides, it is also a rich source of dietary fiber and micro nutrients (Anu Sehgal *et al.*, 2006; and Malik *et al.*, 2002). In all children, high deficit was observed in energy intake, iron, zinc, vitamin C, niacin, and beta carotene in comparison to Recommended Dietary Allowances (RDA) ICMR as well EARs of WHO/FAO (2005) and IZiNCG (2004) and deficit was higher in 6-23 months children in comparison to 23-59 months age. Consumption of proteins, fat, calcium, and folate was adequate in 23-59 months children whereas marginally inadequate in 6-23 months of children (proteins and fat). A survey was conducted on 200 working women from urban area in Jodhpur, mainly to assess their health and nutritional status. Delayed supplementation beyond one year was observed for Lower Income Group (39.8%) as compared to Middle Income Group (12.1%) and well-to-do (6.5%) (Fotedar *et al.*, 2002). Another study revealed that food intake of the children under study was highly inadequate. The results from a 24-hour food recall for children between 6 and 35 months. Only about 28% of the children consumed milk. Almost none of them had consumed egg, meat or fi sh over last 24 hours. Fewer than 10% of the children reported consuming appropriate and nutritional food items such as *daliya* (porridge), rice, pulses and vegetables or fruits, and even those who consumed these items, had it in very small quantities. (Mohan *et al.*, 2016). A community based cross sectional study was conducted on 496 children aged 659 months at Jhalawar district. The study revealed that, 54%, 84% and 63% of children were stunted, underweight and wasted. The prominent factors having significant effect on stunting, wasting and underweight were birth weight, Exclusive Breast Feeding (EBF) and family income. Significant correlation effect was observed between wasting, underweight and stunting. (Sharma *et al.*, 2015). According to WHO (1992), at present, iron and vitamin A supplementation are the most common strategies currently used to control these deficiency in developing countries for the time being. This is likely to remain the case until either significant improvements are made in the diets of entire populations or food fortification is achieved. In addition to iodisation of salt, there is a strong need for formulating nutritional intervention packages for this region by introducing adequate bioavailability of iron and vitamin A, etc., irt their local diets, which can be improved by altering the meal pattern to favour enhancers or lower inhibitors.

CONCLUSION

In this study depicted that 6-23 months of children are more under nourished than 6-59 months of children. Government encourage the exclusive breast feeding which is the 6 months after that complementary feeding and weaning practices should started but rural mothers are not aware from this practices so that children become week and under nourished. Government has started the first weaning practices or complementary feeding at the anganwadi centres to reduce the malnutrition and under nourishment among preschool children. This study concluded that children are always the future of the Nation so that this is our responsibility that we should improve the health status, nutritional status of the each and every child for the upliftment of the whole nation and help for the health functionaries.

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