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Full Length Research paper

Consumption pattern of pulses, vegetables and nutrients among rural population in India

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In spite of several national nutritional intervention programmes, the prevalence of micronutrient malnutrition continues to be a major public health problem in India, and the economic cost of micronutrient malnutrition is 0.8 to 2.4% of the GDP. The most vulnerable segments of the population are children, adolescents, pregnant women and lactating mothers. The objective of this communication was to assess the consumption pattern of pulses and vegetables (including roots and tubers) among the rural population in India, utilizing a population based cross-sectional survey. In general, the rural population subsists on inadequate diets, where the mean intakes of pulses and vegetables were found to be below the recommended dietary intakes (RDI). The intakes of leafy and non-leafy vegetables were less than RDI in 88 and 67% of households respectively, while the corresponding figure for pulses was 73%. Similarly, the diets of rural population were grossly deficient in micronutrients such as vitamin A, iron, riboflavin and folic acid. Thus, the study revealed that the diets of rural population in India were grossly deficient in vegetables and pulses. Therefore, it is suggested that the rural communities through health and nutrition education, should be encouraged to consume a variety of vegetables and pulses.

Key words: Pulses, vegetables, micronutrients, RDI, RDA, undernutrition.

INTRODUCTION

Micronutrient malnutrition is a major nutritional public health problem world-wide, particularly in developing countries (Murray and Lopez, 1996). The World Bank (1994) has estimated the combined economic cost of iron deficiency anemia (IDA), vitamin 'A' deficiency (VAD) and iodine deficiency disorders (IDD) could be as much as 5% of gross domestic product (GDP) of developing countries. Murray and Lopez calculated the global burden of disease, in which IDA, VAD and IDD accounted for 2.4% of overall disease burden of developing countries, while the World Health Organization (1983) attributed four times higher percentage (9 to 10%) of disease burden in developing countries to IDA, VAD and zinc deficiency. In spite of the green revolution and several national nutrition intervention programmes, the pre-valence of undernutrition, especially, multiple micronutrient deficiencies of iron, vitamin A and iodine continues to be of public health significance in India (Vijayaraghavan, 2002).In India, the economic cost of micronutrient malnutrition is 0.8 to 2.4% of the GDP (Stein and Qaim, 2008). The most vulnerable segments of the population are children, adolescents, pregnant women and lactating mothers (Toteja et al., 2002; Toteja et al., 2006; Vijayaraghavan, 2006; UNICEF and MI, 2005; ICMR, 2001).

As per the National Nutrition Monitoring Bureau (NNMB,2002) surveys, rural communities are subsisting on inadequate diets, both in terms of quality and quantity leading to protein, energy and micronutrient malnutrition. The time trends (NNMB, 1999) also show that the mean intake of protective foods such as pulses and legumes and non-leafy vegetables continues to be low and was below the recommended dietary intakes (RDI) for Indians (ICMR, 1981), while the consumption of green leafy vegetables (GLV), a rich source of vitamins and minerals

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was grossly deficient during the three points of time that is 1975 - 1979, 1988 - 9090 and 1996 -1997. This was reflected in the median intakes of micronutrients like iron, vitamin A and folic acid, which were grossly deficient in the diet of the rural community. This was also reflected on nutritional status of the rural community as per NCHS standards (Hamill et al., 1979).

The prevalence of underweight (Weight for Age < Median-2 SD) and stunting (Height for Age < Median-2 SD) was 60 and 49% respectively, while the prevalence of wasting was 23% among the rural pre-school children (NNMB, 2002). Similarly, the under nutrition among adults (NNMB, 2002) in terms of chronic energy deficiency that is Body Mass Index of < 18.5 Kg/ht $(meters)^2$ (James et al., 1988) was 37-39%. Similarly, the proportion of undernutrition was 49 - 54% and 62 - 65% among the elderly population of rural and tribal areas of India (Arlappa et al., 2003, 2005). The micronutrient deficiency survey, conducted by NNMB in rural areas of eight states of India (NNMB, 2003), revealed that the prevalence of IDA was 67 - 78% in pre-school children, adolescent girls, pregnant women and lactating mothers and the blood VAD (< 20 µg/dl) was 62%, among the pre-school children indicating their severe public health significance. The prevalence of IDD was however only 4%. Plant foods such as cereals, pulses and legumes, green leafy and non-leafy vegetables, roots and tubers form bulk of the Indian diets (Saxena et al., 2007). These foods are an important part of diet in the rural areas, as they play a very significant role in food security, health and nutritional status of the rural population of India. However, published data on their consumption pattern are not readily available. The purpose of this communication was to assess utilizing the NNMB data the consumption pattern of vegetables (including green leafy and non-leafy vegetables and roots and tubers) and pulses and their contribution to macro and micronutrients in the diet of rural population in India.

RESEARCH DESIGN AND METHODOLOGY

Sampling design

A population based cross-sectional study adopting multi-stage stratified random sampling procedure was carried out in rural areas of Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal during 2001 - 2002 to assess the diet and nutritional status of the community. The List of the villages covered for the 54th round of consumer expenditure survey carried out by National Sample Survey Organisation (NSSO) (1998) formed the sampling frame. The NSSO adopted two-stage random sampling method. The village was the first stage-sampling unit (FSU), while the household formed the second stage-sampling unit (SSU). The State was divided into different *Strata* based on agro-climatic variables, and one district or part of the district with a population of 1.8 million was considered as one stratum. A total of 16 strata were selected randomly from each State, and a sub-sample of 80 villages (at 5 villages per stratum) from 16 strata was covered for the survey. The total number villages located in the stratum /district was enlisted and 5 villages were selected randomly. For this purpose, each selected village was divided into five natural geographical areas, based on group of houses and/or streets. It was ensured that at least the scheduled caste (SC) and/or scheduled tribe (ST) communities inhabited in one of the five clusters. From each geographical area, four consecutive HHs were surveyed by randomly selecting the first HH. Thus, a total of 20 households were surveyed from each village.

Data collection

The demographic and socio-economic particulars of all the households (20 HHs) were collected adopting standard procedures (questionnaires were finalized after pretesting at community/field level and carrying out mock survey in one village covering all the investigations, and uniform questionnaire was used in all the states surveyed). Anthropometric measurements such as heights and weights of all the available individuals on the day of survey were measured using standard equipment. Weight was measured nearest to 100 g using a SECA lever actuated weighing scale with subjects wearing minimum clothing. Height was measured with accuracy of 0.1 cm, using an anthropometric rod with the subject standing on a flat surface (without shoes) with feet together and the head positioned parallel to the ground; that is Frankfurt horizontal plane. A gentle pull was applied and the headpiece of the rod was brought down to touch the head. This measurement was repeated three times and a consistent reading was recorded. Information on HH dietary intake was collected in a sub-sample of 10 alternate households covered for anthropometry and demographic particulars, using 24-hour-recall method of diet survey (Thimmayamma and Parvathi Rao). Thus, a total of 7131 households (HHs) were covered for diet surveys from 715 villages. However, in this communication, only the data pertaining to HH dietary intakes of pulses and legumes, green leafy and non-leafy vegetables and root and tubers and some major macro and micronutrients were presented and discussed.

In the present study, 24-hour-re-call method of diet survey was carried out. In this method the housewife or the member of the household, who cooks the food was asked about the types of food preparations made for breakfast, lunch, evening tea time and dinner during previous day. An account of raw ingredients actually used at household for each food preparations are obtained and weighed using an accurate balance. Grocer's balance (manufactured at Hyderabad, India) with standard weights and measures form the main equipment. The mean daily household consumption of various foods was expressed in grams per consumption unit (g/CU). (The mean daily intakes various food groups at household level need to be compared according to several socio-economic variables such as community, occupation, income etc). Since the composition of households (HHs) in terms of size, gender, age group, physical activity and physiological status, there is need to give necessary weightings, so that ultimately, the consumption at HH level is expressed for a standardized unit. For this purpose, the energy requirements of one reference man (apparently adult male aged 20 - 39 years, weighing 60 kg and doing sedentary work) is considered as one coefficient or say one consumption unit (CU). Accordingly, the energy coefficients/ CUs vary with age, gender, physical activity and physiological status, for example 1.2 for sedentary male, 1.6 for male doing heavy work, 0.9 for sedentary non- pregnant and non-lactating (NPNL) women, 0.4 for 1 - 3 year child etc. Thus in a given HH, the mean intake of each food group on a given day is derived by dividing total raw amount of each food group (g) by total CUs of family members partaken in meal in that particular day. Foods are converted to nutrients by using "Food Composition Tables", which provide information on quantities of different nutrients per 100 g of edible portion of food (Gpalan, 2007). The nutrient intakes, thus expressed per consumption unit.

The team of investigators comprising of medical officer,

Table 1. Demographic and Socio-economic particulars.

Variable		HHs	%
Community*	ST	761	10.7
	SC	1516	21.3
	OBC	2241	31.4
	Others	2613	36.6
Type of House	Kutcha	2059	28.9
	Semi- pucca	4343	60.9
	Pucca	729	10.2
Family size	1 – 4	3173	44.5
	5 – 7	3423	48.0
	= > 8	535	7.5
Occupation of head HH	Labours	2873	40.3
	Cultivators	1883	26.4
	Artisans	585	8.2
	Others	1790	25.1
Literacy Status of Head of HH	Illiterate	2412	33.8
	Literate	4719	66.2
Land Holding	No land	3832	53.7
	Small	2680	37.6
	Large	619	8.7
Annual per capita Income ($)	< 240	1491	20.9
	≥ 240	5640	79.1

nutritionist and social worker of respective NNMB State units carried out data collection using uniform pre-tested proforma. All the investigators were imparted training and standardization in diet survey methodology and data collection for three weeks at National Institute Nutrition (NIN), Hyderabad. To ensure the quality of the data, scientific and technical staff of NIN made frequent supervisory visits to the field and re-examined the sub-sample of the data already collected by the investigation team.

Statistical analysis

Descriptive analysis was performed using the Windows version of SPSS, Version-15.0 (2005). Mean and standard deviation (SD) of HH consumption of pulses& legumes, vegetables and roots and tubers was calculated for each State and the means were compared using ANOVA F-test and post-hoc test. The Non-parametric test of Kruskal Wallis' one-way ANOVA (Siegal and Castellan Jr, 1988) was used, whenever the assumption of homogeneity of variance was violated. Mean household intakes of vegetables and pulses were compared with RDI for Indians (The mean household dietary intake are expressed in grams per consumption unit) to assess the adequacy status in each State. Households were categorised as adequate and inadequate based on consumption of pulses and vegetables as percent of RDI.The household intakes of pulses and vegetables of < Mean-2SD of RDI (< 70% of RDI) are considered as inadequate, and if the intakes are ≥ Mean - 2SD of RDI (≥ 70% of RDI), they are considered as adequate (NNMB, 1999). Similarly, the median deficit intakes of various nutrients were calculated according to recommended dietary allowances (RDAs) for Indians (ICMR, 1990).

Definition of local terms

Community (Caste): Indian community is categorized into different castes considering their occupations. These were mainly divided into socially and economically underdeveloped poorer sections of the society like Scheduled Caste (SC) and Scheduled Tribes (ST), who are provided with certain social guarantees by the government of India. Other backward communities (Different artisans come under this category) and other communities are socially well developed and economically well off.

Type of house: The houses with mud walls and thatched/tiled roof are referred to as kutcha and are usually inhabited by the poorest. The houses with brick walls and tiled/asbestos/tin roof are considered semi-pucca, and those with brick walls and reinforced cement concrete (RCC) roof as pucca and are inhabited by relatively better-off families.

RESULTS

The socio-demographic particulars are presented in Table 1. The mean (±SE) daily household intakes of

Table 2. Mean (±SE) households consumption of pulses and vegetables (g/CU§/day).

State	HHs	Pulses	GLV	Vegetables	Roots and Tubers
Kerala	800	18 ±0.9	5 ±0.7	53 ±2.5	71 ± 3.1
Tamil Nadu	800	35 ±1.0	8 ±0.8	51 ±1.7	38 ±1.6
Karnataka	797	38 ±1.0	11±1.0	25 ±1.6	45 ±1.7
Andhra Pradesh	799	24 ±1.1	7 ±1.4	34 ±1.9	29 ±1.2
Maharashtra	796	30 ±0.9	9 ±0.9	25 ±1.4	23 ±1.0
Gujarat	743	39 ±1.2	12 ±1.3	58 ±2.5	92 ±3.0
Madhya Pradesh	799	30 ±1.1	17 ±1.3	51 ±2.4	43 ±1.7
Orissa	799	20 ±0.8	33 ±1.7	66 ±2.4	102 ±2.3
West Bengal	798	9 ±0.5	49 ±2.9	67 ±2.9	135 ±2.7
Pooled	7131	27 ±0.3	17 ±0.5	48 ±0.8	64 ±0.8
RDI¥		40	40	60	50

§CU: Consumption Unit. * Fruits have no RDI. ¥ RDI: Recommended Dietary Intakes.

Table 3. Distribution (%) of HHs§ according to consumption of pulse and vegetables < RDI¥.

State	HHs	Pulses		Leafy vegetables		Vegetables		Roots and tubers	
		< RDI	< 50% RDI	< RDI	< 50% RDI	<RDI	<50%RDI	< RDI	< 50% RDI
Kerala	800	84	60	96	94	67	49	61	30
Tamil Nadu	800	65	32	95	89	60	39	75	55
Karnataka	797	59	26	93	87	83	72	68	43
AP*	799	74	54	97	94	74	65	85	63
Maharashtra	796	71	37	95	88	85	64	83	66
Gujarat	743	57	26	91	87	60	47	33	24
MP#	799	66	41	88	82	64	50	62	48
Orissa	799	82	55	73	62	52	38	24	15
WB£	798	96	82	67	65	57	47	12	6
Pooled	7131	73	46	88	83	67	52	56	39

*AP, Andhra Pradesh; #MP, Madhya Pradesh; ¥RDI, Recommended Dietary Intake; £West Bengal; §HHs, Households.

vegetables and pulses are given in Table 2. In general, the mean intakes of pulses and vegetables were below the RDI, except for the intakes of roots and tubers. The mean daily consumption of GLV and vegetables, the rich source of micronutrients was poor as compared to the suggested intakes. However, the intake of green leafy vegetables (GLV) in West Bengal and vegetables in the States of West Bengal and Orissa were more than the recommended levels. Similarly, the mean household intake of pulses, the “rich source” of proteins was below the RDI and none of the States were meeting the suggested intake of 40 g. The lowest intakes were reported in the states of West Bengal and Kerala. The average intake of roots and tubers were more than the RDI. However, the consumption was below the RDI, in the states of Maharashtra, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and Karntaka.

The proportion of HHs consuming pulses and vegetables less than RDI and below 50% of RDI is presented in Table 3. The intakes of GLV were less than RDI in 88% of HHs, which ranged from 67% in the State of West Bengal to 97% in the State of Andhra Pradesh. The intake of GLV was below even 50% RDI in 60 - 94% of HHs, and in case of vegetables, the intake was below 50% RDI, in 52% of HHs. In about 56% of HHs, the intakes of roots and tubers were less than the RDI, while 39% of HHs were consuming less than 50% of suggested intakes. The intake of pulses were less than RDI in 73% of HHs, and the proportion of HHs consuming less than even 50% of RDI was 46%.In a majority (85%) of HHs, the intakes of GLV were inadequate (< 70% of RDI), while the corresponding figures for vegetables and roots and tubers were 57 and 47% respectively. Similarly, about 57% of HHs were consuming inadequate amounts of pulses (Table 4).

Median (±SD) household (HH) consumption of nutrients (CU/day) by States is presented in Table 5. In general, the median intakes of all the nutrients except iron in the state of Gujarat and vitamin C in the states of Orissa and West Bengal were below the RDA. While the intakes of

Table 4. Distribution (%) of HHs as per adequate and inadequate consumption of pulses and vegetables.

State	HHs	Pulses		Green leafy vegetables		Vegetables		Roots and tubers	
		Inadequate	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate	Adequate
Kerala	800	69.9	30.2	94.3	5.7	56.1	43.9	44.4	55.6
Tamil Nadu	800	44.6	55.4	92.1	7.9	46.7	53.3	66.8	33.2
Karnataka	797	38.0	62.0	90.3	9.7	75.2	24.8	54.8	45.2
AP*	799	60.6	39.4	95.5	4.5	66.7	33.3	74.8	25.2
Maharashtra	796	51.4	48.6	90.2	9.8	72.9	27.1	73.9	26.1
Gujarat	743	38.1	61.9	88.3	11.7	50.7	49.3	26.7	73.3
MP[#]	799	47.3	52.7	83.6	16.4	54.4	45.6	52.2	47.8
Orissa	799	66.7	33.3	65.0	35.0	43.1	56.9	17.7	82.3
WB[£]	798	91.4	8.6	653.8	34.2	49.7	50.3	83.3	91.7
Pooled	7131	56.6	43.4	85.0	15.0	57.3	42.7	46.7	53.3

Adequate : Intakes ≥ 70% RDI; Inadequate: Intakes <70%RDI; *AP: Andhra Pradesh. #: Madhya Pradesh; [£]West Benga.

Table 5. Median (SD) household (HH) consumption of nutrients (CU[§]/day) by states.

State	HHs	Protein (g)	Energy (kcal)	Calcium (mg)	Iron (mg)	Vit. A (µg)	Riboflavin (mg)	Vit. C (mg)	FFA (µg)
Kerala	800	53 ± 19	1892 ± 398	482 ± 402	13 ± 7.9	89 ±162	0.6 ± 0.2	29 ± 37	47 ± 18
Tamil Nadu	800	42 ± 13	1812 ± 377	321 ± 296	9 ± 5.6	114 ± 224	0.5 ± 0.3	27 ± 39	54 ± 17
Karnataka	797	51 ± 15	2023 ± 494	437 ± 484	14 ± 7.3	127 ± 316	0.8 ± 0.3	25 ± 33	48 ± 20
AP	799	45 ± 17	2041 ± 481	300 ± 351	8 ± 6.4	93 ± 154	0.5 ± 0.2	24 ± 38	36 ±18
Maharashtra	796	46 ± 13	1689 ± 387	285 ± 256	15 ± 8.5	93 ± 239	0.6 ± 0.2	11 ± 27	48 ± 19
Gujarat	743	70 ± 21	2311 ± 632	450 ± 254	28 ±16.8	174 ± 291	1.1 ±0.5	32 ± 47	81 ± 34
MP	799	50 ± 18	1780 ± 499	217 ± 225	14 ±10.5	84 ± 335	0.6 ± 0.3	20 ± 42	48 ± 23
Orissa	799	39 ± 11	1830 ± 346	220 ± 292	10 ± 7.8	54 ± 507	0.4 ± 0.2	41 ± 60	51 ± 20
WB	798	42 ± 14	1830 ± 426	280 ± 484	10 ± 12.5	52 ± 737	0.4 ± 0.3	48 ± 67	49 ± 26
Pooled	7131	47 ± 18	1897 ± 494	328 ± 368	12 ±11.4	101 ± 382	0.6 ± 0.4	28 ± 47	50 ± 25
RDI[¥]		60	2425	400	28	600	1.4	40	100

CU[§]: Consumption Unit. *Fruits have no RDI. [¥] RDI: Recommended Dietary Intakes; AP: Andhra Pradesh; MP: Madhya Pradesh; WB: West Bengal; FFA: Free Folic Acid.

micronutrients such as iron, vitamin A, riboflavin and free folic acid were grossly deficient when compared with the RDAs. The mean and deficit (50% RDA) intakes of various nutrients among different physiological groups are presented in Table 6. In general, the diets of rural population were grossly deficient in micronutrients. The highest deficit (83%) was reported for vitamin A, followed by iron (58%), riboflavin (57%) and folic acid (50%). In case of protein and energy, the deficit was 21 and 22%, respectively. Similarly, majority of pre-school children, adolescent girls

Table 6. The mean and deficit (<50% RDA) intakes of various nutrients among different physiological groups.

Age group	Protein (g)	Energy (kcal)	Calcium (mg)	Iron (mg)	Vit. A (µg)	Riboflavin (mg)	Vit. C (mg)	FFA (µg)
1 - 3 years	20(17)	729(38)	221(70)	5.3(72)	106(88)	0.3(70)	17(66)	20(38)
4 - 6 years	28(7)	1066(30)	239(55)	8.1(71)	127(87)	0.3(83)	15(61)	28(25)
13 - 15 yr girls	21(25)	1689(6)	355(56)	12.9(68)	180(88)	0.6(68)	36(44)	46(65)
16 - 17 yr girls	49(23)	1856(6)	415(48)	15.3(71)	213(88)	0.6(68)	40(43)	51(58)
Adult males	59(5)	225(3)	523(16)	17.5(71)	242(84)	0.8(55)	51(28)	62(38)
Adult females	48(5)	1878(10)	445(25)	14.1(68)	220(86)	0.6(48)	45(34)	52(28)
Preg. Women	50(15)	1933(2)	463(25)	14.0(68)	227(82)	0.7(55)	45(36)	53(55)
Lact. Women	50(14)	2028(16)	408(27)	14.6(71)	212(87)	0.6(64)	48(32)	58(31)

RDA: Recommended dietary allowances; FFA: Free Folic Acid. Figures in the parenthesis indicate the proportion consuming less than 50% RDA.

Table 7. Mean (± SE) consumption (g/CU§/day) of vegetables and pulses by socio-economic status.

Variable		HHs	Pulses	GLV	Vegetables	Roots andtubers
Community*	ST	761	25 ±1.1	22 ±1.7	49 ±2.4	60 ±2.4
	SC	1516	22 ±0.7	19 ± 1.2	46 ±1.6	65 ±1.8
	OBC	2241	30 ±0.6	11± 0.7	46 ±1.2	52 ±1.3
	Others	2613	28 ±0.6	19± 1.0	49 ±1.3	75 ±1.5
	P-Value		< 0.001	< 0.001	N.S¶	< 0.001
Type of House	Kutcha	2059	23 ±0.6	19 ±1.0	55 ±1.5	69 ±1.5
	Semi- pucca	4343	29 ±0.4	16 ±0.6	43 ±0.9	61 ±1.1
	Pucca	729	29 ±1.1	15 ±1.8	54 ±2.5	67 ±2.7
	P-Value		< 0.001	< 0.001	< 0.001	< 0.001
Literacy Status of Head of HH	Illiterate	2412	24 ±0.6	18 ±0.9	42 ±1.2	59 ±1.4
	Literate	4719	28 ±0.4	16 ±0.6	50 ±0.9	67 ±1.1
	P-Value		< 0.001	N.S	< 0.001	< 0.001
Land Holding	No land	3832	25 ±0.5	17 ±0.7	47 ±1.0	66 ±1.2
	Small	2680	28 ±0.6	16 ±0.8	48 ±1.3	62 ±1.4
	Large	619	38 ±1.2	14 ±1.8	38 ±2.2	51 ±2.3
	P-Value		<0.001	N.S	<0.001	<0.001
Annual per capita Income ($)	<240	1491	24 ±0.7	22 ±1.2	48 ±1.8	66 ±1.8
	≥ 240	5640	28 ±0.4	15 ±0.6	47 ±0.8	64 ±1.0
	P-Value		<0.001	<0.001	N.S	N.S

§CU: Consumption Unit. N.S: Not Significant. *Community = SC: Scheduled Caste. ST: Scheduled Tribe. OBC: Other Backward Caste. Others: Socially and economically developed community.

adults, pregnant and lactating women were not consuming even 50% of the recommended dietary allowances of vitamin A, iron, vitamin C, free folic acid and calcium.

In general, the mean intakes of GLV, vegetables, roots and tubers and pulses were significantly ($p < 0.001$) different among different socio-economic variables such as community, type of house, literacy status of head of the household, per capita income and possession of agricultural land (Table 7).

DISCUSSION

The vegetables and pulses are very important sources of the diet in the rural areas of India, as they play significant role in food security, health and nutritional status of the rural population. This is, perhaps, the largest data base on consumption pattern of different vegetables and pulses in rural India. In general, the rural population is subsisting on inadequate diet, where, the household consumption of pulses and vegetables was grossly

deficient compared to recommended intake for Indians, and the intakes were low as compared to the intakes reported by NNMB studies carried out during 1975 - 1979, 1988 - 1990 and 1996 -1997 (NNMB, 1999). The maximum deficit was observed for GLV followed by pulses, vegetables and roots and tubers. The overall intake of GLV and vegetables, the rich sources of micro-nutrients was less than 50% of RDI in 83 and 52% of HHs, respectively.

Similarly, majority of pre-school children, adolescents, adults, pregnant and lactating women were not consuming even 50% of the recommended amounts of vitamin A, iron, riboflavin, vitamin C, free folic acid and calcium. This was reflected in the NNMB study carried out in same villages during 2003 where high prevalence of iron deficiency anemia and vitamin A deficiency was reported (NNMB, 2003).

The median intake of protein (47 g) was also below the RDA, while in Lebanon the corresponding figures for protein was 88 g (Baba, 2000). Similarly, in 73% of HHs, the intake of pulses and legumes, the rich source of protein was also deficient compared to the recommended levels, contributing to high prevalence of underweight, stunting and wasting among pre-school children and chronic energy deficiency (CED) among adults (NNMB, 2002).

We may attribute the high prevalence of undernutrition and micronutrient deficiencies to the poor dietary intakes of micronutrient rich foods, high levels of poverty and poor purchasing capacity, illiteracy and ignorance about the health benefits of vegetables and pulses among the rural population.

Therefore, it is suggested that the community should be sensitized towards the health benefits of consumption of variety leafy and non-leafy vegetables and pulses through health and nutrition education. Agricultural production of non staples such as leafy and non leafy vegetables, the rich sources of micro-nutrients (Underwood, 2000; Bouis, 2000; Ruel, 2001; Hagenimana and Low, 2000) to be increased, because the green revolution benefited most the staples at the expense of other foods (Welch RM, Graham, 2000).

An increase in the staple food prices are also adversely affecting the consumption of micronutrient rich foods, particularly, the consumption of the leafy and non leafy vegetables. It is also stressed that the variety of vege-tables and pulses to be made available to the community at an affordable price, and the rural community to be encouraged to grow them in their backyard. This may improve the consumption of pulses and vegetables, and thereby decrease the prevalence of undernutrition and multiple micronutrient deficiencies among the rural community.

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