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Regional disparity analysis for dietary diversity and food and nutrient adequacy of school-going children from Punjab, India

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Abstract

Objectives: To assess food and nutrient intake and dietary diversity among school children (11-17y) from three regions of Punjab, India.
Methods: A survey was conducted to assess food and nutrient intake and dietary diversity among one thousand and fifty school children (11-17y) selected from urban and rural government schools of three regions of Punjab, namely, Majha (n=210), Doaba (n=210) and Malwa (n=630) using thirty-cluster multistage sampling technique. For multiple comparisons between regions, analysis of variance followed by Tukey's post-hoc test was applied.
Findings: The diets of the selected school-going children were predominantly composed of roots and tubers followed by Pulses, Cereal and Millets and Sugar; moderate amount of Fats and Oils and Vegetables and highly inadequate quantity of Green leafy Vegetables, Milk and Milk products, Fruits, Meat and Poultry. Further, the diets of children were inadequate in energy, Protein, Fat, Thiamine, Riboflavin, Niacin, Vitamin B12, Folic acid, Vitamin C, Calcium, Iron and Zinc. The overall mean household dietary diversity and food variety scores of the children from Punjab were 5.8 out of 12 and 19.3 out of 44, respectively, which indicated that their diets had poor diversity. Mean food variety scores of the children from Malwa region were significantly ($p \leq 0.01$) higher in comparison to that of Majha and Doaba region; whereas, no regional disparity was seen in the mean household dietary diversity scores. Irrespective of region, it was inferred that all the subjects had poor nutrient adequacy with moderate dietary diversity.
Applications: The study highlights the points to ponder for policy makers in framing and strengthening health programs for better nutritional status of school going children from different regions of the state.
Keywords: Food, nutrient, regional disparity, dietary diversity, school-children, Punjab.

1. Introduction

Since children's nutrition is crucial to their physical and cognitive development and for their productivity and earnings as adults, the health and economic consequences of insufficient food and poor diets are life longs for the individuals as well as for society. An essential element to food-based approaches involves dietary diversification or consumption of a wide variety of foods across nutritionally distinct food groups as a way to meet recommended intakes of nutrients [1]. Dietary diversity defined as the number of individual food items or food groups consumed over a given period of time can be used as a proxy measure of the nutritional quality of the diet and for the access dimension of household food security [2]. Dietary diversity scores have potential for monitoring changes in dietary energy availability, particularly when resources are lacking for quantitative measurements. Increasing dietary diversity is associated with increased household food access as well as the individual probability of adequate micronutrient intake, especially among school-going children [3]. Lack of dietary diversity and food insecurity are the major problems among poor populations in the resource limited countries. These populations tend to rely mostly on monotonous diets based mainly on energy dense, but micronutrient poor starchy staples and often include little or no animal products with few fresh fruits and vegetables, thus resulting in malnutrition in food insecure areas [4]. The important life style changes fuelling the complexity of malnutrition is nutrition transition that is related to higher intakes of animal and partially hydrogenated fats and lower in takes of fiber. Besides this, other factors such as taste, convenience and poor physical access to affordable foods may also lead to the selection of an unhealthy diet [5]. Food and good nutrition are pre-requisite for attainment of proper growth throughout childhood that continues till

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adolescence. Adequate nutrition during childhood can save lives and has a lasting economic impact on the future of a child, community and country. National level surveys of India such as National Family Health Survey (NFHS) and District Level Household Survey (DLHS) are restricting data to children below 5 years of age; National Sample Survey Organization (NSSO), not specifying data for children and National Nutrition Monitoring Bureau (NNMB) representing mostly rural populations, has not provided required information on nutritional status of school children and adolescents. The present study attempts to thoroughly assess whether the diets of Punjabi school children are diverse and nutritionally adequate because there is a great need to focus the attention of stakeholders and policy-makers on the nutritional status of school-going children as one of the main indicators of development and as a pre-condition for the socio-economic advancement of societies in the long term.

2. Material and methods

2.1. Location and selection of the subjects

The selection of the subjects, thirty-cluster multistage sampling technique was used. A total of five districts; one each from Majha (Amritsar) and Doaba (Jalandhar) regions and three districts from Malwa region (Ludhiana, Faridkot and Patiala) of Punjab were selected targeting school-going children. In the next stage of sampling, two blocks from each district were selected. The last stage included selecting two rural and one urban government school from each block selected in order to have a total random sample size of 1050 children (210 each from Majha and Doaba region; and 630 children from Malwa region), in the age group of 11-17 years, representing the school-going children of Punjab state.

2.2. Demographic and socio-economic profile

Information related to age, gender, caste, religion, occupation, education and income of the parents was recorded through a structured questionnaire.

2.3. Dietary survey

A descriptive dietary survey was conducted covering the following parameters.

2.3.1. Food and nutrient intake

In order to obtain data pertaining to food intake of the subjects, an interactive 24-hour recall survey was carried out. The subjects were provided with different sets of standardized bowls and glasses to record the exact amount of foods and beverages consumed by them. The daily nutrient intake was then assessed using Diet Cal software [6]. Food intake of the subjects was compared with suggested intakes by ICMR [7], while nutrient intake was compared with the Recommended Dietary Allowances (RDA) of ICMR [8]. The percent adequacy of food and nutrient intake was calculated.

2.3.2. Dietary diversity

To further assess dietary diversity, two indexes were used i.e. Food Variety Score (FVS) which is a simple count of food items; whereas, Household Dietary Diversity Score (HDDS) is a count of food groups. In order to calculate the food variety score, food variety check list was developed that included 44 food items from different food groups. One point was assigned for each food category eaten throughout one week and each food category was counted only once. The total amount of different foods consumed by the subjects was then summed to obtain a total food variety score. Dietary adequacy of the subjects was then assessed through the food variety score scale as follows; > 30 = very good, 25-29 = good, 20-24 = fair, < 20 = poor, ≤ 10 = very poor. Based on the information obtained from the subjects through 24-hour recall method, food groups consumed were analyzed. The HDDS ranged from 0 to 12, summed using the following food groups: 1) Cereals; 2) Legumes and Pulses; 3) Green leafy vegetables; 4) Roots and Tubers; 5) Vegetables; 6) Fruits; 7) Milk and Milk products; 8) Eggs; 9) Meat and Chicken; 10) Fats and Oil; 11) Sugar; 12) Miscellaneous. A value of 1 and 0 was assigned for each of the food groups consumed and not consumed by the subjects, respectively. Adequacy of the subjects was then assessed through scores obtained as follows; ≤ 4 = low, 5-7 = medium, ≥ 8 = high.

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2.4. Statistical analysis

The completed questionnaire was serially coded and tabulated for statistical analysis using SPSS Windows version 16.0 (SPSS Inc., USA). The mean, standard deviation and percentages were calculated using standard methods [9]. For multiple comparisons between regions, analysis of variance followed by Tukey's post-hoc test was applied.

3. Results and discussion

3.1. Demographic and socio-economic profile

Region-wise analysis of the data on demographic and socio-economic profile of the subjects as depicted in Table 1 revealed that majority of the children were Sikhs, followed by Hindus. Maximum number of children belonged to Scheduled Castes (SC). In comparison to other regions, Doaba region had maximum number of SC subjects, but lowest percentage of those belonging to Sikhism. Data on socio-economic profile of the subjects showed that majority of the children's parents were educated up to matriculation and very few had above higher secondary education, thus indicating that number of those without any worthwhile schooling was quite substantial. Majha region had the highest and Doaba region had the least proportion of illiterate parents. The progress of literacy in the state has not only been slow but is highly iniquitous in many respects such as location, gender, region and district [10]. The results further indicated that labour was the most pursued occupation of the fathers and mothers were mostly house wives. Data on monthly family income of the subjects showed that from Majha and Doaba region, most of the subjects were belonging to families earning ₹. 5000-10000; from Malwa region, majority of the subject's families were earning up to ₹. 5000, which indicated that most of the children studied were from low socio-economic status households, earning less than ₹. 10000 month.

Table 1. Demographic and socio-economic profile of the subjects from three regions of Punjab

Parameter	Category	Majha (n= 210)	Doaba (n= 210)	Malwa (n= 630)
Gender	Girls	119 (57)	130 (62)	364 (58)
	Boys	91 (43)	80 (38)	266 (42)
Religion	Sikh	149 (71)	103 (49)	458 (73)
	Hindu	46 (22)	91 (43)	166 (26)
	Others (Muslim, Christian, Jain)	15 (7)	16 (8)	6 (1)
Caste	General	47 (22)	26 (12.4)	169 (27)
	Scheduled class	111 (53)	152 (72.4)	323 (51)
	Backward Class	52 (25)	32 (15.2)	138 (22)
Parent's education				
Mother	No education	100 (48)	41 (19)	242 (38)
	Up to Matric	103 (49)	146 (70)	342 (54)
	Above higher secondary	7 (3)	23 (11)	46 (7)
Father	No education	61 (29)	27 (13)	176 (28)
	Up to Matric	122 (58)	148 (70)	381 (60)
	Above higher secondary	27(13)	35 (17)	73 (12)
Parent's occupation				
Mother	Farming	-	2 (1)	-
	Service	5 (2)	7 (3)	20 (3)
	Labour	39 (19)	10 (5)	121 (19)
	Self-employed	7 (3)	9 (4)	27 (4)
	Housewife/non-working	159 (76)	182 (87)	462 (73)
Father	Farming	23 (11)	14 (6)	99 (16)
	Business	-	9 (4)	39 (6)
	Service	18 (9)	31 (15)	70 (11)
	Labour	109 (52)	110 (52)	327 (52)
	Self-employed	44 (21)	41 (20)	83 (13)
	Any Other	4 (2)	4 (2)	5 (0.8)
	Non-working/Late	12 (6)	1 (0.5)	7 (1)
Family income (Rs.)	Up to 5000	16 (8)	80 (38.1)	267 (42.4)
	5-10,000	133 (63)	93 (44.3)	197 (31.3)
	10-20,000	48 (23)	26 (12.4)	90 (14.3)
	Above 20,000	13 (6)	11 (5.2)	76 (12)

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3.2. Food and nutrient intake

Regional disparity in the mean daily food and nutrient intake among school children across three regions of Punjab, have been discussed in Table 2, 3 respectively. Mean daily food intake of the children from three regions of Punjab was below the suggested dietary intakes of ICMR [7]. While investigating differences in the mean daily food intake levels of girls across the regions, a significant ($p \leq 0.01$) regional difference was found in the mean daily intake of all the food groups except meat and poultry. Similarly, for boys, a significant ($p \leq 0.01$) regional difference was found in the mean daily intake of all the food groups except meat and poultry and fruits. The findings indicated that for most of the food groups, food intake pattern of the children from Majha and Malwa region was better as compared to those of Doaba region. Regional disparities in food habits and nutritional intake were observed in three different regions of Andhra Pradesh [11].

The mean daily nutrient intake of the children from three regions of Punjab was below RDAs of ICMR [8]. While investigating regional differences in the mean daily nutrient intake levels of girls, statistically significant ($p \leq 0.01$) differences were found in the mean daily intake of all the nutrients, except folic acid and zinc. Regarding mean daily intake of boys, significant ($p \leq 0.01$) differences were found in the mean daily intake of all the nutrients, except protein. The results of the study indicated that mean daily intake of all the nutrients was almost similar for all the regions; though for most of the nutrients; mean intake levels were marginally higher among Majha region subjects and the lowest among Doaba region subjects. Regional variation in the food and nutrient intake can cause significant health disproportion and this variability may be mediated by factors such as food availability, food customs and culture.

Table 2. Regional disparity in the mean daily food intake (g) of the subjects across three regions of Punjab

Food Group	Majha (n=210)	Doaba (n=210)	Malwa (n=630)	F-ratio
Cereals and millets				
Girls	256 ± 60.4^{a}	232 ± 37.2^{b}	254 ± 19.5^{a}	21.75**
Boys	266 ± 60.3^{a}	247 ± 65.7^{b}	255 ± 23.7^{ab}	4.051**
Pulses				
Girls	54.4 ± 5.8^{a}	51.7 ± 7.7^{b}	55.3 ± 5.3^{a}	17.75**
Boys	59.1 ± 5.9^{a}	52.1 ± 7.0^{b}	54.1 ± 7.4^{b}	24.38**
Green leafy vegetables				
Girls	37.1 ± 9.8^{a}	30.1 ± 7.4^{b}	31.0 ± 4.5^{b}	8.180**
Boys	33.2 ± 8.2^{ab}	33.4 ± 7.0^{b}	28.3 ± 4.7^{a}	6.398**
Roots and tubers				
Girls	129 ± 14.6^{a}	117 ± 20.5^{b}	125 ± 12.8^{a}	18.02**
Boys	136 ± 16.3^{a}	124 ± 17.2^{b}	131 ± 13.7^{c}	12.54**
Other vegetables				
Girls	128 ± 31.3^{a}	115 ± 14.3^{b}	122 ± 11.9^{c}	13.26**
Boys	132 ± 22.2^{a}	122 ± 14.0^{b}	127 ± 12.6^{b}	8.870**
Fruits				
Girls	37.3 ± 7.2^{ab}	30.0 ± 4.7^{a}	40.2 ± 10.3^{b}	6.045**
Boys	33.8 ± 6.7	34.4 ± 4.7	37.0 ± 9.0	0.768^{NS}
Milk and milk products				
Girls	177 ± 22.3^{a}	154 ± 25.6^{b}	166 ± 23.6^{c}	31.00**
Boys	185 ± 24.0^{a}	159 ± 29.7^{b}	180 ± 25.4^{a}	25.01**
Fats and oils				
Girls	24.1 ± 3.0^{a}	24.1 ± 2.6^{a}	25.3 ± 2.0^{b}	18.54**
Boys	30.1 ± 5.1^{a}	28.2 ± 5.8^{b}	29.1 ± 3.7^{ab}	3.713*
Sugar				
Girls	19.5 ± 3.5^{a}	20.3 ± 2.0^{b}	20.4 ± 2.0^{b}	7.212**
Boys	21.9 ± 1.9^{a}	20.1 ± 1.5^{b}	21.1 ± 1.9^{c}	20.26**
Meat and poultry				
Girls	24.4 ±8.7	19.4 ±1.0	16.8 ± 6.0	2.486^{NS}
Boys	16.8 ± 4.2	16.1 ± 3.3	19.4 ± 4.4	1.431^{NS}

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Table 3. Regional disparity in the mean daily nutrient of the subjects across three regions of Punjab

Nutrients	Majha (n=210)	Doaba (n=210)	Malwa (n=630)	F-ratio
Energy (kcal)				
Girls	1495 ± 251[a]	1360 ± 183[b]	1446 ± 173[c]	16.02**
Boys	1786 ± 240[a]	1498± 287[b]	1616 ± 218[c]	32.67**
Protein (g)				
Girls	33 ± 6.1[a]	29.8 ± 5.9[b]	33.1 ± 4.2[a]	21.85**
Boys	37.2 ± 6.9	34.6 ± 8.6	35.7 ± 8.1	2.414[NS]
Total fat (g)				
Girls	37.3 ± 4.6[a]	33.7 ± 3.1[b]	36.1 ± 3.1[c]	37.70**
Boys	42.1 ± 6.3[a]	38.5 ± 5.6[b]	39.8 ± 3.7[b]	13.21**
Calcium (mg)				
Girls	566 ± 71.8[a]	498 ± 66.7[b]	566 ± 44.8[a]	74.69**
Boys	610 ± 58.6[a]	539 ± 59.5[b]	598 ± 50.1[a]	45.52**
Iron (mg)				
Girls	11.1 ± 1.4[a]	10.1 ± 1.5[b]	8.7 ± 1.6[c]	124.08**
Boys	11.2 ± 1.3[a]	9.7 ± 1.7[b]	10.8 ± 2.8[a]	8.891**
Zinc (mg)				
Girls	5.8 ± 1.4	6.1 ± 1.6	5.9 ± 1.4	1.666[NS]
Boys	6.6 ±1.4[a]	5.4 ± 1.5[b]	6.1 ± 1.2[c]	17.25**
Thiamine (mg)				
Girls	0.8 ± 0.2[a]	0.6 ± 0.2[b]	0.6 ± 0.2[b]	46.78**
Boys	0.9 ± 0.3[a]	0.8 ± 0.2[a]	0.7 ± 0.3[b]	27.25**
Riboflavin (mg)				
Girls	0.8 ± 0.2[a]	0.7 ± 0.2[b]	0.6 ± 0.2[c]	44.46**
Boys	1.1 ± 0.2[a]	0.9 ± 0.2[b]	0.8 ± 0.2[b]	36.50**
Niacin (mg)				
Girls	8.8 ± 1.3[a]	8.6 ± 1.3[a]	9.2 ± 1.1[b]	15.34**
Boys	11.0 ± 1.0[a]	10.3 ± 0.6[b]	9.8 ± 1.0[c]	47.88**
Total folic acid (µg)				
Girls	108 ± 12.6	106 ± 17.3	107 ± 15.3	0.482[NS]
Boys	11 8± 13.9[a]	110 ± 14.8[b]	113 ± 13.4[b]	7.253**
Vitamin C (mg)				
Girls	27.4 ± 4.2[a]	25.7 ± 2.9[b]	26.7 ± 3.7[a]	7.152**
Boys	30.1 ± 3.8[a]	26.4 ± 2.6[b]	27.3 ± 3.0[b]	35.73**
Vitamin B_{12} (µg)				
Girls	0.3 ± 0.2[a]	0.2 ± 0.1[b]	0.2± 0.1[b]	29.20**
Boys	0.4 ± 0.2[a]	0.2 ± 0.2[b]	0.2 ± 0.2[b]	19.41**

4. Dietary diversity

Table 4. Regional disparity in the mean Household Dietary Diversity Scores (HDDS) and Food Variety Scores (FVS) of the subjects

Parameter	Majha (n=210)	Doaba (n=210)	Malwa (n=630)	F-ratio
HDDS				
Girls	5.7 ± 1.2	5.8 ± 1.1	5.6 ± 1.0	1.414[NS]
Boys	5.9 ± 1.3	6.0 ± 1.1	5.9 ± 1.0	0.592[NS]
Overall	5.8 ± 1.3	5.9 ± 1.1	5.7 ± 1.0	1.715[NS]
FVS				
Girls	17.8 ± 2.9[a]	18.6 ± 2.7[a]	20.0 ± 3.1[b]	28.03**
Boys	18.2 ± 2.7[a]	19.8 ± 3.1[b]	19.7 ± 3.0[b]	10.63**
Overall	18.0 ± 2.8[a]	19.1 ± 2.9[b]	19.9 ± 3.0[c]	33.80**

Table 4 presents, regional disparity in the mean HDDS and FVS of the subjects from three regions of Punjab, on the basis of 12 food groups and 44 food items list. Regional disparity analysis of the data showed no statistically significant difference in the mean HDDS of girls and boys across three regions (Majha, Doaba and Malwa) of Punjab; whereas, substantial ($p \leq 0.01$) differences were seen in the mean FVS of girls and boys across three regions (Majha, Doaba and Malwa) of Punjab. Tukey post-hoc test further revealed that the mean FVS of the boys from Doaba (19.8) and Malwa region (19.7) was higher as compared to Majha region boys (18.2); however, statistically significant ($p \leq 0.01$) difference was found only between Majha vs. Doaba; and Majha vs. Malwa region boys. Regarding mean FVS of girls, it was found that Malwa region (20.0) girls had higher mean

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values as compared to Majha (17.8) and Doaba region girls (18.6); however, statistically significant ($p \leq 0.01$) difference was found only between Majha vs. Malwa region; and Doaba vs. Malwa region girls.

Insignificant difference was noted in the overall mean HDDS of the subjects from Majha (5.8), Doaba (5.9) and Malwa region (5.7); whereas, regarding mean FVS, Malwa region subjects (19.9) had significantly ($p \leq 0.01$) higher mean values as compared to Doaba (19.1) and Majha region subjects (18.0), thus indicating medium household dietary diversity, that may be attributed to lack of knowledge regarding nutritious food, low purchasing power to afford different kinds of food or unavailability of varied food. Consistently, another study documented that in a high income state like Punjab, all the regions had very low levels of dietary diversity; however, nutritional status of children in Punjab, was better compared to other states [12]. Similar studies testing the utility of dietary diversity as an indicator of nutrient adequacy in the diet of preschool and school age children, has been conducted in other developing countries [13-15]. The results further indicated that, although school children from Malwa region were slightly more advantaged in terms of food variety as compared to those from other regions, however, they might be consuming the food items from the same food group, as there were inconsiderable differences in the mean HDDS of the subjects from three regions of Punjab. Increase in FVS could result from either consumption of food items from the same food group or from the different food groups. If it is from same food group, it would only improve FVS, but not dietary diversity scores (DDS); whereas, if the consumption of food items is from nutritionally distinct food groups, it would improve both FVS and DDS [16].

Higher FVS of the subject from Malwa region could be attributed to involvement of NGOs and NRIs in many districts of the region to provide Mid-Day Meal (MDM) in schools by establishing centralized kitchens. A study based on schools in Ahmadabad showed that the on-site cooking in a few schools with the (predominantly) centralized cooking done by an NGO was more hygienic and provided more variety in the food and in comparison, the MDM provided by schools was not balanced in proteins, Fat and Micronutrients like Vitamin A, Folic acid and Iron [17-20]. Therefore, one possibility to increase dietary diversity, access or availability of foods to children is to encourage providers to add variety including more fruits and vegetable options to school mid-day meals. But a continuous monitoring and evaluation of these programs is also needed, which at present seems to be lacking in majority of the government schools of Punjab. With minimum dietary diversity observed among children, it is important that government, nutritionists and stakeholders work collaboratively in coming up with integrated approaches to health and nutrition, in order to improve the well-being of its children. The path to solving these global issues should not merely focus on treating the consequences, but fixing the causes of these problems as well.

5. Conclusion

Daily food and nutrient intake of the children from three regions of Punjab was lesser than the suggested dietary intakes and RDAs of ICMR, respectively. No regional disparity was observed in the mean HDDS of the subjects; whereas, subjects from Malwa region had significantly ($p \leq 0.01$) higher mean FVS than Doaba and Majha region. Based on the overall mean HDDS and FVS of the subjects, it was inferred that they had poor dietary adequacy and moderately diverse diets. The study emphasized the importance of conducting regional analysis of dietary diversity indicators in order to confirm the outcomes of policy interventions and programs and to provide the points to ponder for new endeavors for better nutritional status of school going children.

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