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Research Article

RELATIONSHIP OF DIETARY DIVERSITY WITH THE NUTRIENT INTAKE AMONG RURAL PUNJABI PRESCHOOLERS

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Abstract- The present study has been designed to assess the relationship of dietary diversity with the nutrient intake among Punjabi preschoolers (3-6 years) that were categorized into three groups (n=120) based on the size of landholdings (hectares) as G I: Small farmers having 1-2 hectares, G II : Semi-medium farmers having 2-4 hectares and G III : Medium farmers having 4-10 hectares. The data pertaining to general profile of the subjects, socio-economic status of the households, demographic features, and nutritional status were collected on a pre-designed interview schedule. Appropriate statistical tools were applied to assess the relationship between various parameters. The results findings revealed that the mean adequacy ratio (MAR) was significantly lower in children belonging to families of small farmer (1-2 hectares), in comparison to those of semi-medium farmers (2-4 hectares). The statistical analysis revealed a significant relationship between the dietary diversity and nutrient intake ($p<0.01$).

Keywords- Dietary Diversity Score (DDS), Food Variety Score (FVS), Nutrient Adequacy Ratio (NAR), Mean adequacy ratio (MAR)

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Introduction

Children are mainly susceptible toward micro-nutrient deficiencies due to increase nutrient requirements for development in addition to vulnerability to communicable diseases that may slow down nutrient absorption and reduce hunger [1]. Moreover, vegetarian diets with inadequate quantity are unable to meet the nutritional requirements of the children [2]. To cope with the problem of malnutrition, diversified diets plays a key role in improving the nutritional status of the children [3-5]. Previous researchers have found a strong relationship between the dietary diversity with the socio economic traits. The studies revealed that increase consumption of nutrient dense foods such as dairy and meat products is observed with increase in income while reduced consumption of these foods was observed in poor section of society. So income plays a potential role in improving the nutritional status of the children. Recent researches have also addressed the relationship between dietary diversity and household socio economic characteristics. In one of the study, in southern Andes, dietary diversity was found to be higher in urban regions as compared to rural areas due to less diverse diets in wealthier households. The reasons were mainly due to their significantly lower intake of meals containing meat, dairy products and vegetables among the rural as compared to urban populations. The study conducted by Ferguson and colleagues also refereed the differences by dietary diversity between households from different socio economic status of preschool children belonged to Ghana and Malawian regions [6,7]. For the food security, dietary diversity is adding an additional parameter in assessing the diet quality [8]. Therefore, keeping this in view, the present research work was designed to assess the relationship of dietary diversity with the nutrient intake of Punjabi preschoolers.

Materials and Methods

One hundred and twenty rural preschool children (3-6 years) were randomly selected from rural households of *Lalton Kalan* and *Mullanpur* villages of Ludhiana district. The subjects were categorized into three groups based on the size of landholdings in hectares as G I (small farmers having 1-2 hectares), G II (semi-medium farmers having 2-4 hectares) and G III (medium farmers having 4-10 hectares). The data pertaining to general profile and dietary survey was collected from care givers of the subjects using the interview schedule. The food consumption was collected by 24-hr recall method (3 days). The nutrient intake was calculated with the help of 'MSU Nutriguide' programme [9]. The food and nutrient intake was compared with Suggested Dietary Intakes for balanced diet [10] and Recommended Dietary Allowances [11], respectively. Food variety score (FVS) is the no. of food-stuffs consumed throughout the week. 1 score was given for every food stuff category consumed either once or at any frequency throughout the week and each food category was scored only once. Scores were added and the resultant score gave the FVS of respondent. Average FVS for three categories was calculated separately by dividing the sum of FVS with total number of subjects. The relation between FVS and dietary adequacy was determined by using the standard classification [12]. Dietary Diversity Score (DDS) is the number of twelve different food groups consumed over a given period of time in a day using twenty four recall method. For food group consumed during the previous 24-hrs '1' code was given and for food groups not consumed [table-1], '0' code was given. DDS was calculated by adding the no. of different food groups consumed. Average DDS for three categories was calculated separately by dividing the sum of DDS with total number of subjects. To set DDS targets, the dietary diversity

patterns of wealthier households which belonged to medium (4 – 10 hectare) land holding were used. The mean DDS in the richest 1/3rd of the households served as a channel for setting the target level of DDS [13]. Nutrient Adequacy Ratio (NAR) was calculated for nine micronutrients (vitamin A, B_1, B_2, B_3, B_{12}, C, iron, calcium and folate) and energy and protein. Mean nutrient adequacy ratio (MAR) - The mean ratio of intake to recommended intake (each truncated at 100 %) of energy, protein, fat and rest nine micronutrients, was calculated as a measure of the adequacy of the overall diet. For both NAR and MAR, a value of 100 % is the ideal since it means that the intake is same as the requirement [14]. The percent NAR and MAR calculated by using the following formula –

NAR % = (Intake of nutrient/Recommended intake of nutrient)*100
MAR % = sum of every NAR (truncated at 100 %)/No. of nutrients

Categorization of NAR % was by using standard classification by Jood *et al* [15] [Table-2].

Suitable statistical techniques were applied. Analysis of variance was used to assess the between various parameters using SAS 9.2 software [16]. The correlation coefficients were calculated to find out the relationship DDS, FVS and NAR.

Table-1 *Relationship between food variety score (FVS) and dietary adequacy*

Total food variety score (Per week)	Dietary adequacy
>30	Very good
25-29	Good
20-25	Fair
< 20	Poor
< 10	Very Poor

Source: Savige et al [12]

Table-2 *Categorization of Nutrient adequacy ratio (NAR %) using standard classification*

Categorization	Nutrient adequacy ratio (NAR %)
Adequate	100% and above
Marginally adequate	75% and above
Marginally inadequate	50 to 74.9%
Inadequate	Below 50%

Source: Jood et al [15]

Results and Discussion

Background Information

Age wise distribution of the preschool subjects [Table-3] revealed that on an average 33% of the subjects were of 3 to 4 years and 32% belonged to 4 to 5 years of age and remaining 35% were of 5 to 6 years. Forty one percent were male and fifty-nine percent were females in the study. Majority of the preschool children i.e. 83% were vegetarian and 19% were non-vegetarian while 18 percent were ovatarian. Only 19% children were reported to take nutritional supplements. Majority of the preschool children 78% had a formal education in private school followed by 13% in Anganwari center and 7% in government schools while 2% did not go to school.

Table-3 *General profile of selected preschool children*

Characteristics	G I (n=34)	G II (n=51)	G III (n=35)	Total (n=120)
Age (years)				
3-4	12(35)	14(28)	14(40)	40(33)
4-5	10(30)	18(35)	10(29)	38(32)
5-6	12(35)	19(37)	11(31)	42(35)
Sex				
Male	20(59)	19(37)	10(29)	49(41)
Female	14(41)	32(63)	25(71)	71(59)
Food habits				
Vegetarian	25(73)	30(59)	28(80)	83(69)
Non-vegetarian	03(09)	14(28)	02(06)	19(16)
Ovatarian	06(18)	07(13)	05(14)	18(15)
Supplementation				
Yes	02(6)	09(18)	12(34)	23(19)
No	32(94)	42(82)	23(66)	97(81)
Formal education				
Anganwari center	04(12)	04(08)	08(23)	16(13)
Govt. school	-	04(08)	05(14)	09(07)
Private school	30(88)	43(84)	20(57)	93(78)
No schooling	-	-	02(06)	02(02)

*Figures in the parenthesis represent the percentages

Assessment of dietary diversity pattern

Food Intake

The average daily food intake of preschool children and percent adequacy according to landholdings has been shown in [Table-4]. Data revealed no significant difference among food intake between three groups except in the consumption of dairy products (milk and milk products) that were significantly high in GII and GIII and low in GI. The percent adequacy of other vegetables was found to be maximum followed by fats and oils and pulses while for the fruits it was found to be minimum in all the three land holdings group.

Table-4 *Average daily food intake by the selected preschool children belonging to small (GI), semi medium (GII) and medium (GIII) farm families*

Food groups (g)	G I (n=34)		G II (n=51)		G III (n=35)		Overall (n=120)	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Cereals	82-133	115±26	83-137	113±25	88-146	113±25	82-146	114±25
Pulses	22-39	32±10	25-41	37±12	23-42	37±12	22-42	34±11
Green leafy vegetables	25-39	34±10	28-50	39±11	25-54	39±11	25-54	37±11
Roots and tubers	43-75	60±26	47-79	63±27	55-86	63±27	43-86	62±27
Other vegetables	36-64	51±23	40-71	51±23	41-77	56±24	36-77	53±23
Fruits	34-59	42±32	42-73	53±37	39-71	53±37	34-73	49±37
Milk and milk products	203-334	272±58[ac]	223-347	293±63[a]	217-367	298±63[c]	203-361	287±61
Sugar and jaggery	15-23	18±2	17-26	21±3	13-23	21±3	13-26	20±3
Fats and oils	14-20	19±4	16-29	22±5	16-29	22±5	14-33	21±5

[a] Significant difference between I and II, [b] Significant difference between II and III, [c] Significant difference between I and III,

Nutrient intake

The mean daily nutrient consumption of preschool children and NAR% according to landholdings has been shown in [Table-5] and [Table-6]. The data revealed that non- significant difference was observed in the average daily consumption of nutrients except in the consumption of iron which was low in GI than GII and GIII while the daily intake of vitamin B_2 was higher in GIII than GI and GII. Out of eleven nutrients, protein, vitamin C, Vitamin B_2 and folate was found to be adequate in all the three groups while vitamin B_1 was adequate only in GII and GIII. The energy, calcium and iron intake were marginally adequate whereas, the vitamin B_{12} and vitamin A were marginally inadequate in all the three groups. The average NAR for vitamin B_3 was lesser than 50% and was inadequate in all the three groups [Table-6].

Dietary diversity score (DDS)

The dietary diversity score (DDS) is the number of different food groups consumed in a day. The food group consumed by the children during the previous 24 hour period was scored '1' and the food not consumed was given score '0'. Mean dietary diversity score of the richest 33% of the households was 8.9 and this was used as a reference against which DDS of the subjects in three groups was compared. Dietary diversity score was calculated using a set of twelve food

groups [17]. The mean dietary diversity score of children in GI, GII and GIII was 8.60, 8.84 and 8.80 indicating that the diets become more diverse as the size of land holdings increased. A significantly ($p<0.05$) low dietary diversity score was observed in GI compared to GII. Another study reported that the dietary diversity is directed related with the socio-economic status [18]. The diet diversification increased with the increase in land size was reported by another researcher [19]. Another finding also revealed that the land utilization is directly related to the nutritional status of the children. So socio-economic status has a direct impact on the children's health. [20]. The mean DDS of 7.8 out of 10 food groups was reported in the study [14].

Table-5 *Average daily nutrient intake by the selected preschool children belonging to small (GI), semi medium (GII) and medium (GIII) farm families*

Nutrients	G I (n=34)		G II (N=51)		G III (n=35)		Overall (n=120)	
	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE
Energy (kcal)	746-1107	1052±65	750-1109	1045±65	778-1140	1071±1140	746-1140	1056±66
Protein(g)	14-30	23±0.9	19-32	27±1.0	19-32	28±0.97	14-32	26±0.9
Calcium(mg)	373-567	502±36	388-587	515±36	408-617	532±36	373-617	516±35
Iron(mg)	6-12	9.6±1.4[c]	6-13	10.4±1.5	6-13	10.87±1.5[c]	6-13	10.3±1.5
Vitamin B_{12}(µg)	0.2-0.5	0.4±0.01	0.2-0.5	0.4±0.02	0.2-0.6	0.41±0.01	0.2-0.6	0.4±0.1
Vitamin C(mg)	48-79	70±6.4	47-81	70±6.5	50-80	69±6.17	47-81	70±6.4
Vitamin A(µg)	320-490	421±58	316-503	423±59	325±499	423±58	316-523	422±57
Vitamin B_1(mg)	0.5-1.0	0.72±0.09	0.5-1.1	0.71±0.13	0.6-1.1	0.74±0.1	0.5-1.1	0.72±0.11
Vitamin B_2(mg)	0.6-1.2	0.87±0.04[c]	0.6-1.1	0.87±0.04[b]	0.7-1.2	0.94±0.04[bc]	0.6-1.2	0.89±0.05
Vitamin B_3(mg)	1-6	3.87±0.17	3-7	4.01±0.27	2-7	3.96±0.2	2-7	3.97±0.21
Folate(µg)	83-149	132±2.9	83-153	135±3.1	85-153	135±3.2	83-153	134±3.07

[a] Significant difference between I and II, [b] Significant difference between II and III, [c] Significant difference between I and II

Table-6 *Mean adequacy ratio (MAR), Nutrient adequacy ratio (NARs), Food variety score (FVS) and Dietary diversity score (DDS) of selected preschool children belonging to small (G I), semi medium (G II) and medium (G III) farm families*

NAR (%)	G I (n=34)	G II (n=51)	G III (n=35)	Overall (n=120)
Energy	84.83±1.8	84.09±1.7	86.32±1.7	85.08±1.7
Protein	121±2.4	152.42±2.3	146.72±2.5	140.24±2.4
Vitamin A	52.20±2.5	52.93±2.6	52.84±2.5	52.65±2.5
Vitamin C	176.2±20.2	175.2±20.3	174.42±20.2	175.27±20.2
Vitamin B_1	96.78±10.4	112.67±13.2	117.62±13.9	109.02±12.5
Vitamin B_2	119.72±19.3	119.72±18.9	129.08±20.9	122.84±19.7
Vitamin B_3	39.46±16.9	41.38±17.7	40.32±17.5	40.41±17.37
Vitamin B_{12}	66.66±2.2	67.22±2.9	68.22±2.6	67.37±2.6
Folate	143.62±8.6	146.22±10.0	145.69±9.1	145.17±9.2
Iron	83.59±3.9	91.18±3.6	94.68±3.8	89.82±3.8
Calcium	83.52±4.8	85.87±4.9	88.62±4.9	86±4.9
MAR	85.83±1.4[a]	90.5±1.7[a]	88.8±1.7	88.37±1.6
FVS	18.69±1.2[c]	18.70±1.8	19.20±2.0[c]	18.86±1.7
DDS	08.60±0.82[a]	08.84±0.90[a]	08.80±0.87	08.74±0.86

*Values are Mean± SD, [a] Significant difference between I and II, [b] Significant difference between II and III, [c] Significant difference between I and III

Food variety score

The mean food variety score of the subjects in GI, GII and GIII 18.62±2.15, 18.91±1.74 and 19.25±1.97, respectively. A significantly ($p<0.05$) low food variety score was observed in GI compared to GIII. As per the FVS classification, there was poor food variety score i.e. < 20 foods per week in all the three groups.

Mean nutrient adequacy ratio (MAR)

The percent adequacy ratio (MAR%) GI, GII and GIII was 85.8, 90.5 and 88.8%. Overall the adequacy was comparable in all the three groups but was significantly low in GI when compared to GII.

Correlation coefficients of between different parameters

Among the nutrients, carbohydrate, calcium and vitamin A showed significant ($p<0.01$) relationship with both DDS and FVS [Table-7]. Another findings revealed a significant correlation between dietary diversity scores with the nutrient intake, i.e. calcium, iron, zinc, vitamin A, vitamin C, thiamine, riboflavin and vitamin B_6 [21].

Table-7 *Relationship of dietary diversity with nutrient adequacy among selected pre-school children*

Nutrients	DDS	FVS	MAR (%)
Energy	NS	NS	0.32***
Carbohydrates	0.20**	0.19**	0.34***
Protein	NS	NS	0.50***
Fat	NS	NS	0.36***
Vitamin A	0.37***	0.39***	0.34***
Vitamin C	NS	NS	0.27***
Vitamin B_1	NS	NS	0.27***
Vitamin B_2	NS	NS	0.34***
Vitamin B_3	NS	NS	0.41***
Folate	NS	NS	0.40
Calcium	0.45***	0.34***	0.22***
Iron	NS	NS	0.38***

** Significant at 5% level. *** Significant at 1% level, NS- Non-significant

Conclusion

The study concluded that the mean nutrient adequacy ratio was significantly lower in children belonging to families of small farmer in comparison to those of semi-medium farmers. The statistical analysis revealed that carbohydrates, calcium and vitamin A were significantly ($p<0.01$) correlated with DDS and FVS. MAR% indicating that nutrient intake has an impact on nutrient adequacy of the children. ($p<0.05$).

Recommendations

The study recommends that food variety is essential in improving the nutritional status of children. Moreover, a balanced diet with the combination of different food groups ensures to combat many nutritional problems that are prevailing in both developed and developing countries

Conflict of Interest: None declared

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