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Research Article

Association of Food and Nutrient Intake with Attention Span and Memory Retention among School Children

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ABSTRACT

Dietary habits and food intake largely determine the nutritional and cognitive development of growing children. A total of 240 school children aged 13-15 years were selected from different private and government schools of Punjab. The average daily intake of food and nutrient was calculated using Indian Nutrition Software (Diet Cal). The nutrient intake was compared with the Recommended Dietary Allowances (ICMR 2010) for Indians and percentage adequacy of food and nutrient intake was calculated. The results revealed that percent adequacy of cereals, milk and milk products, sugar and jaggery and fats and oils was adequate in both boys and girls of the private and government schools. While the adequacy of pulses, green leafy vegetables, other vegetables and fruits was marginally adequate. On comparing the percent adequacy of the nutrient intake for the school children, it was found that energy, protein, carbohydrates, fat, calcium, vitamin A, riboflavin, niacin, folic acid and vitamin C was higher in children of private schools than government schools. A significant positive correlation was observed between healthy food consumption (milk, fruits, roots and tubers) with attention span and memory retention. Thus, with better consumption of home-made foods and healthy foods there was an increase in attention span and memory retention among school children.

Key words: *Nutrient intake, Memory retention, Attention span, Dietary intake.*

INTRODUCTION

The fitness and well-being of kids and teenagers depends upon the food consumption providing desired energy and nutrients to encourage ideal physical growth, social and cognitive development[1]. Lack of energy, poor concentration and obesity leading to inferiority complex, heart disease, depression, high cholesterol, premature ageing, stunted growth and tooth decay are the main ill effects of regular consumption of fast foods[10]. Dietary habits and food intake largely determine the nutritional profile of growing children. During the formative years, the nutrients are needed in higher amounts for the building of new tissues and their maintenance, for sound mental functions and personality development.

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A significant difference was observed in the intake of protective foods like milk and milk products, green leafy vegetables and fruits between the school children of high socio-economic than low socio-economic groups. However, children from the high socio-economic background preferred fast foods than traditional foods despite their better nutritional knowledge[35]. Food intakes tend to be low in fruits, vegetables, and calcium rich foods and high in fat. Skipping meals is also a concern among adolescents, especially girls. Factors influencing eating behaviors of adolescents need to be better understood to develop effective nutrition interventions to change eating behaviors[31]. Low consumption of fruit and vegetables increases the risk of cancers and cardiovascular disease, while excessive energy intake, which can occur through overeating and/or eating foods high in fat, sugar and salt and low in micronutrients, is a key mechanism for weight gain and developing type 2 diabetes[13].

Cognitive diminutions is related with very low serum cholesterol in adults. Dietary fat is very important for the children of young age as it may affect the growth and development of central nervous system as it is more prone to environmental influences[23,5,33,36]. There may be a connection between unhealthy eating and cognitive development. Consuming an unbalanced diet on a regular basis (e.g., increased consumption of western processed foods) such practices promote health related risks like depression and anxiety[18,29]. Even though unhealthy eating can be the cause of stress and depression, recent long-term researches have recommended that reverse causality is a hard justification for associations that take place over a period of time[21].

MATERIALS AND METHODS

Stratified random sampling was used for selecting 240 students in 13-15 years age group from three private and three government schools of Ludhiana City. Demographic profile of the respondents, annual family income, background (rural/urban), educational background of parents and occupation of mother, food habits, meal patterns and frequency of fast food consumption was collected. We used 24 hour recall method for three consecutive days to assess the dietary intake. The average daily intake of nutrients were calculated using Indian Nutrition Software[20]. The food and nutrient intake was compared with the suggested dietary intakes for balanced diet and recommended dietary allowances[17]. We also calculated the percentage adequacy of nutrients intake.

We assessed the attention span and memory retention of the respondents. Attention span was assessed with the help of D2 Attention Span test by[7]. The purpose of this test was to assess constant attention and visual scanning capability of the subjects. Memory retention was assessed with the help of Immediate Memory Test from Bhatia's Battery of Performance Tests of Intelligence[6]. Immediate memory has a close relation with mental development or general intelligence, hence it was selected for testing the memory retention in the children. Finally the correlation was used to find out the relationship between different food and nutrient intake, memory retention and attention span variables.

RESULTS AND DISCUSSION

Food intake of the subjects

The data concerning various food groups intake along with their percent adequacy among the boys and girls of both private and government schools has been presented in Table 1 and Figure 1 and 2.

Cereals

We found a high consumption of wheat in the form of *paranthas, chapattis*, bread, biscuits, followed by rice and maize which lead to the percent adequacy of 74.6 and 71.2 percent among the boys of private and government schools whereas 102.5 and 90.6 percent among the girls of private and government schools respectively. In a similar study by Chhabara[9] the data highlighted that the consumption of cereals was significantly higher in group I (government) than in group II (private) boys

but was found to be less than suggested dietary intake (SDI) in both schools. In another study, it was observed that only 38·3 % of participants reported consuming whole grains during the dietary data collection days. Median intake of whole grains in consumers was 15·3 g/d. A significantly lower proportion of Malay children (seven out of fifty-eight; $P < 0·0001$) consumed whole grains than children of other ethnicities[25].

Pulses and Legumes

The percent adequacy of pulses and legumes is 45.4 and 52.3 percent among the boys and 51.1 and 59 percent among the girls of private and government schools respectively. Among these, it can be seen that the government school children are consuming more pulses as compared to private school children as they were consuming pulses for more than 1 meal a day or usually used to have the leftover *dhals* as breakfast maybe in the form of *dhal parantha* or *missi roti*. In a study conducted in urban Asian Indian adolescents and young adults among 1236 subjects (607 males, 629 females) aged 13-25 years from schools and colleges of a metropolitan city of India, it was reported that the intake of pulses declined with increasing age in males. In females, such differences were noted for green leafy vegetables, other vegetables, oils and fats, milk products[14].

Milk and milk products

We observed that the boys and girls studying in private schools were consuming significantly ($p \leq 0.05$) more milk and milk products as compared to those studying in government schools. Although, the percent adequacy of milk and its products was found to be inadequate i.e. 84.3 and 52 percent in boys and 96.6 and 50.3 percent in girls as compared to Suggested Dietary Intakes. However, overall milk and milk product consumption was low in government schools than private schools. Low socio economic status of the children in government schools might have led to low consumption of milk and milk products. It was suggested in a study that the intake of dairy products (only two-thirds taken daily), pasta, fruit and vegetables (daily consumption of 30%) is deficient[27]. A similar study showed that studied that the level of consumption of milk and milk products among the Upper Silesian agglomeration inhabitants is insufficient in relation to nutrition recommendations[19].

Roots and Tubers

Results revealed that the most common roots and tubers consumed by the children were potatoes, onion, carrots and radish. A significant difference in the consumption of roots and tubers in both boys and girls was seen with a higher consumption among private school children. The percent adequacy of roots and tubers among boys was reported as 31.4 and 17.34 for private and government schools, whereas corresponding values for girls of private and government schools were 30.8 and 16.7 indicating a lower intake by the subjects in both private and government schools as against the suggested intake of 200g. Similar results were seen in another study as the adequacy of roots and tubers was found to be very low among the boys and girls[9].

Green Leafy Vegetables

The intake of green leafy vegetable in government school boys was almost double than the private school boys. The percentage adequacy of intake of green leafy vegetables was observed to be lowest among private school boys (45%) and higher in government school boys (80.1%) while girls in private and government schools were having percent adequacy of 59.2 and 55.4 respectively. It was seen that most commonly consumed greens were mustard (*sarson da saag*), fenugreek and spinach. The overall consumption of green leafy vegetables by boys as well as girls was observed to be low as compared to Suggested Dietary Intakes. A non-significant difference in consumption of green leafy vegetables among boys and girls of private and government schools respectively was observed. The intakes of leafy and non-leafy vegetables were reported in a study which showed that the intakes were less than RDI in 88 and 67% of households respectively, while the corresponding figure for pulses was 73%[3].

Table 1: Daily average food intake by selected subjects

Food Groups	Boys (n=121)		t-value	SDI	Girls (n=119)		t-value	SDI
	Private (n=62)	Govt. (n=59)			Private (n=58)	Govt. (n=61)		
Cereals, (g)	335.55±67.11	320.18±84.98	0.8	450	338.28±77.54	298.84±66.29	1.6	330
Pulses and Legumes, (g)	40.86±16.71	47.04±25.54	1.3	90	38.30±15.17	44.21±21.06	1.6	75
Milk and Milk Products, (g)	421.50±187.97	259.99±143.65	5.6*	500	483.04±225.82	251.34±142.94	6.2*	500
Roots And Tubers, (g)	62.72±25.02	34.67±42.27	4.3*	200	61.55±33.76	33.32±20.01	5.5*	200
Green Leafy Vegetables, (g)	45.00±18.71	80.13±63.16	1.5	100	59.17±13.57	55.42±22.91	0.4	100
Other Vegetables, (g)	68.73±45.01	91.62±72.01	2.1*	200	78.80±45.95	70.26±48.93	1.0	200
Fruits, (g)	80.43±75.04	43.17±50.43	3.1*	100	104.95±81.27	43.33±50.80	4.8*	100
Sugar and Jaggery, (g)	27.72±14.09	20.57±9.84	3.2*	30	30.54±12.64	23.86±10.24	2.7*	25
Fats and Oils, (g)	36.81±8.49	32.53±7.75	3.0*	50	38.05±10.59	33.31±6.61	2.5*	35

Fruits

The commonly consumed fruits by the children were fresh, citrus and seasonal fruits like mango, watermelon, orange, *kinnu*, apple, banana etc. The consumption of fruits was found to be higher as compared to suggested dietary intakes by girls of private schools. Also, a significant ($p \leq 0.05$) higher consumption of fruits among boys and girls of private schools as compared to their counterparts was observed. The reason for the low consumption of fruits in government schools was due to low socio economic status. The parents were unable to afford protective foods. The percent adequacy was found to be 80.4 and 43.2 percent and 105 and 43.3 percent in boys and girls of private and government schools respectively, which showed that only girls of private school were consuming fruits as per the SDA recommendations. Whereas, boys and older children were most likely to eat fruit and vegetables infrequently[32].

Sugar and Jaggery

A significant ($p \leq 0.05$) higher consumption of sugars was observed by boys and girls of private schools than boys and girls of government school. The percent adequacy was found to be 92.3 and 68.6 in boys and 122.2 and 95.4 percent in girls of private and government schools respectively when compared with SDA. Sugar was mainly being consumed in the form of biscuits, toffees and chocolates, ice cream, soft drinks, sweets and by addition in milk, tea, coffee etc. Higher consumption in private school girls was due to frequent consumption of sweets, desserts etc. Soft drinks were a major source of added sugars among the adolescents i.e. 34.2% among males and 32.0% among females[11].

Fats and edible oils

Fats and oils were consumed in the form of refined oil, butter, mustard oil and in fried foods like *samosa, pakoras, puri, bhatura, parantha* etc. A significant ($p \leq 0.05$) higher consumption of fats and oils by boys and girls of private schools as compared to the boys and girls of government schools was found as depicted in Table 1. Percent adequacy of fats and oils among boys and girls was found to be 73.62 and 65.06 percent and 108.7 and 95.2 percent. A similar study depicted that fats & oils were consumed in the form of *vanaspati*, refined oil, butter & butter oil and fried foods such as *pakoras, samosa, parantha, puri, bhatoora, pinni, panjeeri* and groundnuts as the subjects were in habit of eating some of these items at lunch-break from school canteen[30]. The daily intake of fat among children and adolescents were 300 (53.0%), 137 (24.2%) were weekly and 129 (22.8%) were rarely[2].

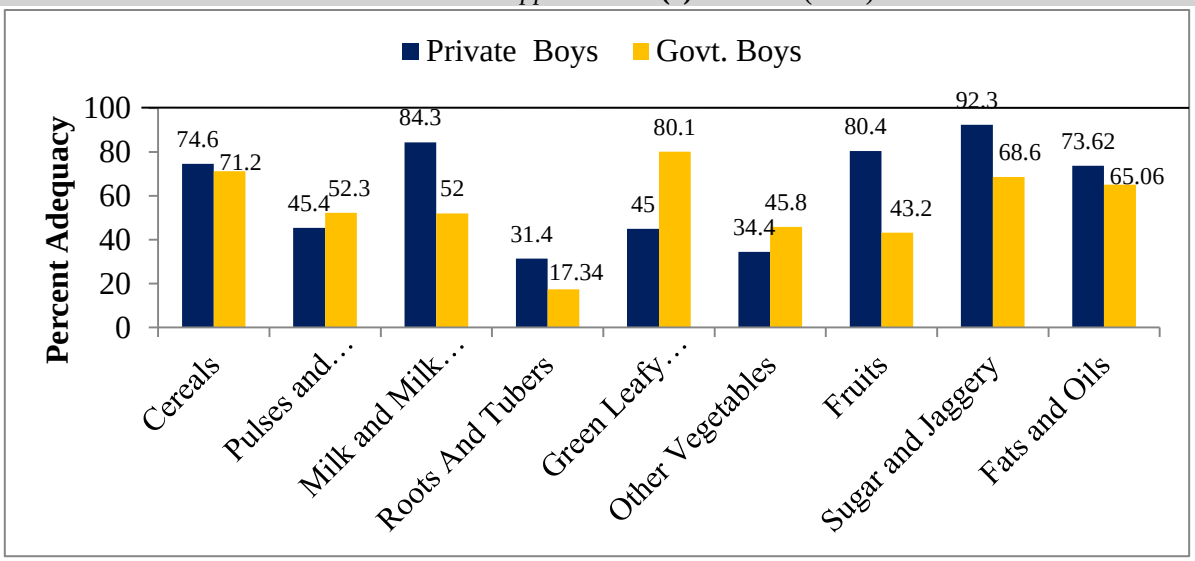

Figure 1: Percent adequacy of food intake of Private and Government boys

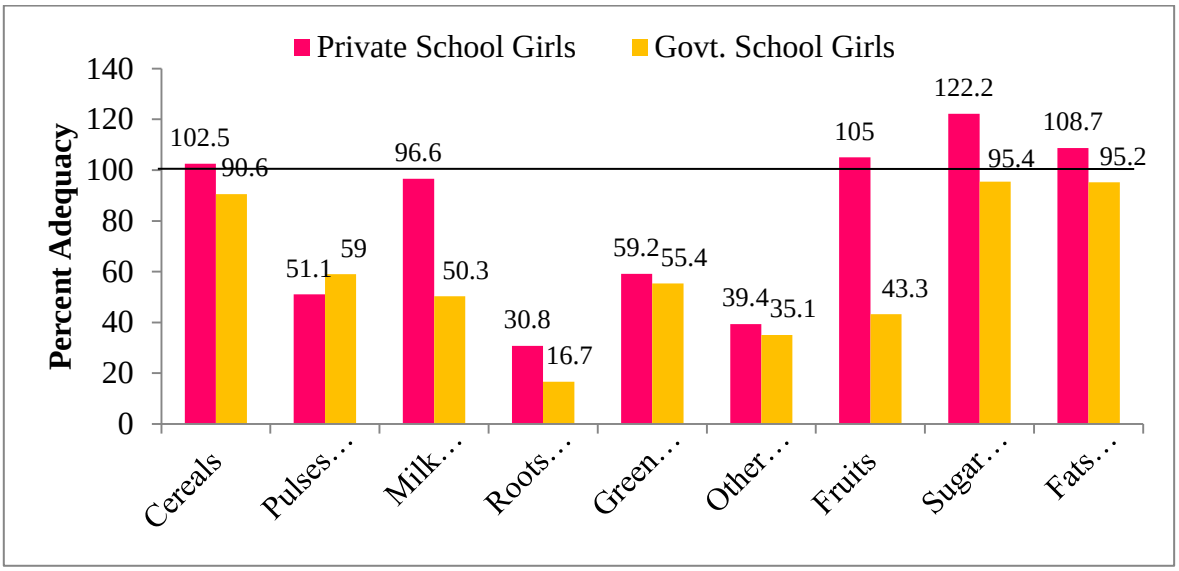

Figure 2: Percent adequacy of food intake of Private and Government girls

Nutrient intake of the subjects

The data concerning average daily intake of various nutrients along with their percent adequacy ratio (PAR) have been presented in Table 2 and figures 3 and 4.

Energy

The data revealed that the percent adequacy ratio (PAR) of energy was observed to be 89.9 and 80.6 among boys, while 106.7 and 96.0 among girls in private and government respectively. This was due to the high consumption of cereals like wheat, rice etc. and due to fast food consumption which also increases the fat intake, thus increasing the energy value. The overall energy intake of selected boys and girls from private schools was found to be significantly ($p \leq 0.05$) higher as compared to that of boys and girls of government schools. Another study revealed that there is a low energy intake and insufficient micronutrient intake among school children and adolescents in developing countries[26].

Protein

The data revealed that the intake of protein was less than the RDA which is 54.3 g and 51.9 g for both boys and girls respectively[17]. The per cent adequacy was 85.04 and 78.3 among boys and 90.5 and 70.0 among girls from private as well as government schools respectively. The high adequacy among private school children was due to high

consumption of milk and milk products. In a similar study, mean intake of protein and milk/milk products was found to be significantly higher in school girls of upper socio-economic status than school girls of lower socio-economic status[28].

Fat

We found out that the intake of fat was more in both boys and girls of private and government schools than the Recommended Dietary Allowance. The per cent adequacy was 192.9 and 158.6 among boys and 211.7 and 198.7 among girls from private as well as government schools respectively. This high adequacy of fats might be due to the high consumption of visible fat as well as invisible fats in the meals also due to the frequent consumption of fast foods. Similar findings were also reported that a large percentage of the subjects consumed exceeded the recommended intakes of total fat (42.4-83.8%), saturated fatty acids (90.4% - 97.1%) while they failed to meet the recommended intake of all other nutrients[34].

Table 2 Average daily nutrient intake by selected subjects

Nutrients	Boys (n=121)		t-value	RDA	Girls (n=119)		t-value	RDA
	Private (n=62)	Govt. (n=59)			Private (n=58)	Govt. (n=61)		
Energy, Kcal	2472± 484.00	2217±617.64	2.3*	2750	2485±506.15	2236±539.37	2.8*	2330
Protein, g	46±11.35	42±15.49	1.6*	54.3	47±12.41	36±10.94	5.2*	51.9
Fat, g	87±28.70	71±30.26	2.7*	45	85±25.81	79±30.27	1.2	40
Carbohydrates, g	371±57.40	333±83.03	1.8*	415	373±66.86	335±62.95	3.7*	350
Calcium, mg	669±244.20	516±245.98	3.1*	800	755±271.41	518±234.05	5.4*	800
Iron, mg	10.58±3.23	10.52±6.59	0.0	32	11.30±4.11	8.83±3.68	3.6*	27
Vitamin A, µg	227±99.58	160±128.98	3.0*	600	253±127.21	152±98.54	5.0*	600
Thiamine, mg	1.09±0.30	0.93±0.42	2.2*	1.4	1.10±0.31	0.79±0.30	5.6*	1.2
Riboflavin, mg	1.08±0.36	0.80±0.35	4.1*	1.6	1.17±0.41	0.74±0.34	6.4*	1.4
Niacin, mg	7.81±2.47	7.23±3.58	0.9	16	7.86±2.58	6.23±2.64	3.5*	14
Vitamin C, mg	56.03±36.36	35.23±35.85	3.4*	40	66.89±33.26	40.73±38.31	3.9*	40
Folic Acid, µg	143.95±49.61	131.58±70.80	1.1	150	148.82±49.85	113.75±52.73	3.6*	150

Calcium

The intake of calcium was inadequate as ICMR recommendations (2010) of 800 mg. The adequacy of intake in both the groups was (83.6 and 65) in boys and (94.3 and 65) in girls from private and government schools respectively. The average daily consumption of calcium was reported to be significantly ($p \leq 0.05$) higher among children of private schools as compared to government schools. Low micronutrient intakes were also found in other studies carried out in Australia amongst 16-18 years old, where females reported low intakes of calcium and other micronutrients like folate and magnesium[8].

Iron

Iron intake was found to be inadequate as ICMR recommendations[17] of 32 mg and 27 mg. The adequacy of intake was very low i.e. (33.1 and 33) in boys and (42 and 25.3) in girls respectively. The overall iron intake by girls of private schools was found to be significantly ($p \leq 0.05$) higher than girls of government schools. The lower intake of iron by girls of government schools might be due to the low consumption of pulses and legumes and green leafy vegetables. The percent adequacy ratio (PAR) revealed an inadequate intake of iron as compared to RDAs by both the groups of boys and girls. Another study observed a similar pattern of inadequate intake of iron which was found to be more common among school girls[12]. Also, the consumption of iron is less as per the requirement of iron[24].

Vitamin A

The data showed that the intake of vitamin A was inadequate as ICMR recommendations[17] of 600 µg. The less consumption of green leafy vegetables and colored fruits was the reason of this low intake. The adequacy of vitamin A intake was quite low in both the groups i.e. (37.8 and 26.7) in boys and (42.1 and 25.3) in girls respectively. The average daily nutrient intake of vitamin A was found to

be significantly ($p \leq 0.05$) higher among both boys and girls of private schools as compared to the children of government schools. The percent adequacy (PAR) exhibited an inadequate intake of vitamin A by all the selected boys and girls which was due to low consumption of green leafy and other vegetables. Another study observed a similar pattern of inadequate intake of vitamin A where the mean daily intake of vitamin A in both the groups (boys and girls) was 538.2±21.5 µg and 458.28±30.89 µg respectively. The intake was inadequate as ICMR recommendations[17] of 600 µg[15].

B Vitamins

It was observed that the mean daily intake of Thiamine for boys and girls was less than the RDA[17]. The adequacy of intake in both the groups was (78 and 89.4 per cent) in boys while (92 and 66 percent) in girls respectively.

The mean daily intake of Riboflavin for boys and girls was also less than the RDA[17]. The adequacy of intake in both the groups was (67.5 and 50 per cent) in boys while (84 and 53 percent) in girls respectively.

The mean daily intake of Niacin for boys and girls in both the groups (private and government) was less than the RDA[17]. The adequacy of intake in both the groups was (49 and 45.2 per cent) in boys while (56.1 and 44.5 percent) in girls respectively.

The average daily intake of thiamine and riboflavin was found to be significantly ($p \leq 0.05$) higher by both boys as well as girls of private schools as compared to their corresponding boys and girls of government schools. However, the average daily consumption of niacin was found to be significantly ($p \leq 0.05$) higher by girls of private schools as compared to girls of government schools while no significant difference was observed among both the groups of boys. In another similar study, it was observed that the mean daily intake of Thiamine for boys was more than the RDA which is 1.2 mg while for girls it did not met the requirement 1.0 mg[16,17].

Vitamin C

The data revealed that the mean daily intake of vitamin C was less than the suggested range in both boys and girls. The percent adequacy ratio (PAR) of energy was observed to be 140.1 and 88.1 among boys, while 167.2 and 101.8 among girls in private and government respectively. This difference in the intake was due to high consumption of seasonal and citrus fruits among the private school children. The percent adequacy of Vitamin C was observed to be adequate with a significant ($p \leq 0.05$) higher consumption by boys as well as girls of private schools as compared to government schools. The mean (SD) plasma levels of vitamin C were 0.76 (0.45) mg/dL in a cross-sectional study which reported that among 775 adolescent girls (11-18 years) residing in a slum of Delhi to assess plasma vitamin C levels[4].

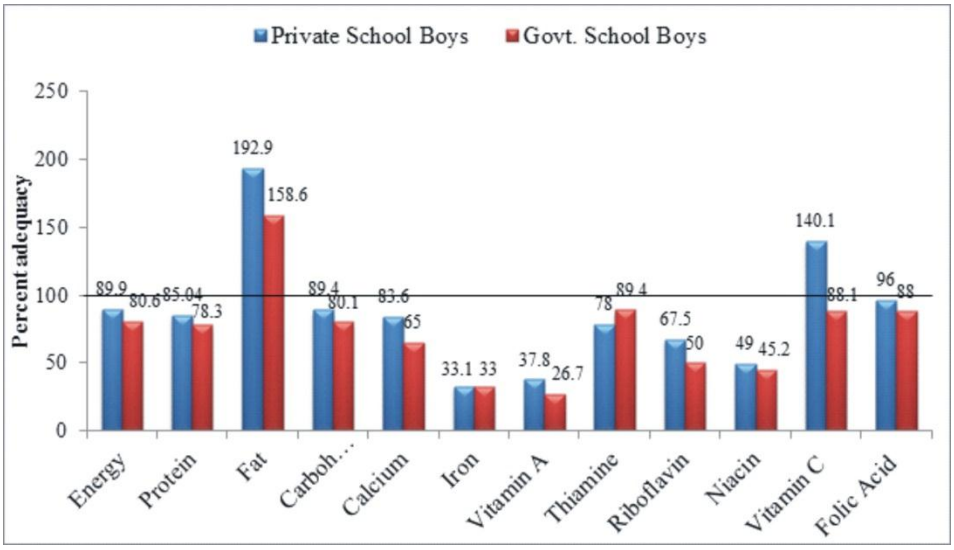

Figure 3: Percent adequacy of nutrient intake of private and government school boys

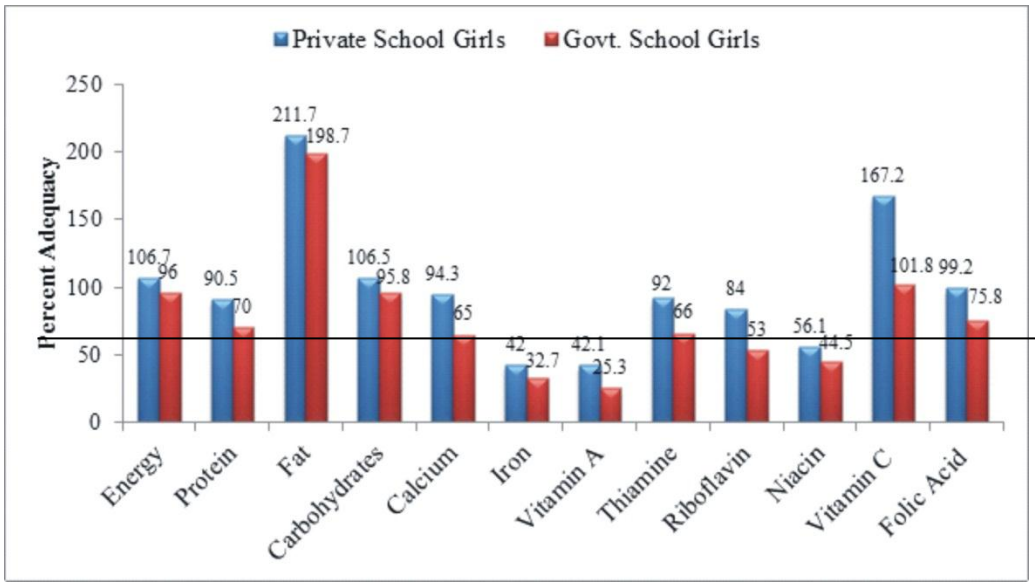

Figure 4: Percent adequacy of nutrient intake of private and government girls

Correlation Analysis

Correlation between food intake with attention span and memory retention is presented in Table 3. A significant ($p \leq 0.01$) positive correlation in the attention span and memory retention was observed. . Thus indicating that with an increase in attention span the memory retention also increased. Simultaneously, significant ($p \leq 0.05$) positive correlation was also noticed between attention span and consumption of fruits ('r'=0.149) and consumption of roots and tubers ('r'=0.147) which was significant at $p \leq 0.01$. Thus, more the consumption of home-made foods and healthy foods (fruits and roots and tubers) there was an increase in attention span among children. Further, a positive significant ($p \leq 0.01$) correlation between memory retention and consumption of milk and milk products ('r'=0.142) and consumption of roots and tubers ('r'=0.234) which is significant at $p \leq 0.01$. Thus, more the consumption healthy foods (milk, roots and tubers, bringing packed lunch to school) increased the memory retention. The combination group (milk and exercise) and exercise group performed significantly better than did the milk and control groups in terms of short-term memory. No significant interaction or group differences were found for sustained attention[22].

Table 3 Coefficient correlation (r) between various factors

S. No.	Variable 1	Variable 2	Correlation Coefficient (r)
1	Attention Span	Memory Retention	0.217**
2	Attention Span	Fruits	0.149*
3	Attention Span	Roots and Tubers	0.147*
4	Attention Span	Milk and Milk products	0.125
5	Memory Retention	Milk and Milk products	0.142*
6	Memory Retention	Roots and Tubers	0.234**

**Correlation is significant at 0.01 level (2-tailed)

*Correlation is significant at 0.05level (2-tailed)

CONCLUSION

When compared with the recommended dietary allowances, it was seen that the nutrient intakes of both boys and girls in private and government schools were found to be lower, except for energy and carbohydrate intake of private school girls. The fat intake of both boys and girls in private and government schoolswas almost double than the recommended dietary allowances. Vitamins

and mineral intakes were lower than the recommended dietary allowances except for Vitamin C intake in boys and girls of private school. A significant positive correlation was observed between attention span and memory retention and consumption of fruits, roots and tubers and milk and milk products. Thus, more the consumption of home-made foods and healthy foods, there was an increase in attention span and memory retention among children.

REFERENCES

1. Akman, M., Akan, H., Izbirak, G., Tanriover, O., Tilev, S. M., Yildiz, A., Tektas, S., Vitrinel, A. and Haryan, O., Eating patterns of Turkish adolescents: a cross-sectional survey, *Nutr. J.* **9:** 67-71 (2010).
2. Al- Agha, A. E., Al-Baradi, W. R., Al-Rahmani, D. A. and Simbawa, B. M., Associations between Various Nutritional Elements and Weight, Height and BMI in Children and Adolescents, *J. Pt. Cr.* **2:** 1-5 (2015).
3. Arlappa, N., Laxmaiah, A., Balakrishna, N. and Brahmam, G. N. V., Consumption pattern of pulses, vegetables and nutrients among rural population in India, *Afr. J. Food Sci.* **4:** 668-75 (2010).
4. Bansal, P. G., Toteja, G. S. and Suman, R., Plasma Vitamin C Status of Adolescent Girls in a Slum of Delhi, *Ind. Pediat.* **51:** 932-33 (2014).
5. Benton, D., Do low cholesterol levels slow mental processing? *Psychosomatic Medicine*, **57:** 50-53 (1995).
6. Bhatia, C. M., Performance intelligence test battery. Oxford University Press, Bombay (1995).
7. Brickenkamp, R., Aufmerksamkeits-Belastungs Test (Test d2). [The d2 test of Attention] (1 edition). Germany, Göttingen: Hogrefe (1962).
8. Caroline, G. M., Lucinda, B. J. and Wendy, O. H., Micronutrients intakes from food and supplements in Australian adolescents, *Nutrs.* **6:** 342-54 (2014).
9. Chhabara, I., Effect of socio economic status on consumption of convenience foods by Urban Adolescents, Unpublished M.Sc. thesis, Punjab Agricultural University, Ludhiana, Punjab, India (2016).
10. Chhibber, C., Children hooked to junk food: Schools fail to curb the Menance, The Tribune, Pp- 1-2, Ludhiana (2010).
11. Colucci, A. C., Cesar, C. L., Marchioni, D. M. and Fisberg, R. M., Factors associated with added sugars intake among adolescents living in Sao Paulo, Brazil, *J. Am. Coll. Nutrtn.* **31:** 259-67 (2012).
12. Dapi, L. N., Hornell, A., Janlert, U. and Stenlund, S., Energy and nutrient intakes in relation to sex and socio-economic status among school adolescents in urban Cameroon, Africa, *Pub. Hlth. Nutrtn.* **14:** 904-13 (2011).
13. Daraganova, G. and Thornton, L., Eating behavior Socio-economic determinants and parental influence. Annual Statistical Report, Australian Institute of Family Studies. Pp 91-109 (2013).
14. Gupta, N., Shah, P., Goel, K., Misra, A., Rastogi, K., Vikram, K. N., Kumari, V., Pandey, M. R., Kondal, D., Wasir, S. J., Bhardwaj, S. and Gulati, S., Imbalanced Dietary Profile, Anthropometry, and Lipids in Urban Asian Indian adolescents and young adults, *J. Am. Coll. Nutrtn.* **29:** 81-91 (2010).
15. Haokip, N., Effect of Nutrition Information Disclosure on Consumer Evaluation Behavior of Fast Food Items, Unpublished M.Sc. thesis, Punjab Agricultural University, Ludhiana, Punjab, India (2015).
16. Haokip, N. and Sharma, S., Trends in fast food consumption among adolescents in Ludhiana (Punjab), *Food Sci. Res. J.* **7:** 276-80 (2016).
17. ICMR, Nutrients requirements and recommended dietary allowances for Indians. National Institution of Nutrition, Indian Council of Medical Research, Hyderabad, India (2010).
18. Jacka, F. N., Pasco, J. A., Mykletun, A., Williams, L. J., Hodge, A. M., O'Reilly, S. L., Nicholson, G. C., Kotowicz, M. A. and Berk, M., Association of Western and traditional diets with depression and anxiety in women, *Am. J. Psy.* **167:** 305-11 (2010).

19. Kardas, M., Grochowska-Niedworok, E., Całyniuk, B., Kolasa, I., Grajek, M., Bielaszka, A., Kiciak, A. and Muc-Wierzgoń, M., Consumption of milk and milk products in the population of the Upper Silesian agglomeration inhabitants, *Food Nutrtn. Res*. **60:** 10 3402 (2016).
20. Kaur, G., Diet Cal-A tool for dietary assessment and planning. AIIMS, New Delhi (2014).
21. Le Port, A., Gueguen, A., Kesse-Guyot, E., Melchior, M., Lemogne, C., Nabi, H., Goldberg, M., Zins, M. and Czernichow, S., Association between dietary patterns and depressive symptoms over time: a 10-year follow-up study of the GAZEL cohort, *PLoS One*. **7:** 515-29 (2012).
22. Leong, I. T., Moghadam, S. and Hashim, H. A., Aggregated effects of combining daily milk consumption and aerobic exercise on short-term memory and sustained attention among female students, *Percep. Mot. Ski.* **120:** 57-66 (2015).
23. Muldoon, M. F., Ryan, C. M., Matthews, K. A. and Manuck, S. B., Serum cholesterol and intellectual performance, *Psychoso. Medi.* **59:** 382-87 (1997).
24. Nassa, R. and Bhatia, B., A comparative study on nutritional status of day scholar and hosteller adolescent boys with intellectual disability, *Int. J. Food Nutri. Sci.* **3:** 125-29 (2014).
25. Neo, J. E., Salleh, S. B. M., Toh, Y. X., How, K. Y. L., Tee, M., Mann, K., Hopkins, S., Thielecke, F., Seal, C. J. and Brownlee, I. A., Whole-grain food consumption in Singaporean children aged 6–12 years, *J. Nutrtn. Sci*. **5:** e33 (2016).
26. Ochola, S. and Masibo, P. K., Dietary intake of school children and adolescents in developing countries, *Anna. Nutrtn. Metab*. **64:** 24-40 (2014).
27. Palenzuela, P. S. M., Pérez, M. A., Pérula de Torres, L. A., Fernández, G. J. A., Maldonado, A. J., Food consumption patterns among adolescents, *Anal. del Sist. Sanit. Nav.* **37:** 47-58 (2014).
28. Puri, S., Marwaha, R. K., Agarwal, N., Tandon, N., Agarwal, R., Grewal, K., Reddy, D. H. and Singh, S., Vitamin D status of apparently healthy school girls from two different socio economic strata in Delhi: relation to nutrition and lifestyle, *Brit. J. Nutrtn.* **99:** 876-82 (2008).
29. Sánchez-Villegas, A., Toledo, E., De Irala, J., Ruiz-Canela, M., Pla-Vidal, J. and Martínez-González, M. A., Fast-food and commercial baked goods consumption and the risk of depression, *Pub. Hlth. Nutrtn.* **15:** 424-32 (2012).
30. Singla, P., Efficacy of Nutrition Counselling on the Intake of Junk foods among adolescent girls of working mothers, Unpublished M.Sc. thesis, Punjab Agricultural University, Ludhiana, Punjab, India (2011).
31. Story, M., Sztainer, D. N. and French, S., Individual and environmental influences on adolescent eating behaviors, *J. Am. Dietet. Assoc.* **102:** 40-51 (2002).
32. Svastisalee, C. M., Holstein, B. E. and Due, P., Fruit and Vegetable Intake in Adolescents: Association with Socioeconomic Status and Exposure to Supermarkets and Fast Food Outlets, *J. Nutrtn. Metab*. **2012:** 1-9 (2012).
33. Swan, G. E., LaRue, A., Carmelli, D., Reed, T. E. and Fabsitz, R. R., Decline in cognitive performance in aging twins. Heritability and bio behavioral predictors from the National Heart, Lung, and Blood Institute Twin Study, *Archi. Neuro.* **49:** 476–81 (1992).
34. Tornaritis, J. M., Philippou, E., Hadjigeorgiou, C., Kourides, A. Y., Panayi, A. and Savva, C. S., A study of the dietary intake of Cypriot children and adolescents aged 6–18 years and the association of mother's educational status and children's weight status on adherence to nutritional recommendations, *BMC Pub. Hlth.* **14:** 13 (2013).
35. Vijayapushpam, T., Menon, K. K., Rao, R. D. and Maria, Antony, G., A qualitative assessment of nutrition knowledge levels and dietary intake of school children in Hyderabad, *Pub. Hlth. Nutrtn.* **6:** 683-88 (2003).
36. Zhang, J., Hebert, J. R. and Muldoon, M. F., Dietary fat intake is associated with psychosocial and cognitive functioning of school-aged children in the United States, *J. Nutrtn.* **135:** 1967-73 (2005).