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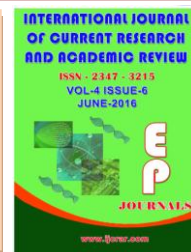
Impact of Mid Day Meal on Nutritional Status of School Going Children with Special Emphasis on Zinc

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KEYWORDS	A B S T R A C T
Mid day meal (MDM), Non mid day meal (NMDM), Zinc deficiency, Under-nutrition, RDA.	Mid day meal programme was introduced in India to protect child from class room hunger, increasing enrolment and attendance in the schools. It includes provision of lunch free of cost to school-children on all working days. Zinc deficiency is widespread and affects the health and well-being of populations worldwide. (i) To assess the nutritional contribution of mid day meal to the dietary zinc intake in school children (ii) to compare the prevalence of zinc deficiency between the children consuming MDM and NMDM school children. A total of 100 study subjects were randomly selected from two schools. Zinc and nutritional assessment was done using anthropometric measurements and 24 hours diet recall. Majority of study subjects (54%) in mid day meal school and also majority (54%) in non mid day meal school belonged to 11-12 years age group. Among 8-9 and 9-10 years of age 100% subjects were having low BMI<18.5. The mean intakes of all macronutrients and micronutrients were found to be lower than the RDA. A significant difference (*p<0.05*) were found in zinc intake between mid day meal and non mid day meal subjects belonging to 10-12 years age group. The nutritional contribution of mid day meal to dietary zinc was lower than the RDA (8-9mg).

Introduction

School children constitute a major segment of the community whose health and nutritional status will indicate the changing trend of nutritional profile of the region. Zinc is an essential trace element and has a number of roles and functions in the human body. This was proved in 1963 by determining zinc to be essential for human growth. Similarly later in 1974 the National Academy of Sciences declared zinc to be an essential element for humans and established a recommended daily allowance. Then in 1990's there was increasing attention on the role of zinc deficiency in childhood morbidity and mortality in developing countries. The significance of zinc in humans and its deficiency leading health issues led to conduct this present

study. In particular the study focuses on the nutritional status assessing the zinc intake of the children consuming mid day meal. Mid day meal program (MDM) was initiated by the central government of India to reduce the number of dropouts, enhance school enrolment, student attendance, student retention and improve nutritional status of children. In a study conducted on 6-12 years old school children it was seen that stunting and malnutrition was reduced after mid day meal introduction in the schools (Minj *et al*., 2014). Since mid day meal program proves to be beneficial and provides 1/3 nutritional requirement of the children in a day, dietary assessment of zinc in mid day meal is important.

Methodology

A comparative study using random sampling method was conducted. Total 100 subjects were screened for zinc status. Two schools were selected for the study on the basis of consuming mid day meal and not consuming mid day meal (NMDM). In each school study subject were in the age group of 8-12 years. A pre-structured questionnaire was used to collect the general information, anthropometry measurements, mid day meal information and three days 24 hours diet recall. The weight and height was measured and recorded to assess the nutritional status of the study samples and compared to WHO (2007) standards.

Results and Discussion

The age wise distribution of the study subjects shows that the majority of the subjects (54%) belonged to age 11-12 years, followed by 22% of subjects in 10-11 years age group and only 12% within 8-9 years range in mid day meal school. Among non mid day meal school 54% of the study subjects were in 11-12 years age group, 24% in 9-10 age group and only 18% in 8-9 years

(Table 1). In a study carried on 6-12 years of children to assess the prevalence of zinc deficiency and to study the association of zinc deficiency with anthropometric measurements and socio-demographic variables, in eastern Nepal reveals that prevalence of zinc deficiency was observed in 6-8 years old children when compared with 10-12 years children (Nepal *et al*., 2014).

Gender classification shows varying results with 64% females and 32% of males in MDM school whereas in NMDM School there were 64% of males and only 32% of females (Table 2). Study done on stunting and zinc deficiency among primary school children among rural area of Jiangsu Province reveals that boys had higher zinc deficiency than girls, whereas the prevalence of anemia in boys was lower than that in girls. The study shows that zinc deficiency and stunting were not highly prevalent among school children in rural regions with low soil zinc concentrations of Jiangsu Province (Yu Qin *et al*., 2008).

An increasing trend was observed in the mean heights as the age increases (Table 3), with the maximum mean height of 142.2 (±6.79) for 11-12 years and minimum mean height being 124.2 (±2.5) for 8-9 years in NMDM school. Similar increasing trend was found under MDM school subjects also, maximum mean height for 11-12 years was 134.7 (±3.56) and minimum mean height for 8-9 years was 115.5 (±12.45). These result was found to be significant (p > 0.05) in the height of the subjects belong to the age group 11-12 years.

In a study conducted to analyze if 10 mg zinc supplemental dose is appropriate for the children and does it have any interactions with copper and iron concentrations in the body. The results show that Z score for initial height-for-age was < -1.3. Significant

change in plasma zinc concentration was observed in relation with zinc dose (P value = 0.001). Incidence of diarrhoea was decreased by 3 mg zinc sulphate per day supplemental dose. No other dose response was noticed in the study subjects. Adverse effects on 10 mg zinc supplements per day on copper and iron status was nil (Wuehler *et al*., 2008).

The table (Table-4) depicts the weight for age of the respondents. The mean weight of the study subjects were found in ascending order in both the schools. The maximum mean weight was seen in 11-12 years subjects with 34.42 (±4.76) and 32.35 (±7.40) in MDM and NMDM schools respectively. Minimum mean weight was found in 8-9 years study subjects with 19 (±3.03) in MDM school and 22.5 (±3.10) in NMDM school.

Several studies on effect of zinc supplementation on children's growth and development have been performed. Each study represent varying results, some studies show that zinc supplementation in higher doses can help and in some studies supplementation is of no benefit. Calculated mean reflects that there is a highly significant effect of zinc supplementation on height and weight increments, but no significant effect of zinc on (weight-for-height) indexes was found (Brown *et al.,* 2006).

The study population was classified as underweight, normal weight, over weight and obese based on their BMI-for-age percentile (WHO, 2007). From the figure it is evident that cent-percent of the subjects in age group 8-9 and 9-10 years were in the underweight category, while 66.6% in the age group 10-11 were underweight, followed by 50% subjects in 11-12 years were also underweight. It was found that 3.7% study subjects in 11-12 years were

falling under overweight category (Figure 1). In another study the extent of under nutrition at district level and the socio-economic determinants of underweight children were assessed. On basis on BMI calculation it was seen that prevalence of under nutrition varied among districts of west Bengal. The percentages of underweight children were more in rural areas among Muslim families with illiterate parents and low standard of living. But in some other districts with lower middle economic status the prevalence of underweight was lesser. Thus it was found that the characteristics like religion, parents' educational status and standard of living index showed significant effect on the children's weights (Bharati *et al*., 2010).

In a study conducted to determine whether school or nonschool environments contribute more to childhood overweight, Comparison between children's gains in body mass index (BMI) when school is in session (during the kindergarten and first-grade school years) with their gains in BMI when school is out (during summer vacation) was made. The results shown were that growth in BMI was typically faster and more variable during summer vacation than during the kindergarten and first-grade school years (Hippel *et al*., 2007).

The macronutrient consumption pattern among 8-10 years old study subjects reveals that mean energy, protein and carbohydrate consumed was fulfilling the requirements as given by the RDA. The mean energy intake was 1355 kcal/d (RDA=1690 kcal/d), followed by mean protein consumption was 18.1 g/d (RDA=29.5g/d) and mean carbohydrate intake 172.1g/d (RDA=253.5 g/d) in MDM school subjects. In 8-10 years NMDM school subject's intake of energy, protein and carbohydrate was higher than MDM school subjects. The means of macronutrients were as follows: energy

1682.2 kcal/d (±314.7), protein 24.7 g/d (±3.3) and carbohydrate 197.3 g/d (±29.8). In both the school subjects fat consumed was found on borderline (29.9g/d in MDM school) and (29.6g/d in NMDM school) as compared with RDA (30g/d). It is known that fat should be consumed in limited amount due to its association with several health risk factors. Significant differences were seen between both the schools macronutrient intake (p<0.05) (Table 5).

It was found that mean iron intake 3.57mg/d and mean zinc 3.25mg/d is lower among MDM school subjects. In NMDM school subjects mean iron intake 4.81 mg/d and mean zinc consumed was 4.05 mg/d was higher than MDM school subjects. Though the micronutrient intake was higher in NMDM school subjects, it was observed that consumption pattern was not meeting the RDA (Iron-21mg/d and zinc- 8mg/d). Statistically significant difference was found in iron intake t=5.29 (p<0.05) (Table 5).

Micronutrients play a central part in metabolism and in the maintenance of tissue function. An adequate intake therefore is necessary, but provision of excess supplements to people who do not need them may be harmful. Single micronutrient deficiency states are comparatively easily recognized and treated (Shenkin, 2006).

The micronutrient status and its relationship with nutritional status in preschool children was assessed in a study including 340 preschool children. Deficiencies of zinc and vitamin A occurred among 67% and 38% of children, respectively. In the surveyed population, zinc deficiency was high and to a lesser degree vitamin A deficiency and vitamin D insufficiency prevailed. The nutritional status of the children was related to vitamin D status and with hemoglobin status. Zinc and vitamin A levels were low in children with severe stunting. Vitamins A, D and zinc levels were associated with haemoglobin status (Marasinghe *et al.,* 2015).

Analyzing the intake of macronutrients of 10-12 years old subjects shows that over consumption of macronutrient was lower among MDM school subjects. Whereas in NMDM school subjects mean energy intake was 1726.5 kcal/d, mean protein consumed was 23.2 g/d, mean carbohydrate intake 206.4 g/d and mean fat intake 29.3 g/d.

However both the schools were not fulfilling the RDA for 10-12 years subjects. Significant difference in protein consumption was found, where protein was consumed in lower quantity among MDM school than in NMDM school (t=4.14, p<0.05). MDM school subjects had lower intake of iron (3.2±0.4) than non NMDM school subjects (Iron 4.77±1.14). Whereas mean zinc intake was found (3.4±0.5) in NMDM school and in MDM school subject's was (4.14±0.64) (Table 6).

Table: 1 Age wise distribution of study subjects

Age group	Respondents			
	Mid day meals (n=50)		Non Mid day meals (n=50)	
	N	%	N	%
8 -9 years	6	12.0	4	8.0
9-10 years	6	12.0	12	24.0
10-11 years	11	22.0	7	14.0
11-12 years	27	54.0	27	54.0

Table: 2 Gender wise distribution of the respondents

Gender	Respondents			
	Mid day meals (n=50)		Non mid day meals (n=50)	
	N	%	N	%
Male	18	36.0	32	64.0
Female	32	64.0	18	32.0

Table: 3 Anthropometry measurements (height-for-age) of the respondents

Age group	Height (cm)				't' test
	Mid day meals (n=50)		Non Mid day meals (n=50)		
	Mean	SD	Mean	SD	
8 -9 years	115.5	12.45	124.2	2.5	1.35 [NS]
9-10 years	132.3	5.68	127.3	8.15	1.52 [NS]
10-11 years	129.5	3.20	134.2	9.96	1.47 [NS]
11-12 years	134.7	3.56	142.2	6.79	5.08*

*Significant at 5% level,   NS: Non significant,   t (0.05, 98df)

Table: 4 Anthropometry measurements (weight-for-age) of the respondents

Age group	Weight (kg)				't' Test
	Mid day meals(n=50)		Non Mid day meals(n=50)		
	Mean	SD	Mean	SD	
8 -9 years	19	3.03	22.5	3.10	1.77 [NS]
9-10 years	27.75	4.33	24.75	5.14	1.22 [NS]
10-11 years	29.13	3.66	30.7	9.72	0.49 [NS]
11-12 years	34.42	4.76	32.35	7.40	1.22 [NS]

NS: Non significant, t (0.05, 98df)

Table: 5 Macronutrient and Micronutrient intake among the study subjects (8-10 years)

Nutrients	RDA*	Mid day meal(n=50)		Non mid day meal(n=50)		't' test
		Mean	SD	Mean	SD	
Energy (kcal)	1690	1355	352.02	1682.2	314.7	2.80*
Protein (g)	29.5	18.1	3.20	24.7	3.3	5.83*
CHO (g)	253.5	172.1	39.94	197.3	29.8	2.043*
Fat (g)	30	29.9	4.6	29.6	2.9	0.222 [NS]
Iron (mg)	21	3.57	0.55	4.81	1.12	5.29*
Zinc (mg)	8	3.25	0.54	4.05	0.88	1.98 [NS]

Source- RDA for Indians, 2010   *Significant at 5% level, NS: Non significant.

Table: 6 Macronutrient and Micronutrient intake among the study subject
(10-12 years)

Nutrients	RDA*	Mid day meal(n=50)		Non mid day meal (n=50)		't' test
		Mean	SD	Mean	SD	
Energy (kcal)	2190	1590.8	522.8	1726.5	337.3	1.266^{NS}
Protein (g)	39.9	19.5	4.6	23.2	2.4	4.145*
CHO (g)	301.5	194.9	51.4	206.4	25.3	1.167^{NS}
Fat (g)	35	27.5	6.4	29.3	4.1	4.1^{NS}
Iron (mg)	27	3.2	0.4	4.77	1.14	7.47*
Zinc (mg)	9	4.14	0.64	3.4	0.5	5.26*

Source- RDA for Indians, 2010   *Significant at 5% level, NS: Non significant

Figure: 1 BMI of the study subjects
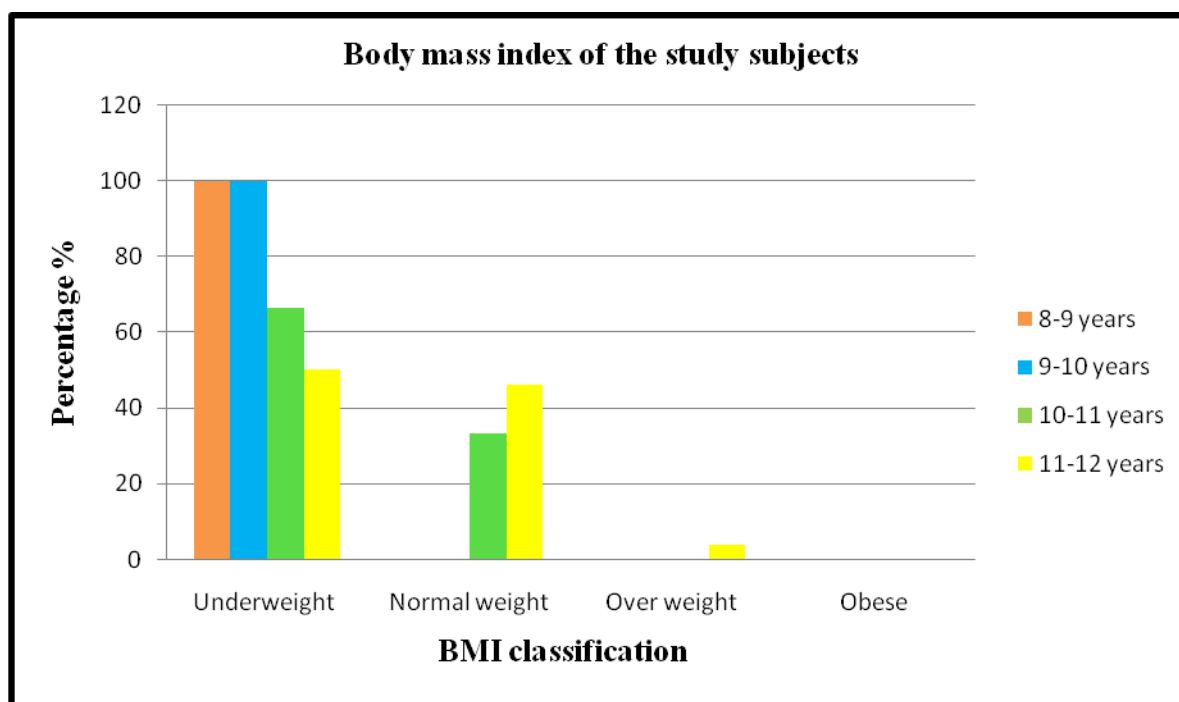
Conclusion

It can be therefore concluded that under-nourishment of the subjects could be leading cause of zinc deficiency. The study subjects could also be at the risk of other nutrient deficiencies as observed through their 24 hours diet recall which shows low intake of energy, protein, carbohydrates, iron and zinc. Both the categories of age group (8-10 and 10-11 years) had low intakes of all macronutrients and micronutrients as compared to RDA. The consumption of fat was on the borderline as compared with RDA. In age group 8-10 years slightly higher zinc intake was found higher (4.05±0.88) than 10-12 years subject's belonging to NMDM school.

The respondents were classified based on BMI-for-age percentile into different categories. The BMI results show that maximum mean height of 142.2±6.79 for 11-12 years and minimum mean height being 124.2±2.5 for 8-9 years in NMDM school. Similar increasing trend was observed under MDM school subjects also, maximum mean height for 11-12 years was 134.7±3.56 and minimum mean height for 8-9 years was 115.5±12.45.

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