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Stunting and Zinc Nutritional Status among Primary School Children in North-Okkalapa Township

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Zinc deficiency is known to be linked to growth retardation in children and stunting is an indicator of chronic malnutrition. This cross-sectional study was aimed to determine the proportion of stunting and serum zinc status among primary school children. Stunting (height for age <z scores -2SD) and underweight (weight for age <z scores -2SD) were defined according to the World Health Organization (WHO) classification by using WHO 2007 growth charts. Serum zinc level was measured using Atomic Absorption Spectrophotometry-Graphite Furnace and level of <9.9 μmol/l was defined as zinc deficiency according to WHO criteria. A total of 102 children (5-10 year-old) from a primary school in North-Okkalapa Township were included. Among them, 52(51%) were boys and 50(49%) were girls. In this study, 29(28.5%) children had underweight and 21(20.6%) were stunted. The mean ±SD serum zinc level was 8.1±4.4 μmol/l and zinc deficiency was present in 71(69.6%) children. Stunting was not associated with age or sex but with lower weight for age ($p<0.001$). Zinc nutritional status was not associated with age, sex, weight or height for age. The present study showed high prevalence of zinc deficiency among primary school children. It highlights the need for population-based larger studies in Myanmar and also urges the need for intervention programs to improve zinc status in primary school children.

Key words: Stunting, Zinc deficiency, Nutritional status, Children, Micronutrient

INTRODUCTION

Stunting is the gaining of insufficient height relative to age and is regarded as an indicator of chronic undernutrition.[1] Stunting often persists into school-age years and if left untreated, it will lead to reduction in adult size, which has been associated with reduced work capacity.[2]

Zinc is an essential trace element that has a prominent role in human nutrition and health.[3] Zinc deficiency has been known to be linked to growth retardation, cognitive impairment and increased susceptibility to infections in children. It is common in developing countries in which low intake of animal source of food leads to deficiency of micronutrients including zinc[4] and high intake of cereal food containing high amount of phytate and fiber leads to impair absorption of zinc.[5] The widely application of fertilizer with nitrogen in these countries may also inhibit zinc uptake by crops.[6] By using the food balance sheets, an estimate suggested that 71.2% of the total population in Southeast Asia is at risk of developing zinc deficiency.[7]

There is limited available information on prevalence of zinc deficiency in Myanmar children although they are vulnerable to it. The report of joint World Health Organization/United Nations International

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Children's Emergency Fund/International Atomic Energy Agency/International Zinc Nutrition Consultative Group (WHO/ UNICEF/IAEA/IZiNCG) interagency meeting concluded that the risk of zinc deficiency is considered to be of increased public health concern when the prevalence of stunting is at least 20% and intervention to improve population zinc status is recommended.[8]

According to Multiple Indicator Cluster Surveys (MCIS) in 2009-2010, 35.1% of children under the age of five were moderately stunted and 12.7% were severely stunted in Myanmar by WHO growth standards.[2] Therefore, there is an urgent need to identify the zinc nutritional status in Myanmar to treat the children at risk of growth retardation with sufficient zinc supplementation.

However, most studies in Myanmar on zinc status have focused on the relationship between zinc supplementation and morbidity from infectious diseases in preschool children and very little information is available for school age children. This study aimed to assess the proportion of stunting and to determine the serum zinc status among primary school children and to find out the association between them.

MATERIALS AND METHODS

It was a cross-sectional descriptive study conducted at a Primary School in North-Okkalapa Township, Yangon. Five to 10 years old, apparently healthy children were included in the study. Children with acute or chronic medical illness and those who have zinc supplementation in last 6 months were excluded. Children underwent health assessment by trained pediatricians and those with acute or chronic medical illnesses at the time of examination were excluded from the study. Height was measured at nearest 0.1 cm and weight was adjusted to nearest 0.1 kg. Equipments were calibrated well, and trained investigators performed the anthropometric measurements. Stunting (height for age <z scores -2SD) and underweight (weight for age <z scores -2SD) were defined according to the WHO classification by using WHO 2007 growth charts. Approximately 2 milliliters of blood were collected by venipuncture in vacutainers and blood samples were sent to Common Research Laboratory of University of Medicine 2. The samples were centrifuged at 3000 rpm for 10 minutes and sera were stored at -20ºC until analysis. Serum zinc level was estimated using Atomic Absorption Spectrophotometry-Graphite furnace. Zinc deficiency was defined according to WHO criteria: <9.9 µmol/l.[8]

Statistical analysis

The data were analyzed using the SPSS 16.0 software package. Data were evaluated using descriptive statistics (mean and standard deviation for age and serum zinc level, frequency and percentages for age group, sex, nutritional classification according to weight and height for age and zinc deficiency). Comparisons of categories for demographic and nutritional variables between children with and without stunting or zinc deficiency were made using Chi square test. Comparison of mean serum zinc level between demographic and nutritional variables were made using Student 't' test or one way ANOVA test. P value less than 0.05 was considered as statistically significant.

Ethical consideration

This study was approved by the Ethics Review Committee of Department of Medical Research. Written informed consent was obtained from the parents of the children before the study. Children were given zinc supplementation after the study.

RESULTS

Total of 102 children were included in the study with the mean age of 7.9±1.4 years. Among them, 52(51%) were boys and 50(49%) were girls. Mean serum zinc level was 8.1±4.4 µmol/l.

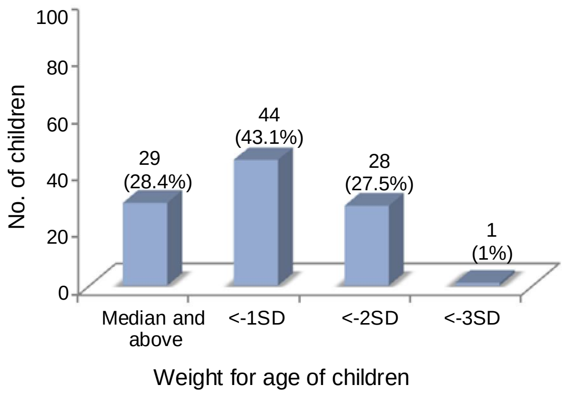

Fig. 1. Weight for age status of children

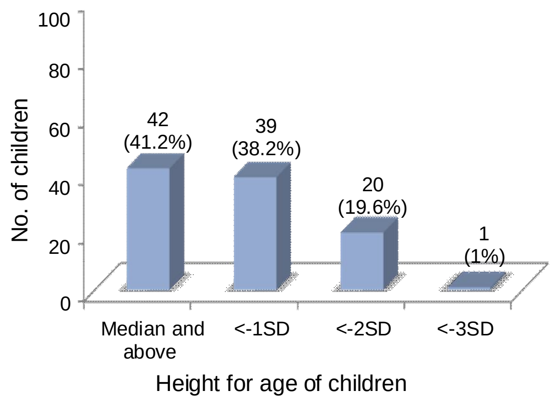

Fig. 2. Height for age status of children

Table 1. Stunting among demographic and nutritional characteristics of children

Characteristics	Stunting		p value
	Yes	No	
Age (year)			0.7
5-7	11(22.0)	39(78.0)	
8-10	10(19.2)	42(80.8)	
Sex			0.7
Male	10(19.2)	42(80.8)	
Female	11(22.0)	39(78.0)	
Weight for age			<0.001*
Median and above	0(0)	29(100)	
<-1SD	5(11.4)	39(88.6)	
<-2SD	16(55.2)	13(44.8)	

In this study, 29(28.5%) children had underweight (Fig. 1) and 21(20.6%) were stunted according to WHO classification (Fig. 2).

Zinc deficiency (serum zinc level less than 9.9 μmol/l) was present in 71(69.6%) of children. Stunting was not associated with age or sex of children. Children with lower weight for age had higher prevalence of stunting which was statistically significant (p<0.001) (Table 1).

Table 2. Serum zinc status among demographic and nutritional characteristics of children

Charac-teristics	Serum zinc level (μmol/l) Mean±SD	P value	Serum zinc status No. (%)		P value
			Deficient	Sufficient	
Age(year)		0.8			0.7
5-7	8.2±4.7		34(68.0)	16(32.0)	
8-10	8.0±4.1		37(71.2)	15(28.8)	
Sex		0.8			0.6
Male	8.2±3.7		35(67.3)	17(32.7)	
Female	8.0±5.0		36(72.0)	14(28.0)	
Weight for age		0.2			0.1
Median & above	7.8±3.4		21(72.4)	8(27.6)	
<-1SD	7.5±4.8		34(77.3)	10(22.7)	
<-2SD	9.2±4.4		16(55.2)	13(44.8)	
Height for age		0.9			0.9
Median & above	8.0±4.4		30(71.4)	12(28.6)	
<-1SD	8.1±4.6		27(69.2)	12(30.8)	
<-2SD	8.2±4.0		14(66.7)	7(33.3)	

In this study, zinc nutritional status was not associated with age, sex, weight for age or height for age among primary school children (Table 2).

DISCUSSION

This study showed high prevalence of zinc deficiency (69.6%) and low mean serum zinc level (8.1±4.4 μmol/l) in primary school children. There is very scanty of Myanmar data for school age children to compare with this study. The only study that determined the effect of zinc supplementation in this age group was conducted at a primary school in North Dagon Township and demonstrated that the baseline mean serum zinc level of 80 μg/dl (equivalent to 12 μmol/l) in 76 children, which was higher than this study[9].

The dietary pattern and the health status of the children in that study and this study may not be different much because the schools are situated in neighboring townships where residents have similar socioeconomic status. Apart from handling of the samples, the timing of blood collection and fasting status can also influence the zinc concentration measured in blood.[10] Blood samples for this study were collected in the morning hours in a non-fasted state as WHO recommendation.

In this study, the proportion of primary school children with stunting was 20.6% and zinc deficiency was 69.6%. It was higher than those of primary school children in China (4.7% stunting and 0.7% serum zinc deficiency)[11] and North-east Thailand (10% stunting and 57% zinc deficiency)[12] but lower than those in Nepal (34.4% stunting and 83.9% and 87.3% zinc deficiency in two districts)[13] and Cambodia (42.9% stunting and 92.8% zinc deficiency).[14] According to these studies in school children, it was found that the prevalence of zinc deficiency increased as that of stunting increased. Although serum zinc does not necessarily reflect individual zinc status, information on the distribution of serum zinc concentration in a population is recognized as the magnitude of the risk of zinc deficiency at the population level.[8]

Although stunting is defined as a functional indicator for zinc deficiency, several studies found varying results regarding the association between them. The present study cannot demonstrate the significant relationship between plasma zinc level with anthropometric status, which is also supported by some studies conducted in school children in China, Thailand and Nepal.[11-13] Contrast to this, a study conducted in Cambodia reported that plasma zinc was significantly associated with height for age.[14] Similarly, a study in Iran also showed that stunting was associated with zinc deficiency in 9-11 years old children.[15] The absence of finding any association between stunting and zinc deficiency may be due to the age group studied, presence of chronic infection or infestation and coexistence of other growth-limiting micronutrient deficiencies other than zinc.

WHO recommended that the risk of zinc deficiency would be considered as elevated public health concern if the prevalence of low height for age is at least 20% and if the prevalence of low serum zinc concentration is greater than 20%.[8] Findings in the present study fulfilled both of these conditions for high risk of zinc deficiency.

However, the small sample size from only one primary school might not be representative for the whole country. Larger population studies on school children from different social background should be conducted to determine the true prevalence of risk of zinc deficiency in this age group. Zinc supplementation should also be provided not only to under-five children with diarrhoea or pneumonia but also to school age children with high risk of zinc deficiency. Dietary survey for zinc intake should also be done and other complications of zinc deficiency in school children like academic performance and existence of subclinical infection should also be studied. Other growth limiting micronutrients deficiencies should also be assessed in this population.

Conclusion

The present study showed high prevalence of zinc deficiency among primary school children, which is much higher than the level, set by WHO as public health concern. It highlights the need for population-based larger studies in Myanmar and also urges the need for intervention programs to improve zinc status in primary school children.

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