Original Paper

ZINC SUPPLEMENTATION REDUCES RECURRENT ACUTE LOWER RESPIRATORY INFECTION (ALRI)

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Abstract

Introduction: Pneumonia is a frequent and serious human illness. In Bangladesh, Acute Lower Respiratory Infection (ALRI) is a major cause of death among young children. Childhood mortality can be reduced by 50% with detection and early treatment of illness with antibiotics and immunization. Zinc plays an important role in the optimal function of the immune system by reducing the risk, severity and duration of infectious diseases. Zinc supplementation improves health and cell mediated immunity.

Objectives: This study is aimed at documenting effect of zinc supplementation in preschool children on reducing ALRI.

Methods: This was a double blind random control trial interventional study among180 child, conducted at Comilla CMH, from January 2010 to December 2011. The children aged 6-60 months were selected randomly for comparison of effect of Zinc and Vitamin B-Complex on ALRI.

Results: In the study population, male to female ratio was 1.05:1. Baseline average age was 32 months and weight for height was 92% Of NCHS mean. It was found that 89% children completed immunization as per EPI schedule, the rest 11% were partially immunized. Twenty nine percent children had family history of Atopy. This study showed 15 episodes of ALRI in Zinc group (0.37episodes/child/year) compared to 47 episodes in the control B-Complex group (1.09episodes/child/year) during the six months follow-up. There was no association of ALRI with sex. The male female ratio in this respect was 1.07:1. In this study there was statistically significant and clinically important (67%) reduction of episodes of ALRI in oral Zinc supplement group.

Conclusion: This finding strongly suggests that oral supplement of Zinc reduces episodes of ALRI in children.

Key-Words: ALRI, Pneumonia, Childhood mortality, Zinc-supplementation.

Introduction

Pneumonia has been a frequent and serious human illness throughout recorded history. In 1901 Sir William Osler stated "The most widespread and fatal of all acute diseases, Pneumonia is now Captain of the Death of Men". Almost 10 decades later, the prominence of pneumonia as a clinical entity remains the same, making the largest contribution to shortcoming of life expectencency[1].

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Out of nearly 12.9 million deaths under 5 children about 4 million deaths annually are attributable to Acute Lower Respiratory Infection (ALRI) in the world and in developing countries they are associated with a third of all deaths in childhood[2,3] In Bangladesh, ALRI are a major cause of death among young children. About 25% of the under 5 childhood deaths are attributable to ALRI[4]. Community-based trials have documented that this childhood mortality can be reduced by 50% with detection and early treatment of illness with antibiotics and immunization against measles and pertussis as carried according to immunization schedule[5,6]. Therefore additional interventions to prevent ALRI are needed to complete the case-management approach in developing countries, as purely preventive programs alone, e.g. the EPI and pollution control, are inadequate[7]

The overall incidence of ARI is 5.5 episodes per child per year observed[8]. Despite the world-wide impact of ARI, or a combination of technical and operational reasons, it has often been neglected until recently, whereas diarrhoeal disease and malnutrition has received considerable attention[7]. As little is known about the changing pattern of etiological agents, a wide variety of viruses and bacteria are associated with pulmonary infection making it impossible to identify the specific etiological agent in each patient. Not only this, high prevalence of malnutrition, poverty and environmental deprivation are important contributors to the problem[7].

Respiratory viruses were shown to impair mucociliary clearance and the functions of the polymorphonuclear neutrophils, alveolar macrophages and T-lymphocytes, thus allowing the pathogenic bacteria to invade the lower respiratory tract and start an infection. Increased incidence, severity and mortality of ALRI are associated with malnutrition and reduced immunological competency may be a mechanism for this association[9]. Even well nourished children of developing countries also suffer from ALRI and it is possible that they have impaired cell mediated immunity due to isolated Zinc deficiency[10]. Zinc plays an important role in the optimal function of the immune system by reducing the risk, severity and duration of infectious diseases like diarrhoea[11]. A sufficient zinc intake decreases the risk of respiratory infections and ensures a better ensures a better gut barrier, which protects against infections[12]. Zinc supplementation improves child health and improved cell mediated immune status[13,14]. It is an essential element for health. The relative safety of this element, especially its lack of redox properties which, in contrast to iron and copper allows its utilization as an antioxidant and can stabilize cell membranes[15,16]. Because of Zinc`s fundamental roles in cell growth and differentiation, the young growing organism is especially vulnerable to adverse effects from inadequate zinc[17]. So plasma zinc is used as a predictor of diarrhoeal and respiratory morbidity in children[18]. Therefore supplementation of zinc in deficient population especially preschool children should substantially reduce serious morbidity[13,19]. This study is aimed at determining effect of zinc supplementation on Acute Lower Respiratory Infection.

Materials and Methods

This observational study was carried out in Combined Military Hospital, Comilla during the period of January 2010 to December 2011. Study populations between 6 months to 5 years of both sexes were enrolled for the study. Undertook a double blind randomized control trial interventional study.Zinc group was designated as A and B-Complex group as B. Children having chronic illness like

chronic renal disease, congenital or acquired heart disease and chronic neurological diseases like cerebral palsy were excluded from the study. Very sick unable to take oral zinc supplementation were also excluded.

A semi-structured questionnaire was prepared which included nutritional status, baseline ALRI and Immunization status. In regard of immunization, complete immunization indicate children were immunized according to age as per EPI schedule and partially immunized indicate those children who could not complete immunization though they have passed normal age of EPI schedule. ALRI were defined according to WHO criteria[20]. Pneumonia and Bronchiolitis were put under diagnosis of ALRI according to WHO guideline[20]. Anthropometric assessments were performed as baseline to exclude severe malnutrition. Weight for height was used for nutritional status assessment. Children whose weight for height is -3SD or <70% of the median of NCHS referred values (termed severe wasting) are severely malnourished.

Out of 180 children (90 in each group) 13 children didn`t contribute, as some of them were missing during follow-up or excluded due to exclusion criteria. A child who was absent continuously for more than a month was considered terminated from the study.

Diagnosis of ALRI was made from history and clinical examination as followed:-

1.History like cough, breathing difficulty, running nose, fever, loss of appetite.

2.Clinical examinations like noisy breathing, respiratory distress (lower chest in drawing), and respiratory rate more than age specific and auscultatory findings.

Zinc group was coded as Group A and control (B-Complex) group was coded as Group B. 5 ml of Zinc preparation contained 10 mg elemental Zinc. The Zinc preparation was in the form of Zinc Sulphate and B-Complex was in the composition of B1, B2 and B6. A fixed dose of 2 mg per kg body weight per child was given daily for 2 months to all enrolled children. Children with baseline ALRI included in the study. After 2 months supplement, patient was reviewed at COPD once a month during 6 months for episodes of ALRI.

Results

Anthropometric assessments were performed at the baseline to exclude severe malnutrition. Baseline weight for height was 92% of NCHS mean as a whole. It was 93% and 91% of NCHS mean in Zinc supplement group and B-Complex group respectively. Nutritional status was well matched, with no significant ($p>0.05$) difference between the groups. The average age of the children of Zinc supplemented group was 34 months while that of B-Complex supplemented group was 31 months. Age was well matched and there was no statistical significant difference ($p > 0.05$) between two groups. In the study as a whole male female ratio was 1.07:1, in Zinc group the ratio was 1.05:1 and in B-Complex group it was 1.09:1. Sex was well matched, with no significant ($p > 0.05$) difference between the groups. At baseline as a whole 22% children suffered from ALRI. Twenty percent in Zinc group and 23% in B-Complex group suffered from ALRI Baseline ALRI was well matched, with no significant ($p > 0.05$) difference between them(Table-I).

Table-I: Comparison of baseline characteristics (mean ± SD) of the two groups (n=180)

	Zinc Supplement Group (Group A) (n = 90)	B-Complex Supplement Group (Group B)(n = 90)	Total (n = 180)	p
Age (month)	34.06±18.01	30.92±16.48	32.46±17.28	0.19
Sex (Male/Female)	46/44	47/43	93/87	0.33
Baseline ALRI	18 (20%)	21 (23.33%)	39 (21.67%)	0.59
Weight for Height*	93.13±12.39	90.59±11.84	91.84±12.15	0.15

***% of NCHS median**

The study shows majority (89%) of children completed immunization as per EPI schedule, while 11% children partially immunized. In zinc group 90% children, against 87% of B-Complex group children had complete immunization as per EPI schedule and the difference was not statistically ($p > 0.05$) significant (Table-II).

Table-II: Comparison of the immunization status of the study population between the two groups

Immunization status	Number of students (%)		
	Zinc supplemen	B-Complex supplement	Total
Complete	73 (90.12%)	75 (87.21%)	148 (88.62%)
Partial	08 (9.88%)	11 (12.79%)	19 (11.38%)
Total	81	86	167

$\chi 2 = 0.35$, $P > 0.5$ (not significant)

Table-III shows number of episodes of ALRI during 6 months follow-up. As a whole, 41(25%) children suffered from one or more (total 62) episodes of ALRI. In Zinc supplement group 12(15%) children had total 15 episodes (0.37 episodes/child/year) of ALRI but in B-Complex supplement group 29(34%) children had total 47 episodes (1.09 episodes/child/year) of ALRI.

Table-III: Number of episodes of ALRI during 6 months follow-up whole population

Number o episode of ALRI	Number of children (Number of episodes)						Total number of episodes	
	Zinc Supplement		B-Complex Supplement		Total			
No	69 (69x0=00)		57 (57x0=00)		126 (126x0=00		0X131 = 00	
One	10 (10x1=10)	12 (15)	13 (13x1=13)	29 (47)	23 (23x1=23)	41 (62)	1X23 = 23	62
Two	01 (1x2=2)		14 (14x2=28)		15 (15x2=30)		2X15 = 30	
Three	01 (1x3=3)		02 (2x3=6)		03 (3x3=09)		3X03=09	

Table-IV shows both Zinc group and control group had no statistically significant difference between particular sex groups with development of ALRI episodes during 6 months follow-up. As a whole, development of ALRI episodes in male and female were 32 and 30 respectively.

Table-IV: Sex distribution of the children who developed ALRI during 6 months follow-up between Zinc and B-Complex group

Gender	Number of episode of ALRI (%)		
	Zinc Supplemen	B-Complex Supplement	Total
Male	06 (40%)	26 (55.3%)	32 (51.6%)
Female	09 (60%)	21 (44.7%)	30 (48.4%)
Total	15	47	62

$\chi 2 = 1.07$, $P > 0.5$ (not significant)

Fig-1 & Table-V show that after intervention there was 39(44%) recurrent and 23(56%) non-recurrent episodes of ALRI as a whole. In Zinc supplementation group there were 5(17%) recurrent episodes and 10(83%) non-recurrent episodes and in control group there were 34(55%)

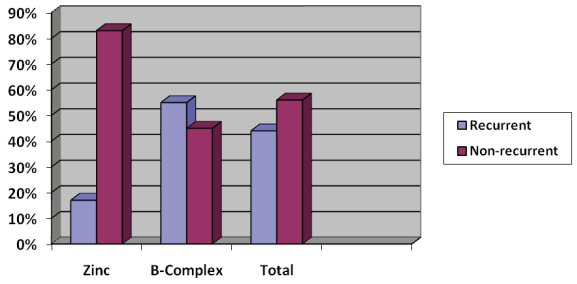

Fig-1: Association of recurrent attack of ALRI with Zinc or B-Complex supplement

Table-V: Association of recurrent attack of ALRI with Zinc or B-Complex supplement

Recurrent attack of ALRI	Number of episode		
	Zinc Supplement	B-Complex Supplement	Total
Recurrent	5 (16.7%)	34 (55.2%)	39 (43.9%)
Non-recurrent	10 (83.3%)	13 (44.8%)	23 (56.1%)
Total	15 (100%)	47 (100%)	62 (100%)

$\chi 2 = 7.43$, $P < 0.01$ (Significant)

recurrent episodes and 13(45%) non-recurrent episodes of ALRI. The difference is statistically significant ($P > 0.01$).

Discussion

Present study showed male predominance in the study population. Male to female ratio was 1.07:1. But after intervention increased episodes of ALRI were not observed in a particular sex group. After intervention development episodes of ALRI in male and female were 32 and 30 respectively out of total 167 children under study. Male female ratio was 1.05:1. Even both Zinc and control (B-Complex) group showed no statistical significant difference between particular sex

distributions with development of ALRI. This finding is different from the observation of McConnochie et al, who showed that episodes of LRTI in male is about double than those in female[21]. This difference may be due to small sample size of our study.

This study shows 15 episodes of ALRI in Zinc group (0.37episodes/child/year) compared with 47 episodes in control group (1.09episodes/child/year). Sazawal et al showed that there were 0.19 episodes/child/year of ALRI in Zinc group compared with 0.35episodes/child/year in the control group[13].
Baseline weight for height was 92% of NCHS mean as a whole. Fauveau et al showed a small percentage of ALRI e.g. pertussis and measles related pneumonia, can be prevented with immunization[3]. Present study showed majority (89%) of children completed immunization as per EPI schedule, in zinc group 90% and in control group 87%. But no significant difference between the two groups for development of ALRI was found.

In our study we found that 41(25%) children had suffered from one or more episodes of ALRI. Twenty three (14%) of them had one episode, 15(09%) of them had two episodes and the rest 3(02%) had three episodes. Zaman et al found that total was 16%[8].
At baseline 38(21%) children suffered from ALRI. Among them 18(47%) children suffered from recurrent attack of ALRI during six months of follow up. Shah et al and Victora et al both showed previous history of ALRI increases the similar illness in later episodes[20,22]. In this study Zinc group had recurrent attack in 02(17%) children whereas in B-Complex group recurrence occurred in 16(55%) children. Therefore strong association of recurrent ALRI with B-Complex group than Zinc supplement group was found. In other word, Zinc supplementation had significantly reduced the recurrence of ALRI in the present study.

Zinc supplementation caused 67% reduction in the episodes of ALRI. A three month trial with Zinc-fortified bread reduced diarrhoea, illness and skin infection by 56% ($p<0.05\%$)among Turkish school children[23]. Sazawal et al in India demonstrated reduction of 45% of incidence of ALRI in Zinc supplemented group[13]. This study supports these findings.

Conclusion

Oral supplement of Zinc resulted in a significant reduction of ALRI in preschool children. These findings, along with documented effects of Zinc on ALRI indicate that interventions to improve Zinc intake deserve more attention as means to improve child immune status and ALRI.

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