

# Efficacy of Vitamin C in Reducing Duration of Severe Pneumonia in Children

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## Abstract

**Background :** To determine the efficacy of vitamin C in reducing duration of severe pneumonia in children

**Methods:** In this descriptive study children suffering from pneumonia , under age 5 were enrolled.. In vitamin C group (n=111), patient received 200mg of vitamin C once daily and in other group 111 children received placebo drops which matched exactly in color and taste. Clinical progress of both groups was taken thrice daily in terms of oxygen saturation, respiratory rate and chest in drawing.

**Results:** Among 222 children, majority (61.71%) were male and 85(38.28%) were female. Majority (58.55%) were infants, 29.72% were between 1-3 years and 11.71% were between 4-5 years(15.14±7.76 months). Oxygen saturation was improved in  $\leq 01$  day ( $p=0.003$ ) and respiratory rate was improved in  $\leq 04$  days ( $p=0.03$ ) in vitamin C group. No statistically significant difference was found in chest in drawing.

**Conclusion:** Vitamin C is effective in reducing duration of severe pneumonia in children less than five years of age.

**Key Words:** Vitamin C, Pneumonia, Antioxidant

## Introduction

Pneumonia is a disease causing inflammation of parenchyma of lungs. It is caused by variety of organisms including bacteria, viruses, fungi, or parasites.<sup>1</sup> According to UNICEF and WHO, pneumonia is the 2<sup>nd</sup> most common cause of under 5 mortality after neonatal deaths accounting for 19% of deaths and 95% of all new pneumonia cases in children occur in developing countries with highest number of cases in India followed by China, Pakistan and Bangladesh. <sup>2</sup> , <sup>3</sup> Pakistan is the 4<sup>th</sup> largest contributor with 7 million cases per year in children less than 5 years of age out of which over 92,000 children die each year.<sup>2</sup>

Risk factors for developing pneumonia include lack of breast feeding, top feeding, malnutrition, low immunization coverage, low socioeconomic status and deficiency of vitamin C and zinc.<sup>3</sup> In malnourished children vitamin C levels in body are negligible and decrease further during infections. It acts as major biological antioxidant and protects against reactive oxygen species generated during inflammatory response and reduces duration and severity of infections.<sup>4</sup> Amongst Millennium Development Goal the 4<sup>th</sup> goal focuses on reducing under 5 mortality to two third by 2015 and it requires urgent actions to reduce childhood pneumonia deaths. <sup>2,5</sup>

Vitamin C is an important antioxidant acting as a reducing agent to reverse oxidation in liquids.<sup>6,7</sup> When there are more free radicals in the human body than antioxidants, the condition is called oxidative stress and has an impact on cardiovascular disease, hypertension, chronic inflammatory diseases, diabetes as well as on critically ill patients and individuals with severe burns.<sup>8,9</sup> Beneficial effects of vitamin C against respiratory tract infections (RTIs) are caused by its antioxidant properties. In RTIs, neutrophils release large amounts of oxidizing compounds that are toxic to other cells. Activation of neutrophils promotes an efficient consumption of extracellular vitamin C, which suggests that high concentration of vitamin C may provide protection against the harmful effects of oxidants released.<sup>10-12</sup>

Vitamin C has special importance in malnourished children in whom vitamin C and zinc level are very low and immune system becomes very weak. Antibiotics have a role in bacterial infection but not in viral infections which are usually self limited by body's immune response. So if body immune response is weak, viral infection can become very serious and life threatening. Currently there is no role of antiviral therapy in pneumonia. To strengthen the immune response, vitamin C and zinc are the suggested therapeutic candidates in these patients.<sup>13</sup> Various

studies have proved that zinc and vitamin C have synergistic effect against pneumonia. Hence it is appropriate and beneficial to give combination of zinc and vitamin C to children during treatment of pneumonia along with antibiotic and bronchodilator.<sup>4,14</sup> Various studies have been done on vitamin C in the prophylaxis and treatment of respiratory tract infections in adults, however research on Vitamin C for children is rare. Two studies have been found addressing this issue one in Bangladesh and other in United States of America.<sup>15, 16, 17</sup>

### Patients and Methods

This study was conducted at Pediatric Department, Islamic International Medical College-Trust, (IIMC-T), Railway Hospital, Rawalpindi, from 1<sup>st</sup> April 2010 to 31<sup>st</sup> March 2011.

Children aged 2 month to 5 years suffering from severe pneumonia admitted in pediatric ward of Railway Hospital were included in the study. Children having severe neutropenia (Absolute neutrophil count <500/mm<sup>3</sup>), children with concomitant non-pulmonary infections, lack of improvement with treatment within 48 hours and children referred from other hospitals who had already got some treatment were excluded from the study.

In vitamin C group (n=111), children received 200mg of vitamin C drops (2 ml = 4 dropper mixed in milk or water) once daily. In other group (n=111) children received placebo drops (consisted of sodium citrate along with coloring agent mixed in water), which matched exactly with vitamin C drops in color and taste. Rest of the treatment (IV Amoxicillin and supportive treatment) was same in both groups. Clinical progress of both the groups was taken thrice daily in terms of oxygen saturation, respiratory rate and chest indrawing. The number of days taken by severe pneumonia to improve was recorded. Criteria for improvement was respiratory rate less than 50/min (in an infant 2 months up to 12 months and less than 40/min( in a child 1 year up to 5 years), no chest Indrawing and Oxygen saturation ≥95% on room air. Chi square test was used to compare the efficacy of drugs in both groups. p-value less than 0.05 was considered significant.

### Results

In vitamin C group 73(65.76%) were male and 38(34.23%) were female. In placebo group 64 (57.65%) were male and 47(42.34%) were female. Majority were less than one year of age (Table 1) and majority had weight between 5<sup>th</sup> to 25<sup>th</sup> centile (Table 2). In Vitamin

C group significant difference was observed between number of days consumed to show improvement in respiratory rate (3.61± 1.50 mean ± SD) and oxygen saturation (1.03± 0.16 mean ± SD) as compared to placebo group where days taken by respiratory rate and oxygen saturation to improve were (4.04 ± 1.62 mean ± SD) and (1.14± 1.0 mean ± SD) respectively. No significant difference was detected between the two groups for chest indrawing (Table 3).

**Table 1: Distribution of age in study groups**

Age	Vitamin C	Placebo	Total
Less than 1 Year	59	71	130
1-3 Years	38	28	66
4-5 Years	14	12	26

**Table2: Distribution of weight by centile**

Centile	Vitamin C	Placebo	Total
Less than 5 <sup>th</sup> centile	32	27	59
Between 5 <sup>th</sup> and 25 <sup>th</sup> centile	47	69	116
Between 50 <sup>th</sup> and 95 <sup>th</sup> centile	28	14	42
Above 95 <sup>th</sup> centile	3	2	5

**Table 3: Comparison between vitamin C and placebo group**

Indicators		Vitamin C (n=111) freq (%)	Placebo (n=111) freq (%)	P-value
Respiratory Rate to improve < 04 days	Yes	84(76)	69(62)	0.030*
	No	27(24)	42(38)	
Chest in drawing to improve < 02 days	Yes	70(63)	59(53)	0.135
	No	41(37)	52(47)	
Oxygen Saturation to improve < 01 day	Yes	108(97)	96(86)	0.003**
	No	03(03)	15(14)	

\*Statistically significant at <0.05;\*\* Statistically significant at <0.01

### Discussion

Few studies have been carried out regarding role of vitamin C in pneumonia. In these studies improvement was monitored in terms of respiratory rate and chest indrawing but oxygen saturation was not considered in any of these studies. In our study, oxygen saturation improved first followed by chest indrawing and fast breathing with mean ± SD of 1.03±0.16, 2.23±1.11 and 3.61±1.50 respectively in vitamin C group as compared to 1.14 ± 0.34(P 0.003)=, 2.54 ±1.14 (p = 0.038) and 4.04 ±1.62 (p = 0.44) days in

placebo group. These results are comparable to the study done in Rangpur Bangladesh where chest indrawing improved in 3.0 days in vitamin C group as compared to 3.5 days in control group and fast breathing improved in 4 days in vitamin C group as compared to 4.5 days in control group.<sup>16</sup>

In a study conducted in Israel, total no. of days (mean  $\pm$  SD) of acute respiratory tract infections were 2.1 $\pm$ 2.9 in vitamin C group as compared to 5.4 $\pm$ 4.4 in placebo group.<sup>17</sup> These results are comparable to our study but showed much greater improvement as compared to present study and that conducted in Rangpur, Bangladesh. One study conducted in Soviet Union in adults suffering from pneumonia found a dose dependant reduction in time to recovery with 2 doses of vitamin C.<sup>15</sup> In study done in United Kingdom on elderly patients suffering from pneumonia, low mortality and good progress in the vitamin C group was noted as compared to those in placebo group.<sup>18</sup>

In present study vitamin C levels were not done, due to non-availability. Double blinding of study was not done which could be the source of bias in this study. We didn't group the children having bacterial or viral pneumonia. Further studies should be done separately in bacterial and viral pneumonia to see in which group vitamin C is more effective and also separate studies should be done in children having normal level of vitamin C and vitamin C deficient children to see in which group it is more effective. We exclude the children less than 2 months of age and with neutropenia.

### **Conclusion**

1. Vitamin C is effective in reducing duration of severe pneumonia in children less than five years of age.
2. Vitamin C should be included in treatment protocol of children with pneumonia so that mortality and morbidity can be reduced cost effectively.
3. It is important to find out the response of vitamin C in pneumonias, in relation to different age groups and etiologies.

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