FREQUENCY OF PULMONARY TUBERCULOSIS IN SEVERELY ACUTE MALNOURISHED CHILDREN AND ITS ASSOCIATION WITH INAPPROPRIATE FEEDING PRACTICES

Bushra Khalil[1], Mohammad Hussain[1], Wajiha Taj[1], Sajid Iqbal[1], Mohammad Irshad[1], Muhammad Jamal Khan[2], Ihsan Ullah[3]

[1]Department of Pediatrics, MTI Lady Reading Hospital, Peshawar - Pakistan

[2]Department of Human Nutrition the University of Agriculture, Peshawar -Pakistan

[3]Department of Microbiology, IBMS Khyber Medical University, Peshawar - Pakistan

ABSTRACT

Objective: To determine the frequency of pulmonary Tuberculosis (TB) among severely malnourished children and its association with inappropriate feeding practices.

Materials and Methods: This cross-sectional study was conducted at the Nutritional Rehabilitation Unit/Stabilization Center (NRU/SC), Pediatric ward, Lady reading hospital Peshawar. A total of 222 (118 male and 104 females) severely malnourished In-patients, aged 2-59 months were enrolled and their demographics like age, gender, parent's literacy rate, family income and family type were studied. All enrolled patients were screened for TB using the National TB control Program and Pakistan Pediatric Association scoring chart. Socio-demographic characteristics, nutritional status, immunization status, and feeding practices of all the enrolled subjects were determined and analyzed.

Results: Amongst 222 patients, 82(36.9%) were diagnosed with TB. Among these, 58 patients (70.7%) were severely malnourished, indicating that malnutrition may be a risk factor for TB. Among these, only 2.4% were breastfed. Lower rate of breast feeding was significantly (p<0.05) associated with greater occurrence of TB. Majority (63.4%) of TB cases started complimentary feeding late as compared to the recommended age (p<0.05). Other characteristics like family type, illiteracy, poverty and lack of immunization had insignificant association with increased risk of TB

Conclusion: Malnutrition and inappropriate feeding practices increased the risk of developing Pulmonary Tuberculosis.

Keywords: Tuberculosis, Malnutrition, Breastfeeding, Severe Acute Malnutrition.

INTRODUCTION

Breast milk is first and most appropriate nutrition for the infant [1]. Benefits of breast feeding includes financial, psycho-social, developmental and is a mean of prevention from infection and other diseases[1]. Colostrum is the immunological rather than nutritional component of breast milk as it contains over 250 immunologically active protein which include hormones, enzymes, immunoglobulins, signaling molecules, cytokines, inflammatory mediators and soluble receptors[2]. Studies have documented that the use of breast milk is associated with a decrease in the incidence and severity of infections[3]. It is a great source of Glucans, which acts as a substrate for the fermentation and colonization of commensal bacteria and prevents the binding of pathogens to the mucosal surface[4]. In breast milk, nucleotide content is higher as compared to cow milk or cow milk protein-based infant formula, and it plays a vital role in immune function[5]. Weak immune system of the baby is responsible for more than 80 different auto-immune diseases[2]. Protective factors of human milk contribute against infections by direct immunity and immune regulatory effects built on anti-inflammatory capacity[2]. Epidemiological studies in highly populated areas have found that bottle fed children had a 3 to 10 times higher risk of infectious disease as compared to breastfed children[6].

Malnutrition, human immune system and infectious diseases are linked together in a complex triangular association[7]. Malnutrition leads to malfunction of human defense mechanism and because of impaired immune system, body is more vulnerable to infectious diseases[7].

Among infectious diseases, Tuberculosis is one of

Correspondence
Dr. Muhammad Hussain
Associate Professor
Incharge Children C Ward
Department of Pediatrics, MTI Lady Reading Hospital Peshawar
Email: drmhussainkhan@hotmail.com
Cell:+92-333-914443

the most common and is among top 10 causes of death worldwide (WHO report, 2018). Ten million peoples were infected by Tuberculosis in 2017, while 1.6 million people died of it (WHO report,2018). Among those 10 million infected people, 1 million were children and 230,000 TB affected children died of it (WHO report, 2018). Pakistan ranks 5th among the 30 countries having high TB burden.

WHO states that malnutrition is a significant risk factor for tuberculosis. In tuberculosis dominant countries, malnutrition contributes to 2.2 million deaths in under 5 years of age children. Tuberculosis is found among infants having suppressed cell mediated immunity as a result of malnutrition[4, 8]. NAIDS (Nutritionally Acquired Immune Deficiency Syndrome) is often found in children worldwide and is a major cause of tuberculosis[7]. There exists a bilateral interaction between malnutrition and TB, i.e., tuberculosis may be caused by malnutrition and vice versa[9]. Malnutrition is linked to the abnormal Cell Mediated Immunity, which is key against Tuberculosis infection[10]. In this study, we prospectively investigated both the frequency of tuberculosis and the relationship of inappropriate feeding practices on the occurrence of TB infection among severely acute malnourished children that were admitted in Nutritional Rehabilitation Unit / Stabilization Center, Lady Reading Hospital, Peshawar

MATERIAL AND METHODS

This cross-sectional study was conducted at the Nutritional Rehabilitation Unit/Stabilization Center (NRU/SC), Pediatric ward, Lady reading hospital Peshawar from August 14, 2018 to October 14, 2018. A total of 222 (118 male and 104 females) severely malnourished in-patients aged 2-59 months were enrolled and their demographics like age, gender, parent's literacy rate, family income and family type were recorded after informed consent from the parents. Patients are admitted based on the criteria of anthropometric measurements, i.e., weight, height/length, and Z-score (weight for height/length). Z-score was determined by using WHO Z-score table manually. Patients having Z-score of <-3SD and those having a Z-score of <-2SD with no appetite or medical complication were considered for admission in NRU/SC. Those patients having other chronic diseases and more than 5 years were excluded from the study.

Mothers of children were interviewed for family history, demographic and socio-economic data, infant feeding history, immunization status. Later, on the second day of admission, mothers were re-interviewed for Tuberculosis scoring using the NTP and PPA scoring chart for screening of TB in children. After admission, complete blood count, erythrocyte sedimentation rate and chest X-Ray was done. The degree of malnutrition was determined using WHO Z-score and those having Z-score of -2 to3SD to<-2SD were termed as moderately malnourished, while those with a Z-score of <3SD or having edema were termed as severely malnourished. Patients were diagnosed as TB and Non-TB patients based on TB scoring chart. If TB score was 7 or more, patient was diagnosed as Pulmonary Tuberculosis patient and less than 7 score was termed as Non-Tuberculosis patient. Patients having TB score of 5 or 6 were referred for further investigations.

STATISTICAL ANALYSIS

SPSS v16.0 was used for performing the statistical analysis. The significance level was set at 5% (α=0.05) or 95% CI were calculated. Means, standard deviations and significant differences were calculated. Frequency of Pulmonary Tuberculosis was measured. Two tailed Pearson correlation coefficient was performed to evaluate the P-value. Comparisons between different variables of socio-demographic characteristic, nutritional status, and feeding practices based on presence and absence of Tuberculosis were calculated.

RESULTS

According to TB scoring of the study population, 82 (36.9%) patients were having a TB score of 7 or more and they were diagnosed to be TB infected, 131 (59%) patients were having a TB score of (0-4) and were diagnosed as Non-TB, while 9 (4.1%) patients had TB score between 5-6. They were referred for further investigations for the confirmation of tuberculosis as show in table 1. According to the socio-demographic characteristics, parents' education, financial status, family status and age are all variables were insignificant for the development of tuberculosis as shown in the table 2. According to grades of nutritional status of the patients, severe malnutrition was more prevalent where TB was more prevalent than the moderate nutritional deficiency as shown in the figure as shown in table 3. When we looked at the feeding practices of patients, no breast-feeding was done to most 80 (97.6%) of TB patients while only 18 (12.9%) non-TB patients received no breast-feeding with (P<0.0001) as shown in the table 4.

Table 1: Frequency of Tuberculosis based on TB scoring chart (n=222).

Tuberculosis Scoring	Frequency (%)
Non-Tuberculosis (0-4)	131 (59%)
Possible tuberculosis (5-6) [needed further investigation]	09 (4.1%)
Confirm Tuberculosis (7 or more)	82 (36.9%)

Table 2: Socio-demographic characteristics of subjects (n=222).

Variable		Tuberculosis Mean ± S.D/ Frequency (%)		P-value
		Yes	No	
Father education	Illiterate	54 (65.8%)	102 (72.8%)	0.273
	Literate	28 (34.2%)	38 (27.2%)	
Mother education	Illiterate	78 (95.1%)	130 (92.85%)	0.505
	Literate	4 (4.9%)	10 (7.2%)	
Monthly income	Poor	54 (65.8%)	88 (62.8%)	0.655
	Satisfactory	28 (34.2%)	52 (37.2%)	
Family type	Joint	68 (82.9%)	106 (75.7%)	0.158
	Independent	14 (17.1%)	34 (24.3%)	
Age	1-6 months	6 (7.3%)	12 (8.5%)	0.155
	7-12 months	14 (17.0%)	38 (27.1%)	
	>12 months	62 (75.6%)	90 (64.2%)	

Table 3: Nutritional status of subjects(n=222).

Variable		Tuberculosis Mean ± S.D/ Frequency (%)		P-value
		Yes	No	
Grades of alnutrition	Moderate	18 (22.0%)	14 (10.0%)	0.014
	Severe	64 (78.0%)	126(90.0%)	

Table 4: Feeding practices of the subjects(n=222).

Variable		Tuberculosis Mean ± S.D/ Frequency (%)		P-value
		Yes	No	
Breast feeding	Yes	2 (2.4%)	122 (87.1%)	0.001
	No	80 (97.6%)	18 (12.9%)	
Exclusive Breastfeeding	Yes	0 (0%)	128 (91.4%)	0.001
	No	82 (100.0%)	12 (8.6%)	
Exclusive Breastfeeding in months	No EBF	82 (100%)	14 (10.0%)	0.001
	EBF for 1-3 months	0 (0%)	18 (12.8%)	
	EBF for 4-6 months	0 (0%)	66 (47.1%)	
	EBF for 7-12 months	0 (0%)	30 (21.4%)	
	EBF for >12 months	0 (0%)	12 (8.5%)	
Bottle feeding	Yes	80 (97.5%)	60 (42.8%)	0.001
	No	2 (2.5%)	80 (57.2%)	
Complimentary Feeding initiation	CF not started yet	12 (14.6%)	10 (7.1%)	0.711
	Early Initiation	4 (4.8%)	10 (7.1%)	
	CF at 6 Months	14 %17.0))	%30) 42)	
	Late Initiation	52 %63.4))	78 %55.8))	

DISCUSSION

The study revealed that among malnourished patients, over one third of patients were suffering from pulmonary Tuberculosis. Our results in the present study demonstrated that the chances of Tuberculosis increased with the severity of malnutrition. Another study also concluded that chances of Pulmonary Tuberculosis increases with increase in the severity of malnutrition[12]. Furthermore, it was noted that low frequency of proper breastfeeding (i.e., late initiation of breast feeding and exclusive breast feeding for more than 6 months) was associated with greater chances of Tuberculosis. The presence of antibodies and protective agents in breast milk protect body against Pulmonary tuberculosis infection[2,4,5]. Breast milk improves cell mediated immunity and it also helps in the maturation of T-cells enhances the body immune system specially the innate immune system which has a protective role against tuberculosis[4,7,11].

Moreover, from the results, characteristics like age, family type, parent's education, poverty level and immunization status had some non-significant impact on the occurrence of Tuberculosis. Annual report of National Tuberculosis control Program (NTP 2016) and the results of previous studies indicates that children aged between 12 months and 5 years of age are highly susceptible towards Tuberculosis infection, while the characteristics like illiteracy, poverty, overcrowding, malnutrition and lack of BCG vaccination also contribute towards higher chances of developing tuberculosis[4,8,9,13].

There are a few limitations to this study. First, all patients were enrolled in Nutritional Rehabilitation Unit/ Stabilization Center (NRU/SC). Secondly, age of the study patients was between 2 months and 5 years of age. Thus, study patient did not imitate all population of Tuberculosis patients, which limits generalization. Thirdly, confirmatory tests for Tuberculosis which include Gene X-pert test and histology were not performed in some patients (8 in number) whose TB score was 5-6 and further investigations were needed but not done because of non-availability of these facilities.

CONCLUSION

The severity of malnutrition increases the chances of Pulmonary Tuberculosis among children aged <5 years. Besides malnutrition, other characteristics like illiteracy, overcrowding, poverty and lack of vaccination also enhances the chances of Tuberculous infection. Other important findings include inappropriate feeding practices such as late initiation of breastfeeding and no exclusive breastfeeding for 6 months, which may lead to more chances of tuberculosis infection We need more prospective studies that evaluate the impact of how nutritional status influences increased Tuberculosis risk.

REFRENCES

1. Ladomenou F, Moschandreas J, Kafatos A, Tselentis Y, Galanakis E. Protective effect of exclusive breastfeeding against infections during infancy: a prospective study. Archives of disease in childhood. 2010;95(12):1004-8.

2. Vieira Borba V, Sharif K, Shoenfeld Y. Breastfeeding and autoimmunity: Programing health from the beginning. American Journal of Reproductive Immunology. 2018;79(1):e12778.

3. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, Eidelman AI. Breastfeeding and the use of human milk. Pediatrics. 2005;115(2):496-506.

4. Jaganath D, Mupere E. Childhood tuberculosis and malnutrition. The Journal of infectious diseases. 2012

;206(12):1809-15.

5. Pickering LK, Granoff DM, Erickson JR, Masor ML, Cordle CT, Schaller JP, Winship TR, Paule CL, Hilty MD. Modulation of the immune system by human milk and infant formula containing nucleotides. Pediatrics. 1998;101(2):242-9.

6. Newburg DS, Walker WA. Protection of the neonate by the innate immune system of developing gut and of human milk. Pediatric research. 2007;61(1):2.

7. Beisel WR. Nutrition and immune function: overview. The Journal of nutrition. 1996;126(suppl_10):2611S-5S.

8. Shaji B, Thomas EA, Sasidharan PK. Tuberculosis control in India: refocus on nutrition. Indian Journal of Tuberculosis. 2019;66(1):26-9.

9. Macallan DC. Malnutrition in pulmonary tuberculosis. Diagnostic microbiology and infectious disease. 1999;34(2):153-7.

10. Cegielski JP, McMurray DN. The relationship between malnutrition and tuberculosis: evidence from studies in humans and experimental animals. The international journal of tuberculosis and lung disease. 2004;8(3):286-98.

11. Pabst H, Grace M, Godel J, Cho H, Spady D. Effect of breast-feeding on immune response to BCG vaccination. The Lancet. 1989;333(8633):295-7.

12. Zachariah R, Spielmann MP, Harries AD, Salaniponi FM. Moderate to severe malnutrition in patients with tuberculosis is a risk factor associated with early death. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2002;96(3):291-4.

13. Brieger EM. Children in a tuberculosis colony: A Survey of the Papworth Children. Archives of disease in childhood. 1943(96):178.

AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Khalil B:	Data Collection, analysis and introduction
Hussain M:	Concept ,study design facilitation for the study and correspondence
Taj W:	Data collection, discussion
Iqbal S:	Data collection, data analysis conclusion
Irshad M:	Methodology, data analysis, table and graphs
Jamal M:	Data Collection analysis and methodology
Ullah I:	References and final proof reading

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.