International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 25-10-2018; Accepted: 28-11-2018
www.medicalsciencejournal.com
Volume 4; Issue 12; December 2018; Page No. 121-125

Original research Article: The proportion of tuberculin test positive patients among severely acute malnourished / moderately acute malnourished children registered with Anganwadi centers in Karad TU

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Abstract
Background: WHO has declared TB to be responsible for more deaths than any other single infectious disease. The rate of infection is higher in malnourished children compared to well nourished children. India houses highest number of malnourished children in the world. The Tuberculin skin test (TST) is one of the investigations widely used as an important test for diagnosing tuberculosis. The present study is therefore done to maximise the detection of TB cases in SAM and MAM children by using TST as the diagnostic investigation.
Objective: To study the prevalance of TST positivity in SAM / MAM children, registered with anganwadi centres of Karad Taluka.
Method: It is a cross-sectional prevalance study involving all the children registered in anganwadi centres in Karad Taluka of Satara Distt.
Results: Prevelance of TST positivity in SAM/MAM children was estimated to be 12.5% Out of the 4500 children, 104 were either SAM (42) or MAM (62). After testing the 104 children with TST, 13 children (12.5%) showed a positive response, 5 out of which had SAM and 8 had MAM. Also, 4 children showed Chest X-Ray signs s/o TB (3 SAM, 1 MAM). 2 children (0 SAM, 2MAM) had matted lymph nodes.
Conclusion: TST serves as an indicator of latent TB infection. This test could be used to it's full potential for early detection and treatment of M. Tuberculosis infection, before it presents as full blown TB disease. Since children with SAM/MAM show a degree of immunosuppression, they are at a higher risk of getting infected with tuberculosis and should be screened prudently.

Keywords: malnourished children, Anganwadi, tuberculosis

Introduction

Tuberculosis remains a leading cause of morbidity and mortality in the world, especially in developing countries. Tuberculosis (TB) in children is increasingly being recognised as a significant public health issue and now the new figures have estimated that at least 67 million children were infected by Mycobacterium tuberculosis with 850,000 developing active disease [1].

Malnutrition is also highly prevalent in children living in tuberculosis endemic countries and contributes to 2.2 million deaths in children under 5 years of age globally [2].

Severe malnutrition, younger age and absence of BCG vaccination are significant risk factors for acquiring of infection. The only evidence of infection may be a positive TST [3]. Malnutrition is lethal in combination with TB. Severe malnutrition leads to an immunodeficiency state known as NAIDs (Nutritionally Acquired Immune Deficiency) [4, 5]. Malnutrition mainly affects cell mediated immunity (CMI) and CMI is the principal host defence against tuberculosis [4-6]. Tuberculosis infection among children can be used as a marker of recent ongoing transmission in the communities. Therefore information on prevalence of tuberculosis infection among children is important to evaluate tuberculosis transmission in community. The commonest age for developing childhood tuberculosis is 1 to 4 years [7, 8].

Studies have also shown that the socio economic factors such as poor housing, crowded condition, poorly ventilated spaces, low income, lack of access to medical care, lack of knowledge of tuberculosis prevention are associated with tuberculosis infection. Globally, tuberculosis control program has given low priority to childhood tuberculosis [9].

The reason for this may be diagnostic difficulties faced in paediatric tuberculosis, the limited resources available for tuberculosis control activities, a misplaced faith in BCG, a lack of data on treatment and the belief that tuberculosis in children is rarely infectious. Additionally, contact tracing is rarely done in developing countries like India because of lack of resources and social stigma.

What This Study Adds?

This study provides baseline information of tuberculin test positivity in SAM and MAM children in Karad TU, which can help in the estimation of Latent TB Infection in the malnourished children.

AIM of the Study

This study was planned to detect TB cases by the help of TST in severe acute malnourished (SAM) and moderately acute malnourished (MAM) children and to know what is the extent of the infection among SAM and MAM children registered in anganwadi centers in Karad TU of district Satara.

Methods

Study design

This was a cross-sectional prevelance study involving all the children registered in anganwadi centers in Karad TU of Satara district.

Karad TU was selected because of the feasibility of the study due to close proximity of Krishna Institute of Medical Sciences with the anganwadi centers of this TU.

Study population

Inclusion criteria

- All the SAM and MAM children registered in anganwadi centers in Karad TU of Satara district

Exclusion criteria

- Children who were not registered in the anganwadi centers of Karad TU,
- Children above 5 years of age,
- Children whose parents did not give consent for getting enrolled in this study.

Operational definitions

1 Tuberculin skin testing (TST)

The TST is the intradermal injection of 5 tuberculin units (TU) (0.1ml). PPD-RT 23 with Tween 80 of strength 1 TU and 2 TU are standardized tuberculins available in India supplied by the Bacillus Calmette-Guérin (BCG) vaccine Laboratory, Guindy, Chennai. Tween 80 is a detergent added to tuberculin to prevent its adsorption on glass or plastic surface. TST is read at 48-72 hours [10]. Grossly, it is considered positive if induration of 5mm or more is seen in unvaccinated children and induration of 10 mm or more in children who has received BCG vaccination.

2 Chest X-ray

Chest x ray PA view showing focal opacities, hilar lymphadenopathies, consolidation or pleural effusion alone or in combination are considered to be suggestive of positive tuberculosis changes.

3 Severe acute malnutrition

Severe acute malnutrition is defined as weight for height Z-score < −3 or MUAC < 115 millimeters (11.5 cms), or the presence of bilateral pitting oedema, or both [11].

4 Moderately acute malnutrition

Moderate acute malnutrition (MAM) is defined as weight-for-height z-score (WHZ) between −2 and −3 or mid-upper arm circumference (MUAC) between 115 millimeters (11.5 cms) and <125 millimeters (12.5 cms) [11].

Shakir's tape was used for measurement of mid-arm circumference.

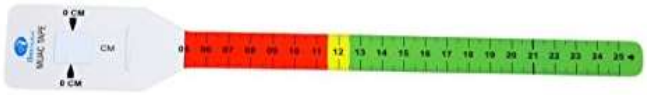

Fig 1

Sample size

There are around 150 anganwadi in Karad TU and each anganwadi has around 30 children. So total of around 4500 children were screened for SAM and MAM.

Data collection

All the children registered with anganwadi centers of Karad TU were screened for severe or moderate malnutrion by anganwadi workers, and sent to Krishna Hospital for further evaluation.

1. **Phase I:** In this phase, children were excluded on the basis of age and not fulfilling criteria to be under SAM/MAM as screened by Anganwadi workers
2. **Phase II:** In this phase, the remaining children were received by the paediatric residents at KIMS, and were meticulously screened with respect to anthropometry. Those who were confirmed to be SAM or MAM were then included in the next phase
3. **Phase III:** A detailed physical examination, Tuberculin skin test and chest xray was done on the remaining children. Interpretation of the TST was done at 48-72 hours.

   Those testing positive for any of the above were referred to RNTCP for further investigations like sputum for AFB and CBNAAT.

Sampling procedure

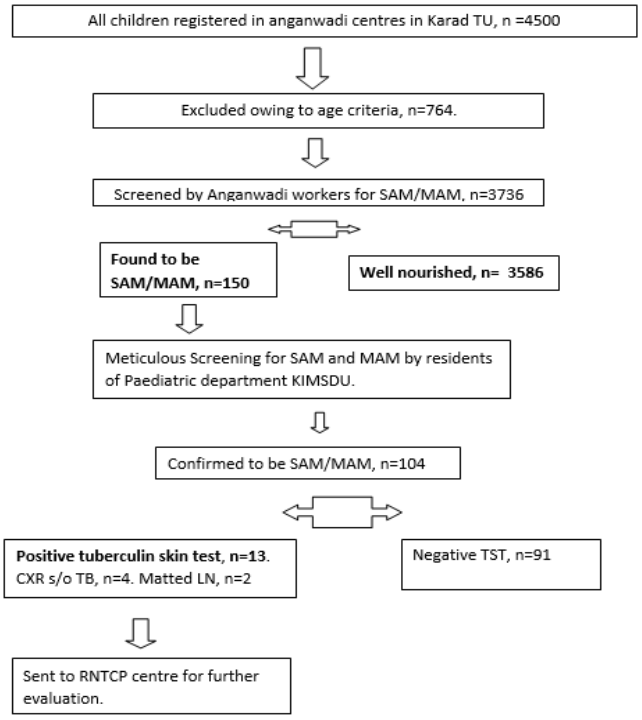

Fig 2

Results

Out of 4500 children, 764 were excluded owing to age criteria. The remaining children (n=3736) were screened by Anganwadi workers, who found 150 children falling under SAM/MAM according to anthropometric measures. The 150 children received by the paediatric residents at KIMS, were meticulously screened with respect to anthropometry, of which 104 were confirmed to have SAM/MAM. A detailed physical examination, Tuberculin skin test and chest xray was done on these 104 children. Interpretation of the TST was done at 48-72 hours.

- Out of 104 children, 42 were found to have SAM, and 62 had MAM
- Out of 3736 children of the age group 6-60months, 1.12% were SAM (n = 42) and 1.66% were MAM (n= 62)
- 13 out of 104 children tested positive for tuberculin test (12.5%).
  - 5 out of 42 SAM (11.9%) and 8 out of 62 MAM (12.9%) had a positive TST.
- There were 61 males and 43 females.
  - 7 males (11.4%) and 6 females (13.9%) had a positive TST
- There are 32 children less than 3 years of age and 72 children more than 3 years. Of the malnourished children who were less than 3 years of age, 25% were positive for TST as compared to only 7 % of the malnourished children who were more than 3 years of age

Table 1: Nutritional Status among Patients.

Nutritional Status	Frequency	Percent
MAM	62	59.6
SAM	42	40.4
Total	104	100.0

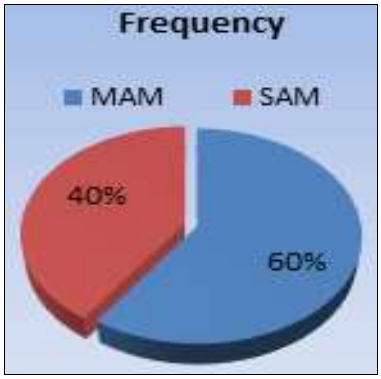

Fig 3: PIE chart showing frequency of SAM and MAM

Table 2: Genderwise Distribution of SAM and MAM Children in Anganwadi.

Gender	No. of Participants	Percent %
Male	61	59
Female	43	41
Total	104	100

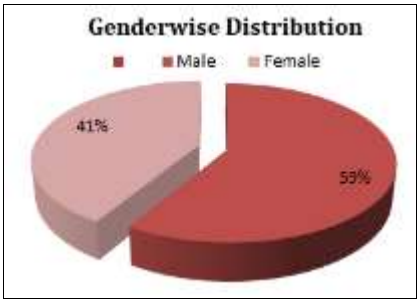

Fig 4: Pie-chart Showing Gender wise Distribution

Table 3: Gender wise distribution of TST status among anganwadi children

Gender	TST		Total	Odd's Ratio	P-value
	Positive	Negative			
Male	7	54	61	0.7994	0.7683
Female	6	37	43		
Total	13	91	104		

Table 4: Gender wise distribution with nutritional Status of TST Positive Children

Gender	Nutritional status		Total	Odd's Ratio	P-value
	SAM	MAM			
Male	1	6	7	0.08333	0.1026
Female	4	2	6		
Total	5	8	13		

Table 5: Age wise Distribution of TST Status among Anganwadi Children

Age	TST		Total	Chi-square	P-value
	Positive	Negative			
Less than 3 years (< 36 months)	8	26	34	9.716	0.0211
3-5 years	5	65	70		
Total	13	91	104		

Table 6: Age wise Distribution with nutrirional status of TST Positive children

Age	*Nutritionol status*		*Total*	*Chi-square*	*P-value*
	SAM	*MAM*			
Less than 3years (< 36 Months)	2	6	8 (62%)		
3-5 years	3	2	5(38%)	4.813	0.1861
Total	5 (38 %)	8 (62%)	13 (100%)		

Discussion

Tuberculin skin test is normally read at 48–72 hours after administration [12]. Charles Mantoux gave the basis for this time limit in his original description of intradermal tuberculin test in which he indicated that the presence of induration within 72 h constituted a positive response [13]. Further, as tuberculin reaction is a type of delayed hypersensitivity reaction, which has been noted to peak at 48–72 h, it is logical that this test is read at this time [14].

Latent TB occurs when a person has the TB bacteria within their body, but the bacteria are present in very small numbers. They are kept under control by the body's immune system. So, a person with latent TB does not have any symptoms. Children with latent TB do not feel sick. They cannot pass the bacteria on to other people. In addition they will usually have a normal chest x-ray and a negative sputum test. It is often only known that someone has latent TB because they have had a Tuberculin skin test. Children are at much higher risk of progression to active disease than adults. This risk is greatest for infants and children under 2 years of age [15].

It is not recommended that everyone with latent TB infection (LTBI) should have TB treatment. Rather it is recommended that certain "target" groups should receive treatment. The main "target" groups considered by the World Health Organisation (WHO) to be most at risk from progressing from latent to active TB include children:

- Who have had recent contact with an infectious patient;
- Infected with both TB and HIV
- Who are homeless
- Who have conditions which compromise their immune system.
- Under five who are household contacts of pulmonary TB cases [16].

Young children are at risk of developing primary progressive disease with the risk being higher among malnourished children and children under-5 years of age.

In our study, 12.5% of SAM and MAM children were found to be tuberculin positive. This is not strictly comparable with other studies, as different workers have used different strengths of purified protein derivative or variable cut off criteria. However, the trend of tuberculin positivity was similar to other studies from developing countries, but higher than the results reported from developed countries.

In a previous study by Shah *et al.* in Pondicherry, the prevalence of tuberculin positivity was found to be 15.3%.[17] In high-income countries like Australia and Italy, the reported prevalence of tuberculin positivity was 10 and 8.4% respectively [18, 19]. In an Iranian study, TST was performed on 10,184 children aged 7-11 years. The rate of positive TST cases was 8.15% with no new cases of active tuberculosis detection within five-year follow-up [20].

Malnutrition can also impair the protective efficacy of Bacillus Calmette-Guerin (BCG) vaccine among a nutritionally deficient vaccinated population [21, 22]. In a study done in the 1960s it was shown that following BCG vaccination, malnourished children were twice as likely to develop TB as their well-nourished peers [21, 22]. Undernourished contacts of drug-resistant TB patients showed a higher risk of developing active disease.

In advanced malnutrition, false negative tuberculin reactions are very frequent [23]. In a study, within a month of starting routine radiographic examination of cases of malnutrition, it was observed that 11 cases of advanced malnutrition were showing evidence of tuberculosis, but with negative Montoux reaction. False negative tuberculin reaction is because of immunosuppression in protein malnutrition states. Nutritional rehabilitation of such children renders the tuberculin test positive in these children [24].

Conclusion

TST serves as an indicator of latent TB infection. This test could be used to it's full potential for early detection and treatment of M. Tuberculosis infection, before it presents as full blown TB disease. Since children with SAM/MAM show a degree of immunosuppression, they are at a higher risk of getting infected with tuberculosis and should be screened prudently. Whilst at one end of the spectrum, we are witnessing a heightened discourse on the crisis of malnutrition, there is very little attention being given to the dyadic relationship between tuberculosis and malnutrition. Diagnosis of TB amongst the children affected with malnutrition has not yet been seen as a significant strategic need. The reality, however is that we cannot ignore the impact of TB when there is such a widespread prevalance of TB amongst the children.

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