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# Investment in paediatric tuberculosis prevention in Pakistan: Loss or gain?

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## Abstract

**Objective:** To assess the effectiveness of paediatric tuberculosis prevention, by reevaluation factors in children exposed to tuberculosis from less privileged strata of Pakistan.

**Methods:** This cross sectional descriptive study was conducted at National Institute of Child Health, from January 2004 to December 2005. Paediatric patients under 15 years of either gender, diagnosed with active tuberculosis were enrolled. Interviews were conducted with parents regarding common preventive measures and factors advocating tuberculosis spread. Later factors leading to non-compliance to safety recommendations were also evaluated.

**Results:** Fifty five (70%) children younger than 5 years, had index cases in direct contact within their own house. Fifteen (14%) patients contracted the infection from neighbours, with 11 being older than 5 years. There were 82 (51%) cases with Protein Calorie Malnutrition (PCM). Total of 66(41%) cases of PCM were <5 years age (p <0.005). Data showed 123(77%) children living in a family with 5 or more members. Sixty eight (55%) children of these large families had to live in a single room house.

**Conclusion:** There is a high frequency of direct contact tuberculosis in children belonging to the lower socio-economic class. This is attributed to poor housing condition and over crowding. The current paediatric tuberculosis prevention strategies as adapted from World Health Organizations' Millennium Development Goals are ineffectual to make changes in children exposed to tuberculosis from less privileged strata of Pakistan.

Our societal and demographic factors remain static, continually exposing our children to higher risk of tuberculosis exposure (JPMA 60:897; 2010).

## Introduction

There is a rising trend of global TB incidence, with 9 million new cases and 2 million deaths each year, 75% of them residing in 22 high-burden countries, with 1 million (11%) new cases in children.<sup>1,2</sup> WHO estimates that till 2010 the death toll due to tuberculosis might mount to 3 million deaths per year. Nearly 8-20% deaths due to tuberculosis occur in children.<sup>3</sup> In developing countries the annual risk of tuberculous infection is 2-5% per year. Pakistan ranks 6th among 22 countries of the EMRO region, where incidence and prevalence of TB is 181 and 297/100,000 population/year respectively with 1.7% annual risk of infection.<sup>4,5</sup> Millennium development goals (MDG's) of WHO as its 6th agenda, is to slow down the spread of TB from South Eastern countries, like Pakistan where the mortality rates are high.<sup>6</sup> In spite of good DOTS coverage from 2% in 1995 to 100% in 2005 with a spending of 12 million US \$ in 2007, the success out come is still not known.<sup>6</sup> The escalating incidence of tuberculosis in Pakistan is probably due to the persistent poor socio-political conditions, inadequate health care infrastructure, under-nutrition, overcrowded living conditions, influx of refugees and rising incidence of HIV/AIDS. Hence the MDGs achievement still appears difficult.

Despite the massive funding, wide spread acceptance of WHO tuberculosis control programme and with the implementation of DOTS (directly observed treatment strategy), the targets of 70% case detection and curing 85% of those detected are difficult to achieve.<sup>7</sup> In paediatric population mode of transmission of TB differs from adults, as the victims of the tuberculosis are children of infected adults, especially in low socio-economic societies. Young TB infected children rarely transmit the organism to other children or adults. Adolescence may have adult type cavitory tuberculosis which might transmit the disease.<sup>8</sup> In the absence of adequate treatment, untreated smear positive adults might infect an average 10-14 persons/children per year in their vicinity.<sup>9</sup> Data available to determine the significance of contact history, demography and other societal factors on childhood tuberculosis, document that closer and prolonged contact is more likely to provide the chance of disease exposure.

The main constrains as observed by WHO was inefficient political commitments, improper use of resources, poor health and managerial system, lack of information and data collection and interrupted drugs supplies.<sup>10</sup> Thus most of the paediatric tuberculosis control programme is based on the current understanding of societal and demographical factors

that influence transmission of Mycobacterium tuberculosis.<sup>11</sup> The present day situation of modified clinical features, nature and trends of this deadly disease, with new emerging multiresistant tuberculosis, and decades of extensive investment and researches, the idea of looking behind on the significance of demography, contact history and other societal factors in the resurgence of tuberculosis in our paediatric population in current situation needs to be re-emphasized. Factors associated with paediatric tuberculosis spread and its influence on children were re-assessed in this study moreso to note any change.

### Patients and Methods

The study was conducted at National Institute of Child Health (NICH) Karachi, Pakistan. NICH is the largest tertiary care paediatric teaching hospital in Karachi with 500 beds and an average 50,000 patients per year to the emergency and OPD. Population strata residing within its catchment area are economically deprived, more prone to get infected with communicable diseases like TB and are similar to the general population.

A cross sectional descriptive study design was adapted. After institutional permission and informed consent, all admitted patients with diagnosis of tuberculosis by WHO criteria were included.

Index case definition was applied according to WHO criteria.<sup>10</sup> Contact was defined as "Living in same household a source case (e.g. the child's caregiver) or in frequent contact with a source case."<sup>2</sup> Household was defined as people living and sleeping in the same house or group of houses/shacks on the same residential site using the same cooking and ablution amenities.<sup>12</sup>

A pretested questionnaire was used. Interviews were conducted from parents regarding common preventive measures and factors advocating tuberculosis spread. All variables in the questionnaire were categorical inquiring about age, gender, contact history, family members, socioeconomic status and Modified Gomez classification was adopted to assess the nutritional status of the child.<sup>12</sup> In-house spacing and rooms as shared by index case, propinquity and duration of index contact with the case was further elaborated. History of contact and the duration was

elaborated in detail. The approximate duration of contact between the case and index was also noted.

Although the sample was taken from the low socio economic families, they were further divided in three groups, high having more than 10,000 rupee monthly salary, middle as 5000-10000 rupee and low as less than 5000 rupees.<sup>13</sup> Children under 15 years of age and either gender were included. Patients with chronic illness, congenital or acquired immunodeficiency states, and patients with malignancy or on steroids/chemotherapy were excluded from the study after being confirmed by the relevant investigations. Outpatient cases of TB were also excluded.

Data collection started in January 2004 and continued till December 2005. One hundred and eighty admitted patients were approached and 160 consented to participate in the study. Response rate of 89% was observed.

A descriptive analysis was done for all variables, using SPSS version 16. Frequencies and percentages are presented for categorical variables.

### Results

Of the 180 paediatric patients, care givers of 20 children refused to enroll in the study. Details of demographic factors and history of contacts are shown in Table-1. Among 97 (61%) children of less than 5 years of age, 44 (45%) were males and 53 (55%) were females. In age group between 5-10 years a similar gender distribution pattern was observed

**Table-1: Comparison of demographical factors to history of contact.**

Variable	N (%) 160 (100)	History of contact	
		Positive (%)	Negative (%)
Age			
<5 years	97 (61)	64 (66)	33 (34)
6-10 years	37 (23)	25 (68)	12 (32)
11-15 years	26 (16)	19 (73)	7 (27)
Gender			
Male	73 (46)	48 (66)	25 (34)
Female	87 (54)	60 (69)	27 (31)
Protein Calorie Malnutrition Status			
PCM I	28 (17)	18 (64)	10 (36)
PCM II	22 (14)	14 (64)	8 (36)
PCM III	32 (20)	20 (63)	12 (38)
Normal	78 (49)	56 (72)	22 (28)

**Table-2: Comparison of Housing Structure and Index Case Locality.**

Housing structure	Index Case Locality				
	Within house	Neighbourhood	Frequently visiting relatives	Others*	Untraceable
Single roomed House	53	4	3	1	30
2-4 roomed house	17	9	4	3	17
>4 roomed house	9	2	3	0	5
Total	79 (49%)	15 (9%)	10 (6%)	4 (3%)	52 (33%)

\*Others include infrequent visitors, friend and servants.

with 22 (59%) females and 15 (41%) males.

A positive contact history was given by 108(68%) active TB patients. Of all the children, 91(57%) lived in a single room house. Duration of contact was another variable analyzed, although in 52(33%) cases the index case could not be identified. Hours of exposure were calculated as approximate time the child spent with the index case per day. Children who spent 4 to 7 hours per day with the index case were more vulnerable to get infected, as noted through 106(98%) cases. Out of 108 contact positive cases, 64(59%) children were younger than 5 years, while 44(41%) were 5 years or older, though the p value was not significant. Narrowing down the propinquity of contact within the surroundings of the children, it was observed that under five were more prone to have droplet infection from immediate family members. Fifty five (70%) children younger than 5 years, had index cases in direct contact within their own house. Fifteen (14%) patients contracted the infection from neighbours, 11 of these children were older than 5 years. Comparison of the housing structure with the index case locality is shown in Table-2.

There were 82(51%) cases with PCM, including 47(57%) females and 35(43%) males.

Nutritional status of our children is another important factor significantly related to the ignorance and partially linked to the socioeconomic status. Total of 66(41%) cases of PCM were <5 year of age. Thirty two (20%) cases under 5 years were in PCM III. Females were most neglected especially in the low income class. In PCM III there were 20(63%) females as compared to 12(37%) males.

The number of members per family in our society correlates with the results. In this study 123(77%) cases had 5 or more family members. Sixty eight (55%) children of these large families had to live in a single room house. Twenty four (75%) children out of total 32 PCM III belonged to large families. Most of these families were economically deprived.

## Discussion

Tuberculosis transmission has been long documented in literature and numerous infection control agencies are trying to combat this deadly disease. However, to date it is still a public health problem, draining the human and economical resources. As evident from the 2007 WHO report, authentic figures from 2004 and 2005 are lacking.<sup>7</sup> Children fall prey to tuberculosis when they come in-line of transmission from adult to adult or adult to children. Virtually all transmission of M. Tuberculosis is from person to person, usually by mucous droplets, thus the demographic factors play an important role in the spread and reemergence of disease.<sup>14</sup>

To control paediatric TB, adult TB has to be controlled. Our data showed an under 5 years morbidity of 97(61%) comparable with Schaaf HS and others.<sup>15,16</sup> The age distribution among contact positive and contact negative matched that of Schaaf HS.<sup>15</sup> It is generally accepted that 30% to 50% of children got infected with household contacts of infectious adult TB. The risk for young children exposed to untreated infection and to develop TB is up to 67% in children younger than 5 years of age as compared to our study which had a figure of 70%.<sup>16,17</sup>

More affected are non-immunized, malnourished, less privileged and ignored female children. This is because the privileged and male dominated society usually delays medical treatment for their female children. Male children older than 10 years of age had more outdoor socialization and contact. They were exposed to tuberculosis from others than household members, thus making it difficult to identify the index case.<sup>16</sup>

Contact tracing of tuberculosis is always a dilemma especially in less resourced countries. Even the contact identification of persons living in the close vicinity or the household remains a challenge for the health care providers. Contact tracing of children aged less than 5 years is an important component of many tuberculosis control programmes.<sup>18</sup> Vertical transmission from parents to children and other siblings in the joint society as of our communities has become a common phenomenon.<sup>19</sup> Close contact generally occur within the household, from parents, elder siblings, care-givers, close relatives, friends, visitors or other household members.<sup>3</sup> A family contact identified by Guillermo E et al<sup>20</sup> was 57% had more or less the same results from developing countries but a much higher figure was observed from developed countries.<sup>21</sup> Positive contact history was identified in 30% of paediatric tuberculosis as published in 2006.<sup>3</sup> Comparatively in 1993, 50-80% were identified by other investigators in 1993.<sup>21</sup> This indicates that in other continents the preventive measures for the control of paediatric tuberculosis is successful in contrast to our local findings. Few of the important societal factors for tuberculous spread in paediatric population, which are preventable by minimizing the contact with index cases with early detection and prompt treatment, good nutritional intake and living in well ventilated houses.

The number of possible contacts with the index patient per unit time per family and number of rooms shared by them are directly proportional to the increase risk of TB for that family or community. In Pakistan we found a large house hold size as identified in population census of Pakistan statistics as 6.8 person/family.<sup>13</sup> Our data showed 2/3rd of our children had 5-7 member family, one third (37%) of these children had to live with index case in a single room house similar to the general population using a single room (38%) house.<sup>22</sup>

Tuberculosis and poverty has been long related. It dictates the predisposing factors and course of tuberculosis epidemic. Transmission of TB to children can occur in overcrowded areas such as public schools, hospitals, homeless shelters, congested and non ventilated houses and poverty, with meager access to medical care facilities all of which increase the chance of spread.<sup>18-21</sup> These localities have lack of ventilation and increased bacterial concentration in confined space as comment elements. We focused on such families and found a large number of children living in such an environment.

The tubercle bacilli expelled by the patient in a confined and poorly ventilated space may retain viability for a long period of time. Children exposed to such houses/rooms may be infected even after the source has long before left the room. Transmission is greatly influenced by the characteristics of the source case (such as number of bacteria excreted) and the nature of the encounter (such as the duration and closeness of exposure).<sup>23</sup> Duration of contact for 4-7 hours in such places as shown in our data confirms the transmission. Even, as few as 1-5 bacteria if deposited in terminal alveoli can cause the disease.

Another, important aspect in TB transmission and prevention is the nutritional status. In the underprivileged societies of developing countries, treatment of malnutrition has its own limitation, to implement the nutrition rehabilitation plans. Regarding the nutritional status 38% of Pakistani children less than 5 years age are malnourished.<sup>12</sup> In our data set we identified 51% malnourished children. Females were observed to suffer more from malnourishment and subsequently fall prey to TB.

NICH caters to low socioeconomic paediatric population from Pakistan. A comprehensive field trial with adequate resources in terms of funding and manpower should be conducted to identify the true status of preventive measures being taken and the changes needed in our population. The limitations of the study included failure to confirm the immunization status. The Modified Gomez classification was used instead of the WHO classification of nutrition status. The comparison with other published work was therefore limited.

### Conclusion

Our societal and demographic factors remain static, continually exposing our children to higher risk of tuberculosis exposure. The current paediatric tuberculosis prevention strategies as adapted from World Health Organizations' Millennium Development Goals are ineffectual to make changes in children exposed to tuberculosis from less privileged strata of Pakistan. The paediatric tuberculosis preventive strategies need to be re-evaluated on a national scale. The pace towards achieving

goals 6b and 4a of WHO MDG should be rechecked, especially in developing countries. Poverty, malnutrition, overcrowded families, close vicinity, less spacious or single room house and duration of contact with index case are still the major problems isolated in the study for all paediatric ages, but a disaster for our under 5 years, malnourished females.

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