

Sizes of induration and nutritional status in children with positive Mantoux test

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Abstract

Background: The immune status of children is always affected by nutrition. Sometime severe malnutrition is associated with false negative Mantoux test. There is a need to study to observe the effect of nutritional status on the size of indurations in Mantoux positive children. **Study Design:** Observational analytical cross-sectional study. **Methods:** The study population consisted of 310 patients, belonging to both sexes and age of 1-14 years, attending the outpatient department of UP Rural Institute of Medical Sciences and Research, Saifai, Etawah. Only Mantoux positive cases were included in the study. Their sizes of indurations of skin reaction were measured and recorded in mm. The nutritional status was calculated as the weight for age and height for age standard (Z-score), using the NCHS charts of for males and females. **Results:** Out of 800 children screened for tuberculosis, 310 children had positive Mantoux test and were recruited in the study. Mean induration (20 mm) was similar in all the groups. However, the size of indurations ranged from 10-40 mm, 11-33 mm, and 12-24 among normal weight, underweight, and overweight Z-score groups. Mean induration was same (20 mm) in two Z-score height for age groups (normal height, stunting), while it was 20.6 mm in the over-height group. Although, the range of Mantoux positivity ranges from 10-35 mm, 11-40 mm, and 18-22 mm among normal height, stunting, and over height Z-score groups. **Conclusion:** Although, nutritional status can affect the positivity of Mantoux test; in Mantoux positive children, the size of indurations does not depend on their nutritional status.

Key words: Indurations, Mantoux test, Nutritional status, Z-score

Mantoux positivity in tuberculosis (TB) infection depends on the immune response of the host in terms of degree of cell-mediated immunity. The immune response is affected by multiple variables in relation to the host as well as bacteria. Nutritional status, age, vaccination status, and previous exposure to mycobacteria play a significant role in the ultimate host response [1]. The Mantoux test does not measure the immunity to TB rather a degree of hypersensitivity to tuberculin. There is no correlation between the size of induration and likelihood of current active TB disease, but the reaction size is correlated with the future risk of developing TB disease. The test has a poor positive predictive value for current active disease [2].

Undernourishment suppresses the tuberculin skin test, as well as the whole immune response of the organism [3]. Sometime severe malnutrition is associated with false negative Mantoux test. However, the effect of nutritional status on the size of indurations in Mantoux positive children is not well-established. Therefore, we planned this study to correlate the size of indurations in Mantoux positive children with their nutritional status.

SUBJECTS AND METHODS

This observational analytic cross-sectional study was conducted from July 2013 to December 2014 in Department of Pediatrics at UP Rural Institute of Medical Sciences and Research, Saifai, Etawah at a tertiary-care referral teaching hospital. Ethical approval was obtained from Institute's Ethics Committee. The study included children aged 1-14 years of both sexes who presented with a history suggestive of TB. Following symptoms were taken as suggestive of TB, i.e., persistent fever and/or a cough >2 weeks, loss of weight/no weight gain, history of contact with infectious TB case.

Written informed consent was taken from parents/guardian prior to investigation. The patient not willing to participate in the study, hemodynamically unstable patients, those received steroids in the last 3 months, children with severe acute malnutrition with unstable vitals and HIV-infected patients were excluded from the study. A detailed history was taken and thorough clinical examination done in all the recruited cases. Standard Mantoux test and sputum examination for acid-fast bacilli were performed in all these children.

A pilot study was conducted on 20 Mantoux positive subjects to find out mean induration and standard deviation. Mean induration of Mantoux positivity was 18.76 ± 6.40 mm. With an allowable error of 1, the final sample size was calculated as 172.

Mantoux Testing and Reading [4,5]

A standard dose of purified protein derivative-RT 23 with Tween 80 of strength, two tuberculin units 0.1 ml was injected intradermally into the volar surface of the long axis of the forearm skin and read 48-72 h later. The reading was made in good light with forearm slightly flexed at the elbow. Presence or absence of induration was determined either by palpation or the pen method. A ballpoint pen slightly ran transversely from the side of the arm toward the indurated area starting approximately 4 cm away. When the border of the induration was reached, a slight resistance felt, and the pen was lifted. The diameter of induration was measured transversely and recorded in millimeter. A positive Mantoux test was defined as an induration of 10 mm or more, measured 48-72 h later.

Nutritional Assessment

The nutritional status was calculated as the weight for age and height for age standard (Z-score), using the NCHS Charts for male and females. A Z-score < -2 shows undernourishment and stunting. A Z-score -2 to $+2$ shows normal weight and height. A Z-score > 2 shows overweight and over height [6]. Weight was recorded by digital type of weighing machine. The children were weighed in minimal clothing. The weighing scale was checked for zero error each time the subject is weighed.

In children age more than 2 years, height was recorded by stadiometer fitted against the wall. A child without shoes and socks was to stand with feet parallel on the even flat platform, arm hanging on this sides, buttocks and heels touching against the wall. The head was held comfortable, erect, with the lower border of the orbit of the eye in the same horizontal plane as the external canal of the ear (Frankfort) plane. The head piece of the measuring device which should gently lower to make contact with the top of the head. The height was recorded in centimeters. Length was measured in children below 2 years by infantometer which has an acrylic base with one sliding side as per length of a baby with dual scale for direct reading in cm from 0-45 and 45-90.

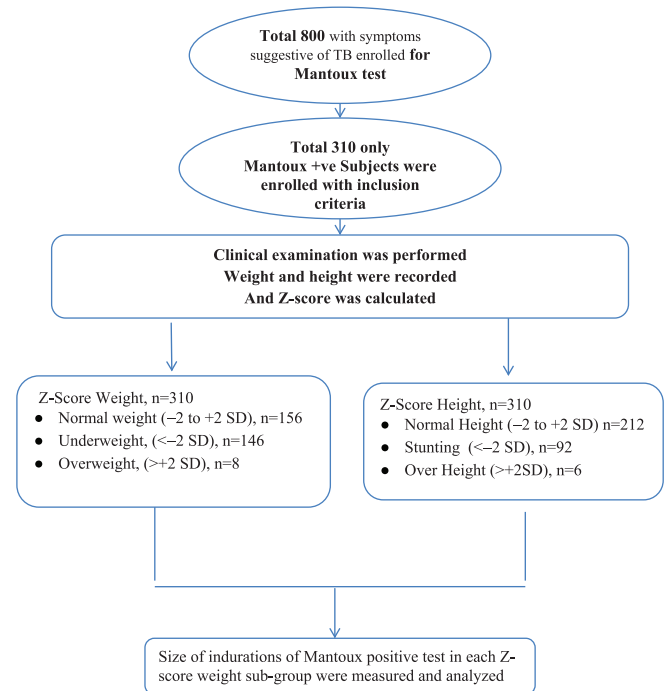
Data Analysis

Data were analyzed using SPSS software version 17.0. To describe nominal data, simple percentages were used. Mean and standard deviations were used to describe normally distributed data. The Spearman rank correlation test was used to determine the relationship between different continuous variables.

RESULTS

Total 800 children were screened for TB during the study period and of these, 310 children had positive Mantoux test and were recruited in the study (Fig. 1). Out of 310 patients, enrolled in the study, 202 (65.2%) were male, and 108 (34.8%) were female. Mean age of the patients was 7.73 ± 3.52 years (range: 1-14 years). Mean weight was 20.4 ± 8.75 kg and mean height was 116.76 ± 21.36 cm.

Study Design



Mean size of induration in Mantoux positive case was 20.11 ± 6.65 mm. According to Z-score weight for age, approximately half (50.3%) of the children were having normal weight (-2 to $+2$ SD), 47.1% were underweight (< -2 SD), and 2.6% were overweight (> 2 SD). Similarly, according to Z-score height for age, 68.4% children were having normal height (between -2 to $+2$ SD), 29.7% were stunted (< -2 SD), and 1.9% were having over height (> 2 SD).

Boxpol diagram (Fig. 1) is showing the relation of Mantoux positivity with sex of subjects. Both male and female subjects are having Mantoux same mean induration (20 mm). Although, the range of Mantoux positivity ranges from 10-40 mm among males and 10-32 mm among females.

Boxpol diagram (Fig. 2) is showing the relation of Mantoux positivity with Z-score weight for age groups (nutritional status). All Z-score weight for age groups are having Mantoux same mean induration (20 mm). Although, the range of Mantoux positivity ranges from 10-40 mm, 11-33 mm, and 12-24 among normal weight, underweight, and overweight Z-score groups.

Boxpol diagram (Fig. 3) is showing the relation of Mantoux positivity with Z-score height for age groups. Two Z-score height for age groups (normal height, stunting) are having same mean Mantoux induration (20 mm) while over height group is having 20.6 mm mean Mantoux induration. Although, the

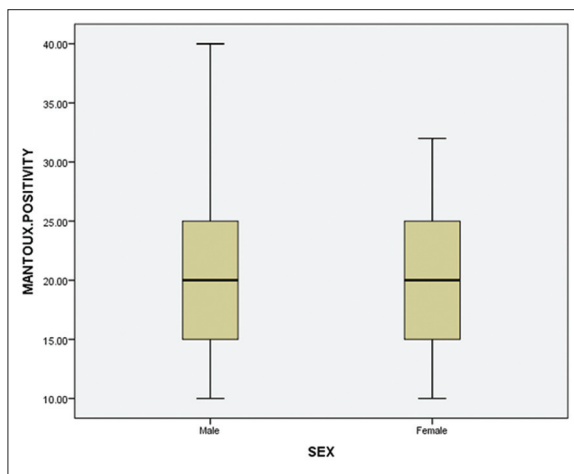


Figure 1: Relation of Mantoux positivity with the gender of subjects

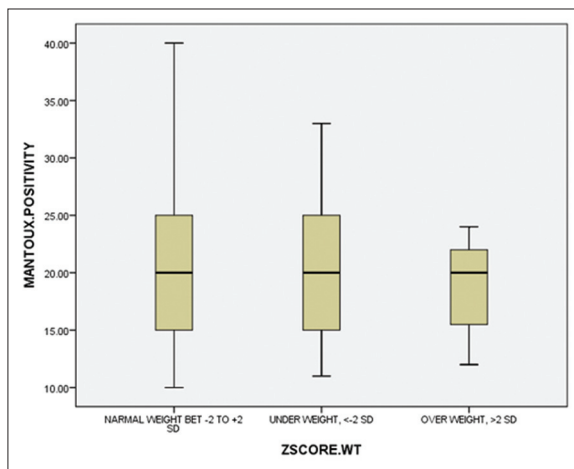


Figure 2: Relation of Mantoux positivity with Z-score weight for age groups (nutritional status).

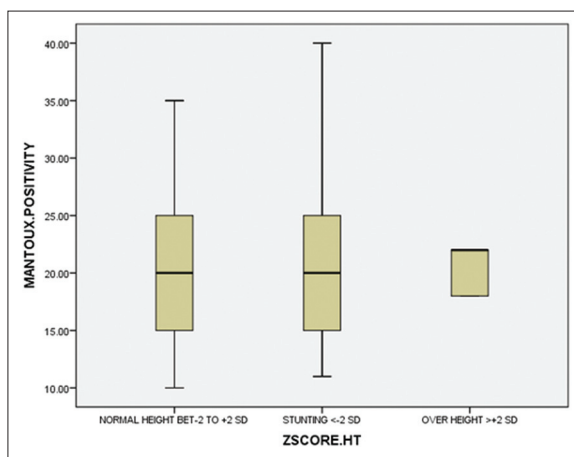


Figure 3: Relation of Mantoux positivity with Z-score height for age groups

range of Mantoux positivity ranges from 10-35 mm, 11-40 mm, and 18-22 mm among normal height, stunting, and over height Z-score groups.

DISCUSSION

In our study, all weight for age and height for age groups had same mean induration on Mantoux testing. Therefore, we can conclude that in Mantoux positive children, the size of induration did not depend on their nutritional status. Existing studies showed severe malnutrition are usually associated with negative Mantoux induration. Kiwanuka [6] and Ganapathy and Chakraborty [7] also reported no influence of nutritional status on the size of induration of positive Mantoux test. Collet et al. [8] and Reyes et al. [9] also showed similar results.

Chandra and Ojha [10] observed that Mantoux test was positive in only one-third of the subjects with severe malnutrition, but three grades of induration of Mantoux test were comparable to all three grades of nutritional status. Piñeiro et al. [11] reported that there was no difference in Mantoux test results among different nutritional status children. Mantoux test could be positive or negative depending on the nutritional status of children. Once it becomes positive, the size of induration did not depend on nutritional status. A possible reason behind that malnutrition does not suppress caloric immune reaction to TB antigen until unless very severe.

Contradictory to above observations, only a few authors showed that malnutrition affects the induration of Mantoux test. Jenum et al. [12] reported that a positive Mantoux test was reduced with a weight-for-height Z-score within the lowest quartile. The limiting factor of our study was consideration of only Mantoux positive subjects irrespective of tubercular disease status. Since it was a hospital-based study among children with age 1-10 years, the finding can be generalized after multicentric and large community-based studies.

CONCLUSION

In Mantoux positive children, the size of indurations does not depend on their nutritional status. However, nutritional status can affect the positivity of the test.

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