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RESEARCH ARTICLE OPEN ACCESS

Tuberculin Skin Test Reactivity among Health Care Workers in the Abia State University Teaching Hospital, Aba South-east Nigeria

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Abstract:

Background: Tuberculosis is one of the infections targeted for eradication and is still under surveillance. Hospital workers in Nigeria take little or no precautions against tuberculosis while attending to patients.

Objectives: This research aimed to study the prevalence of the reactivity of positive Tuberculin Skin Tests among healthcare workers in a Nigerian University Teaching Hospital.

Methods: Ethical approval and informed consent were obtained from the participants. Two hundred and ten consented participants were recruited for this study, while 185 contributed till the end. The Tuberculin Skin Test was conducted following the standard operating procedures. The chi-square test was used to compare the variable at a significant level of $P < 0.05$. Of those who received a BGC vaccine < 3 years, 4.8% were excluded from the analyses.

Results: Mean ± SD of participants' age was approximately 30 ± 8 years. Participants comprised 87 (47%) males and 98 (53%) females. The modal age group was 21-25 years. Most participants were clinical medical students, 93(50.3%), while doctors, 7 (3.8%), were second to least. The prevalence of positive reactivity to the Tuberculin Skin Test was 29.9%. There was no significant difference observed regarding sexes and positive reactivity. A significant difference was found in reactivity ≥ 10 mm between those who didn't receive BCG and those who received BCG vaccine ≥ 10 years before the study.

Conclusion: Healthcare workers can be potential active TB patients and reservoirs. We recommend highly sensitive and specific periodic TB screening, prophylactic treatment, and re-vaccination of Health Care Workers in Nigeria.

Keywords: Tuberculin skin test, Reactivity, Health care workers, Nigeria, Treatment, Mycobacterium.

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1. INTRODUCTION

Pulmonary Tuberculosis (PT) is an infection of the lungs or chest caused by Mycobacterium Tuberculosis Complex (MTC/MTBC). This complex comprises five or more species of Mycobacteria, including *Mycobacterium tuberculosis*, *Mycobacterium bovis*, *Mycobacterium africanum*, *Mycobacterium microti*, and *Mycobacterium canetti*, that may cause PT..Tuberculosis infection can be

Pulmonary TB in 90% of cases [1] or extra-pulmonary TB in 15-20% of cases [2], including miliary TB [3, 4]. Nontuberculous mycobacteria cause neither tuberculosis nor leprosy [5].

Tuberculosis is spread through the air as droplets from active TB patients. About 90% of infected persons have asymptomatic Latent TB Infection (LTBI), with only a 10% lifetime chance of progressing to active TB [6]. TB is the most frequent occupational infection in Health Care Workers (HCWs) [7]. Hence, its continuous surveillance is of utmost importance worldwide.

Latent TB testing is conducted with the Tuberculin Skin Test (TST) to screen persons at high risk of TB infection. A high surge of Human Immunodeficiency Virus infection and the emergence of Multi-Drug Resistance Tuberculosis would not allow the World Health Organization to achieve its aim [8]. Limitations of TST can be curbed with Interferon Gamma Release Assay, which is more sensitive [9, 10].

Nigeria is among the developing countries with a high prevalence of TB [9]. Hence, this study aimed to evaluate the prevalence of positive TST as one of the four basic strategies for controlling TB [11] among healthcare workers in a University Teaching Hospital in Southeast Nigeria with the following specific objectives: Tuberculin Skin Test Reactivity among Hospital staff, TST reactivity between male and female staff, TST reactivity between BCG vaccine received and none BCG vaccine received participants, TST reactivity among different professions working in the hospital. However, there needs to be more data on Latent TB screening among healthcare workers in this region.

2. MATERIALS AND METHODS

This cross-sectional, hospital-based pilot study was conducted from December 2017 to March 2018 in a University Teaching Hospital in Southeast Nigeria. Ethical approval was obtained from the University's Research Ethics Committee with identification number ABSU/TH/ar771. Informed consents were properly obtained and signed by the two hundred and ten participants recruited for this research. Participants included Hospital staff and clinical students with at least two years of exposure to the hospital environment. TST-positive participants were referred for further testing and possible treatment. Structured self-administered questionnaires were used to obtain participants' demographic data, vaccine, and medical history. The procedure for TST was according to the Centers for Disease Control and Prevention guidelines [10]. Purified Protein Derivative with 0.1ml of *M. tuberculosis* (5 Tuberculin Unit) (manufactured by BB-NCIPD Ltd Sofia, Bulgaria) was placed intradermally on the volar surface of the forearm by trained and experienced Medical Personnel placing the syringe at approximately 15° to the skin surface. The correct placement of tuberculin was checked by measuring the 'wheal' formed immediately to ensure the diameter was 6-10 mm. A permanent marker was used to circle the area, and participants were strictly advised to avoid scratching or sponging the area. Participants were encouraged to return within 48-72 hours for a reading of the results. The widest transverse diameter of skin indurations was measured by a standardized popular method with the meter rule. For the analyses, sizes of indurations were scored 0-4 mm, 5-9 mm, 10-14 mm, and ≥ 15 mm. Any case of blister was regarded as a positive reaction. Indurations ≥ 10 mm were regarded as Positive, according to CDC. Those who had positive results were advised to go for TB evaluations, which include clinical assessment, chest X-ray, laboratory diagnostic examinations (sputum culture and Acid Fast Bacilli staining), and possibly register for TB treatment if need be. Results of those who had BCG vaccine less than 3 years before the research were excluded during analyses. Data were analyzed using SPSS 20.0 version software. Cross tabulation of nominal variables was compared using the Chi-square test at a statistically significant level, $P \leq 0.05$. Prevalence calculation was used as an epidemiology tool. Odds Ratio at 95% Confidence Interval was also applied.

3. RESULTS

One hundred and eighty-five ($^{185}/_{210}$), 88.1% of participants properly complied and had their results reported after 48-72 hours and returned their filled questionnaires. The results of 8 participants who received BCG vaccine less than 3 years before the research were excluded from analyses.

Table **1** represents the Age - sex distributions of the participants. The modal age group was 21- 25 years; 40.5% ($^{75}/_{185}$), (males – 22.7% ($^{42}/_{185}$), females – 17.8% ($^{33}/_{185}$). The lowest age group was 56 – 60, 0.5% ($^{1}/_{185}$). More females, 53% ($^{98}/_{185}$), participated in the research compared to males, 47% (87/185).

Table 1. Age-sex distribution of participants.

Age (years)	Males n(%)	Females n(%)	Total
16-20	0(0)	2(1.1)	2(1.1)
21-25	42(22.7)	33(17.8)	75(40.5)*
26-30	31(16.7)	19(10.3)	50(27)
31-35	0(0)	9(4.9)	9(4.9)
36-40	9(4.9)	12(6.5)	21(11.4)
41-45	2(1.1)	17(9.2)	19(10.3)
46-50	0(0)	6(3.2)	6(3.2)
51-55	2(1.1)	0(0)	2(1.1)
56-60	1(0.5)	0(0)	1(0.5)*
Total	87(47)	98(53)	185(100)

Table 2 demonstrates profession–TST–TST reactivity. The prevalence of TST reactivity among HCWs with indurations ≥ 5 mm was 78.0% (138/177), while the prevalence of positive TST with indurations ≥ 10 mm was 29.9% ($^{53}/_{177}$). The profession with the highest prevalence concerning the number of participants was Medical Laboratory Scientists at 58.3% ($^{7}/_{12}$), while the least was Pharmacists at 11.1% ($^{1}/_{9}$).

Table 3 shows that the prevalence of TST reactivity ≥ 5 mm among male participants was 84.1% ($^{69}/_{82}$) and 69.5% ($^{64}/_{94}$) among female participants, and it was statistically significant. Considering positive TST ≥ 10 mm, prevalence among male and female participants was 34.1% ($^{28}/_{82}$) and 26.3% ($^{23}/_{95}$), respectively, but it was not statistically significant (P > 0.05). Indurations ≥ 5 mm comparing males' and females' reactivity (P = 0.022; X^2 = 5.23). Indurations ≥ 10 mm comparing males' and females' reactivity (P = 0.257; X^2 = 1.29). Odds Ratio at 95% Confidence Intervals (OR [95% CI]; p-value) was 1.45 [0.76 – 2.77]; P = 0.25. Being a male was associated with positive TST, but it was not statistically significant.

Table 4 shows that 44.1% ($^{78}/_{177}$) of participants who received Bacillus Calmette Guerin (BCG) vaccines ≥ 10 years before the research significantly had indurations < 10 mm compared to 26% ($^{46}/_{177}$) of participants who did not receive BCG vaccine. Of participants who didn't receive the BCG vaccine, 23.2% ($^{41}/_{177}$) had indurations ≥ 10 mm as against 6.8% ($^{12}/_{177}$) of participants who received the BCG vaccine ≥ 10 years before the research. (P = 0.00001; X^2 = 23.93). Hence, there was a very highly statistically significant difference. The odds Ratio at 95% Confidence Intervals (OR [95% CI]; p-value) for "no BCG vaccination" ≥ 10 years before the research was 5.79 [2.77 – 12.13]; P = 0.00001. Analyses show that "no BCG vaccination" was highly statistically significant and associated with positive indurations ≥ 10 mm among participants.

Table 2. Profession - TST reactivity distribution.

-	0-4 mm	5-9 mm	10-14 mm	≥15 mm	Blisters	Total n(%)	Reactivity ≥10 n(%)
Physicians	2	2	2	0	1	7(3.8)	3(42.9)
Med Lab. Scientist	1	4	7	0	0	12(6.5)	7(58.3)*
Nurses	5	9	9	0	1	24(13)	10(41.7)
Pharmacist	4	4	1	0	0	9(4.5)	1(11.1)*
Social service staff	1	4	6	0	0	11(5.9)	6(54.5)
Security	0	4	1	0	0	5(2.7)	1(20)
Clin. Medical Students	25	45	23	0	0	93(50.3)	23(24.7)
Clin. Nursing Students	4	10	2	0	0	16(8.6)	2(12.5)
Total	42	82	51	0	2	177(100)	-

Table 3. TST reactivity - sex distribution.

TST Reactivity	Males n(%)	Females n(%)	Total n(%)
0-4 mm	13(7.3)	29(16.4)	42(23.7)
5-9 mm	41(23.2)	41(23.2)	82(46.3)
10-14 mm	28(15.8)	23(13)	51(28.8)
≥15 mm	0	0	0
Blisters	0	2(1.1)	2(1.1)
Total	82(46.3)	95(53.7)	177(100)

Note: ≥5 mm = comparing male and female reactivity; P = 0.022; X^2 = 5.23
≥10 mm = comparing male and female reactivity; P = 0.257; X^2 = 1.29

Table 4. Sex-BCG vaccine-TST reactivity ≥ 10 mm.

-	BCG Vaccine ≥ 10 Years		BCG Vaccine < 1 Year		No BCG Vaccine	
	TST < 10 mm n(%)	TST ≥ 10 mm n(%)	TST < 10 mm n(%)	TST ≥ 10 mm n(%)	TST < 10 mm n(%)	TST ≥ 10 mm n(%)
Males	27(14.6)	7(3.8)	3(1.6)	2(1.1)	27(14.6)	21(11.4)
Females	51(27.6)	5(2.7)	3(1.6)	0	19(10.2)	20(10.8)
Total	$^{78}/_{185}$ (42.2)*	$^{12}/_{185}$ (6.5)*	$^{6}/_{185}$ (3.2)	$^{2}/_{185}$(1.1)	$^{46}/_{185}$ (24.9)*	$^{41}/_{185}$ (22.2)*

Note: P < 0.00001; X^2 = 23.93.

4. DISCUSSIONS

A total of 210 participants received the tuberculin injection, but 185(88.1%) returned after 48-72 hours to read the results. The reduction could be attributed to the difficulty of the "second visit," which is one of the limitations of TST.

The present study revealed a moderately high prevalence of TST positive reactivity (≥ 10mm), approximately the same as reported previously by Asuquo *et al*. [12] but lower than another report by Adeyekun *et al*. [13] and Koshak and Tawfeeg [14].

The highest prevalence of TST reaction among Medical Laboratory Scientists could be attributed to their frequent and close exposure to the patients and sputum samples during sample collection, preparation, and analyses, unlike the least prevalence among pharmacists who were Health care workers who had less and distant interaction with the patients and no exposure to infectious samples. This was supported by a report from Kassim [15]. The increased Tuberculin Skin Test conversion rate among HCWs may be explained by poor compliance with standard infection control measures and delay in diagnosis of infection [7].

The prevalence of positive TST reaction was higher among males than females but is not statistically significant in the present work. Previous work in Calabar, Nigeria, reported no relationship between gender and indurations [12]. In contrast, research conducted in the USA recorded indurations > 15 mm more among males compared to females, $p < 0.001$ by Reyn *et al*. [16]. The higher prevalence among males could be related to their lifestyle. Tobacco and smoking increases risk by several mechanisms [17].

The present research revealed that BCG vaccination protected many participants from TB infections, as in Table **4**. Participants who received the BCG vaccine ≥ 10 years before the research were likely to be grownups. They might have also received the BCG vaccine as infants. Hence, re-vaccination of HCWs can protect them. Vaccination is the first line of choice for controlling TB [11, 16], and from prior research in the USA, authors concluded and recommended BCG vaccination as the best method of protecting HCWs against Mycobacteria tuberculosis infection [18].

CONCLUSION AND RECOMMENDATIONS

Healthcare workers can be potential reservoirs for Mycobacteria tuberculosis Complex and potential active tuberculosis patients. Bacillus Calmette Guerin vaccination and re-vaccination can protect HCWs from Mycobacteria tuberculosis Complex infection.

We recommend establishing and strictly implementing policies to protect, screen, and treat HCWs against TB infections in our region and country.

LIMITATIONS

There is a need to carry out this research with more sensitive and specific kits, which could not be applied in this research due to limited funds and resources.

LIST OF ABBREVIATIONS

LTBI	=	Latent TB Infection
HCWs	=	Health Care Workers
PT	=	Pulmonary Tuberculosis
MTC/MTBC	=	Mycobacterium Tuberculosis Complex

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

This human study was approved by the Abia State University Teaching Hospital Aba and Department of Community Medicine, Abia State University Teaching Hospital Aba, with identification number ABSU/TH/ar771.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were by the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data is deposited at the library of Abia state University, Uturu Abia state.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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REFERENCES

[1] Lawn SD, Zumla AI. Tuberculosis. Lancet 2011; 378(9785): 57-72. http://dx.doi.org/10.1016/S0140-6736(10)62173-3 PMID: 21420161

[2] Jindal SK. Textbook of Pharmacy and Critical Care Medicine. (2nd ed.). New Delhi: Jayvee Brothers Medical Publishers 2010; p. 549.

[3] Thomas M, Haberman AK. Mayo Clinical Internal Medicine: Concise textbook. Rochester: MN Mayo Clinic Scientific Press 2008; p. 789.

[4] Golden MP, Vikram HR. Extrapulmonary tuberculosis: An overview. Am Fam Physician 2005; 72(9): 1761-8. PMID: 16300038

[5] Acton QA. Mycobacterium Infections: New Insights for the Healthcare Professional: 2011 Edition. Scholarly Editions 2012; p. 182.

[6] Skolnik R. Global Health 101. (2nd edi.). Boston, MA: Jones & Bartlett Publishers 2012; p. 434.

[7] Blumberg HM, Watkins DL, Berschling JD, *et al*. Preventing the nosocomial transmission of tuberculosis. Ann Intern Med 1995; 122(9): 658-63. http://dx.doi.org/10.7326/0003-4819-122-9-199505010-00003

PMID: 7702227

[8] World Health Organisation. The Global plan to stop TB. 2011. Avaialble From: http://www.stoptb.org/global/plan

[9] National Institute for Health and Clinical Excellence. Tuberculosis: clinical diagnosis and management of tuberculosis, and measures for its prevention and control. 2011. Available From: https://www.nice.org.uk/Guidance/CG117

[10] Centers for Disease Control and Prevention (CDC). Expanded tuberculosis surveillance and tuberculosis morbidity--United States, 1993. MMWR Morb Mortal Wkly Rep 1994; 43(20): 361-6. PMID: 8183227

[11] Pherson R, Pincus M. Mycobacteria Henry's clinical diagnosis and management by laboratory methods. (24th ed..). Elsevier Health Sciences 2011; pp. 1183-93.

[12] Asuquo AE, Dairo AN, Abia-Bassey L, Meremiku MM, Thumamo BP. Tuberculin Skin Test (TST) Indurations in Smear Positive TB Patients and Healthy Individuals in Calabar, Nigeria. Stud Ethno-Med 2009; 3(1): 75-9.

[13] Adeyekun AA, Egbagbe EE, Oni OA. Contact tracing / pre-employment screening for pulmonary tuberculosis: Should positive mantoux test necessitates routine chest X-ray? Ann Afr Med 2010; 9(3): 159-63. http://dx.doi.org/10.4103/1596-3519.68364 PMID: 20710107

[14] Koshak EA, Tawfeeg RZ. Tuberculin Reactivity among Health Care Workers at King Abdulazi's University Hospital, Saudi Arabia. East Mediterr Health J 2002; 9(5-6): 1034-41. http://dx.doi.org/10.26719/2003.9.5-6.1034 PMID: 16450534

[15] Kassim S, Zuber P, Wiktor SZ, *et al*. Tuberculin skin testing to assess the occupational risk of Mycobacterium tuberculosis infection among health care workers in Abidjan, Côte d'Ivoire. Int J Tuberc Lung Dis 2000; 4(4): 321-6. PMID: 10777080

[16] von Reyn CF, Horsburgh CR, Olivier KN, *et al*. Skin test reactions to Mycobacterium tuberculosis purified protein derivative and Mycobacterium avium sensitin among health care workers and medical students in the United States. Int J Tuberc Lung Dis 2001; 5(12): 1122-8. PMID: 11769770

[17] Elsner M. Biology and mechanisms for tobacco – attributable respiratory disease, including TB bacterial pneumonia and other respiratory diseases. Int J Resp Dis 2008; 2008: S11.

[18] Marcus AM, Rose DN, Sacks HS, Schechter CB. BCG vaccination to prevent tuberculosis in health care workers: a decision analysis. Prev Med 1997; 26(2): 201-7. http://dx.doi.org/10.1006/pmed.1996.0123 PMID: 9085388