# Workplace pulmonary tuberculosis case detection in Mansoura City and neighborhood villages

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***Context*** Tuberculosis (TB) represents a high burden in workplaces.

***Aims*** Therefore, the aim of this study was to detect pulmonary TB cases in the workplace and assess the associated risk factors.

***Settings and design*** This cross section study was carried out from January 2011 to December 2013. This study included 253 participants recruited from Mansoura City and neighborhood villages Dakahlia Governorate. The catchment areas and occupational categories were determined according to a 1-year retrospective study reviewing hospital records.

***Participants and methods*** All participants were subjected to the following: (a) assessment of sociodemographic data, occupational data, and risk factors for TB. (b) Clinical examination. (c) Screening by chest radiography, the tuberculin skin test, and sputum Ziehl–Neelsen stain. (d) Assessment of knowledge of TB. Data were analyzed using statistical package for the social sciences, version 15. Qualitative data were presented as number and percentage. Comparison between groups was carried out using the $\chi^2$-test.

***Results*** Most participants were younger than 35 years of age, men, smokers, married, and with low educational and monthly income. Silica-related occupations were the most common. History of Bacillus Calmette–Guérin vaccination was not found among TB participants and was found in only 8.9% of non-TB participants. The majority of participants reported 8 working hours with no use of protective tools. The TB participants had significantly lower knowledge scores than nontuberculous participants. A total of 136 out of 148 participants had a positive tuberculin skin test. Chest radiography indicated an abnormality in six out of 253 participants and five of these were positive for sputum Ziehl–Neelsen.

***Conclusion*** TB screening in workplaces is mandatory because it can identify asymptomatic cases with active TB. A poor knowledge score may be considered a risk factor for TB infection in the workplace.

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## Introduction

Tuberculosis (TB) is one of the major killers among infectious diseases [1]. The occupational risk of TB can be defined as the probability of acquiring TB as a result of workplace exposure [2].

The workplace burden of TB includes loss of productivity, absenteeism, and disease transmission to other employees [3]. Therefore, workplace screening of infectious diseases is essential in the working environment to combat the associated risks [4]. The majority of working population works in unhealthy conditions, with little job security; thus, they are more vulnerable to TB [5].

## Participants and methods

This cross section study was carried out in the Public Health and Community Medicine Department in collaboration with the Chest Medicine Department, Mansoura University, Egypt, in the period from January 2010 to January 2013. The study comprised 253 workers/employees recruited from Mansoura City and neighborhoods Villages DaKahlia Governorate. They were recruited from hot spots and occupational categories determined according to a 1-year retrospective hospital-based record study in the period from August 2008 to August 2009. This retrospective hospital-based record study was carried out by reviewing the records of 588 TB patients admitted to Mansoura Chest Hospital during 5 years from January 2005 to August 2010. According to the data obtained from retrospective hospital-based records, the participants were recruited from a primary school in Meet Mazah, seven private nursery homes in Mansoura city and Gedila, three brick factories in Mansoura, Nawasa El Bahr and Talkha, six bakeries in Mansoura city and Gedila, General Mansoura



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Hospital, five private laboratories, East Delta Company for transportation, and four cafes in Mansoura.

### Methods

All 253 participants were subjected to the following evaluations:

(1) Sociodemographic characteristics such as age, sex, marital status, educational level, special habits, monthly income, shisha, and cigarette smoking.
(2) Occupational profile of workers including duration of employment, working hours per day, and use of personal protective equipment in workplace.
(3) Potential risk factors for TB such as lack of Bacillus Calmette–Guérin (BCG) vaccination, TB contact in the family, close friend, or at the working place, medical comorbidity, and prolonged use of immunosuppressive drugs.
(4) Full clinical examination: general and local examination to exclude extrapulmonary TB, and detection of BCG scar.
(5) Screening tools:
    (a) Tuberculin skin test according to the American Thoracic Society/Centers for Disease Control and Prevention [6] recommendation.
    (b) Posteroanterior chest radiography.
    (c) Sputum Ziehl–Neelsen stains were performed only for those with abnormal chest radiography
(6) Knowledge of TB in terms of cause, clinical picture, modes of transmission, prevention, and control of the disease was assessed.

The questionnaire was completed over 15–20 min.

### Knowledge scoring system

The total knowledge questionnaire included five topics of 19 items. Calculation of the knowledge score was carried out as follows: for each individual item, correct answers were recorded as '1' and 'incorrect' or 'do not know' answers as '0'. An aggregate measure was then computed, summing the values of each topic divided by the number of items to obtain the average score for each participant. These scores were converted into a percent score. The total score was represented as four grades [7].

Poor (no knowledge at all): 0–25%, low: 26–50%, moderate: 51–75%, and high: greater than 75%.

### Statistical analysis

Data were analyzed using statistical package for the social sciences version 15 (SPSS Inc., Chicago, Illinois, USA). Qualitative data were presented as number and percent. Comparison between groups was carried out using the $\chi^2$-test.

## Results

The sociodemographic characteristics showed that most of the non-TB and TB participants were younger than 35 years of age, men, smokers, and most of them married, with low educational and monthly income level (Table 1).

Silica-related occupations were the most common (17%) among the studied participants, followed by nurses (13%), teachers (12.5%), and then baby sitters (11.2%), whereas the least common occupation was coffee shop workers (8.5%). However, 60% of the participants who were proven to have TB were in silica-related occupations and 20% were coffee shop workers and manual workers (Table 2).

None of the participants who were proven to have TB had reported receiving previous BCG vaccinations. Only 8.9% of the nontuberculous participants reported a history of BCG inoculation

**Table 1 Sociodemographic characteristics of studied participants of phase II**

| Characteristics of patients | Studied participants ($n$=253) [$n$ (%)] | | $P$ value |
|---|---|---|---|
| | Non-TB participants ($n$=248) | TB participants ($n$=5) | |
| Age (years) | | | |
| <35 | 161 (64.9) | 4 (80.0) | 0.43 |
| 35–50 | 86 (34.6) | 1 (20.0) | |
| >50 | 1 (0.4) | 0 (0.0) | |
| Mean±SD | 32.3±7.4 | 27.8±7.6 | |
| Sex | | | |
| Male | 178 (71.7) | 5 (100.0) | 0.37 |
| Female | 70 (28.3) | 0 (0.0) | |
| Marital status | | | |
| Married | 199 (80.2) | 5 (100.0) | 0.59 |
| Unmarried | 49 (19.7) | 0 (0.0) | |
| Educational level | | | |
| Illiterate | 98 (39.5) | 3 (60.0) | 0.39 |
| Basic education | 35 (14.1) | 2 (40.0) | |
| Secondary and higher | 115 (46.4) | 0 (0.0) | |
| Income/month | | | |
| <500 LE | 212 (85.4) | 5 (100.0) | 0.46 |
| 500–1000 LE | 32 (12.9) | 0 (0.0) | |
| > 1000 | 4 (1.6) | 0 (0.0) | |
| Smoking (cigarette and shisha) | | | |
| Nonsmoker | 104 (41.9) | 1 (20.0) | 0.41 |
| Smoker | 144 (58.1) | 4 (80.0) | |

LE, Egyptian pound; Low: less than 500 Egyptian pound; moderate: 500–1000 Egyptian pound; high: more than 1000 Egyptian pound; TB, tuberculosis; $P$<0.05, significant.

**Table 2 Frequency of occupational category among studied participant**

| Occupational categories | Total | Studied participants ($n$=253) [$n$ (%)] | | Test of significance |
|---|---|---|---|---|
| | | Non-TB participants [248 (98.1)] | TB participants [5 (1.9)] | |
| Silica-related occupations | 45 | 42 (17.0) | 3 (60.0) | Fisher exact test ($P$=0.04) |
| Nurse | 32 | 32 (13.0) | 0 (0.0) | |
| Teacher | 31 | 31 (12.5) | 0 (0.0) | |
| Baby sitter | 28 | 28 (11.2) | 0 (0.0) | |
| Baker | 24 | 24 (9.6) | 0 (0.0) | |
| Bus driver | 24 | 24 (9.6) | 0 (0.0) | |
| Manual worker | 24 | 23 (9.3) | 1 (20.0) | |
| Laboratory personnel | 23 | 23 (9.3) | 0 (0.0) | |
| Coffee shop worker | 22 | 21 (8.5) | 1 (20.0) | |

TB, tuberculosis; $P<0.05$, significant.

The majority of the studied participants reported 8 working hours/day for about 5–10 years or more than 10 years. They lived in houses where there were 2–3 or more than 3 persons/room. No history of medical comorbidity, use of immunosuppressive drugs, or contact was detected among the TB participants. None of the studied participants used protective tools during work. There was no significant difference between the two groups (Table 3).

In terms of knowledge of the causes of pulmonary TB, symptoms, modes of transmission, prevention, and control, the majority of participants answered incorrectly or did not know the correct answers. There was a significant difference between the TB participants and the non-TB participants (Table 4). The TB participants had significantly lower knowledge scores than nontuberculous participants (Table 5).

The current study showed that 136 out of 148 participants had a positive tuberculin skin test (105 participants refuse to undergo the test). Chest radiography indicated an abnormality in 6 out of 253 participants and five of these were positive for sputum Ziehl–Neelsen (Table 6).

**Table 3 Tuberculosis risk factors of the of studied participants**

| TB risk factors | Studied participants ($n$=253) [$n$ (%)] | | $P$ value |
|---|---|---|---|
| | Nontuberculous ($n$=248) | Tuberculous ($n$=5) | |
| BCG inoculation | | | |
| Yes | 22 (8.9) | 0 (0.0) | 0.63 |
| No | 196 (79.0) | 1 (20.0) | |
| Do not know | 30 (12.1) | 4 (80.0) | |
| Contact to TB case | | | |
| Family member | 1 (0.4) | 0 (0.0) | – |
| Close friend | 3 (1.2) | 0 (0.0) | |
| Workplace | 49 (19.7) | 0 (0.0) | |
| Number of persons/room | | | |
| 1 | 29 (11.7) | 0 (0.0) | 0.65 |
| 2–3 | 116 (46.8) | 4 (80.0) | |
| >3 | 103 (41.5) | 1 (20.0) | |
| Immunosuppressive drugs | | | |
| Present | 4 (1.6) | 0 (0.0) | 0.92 |
| Absent | 244 (98.4) | 5 (100.0) | |
| Medical comorbidity | | | |
| Present | 3 (1.2) | 0 (0.0) | 0.94 |
| Absent | 245 (98.8) | 5 (100.0) | |
| Work duration | | | |
| <5 years | 38 (15.0) | 0 (0.0) | 0.42 |
| 5–10 years | 89 (35.2) | 2 (2.3) | |
| >10 years | 126 (49.8) | 3 (2.4) | |
| Working hours/day | | | |
| ≤8 h | 213 (84.2) | 4 (1.9) | 0.58 |
| >8 h | 40 (15.8) | 1 (2.5) | |
| Use of protective tools | | | |
| Yes | 0 (0.0) | 0 (0.0) | 0.41 |
| No | 248 (100.0) | 5 (100.0) | |

BCG, Bacillus Calmette–Guérin; TB, tuberculosis; $P<0.05$, significant.

## Discussion

Occupationally acquired TB may be attributed to an increased risk of contracting TB among some workers or occupations that lead to increased susceptibility or chance of exposure to infection [8].

This study aimed to detect pulmonary TB cases in the workplace and assess the associated risk factors in Mansoura City and neighborhood villages.

### Sociodemographic characteristics and occupational category

The participants in this study were younger than 35 years of age, predominantly men, married, smokers, and with low income and education levels. A study in Nigeria found that the mean age among the TB patients was 32.9±12.3 years [6]. The mean age of 180 admitted TB patients in Abbassia Chest Hospital was 36.8±12.5 years [9]. Sobhy *et al.* [10] found that the mean age among smear-positive TB patients was 36.2±12.4 years. A study in Upper Egypt [11] detected a higher mean age of 42.4±17.6 years.

**Table 4 Knowledge of studied participants**

| Knowledge about TB | Studied participants (*n*=253) [*n* (%)] | | *P* value |
|---|---|---|---|
| | Non-TB (*n*=248) | TB (*n*=5) | |
| Causes | | | |
| Yes with correct answers | 165 (66.5) | 1 (20.0) | 0.030* |
| Do not know or incorrect answers | 83 (33.5) | 4 (80.0) | |
| Symptoms | | | |
| Yes with correct answers | 67 (27.0) | 0 (0.0) | 0.181 |
| Do not know or incorrect answers | 186 (73.0) | 5 (100.0) | |
| Risk factors | | | |
| Yes with correct answers | 109 (43.9) | 4 (80.0) | 0.108 |
| Do not know or incorrect answers | 139 (56.1) | 1 (20.0) | |
| Modes of transmission | | | |
| Yes with correct answers | 126 (50.8) | 0 (0.0) | 0.027* |
| Do not know or incorrect answers | 122 (49.2) | 5 (100.0) | |
| Prevention and control | | | |
| Yes with correct answers | 63 (25.5) | 1 (20.0) | 0.004* |
| Do not know or incorrect answers | 185 (74.6) | 4 (80.0) | |

TB, tuberculosis; *$P<0.05$, significant.

**Table 5 Knowledge scoring of studied participants**

| Knowledge levels | Studied participants (*n*=253) [*n* (%)] | |
|---|---|---|
| | Non-TB (*n*=248) | TB (*n*=5) |
| Poor (0–25%) | 130 (52.4) | 5 (100) |
| Low (26–50%) | 48 (19.4) | 0 (0.0) |
| Moderate (51–75%) | 7 (2.8) | 0 (0.0) |
| High (>75%) | 63 (25.4) | 0 (0.0) |
| *P* value | $P_2$=0.04* | |

TB, tuberculosis; *$P<0.05$, significant.

**Table 6 Screening tools used for screening among studied participants**

| Screening tools used for diagnosis | Studied participants (*n*=253) [*n* (%)] |
|---|---|
| Tuberculin skin test (*n*=148) | |
| Positive | 136 (91.9) |
| Negative | 12 (8.1) |
| Chest radiography (*n*=253) | |
| Normal | 247 (97.6) |
| Abnormal | 6 (2.4) |
| Sputum examination (*n*=6) | |
| Smear positive | 5 (83.3) |
| Smear negative | 1 (16.7) |

WHO report [12] stated that more male than female patients with TB are registered in Africa each year. The majority of TB patients (74%) were men in Sudan [13]. Two studies in Egypt reported a majority of male patients: 72.2% and 77.3%, respectively [9,10]. Babalik *et al.* [14] studied the occupation of admitted tuberculous patients in Turkey and found that the majority were men (67%). Tiwari *et al.* [15] found that the majority of TB workers exposed to free silica in India were men (75.5%).

Rabie *et al.* [11] reported that 70.7% of TB patients in Upper Egypt were married. A study in Malaysia by Rafiza, *et al.* [16], found that 78% of tuberculous healthcare workers (HCWs) were married. In contrast, Lienhardt *et al.* [17] reported that the risk of TB was higher among single individuals than married individuals in West Africa.

Ogboi *et al.* [18], in Nigeria, detected a positive relationship between active TB and lower education. Industries and occupations associated with low socioeconomic status had a significantly increased prevalence of TB [19]. Also, El-Hamid *et al.* [20], in their study, found that pulmonary TB increased among workers in occupations associated with low socioeconomic status.

Sobhy *et al.* [10], in their study of TB in Egypt, detected a prevalence of cigarette and shisha smoking among TB inpatients: ~39.5 and 29.4%, respectively. On studying TB among HCWs in Brazil, it was found that 33% of them were smokers [21]. In Japan, it was found that 37.1% of TB caregivers were smokers [22]. Smoking increases the risk for pulmonary TB [23].

Silica-related occupations were the most common (17%) among the participants studied. Also, 60% of the participants who were proven to have TB were in silica-related occupations and 20% were coffee shop workers and manual workers. Industries and occupations with silica exposure led to a significantly increased prevalence of TB [20]. Tiwari *et al.* [15] detected that the prevalence of TB among stone crushers was about 10.7%. Acharya *et al.* [24] reported a high rate of pulmonary TB among workers in brick industries in Nepal.

Hoshino *et al.* [25] reported that elevated TB incidence rates were observed among female nurses and laboratory technicians. The mean incidence of TB in all HCWs was 199.9 of 100,000 individuals in Turkey [26]. Babalik *et al.* [14] studied the occupation of admitted tuberculous patients in Turkey and found that among the most frequently identified major occupational groups, motor vehicle drivers represented 5.8%. This study that showed teachers and drivers had a prevalence of TB of 12.5 and 9.6%, respectively.

Munckhof *et al.* [27] reported in their study that sharing water pipes was associated with an

increased risk of TB transmission in Australia. Maziak *et al.* [28] reported that sharing water pipes, which is a common practice in Egypt, may enable the spread of TB. Coffee shop workers represented 8.5% of non-TB participants and 20% of detected new TB patients.

#### Risk factors

None of the participants who were proven to have TB reported previous BCG vaccination. Only 8.9% of the nontuberculous participants reported a history of BCG inoculation. Aaby *et al.* [29] reported that children with BCG scar have better immunity agonist TB than those without scar.

The majority (80.0%) of the participants who were proven to have TB and 46.8% of the nontuberculous participants lived in houses with 2–3 persons/room. A study in Canada by Clark *et al.* [30] found that the incidence of TB was higher in communities with a higher average housing density. Rabie *et al.* [11] reported in their study in Egypt that overcrowding was one of the most important factors in the development of pulmonary TB. Overcrowding (≥3persons/room) reflects the poor socioeconomic status in some localities in Egypt [31].

Rabie *et al.* [11], in Upper Egypt, found that 33.3% of tuberculous patients had a history of contact with smear-positive cases; also, they reported that diabetic patients were more susceptible to TB than others and ~17.3% of tuberculous cases had a history of prolonged steroid therapy. The absence of any risk factor or having a protective factor does not necessarily prevent against contracting TB [32].

The participants studied had worked about 8 h/day for 5–10 or more than 10 years. None of our participants used protective tools. Bock *et al.* [33], on studying occupational TB in healthcare settings, found an association of higher infection rates with longer durations of work. Skodric-Trifunovic *et al.* [34], on studying occupational TB in Serbia, found that the mean working period before the onset of illness was 8.1 years for HCWs. It was reported in Thailand that working more than 8 h/day increases the risk of latent TB among HCWs [35]. The highest proportion of indoor contact hours occurred in workplaces in Western Cape. The probability of infection was related to the duration of exposure to infected air [36].

None of the participants studied used any personal protective equipment. This indicates a lack of enforcement of industrial safety measures.

#### Screening at the workplace and Knowledge assessment

Asuque *et al.* [37], in their study in Nigeria, found that 25.0% of apparently healthy individuals were tuberculin positive compared with 96.0% among smear-positive TB patients. The Tuberculin skin test was applied only for 148 participants; 91.9% of these were tuberculin positive. High prevalence of tuberculin positive individuals was probably related to certain work locations associated with a higher risk of exposure to TB. Also, contact with family and close friends in the workplace may explain the high percentage of tuberculin positive. In the current study, all at-risk workers were subjected to chest radiography and only six (2.4%) workers had abnormal radiological findings; of these, five (1.9%) cases showed a positive sputum smear for acid-fast bacilli. Abnormalities on chest radiographs may be suggestive, but are never diagnostic of TB. However, chest radiographs may be used to rule out the possibility of pulmonary TB in an individual who has a positive reaction to the tuberculin skin test and with no symptoms of disease [38]. The positive results of contact investigation were highest among workplace contact [39].

The majority of participants in the current study scored poorly in terms of knowledge; a low percentage scored a moderate or a high score. The difference in knowledge between tuberculous and nontuberculous participants was significant ($P<0.05$). Mesfin *et al.* [40] carried out a study in Ethiopia and found that only 9.6% of respondents reported the primary cause of pulmonary TB, nearly half of the respondents (47.5%) did not know how pulmonary TB was transmitted, and only 14.5% of respondents reported vaccination and modern treatment as a means of prevention of pulmonary TB.

A study in Tehran showed that 95% of medical students had poor levels of knowledge of the signs and symptoms of TB. Also, 51% had poor knowledge levels of TB transmission, whereas 41% had moderate levels and 8% had high levels of knowledge. In terms of the prevention of TB, poor, moderate, and high knowledge levels were found in 57, 40, and 3%, respectively [41]. A study in Northern Iran showed that the overall knowledge mean score among 80 medical students was poor in Knowledge; none of them achieved a moderate or a high score [42].

Sabir *et al.* [43] found that the majority of individuals taking care of TB patients did not know about the cause (79.02%), modes of spread (64.31%), and the precaution measures (72.77%) necessary to follow while living in close contact with TB patients.

There was a significantly higher level of knowledge among nontuberculous participants than tuberculous participants in this study. This result can probably be attributed to higher education levels of the nontuberculous participants as they comprised groups of nurses, laboratory personnel, and teachers. HCWs probably acquired their knowledge of TB during their work practice in the medical field. The lower knowledge score could be explained by the negligence in the use of protective equipment by the majority of our participants.

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**Conflicts of interest**

There are no conflicts of interest.

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