Research Article

# Association of Lifestyle with Pulmonary Tuberculosis among Hospital Patients in Asir Region of Saudi Arabia

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## Abstract

**Background:** Tuberculosis is remains to be a major public health problem. Lifestyle factors that have been shown to influence the burden of tuberculosis. The aim of this study is to determine association of lifestyle with pulmonary tuberculosis among hospitals patients in Asir region of Saudi Arabia. **Materials and Methods:** It is a Case- control study which was conducted in the tertiary care hospital of from April 2019 to July 2019. Total 135 participants were selected through simple random sampling and sample was divided into 67 cases and 68 controls. Cases were included from hospital database and controls were selected from outpatient department of same hospital with respiratory disease other than tuberculosis. Lifestyle Factors associated with tuberculosis were analyzed using logistic regression. **Results:** After adjustment of covariates, the resulting factors were significant: patient with overweight and obese [OR=4.40, 95% CI 1.27-15.25 and 2.38 (1.61-9.22)], Smoker [OR=1.34, 95% CI-0.52-3.43], abnormal sleep at night (<8 hours) [OR=5.03, 95% CI-1.57-16.10], blue color job worker [OR=2.69, 95% CI-1.02-7.28], frequency of eat outside (>3 day/week) [OR=1.75, 95% CI 1.01-3.01], Besides hunger other reason (s) do you eat [OR=2.08, 95% CI-1.02-5.27], physical exercise < 3 days/week [OR= 1.41, 95% CI 1.21-3.47]. **Conclusion:** The result of study was found that strong association of lifestyle factors with pulmonary tuberculosis. There is need of interventions which focused on improving the quality of life of tuberculosis patients by removing the lifestyle risk factors.

**Keywords:** Tuberculosis; Lifestyle; Risk; Prevention; Saudi Arabia

## Introduction

Tuberculosis is the fourth leading cause of death globally and 1.7 million deaths per year due to tuberculosis. [1] Tuberculosis (TB) remains a public health concern worldwide. [1-4] There are lot of efforts to control this disease have been largely focused only improving treatment and diagnosis of patients with active disease. However, despite those intensive efforts, prevalence of TB is still high specifically in developed countries due to certain lifestyle factors contributed to increase its prevalence. [1,2] WHO has recognizes that promoting healthy lifestyles is efficient and cost-effective methods for preventing communicable and non-communicable diseases including tuberculosis. WHO urges Member States to formulate policies, strategies and action plans which aimed to prevent the health risk and managing these risks through efficient surveillance systems. [1]

Lifestyle risk factors which include eating habits, living conditions, educations, smoking, alcohol and occupation, etc. has been contributed to burden of tuberculosis. [3,4] These factors that have been shown to influence the burden of tuberculosis. Many previous studies are exploring risk factors for TB. Causative bacteria and human related lifestyle risk factors were generally explored separately. [5-9] It's an established fact that poor nutrition associated with tuberculosis but previous study shows that those who have undergone gastrectomy surgery may also be a risk factor for the tuberculosis. [10-14] Anorexia is also a risk factor for in tuberculosis. In a study which was conducted in American patients with tuberculosis found that patient had 45% lost weight and 20% had anorexia. [15] Production of cytokines and lipolysis activity also increased in TB. [16-17] Another study conducted in Canada, housing density and income level associated with TB. Congested housing has associated with TB, and isolation from health services due to lack of accessibility and affordability may increase the likelihood of TB. [18]

Another study result showed that incidence of TB cases has increases among unemployed people (RR=1.68, 95% CI: 1.51-1.88), social disharmony (RR=1.29, 95% CI: 1. 04-1.58), overpopulation (RR=1.36, 95% CI: 1.19-1.55). Regions with extreme poverty and inner-city neighborhoods showed a higher risk of tuberculosis (RR=1.11, 95% CI, 1.08-1.135 and RR=1.80, 95% CI: 1.51-2.14). [19]

Another Study found that smokers were increased risk of TB (OR, 2.87; 95% confidence interval, 2.00–4.11; $p < 0.001$). In the smokers, persons who had TB, smoked additional cigarettes per day, (13.43, SD 8.76 vs. 10.96, SD 7.87, p=0.01). [20]

Heavy alcohol user was more likely associated with TB. A meta-analysis was conducted which showed that yielded a pooled relative risk of 2.94 (95% CI: 1.89-4.59). [20] Several previous studies show that pathogenic influence of alcohol on the immune system of body. [21-25] Heavy alcohol uses strongly related with the TB. [21] Social marginalization and higher rate of treatment defaults which produce development of drug-resistant of TB. [21] A previous study result showed that the effect of age, nationality, economic and social situation, educational level,



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awareness level and the surrounding environment of the person has increased incidence of tuberculosis compare to healthy person. [22] Smoking one of the lifestyle risk factors which has been associated with of TB infection, disease and death [21]. Nutrition status has also associated with TB. Overweight and obesity is related with increased risk of TB. Diabetes mellitus is also risk of TB, but because those with poor control of diabetes. [10-14] TB is associated with the other diseases such as Human immunodeficiency virus in Saudi Arabia, as in other developed countries; [15-19].

According to world health organization it is estimated that annual TB a prevalence of 3.2 per 100,000 populations in Saudi Arabia. [1] Saudi Arabia now under wide economic growth which led to enhancing social, economic and health services in the country. This was related with a presence of high numbers of expatriates and Most of them belongs to countries where high prevalence of TB such as India, Pakistan, Bangladesh, Indonesia, and Yemen.

In current years, importance of lifestyle related factors has been progressively recognized because changes of lifestyle everywhere in the world which were caused many diseases reemerged. There is a prerequisite to explore the contribution of lifestyle factors for TB and find factors that can influence the development of TB in human and for re-orient and developed TB control policies. [11-13] On best of our knowledge there is no study was conducted in Middle east countries which determine the association of lifestyle factors with pulmonary tuberculosis. There is knowledge gap which require exploring the association between TB and lifestyle. The objective of study is to determine the association of lifestyle risk factors with pulmonary tuberculosis patients in Asir region of KSA. .

## Methods

The setting of the study in the Military Hospital of the Armed Forces in the South in Khamis Mushait, this is the big hospital in the south region and daily 2000 outpatient come to that hospital. Study design was a case control study and Inclusion criteria of the Cases are all TB patients with confirm diagnosis of Hospital record were included and all Saudi nationals and Control all patients with respiratory disease other than the tuberculosis were included from medical outpatient department (OPD), all Saudi Nationals. Exclusion criteria Those Patients who are co-morbid such as heart, diabetes were excluded. The sample size was calculated by Epi info, 95% CI, 40% relative accuracy, the expected probability of exposure to a disease is 0.34, the expected probability of exposure from non-disease 0.30 and the expected individual odds ratio is 1.25, the total sample size is 135 and divided equally (67) in cases and (68) in controls. [9] Simple Random Sampling was used to select the study participants. Data collection tool is validated and structured questionnaire. The questionnaire consists of two main parts: Part 1: Socio-Demographic Characteristics of Study Participants, Part Two: consists of lifestyle questions, it includes smoking, alcohol use, nutrition, fitness, physical activity, education and employment history, social and outside activities and medical history. To validate the questionnaire, a jury of ten specialists was asked to examine it. They suggested editing some of the items. The researcher edited them accordingly.

Dependent variable is Tuberculosis and independent variables are age, gender, education, marital status, work status, income, housing, person per household, nutrition status, physical exercise, and smoking. The study was approved by military hospital ethical committee at Asir region of Saudi. The ethical document no is 23452. Permission was taken from respective departments, consent form signed from each participant before conducting an interview. Participation should be voluntary, and participants are free to withdraw at any time without any explanations. The confidentiality and privacy of the subjects were maintained and there was no financial benefit to either the subject or the researcher. Secondary data for the study population was abstracted from TB treatment registers in selected treatment facilities. These included demographic data (age, sex, residence, marital status) and medical and treatment data. To obtain primary data, sampled cases (n=67) and controls (n=68) were interviewed using validated structured questionnaire. Data was double entered using SPSS version 24. Cases were compared with control with lifestyle and demographic factors by chi square test. Odds ratios (OR) were calculated by logistic regression, with TB as an outcome. Multivariate models were developed, that showed a significant statistical effect in the prediction of TB ($P<0.05$).

## Results

Table 1 shows that the mean age of cases was 38.0 ± 9.7 years, while for control subjects; the mean age was 40.2 ± 7.7 years. More than half of cases and control subjects were males (58.2% and 55.9%, respectively). More than half of cases and control subjects were university graduates (50.7% and 58.8% respectively). More than half of cases and control subjects lived in rural areas (55.2% and 52.9%, respectively). Most cases and control subjects were married (77.6% and 83.8%, respectively), while 14.9% of cases and 10.3% of control subjects were single. Most cases and control subjects lived in popular houses (49.3% and 47.1%, respectively) or apartments (48.8% and 50%, respectively). More than half of cases' and control subjects' residence were owned by them (55.2% and 55.9%, respectively). The monthly income of 52.9% of cases and 47.1% of control subjects was more than 7000 SR. Regarding family size, 46.7% of cases and 53.3% of control subjects was more than 6 members. About half of cases (46.3%) and 58.8% of control subjects were overweight, while 25.4% of cases and 27.9% of control subjects were obese. More than half of cases (53.7%) and 45.6% of control subjects were smokers.

Table 2 shows prevalence of severe stress was higher among cases than control subjects (44.8% and 35.3%, respectively). Cases had higher family history of obesity than control subjects (68.8% and 41.2%, respectively). Most cases and control subjects practiced regular exercise during the last 3 months (67.2% and 70.6%, respectively). Most cases and control subjects skip meals during the day (71.6% and 73.5%, respectively). More than half of cases and control subjects sometimes eat late at night (52.2%

| Table 1: Socio-demographic characteristics of study participants. (n=135). | | | | |
|---|---|---|---|---|
| **S. No** | **Characteristics** | **Cases (%) n=67** | **Control (%) n=68** | **P- value*** |
| 1 | **Age (years) (Mean ± SD)** | 38.04 ± 9.66 | 40.16 ± 7.72 | 0.16 |
| 2 | Gender | | | |
| | Male | 39 (58.2) | 38 (55.5) | 0.75 |
| | Female | 28 (41.8) | 30 (44.1) | |
| 3 | Education | | | |
| | Secondary | 34 (49.3) | 40 (58.8) | 0.34 |
| | Bachelor | 33 (50.7) | 28 (41.2) | |
| 4 | Resident | | | |
| | City | 30 (44.8) | 32 (47.1) | 0.79 |
| | Village | 37 (55.2) | 36 (52.9) | |
| 5 | Marital status | | | 0.65 |
| | Single | 10 (14.9) | 07 (10.3) | |
| | Divorce | 5 (7.5) | 4. (5.9) | |
| | Married | 52 (77.6) | 57 (83.8) | |
| 6 | Type of Housing | | | 0.96 |
| | Popular House | 33 (49.3) | 32 (47.1) | |
| | Apartment | 32 (47.8) | 34 (50) | |
| | Villa | 02 (003) | 02 (2.9) | |
| 7 | Ownership of housing | | | 0.93 |
| | Owner | 37 (55.2) | 38 (55.9) | |
| | Rent | 30 (44.8) | 30 (44.1) | |
| 8 | Income (Saudi Riyal) | | | 0.43 |
| | ≤7000 SR | 31 (46.3) | 36 (52.9) | |
| | >7000 SR | 36 (53.7) | 32 (47.1) | |
| 9 | Family Size | | | 0.91 |
| | 6≥ Members | 26 (38.8) | 27 (39.7) | |
| | 6 ≤ Members | 41 (61.2) | 41 (60.3) | |
| 10 | BMI (Body Mass Index) | | | 0.04 |
| | Normal (18.5-24.5) | 19 (28.4) | 9 (13.2) | |
| | Overweight (25-29.9) | 31 (46.3) | 40 (58.8) | |
| | Obese (>30) | 17 (25.4) | 19 (27.9) | |
| 11 | Smoke | | | 0.34 |
| | Yes | 31 (46.3) | 37 (54.4) | |
| | No | 36 (53.7) | 31 (45.6) | |
| 12 | Family history of obesity | | | 0.23 |
| | Yes | 30 (44.8) | 24 (35.3) | |
| | No | 46 (68.7) | 40 (58.8) | |

| Table 2: Lifestyle risk factors among study participants (n=135). | | | | |
|---|---|---|---|---|
| **S. No** | **Characteristics** | **Cases (%) n=67** | **Control (%) n=68** | **p-value*** |
| 1 | **Average duration of sleep at night** | | | 0 |
| | Normal (8 hours) | 27 (40.3) | 07 (10.3) | |
| | Abnormal (8< hours) | 40 (59.7) | 61 (89.7) | |
| 2 | **Nature of job** | | | 0.52 |
| | White collar | 24 (35.8) | 28 (41.2) | |
| | Blue collar | 43 (64.2) | 40 (58.8) | |
| 3 | **Stress level** | | | 0.43 |
| | Mild | 16 (23.9) | 16 (23.5) | |
| | Moderate | 21 (31.3) | 28 (41.2) | |
| | Severe | 30 (44.8) | 24 (35.3) | |
| 4 | **Regular exercise during the last 3 months** | | | 0.66 |
| | Yes | 45 (67.2) | 48 (70.6) | |
| | No | 22 (32.8) | 20 (29.4) | |
| 5 | **Frequency of Junk Food eating (including snacks)** | | | 0.005 |
| | 3> day/week | 10 (14.9) | 19 (27.9) | |
| | 3<day/week | 57 (85.1) | 49 (72.1) | |
| 6 | **Skipping meals during the day** | | | 80 |
| | Yes | 48 (71.6) | 50 (73.5) | |
| | No | 19 (28.4) | 18 (26.5) | |

| | | | | |
|---|---|---|---|---|
| 7 | **Late Night Eating** | | | 0.67 |
| | Never | 32 (47.8) | 30 (44.1) | |
| | Sometimes | 35 (52.2) | 38 (55.1) | |
| 8 | **Feeling energy level drop throughout the day** | | | 0.31 |
| | Yes | 21 (31.3) | 27 (39.7) | |
| | No | 46 (68.7) | 41 (60.3) | |
| 9 | **Ever taken a multivitamin or food supplements?** | | | 0.91 |
| | Yes | 27 (40.3) | 28 (41.2) | |
| | No | 40 (59.7) | 40 (59.8) | |
| 10 | **Eating out per week** | | | 0 |
| | 1≥ times per week | 17 (25.4) | 23 (33.8) | |
| | 1≤ times per week | 50 (74.6) | 45 (66.2) | |
| 11 | **Reason for eating besides hunger** | | | 0.55 |
| | Stressed | 36 (53.7) | 40 (58.8) | |
| | Social | 31 (46.3) | 28 (41.2) | |
| 12 | **Eating beyond the point of fullness** | | | 0.05 |
| | Sometimes | 47 (70.2) | 43 (63.3) | |
| | Never | 20 (29.8) | 25 (36.7) | |
| 13 | **Frequency of physical exercise** | | | 0.53 |
| | ≤3-4 day/week | 41 (61.2) | 38 (55.9) | |
| | ≥ 3-4 day/week | 26 (38.8) | 30 (44.1) | |
| 14 | **Priority of Health** | | | 0.07 |
| | Low priority | 24 (35.8) | 24 (35.3) | |
| | Medium Priority | 22 (32.8) | 20 (29.4) | |
| | High priority | 21 (31.3) | 24 (35.3) | |

*Chi-square test

and 55.9%, respectively). About one third of cases and control subjects experience the feeling of energy drop during the day (31.3% and 39.7%, respectively). Less than half of cases and control subjects take multivitamins or food supplements (40.3% and 41.2%, respectively). Most cases and control subjects sometimes eat out weekly (74.6% and 66.2%, respectively). Other than hunger, more than half of cases and control subjects eat as a result of stress (53.7% and 58.8%, respectively). Most cases and control subjects sometimes eat beyond the point of fullness (70.1% and 72.1%, respectively). More than half of cases and control subjects practice physical exercise less than 3-4 days/week (61.2% and 55.9%, respectively). About one-third of cases and control subjects consider the priority of their health as high (31.3% and 35.3%, respectively).

Table 2 shows that most cases and control subjects have an average duration of sleep less than 8 hours (61.2% and 89.7%, respectively, $p<0.001$), The occupation of more than half of cases and control subjects belonged to the "Blue Collar" job type (64.2% and 58.8%, respectively). However, difference between both groups was not Table 3 shows that the odds ratio (OR) for female gender is above 1 (crude OR=1.01 and AOR=1.65). Secondary level of education was associated with OR>1 (crude OR=1.38 and AOR=1.58). Rural residence was associated with OR>1 (crude OR=1.09 and AOR=1.16). Being divorced or married was associated with OR>1 (crude OR=1.14 and 1.56, respectively; and AOR=1.19 and 1.01, respectively). Living in a popular house was associated with OR >1 (crude OR=1.06 and AOR=1.12). Having a monthly income of more than 7000 SR was associated with a crude OR=0.76 and AOR=1.9. Family size of >6 members is associated with OR>1, with crude OR=1.03 and AOR=1.9. Having a positive family history of obesity is associated with OR >1, with crude OR=1.53 and AOR=1.43. Odds ratios of all sociodemographic factors were not statistically significant.

Table 4 shows that the odds ratios for both overweight and obesity were significantly above 1 (crude OR=2.72 and 2.35, respectively and AOR=4.4 and 2.38, respectively). For smoking OR >1 (crude OR=5.88 and AOR=5.03). Average duration of sleep at night for <8 hours was significantly associated with OR>1 (crude OR=5.88 and AOR=5.03). Blue collar jobs were associated with OR>1 (crude OR=1.25 and AOR=2.69). Moderate stress is associated with OR>1 (crude OR=1.33 and AOR – 1.84). Non-practice of regular exercise for the past 3 months is associated with OR>1 (crude OR=1.17 and AOR=1.51). Number of meals <3 is associated with OR>1 (crude OR=1.5 and AOR=1.75). Skipping meals during the day is associated with OR>1 (crude OR=1.1 and AOR=1.59). Late night eating is associated OR>1 (crude OR=1.15 and AOR=1.33). Not taking multivitamins or food supplements is associated with OR>1 (crude OR=1.03 and AOR=1.04). Eating out per week is associated with OR>1 (crude OR 1.5 and AOR=1.3). Eating for social reasons is associated with OR>1 (crude OR=1.23 and AOR=2.08). Physical exercise less than 3-4 days/week is associated with OR>1 (crude OR=1.24 and AOR=1.41).

## Discussion

The study result has revealed that lifestyle factors for tuberculosis are multi-layered. Contact to different lifestyle exposure including smoking, high body mass index, irregular sleep at night, stress level, frequency of junk of food, eating out per week, stressed because eating and frequency of physical

**Table 3: Association of socio-demographic factors and tuberculosis (n=135).**

| S. No | Characteristics | Cases Crude OR (Confidence Interval) | p-value | Cases Adjusted OR (Confidence Interval) | p-value |
|---|---|---|---|---|---|
| **1** | Gender | | | | |
| | Male | 1 | | 1 | |
| | Female | 1.01 (0.55-1.21) | 0.09 | 1.65 (0.61-4.45) | 0.08 |
| **2** | Education | | | | |
| | Bachelor | 1 | | 1 | |
| | Secondary | 1.38 (0.70-2.737) | 0.07 | 1.58 (0.61-4.45) | 0.08 |
| **3** | Resident | | | | |
| | City | 1 | | 1 | |
| | Village | 1.09 (0.55-2.15) | 0.09 | 1.16 (0.49-2.75) | 0.06 |
| **4** | Marital Status | | | | |
| | Single | 1 | | 1 | |
| | Divorce | 1.14 (0.22-5.84) | 0.07 | 1.19 (0.28-4.96) | 0.08 |
| | Married | 1.56 (0.55-4.41) | 0.08 | 1.01 (0.17-5.73) | 0.06 |
| **5** | Type of Housing | | | | |
| | Villa | 1 | | 1 | |
| | Popular House | 1.06 (0.14-7.99) | 0.08 | 1.12 (0.34-2.18) | 0.09 |
| | Apartment | 0.97 (0.12-7.30) | 0.09 | 1.02 (0.13-8.10) | 0.12 |
| **6** | Income | | | | |
| | ≤ 7000 SR | 1 | | 1 | |
| | >7000 SR | 0.76 (0.38-1.50) | 0.07 | 1.90 (0.67-5.37) | 0.2 |
| **7** | Family Size | | | | |
| | ≤ 6 Members | 1 | | 1 | |
| | > 6 Members | 1.03 (0.52-2.07) | 0.12 | 1.90 (0.54-2.28) | 0.14 |
| **8** | Family History overweight | | | | |
| | No | 1 | | 1 | |
| | Yes | 1.53 (0.75-3.10) | 0.11 | 1.43 (0.68-3.00) | 0.12 |

**Table 4: Association of life style risk factors and Tuberculosis (n=135).**

| S. No | Characteristics | Cases Crude OR (Confidence Interval) | p-value | Cases Adjusted OR (Confidence Interval) | p-value |
|---|---|---|---|---|---|
| 1 | BMI | | | | |
| | Normal (18.5-24.5) | 1 | | 1 | |
| | Overweight (25-29.9) | 2.72 (1.08-6.84) | 0.03 | 4.4 (1.27-15.25) | 0.02 |
| | Obese (>30) | 2.35 (1.84-6.59) | 0.04 | 2.38 (0.61-9.22) | 0.07 |
| 2 | Smoking | | | | |
| | No | 1 | | 1 | |
| | Yes | 1.38 (0.70-2.72) | 0.09 | 1.34 (0.52-3.43) | 0.12 |
| 3 | Regularly sleep at night? | | | 1 | |
| | Normal (8 hours) | 1 | | 1 | |
| | Abnormal (8< hours) | 5.88 (2.33-14.78) | 0.01 | 5.03 (1.57-16.10) | 0.02 |
| | Nature of job | | | | |
| | Blue collar | 1 | | 1 | |
| | White collar | 1.25 (0.62-2.51) | 0.09 | 2.69 (1.00-7.28) | 0.05 |
| 5 | Stress level | | | | |
| | Mild | 1 | | 1 | |
| | Moderate | 1.33 (0.54-3.26) | 0.14 | 1.84 (0.56-6.05) | 0.12 |
| | Severe | 0.80 (0.33-1.92) | 0.12 | 0.75 (0.23-2.39) | 0.09 |
| 6. | Regular Exercise for past 3 month | | | | |
| | Yes | 1 | | 1 | |
| | No | 1.17 (0.56-2.43) | 0.08 | 1.51 (0.59-3.85) | 0.09 |
| 7. | Frequency of Junk Food eating (including snacks) | | | | |
| | 3> days/Week | 1 | | 1 | |
| | 3< days/ Week | 1.50 (0.71-3.16) | 0.14 | 1.75 (1.01-3.01) | 0.04 |
| 8. | Skipping meals during day | | | | |
| | No | 1 | | 1 | |
| | Yes | 1.10 (0.51-2.34) | 0.11 | 1.59 (0.50-5.01) | 0.1 |

| | | | | | |
|---|---|---|---|---|---|
| 9 | Late Night Eating | | | | |
| | Never | 1 | | 1 | |
| | Ever | 1.03 (0.52-2.06) | 0.13 | 1.04 (0.36-2.99) | 0.11 |
| 10 | Ever taken a multivitamin or other food supplements? | | | | |
| | No | 1 | | 1 | |
| | Yes | 1.03 (0.52-2.06) | 0.15 | 1.04 (0.36-2.99) | 0.12 |
| 11 | Eating out per week | | | | |
| | 1≥ times per week | 1 | | 1 | |
| | 1< times per week | 1.50 (0.71-3.16) | 0.1 | 1.30 (1.02-3.98) | 0.03 |
| 12 | Reason of eating besides hunger | | | | |
| | Social | 1 | | 1 | |
| | Stressed | 1.23 (0.62-2.43) | 0.08 | 2.08 (1.02-5.27) | 0.04 |
| 13 | Frequency of physical exercise | | | | |
| | 3-4 < day/week | 1 | | 1 | |
| | 3-4 > day/week | 1.24 (0.62-2.47) | 0.07 | 1.41 (1.21-3.47) | 0.03 |

exercise were associated with in the probability of developing tuberculosis. Even though personal characteristics of participants in the study group (with tuberculosis) were comparable to those in the healthy control groups, some lifestyle risk factors differed between them.

Findings of the present study revealed that enough duration of sleep (≥8 hours) was not fulfilled by more than one-third of TB cases (38.8%), compared with only 10.3% of subjects in the control group. Difference between TB cases and control subjects regarding duration of sleep was statistically significant. These findings are in accordance with those reported by Al-Osaimi [9] in Al-Taif Province, Saudi Arabia, who reported a high rate of malnutrition among tuberculosis patients.

This relation between lack of sleep and tuberculosis has been explained by several studies, which described the association lack of sleep and disturbed immunity. Previous study stated that [26] stated that sleep is insignificant modulator of the immune response. Therefore, abnormal sleep weakens the immunity and increase susceptibility to infection. Previous study stated that [27] the capacity to remain healthy is greatly affected by poor sleep. It has been noted that sleep demand is increased in most chronic diseases, [28] and vulnerability to infectious diseases is increased by lack of sleep. [29,30] Several malnutrition-related lifestyle factors were significantly associated with tuberculosis in the present study, i.e., infrequent meals (<3 meals/day), frequently eating outdoors, and eating in social occasions.

The relation between nutritional status and tuberculosis has been studied worldwide. Previous study noted that [31] in both industrialized and emerging countries, tuberculosis is generally associated with nutrition. Previous study [32] found that how body mass index caused the disturbance between human immunity which lead to risk factors of TB. The present study showed that having a white collar (office-based sedentary) job, and lack of physical activity (as indicated by practicing physical exercise for less than 3 days/week) were significantly associated with tuberculosis.

It seems that lowered physical activity among tuberculosis patients is a result rather than a risk factor stated that tuberculosis results in muscle atrophy and, impaired lung function and gas exchange. The consequences of changes observed in muscle system are lower exercise tolerance, decrease in daily physical activities and impaired quality of life. [33]

Previous study [34] reported a significant difference between adult normal person and adult with TB for physical functional capacity. The tuberculosis patients group had a poor aerobic capacity indicating the significant impact of tuberculosis on cardiorespiratory endurance. Previous study [35] demonstrated the importance of physical exercise in the rehabilitation of pulmonary tuberculosis patients' rehabilitation. They found improvement in the maximum rate of oxygen consumption measured during exercise after two weeks of daily walking exercise training. Present study shows that smoking habit almost same between cases and control, although its associated more than one-fold with tuberculosis.

Previous study [36] determine that the association between smoking and pulmonary tuberculosis. The study found that disease rates of 0.42/1000 for male non-smokers and 2.09/1000 for male current smokers with a rate ratio of 1:5. There is association of tobacco and alcohol with tb among ex-servicemen with TB. In a study which was conducted in Hong Kong [37], smokers had a three times increased risk of TB (OR, 2.87 [2.00–4.11]), among the ageing papulation. The observed difference in risk between Taiwan and Hong Kong elderly might be due to bias for all age group or increased smoking habit among elderly.

## Conclusion

Results of the present study identified main categories of lifestyle risk factors significantly associated with tuberculosis. These categories are: high body mass index, eating outside, lack of sleep, malnutrition, and physical inactivity. Therefore, it is important that the Saudi Ministry of Health should design and implement health education programs addressing these lifestyle risk factors for prevention of tuberculosis

## Competing Interests

The authors declare that they have no competing interests.

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