Original Article

Diabetes Mellitus and its Association with Body Mass Index in Sputum Positive Tuberculosis Patients in a Tertiary Health Care Centre

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Abstract

Background: Tuberculosis is a chronic infectious disease that causes pulmonary tuberculosis and also affects other tissues of the body. People with diabetes mellitus and those who are underweight have an increased risk of getting active tuberculosis. The objectives of the study were to estimate the prevalence of diabetes mellitus and to determine its association with Body Mass Index in tuberculosis patients.

Methods: In the present record-based cross-sectional study, 100 sputum smear positive tuberculosis patients 18 years and older who attended the out-patient department of Pulmonary Medicine from 1/6/2020 to 31/12/2022 were included and sputum smear negative patients were excluded. Data entry and analysis was done in Microsoft Excel. Percentages were calculated and association between diabetes mellitus and Body Mass Index of the study population was assessed by chi square test.

Conclusion: The prevalence of diabetes mellitus in tuberculosis patients was almost double than that of the general population of India and its association with underweight was found to be statistically significant. So proper screening of all patients of tuberculosis for diabetes mellitus is necessary for early diagnosis and treatment. Health education and counselling are equally important.

Keywords: Body Mass Index, diabetes mellitus, prevalence, tuberculosis.

Introduction

Tuberculosis is a chronic infectious disease caused by Mycobacterium Tuberculosis. It affects the lungs causing pulmonary tuberculosis, and can also affect intestine, meninges, skin, lymph glands, bones and joints and other tissues of the body.[1] As of today, about one-third of the population all over the world is infected asymptomatically with tuberculosis, out of which 5 to 10 percent will develop signs and symptoms of the disease in their lifetime.[2] The infection is usually acquired during childhood in the developing countries from where many new cases and deaths are reported. The annual risk of tuberculosis infection is about 0.5 to 2 percent in high burden countries.[3]

India has the highest number of incident cases of tuberculosis that occur each year. About 26 percent of the global incident tuberculosis cases in India in

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the year 2019.[4,5] In addition to the disease burden caused by tuberculosis, it also causes an enormous socioeconomic burden to India. Tuberculosis usually affects individuals in their most productive years of life. About two-thirds of all tuberculosis cases in India are male, but more than 50 percent of female cases occur before the age of 34 years.[6] In India, tuberculosis affects the poor people that include slum dwellers, migrant labourers and people residing in backward areas and tribal areas. Malnutrition, overcrowding, poor housing conditions are the reasons for the spread of the disease.[7]

There are over 347 million people all over the world suffering from diabetes mellitus, as reported by the World Health Organization.[8] The low and middle income countries have about 95 percent of tuberculosis patients and 70 percent of diabetes mellitus patients.[9,10] The prevalence of diabetes mellitus in India is 7.3% with urban regions in the country having a prevalence of 11.2%.[11] It is indicated that by the year 2030, diabetes mellitus will become the seventh leading cause of death all over the world and 90 percent of the diabetes mellitus cases will be of type 2 diabetes mellitus.[12] People with diabetes mellitus have two to three times increased risk of getting active tuberculosis compared to people without diabetes mellitus.[13]

In most of the underdeveloped regions of the world, malnutrition and tuberculosis are both serious problems, mainly in South Asian countries.[14] It is necessary to study the interaction of these two problems with each other. Malnutrition is associated with increased severity of infections including tuberculosis while infections in turn lead to malnutrition. In India, malnutrition is the most prevalent risk factor for tuberculosis. In immune compromised individuals and those with certain diseases, the risk of acquiring tuberculosis is significantly increased.[15] People with a weakened immune system such as people living with HIV (Human Immunodeficiency Virus) infection, malnutrition, diabetes mellitus or smokers have an increased risk of getting infected with tuberculosis. There are five risk factors that cause an increase in the number of new cases of tuberculosis. They are undernutrition, HIV infection, alcohol use, smoking and diabetes mellitus.[16]

The present study was carried out with the following objectives:

i). To estimate the prevalence of diabetes mellitus in study population.

ii). To estimate the prevalence of underweight in study population.

iii). To determine the association of diabetes, addictions and HIV with BMI (Body Mass Index) instudy population.

Materials and Methods

The present record based cross-sectional study was carried out in a tertiary health care centre. The laboratory investigations of all the patients suspected of having tuberculosis that attended the OPD (Out-Patient Department) of Pulmonary Medicine from June 2020 to December 2022 with the complaints of cough more than 2 weeks duration that was not resolved by medication, were carried out. There were 2,224 such patients that attended the OPD during the study period. Out of these, 100 patients tested positive for sputum smear. These 100 patients were included in the present study.

Inclusion criteria: All the patients aged 18 years and above that were sputum smear positive.

Exclusion criteria: Patients who had symptoms suspected of tuberculosis but who tested sputum smear negative.

Demographic information of the study participants such as age, gender and place of residence was noted down. History of addictions was also noted. Anthropometric data such as height in centimetres and weight in kilograms was noted. The Body Mass Index (BMI) of each patient was calculated accordingly using the formula = weight in kilograms/square of the height in metres.

Laboratory investigations like blood sugar level, HIV (Human Immunodeficiency Virus) infection status was also noted down.

Before including the study participants in the present study, during their OPD visit they were explained about the nature and purpose of the study, they were informed that their names won't be revealed and verbal consent was obtained from them.

Data entry and analysis was done in Microsoft Excel. The mean age, mean height and mean weight of the study participants was calculated. The percentage of study participants who were underweight, those who had diabetes mellitus, those who had addictions was calculated. The association of diabetes mellitus, addictions and reactive HIV infection with underweight study participants was tested for significance with the help of chi square test by constructing 2 2 tables. The degree of freedom was 1, meaning that at 5% level of significance, the chi square values more than 3.84 were considered statistically significant and those with a value below 3.84 were not statistically significant. The results were analysed and are given as follows.

Results

Table 1: Age and gender wise distribution of study population (n=100).

Age group in years	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
15 to 24	3	3	7	7	10	10
25 to 34	11	11	4	4	15	15
35 to 44	19	19	5	5	24	24
45 to 54	15	15	5	5	20	20
55 to 64	12	12	6	6	18	18
65 and above	10	10	3	3	13	13
Total	70	70	30	30	100	100

Out of the total 100 study participants, 70 were males and 30 were females. The mean age of all the participants was 45.29 15.64 years. The mean age of males was 47.01 14.40 years while that of the females was 41.27 17.84 years. There were 38 participants that were residing in an urban area while 62 participants were residing in a rural area. The prevalence of tuberculosis was highest (24%) in the age group of 35 to 44 years and lowest (10%) in the age group of 15 to 24 years.

Out of the total study participants, 38 (26 males and 12 females) were staying in an urban area while 62 (44 males and 18 females) were staying in a rural area.

Table 2: Distribution of study population according to addictions (n=100).

Addictions	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
Tobacco	10	10	1	1	11	11
Alcohol	1	1	0	0	1	1
Tobacco and alcohol	7	7	0	0	7	7
Smoking	1	1	0	0	1	1
Total	19	19	1	1	20	20

There were 20 percent study participants who had addictions with a majority of them (11%) having the addiction of tobacco chewing.

Table 3: Distribution of study population according to their Body Mass Index (n=100).

Body Mass Index	Males		Females		Total	
	Number	Percent	Number	Percent	Number	Percent
Underweight	38	38	14	14	52	52
Normal	27	27	12	12	39	39
Pre-obese	5	5	3	3	8	8
Obese class I	0	0	1	1	1	1
Obese class II	0	0	0	0	0	0
Obese class III	0	0	0	0	0	0
Total	70	70	30	30	100	100

The mean height of all study participants was 158.22 7.40 cm. The mean height of the males was 160.60 6.41 cm while that of the females was 152.7 6.61 cm. The mean weight of all the study participants was 47.01 10.55 kg. The mean weight of the males was 47.2 10.21 kg while that of the females was 46.57 11.48 kg.

A majority of the study participants (52 percent) were underweight followed by normal BMI participants (39 percent), pre-obese participants (8 percent) and class I obesity participants (1 percent).

The mean BSL (Blood Sugar Level) of all the study participants was 133.8 71.54 mg/dl. The mean BSL of the males was 135.31 74.16 mg/dl while that of the females was 130.27 66.08 mg/dl. There were 16 study participants who had diabetes mellitus out of which 12 were males and 4 were females.

Out of the total 100 study participants, there were 6 study participants (3 males and 3 females) that had a reactive HIV test.

Table 4: Association of diabetes with underweight in study population.

Diabetes mellitus	Underweight (BMI<18.50)	
	Yes	No
Present	3	13
Absent	49	35

CHI SQUARE VALUE = 8.44 p value = 0.03677
p < 0.05

The association of diabetes mellitus in the sputum positive tuberculosis study participants was statistically significant with their underweight status as shown by the chi square value of 8.44 and a p value less than 0.05.

Table 5: Association of addictions with underweight in study population.

Addictions	Underweight (BMI<18.50)	
	Yes	No
Yes	14	6
No	38	42

CHI SQUARE VALUE = 3.24 p value = 0.072
p > 0.05

As it is evident from the table 8, the association of addictions of the study participants with their underweight status is not statistically significant as the chi square value is less than 3.84 and p value is more than 0.05.

Table 6: Association of HIV infection with underweight in study population.

HIV status	Underweight (BMI<18.50)	
	Yes	No
Reactive	2	4
Non-reactive	50	44

CHI SQUARE VALUE = 0.90 p value = 0.34
p > 0.05

The association of the HIV status of the study participants is not significant with their underweight status.

Discussion

The mortality due to tuberculosis can be due to many risk factors that include diabetes mellitus, smoking, malnutrition and HIV infection.[17] The prevalence of diabetes mellitus in the study participants found by the present study was 16 percent which is higher than that of the general population of India (7.3%).

Similar findings were found by a study done by Kottarath MD et al.[18] in Kerala that showed a prevalence of diabetes mellitus to be 19.6% in the patients of tuberculosis. Studies done by Kumpatla S et al.[19] in Tamil Nadu and by Raghuraman S et al.[20] in Puducherry reported a prevalence of diabetes mellitus in tuberculosis patients to be 25 percent and 29 percent respectively. This was more than that found by the present study.

All the studies are showing a similar finding that the prevalence of diabetes in the tuberculosis patients is greater than that found in the general population. This tells us about the fact that diabetes mellitus and uncontrolled blood sugar level can reduce the immunity of an individual and make him or her more susceptible to acquiring tuberculosis.

Screening of the patients of tuberculosis for diabetes mellitus with tests for blood sugar level, glycated haemoglobin, etc. is necessary for its early diagnosis and treatment in order to keep a controlled blood sugar level and maintain the health and quality of life of the patients.

In the present study, the prevalence of underweight study participants was 52 percent and the association of diabetes mellitus with underweight was statistically significant. Similar findings were reported by a study conducted by A. Z. Soh et al.[21] which showed that diabetes mellitus and underweight were associated with approximately 2 to 3 times increased risk of acquiring tuberculosis. Low BMI increases the risk of tuberculosis and tuberculosis can cause loss of weight.[22] Low BMI indicates poor nutritional status and impaired cell-mediated immunity caused due to malnutrition increases the risk of acquiring tuberculosis.[23]

Conclusion

In the present study, the prevalence of diabetes mellitus in the tuberculosis patients was found to be almost double than that of the general population of India with the prevalence being more in the males than the females. The association of diabetes mellitus with underweight of the study participants was statistically significant. So proper screening of all the patients of tuberculosis for diabetes mellitus is necessary for early diagnosis and treatment.

Though the association of addictions with the underweight status of study population was not statistically significant, it is known that addictions, especially smoking in case of tuberculosis aggravate the health status of a person and smoking damages the respiratory as well as cardiovascular system. So, the patients must be advised to completely stop the addiction that they are having.

Health education and counselling of the patients of tuberculosis about the things that they can do to maintain a normal blood sugar level in diabetic as well as non-diabetic study participants such as moderate exercise like walking every day for at least one hour, eating frequent meals without starving oneself, self-care in diabetes mellitus, importance of continuing the ongoing treatment and follow up, the harmful effects of addictions, consuming a healthy and balanced diet in order to maintain normal weight and to increase the weight to normal range in case of underweight patients, and proper nutrition is necessary.

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