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Awareness and proportion of diabetes mellitus among newly diagnosed pulmonary tuberculosis patients at a tertiary care institution in Eastern India: A cross-sectional study

Tapodeb Chatterjee [1], Sanjay Pandey[2], SS V Prasad[3], Alok Ranjan[4], Santosh Kr Nirala[5], Deependra Kumar Rai[6], Sushil Kumar[7]

ABSTRACT

Introduction: The worldwide impact of tuberculosis (TB) and diabetes mellitus (DM) is significant, with these diseases disproportionately affecting the most at-risk populations, including those living in poverty, malnourished individuals, and the elderly. **Methodology:** A hospital-based cross sectional study was conducted at a tertiary care institution, with a total sample of 194. Convenient sampling was used for sample collection. A pretested semi-structured questionnaire was used to assess knowledge, attitude, and practice regarding Diabetes mellitus. All qualitative variables were represented in proportions. **Result:** Among the newly diagnosed tuberculosis patients, 17% had diabetes mellitus. Diabetes mellitus is due to a rise in blood sugar, which was reported by 87.6% of participants. Around half of the participants reported lack of physical activity as both the cause and the risk factor for diabetes mellitus. Willingness to visit the government facility for the treatment of DM was reported among 84%, while only 40.2% are willing to take drugs for DM for life. **Conclusion:** It was found that 2 out of every 10 newly diagnosed patients had diabetes mellitus. The knowledge regarding the cause of diabetes mellitus due to the increased blood sugar was there. However, there is a gap in the attitude and practice regarding diabetes among all the newly diagnosed patients of tuberculosis. There is an urgent need for the proper implementation of a collaborative framework for diagnosis, treatment, care, and control of tuberculosis and diabetes mellitus.

Keywords: Tuberculosis, Diabetes Mellitus, Awareness, India, Attitude, Practices.

Introduction

Tuberculosis (TB) is a fatal infectious illness that affects a significant portion of the global population, with Mycobacterium tuberculosis infecting approximately 25% of people globally. Approximately 10 million individuals have tuberculosis annually, resulting in more than 1.5 million deaths.[1] Approximately 25% of the world's population has been estimated to have contracted tuberculosis germs. Approximately 5-10% of individuals who contract tuberculosis will later experience symptoms and progress to develop tuberculosis illness.[2] It can affect any part of the body however; the lungs are the most affected organs and it is of major importance as we can stop the spread of the disease by diagnosing it early and treating it effectively.

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1. Senior Resident, Department of Community Medicine, IMS BHU, Varanasi, Mob. 6291877160, **Email.:** ctapodeb@gmail.com
2. Professor & Head, Department of Community and Family Medicine, AIIMS Patna, 9472418934, **Email.:** drsanjayp69@gmail.com
3. Senior Resident, Department of Community and Family Medicine, AIIMS Patna, Bihar, Mobile 9986649791, **Email.:** drssvprasad015@gmail.com
4. Assistant Professor, Dept. of Community & Family Medicine, AIIMS Patna, Mobile 9471007028, **Email.:** aranjan30@gmail.com
5. Associate Professor, Department of Community and Family Medicine, AIIMS Patna, Mobile 7800778534, **Email.:** drsantoshnirala@gmail.com
6. Professor & Head, Department of Pulmonary Medicine, AIIMS Patna, Mobile No.7764981421, **Email.:** deependra78@gmail.com
7. Associate Professor, Department of Biochemistry, AIIMS Patna, Bihar, Mobile No.9006671371, **Email.:** kumarsshl@yahoo.com

Corresponding Address: Dr Sanjay Pandey, Professor & Head, Department of Community and Family Medicine, AIIMS Patna, Bihar,Mobile No. 9472418934, **Email.:** drsanjayp69@gmail.com

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Tuberculosis like diabetes is generally a chronic condition with varying clinical manifestations.[1]The majority of individuals diagnosed with tuberculosis (TB), over 95%, and diabetes mellitus (DM), around 70%, reside in poor and middle income nations.[3, 4] Low and middle-income countries (LMICs) are experiencing significant challenges as a result of a high prevalence of tuberculosis (TB) and the emergence of instances of multi-drug resistance tuberculosis (MDR TB). Conversely, DM has been officially recognized as a pandemic in the South Asian region. Moreover, the simultaneous presence of these two disorders is causing additional complexity. The issue of co-morbidity between DM (diabetes mellitus) and TB (tuberculosis) is predominantly observed in LMICs (low- and middle-income countries) due to the prevalence of TB and DM resulting from low socio-economic status and unfavourable living conditions.[5]

The swiftly increasing incidence of DM has occurred in poor nations where TB is prevalent. Consequently, the coexistence of DM and TB is becoming more prevalent, which necessitates a fresh focus on this subject.[6] India is currently grappling with the combined predicament of being the country with the highest burden of tuberculosis, while also having a significant population of individuals with diabetes. This situation presents a formidable task for the healthcare system.[7] Furthermore, research has revealed that diabetes is linked to 20% of all tuberculosis cases and 10% of all smear-positive tuberculosis cases. This is because individuals with diabetes have a compromised immune system, resulting in nearly a threefold increase in the likelihood of transitioning from latent to active tuberculosis compared to those without diabetes.[8] It has been seen that approximately 70 percent of adult diabetic patients are found in developing countries where high or moderate burden of tuberculosis also exists. Thus, it is very essential to clearly under stand the association between DM and tuberculosis to determine the most effective public health measures to stop the merging of these two epidemics.[9]A systematic analysis has revealed that individuals with both Tuberculosis and Diabetes have a higher risk of mortality, combined outcome failure, death, and relapse compared to patients with Tuberculosis alone.[10] The relationship between tuberculosis and diabetes mellitus is currently one of the most pressing issues for clinicians, as Diabetes mellitus influences the disease presentation and clinical outcome of Tuberculosis.

The World Health Organization (WHO) and the International Union against Tuberculosis and Lung Disease (IUATLD) have created a joint framework for managing and preventing diabetes and tuberculosis. This framework highlights the importance of regularly screening for both diseases in order to provide comprehensive care and control. It is highly advisable to monitor diabetes in tuberculosis patients in basic healthcare settings across all countries. Conducting diabetes screening in tuberculosis patients will not only result in the early identification of cases but also improve the management of diabetes.[11] Consequently, this would reduce the financial burden on both the patient and the healthcare system, as well as minimise unnecessary duplication of service delivery. The co-location of DOTS centres and diabetic clinics will significantly enhance the ability to promptly detect and manage both conditions.[11] In some studies mechanisms related to the impact of diabetes on tuberculosis treatment outcomes have been put forward which include altered immunological response, higher insulin resistance due to anti-tuberculosis drugs especially Rifampicin in addition to the weakened immune system due to diabetes itself.[12] However, there is a scarcity of information demonstrating the proportion of diabetes mellitus among the newly diagnosed patients of tuberculosis, hence this study was planned to see the proportion of diabetes mellitus and the attitude and practices of the tuberculosis patients towards diabetes mellitus.

Methodology

Study setting: The study was carried out at All India Institute of Medical Sciences, Patna, an institute of national importance. The tertiary care centre caters for patients from various districts of Bihar, Eastern Uttar Pradesh, Jharkhand, Chhattisgarh and even from the adjoining neighbouring country, Nepal. The study incorporated the newly diagnosed adult pulmonary tuberculosis patients attending the Outpatient department of the Pulmonary Medicine Department. The clinic is regularly held on all six days of the week from Monday to Saturday under the supervision of a senior consultant of the Department of Pulmonary Medicine.

Study design: This study adopted a hospital-based cross-sectional study.

Study population: All newly diagnosed pulmonary tuberculosis patients aged 18 years and above who attended the

OPD of the Department of Pulmonary Medicine, AIIMS Patna between 1st June 2021 to 30th November 2021. Patients less than 18 years of age & previously treated tuberculosis patients were excluded from the study.

Sample size and sampling technique: Taking the total number of patients attending the pulmonology OPD who are newly diagnosed with the pulmonary tuberculosis and have completed the treatment and the followed up in year as 515, and the absolute margin of error 5% using the Taro Yamane formula; sample size = N/K+N\(e)^2 the sample size calculated was 225. The final sample which got collected for the study was 194 because of the unforeseen circumstances of the COVID-19 pandemic.

Study tool and procedure: The adult newly diagnosed pulmonary T.B. patients after meeting the inclusion criteria were first classified into two groups based on the self-reporting and the random blood glucose (RBG) test done on the capillary blood and the levels of the glycated haemoglobin (HbA_1C) into the diabetic pulmonary tuberculosis (RBG ≥ 200 mg/dl and HbA_1C ≥6.5%) and non-diabetic tuberculosis. Data was collected regarding their places of diagnosis and the treatment towards the diabetes mellitus. After that study participants knowledge attitude and the practice was checked using structured questionnaire.

Data collection and Statistical analysis plan: All the data was collected and cleaned in the Windows MS Excel 365 and was imported to the Jamovi solid version 2.3.23 for analysis. The qualitative data is represented in proportions, and the quantitative data is represented in the mean (SD). The mean difference between the variables was statistically tested using the independent t-test and the chi-square test of association was used to see the association between the variables, p-value of less than 0.05 was taken as statistical.

Ethical consideration: The study was approved by the Institute ethics committee, AIIMS Patna (AIIMS/ Pat/ IEC/ PGTh/ Jan 20/ 21). The principals of ethics were followed throughout the study thereafter.

Results

The age of the patients ranged from 18 to 87 years, with the mean age 43±17.29 years. The majority of the patients were from age 21-30 years [50, (25.8%)]. The majority were males [125 (64%)], and around half of the patients came from rural backgrounds [105 (54%)]. The majority of the patients had a high-school education [64 (33%)], and the majority were from a joint family [131 (67.5%)]; most of the patients were Hindu by religion [178 (91.8%)].

Table- 1: Baseline sociodemographic details of the patients (N=194)

Variable	Group	No.	%
Age group	18-20 Years	14	7.2
	21-30 Years	50	25.8
	31-40 Years	27	13.9
	41-50 Years	38	19.6
	51-60 Years	33	17.0
	Above 60 Years	32	16.5
Gender	Male	125	64.0
	Female	69	36.0
Residence	Urban	89	46.0
	Rural	105	54.0
Education	Illiterate	6	3.1
	Primary School level	48	24.7
	Middle school level	30	15.5
	High school level	64	33.0
	Graduate level	31	16.0
	Professional level	15	7.7
Type of family	Nuclear family	63	32.5
	Joint Family	131	67.5
Religion	Hindu	178	91.8
	Muslim	13	6.7
	Others	3	1.5
Category	General	111	57.2
	OBC[#]	36	18.6
	SC[$]	45	23.2
	ST[*]	2	1.0
Socio-economic status*	Class 1 (Upper class)	1	0.5
	Class 2 (Upper middle class)	32	16.4
	Class 3 (Middle Class)	61	31.4
	Class 4 (Lower middle class)	86	44.3
	Class 5 (Lower class)	14	7.2
BMI Status	Underweight	57	29.4
	Normal	92	47.4
	Overweight	20	10.3
	Obese Class I	21	10.8
	Obese Class II	4	2.1

*Modified BG Prasad classification; #-Other backward class, $-Schedule caste, *-Schedule tribe

The majority of the patients belonged to the Schedule caste (SC) category [45 (23.2%)], and the socio-economic status using modified B G Prasad reported that the majority belonged to Class 4 [86 (44.3%)] {Table- 1}.

The proportion of diabetes mellitus among tuberculosis patients is 34 (17%) [95% CI (11.7-22.7%)] {Fig.-1}. Among 34 patients, 19 (57.6%) were diagnosed at the laboratory and 28 (84.8%) were using oral hypoglycaemic drugs. Patients also had complaints of fainting episodes, non-healing ulcers, vision difficulty and numbness and tingling sensation (Table 2).

Figure-1: Proportion of diabetes among the tuberculosis patients

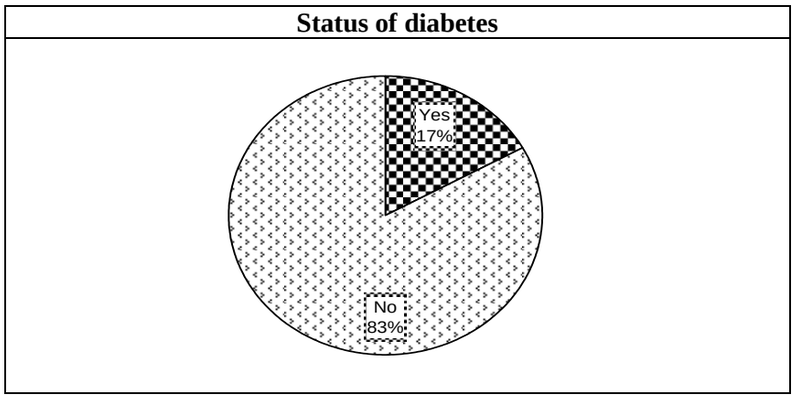

Table-2: Diabetic details of the tuberculosis patients (n=33)

Details of Diabetes		No.	%
Place of diagnosis	Hospital	14	42.4
	Diagnostic laboratory	19	57.6
Type of treatment	Oral hypoglycaemic drugs	28	84.8
	Insulin	2	6.1
	No treatment	2	9.1
Complication	Fainting episodes	5	15.2
	Non healing foot ulcers	2	6.1
	Difficulty of vision	10	30.3
	Numbness or tingling sensation in limbs	25	75.8

Among the patient's knowledge towards diabetes mellitus (DM), most of the TB patients reported that the DM is due to the increased blood sugar level 170 (87.6%). Most TB patients said that the lack of physical activity is both the cause and the risk factor for DM 113 (58.2%) and 116 (59.8%) respectively. The diagnosis of DM can be done with the help of a blood sugar level was told by 187 (86.4%). The majority of the TB patients knew that dietary modification can help in the control of DM 172 (88.2%), also almost all the patients i.e. 182 (93.8%) have said that cardiovascular disease can be one of the complications due the DM. Attitude towards the diabetes mellitus was seen in the TB patients in which 125 (64.4%) patients are willing towards change in their sedentary lifestyle for the prevention of DM, while 163 (84%) are willing to visit the government facility for the treatment of the DM and only 78 (40.2%) are willing to take the drugs for the DM for life long (Table -3).

Table-3: Knowledge, attitude and practices regarding diabetes mellitus among tuberculosis patients (N=194)

Knowledge		No.	%
DM due to raised blood sugar		**170**	**87.6**
Cause of DM	Hereditary cause	61	31.4
	Sweetened beverage & food	190	97.9
	Rich fatty food	79	40.7
	Lack of physical activity	113	58.2
	Emotional stress	2	1.0
Risk factor	Sweetened beverage & food	190	97.9
	Rich fatty food	74	38.1
	Lack of physical activity	116	59.8
	Obesity	137	70.6
	HTN	59	30.4
	Smoking	14	7.2
	Alcohol	11	5.7
	Mental stress	4	2.1
	Emotional stress	2	1.0
Diagnosis	Blood sugar level	187	96.4
	Urine test	15	7.7
Prevention	Exercise regularly	117	60.3
	Dietary modification	172	88.7
	Reduction in blood sugar level	21	10.8
Complications	Loosing feels around feet	42	21.6
	Eye problem	86	44.3
	CVD	182	93.8
	Kidney problem	146	75.3
Control	Tablets	194	100
	Insulin	76	39.2
	Herbal medicine	16	8.2
	AYUSH	57	29.4
	Diet modification	161	83
	Physical activity	117	60.3
	Meditation	2	1.0
Attitude towards the Diabetes Mellitus	Desire to change the sedentary life study	125	64.4
	Willing take the anti DM drugs lifetime	78	40.2
	Places willing to visit for the treatment of the DM	163	84.0
Practices	Annual check-up of the blood pressure and the sugar test from the physician	60	30.9
	Physical activity for the prevention of the diabetes mellitus	34	17.5
	Timely habit of the eating	115	59.3
	Staying away from the smoking	155	59.3
	Timely taking of the drugs	30	15.5

Discussion

A total of 194 adult pulmonary tuberculosis patients were included in the present study. The mean age of the study participants was 43.10 ± 17.29 years, the minimum age being 18 years and the maximum age of 87 years. Most of the participants (25.8%) were between the ages of 21-30years in the study. Thus, young adults affected by pulmonary tuberculosis were more in number. However, in a cross-sectional study conducted in the urban and rural populations of

Jabalpur district of the central Indian state of Madhya Pradesh, Vikas G. Rao et al observed that the 35–44 year age group had the highest proportion of total pulmonary tuberculosis cases (25.8%), followed by 17.7 % and 16.3% in the 45-54 and 25-34 year age groups, respectively.[13]In another descriptive study conducted at Anklav Tuberculosis Unit, Anand, Gujarat, India P. Dave et al reported that out of the 556 Tuberculosis patients registered in the study, the median age was 35 years with inter quartile range [IQR] of 25–50 years.[14] In another study consisting of 304 patients carried out at the Tuberculosis Research Centre, Indian Council of Medical Research, Chetput, Chennai, India R. Rajeswari et al reported that the mean age of the study participants was 37.8+14.9 years.[15]Another descriptive observational study conducted by Ogbera et al. reported that the mean age of the study participants was 35.6+13.1 years which is close to the finding of this study.[16]

In the current study, the proportion of male participants was 64 % and females comprised of 36 %. In a descriptive observational study carried out in Lagos, Nigeria Anthonia Okeoghene Ogbera et al. demonstrated a similar finding that out of a total of 4000 Tuberculosis patients recruited into the study, 2383 were males and comprised 60% of the study population.[16] In another descriptive study conducted at Bowring and Lady Curzon Hospital, a tertiary care centre in Bangalore, India B. C. Prakash et al found that out of the total 510 Tuberculosis patients recruited into the study, 316 patients (61.9%) were males which is quite similar to the findings of our study.[17]

In the present study, the majority of the participants (54%) reside in rural areas and as per education status, about 33% of our study participants have completed high school, 24.7% have completed primary school, 16% were college graduates, 15.5% have completed middle school and only 3.1% were illiterates. A cross-sectional study done by Mushtaq et al. in Pakistan reported that 60 % of the participants resided in rural areas and the majority (76.5%) of the participants were males which is quite similar to the findings of the current study. The majority of the participants (76.3%) were married, 21.1% were single and 2.6% were widowed in the present study. The majority of the study participants (76.8%) have a family size of 5-8 members with more than two-thirds (67.5%) of the participants belonging to the joint family. The study done by Mushtaq et al. reported that the mean number of persons per household was 6.8±3.0 which is almost similar to the finding in the present study, according to religion, 91.8% of the study participants were Hindu, 6.7% were Muslim, 1% were Sikh and only 0.5% was Christian. In our study, category-wise distribution showed that 57.2% of the participants belonged to the General category, 23.2% belonged to SC, 18.6% belonged to OBC and 1% belonged to the ST category. As per the occupation status, most of the participants in this study were Unemployed (28.4%) and Students (17%). As per the socioeconomic status, most (44.3%) of the participants belonged to Lower Middle Class according to Modified B.G. Prasad Socioeconomic Scale. A cross-sectional study done by Mushtaq et al showed that the majority of respondents (47.6%) had a low per capita income.[18]A cross-sectional study conducted by Raghuraman et al. reported about 29% of the study participants were unemployed, which is quite similar to the finding of this study. It also reported that one-fourth of the subjects were illiterates which was not similar to the finding of this study.[11] The study done by Ogbera et al. reported that 5% of the study participants were illiterates which is similar to the finding of the current study.[16]

In the current study, the prevalence of diabetes among the study participants was 17%, the majority of them (63.6%) had been diabetic for the last 1-5 years. More than half (57.6%) were diagnosed in a diagnostic laboratory. 84.8% were on Oral Hypoglycaemic drugs. Among all the diabetic patients, around 15% had a history of fainting episodes, 6.1% had a history of non-healing foot ulcers, 30.3% had a history of vision problems, and 75.8% had a history of numbness or tingling in their limbs. The study done by Raghuraman et al. reported that the prevalence of diabetes among Tuberculosis participants was found to be 29% which is near about similar to the finding of this study.[11] Another descriptive observational study conducted by Ogbera et al. reported that the prevalence of diabetes mellitus in participants was 12.3%.[16]

The participants of this current study identified sweetened food and beverages, obesity, lack of physical exercise, eating rich fatty food, hypertension, smoking and alcohol consumption and mental stress in the decreasing order of frequency as risk factors for Diabetes Mellitus. The majority (87.6%) of the participants stated that high blood sugar

levels indicated Diabetes Mellitus. Only 21.1 % of the study participants correctly stated that diabetes causes sensory loss and foot ulcers, while 44.3% correctly stated that it causes ophthalmic problems. The fact that Diabetes also causes Cardiovascular and Kidney complications was stated according to approximately 93.8% and 75.3% of respondents, respectively. All 194 participants said that tablets for the disease can control Diabetes Mellitus. In addition, the participants also identified modified diet, physical activity, Insulin, Traditional AYUSH treatment, Herbal remedies and meditation in decreasing order of frequency respectively as means of diabetes control. In this study, healthy exercise, according to an estimated 60% of participants, and dietary modification, according to nearly 88.7%, can prevent diabetes. Only 10.8% of respondents believed that lowering blood sugar levels could help prevent diabetes. In a cross-sectional study done in the United Arab Emirates to assess the knowledge, attitude and practices of participants regarding Diabetes mellitus Maskari et al. reported that the majority (69%) of the participants said that high blood sugar levels indicated a condition called Diabetes Mellitus. The fact that Diabetes also causes Cardiovascular and Kidney complications was stated according to approximately 82% and 87% of respondents respectively while 86% of the participants correctly stated that it causes ophthalmic problems like blurred vision which is not similar to the findings of present study due to difference in socio-demographic characteristics of two different study populations.[19]Almost two-thirds of the participants (64.4%) wanted to change their sedentary lifestyle, and 40.2% were willing to take anti-diabetic drugs if necessary. Around 84.0% said they would visit government hospitals to manage complicated Diabetes, and 80.4 per cent said they would try to help family members who have diabetes. The study done by Maskari et al showed that the majority of the participants expressed a positive attitude towards the priority of Diabetes mellitus care including controlling blood sugar levels and body weight by changing sedentary lifestyle and showing good compliance with anti-diabetic medications which is a bit similar to the finding of the current study.[19] In this present study, every year, the majority of participants (30.9 %) went to a doctor to have their blood glucose and blood pressure levels checked. Regrettably, only 17.5 % did a physical activity to control and prevent Diabetes Mellitus. 59.3 % of the participants invariably ate their meals on time, and nearly 80 % did not smoke. The majority (90.9%) of the known diabetic participants took anti-diabetic medication on time however; diabetes mellitus was the reason for only 19.1% of participants visiting a government hospital. A study done by Maskari et al. reported that most (41.7%) of the participants always have their blood glucose checked, 90.2% of the participants took anti-diabetic medications on time and only 5% of the participants did a physical activity to control and prevent Diabetes Mellitus which is in agreement to the finding of the present study.[19]

The results should be interpreted with a few limitations in mind, as they are not representative of all tuberculosis patients. We limited our study to newly diagnosed adult pulmonary tuberculosis patients only leaving other categories of tuberculosis patients. This work was confined to the patients attending a single tertiary care Centre so data from patients attending other lower levels of health facilities is required for a better interpretation of the outcome of this study. Thus, this study is limited by the fact of being a single-centre study whose results cannot be generalized nevertheless it provides a plethora of opportunities for clinicians and researchers to undertake further studies involving different geographical areas of our country. Moreover, this study did not investigate the link between poorly controlled diabetes and Multi Drug Resistant Tuberculosis which is important to clarify many unanswered issues in this field of study. In addition, the study failed to reach the desired calculated sample size due to unforeseen reasons of the COVID-19 pandemic.

Conclusion

This study was planned to see the proportion of diabetes mellitus among the newly diagnosed patients of tuberculosis, and it was found that 2 out of every 10 newly diagnosed patients had diabetes mellitus. The knowledge regarding the cause of diabetes mellitus due to the increased blood sugar was there in all the patients, but there was a gap in the attitude and the practice regarding diabetes mellitus among these newly diagnosed patients of tuberculosis. There is an urgent need for proper implementation of a collaborative framework for diagnosis, treatment, care and control of Tuberculosis and diabetes mellitus so that the tuberculosis patients accessing health care centres can also get the facilities for diagnosis and management of diabetes at the same time. Thus, it is recommended that DOTS centres and Diabetic clinics are located together which will lead to great advancement towards early detection and management of these two diseases of public health concern.

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