THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY

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MAY 2020

BONAFIDE CERTIFICATE

This is to certify that the dissertation titled **"THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS - A CROSS SECTIONAL STUDY" -** is a bonafide research work done by **Dr.V.DEVANATHAN**, during his academic years 2017- 2020, in Government Stanley Medical College, Chennai, in partial fulfilment of the M. D. (Tuberculosis & Respiratory Medicine) examination of The Tamilnadu Dr. M. G. R. Medical University to be held in May 2020. This work has not previously formed the basis for the award of any degree.

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CONTENTS

ANNEXURES

- Institutional ethical committee approval
- Proforma
- Patient information sheet- English
- Patient consent form- English
- Patient information sheet- Tamil
- Patient consent form- Tamil
- Plagiarism screenshot
- Plagiarism certificate
- Abbreviations
- Master chart

ABSTRACT

THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY

BACKGROUND:

Diabetes mellitus may increase the risk of Pulmonary Tuberculosis up to 3 times and influences its radiological manifestations. Radiological features of diabetic Tuberculosis patients shows increased frequency of atypical involvement. Diabetes being an immunosuppressive state, causes severe disease manifestations in Tuberculosis patients with more incidence of multi lobar, multi cavitary, and bilateral lung involvement. Hence early detection of diabetes and proper glycemic control helps to reduce the disease progression in Tuberculosis patients.

AIMS:

Primary objective:

1. To compare the clinico-radiological profile of Pulmonary Tuberculosis among Prediabetics, newly diagnosed diabetics and known diabetic patients.

Secondary objective:

2. To assess the clinico-radiological profile of Pulmonary Tuberculosis patients with good controlled and poorly controlled diabetes.

Methodology:

150 patients with newly detected microbiologically positive Pulmonary Tuberculosis who are willing to participate in this study were included. Based on the blood glucose and HbA1c levels patients were classified into prediabetics, newly diagnosed diabetics and known diabetic patients. HbA1C level of 7 was taken as a cut off to differentiate between good control and poorly controlled diabetes patients. The clinico-radiological features among the different groups are assessed.

OBSERVATION:

Cough was the predominant symptom seen in all the 3 groups ie prediabetes, newly diagnosed diabetes and known diabetes, followed by loss of appetite and fever. Prediabetes patients had a significantly lower frequency of chest pain and hemoptysis when compared to newly

diagnosed and known diabetic patients. The symptom score was also lower in prediabetes (3.08) when compared to newly diagnosed (4) and known diabetic (3.79) patients. Atypical lung field involvement such as

lower lobe infiltrates and lower lobe cavity were more significantly seen in newly diagnosed and known diabetic patients, when compared to prediabetes. Extensive radiological involvement in the form of multiple cavity, multi zonar and bilateral involvement were more commonly seen in newly diagnosed and known diabetic patients, when compared to prediabetes.

There is no significant difference in the symptom score between the good control and poorly controlled diabetic groups. Multi zonar invovement, bilateral involvement and multiple cavities were more frequently seen in the poorly controlled diabetic group when compared to the well controlled diabetic group.

CONCLUSION:

Diagnosis of prediabetes at early phase is necessary so that primary prevention methods may be initiated timely. Strategies are needed to ensure that optimal care is provided to patients with both diseases: TB must be diagnosed early in people with diabetes, and diabetes must be diagnosed early in people with TB. Adequate glycemic control is very important in these patients, since poorly controlled diabetic patients tends to have far advanced disease involvement.

INTRODUCTION

TUBERCULOSIS:

Mycobacterium tuberculosis causes tuberculosis and the human host serves as a natural reservoir for the infection.

Global scenario: The ability of the organism to efficiently establish latent infection has enabled it to spread to nearly one-third of the population worldwide. It is estimated that the global prevalence of tuberculosis is 10 million cases in 2018. Tuberculosis had lead to 1.3 million deaths worldwide in 2018.

Indian scenario: India has one of the highest TB incidence worldwide, with 2.74 million cases notified in 2018. This has caused around 0.41 million TB related mortality in india. The incidence of drug resistant TB was 0.13 million.

NATURAL HISTORY OF INFECTION

Inhalation of aerosol droplets containing M.tuberculosis with subsequent deposition in the lungs can lead to one of the four possible outcomes:

- Immediate clearance of the organism
- Primary disease: immediate onset of active disease
- Latent infection
- Reactivation disease: onset of active disease many years following a period of latent infection

Among individuals with latent infection and no underlying comorbid conditions, reactivation disease occurs in approximately 5 to 10 percent of cases. The risk of reactivation is markedly increased in immunocompromised patients such as HIV/AIDS, diabetes mellitus and those on steroids.

Primary disease:

The tubercle bacilli establishes infection in the lungs after they are carried in droplets small enough to reach the alveolar space (5 to 10 microns). If the innate immune system of the host fails to eliminate the infection, the bacilli will proliferate inside alveolar macrophages, which may migrate away from the lungs to enter other tissue.

While in the lungs, macrophages produce cytokines and chemokines that attract other phagocytic cells, including monocytes, other alveolar macrophages, and neutrophils, which then form a nodular granulomatous structure called a tubercle. If the bacterial replication is not contained, the tubercle enlarges and the bacilli enter local draining lymph nodes. This leads to lymphadenopathy, a characteristic feature of primary tuberculosis. The lesion (called Ghon focus) produced by the expansion of the tubercle into the lung parenchyma and lymph

node enlargement or calcification together comprise the Ranke complex. Bacteremia also may occur with the initial infection.

The bacteria continues to proliferate until an effective cell-mediated immune (CMI) response develops, usually 2 to 10 weeks following initial infection; this occurs in more than ninety percentage of exposed infected individuals. A successful cell-mediated immune response contains viable organisms at sites to which they have migrated before sensitization was achieved. In the lung, failure of the host to mount an effective cell-mediated immune response and tissue repair leads to progressive destruction of lung. Tumor necrosis factor (TNF)-alpha, reactive oxygen and nitrogen intermediates, and the contents of cytotoxic cells (granzymes, perforin), which function to eliminate M.tuberculosis, may also contribute to collateral host cell damage and the development of caseating necrosis. Hence, most of the TB pathology results from an infected host's proinflammatory immune response to the tubercle bacilli. Caseous necrosis is most frequently associated with tuberculosis but can also be caused by other organisms, including syphilis, histoplasmosis, cryptococcosis, and coccidioidomycosis.

Unchecked bacterial growth may lead to hematogenous spread of bacilli to produce disseminated tuberculosis. Disseminated disease with lesions resembling millet seeds has been termed miliary tuberculosis. Bacilli can also spread mechanically by erosion of the caseating lesions into the airways; at this

point, the host becomes infectious to others. In the absence of treatment, death occurs in up to eighty percent of the cases.

The remaining patients either develop chronic disease or recover. Chronic disease is characterized by recurrent episodes of healing by fibrotic changes around the lesions and tissue breakdown. Complete spontaneous eradication of the bacilli is very rarely seen.

Reactivation disease:

Multiple terminologies has been used to describe reactivation tuberculosis: chronic tuberculosis, post primary disease, recrudescent tuberculosis, endogenous reinfection, and adult-type progressive tuberculosis.

Reactivation of tuberculosis infection results from proliferation of a previously latent bacilli seeded at the time of the primary infection. The apical posterior segments of the upper lobes or the sixth segment of the lower lobe of the lung are frequently involved. Poor lymphatic flow and the higher oxygen tensions in the apical area of the lungs may be the cause for their increased susceptibility.

Simon focus which is the original site of infection may have been previously visible as a small scar.

Among people with latent infection and no underlying co-morbid conditions, it has been estimated that the lifetime risk of reactivation disease after an index infection is 5 to 10 percent, with a five percent risk in the two to five years following infection and another five percent risk over the remaining lifetime. Immunosuppression is clearly associated with reactivation tuberculosis, although it is not clear which specific host factors maintain the infection in a latent state and what causes the latent infection to break containment and become active.

Immunosuppressive conditions associated with reactivation tuberculosis include:

- HIV infection and AIDS
- Chronic and end-stage renal disease
- Diabetes mellitus
- Malignant lymphoma
- Steroid usage
- TNF-alpha inhibitors
- Diminution in cell-mediated immunity associated with age
- Smoking

Environmental factors, such as over crowding, low socioeconomic status, poor access to healthcare, and family history, also leads to increased susceptibility.

The disease process in reactivation tuberculosis tends to be localized (in contrast with primary disease); in general, there is little regional lymph node involvement and less caseation. The lesion usually occurs at the lung apices, and disseminated disease is rare unless the host is severely immunosuppressed. Prior tuberculosis infection, contained as latent tuberculosis, gives some protection against subsequent tuberculosis disease.

One review evaluating 23 paired cohorts (total more than 19,000 individuals) noted that individuals with latent tuberculosis had 79 percent lower risk of progressive tuberculosis following reinfection compared with uninfected individuals.

On the other hand, previous tuberculosis disease is associated with an increased risk of subsequent tuberculosis disease. Studies in both HIV-uninfected and HIV-infected individuals with one episode of active tuberculosis have noted a 2 to 4 fold increased risk of a second episode of active tuberculosis compared with individuals without prior active disease.

By comparing DNA fingerprints of the Mycobacterium tuberculosis isolates from the first and second episodes of tuberculosis, the investigators showed that 77 percent of the recurrences were new infections rather than relapse. The rate of reinfection tuberculosis was 4 times the rate of new tuberculosis.

The increased risk of active disease in those with previous tuberculosis infection may be a reflection of the high prevalence of the disease and therefore high transmission frequency in a community with a large number of high-risk hosts.

MICROBIOLOGY:

Mycobacterium tuberculosis belongs to the genus Mycobacterium, which includes more than fifty other species, often together referred to as

nontuberculous mycobacteria. Tuberculosis is defined as a disease caused by members of the Mycobacterium tuberculosis complex, which include the tubercle bacillus Mycobacterium tuberculosis M. bovis, M. africanum, M. caprae, M. microti, M. canetti, M. orygis and M. pinnipedii.

Cell envelope:

The cell envelope is a characteristic feature of the organisms belonging to the genus *Mycobacterium*. Mycolic acid is the major constituent of the cell envelope; this structure defines the genus. The mycolic acid structure provides the ability to resist destaining by acid alcohol after being stained by certain aniline dyes, leading to the term acid-fast bacillus.

Growth characteristics:

The distinguishing character of mycobacterium tuberculosis is its slow growth rate. In artificial media and animal tissues, its generation time is around 20 to 24 hours.This implies that the cultures may take up to 6 weeks to detect growth.

PATHOGENESIS:

The following virulence factors have been described:

1. Mycolic acid glycolipids and trehalose dimycolate ("cord factor"), which can cause granuloma formation in animal tissue.

2. Catalase-peroxidase (resists the host cell oxidative response)

3. Sulfatides and trehalose dimycolate (which can trigger toxicity in animal models)

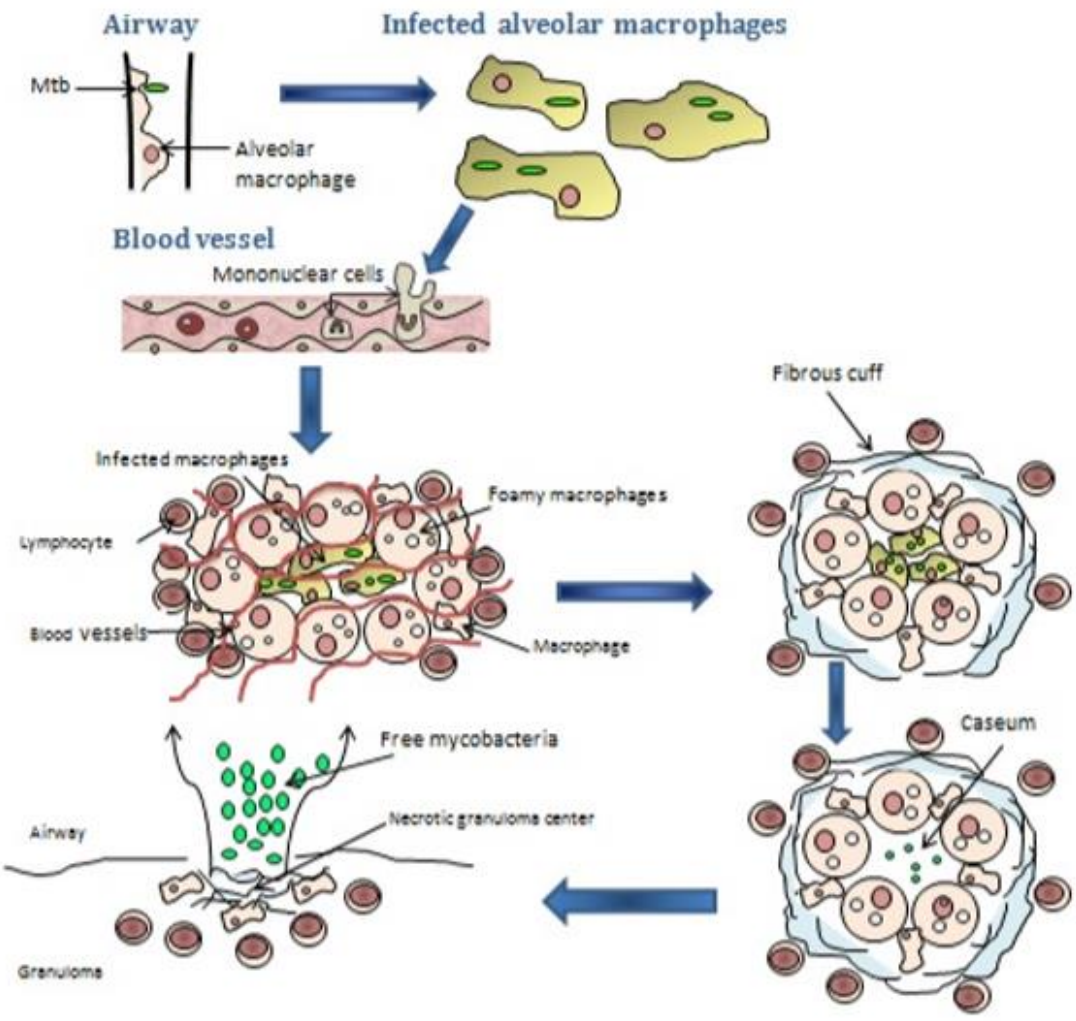
4.Lipoarabinomannan (LAM; which induces cytokines and resist hosts oxidative stress), and secreted proteins, including CFP10 and ESAT-6. Molecular biology techniques have identified many other gene products that may be involved in the ability of mycobacterium tuberculosis to enter cells, resist intracellular killing, establish persistence, inhibit host cytosolic surveillance, and come out of latency.

In the lungs, the bacteria are phagocytized by alveolar macrophages, which then invade the underlying epithelium. Here, monocytes from adjacent blood vessels leads to the formation of granuloma, as the immune system attempts to ward off the disease.

Granuloma are defined as a focal, compact collection of inflammatory cells in which mononuclear cells predominate. Granulomas are produced by persistent non-degradable products or organism, or the result of hypersensitivity or both. Within the granuloma, a core of infected macrophages is surrounded by foamy macrophages, monocytes and lymphocytes. This results in a fibrous capsule with increased foamy macrophages, presumed to create the typical caseous debris (necrotic tissue resembling cheese) in the center of the granuloma.

Although it appears contained immunologically, the caseous center tends to liquefy and cavitate as it empties thousands of Mycobacterium TB bacteria into the airway.

Infected macrophages may be carried by the lymphatics to the lungs, lymph nodes, kidneys, epiphyses of the long bones, and other areas of the body. Infected macrophages may also be carried in the blood of an immunocompromised host (eg, HIV patients).



Progression of the tuberculosis granuloma

Figure1

CLINICO RADIOLOGICAL PROFILE

Clinical manifestations of pulmonary tuberculosis include primary tuberculosis, reactivation tuberculosis, endobronchial tuberculosis, lower lung field tuberculosis and tuberculoma.

Primary tuberculosis:

Symptoms:

People with asymptomatic primary infection have no symptoms or signs suggesting tuberculosis disease. Among the symptomatic individuals fever is the most common symptom. The onset of fever is usually gradual and a low grade fever is seen in most individuals. Fever usually resolves after 10 weeks.

Pleuritic or retrosternal pain is seen in 25 percent of the cases. 50% of patients with pleuritic chest pain had evidence of a pleural effusion. Retrosternal and dull interscapular pain were attributed due to enlarged bronchial lymph nodes and sometimes it worsened with deglutination. Rarer symptoms included myalgia, cough, arthralgia, and pharyngitis.

Radiological profile:

The chest radiograph is often normal in primary pulmonary tuberculosis. Hilar lymphadenopathy is the most common radiological abnormality seen. Right middle lobe collapse may complicate the lymphadenopathy but usually resolves with anti tuberculosis treatment. Several factors probably favour the involvement of right middle lobe. The right middle lobe bronchus is more densely surrounded by lymph nodes, it has a relatively longer length and smaller internal diameter, and it has a sharper branching angle.

Pleural effusions developed in about 1/3rd of the patients, typically within the first 3 to 4 months after infection but occasionally as late as 1 year.

Pulmonary infiltrates are most commonly seen in the perihilar region. Right-sided infiltrates are common, and ipsilateral hilar enlargement is the rule. Bilateral infiltrates are infrequently seen.

Reactivation tuberculosis:

Symptoms:

Reactivation tuberculosis may remain undiagnosed and potentially infectious for 2 to 3 years or longer, with the development of clinical features only late in the course of the disease.

Clinical features typically began insidiously and were present for weeks or months before the diagnosis was made.

Cough, loss of weight, fever and night sweats are the predominant symptoms seen in around 50% of the cases. Chest pain and breathlessness each were reported in about 1/3rd of the patients and hemoptysis in approximately 25% of the cases. Many cases were also diagnosed with tuberculosis after admission for unrelated complaints.

Fever is generally low grade at onset but marked with progression of disease. It is classically diurnal, with an afebrile period in the morning and a gradually increasing temperature throughout the day, attaining a peak in the late afternoon or evening. Fever usually subsides during sleep, but night sweats may occur. Fever and night sweats are generally more commonly seen in patients with advanced pulmonary tuberculosis.

Cough may be initially absent or mild and may be nonproductive or productive of only scanty sputum, As the disease advances, cough becomes more continuous throughout the day and production of yellow or yellow-green and occasionally blood-streaked sputum is seen.

Frank hemoptysis occurs due to caseous necrosis or endobronchial erosion, typically occurs later in the disease and is rarely massive. Nocturnal coughing is seen in patients with advanced disease, often with cavitation.

Breathlessness occurs in patients with extensive parenchymal involvement, pleural effusions, or a pneumothorax.

Pleuritic chest pain implies that the inflammation is abutting or invading the pleura, with or without a pleural effusion.

Anorexia and malaise are features of advanced disease and may be the only presenting clinical feature in certain patients.

Patients may rarely present with painful ulcers of the mouth, tongue, larynx, or gastrointestinal tract due to chronic expectoration and swallowing of highly infectious secretions, mainly seen in individuals not taking treatment.

A meta-analysis including 12 studies noted no significant differences between patients above 60 years and patients less than 60 years with respect to time to diagnosis, prevalence of cough, sputum production, weight loss, or

fatigue/malaise. Findings observed less commonly among older adults included fever, sweats, hemoptysis, cavitary disease, and a positive tuberculin skin test, but they were likely to present with the nonspecific symptoms of breathlessness and malaise.

Findings observed more frequently among older adults included hypoalbuminemia and leukopenia. While cavitary disease is less common, and multilobar and lower lobe involvement are more commonly seen in older adults

Signs:

Clinical signs of pulmonary tuberculosis are non specific and are usually absent in mild or moderate disease. Dullness with decreased vocal fremitus may indicate pleural thickening or effusion. Crackles can be present throughout inspiration or may be heard only after a cough (posttussive crackles). When large areas of the lung are involved, signs of consolidation associated with open bronchi, such as bronchophony, whispering pectoriloquy or tubular breath sounds, may be heard. Distant hollow breath sounds over cavities are called amphoric breath sounds, which resembles the sound made by blowing across the mouth of jars used in antiquity (amphorae). Extrapulmonary signs include clubbing and findings localized to other areas of involvement.

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Radiological profile:

Most patients with reactivation tuberculosis have abnormalities on chest radiograph, even in the absence of clinical symptoms. Reactivation tuberculosis typically involves the apical-posterior segments of the upper lobes, followed in frequency by the superior segment of the lower lobes and the anterior segment of the upper lobes. Commonly seen radiological features include a cavity or apicoposterior infiltrates, cavities, pleural effusions, fibrotic lesions causing distortion of lung parenchyma, elevation of fissures and hila, pleural adhesions, and formation of traction bronchiectasis. High-resolution CT is the gold standard technique to detect early bronchogenic spread. The most common findings seen are centrilobular 2 to 4 mm nodules or branching linear lesions representing intrabronchiolar and peribronchiolar caseation necrosis.

Endobronchial tuberculosis :

Endobronchial tuberculosis is defined as tuberculous disease that involves the tracheobronchial tree. It may develop through direct extension to the bronchi from an adjacent parenchymal focus (usually a cavity) or through spread of organisms to the bronchi via infected sputum. Lesions are more commonly seen in the main and upper bronchi.

Prior to the availability of antituberculous therapy, endobronchial tuberculosis was more common in the setting of primary infection and reactivation tuberculosis. Endobronchial tuberculosis was more frequently seen among patients with extensive pulmonary tuberculosis, particularly cavitary lesions.

Upper lung parenchymal or cavitary disease with bronchogenic spread to the lower lung fields was commonly seen, presumably from pooled infected secretions. Endobronchial tuberculosis appears to have a preponderance in females in their second and third decades of life and in the older adult population (mean age 70 years).

Symptoms:

Clinical symptoms include a productive cough, chest pain, hemoptysis, malaise, fever, and breathlessness. Symptoms may be acute in onset and be confused with pneumonia, bronchial asthma or foreign body aspiration. Barking cough is seen in approximately two-thirds of patients with endobronchial tuberculosis, often accompanied by sputum production. Rarely, patients can also develop bronchorrhea.

In some patients, caseous material from endobronchial lesions or calcified material from extension of calcific nodes into the bronchi is expectorated (known as lithoptysis). The presence of breathlessness may signal airway obstruction or atelectasis.

Signs:

Clinical signs include diminished breath sounds, rhonchi, or wheezing. The wheeze is classically low pitched, monophonic, constant, and is auscultated consistently over the same area on the chest wall.

Radiological profile:

Because endobronchial lesions can exist without extensive parenchymal abnormalities, a normal chest radiography is seen in 10 to 20 percent of

patients. In such patients, CT scan may reveal endobronchial lesions or stenosis and rarely fistulas. The most common radiological finding of endobronchial tuberculosis in adults is an upper lobe infiltrate and cavity with ipsilateral spread to the lower lobe and possibly to the superior segment of the contralateral lower lobe. Patchy, small lower lobe infiltrates may progress to confluence or even cavitation. Extensive endobronchial tuberculosis can also be associated with bronchiectasis on computed tomography.

Lower lung field tuberculosis:

Lower lung field tuberculosis refers to lesions involving below the hila (including the perihilar regions) on chest radiograph. Consolidation in lower lung field tuberculosis tends to be more extensive and homogeneous than upper lobe tuberculosis. Cavities may also be seen in lower lobe but its frequency is less when compared to upper lobe cavities.

Lower lobe involvement can be a manifestation of primary tuberculosis (with involvement of adjacent lymph nodes), reactivation tuberculosis (involving the superior segments of the lower lobes), or endobronchial tuberculosis. Endobronchial tuberculosis can affect lower lung fields in both primary infection (especially when adjacent lymph nodes are involved) and reactivation (spread from upper lobe disease can secondarily infect the lower lung fields). Older adult patients and those with HIV, diabetes mellitus, renal or hepatic disease, those receiving corticosteroids appear at highest risk for lower lobe tuberculosis.

Tuberculoma:

Rounded mass lesions can develop during primary infection or when a focus of reactivation tuberculosis becomes encapsulated. Cavitation is rarely seen. The differential diagnosis of solitary pulmonary nodule is extensive, and the diagnosis of tuberculoma can be difficult since airway cultures are often negative. Fine needle aspiration or lung biopsy are necessary for diagnosis.

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Complications of Tuberculosis:

Pulmonary complications of tuberculosis include hemoptysis, pneumothorax, empyema, bronchiectasis, extensive parenchymal destruction (including pulmonary gangrene), malignancy, venous thromboembolism, and

aspergillosis.

REVIEW OF LITERATURE:

TB-DM CO-MORBIDITY:

There is an increase in the incidence of type 2 diabetes mellitus which has led to an identified reemerging risk and challenge to the control of tuberculosis (1). Diabetes mellitus patients are known to have three times the risk of developing tuberculosis, and there are now lesser individuals with TB-HIV co-infection when compared to TB-DM co-morbidity (2,3).

The association between DM and TB was first described by Avincenna centuries ago, a persian philosopher (4-7). The worldwide prevalence of diabetes has increased by 20% among adults in the past three decades, and the number of individuals with diabetes in predicted to reach 642 million worldwide by 2040, with most of the patients belonging low to middle income countries where TB is an endemic (8-10).

Since 2011, the World Health Organization has recommended bidirectional screening of all tuberculosis patients for diabetes mellitus. Following the American Diabetes Association, diabetes is diagnosed by a fasting plasma glucose $\geqslant$126 mg/dl, a 2-h plasma glucose value $\geqslant$200mg/dl during the oral glucose tolerance test, glycated haemoglobin (HbA1C) $\geqslant$ 6.5 or a random plasma glucose value $\geqslant$200.

The Concurrent Tuberculosis and Diabetes Mellitus (TANDEM) consortium recently suggested a simplified two-step diagnostic algorithm where all patients with random plasma glucose levels >126 mg/dl receive point-of-care HbA1C testing. With laboratory-based HbA1C as the gold standard, this two-step combination resulted in a sensitivity and specificity of >90% to detect diabetes mellitus. Gröschel MI et all, assesed the feasibility of diabetes screening by random glucose sampling among disadvantaged tuberculosis patients residing in urban slums in New Delhi, India (11).

Diabetes screening among tuberculosis patients registered under the RNTCP yielded a prevalence of 11.9%, however, no information is available on patients who are treated outside the RNTCP. Operation ASHA (OpASHA), a not-for-profit nongovernmental organisation (NGO) that is dedicated to bringing free tuberculosis treatment to disadvantaged patients in urban slums and poor rural communities that might otherwise not be able to seek treatment through private entities or the RNTCP. OpASHA currently serves 20 million people in 6 Indian states, in 8 Cambodian provinces and in Afghanistan. They have a team of 292 field workers, 150 community partners and around 4000 village healthcare workers.

Gröschel MI et all aimed to investigate the feasibility of random glucose sampling, the first step of the two-step diagnostic approach proposed by the TANDEM consortium, among this difficult-to-reach patient population.

OpASHA initiated a pilot intervention in its tuberculosis treatment centres in East, West and South Delhi consisting of training staff to measure blood glucose and to provide appropriate diabetes counselling, as well as distribution of glucometers, and test kit supply and minor infrastructure investments. Endocrinologists practicing in proximity to the Delhi slum areas agreed to treat patients diagnosed with possible diabetes mellitus.

Between 2013 and 2015, a total of 1773 patients were screened for diabetes mellitus by trained OpASHA personnel. We identified a total of 336 (19%) patients with random glucose levels 126 mg/dl who qualified to receive point-of-care HbA1c testing to confirm diabetes following the TANDEM two-step algorithm, which was, however, not available in the OpASHA treatment centres. Among these patients, 66 (4%) were found to have diabetes based on glucose levels >200mg/dl. Of these 66 patients, 20 were known diabetics and already on treatment. The remaining patients were referred to one of the collaborating endocrinologists for further diagnostics and treatment.

The study stated that increasing age was significantly associated with elevated glucose levels. Male sex was slightly overrepresented in the screening population but was not linked to increased glucose values.

The study concluded that random glucose sampling is a feasible and simple tool to implement in resource-poor settings with disadvantaged communities once appropriate training of staff is achieved. In the study there was a high number of patients with elevated random glucose levels. However, to accurately diagnose diabetes mellitus in this setting and to follow the TANDEM diagnostic algorithm, local point-of-care HbA1c testing is indispensable and future efforts should concentrate on implementing this second step of the TANDEM approach in such settings.

Limitations of this study include challenging data collection that resulted in missing data and incorrect data entry in a few cases. The voluntary nature of the glucose measurement could be subject to unaccounted selection bias.

EPIDEMIOLOGY OF TB –DM

DIABETES AS A RISK FACTOR FOR TB:

As a result of various factors such as population aging, urbanization, dietary changes and sedentary lifestyle there is an increasing prevalence of diabetes worldwide (12). Co–occurrence of diabetes with other host characteristics can further aid the risk of TB among diabetes patients as suggested for diabetes mellitus patients with a smoking habit, micro and macrovascular complications of diabetes and even social environment (13-15). Certain regions display high

rates of prevalence of diabetes among tuberculous patients such as South India (54%), The Pacific Islands (40%) and North Eastern Mexico (36%) (16-20).

Longitudinal analysis of 163 countries reported increased tuberculosis incidence in countries where diabetes prevalence increased over time (20).

TB DM patients are more likely to have lower education and higher unemployment. These socio demographic factors are associated with less access to health care and poor glycaemic control (21)

In a retrospective study by Li-Kuo Huang et all (22) in the National Yan-Ming University Hospital, compared the radiological features of 214 tuberculosis patients with diabetes and 214 non diabetic tuberculosis patients. Further comparison with glycemic control was done in the diabetic tuberculosis group. All cases with glycosylated hemoglobin (HbA1c) less than 8 was taken as good control while the rest of the cases were grouped under poorly controlled diabetic cases.

It was found that multiple cavity, multi lobar and atypical involvement were more frequently seen in tuberculous diabetic patients when compared to tuberculous non diabetic patients. Compared with non diabetic patients, primary PTB pattern and extensive disease on radiograph, more than one cavity in a single lesion, atypical location, and all lobe involvement of lesions on thoracic CT scans were more common in DM patients.

The study also concluded that diabetics with poor glycemic control of HbA1c > 8% had atypical radiological features and far advanced radiological lesions when compared with the cases with good glycemic control.

The study concluded that diabetes influences the radiological features in tuberculosis patients. The study also emphasized that the clinicians must be aware of these atypical radiological features in diabetic tuberculosis patients in order to prevent the delay in the diagnosis. The mechanisms underlying atypical radiological manifestations in diabetic tuberculosis patients remain unclear. Immune derangements were identified in the studies of both hyperglycemic mice and diabetic individuals, which might play a important role in their TB susceptibility.

In a study by Jahnavi K et all (23) in 2015 studied the clinico radiological profile of tuberculous patients with diabetes and without diabetes. The predominent age group in the study was 35-60 years. The most common general symptoms observed were loss of appetite (96%) and cough with expectoration in more than 50% patients. Bilateral and multizonal involvement was most frequently seen in tuberculous patients with diabetes while lower zone predominence was seen in tuberculous patients with diabetes.

The study revealed a prevalence of 47.6% of diabetic patients among tuberculous patients. This prevelance was significantly higher when compared to other studies.

CONTRIBUTION OF DIABETES TO TB CONTROL :

The attributable risk of diabetes to tuberculosis is generally between 10-20%, but it can vary even within a country, for example: The population attributable risk in countries such as India and Mexico reaches up to atleast 20% (22,25). In the United Kingdom the general population attributable risk is 10%, but the risk rises to 20% in asian males (26).

While diabetes is known to increase the risk of tuberculosis three times, HIV increases it by 20 fold. But the sheer number of diabetes patients is high and hence the contribution of diabetes to TB can be much higher than that of HIV (27). Thus various studies reveal that stopping the rise of diabetes would decrease the incidence and mortality of tuberculosis cases (28).

In the study by vivek nagar et all (29), wherein the prevalence of prediabetes and diabetes among diagnosed cases of TB registered under RNTCP in Bhopal district was anlaysed. The prevalence of prediabetic tuberculous patients was 15.3% and that of diabetic tuberculous patients was 11.9%. The number needed

to screen to find out a new case of diabetes among tuberculous patients was 22. The results of the study were diabetic tuberculous patients mostly were above 50 years, belonged to male gender, were smokers and had a BMI greater than 25. The study emphasized the need for early glycemic screening of patients with tuberculosis so that treatment can be started promptly. Diagnosis of prediabetes at early phase is necessary inorder to initiate primary prevention methods timely.

The clinico radiological profile of 60 diabetic tuberculous patients were studied by babu anand et all (30) in 2017. The most frequent symptoms noted in the study was anorexia (81.7%), cough (80%) and fever (60%). Among the male patients 56% were smokers. The maximum incidence of pulmonary tuberculosis was noted in the age group of 40 to 60 years. The average duration of diabetes in the study was 6.8 years. The average FBS and PPBS values in the study group was 238.5 and 340.0 mg/dL, respectively. Radiologically cavitary lesions (52%) was the most frequent type of lesion noted followed by fibrosis (33%) and infiltration (25%). Lower lung field involvement was seen in 32% of patients and was more commonly seen in cases above the age of 40 years. The study concluded that severe hyperglycaemia appears to be a contributory factor to the development of pulmonary tuberculosis in diabetes mellitus patients. Diabetes had a significant impact on treatment and control of tuberculosis in patients with diabetes. Due to the potentially serious implications for

tuberculosis control, it must become a priority to initiate focused and coordinated action like case finding, treatment of latent tuberculosis and efforts to diagnose, detect and treat diabetes mellitus may have a beneficial impact on tuberculosis control.

The limitations of the study are it was primarily cross sectional in nature and sample population was very small. The study was done in a tertiary hospital, in an urban setting and hence the results cannot be generalised and the study dint take into account the treatment outcomes.

DIRECTIONALITY OF THE ASSOCIATION :

All cohort studies to date indicate that diabetes develops before tuberculosis and suggest that only poorly controlled diabetes increases the risk of tuberculosis (31,32).

Diabetic complications develop prior to TB development in most patients. This emphasizes the missed opportunities for preventing tuberculosis among diabetic patients (33). Hence the importance of good glycemic control must be stressed in diabetic patients and measures should be taken to identify the new cases.

However, a caveat is that TB-DM patients should be distinguished from tuberculous patients with transient hyperglycaemia caused by inflammation

induced during TB (34-39). This hyperglycemia resolves with anti tuberculous treatment.

In a prospective observational study by anand patel et all (40) at Guru Gobind Sing Hospital & Shree M. P. Shah Medical College, Jamnagar, between October 2005 to September 2006, analysed the clinico radiological features of sputum smear positive patients with diabetes mellitus. The mean age group was 51 to 60 years. Over all non-cavitary lesion was more common when compared to cavitary lesion. Elderly patients (age >50 years) had less incidence of fever, chest pain, haemoptysis and higher incidence of dyspnoea when compared to young adults (age < 50 years). Elderly patients had more of atypical and multizonar involvement with non-cavitary and advance disease when compared to patients with < 50 years of age.

Cavitary lesion was significantly higher in frequency in patients with uncontrolled diabetes while non-cavitary lesion was predominant in patients with controlled diabetes. Lower zone or multiple zone involvement with advance disease was more common in patient with controlled diabetes as compare to patients with uncontrolled diabetes. Lower zone and multizonar involvement with advance disease was more frequently seen in patient with controlled diabetes as compare to patients with uncontrolled diabetes.

A cross-sectional study by manjareeka et all (41) analysed the fasting blood sugar (FBS) levels of 110 newly diagnosed cases with pulmonary tuberculosis. the study was conducted in a tribal district (Malkangiri) of Odisha. FBS < 110 was taken as normal, values of 110 to 125 mg/dl was taken as impaired fasting glucose and FBS above 126 mg/dl was taken was diabetes.

The mean age group of the participants was 46.7% and average duration of the present symptoms suggestive of tuberculosis was 18 days. Among the patients having both tuberculosis and diabetes at the time of diagnosis, 85.7% were sputum smear positive and 14.3% were sputum smear negative while 79.3% of isolated tuberculosis patients were sputum smear positive. No significant statistical difference was observed for sputum smear positivity between the 2 groups. The mean age (53.8 years) of diabetic tuberculosis patients was higher than that of isolated tuberculosis patients (45.9 years).

No significant association was found between gender and diabetes. The predominant symptoms reported were cough (87.1%), loss of weight (80.2%), digestion related problems (60.4%), night sweats (46.5%) and haemoptysis (10.9%). Clinical features of tuberculosis were similar in both the diabetic and the non diabetic group.

The prevalence of diabetes in this study was 13.9% among the tuberculosis patients. This is worrisome since traditionally tribal populations in India have exhibited lower prevalence of diabetes compared to the mainstream population.

This also indicates the changing nature of lifestyle among the tribal population in Odisha with growing urbanization.

The limitation of the study are the small size, post prandial blood sugar level and HbA1c was not seen. The sample population was from a tribal population from a single district and hence results could not be generalized.

The study concluded that the prevalence of fasting blood sugar was found to be higher in newly diagnosed pulmonary tuberculosis patients belonging to tribal ethnicity thus indicating the need for intensified bidirectional screening.

CLINICAL PRESENTATION

Disseminated form of tuberculosis is seen more commonly in patients with HIV-AIDS (42) and those taking TNF blockers (43). This contrasts with TB-DM patients who are less likely to present with disseminated tuberculosis (44,45). This may be due to a hyperreactive cell-mediated immune response to mycobacterium tuberculosis in diabetic patients that may be inadequate for containing its growth within the lungs but effective for preventing its dissemination and reactivation elsewhere (44-48).

M.tuberculosis induces a strong cell-mediated immunity leading to the formation of pulmonary granulomas (49). Granulomas initially limit M.tuberculosis growth, but in certain hosts in whom the organism continues to replicate, they undergo central caseation with rupturing and spilling of

thousands of viable bacilli into the airways. This cavitary TB is associated with sputum smear positivity (50).

In Tuberculous diabetic patients there is a higher frequency of cavitary TB that is accompanied by higher bacillary load in the sputum (51).

Hence the higher frequency of pulmonary versus extra-pulmonary TB, sputum smear positive TB and cavitary TB suggest that TB diabetes patients are more infectious than non-diabetic tuberculous patients (52). The association between drug resistant or MDR TB and diabetes is unclear, since some studies state that there is a higher frequency of drug resistant or MDR TB in TB patients with diabetes when compared to those without diabetes (53-62). However in a meta-analysis of publications up to 2010, there was no association between drug resistant or MDR TB with diabetic tuberculous patients (63-69).

In the study by Vinay Mahishale (70) et all compared the clinico radiological features of optimally controlled and poorly controlled tuberculous diabetic patients. Glycosylated hemoglobin (HbA1c) cut off of 7 was taken to differentiate between good controlled and poorly controlled diabetic patients. Totally 630 tuberculous diabetic patients were analysed in the study and the treatment outcome was also taken into account. Among the 630 patients 207 cases had good glycemic control while 423 cases had poor glycemic control.

Fever was the predominant symptom in both the groups. Breathlessness and weight loss were significantly more often reported by patients in the poorly controlled diabetic group when compared to the optimally controlled diabetic group.

Patients in the poorly controlled diabetic group had more frequency of lower lung field and multilobar involvement when compared to the optimally controlled diabetic group. Extensive radiological involvement was more frequently seen in the poorly controlled diabetic group when compared to the optimally controlled diabetic group. Sputum bacillary load at presentation was significantly higher in the poorly controlled diabetic group when compared to the optimally controlled diabetic group. Poorly controlled diabetic tuberculous patients also were significantly sputum smear positive at the end of two months of ATT treatment and had higher rates of treatment failure.

The study concluded that people with poor glycemic control had more symptom score and more extensive radiological features. Poor glycemic control also had a negative effect on the treatment completion, cure, and relapse rates in patients with pulmonary tuberculosis. A major strength of this study is the prospective design, which avoided the problems of control selection in case-control studies and obscured temporality in cross-sectional studies. The main limitation of the study is the fact that it is a single-centre study and hence the results of which cannot be generalized.

In a study by perez guzman et all (71) studied the radiological profile of tuberculosis patients with diabetes and those without diabetes. Totally 192 patients were enrolled in the study. INER, the institute where this study was conducted, is a national reference center for pulmonary diseases located in Mexico City

Patients in the non diabetic tuberculosis group were younger when compared to those in the diabetic tuberculosis group. The average duration of diabetes in the diabetic tuberculosis group was eight years. The study had one patient with a normal radiograph in the non diabetic tuberculosis group. Atypical radiological features were more commonly seen in the diabetic tuberculosis group when compared to the non diabetic group. TB diabetic group showed a lower frequency of upper lung field lesions in comparison with the non diabetic group.

Lower lung field involvement was predominantly seen in TB diabetic group.

For lower lung field, as well as for upper and lower lung fields, there were no statistical differences in the frequency of unilateral or bilateral lesions in the

between the two groups.

TB TREATMENT OUTCOMES IN TB-DM PATIENTS

Most of the observational studies reveal that TB-DM is associated with an increase in adverse TB treatment outcomes, specifically for delays in mycobacterial clearance, treatment failures, death, relapse and re-infection (59,60).

TB-DM patients are more likely to remain smear positive after completion of intensive phase of treatment than tuberculous patients without diabetes mellitus and this is an early predictor of treatment failure(60).

The poor clinico-radiological features and treatment outcomes in TB-DM patients are mainly due to 2 factors, the first one being poor glycemic control which is associated with dysfunctional immunity and the second being sub-optimal levels of anti mycobacterial antibiotics in the plasma of diabetic patients when compared to non diabetic patients

In particular, if the diabetic patient has chronic renal disease, then therapeutic drug monitoring may be necessary to adjust drug levels in the context of dialysis, asses interactions with other medications for the co-morbid condition and monitor toxicity.

Diabetes is associated with increased tuberculosis incidence among patients with HIV, malnutrition, ageing and smoking.

But diabetes differs from these other underlying conditions in that the immunity is not necessarily compromised but rather dysfunctional, with excessive or delayed responses against Mycobacterium infection.

In a cross sectional study done by krishna v et all (72), analysed the radiological features of 50 patients with TB DM. The male to female ratio was 7:3. Most of the patients were in the age group of 40 to 60 years.

There was a higher frequency of lower lung field involvement when compared to upper lung field. Bilateral involvement was seen in 18% of patients. Cavity was seen in 18% of the cases. Cavity was more frequently confined to upper lung field when compared to the lower lung field.

Total 27 patients of pulmonary TB were newly detected diabetics and among them 20 patients had higher bacillary load (sputum >2+). Out of the 27 newly detected diabetic patients 15 required insulin.

The study concluded that there was a higher involvement of lower lung field when compared to upper lung field. But Cavitary lesions were confined to upper lung field. Newly detected and poorly controlled diabetic patients had more lower lung field involvement. Extensive radiological involvement was seen in patients with blood sugar level above 300 mg% on admission.

Thus in diabetic patients presenting with lower lung field lesions, possibility of TB should always be considered for early diagnosis and treatment. The study emphasized the need for TB control programs to target patients with diabetes. for active case findings and efforts for early detection and treatment of diabetes mellitus which may have a favourable impact on tuberculosis control.

The main limitation of the study was it dint assess how tuberculosis risk varies by type, duration, and severity of diabetes mellitus.

AIMS AND OBJECTIVES

Aim of the study:

- To evaluate the clinico-radiological presentations of Pulmonary Tuberculosis among Prediabetics, newly diagnosed diabetics and known diabetic patients and to correlate their disease severity with the severity of diabetes mellitus.

Objectives:

1. To compare the clinico-radiological profile among of Pulmonary Tuberculosis among Prediabetics, newly diagnosed diabetics and known diabetic patients.
2. To assess the clinico-radiological profile of Pulmonary Tuberculosis among good control and poorly controlled diabetic patients.

MATERIALS AND METHODOLGY

STUDY DESIGN:

- The study was a Cross sectional study.
- 150 patients with newly detected microbiologically positive Pulmonary Tuberculosis patients admitted in Government hospital of Thoracic medicine, Tambaram sanatorium and Department of Pulmonary Medicine, Govt Stanley Medical College willing to participate in this study were included.
- Informed consent was obtained before inclusion.
- Based on the blood glucose and HbA1c levels, patients were classified into prediabetics, newly diagnosed diabetics and known diabetic patients.
- HbA1C level of 7 is taken as a cut off to differentiate between good control and poorly controlled diabetes patients.
- The clinico-radiological features among the different groups are assessed.

STUDY PERIOD:

From August 2018 to August 2019 for 1 year

STUDY CENTRE:

Study was conducted in Government Hospital of Thoracic Medicine, Tambaram sanatorium, Tambaram and Department of Pulmonary Medicine, Government Stanley Medical College, Chennai

SUBJECT SELECTION

INCLUSION CRITERIA:

All patients with newly detected microbiologically positive Pulmonary Tuberculosis with either prediabetes or diabetes mellitus.

EXCLUSION CRITERIA:

- Non diabetes patients
- Old pulmonary TB patients
- Extra pulmonary TB patients
- Drug resistant TB patients
- Pregnant patients

- Any Co-morbid conditions like HIV, renal or liver failure, cerebrovascular disease, occupational exposure and any other immunosuppresive disorders
- Patients not willing to participate in the study.

SAMPLE SIZE:

Sample size was calculated using previous studies as reference and 150 pulmonary tuberculosis patients with either prediabetes or diabetes mellitus who satisfied the inclusion and exclusion criteria were enrolled in the study.

Informed consent was obtained after explaining the nature of the study.

DATA COLLECTION:

Data collection was done with the following evaluation form:

- NAME:
- AGE
- SEX:
- IP NO:
- Chief complaints:
- Prior h/o ATT:
- Prior h/o DM:
- Occupation:

- Smoking history:
- Marital history:
- Vitals:

  Pulse rate:

  Respiratory rate:

  Blood pressure:

  Spo2:

- INVESTIGATIONS:
- Sputum for AFB:
- Sputum CBNAAT:
- Blood investigations:

  CBC:

  FBS:

  PPBS:

  HBA1C:

- Chest radiograph:

We have used the the American Diabetes Association criteria to classify patients into prediabetes and diabetes mellitus.

Prediabetes is the term used for cases whose blood glucose levels do not meet the criteria for diabetes mellitus but are too high to be normal. Patients with prediabetes are defined by the presence of impaired fasting glucose and/or impaired glucose tolerance and/or HbA1c between 5.7–6.4% (39–47 mmol/mol).

“Impaired fasting glucose is defined as FPG levels between 100 and 125 mg/dL (between 5.6 and 6.9 mmol/L)” and “Impaired glucose tolerance as 2 hour plasma glucose during 75-g oral glucose tolerance test between 140 and 199 mg/dL (between 7.8 and 11.0 mmol/L)”

TABLE 1:

	FBS	PPBS	HbA1c
Normoglycemia	< 99 mg/dl	<139 mg/dl	< 5.6
Prediabetes	100-125 mg/dl	140 – 199 mg/dl	5.7-6.4
Diabetes mellitus	>126 mg/dl	>200 mg/dl	>6.5

For assessing the clinical symptoms six parameters were taken into account. They include cough, breathlessness, chest pain, fever, loss of appetite and hemoptysis.

The various radiological features that were taken into account were upper zone and lower zone infiltrates, multi zonar involvement, upper zone and lower zone cavity, multiple cavities, bilateral involvement, miliary pattern, consolidation, pleural effusion and hydropneumothorax.

All the microbiologically confirmed tuberculosis patients who were taken up for the study, based on the blood glucose levels and history were classified into prediabetics, newly diagnosed diabetics and known diabetics. The various clinical and radiological features among the 3 groups were analysed.

Further based on HbA1c levels a cut off of 7, was taken to categorize the diabetics into good and poorly controlled diabetes, and their clinico-radiological features were analysed.

STATISTICAL ANALYSIS:

Data was entered in Microsoft Excel and analyzed using SPSS software.

Analysis was done using Kruskal Wallis test to assess significance and chi square test to assess association. A p value of less than 0.05 was considered as statistically significant.

RESULTS

DEMOGRAPHIC PROFILE

A total of 150 microbiologically confirmed tuberculosis patients were included in the study. Among the 150 cases 38 were prediabetics, 55 were newly diagnosed diabetics and the remaining 57 cases were known diabetics.

AGE DISTRIBUTION:

The mean age of the study population was 52 years+, with the minimum age being 24 years and the maximum age being 82 years.

TABLE 2: Mean age

	N	Minimum	Maximum	Mean	Std. Deviation
Age	150	24	82	52	10.32462

In our study majority of the patients were in the age group of 40 to 60 years.

TABLE 3: Age group distribution

Age group	21-40 yrs	41-60 yrs	>60yrs
Frequency	14%	63%	23%

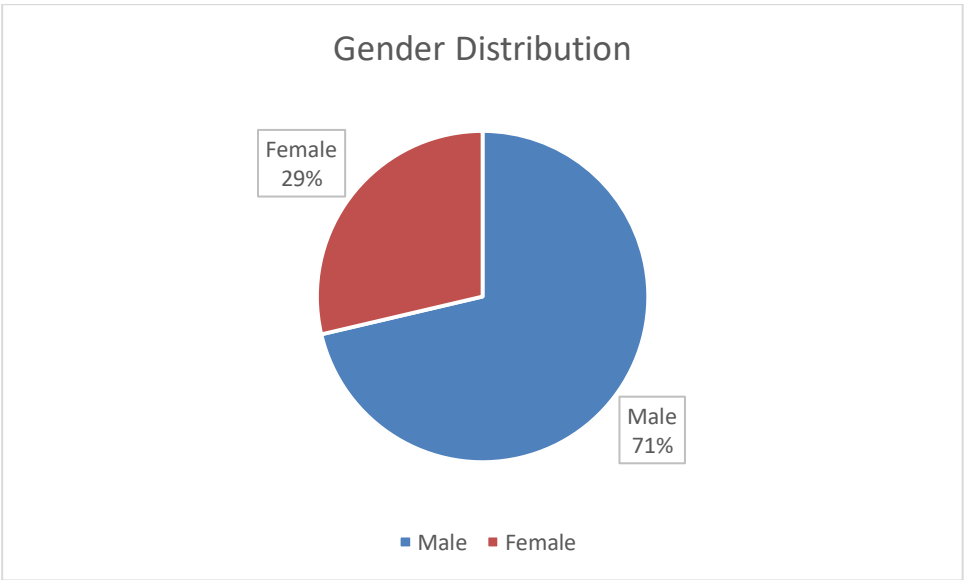
GENDER DISTRIBUTION:

Out of the 150 cases in the study population, 107 were males (71%) and 43 (29%) were females. The male to female ratio was around 2.5:1.

TABLE 4:

Gender	Number	Percentage
Male	107	71
Female	43	29
Total	150	100

FIGURE 2: BAR DIAGRAM OF GENDER DISTRIBUTION



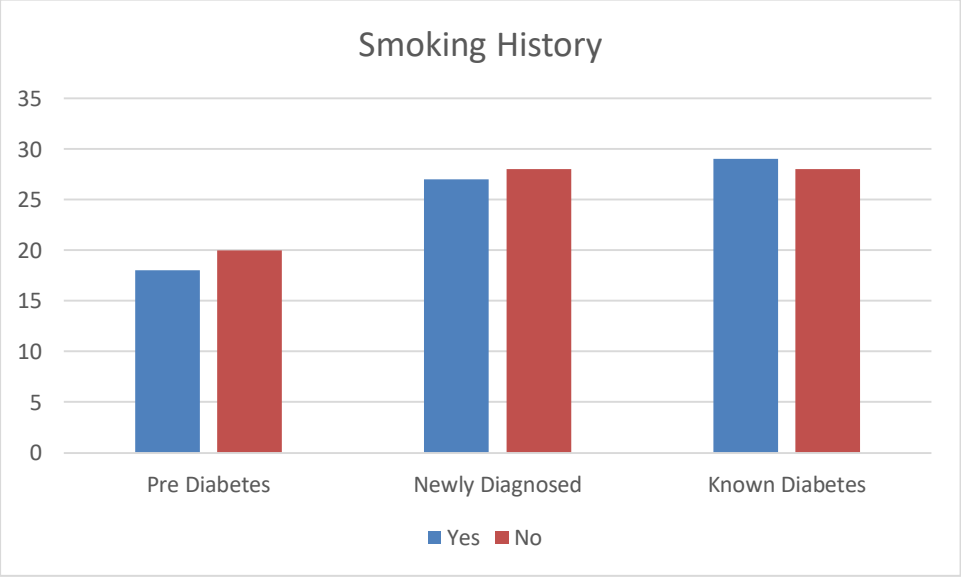
Smokers:

In our study around 50% of the cases were smokers. All the smokers were males. There wasn't any significant variation in the percentage of smokers among the 3 groups.

TABLE 5:

	Smoker	Non smokers	Total
Prediabetes	18	20	38
Newly Diagnosed diabetics	27	28	55
Known Diabetics	29	28	57
Total	74	76	150

FIGURE 3: BAR DIAGRAM OF SMOKERS



HbA1c:

The lowest HbA1c seen in the study group was 5.7 while the highest was 14.5.

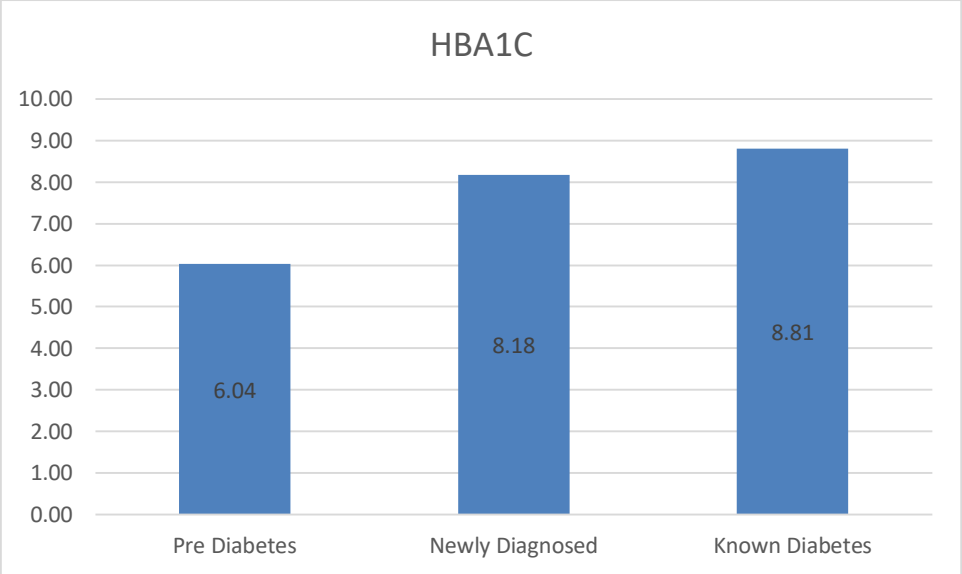
The mean HbA1c of the 150 cases together was 7.88.

TABLE 6:

	N	Minimum	Maximum	Mean
HBA1C	150	5.7	14.5	7.88

The mean HbA1c among prediabetics was 6.04, while in newly diagnosed diabetics it was 8.18 and in known diabetic cases it was 8.81.

FIGURE 4:



Sputum for AFB:

Sputum AFB was positive in 79% of the cases in prediabetes, 75% in newly diagnosed and 72% in known diabetic patients. The remaining smear negative cases were diagnosed by sputum CBNAAT.

TABLE 7:

	Sputum AFB		Total
	Yes	No	
Prediabetes	30	8	38
Newly Diagnosed	41	14	55
Known Diabetes	41	16	57
	112	38	150

Clinical profile:

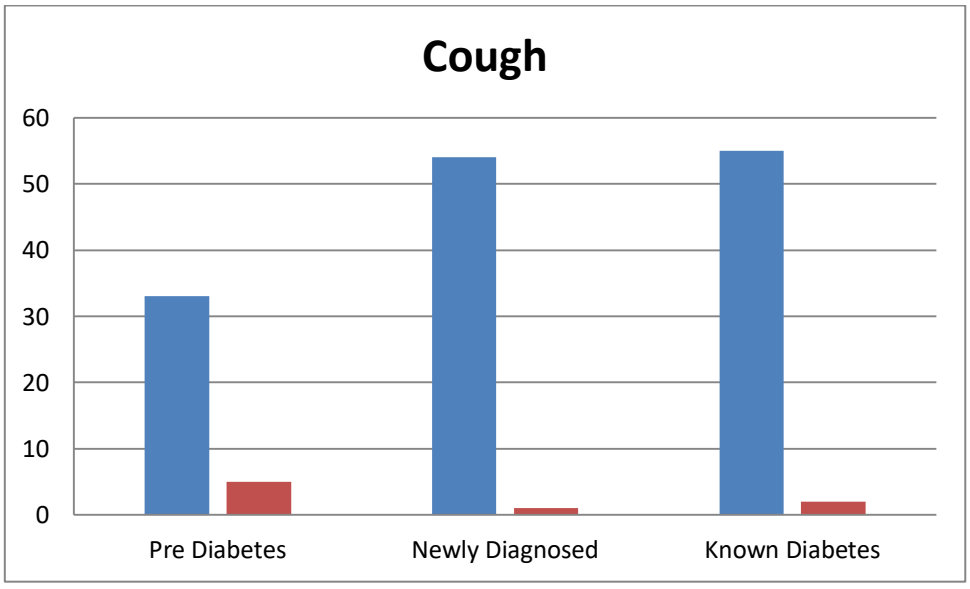
Cough:

Cough was the most common clinical symptom in all the 3 groups and was seen in around 142 cases.

TABLE 8:

	Cough		Total
	Yes	No	
Prediabetes	33	5	38
Newly Diagnosed	54	1	55
Known Diabetes	55	2	57
	142	8	150

FIGURE 5:



There was no significant variation in the frequency of cough in between the 3 groups

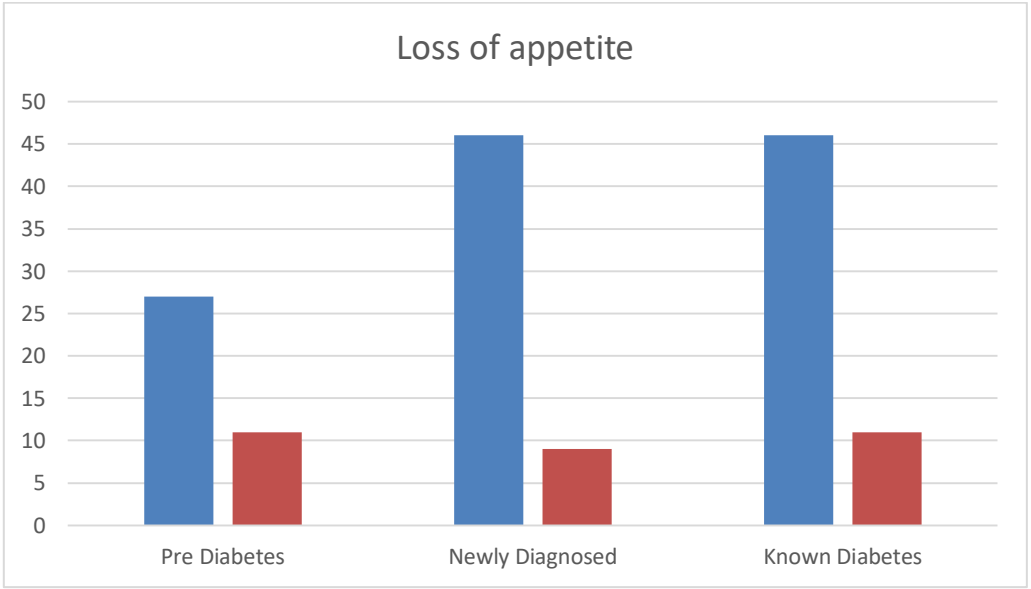
Loss of appetite:

Next to cough the predominant symptom seen was loss of appetite which was present in 119 cases out of the total 150 cases.

TABLE 9:

	Loss of Appetite		Total
	Yes	No	
Prediabetes	27	11	38
Newly Diagnosed	46	9	55
Known Diabetes	46	11	57
	119	31	150

FIGURE 6:



Fever:

Fever was present in 117 cases out of the total 150 cases. There was no significant variation in the frequency of fever between the 3 groups.

FIGURE 7:

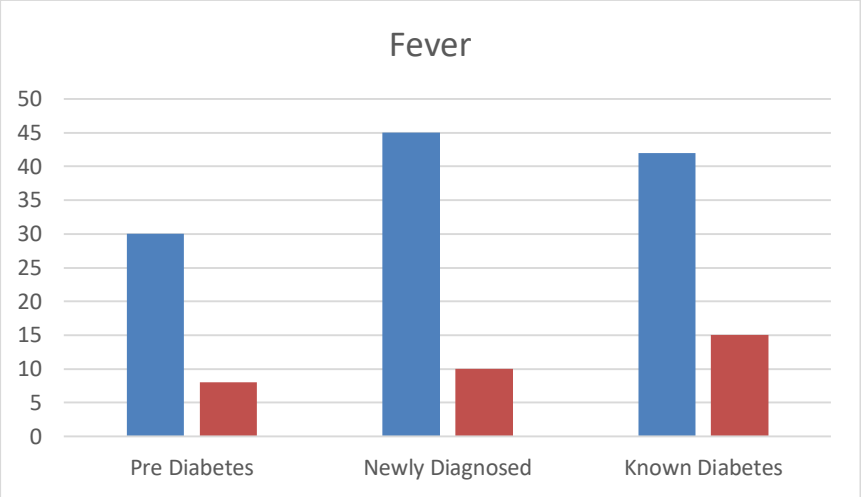


TABLE 10:

	Fever		Total
	Yes	No	
Prediabetes	30	8	38
Newly Diagnosed	45	10	55
Known Diabetes	42	15	57
	117	33	150

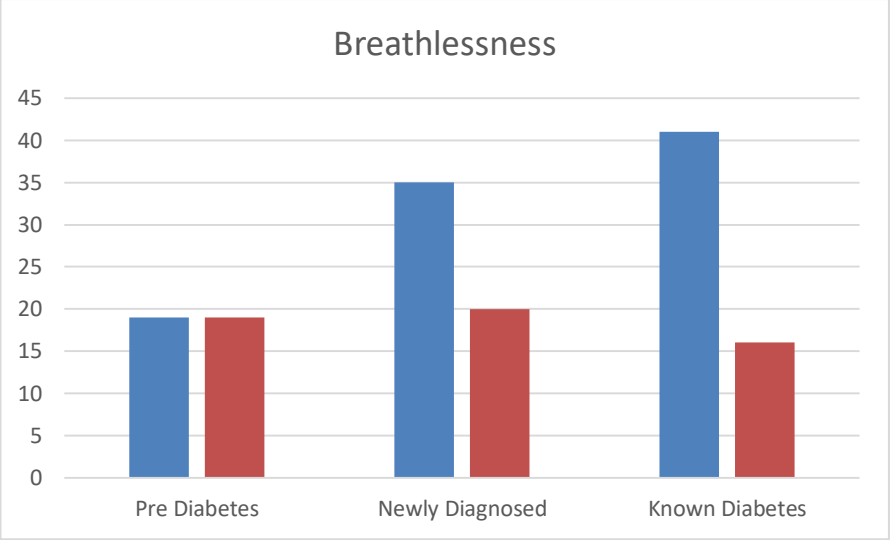
Breathlessness:

Out of the total 150 cases, 95 of them had breathlessness. It was seen in 50% of the cases among prediabetes, around 63% in newly diagnosed diabetics and among 72 % cases in known diabetics.

TABLE 11:

	Breathlessness		Total
	Yes	No	
Prediabetes	19	19	38
Newly Diagnosed	35	20	55
Known Diabetes	41	16	57
	95	55	150

FIGURE 8:



Chest pain:

Chest pain was seen in 42 cases out of the total 150 cases. The freqency of chest pain was significantly lower in prediabetics when compared to newly diagnosed diabetics and known diabetics.

FIGURE 9:

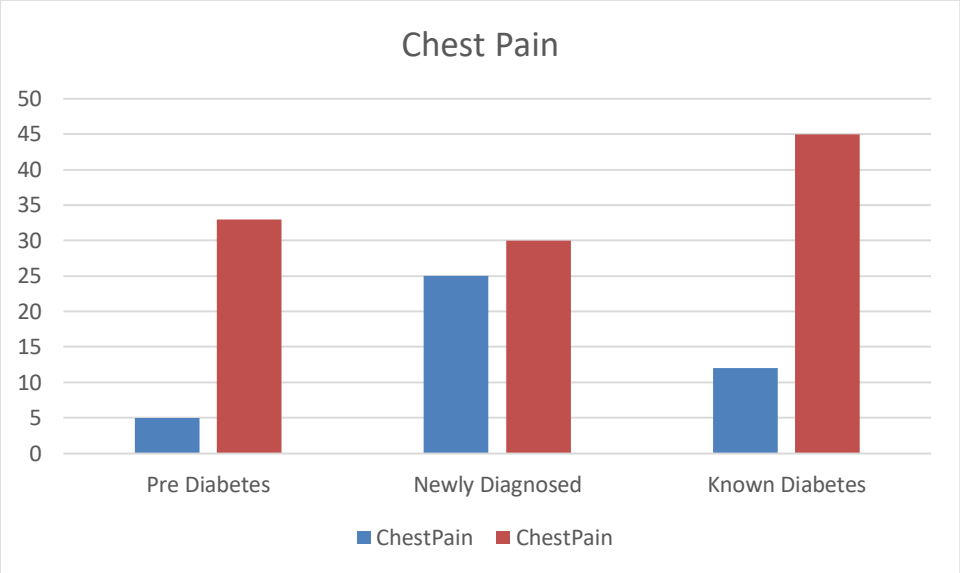


TABLE 12:

	Chest Pain		Total
	Yes	No	
Prediabetes	5	33	38
Newly Diagnosed	25	30	55
Known Diabetes	12	45	57
	42	108	150

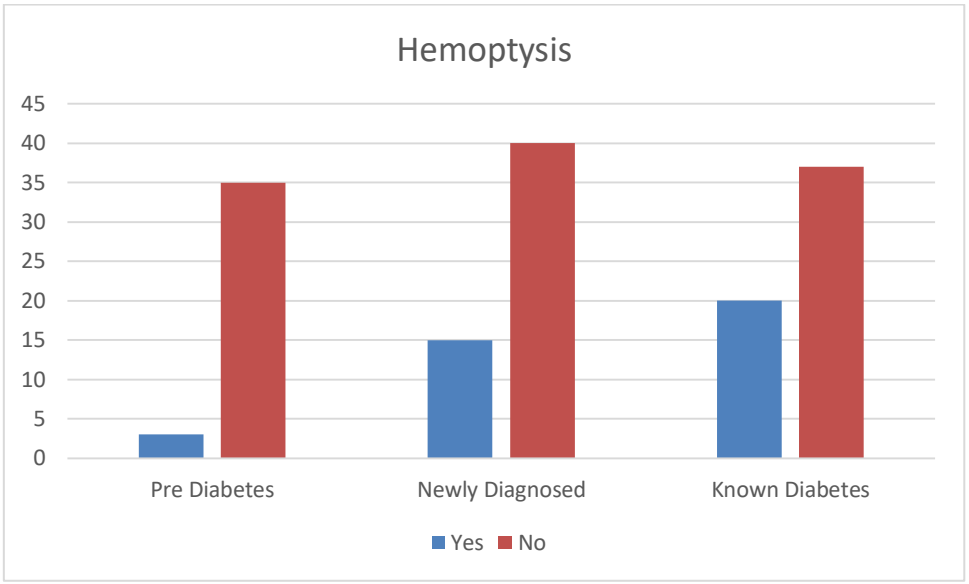
Hemoptysis:

Hemoptysis was the least common clinical symptom noticed when compared to the other symptoms. It was present only in 38 cases out of the total 150 cases. The freqency of hemoptysis was significantly lower in prediabetics when compared to newly diagnosed diabetics and known diabetics.

TABLE 13:

	Hemoptysis		Total
	Yes	No	
Prediabetes	3	35	38
Newly Diagnosed	15	40	55
Known Diabetes	20	37	57
	38	112	150

FIGURE 10:



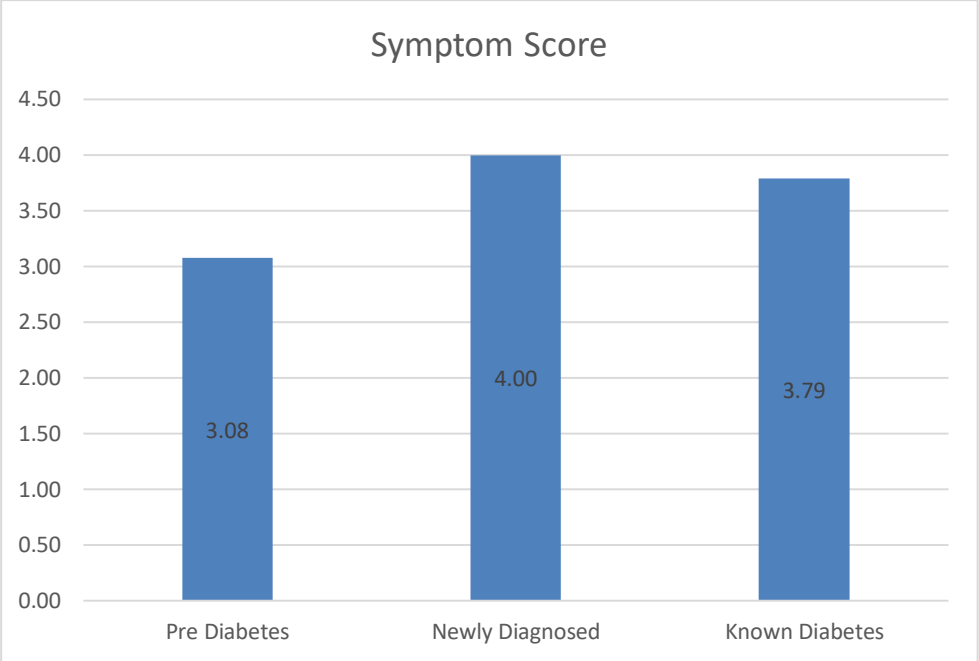
Symptom score:

The average of the total 6 symptoms among the 3 groups were analysed. While prediabetes had a mean symptom score of 3.08, newly diagnosed diabetics had a score of 4 and known diabetics had a score of 3.69.

TABLE 14:

Symptom score		
Diabetes group	Mean	Std. Deviation
Prediabetes	3.08	1.05
Newly Diagnosed	4.00*	1.19
Known Diabetes	3.79#	1.15
Total	3.69	1.19

FIGURE 11:



Radiological profile:

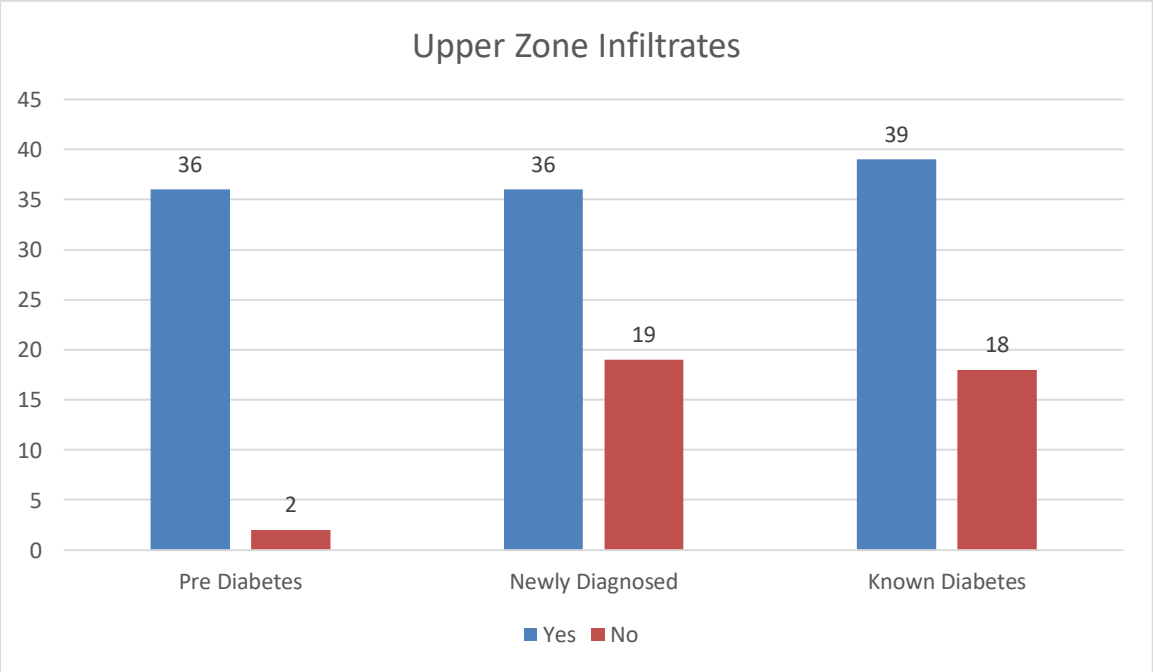
Upper zone infiltrates:

The frequency of upper zone infiltrates was significantly higher in prediabetes when compared to newly diagnosed and known diabetic patients.

TABLE 15:

	Upper Zone Infiltrates		Total
	Yes	No	
Prediabetes	36	2	38
Newly Diagnosed	36	19	55
Known Diabetes	39	18	57
	111	39	150

FIGURE 12:



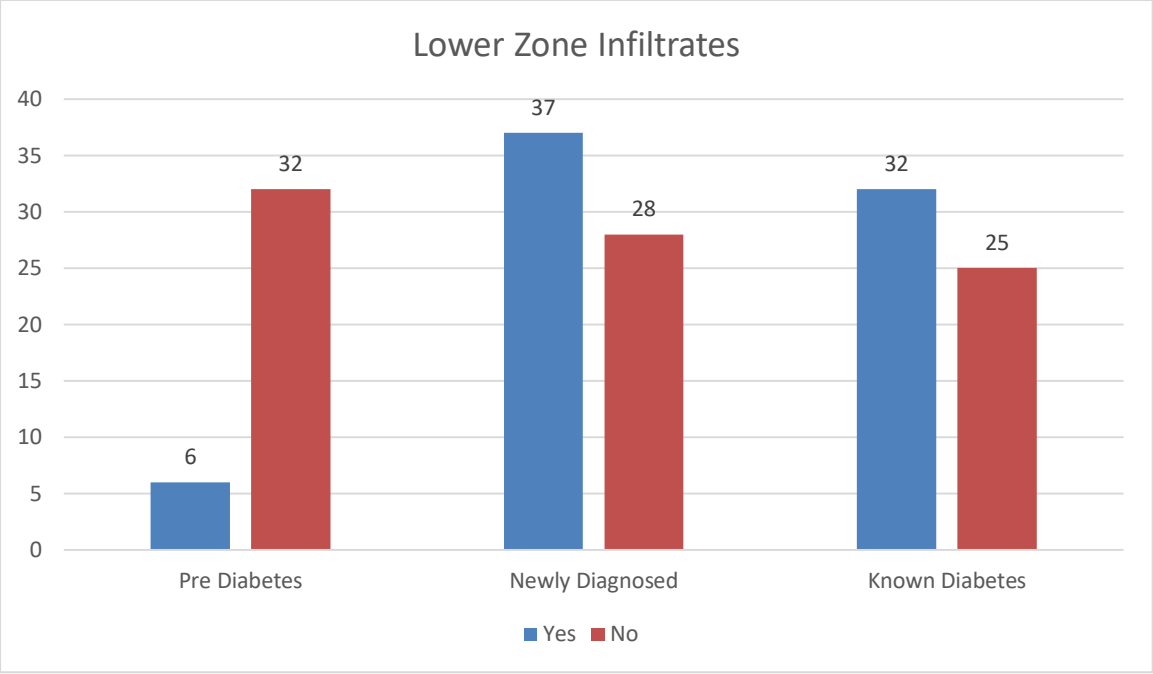
Lower zone infiltrates:

The percentage of lower zone infiltrates was higher in newly diagnosed (67%) and known diabetic patients (56%) when compared to prediabetes (16%).

TABLE 16:

	Lower Zone Infiltrates		Total
	Yes	No	
Prediabetes	6	32	38
Newly Diagnosed	37	18	55
Known Diabetes	32	25	57
	75	75	150

FIGURE 13:



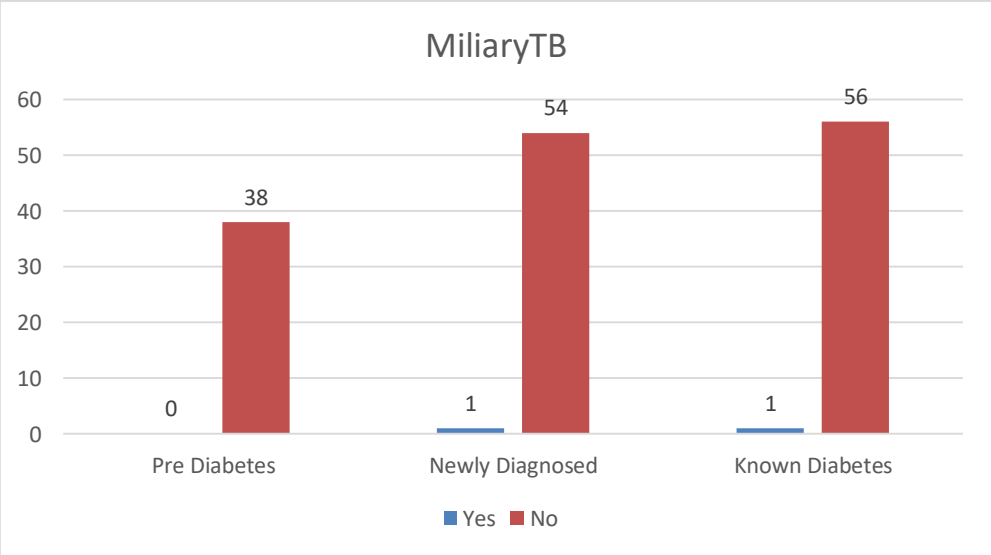
Multi zonar involvement:

The frequency of multi zonar involvement in prediabetes was (27%), while it is significantly higher in newly diagnosed (85%) and known diabetic patients (72%)

Miliary TB:

2 cases of Miliary TB was seen in the study, one each in newly diagnosed and known diabetic patients.

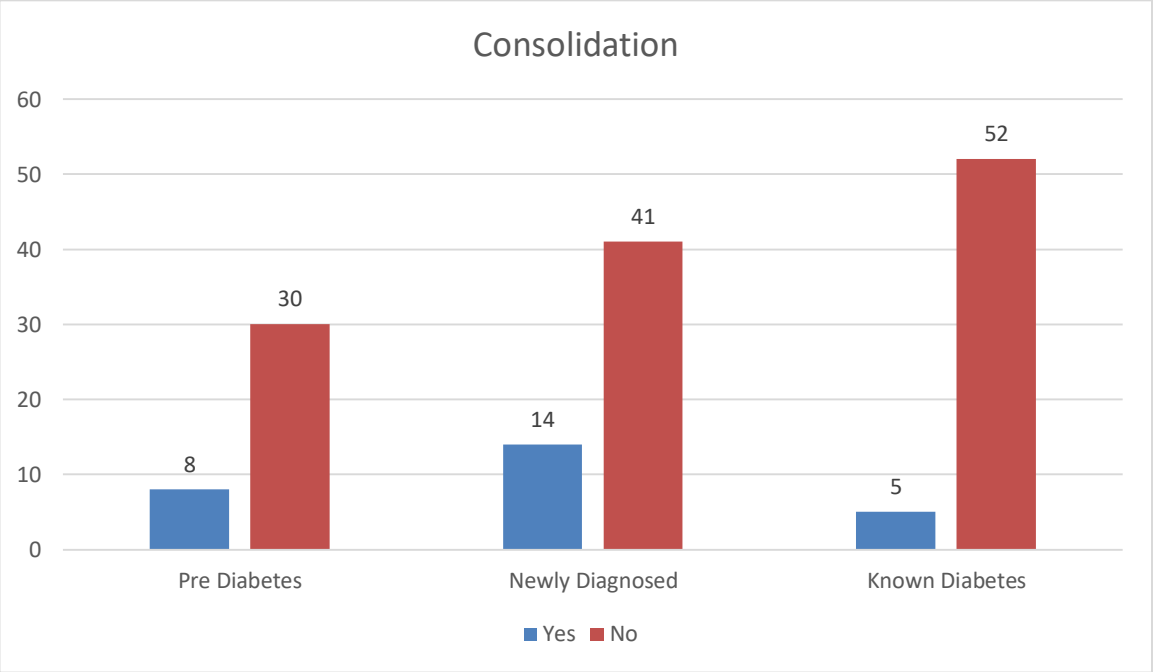
FIGURE 14:



Consolidation:

It was present in 27 cases out of the total 150 cases.

FIGURE 15:



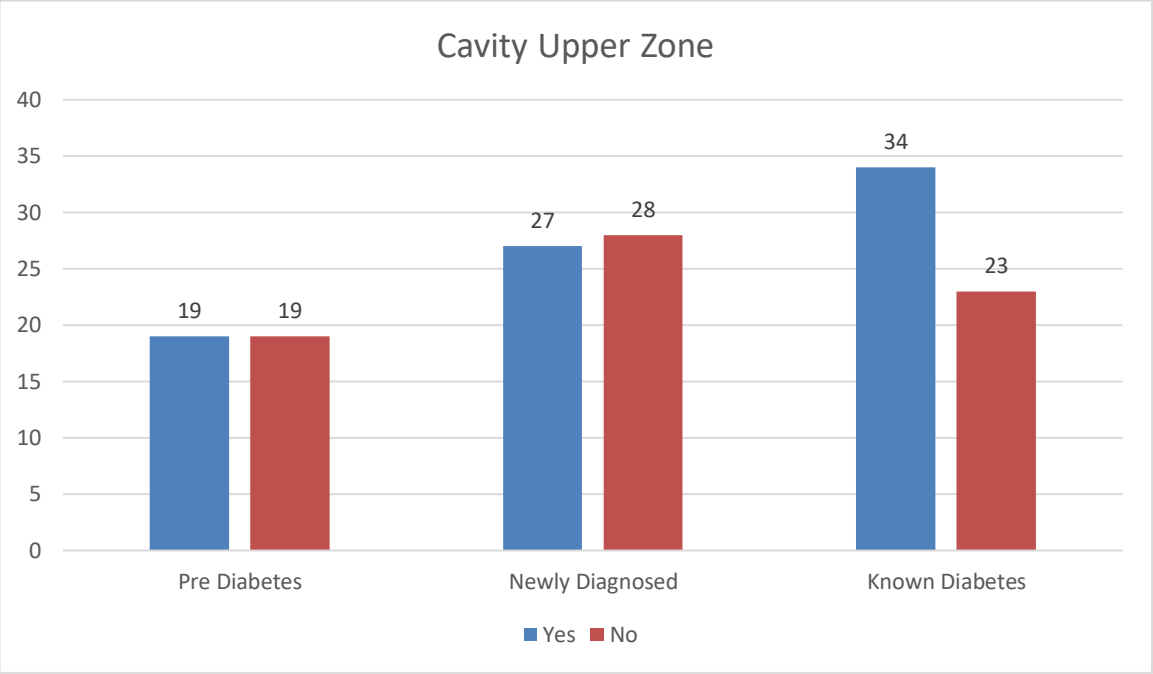
Upper zone cavity:

The percentage upper zone cavity is 50% in prediabetes, 49% in newly diagnosed diabetics and 60% in known diabetics.

TABLE 17:

	Cavity Upper Zone		Total
	Yes	No	
Prediabetes	19	19	38
Newly Diagnosed	27	28	55
Known Diabetes	34	23	57
	80	70	150

FIGURE 16:



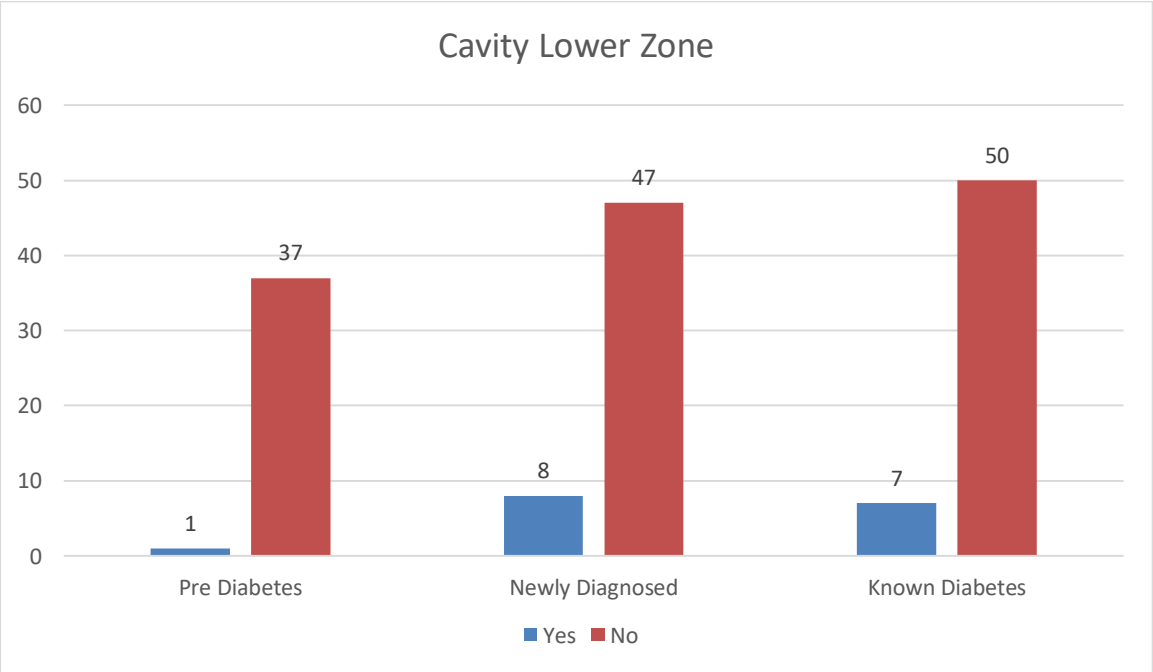
Lower zone cavity:

The percentage lower zone cavity in newly diagnosed diabetics is 15% and 12% in known diabetics, while it is significantly lower in prediabetes.

TABLE 18:

	Cavity Lower Zone		Total
	Yes	No	
Prediabetes	1	37	38
Newly Diagnosed	8	47	55
Known Diabetes	7	50	57
	16	134	150

FIGURE 17:



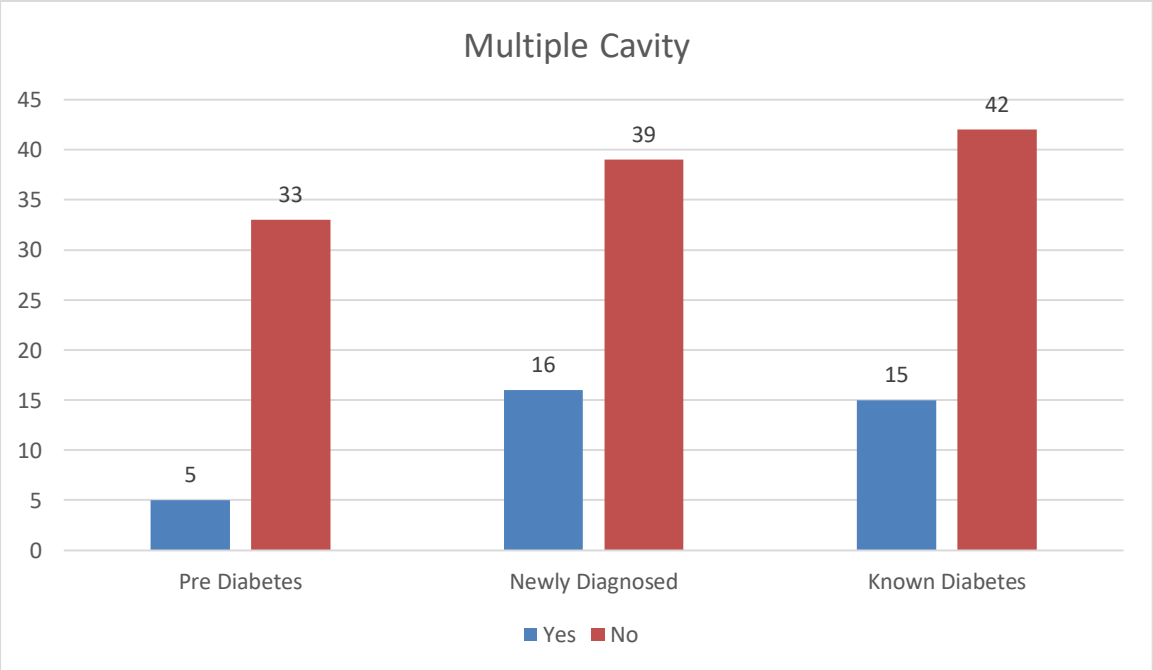
Multiple cavity:

The incidence of multiple cavities is significantly lower in prediabetes when compared to newly diagnosed and known diabetic patients

TABLE 19:

	Multiple Cavity		Total
	Yes	No	
Prediabetes	5	33	38
Newly Diagnosed	16	39	55
Known Diabetes	15	42	57
	36	114	150

FIGURE 18:



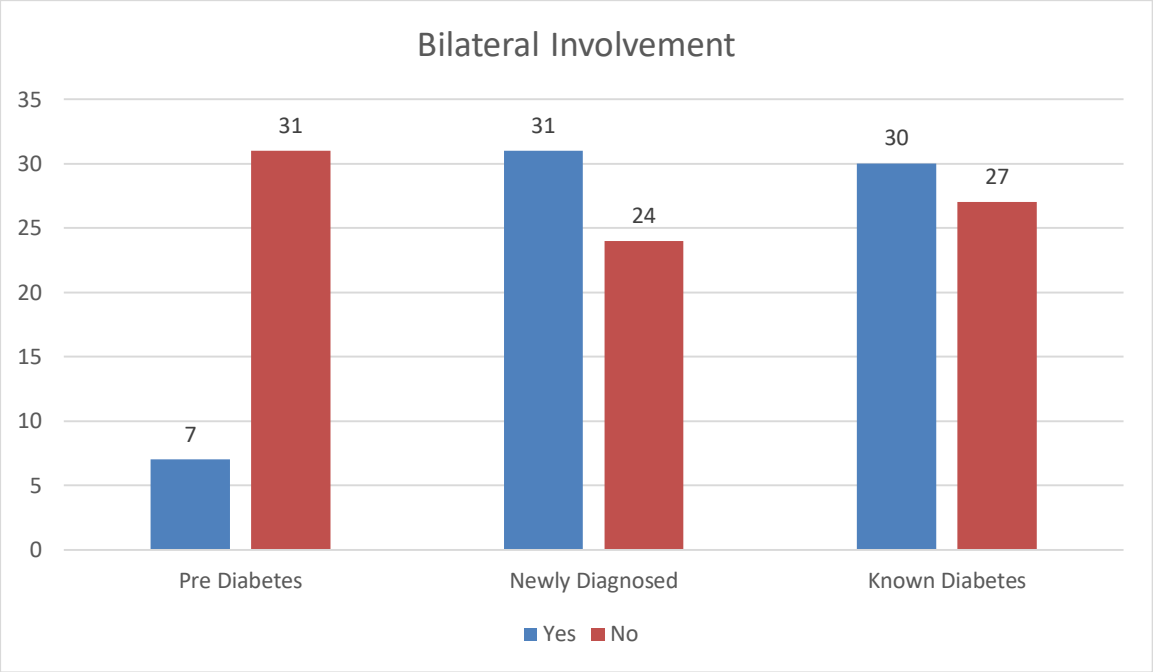
Bilateral involvement:

The incidence of multiple cavities is significantly lower in prediabetes when compared to newly diagnosed and known diabetic patients

TABLE 20:

	Bilateral Involvement		Total
	Yes	No	
Prediabetes	7	31	38
Newly Diagnosed	31	24	55
Known Diabetes	30	27	57
	68	82	150

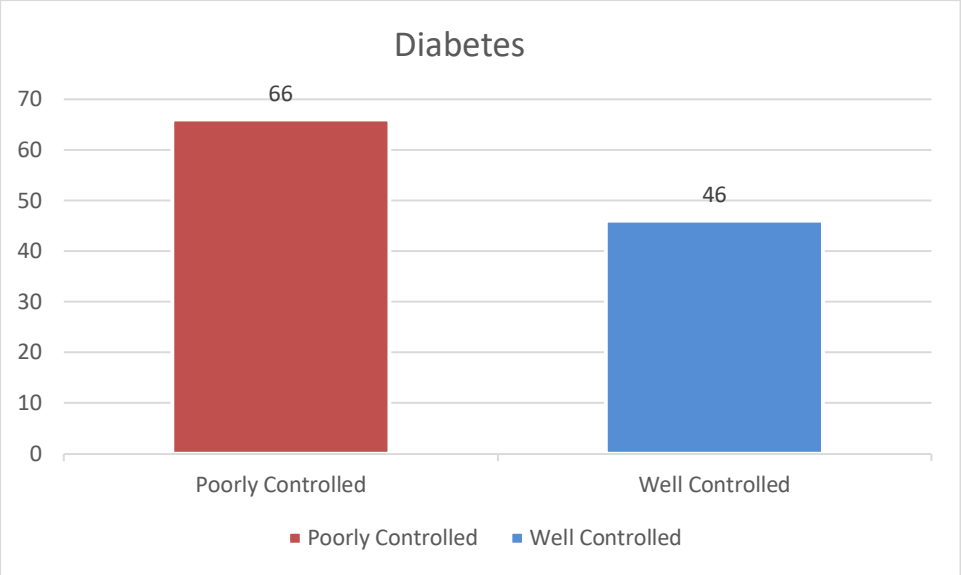
FIGURE 19:



Good control vs poorly controlled diabetes:

Among the 112 diabetic patients, patients were divided into good control and poorly controlled diabetes based on the HbA1c cut off 7. There were 46 cases with good controlled diabetes and 66 cases with poorly controlled diabetes.

FIGURE 20:



Clinical profile:

Symptom score:

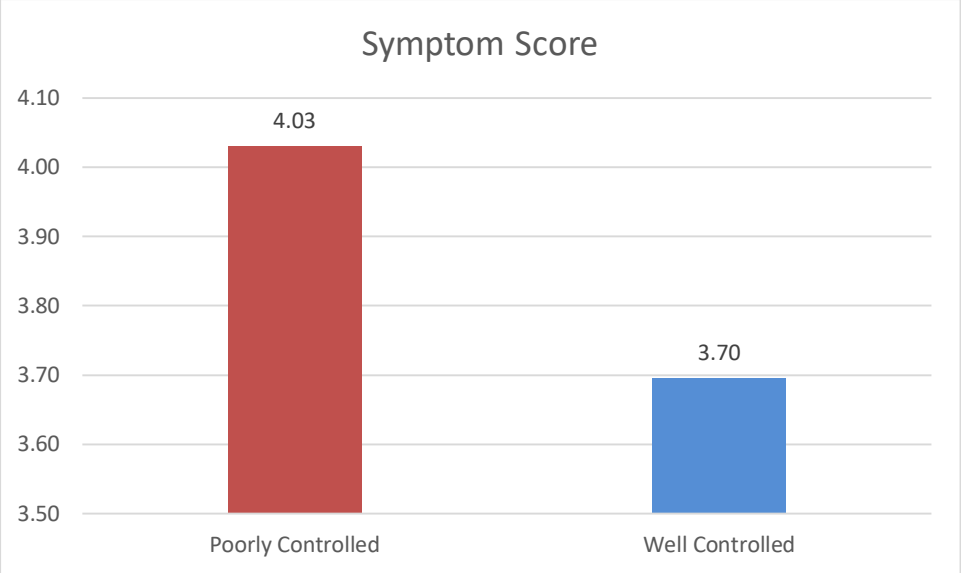
The mean symptom score in the good control was 3.70 when compared to 4.03 of the poorly controlled diabetic tuberculosis patients.

TABLE 21:

Diabetes	N	Mean	Std. Deviation
Poorly Controlled	66	4.03	1.18
Well Controlled	46	3.70	1.13
Total	112	3.89	1.17

No significant difference between two groups

FIGURE 21:



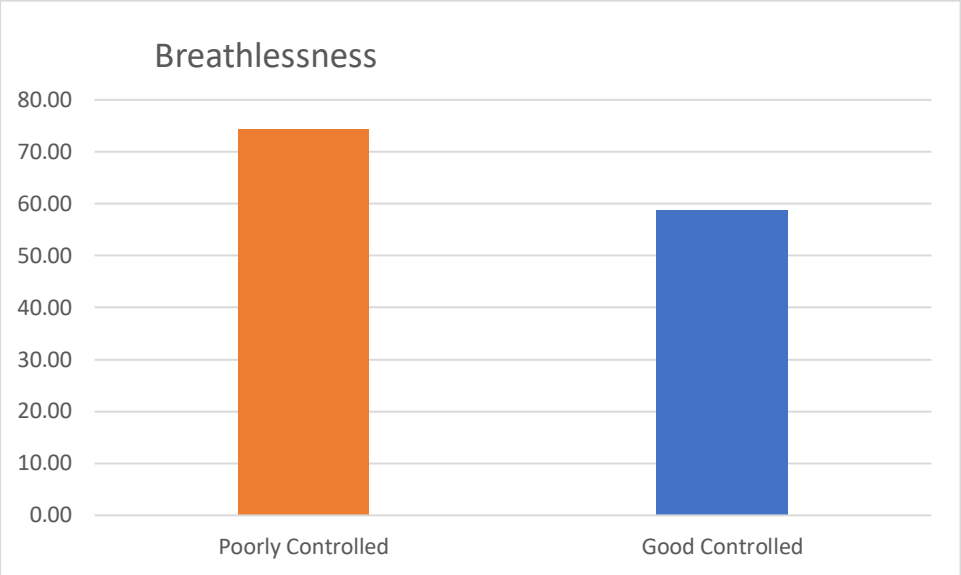
Clinical features:

There was no significant changes in clinical symptoms with respect to cough, chest pain, fever and loss of appetite.

Cough was the most predominant symptom seen in both the groups followed by loss of appetite.

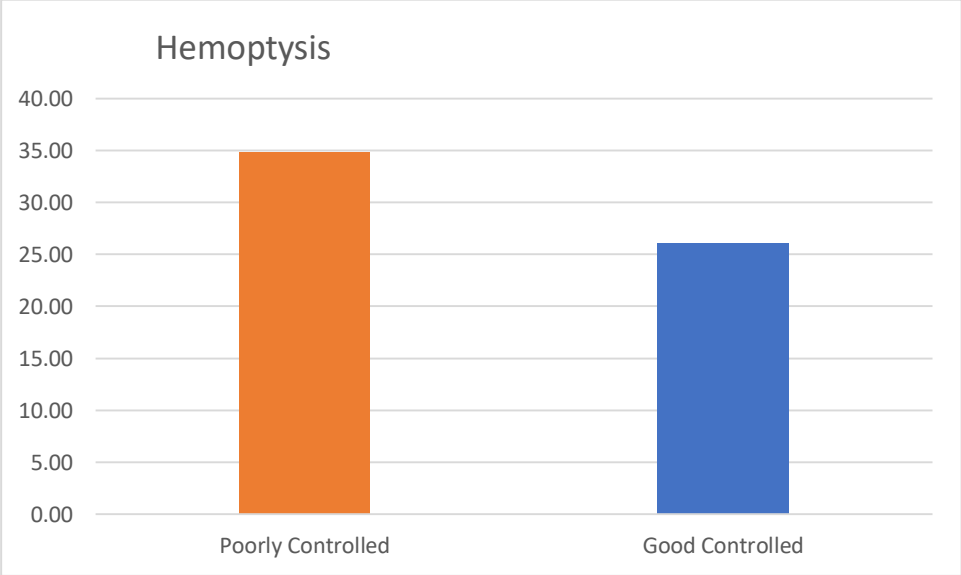
While breathlessness was seen in 58% of the cases in the good contolled group, its frequency in the poorly controlled group was 74%.

FIGURE 22:



Hemoptysis was seen in 26% of the cases in good control while it was 34% in the poorly controlled diabetic group

FIGURE 23:



Radiological profile:

Upper zone infiltrates:

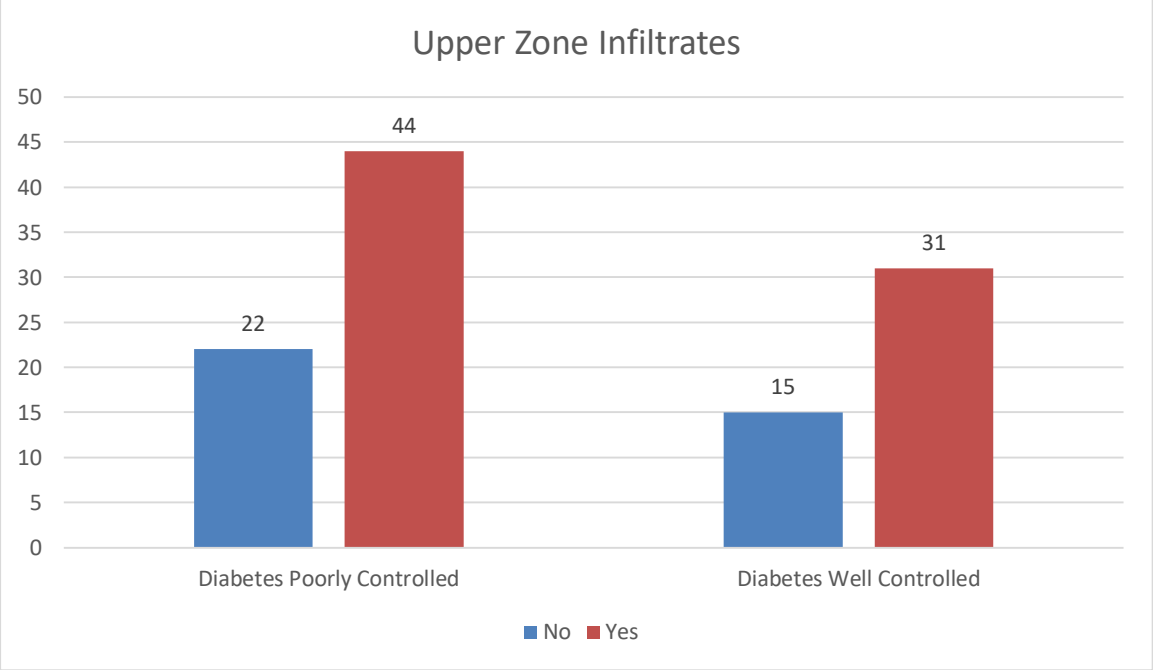
There was no significant difference in frequency with respect to upper zone infiltrates between the 2 groups.

TABLE 22:

		Upper Zone Infiltrates		Total
		No	Yes	
Diabetes	Poorly Controlled	22	44	66
	Well Controlled	15	31	46
Total		37	75	112

Analysis done using Chi square test

FIGURE 24:



Lower zone infiltrates:

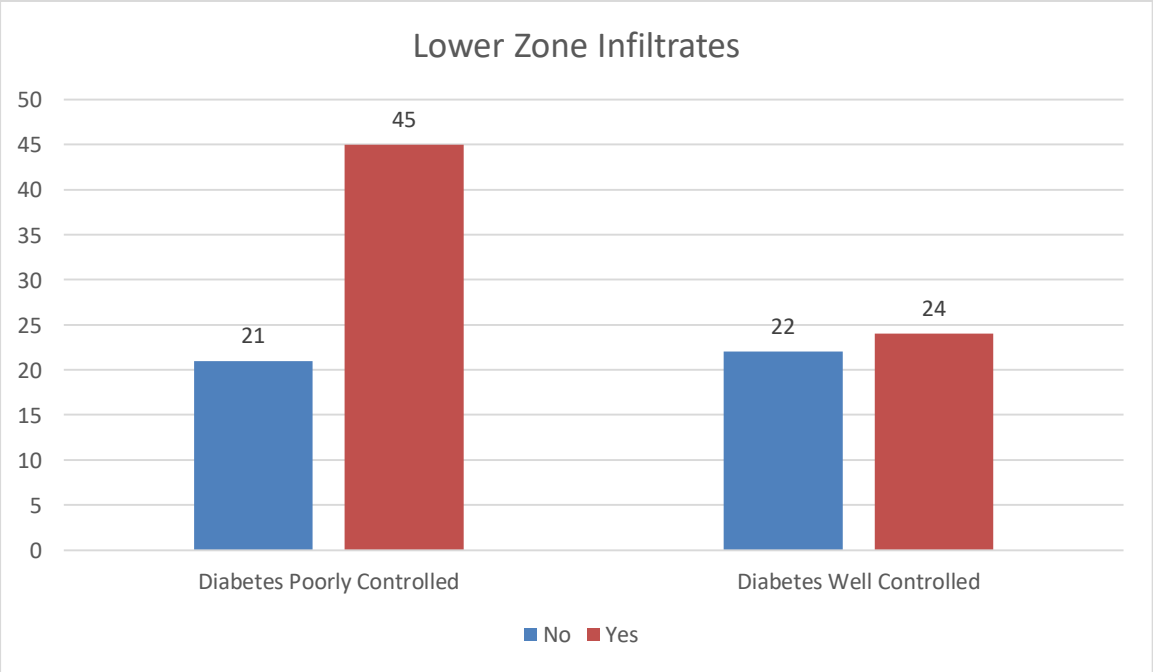
There was no significant variation in the frequency of Lower zone infiltrates between the two groups.

TABLE 23:

		Lower Zone Infiltrates		Total
		No	Yes	
Diabetes	Poorly Controlled	21	45	66
	Well Controlled	22	24	46
Total		43	69	112

Analysis done using Chi square test

FIGURE 25:



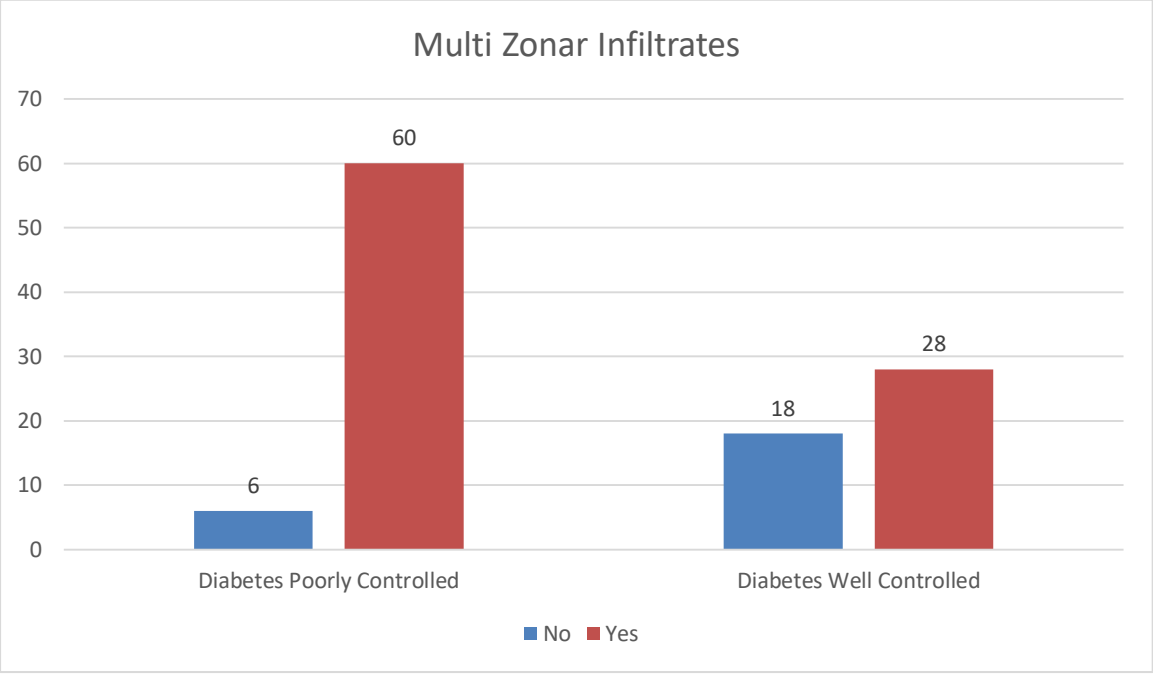
Multi zonar infiltrates :

The incidence of multizonar involvement is more commonly seen in poorly controlled diabetic group when compared to the good controlled diabetic group.

TABLE 24:

		Multi zonar Infiltrates		Total
		No	Yes	
Diabetes	Poorly Controlled	6	60	66
	Well Controlled	18	28	46
Total		24	88	112

FIGURE 26:



Bilateral involvement:

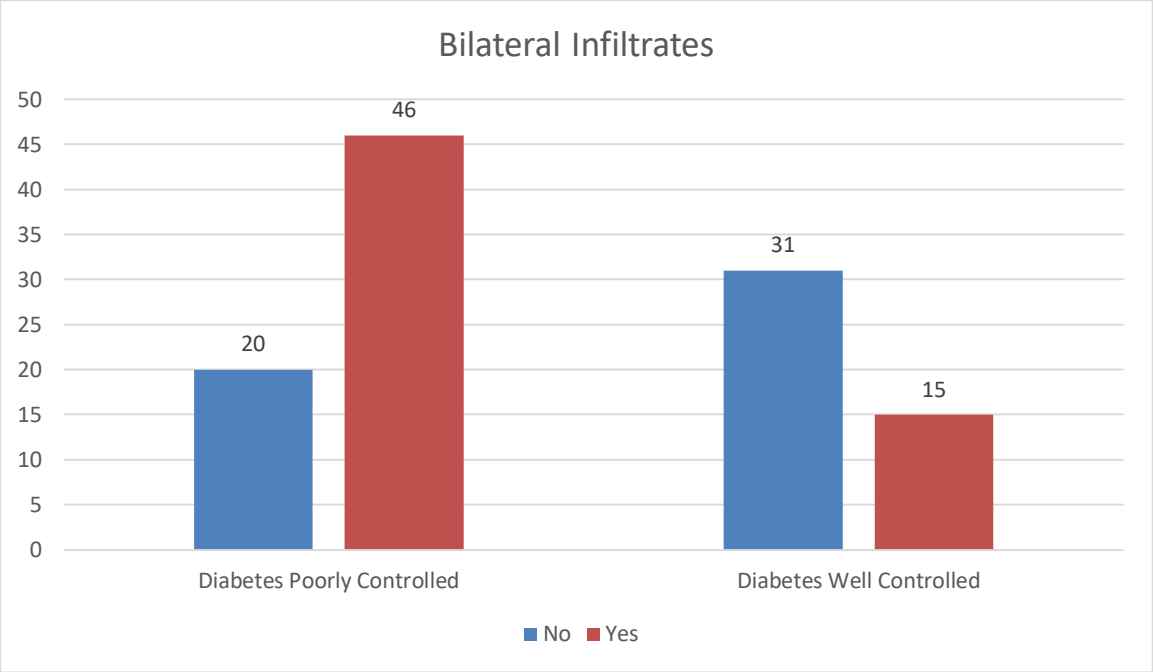
The incidence of bilateral involvement is more frequently seen in poorly controlled diabetic group when compared to the good controlled diabetic group.

TABLE 25:

		Bilateral Infiltrates		Total
		No	Yes	
Diabetes	Poorly Controlled	20	46	66
	Well Controlled	31	15	46
Total		51	61	112

Analysis done using Chi square test

FIGURE 27:



Multiple cavity:

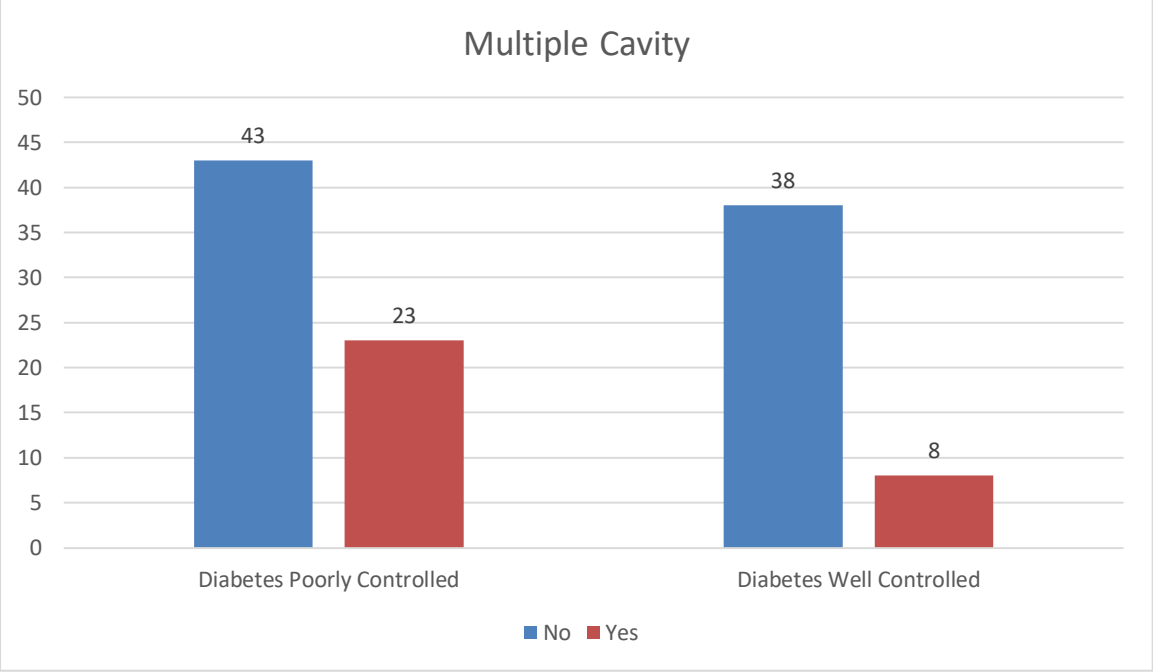
The frequency of multiple cavities is more in the poorly controlled diabetic group when compared to the good controlled diabetic group.

TABLE 26:

		Multiple Cavity		Total
		No	Yes	
Diabetes	Poorly Controlled	43	23	66
	Well Controlled	38	8	46
Total		81	31	112

Analysis done using Chi square test

FIGURE 28:



DISCUSSION

CLINICAL FEATURES

- The mean age in the study population was 52 years and the mean age group was 40 to 60 years.
- The male to female ratio was 2.5: 1
- The mean HbA1c among prediabetics was 6, while in the newly diagnosed diabetics it was 8.18 and in known diabetic cases it was 8.81.
- Cough was the predominant symptom seen in all the 3 groups followed by loss of appetite and fever.
- Chest pain and hemoptysis was seen in only a lower frequency of patients.
- Prediabetes patients had a significant lower frequency of chest pain and hemoptysis when compared to newly diagnosed and known diabetic patients.
- The symptom score was also lower in prediabetes (3.08) when compared to newly diagnosed (4) and known diabetic (3.79) patients.

RADIOLOGICAL PROFILE:

- 2 cases of Miliary TB was seen in one each in newly diagnosed and known diabetic patients.
- 3 cases of pleural effusion was present. In that 1 case was a newly diagnosed diabetic while the other 2 were known diabetics.
- 4 cases of pyopneumothorax was present. In that 1 case was a newly diagnosed diabetic while the other 3 were known diabetics
- Atypical lung field involvement such as lower zone infiltrates and lower zone cavity were more significantly seen in newly diagnosed and known diabetic patients, when compared to prediabetes
- Extensive radiological involvement in the form of multiple cavity, multi zonar involvement and bilateral involvement were more commonly seen in newly diagnosed and known diabetic patients, when compared to prediabetes

With regards to the comparison between good control and poorly controlled diabetes the study showed :

Clinical profile:

- There is no significant difference in the symptom score between the 2 groups.
- Cough is the predominant symptom followed by loss of appetite

Radiological profile:

- Multi zonar involvement, bilateral involvement and multiple cavities were more frequently seen in the poorly controlled diabetic group when compared to the good controlled diabetic group.

Our study was in concordance with the study done by Li-Kuo Huang et all, which showed that patients with poor glycemic control of HbA1c > 8% had atypical radiological features and far advanced radiological lesions when compared with the cases with good glycemic control. Our study also had similar result but the cut off of HbA1C was chosen as 7 in our study while it was 8 in the study done by Li-Kuo Huang et all(11).

Their study also inferred that multiple cavity, multi lobar and atypical involvement were more frequently seen in tuberculous diabetic patients when compared to tuberculous non diabetic patients. Our study also showed the same result but the comparison was between prediabetics and diabetes mellitus patients. The study also used CT scan to assess the radiological features while in our study only chest radiograph was used.

In the study by Vinay Mahishale et all compared the clinico radiological features of optimally controlled and poorly controlled tuberculous diabetic patients(70). Glycosylated hemoglobin (HbA1c) cut off of 7 was taken to differentiate between good controlled and poorly controlled diabetic patients

This cut off was in concordance with our HbA1c cut off. While their study had 630 patients of which 207 cases had good glycemic control while 423 cases had poor glycemic control, our study had totally 112 cases with 46 patients having good control and the remaining 66 cases with poor glycemic control.

While Fever was the predominant symptom in their study, our study had cough as the predominant symptom in all the groups. Breathlessness and weight loss were significantly more often reported by patients in the poorly controlled diabetic group in the study, while in our study breathlessness and hemoptysis were more significantly reported in the poorly control group.

The study result was in concordance with our study in which Patients with poorly controlled diabetic group had more frequency of multilobar involvement and more extensive lung involvement.

Their study also took into account Sputum bacillary load at presentation, which was significantly higher in the poorly controlled diabetic group, which we dint assess. Their study was also prospective in nature, while our study was cross sectional in nature

The clinico radiological profile of 60 diabetic tuberculous patients were studied by babu anand et all in 2017(30). The most frequent symptoms noted in the study was anorexia (81.7%), cough (80%) and fever (60%), while in our study the predominant symptom was cough followed by loss of appetite and fever.

Predominant age group in their study was 40 to 60 years, which was similar to our study. Cavitary lesion was the most common radiological abnormality in their study, while infiltrates were the most common radiographic finding in our study. The sample size was very small in this study with 60 cases only.

In a study by anand patel et all, compared the clinico radiological features of diabetic tuberculosis patients(40). The mean age in their study was 50 years while in our study it was 52 years. This study was in concordance with our study that non cavitary lesions where the predominant finding. Elderly patients (age >50 years) had less incidence of fever, chest pain, haemoptysis and higher incidence of dyspnoea when compared to young adults (age < 50 years). Elderly patients had more of atypical and multizonar involvement with non-cavitary and advance disease when compared to patients with < 50 years of age

The study showed controlled diabetic patients having more of lower zone and more advanced disease involvement, while in our study it was the opposite. This was against most of the previous studies and would probably due to the small size in the study population.

In a study by Jahnavi K et all in 2015 studied the clinico radiological profile of tuberculous patients with diabetes and without diabetes (23).

The study was in concordance with our study stating that bilateral and multizonar involvement was most frequently seen in tuberculous patients with diabetes. Their study differed from our study finding in stating that lower zone predominence was seen in tuberculous patients without diabetes. The study revealed a prevalence of 47.6% of diabetic patients among tuberculous patients. This prevelance was significantly higher when compared to other studies

In a study by perez guzman et all studied the radiological profile of tuberculosis patients with diabetes and those without diabetes (71). The study stated that Patients in the non diabetic tuberculosis group were younger when compared to those in the diabetic tuberculosis group.

Their study was in concordance with our finding that atypical radiological features were more commonly seen in the diabetic tuberculosis group when compared to the non diabetic group. TB diabetic group showed a lower frequency of upper lung field lesions in comparison with the non diabetic group.

Lower lung field involvement was predominantly seen in TB diabetic group
Our study differed from this study by perez guzman et all, which stated there was no differences in the frequency of unilateral or bilateral lesions in the between the two groups while in our study bilateral lesion was more commonly seen in TB diabetic group.

CONCLUSION

- This study shows the importance of early screening of patients with TB for diabetes which will enable us to manage these patients in the early phase.
- Diagnosis of prediabetes at early phase is necessary so that primary prevention methods may be initiated timely.
- In diabetic patients the possibility of atypical features such as lower lung field involvement should be kept in mind in order to prevent delay in diagnosis.
- Strategies are needed to ensure that optimal care is provided to patients with both diseases: TB must be diagnosed early in people with diabetes, and diabetes must be diagnosed early in people with TB.
- Adequate glycemic control is very important in these patients, since poorly controlled diabetic patients tends to have far advanced disease involvement.

LIMITATIONS

- The present study was done in a tertiary hospital in a urban area and hence the results cannot be generalised to the population at large.
- The study has been primarily cross sectional in nature.
- Treatment outcomes were not analysed.
- MDR TB and drug resistant cases were excluded from the study.

RECOMMENDATIONS

- Bidirectional screening between tuberculosis and diabetes should look into the feasibility of doing HbA1C especially in a country like india where the prevalence of both the disease is high, since a proportion of the cases might be missed by doing fasting and post prandial blood sugars alone.
- Prediabetes patients must be regularly followed up and, the importance of lifestyle and dietary modifications must be stressed.
- Diabetic patients must be aggressively treated inorder to achieve good glycemic control.
- More studies are needed to assess the association of diabetes and drug resitant tuberculosis.
- Further studies are needed on the role of metformin as an anti tuberculous agent.

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ANNEXURES

INSTITUTIONAL ETHICAL COMMITTEE APPROVAL

GOVERNMENT STANLEY MEDICAL COLLEGE & HOSPITAL,CHENNAI -01
INSTITUTIONAL ETHICS COMMITTEE

TITLE OF THE WORK : THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY.

PRINCIPAL INVESTIGATOR : DR. V. DEVANATHAN
DESIGNATION : PG IN MD TUBERCLOSIS AND RESPIRATORY DISEASES.
DEPARTMENT : DEPARTMENT OF TB & RESPIRATORY DISEASES, GOVT. STANLEY MEDICAL COLLEGE.

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 27.06.2018 at the Council Hall, Stanley Medical College, Chennai-1 at 10am.

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if any extension of time is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

MEMBER SECRETARY,
IEC, SMC, CHENNAI

MEMBER SECRETARY
ETHICAL COMMITTEE,
STANLEY MEDICAL COLLEGE
CHENNAI-600 001.

EVALUATION FORM:

- NAME:
- AGE:
- SEX:
- IP NO:
- Chief complaints:
- Prior h/o ATT:
- Prior h/o DM:
- Occupation H/O:
- Smoking history:
- INVESTIGATIONS:
- Sputum for AFB:
- Sputum for CBNAAT:
- FBS:
- PPBS:
- HBA1C:
- Chest radiograph:

PATIENT INFORMATION SHEET

TITLE OF THE STUDY: **"THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY"**

We are conducting a study among patients attending Department of Pulmonary Medicine, Stanley Medical College and Govt. Hospital of Thoracic Medicine, Tambaram. The purpose of this study is to analyze the clinico-radiological features of Pulmonary Tuberculosis among Prediabetics, newly diagnosed diabetics and known diabetic patients. Routine blood investigations, blood glucose levels, sputum for AFB, sputum CBNAAT and chest radiograph are done.

Pulmonary Tuberculosis patients with raised blood glucose levels are selected. Patients are further sub classified into good and poorly controlled diabetic patients based on HbA1C values. Patients clinico-radiological profile among the different groups are assessed.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the study will be intimated to you at the end of the study to aid in the management or treatment.

Signature of Investigator Signature of Participant

Date:

PATIENT CONSENT FORM

STUDY DETAIL: "THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY"

Study Centre: Dept of Respiratory medicine, Stanley Medical College and GHTM, Tambaram.

Patient's Name:

Patient's Age/sex:

ID No:

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ❑

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ❑

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not

need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. I agree not to restrict the use of any data or results that arise from this study. ❑

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms. ❑

e) I hereby give permission to undergo detailed clinical examination, radiographs, sputum and blood investigations as required ❑

Signature/thumb impression Signature of Investigator

Patient's Name and Address: Study Investigator's Name:

ஆராய்ச்சி தகவல் தாள்

ஆராய்ச்சி தலைப்பு:

ஒரு மூன்றாம் நிலை மருத்துவமனையில் ஒரு வருங்கால ஆய்வின் மூலம் முன்நீரழிவு நோயாளி, புதிதாக கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளி மற்றும் முன்பே கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளிகளுக்குமான காசநோய் மருத்துவ மற்றும் கதிர்வரைபட வேறுபாடு பற்றிய ஆய்வு

ஆராய்ச்சியாளர் பெயர் : மருத்துவர் வ. தேவநாதன்.

பங்கேற்பாளர் பெயர் :

ஆராய்ச்சியின் நோக்கம் :

தாம்பரம் நெஞ்சக நோய் மருத்துவமனைக்கும் அரசு ஸ்டான்லி மருத்துவமனை நெஞ்சக பிரிவுக்கும் வரும் முன்நீரழிவு நோயாளி, புதிதாக கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளி மற்றும் முன்பே கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளிக்கும் மேலும் நன்கு கட்டுப்பாட்டில் உள்ள நீரழிவு நோயாளி மற்றும் கட்டுப்பாடற்ற நீரழிவு நோயாளிகளுக்குமான காசநோய் மருத்துவ மற்றும் கதிர்வரைபட வேறுபாடுகளை கண்டறிதல்:

ஆய்வு முறை :

காசநோய் மற்றும் நீரழிவு நோய் உள்ள நோயாளிகளை தேர்ந்தெடுத்து அவர்களுக்கு அடிப்படை இரத்த பரிசோதனை, கதிர்வரைபட பரிசோதனை மற்றும் பிற அடிப்படை பரிசோதனைகள் செய்யப்படும். இதன் அடிப்படையில் நோயாளிகளுக்கு தக்க மருத்துவம் அளிக்கப்படும்..

நோயாளிகளின் ரகசியத்தன்மை ஆய்வின் முழுவதும் பாதுகாக்கப்படும். ஆய்வில் பங்கேற்பது நோயாளிகளின் சொந்த விருப்பத்திற்கு உட்பட்டது. ஆய்வினிடையே நோயாளிகள் தொடர்ந்து பங்கேற்க விரும்பாவிட்டால் அவர்கள் விலகிக் கொள்ளலாம். இதனால் அவர்களுக்குண்டான எவ்வித மருத்துவ மற்றும் பிற சலுகைகளும் மறுக்கப்பட மாட்டாது. ஆய்வின் மூலம் கண்டறியும் முடிவுகள் நோயாளிகளிடம் தெரிவிக்கப்படும்.

ஆராய்ச்சியாளர் கையொப்பம் பங்கேற்பாளர் கையொப்பம்

தேதி

ஆராய்ச்சி ஒப்புதல் படிவம்

ஆராய்ச்சி தலைப்பு:

ஒரு மூன்றாம் நிலை மருத்துவமனையில் ஒரு வருங்கால ஆய்வின் மூலம் முன்நீரழிவு நோயாளி, புதிதாக கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளி மற்றும் முன்பே கண்டுபிடிக்கப்பட்ட நீரழிவு நோயாளிகளுக்குமான காசநோய் மருத்துவ மற்றும் கதிர்வரைபட வேறுபாடு பற்றிய ஆய்வு

ஆய்வு நிலையம்: தாம்பரம் நெஞ்சக மருத்துவமனை மற்றும் ஸ்டான்லி மருத்துவ கல்லூரி

ஆராய்ச்சியாளர் பெயர் : மருத்துவர் வ. தேவநாதன்.

பங்கேற்பாளர் பெயர் :

பங்கேற்பாளர் எண் :

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது.

நான் இவ்வாய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்மந்தமாகவோ இதை சார்ந்த மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகி கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர்

மேற்கொள்ளும் ஆய்வில் பயப்படுத்திக்கொள்ளவும் அதை பிரசுரிக்கவும் என் முழுமனதுடன் சம்மதிக்கின்றேன்

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன்.எனக்கு கொடுக்கப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன் இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன்.

ஆராய்ச்சியாளர் கையொப்பம் பங்கேற்பாளர் கையொப்பம்

தேதி

PLAGIARISM-SCREENSHOT

URKUND

Urkund Analysis Result

Analysed Document: devanathan v md tb rd.docx (D57366409)
Submitted: 10/21/2019 1:53:00 PM
Submitted By: devrocz@gmail.com
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Dissertation-Sonia N Misquitta-Radiology-2016-17.pdf (D44659805)
Diagnostic value of serum adenosine deaminase in pulmonary tuberculosis.pdf (D57276283)
STUDY OF PLEUROPULMONARY INFECTIONS IN DIABETES MELLITUS PATIENTS_Dr_Vipin_Chaudhary_Department_of_Respiratory_Medicine.docx (D42725283)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6409081/
https://www.ncbi.nlm.nih.gov/books/NBK189854/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3938870/
https://www.researchgate.net/publication/331660400_Random_glucose_sampling_as_screening_tool_for_diabetes_among_disadvantaged_tuberculosis_patients_residing_in_urban_slums_in_India

PLAGIARISM CERTIFICATE

This is to certify that this dissertation work titled "**THE EFFECT OF GLYCEMIC CONTROL ON CLINICO-RADIOLOGICAL PRESENTATIONS OF PULMONARY TUBERCULOSIS IN DIABETES MELLITUS PATIENTS – A CROSS SECTIONAL STUDY**" of the candidate Dr. DEVANATHAN.V, with registration Number 201727052 for the award of MD in the branch of Tuberculosis & Respiratory Diseases. I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 7% of plagiarism in the dissertation.

Guide & Supervisor sign with Seal.

ABBREVIATIONS

- TB TUBERCULOSIS
- DM DIABETES MELLITUS
- MDR MULTI DRUG RESISTANT
- DR DRUG RESISTANT
- HbA1c GLYCOSYLATED HEMOGLOBIN
- HIV HUMAN IMMUNODEFICIENCY VIRUS
- UZ UPPER ZONE
- LZ LOWER ZONE
- CBNAAT CATRIDGE BASED NUCLEIC ACID AMPLIFICATION TEST
- AFB ACID FAST BACILLI
- M. TB MYCOBACTERIUM TUBERCULOSIS
- AIDS ACQUIRED IMMUNODEFICEINCY SYNDROME

MASTER CHART

Age	Sex	Cough	Breathlessness	Loss of appetite	Fever	Chest pain	Hemoptysis	Smoker	Sp.AFB	FBS	PPBS	HbA1C	L2 infiltrates	Bilateral involvement	multizonal involvement	UZ cavity	LZ cavity	multiple cavity	UZ infiltrates	Category	Control
70	M	YES	NO	YES	YES	NO	NO	YES	YES	212	309	8.8	YES	YES	YES	YES	YES	YES	YES	New diabetes	New diabetes POOR
63	F	YES	YES	YES	YES	NO	NO	NO	YES	162	208	10.2	YES	YES	YES	NO	YES	NO	YES	New diabetes	New diabetes POOR
53	F	YES	YES	YES	NO	NO	NO	NO	NO	150	212	6.9	YES	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes GOOD
52	F	YES	YES	YES	YES	NO	NO	NO	YES	120	181	5.9	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
64	M	YES	YES	YES	YES	NO	NO	YES	YES	163	210	6.8	NO	NO	NO	YES	NO	NO	YES	New diabetes	New diabetes GOOD
74	M	YES	NO	YES	YES	YES	NO	YES	YES	157	276	7.6	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
64	M	YES	YES	YES	YES	YES	NO	YES	YES	124	189	6.1	YES	YES	YES	YES	NO	YES	YES	Prediabetes	
58	M	YES	YES	YES	YES	NO	YES	NO	NO	262	384	10.2	YES	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes POOR
56	F	YES	YES	YES	YES	NO	NO	NO	YES	261	371	8.7	NO	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
37	M	YES	YES	YES	YES	NO	NO	YES	YES	255	335	8.6	NO	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
40	F	YES	YES	YES	YES	YES	NO	NO	NO	210	276	9.2	NO	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
62	F	YES	YES	YES	YES	NO	YES	NO	NO	267	370	12	YES	YES	YES	YES	YES	YES	YES	Known diabetes	Known diabetes POOR
47	M	YES	YES	NO	YES	YES	YES	NO	YES	256	472	10.9	NO	NO	NO	YES	NO	NO	NO	Known diabetes	Known diabetes POOR
65	M	YES	YES	YES	YES	NO	NO	YES	YES	150	240	6.7	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
67	M	YES	NO	YES	YES	YES	NO	YES	YES	122	228	7.8	YES	YES	YES	YES	NO	YES	YES	New diabetes	New diabetes POOR
40	M	YES	YES	NO	YES	NO	NO	YES	YES	130	200	7.3	YES	NO	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
47	M	YES	YES	YES	NO	NO	NO	YES	YES	152	311	6.8	YES	YES	YES	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD
43	M	YES	YES	YES	YES	NO	NO	YES	YES	176	233	10.1	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
66	M	YES	YES	YES	YES	NO	NO	YES	YES	170	230	6.9	YES	NO	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
65	M	YES	YES	YES	NO	NO	NO	YES	YES	156	220	6.7	YES	NO	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
60	F	YES	YES	YES	YES	NO	NO	NO	YES	199	250	6.8	NO	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
56	F	YES	YES	YES	YES	NO	NO	NO	YES	164	282	11.2	YES	YES	YES	YES	NO	NO	YES	New diabetes	New diabetes POOR
70	M	YES	YES	YES	NO	NO	NO	NO	YES	248	312	10.8	NO	NO	NO	NO	NO	NO	YES	New diabetes	New diabetes POOR
44	F	YES	YES	YES	YES	NO	NO	NO	YES	110	178	6	YES	NO	NO	NO	YES	NO	NO	Prediabetes	
65	F	YES	YES	YES	YES	YES	NO	NO	YES	226	285	9.5	NO	NO	NO	YES	NO	NO	YES	Known diabetes	Known diabetes POOR
55	F	YES	NO	NO	YES	NO	NO	NO	YES	280	344	7.5	YES	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
66	M	YES	YES	YES	YES	NO	NO	NO	YES	127	232	6.6	NO	NO	NO	YES	NO	YES	YES	New diabetes	New diabetes GOOD
64	F	YES	YES	YES	YES	NO	YES	NO	YES	206	326	6.8	NO	NO	NO	NO	NO	NO	YES	Known diabetes	Known diabetes GOOD
61	M	YES	NO	YES	YES	NO	NO	YES	YES	116	178	6.4	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
52	F	YES	NO	YES	YES	NO	NO	NO	YES	102	142	5.7	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
60	M	YES	NO	NO	NO	NO	NO	YES	YES	122	182	6	NO	YES	YES	NO	NO	NO	YES	Prediabetes	
54	M	YES	NO	YES	YES	NO	NO	NO	YES	120	175	6.3	YES	NO	NO	NO	NO	NO	YES	Prediabetes	
45	F	YES	YES	YES	YES	NO	NO	NO	YES	123	190	6.2	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
62	M	YES	YES	YES	YES	NO	YES	YES	NO	245	374	11.7	NO	NO	YES	YES	NO	YES	NO	New diabetes	New diabetes POOR
42	M	YES	NO	YES	YES	NO	NO	YES	NO	242	437	9.6	NO	NO	NO	YES	NO	YES	NO	Known diabetes	Known diabetes POOR
65	F	YES	NO	YES	YES	NO	NO	NO	YES	230	340	7.3	YES	YES	YES	YES	NO	NO	NO	Known diabetes	Known diabetes POOR
60	F	YES	YES	YES	NO	NO	NO	NO	YES	103	160	6.2	YES	YES	YES	YES	NO	NO	YES	Prediabetes	
65	F	YES	YES	YES	YES	NO	YES	NO	NO	216	372	6.9	NO	NO	YES	YES	NO	NO	NO	Known diabetes	Known diabetes GOOD
62	F	YES	YES	YES	YES	NO	NO	NO	NO	192	360	6.7	NO	NO	NO	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
47	M	YES	NO	YES	YES	NO	NO	YES	YES	179	316	6.6	NO	NO	NO	YES	NO	NO	NO	New diabetes	New diabetes GOOD
46	F	YES	YES	YES	YES	NO	NO	NO	YES	156	240	6.8	YES	YES	YES	NO	YES	NO	NO	New diabetes	New diabetes GOOD
36	M	YES	YES	YES	YES	NO	NO	NO	NO	164	308	6.9	NO	NO	YES	YES	NO	YES	YES	New diabetes	New diabetes GOOD
40	M	YES	YES	YES	YES	NO	YES	NO	NO	186	234	6.6	YES	NO	YES	YES	NO	YES	YES	New diabetes	New diabetes GOOD
45	M	YES	YES	YES	YES	YES	NO	NO	YES	285	483	7.7	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
43	F	YES	YES	YES	YES	NO	NO	NO	YES	112	197	5.9	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
53	M	YES	YES	YES	NO	NO	NO	NO	YES	105	160	5.7	NO	NO	NO	YES	NO	YES	YES	Prediabetes	
63	M	YES	YES	YES	YES	YES	NO	YES	YES	175	300	6.9	NO	NO	NO	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD
39	M	YES	YES	YES	NO	YES	YES	YES	NO	226	320	6.6	NO	NO	YES	YES	NO	YES	YES	Known diabetes	Known diabetes GOOD
63	M	YES	YES	YES	YES	YES	NO	YES	YES	194	289	10.2	YES	NO	NO	NO	YES	NO	NO	Known diabetes	Known diabetes POOR
65	M	YES	YES	NO	NO	NO	YES	YES	YES	280	450	10.8	YES	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
54	M	YES	YES	NO	YES	NO	NO	YES	YES	137	269	11.7	YES	NO	NO	YES	NO	NO	NO	Known diabetes	Known diabetes POOR
52	F	YES	YES	YES	YES	NO	NO	NO	NO	200	310	6.7	NO	NO	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
45	M	YES	YES	YES	NO	NO	NO	YES	YES	267	428	11.2	NO	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
52	F	YES	NO	YES	YES	NO	NO	YES	YES	147	280	8.5	NO	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
63	M	YES	YES	YES	NO	YES	NO	NO	YES	171	240	9.2	YES	NO	YES	NO	YES	NO	NO	New diabetes	New diabetes POOR
50	M	YES	YES	YES	YES	NO	NO	YES	YES	104	189	6.3	NO	YES	YES	YES	NO	YES	YES	Prediabetes	
65	F	YES	NO	YES	YES	NO	YES	NO	NO	216	310	6.8	NO	NO	NO	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
40	M	YES	YES	YES	YES	YES	NO	YES	YES	137	236	6.8	YES	NO	NO	NO	NO	NO	NO	New diabetes	New diabetes GOOD
47	M	YES	YES	YES	YES	YES	YES	YES	YES	133	279	6.6	YES	YES	YES	YES	NO	NO	YES	New diabetes	New diabetes GOOD
53	F	YES	YES	YES	YES	NO	NO	NO	YES	102	187	6.7	NO	NO	NO	YES	NO	YES	YES	New diabetes	New diabetes GOOD
42	M	YES	YES	YES	YES	NO	YES	NO	NO	136	228	6.6	NO	NO	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
60	M	YES	YES	YES	YES	NO	NO	YES	YES	315	477	9.9	NO	NO	YES	YES	NO	NO	YES	Known diabetes	Known diabetes POOR
47	M	YES	NO	YES	NO	NO	YES	YES	NO	203	309	6.7	NO	NO	NO	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
60	M	YES	YES	YES	YES	YES	YES	YES	YES	201	394	7.4	YES	NO	YES	YES	NO	NO	YES	New diabetes	New diabetes POOR
68	M	YES	NO	YES	YES	NO	NO	NO	NO	146	209	6.6	YES	NO	YES	YES	NO	YES	YES	Known diabetes	Known diabetes GOOD
49	M	YES	NO	YES	YES	NO	NO	YES	YES	152	346	7.4	NO	YES	YES	YES	NO	YES	NO	New diabetes	New diabetes POOR
48	M	YES	YES	YES	YES	NO	NO	YES	YES	210	302	8.1	NO	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
36	M	YES	NO	YES	YES	YES	NO	YES	YES	122	196	7.6	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
63	M	YES	YES	YES	YES	NO	NO	YES	NO	155	276	8.7	YES	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
40	M	YES	YES	YES	YES	NO	YES	NO	NO	107	171	5.9	NO	YES	YES	NO	NO	NO	YES	Prediabetes	
32	F	YES	NO	YES	YES	NO	NO	NO	NO	264	380	6.8	YES	NO	NO	NO	YES	NO	YES	Known diabetes	Known diabetes GOOD
55	M	YES	YES	YES	YES	YES	YES	YES	NO	210	286	7.7	YES	NO	YES	YES	NO	NO	NO	New diabetes	New diabetes POOR
60	M	YES	NO	NO	NO	NO	NO	YES	NO	316	488	11.4	NO	NO	YES	YES	NO	NO	YES	Known diabetes	Known diabetes POOR
38	M	YES	NO	YES	YES	YES	NO	NO	NO	210	282	6.8	NO	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
50	F	YES	YES	NO	YES	NO	YES	NO	NO	220	360	7.5	NO	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
40	M	YES	YES	YES	YES	NO	NO	YES	YES	122	176	5.6	NO	YES	YES	YES	NO	YES	YES	Prediabetes	

24	M	YES	YES	YES	YES	YES	NO	NO	YES	320	460	13.2	NO	NO	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
31	M	YES	YES	YES	NO	NO	NO	NO	YES	184	260	9.2	YES	NO	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
47	M	YES	NO	YES	YES	YES	YES	YES	YES	168	223	6.9	NO	NO	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
35	M	YES	NO	NO	NO	NO	NO	NO	YES	212	280	10.3	YES	NO	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
55	M	YES	YES	YES	YES	NO	NO	NO	YES	149	320	8.5	YES	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
52	M	YES	YES	NO	YES	YES	NO	NO	NO	108	163	6.1	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
40	M	YES	NO	YES	YES	NO	NO	YES	YES	109	192	6.3	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
39	F	YES	YES	YES	YES	YES	NO	NO	NO	214	357	10.1	YES	NO	YES	NO	NO	NO	NO	Known diabetes	Known diabetes POOR
45	M	YES	YES	YES	YES	YES	NO	YES	NO	106	190	6.1	YES	NO	YES	YES	NO	NO	YES	Prediabetes	
57	M	YES	YES	NO	YES	NO	NO	YES	YES	120	184	6.2	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
48	M	YES	YES	YES	YES	NO	NO	YES	NO	124	197	6.4	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
60	F	YES	NO	YES	YES	YES	NO	NO	NO	127	200	6.8	NO	NO	YES	YES	NO	NO	YES	New diabetes	New diabetes GOOD
54	M	YES	YES	YES	YES	YES	NO	NO	NO	170	284	8.5	YES	YES	YES	YES	NO	YES	YES	New diabetes	New diabetes POOR
47	M	YES	YES	NO	NO	NO	NO	NO	YES	339	472	14.5	NO	YES	YES	NO	NO	NO	YES	Known diabetes	Known diabetes POOR
55	M	YES	YES	YES	YES	YES	YES	NO	NO	280	392	12.1	YES	NO	YES	YES	YES	YES	NO	New diabetes	New diabetes POOR
48	M	YES	YES	YES	YES	NO	NO	YES	YES	108	179	6.1	NO	NO	NO	NO	NO	YES	YES	Prediabetes	
47	M	YES	NO	YES	YES	YES	YES	NO	YES	168	323	11.4	NO	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes POOR
32	M	YES	NO	NO	NO	NO	NO	NO	NO	188	260	6.7	NO	NO	YES	YES	NO	NO	YES	New diabetes	New diabetes GOOD
60	F	YES	NO	YES	YES	NO	NO	NO	YES	146	216	6.8	YES	NO	NO	NO	NO	NO	NO	New diabetes	New diabetes GOOD
55	M	YES	NO	NO	NO	NO	NO	YES	NO	246	380	11.6	NO	YES	YES	YES	NO	NO	YES	New diabetes	New diabetes POOR
62	M	YES	NO	YES	YES	NO	YES	NO	YES	196	250	7.9	YES	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
34	F	YES	NO	YES	YES	NO	YES	NO	YES	256	340	10.6	YES	YES	YES	NO	YES	NO	NO	Known diabetes	Known diabetes POOR
59	M	YES	NO	YES	NO	NO	NO	YES	YES	201	399	11.7	NO	NO	YES	YES	NO	NO	YES	New diabetes	New diabetes POOR
68	M	YES	YES	YES	YES	NO	YES	YES	YES	390	460	9.6	YES	YES	YES	NO	NO	NO	NO	Known diabetes	Known diabetes POOR
45	F	YES	YES	YES	YES	NO	NO	NO	YES	150	266	8.3	YES	NO	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
65	M	YES	YES	YES	NO	NO	NO	YES	YES	200	310	9.7	NO	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes POOR
48	M	YES	YES	YES	YES	NO	NO	YES	YES	180	284	6.7	NO	NO	NO	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
44	M	NO	NO	YES	NO	NO	NO	YES	YES	121	190	6.1	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
47	M	NO	NO	YES	YES	NO	NO	YES	NO	210	315	6.9	NO	NO	YES	YES	NO	YES	YES	Known diabetes	Known diabetes GOOD
31	M	NO	YES	YES	NO	NO	NO	NO	NO	112	192	6.1	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
68	M	YES	YES	YES	NO	NO	YES	YES	YES	320	473	11.2	YES	YES	YES	YES	NO	YES	NO	Known diabetes	Known diabetes POOR
60	F	YES	YES	YES	NO	YES	NO	NO	YES	211	332	8.5	YES	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes POOR
63	F	NO	YES	YES	YES	NO	YES	NO	YES	187	386	8.8	YES	YES	YES	NO	NO	NO	NO	Known diabetes	Known diabetes POOR
49	M	NO	NO	YES	YES	NO	NO	YES	YES	118	176	6.3	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
56	F	YES	NO	YES	YES	NO	NO	NO	YES	124	194	6.2	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
61	M	YES	YES	YES	YES	YES	YES	NO	YES	216	292	6.8	YES	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
56	M	YES	YES	NO	YES	NO	NO	YES	YES	117	165	6	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
44	M	NO	NO	YES	YES	NO	YES	NO	NO	222	304	6.7	YES	YES	YES	YES	NO	YES	YES	New diabetes	New diabetes GOOD
68	M	YES	NO	YES	YES	NO	NO	YES	NO	123	172	5.8	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
47	M	YES	NO	YES	NO	YES	NO	YES	NO	115	159	5.9	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
55	M	YES	YES	YES	YES	YES	YES	YES	YES	170	264	8.2	YES	YES	YES	YES	NO	YES	YES	New diabetes	New diabetes POOR
44	F	YES	NO	YES	YES	NO	NO	NO	YES	118	186	6.1	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
49	M	YES	YES	YES	YES	NO	YES	YES	YES	231	308	9.1	YES	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
39	M	YES	YES	NO	YES	NO	YES	NO	YES	236	420	10.4	YES	YES	YES	YES	YES	YES	YES	Known diabetes	Known diabetes POOR
56	M	YES	NO	NO	NO	YES	NO	NO	YES	160	274	6.8	YES	YES	YES	NO	NO	NO	YES	New diabetes	New diabetes GOOD
42	F	YES	NO	YES	YES	NO	NO	NO	YES	184	259	6.6	YES	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
52	M	YES	NO	NO	YES	NO	NO	YES	YES	125	198	6.3	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
44	M	YES	YES	YES	YES	NO	YES	YES	YES	211	307	9.7	YES	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
51	F	YES	NO	NO	YES	NO	NO	NO	YES	121	158	5.7	NO	NO	YES	YES	NO	NO	YES	Prediabetes	
47	M	YES	NO	NO	YES	NO	NO	YES	YES	108	165	5.9	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
49	M	YES	YES	YES	YES	YES	NO	YES	YES	240	373	10.1	YES	YES	YES	YES	YES	YES	YES	New diabetes	New diabetes POOR
52	M	NO	NO	YES	YES	YES	NO	NO	YES	104	163	5.7	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
66	M	YES	YES	YES	YES	NO	NO	NO	YES	224	356	10.6	YES	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
46	M	YES	NO	YES	NO	NO	NO	YES	YES	198	249	6.8	YES	YES	YES	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD
62	M	YES	YES	YES	YES	YES	NO	YES	YES	196	336	10.8	YES	YES	YES	YES	YES	YES	YES	New diabetes	New diabetes POOR
52	F	YES	YES	NO	NO	NO	NO	NO	YES	175	302	6.9	YES	YES	YES	YES	NO	NO	YES	New diabetes	New diabetes GOOD
47	M	YES	YES	YES	YES	YES	NO	YES	YES	212	382	11.2	YES	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
73	F	NO	YES	YES	YES	NO	NO	NO	NO	114	173	6	NO	NO	YES	NO	NO	NO	YES	Prediabetes	
43	M	YES	NO	NO	NO	NO	NO	NO	YES	123	187	6.2	NO	NO	NO	YES	NO	NO	YES	Prediabetes	
70	M	YES	NO	YES	NO	YES	NO	YES	YES	176	343	6.8	YES	NO	NO	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD
57	M	YES	NO	YES	YES	NO	YES	YES	YES	139	289	10.7	YES	YES	YES	YES	NO	YES	YES	New diabetes	New diabetes POOR
51	M	YES	NO	NO	YES	NO	NO	YES	YES	108	158	6.1	NO	YES	YES	YES	NO	NO	YES	Prediabetes	
49	M	YES	YES	NO	YES	NO	NO	YES	YES	172	246	6.9	YES	NO	NO	NO	YES	NO	NO	Known diabetes	Known diabetes GOOD
47	M	YES	NO	NO	YES	YES	YES	NO	YES	102	148	5.7	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
53	M	YES	YES	YES	YES	YES	YES	YES	YES	262	474	12.4	YES	YES	YES	YES	YES	YES	YES	Known diabetes	Known diabetes POOR
68	F	YES	NO	NO	YES	NO	NO	NO	YES	160	256	6.7	NO	YES	YES	YES	NO	NO	YES	Known diabetes	Known diabetes GOOD
44	F	YES	YES	NO	YES	YES	YES	NO	YES	150	218	6.6	YES	NO	NO	NO	NO	NO	NO	New diabetes	New diabetes GOOD
47	M	YES	NO	NO	YES	YES	YES	YES	YES	175	246	6.6	YES	YES	YES	NO	NO	NO	NO	New diabetes	New diabetes GOOD
41	F	YES	YES	YES	NO	NO	NO	NO	YES	113	177	5.9	NO	NO	NO	NO	NO	NO	YES	Prediabetes	
49	F	YES	YES	YES	NO	NO	YES	NO	YES	218	351	10.7	YES	YES	YES	YES	NO	YES	YES	Known diabetes	Known diabetes POOR
56	M	YES	YES	YES	YES	NO	NO	YES	YES	136	209	6.6	YES	NO	NO	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD
48	M	YES	YES	NO	YES	YES	YES	YES	YES	195	270	8.9	YES	YES	YES	YES	YES	YES	YES	New diabetes	New diabetes POOR
38	M	YES	NO	NO	YES	NO	NO	YES	YES	116	184	5.9	YES	NO	NO	NO	NO	NO	NO	Prediabetes	
52	M	YES	NO	NO	NO	YES	NO	YES	YES	168	277	6.8	YES	NO	NO	NO	NO	NO	NO	Known diabetes	Known diabetes GOOD