THE ASSOCIATION OF BODY MASS INDEX (BMI) WITH CLINICAL OUTCOMES IN PATIENTS WITH PULMONARY TUBERCULOSIS

By :

DR DZAWANI BINTI MUHAMAD

DISSERTATION SUBMITTED IN PARTIAL FULLFILLMENT FOR THE DEGREE OF MASTER OF MEDICINE (INTERNAL MEDICINE)

UNIVERSITI SAINS MALAYSIA

NOVEMBER 2011

1. INTRODUCTION AND LITERATURE REVIEW

1.1 Overview of Tuberculosis

Tuberculosis (TB) is a global pandemic issue and the incidence is rising. It is accounted for the top ten leading cause of death especially in the middle income countries. Globally, according to World Health Organization (WHO), there were an estimated 9.4 million new cases of TB in 2008 with 140 new cases per 100 000 population. Although the total number of new cases of TB is increasing, the number of cases per capita is falling as a result of global population growth. However, the rate of decline is very slow, at less than 1% per year.

In many industrialized countries with good treatment facilities and a secured supply of drugs free of charge for patients, treatment results have not reached the targets set by WHO (Vasankari *et al.*, 2007). The main reason for this is the high rate of death as an unfavourable outcome, frequently with much co-morbidity from other diseases.

Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome (HIV/AIDS) is responsible for most increase cases of active TB. In the era of Highly Active Anti-Retroviral Therapy (HAART), TB remains the most common opportunistic infection and a major cause of death among HIV infected individuals especially in Sub-Saharan Africa and Asian countries (Badri *et al.*, 2001, Narain and Lo, 2004). The incidence of active TB is more than eight times higher in HIV- positive then HIV-negative (WHO., 2006b).

Mycobacterium tuberculosis is spread to the public through airborne droplets from active person via coughing, sneezing, singing or talking. These infectious particles are very small and can remain airborne for minutes to hours (Frieden TR *et al.*, 2003). TB infection occurs when the droplets entered the lungs. The bacterium is then taken up by the

macrophages, a type of white blood cells and then the inflammatory response will be activated. This response will result in either containment of the infection or development of active disease (Frieden TR *et al.*, 2003). A healthy immune system is very effective in containing TB, but is not able to eradicate it, so that the TB bacilli will remain in the macrophages (Chandra *et al.*, 2004).

In healthy individual who are exposed to the TB, cell mediated immune response will react involving T-cells, macrophages and cytokines (Chandra *et al.*, 2004). The infection usually controlled unless the immune function is weakened (Frieden TR *et al.*, 2003, Wilkinson *et al.*, 2000, Karyadi E *et al.*, 2000, Karyadi *et al.*, 2002).

1.1.1 Risk factors

There are several factors that can increase the risk for developing active TB. It can be divided into environmental and clinical disease with immune-compromised related. The common risk factors that contribute to the development of active TB are diabetes mellitus, chronic renal failure and also on haemodialysis (Jeon and Murray, 2008),(Segall and Covic, 2010).

Other clinical conditions that have been associated with active TB include gastrectomy with marked weight loss and malabsorption, jejuno-ileal bypass, renal and cardiac transplantation and malignancy (e.g., lung cancer, lymphoma and leukemia) (Cohn *et al.*, 2000).

Low body weight is another most important risk factor for tuberculosis. A body mass index (BMI) below 18.5 increases the risk by 2-3 times as compared to normal BMI. An increase in the body weight lowers the risk for developing TB (Leung *et al.*, 2007).

About 90% of those infected with Mycobacterium tuberculosis have asymptomatic. However, if untreated, the death rate for active TB cases is more than 50%.

Symptoms include chest pain, coughing up blood, and a productive, prolonged cough for more than three weeks. Systemic symptoms include fever, chills, night sweats, appetite loss, weight loss, pallor, and fatigue (Frieden TR *et al.*, 2003).

1.1.2 Diagnosis

Bacteriology remains the recommended method for diagnosing active TB, first through sputum smear microscopy then mycobacterium culture and sensitivity (WHO., 2007, WHO., 2006b). However, TB culture will not immediately available (WHO., 2007, Frieden TR *et al.*, 2003). In countries where the culture is not routinely available, sputum smear will be the primary diagnostic tool. However, relying on sputum smears to diagnose TB has its own limitations especially among HIV- positive individuals who are generally less likely to have positive smear results, particularly in the advance stage (Harries *et al.*, 1998).

Tuberculin skin test is one of the screening methods for TB. A positive tuberculin test indicates that the body has developed cell-mediated immunity against TB (Frieden TR *et al.*, 2003). Progression to the active TB can be caused by a recent infection, activation of latent TB, or a relapse of earlier treatment (Dye., 2006, C., 2006, WHO., 2006b).

The newer interferon release assays (IGRAs) such as T-SPOT.TB and QuantiFERON-TB Gold In Tube overcome many of these problems. IGRAs are in vitro blood tests that are more specific than the skin test. IGRAs detect the release of interferon-gamma in response to mycobacterial proteins such as ESAT-6 (Nahid *et al.*, 2006). These are not affected by immunization or environmental mycobacterium, so generate fewer false positive result (Pai *et al.*, 2008). There is also evidence that IGRAs are more sensitive than the skin test (Pai *et al.*, 2004).

New TB tests have been developed that are fast and accurate. These include polymerase chain reaction assays for the detection of bacterial DNA (Reddy *et al.,* 2002). The result will be available as fast as 100 minutes.

Another such test, which was approved by the FDA in 1996, is the amplified mycobacterium tuberculosis direct test (MTD, Gen-Probe). This test yields results in 2.5 to 3.5 hours, and it is highly sensitive and specific when used to test smears positive for acid-fast bacilli (AFB) (Guerra *et al.*, 2007).

1.1.3 Treatment

The goals of TB treatment include:

- Cure of active TB disease without recurrence
- Prevention of transmission
- Prevention of drug resistance
- Improved survival

Standardized short course chemotherapy is used for 6-8 months in confirmed smear positive cases (WHO., 2007). Combinations of drugs therapy with good adherence are necessary to achieve a cure.

The treatment will be divided into two phases. The intensive phase of treatment takes around 2-3 months depending on the response. At least three or preferably four daily antibacterial drugs regime will use including isoniazide and rifampicin. The maintenance phase usually uses two drugs daily or three times a week and lasts 4-6 months (Frieden TR *et al.*, 2003).

Directly observed treatment, short course (DOTS) is an important approach to promote

adherence to the treatment (WHO., 2006b). This approach was proved in improving completion of anti-TB therapy, reducing multidrug resistant and preventing disease relapse. This strategy was further enhanced in The Global Plan to Stop TB. This plan also highlighted the issues of TB/HIV co-infection and multidrug resistance, strengthening health systems, engaging all providers, empowering individuals with TB and their communities and promoting research (WHO., 2006a).

1.2 Overview of Body Mass Index and Nutrition Screening Tools

Various nutrition screening methods, including subjective global assessment, prognostic nutrition index, prognostic inflammatory and nutritional index and nutritional risk index require questionnaires or complex scoring system, or are not routinely checked in general clinical settings. Moreover, these methods are not used in TB patients for predicting disease outcomes. While nutritional predictors of poor prognosis in TB patients have been reported in some studies, the parameters are variable and show inconsistent results, depending on specific studies and patients (Mehta *et al.*, 1996, Sharma *et al.*, 2006, Zachariah *et al.*, 2002)

Anthropometry is one of the most basic tools for assessing nutritional status, whether over nutrition or undernutrition (Mei *et al.*, 2002). A variety of methods are available to measure body fatness or thinness however the used was limited due to its complexity and cost. The most frequently used tools in public health evaluation and clinical screening are anthropometric- based measurement screening such as skinfold-thickness or circumference measurements and Body Mass Index (BMI).

Body Mass Index (BMI) is defined as the weight in kilograms divided by the square of the height in meters. It is a simple and useful index of relative weight that can be used to assess obesity or nutritional deficiency (Bailey and Ferro-Luzzi, 1995).

The association between BMI and mortality has been extensively reported. The relationship between Body mass Index is U shaped. Both low and high BMI are associated with increased risk of mortality and morbidity in adults (Diehr *et al.*, 2008).

In Malaysia, there were few studies conducted to evaluate the prevalence of BMI among the populations group. The earlier study reported that among adults population in Malaysia, 60-64% were normal weight, 11-20 % was underweight and 29-30% was obese (Ismail *et al.*, 1995). R Visvanathan *et.al* reported that approximately 14 % of elderly residents had BMI < 18.5 kg/m² (Visvanathan *et al.*, 2004). One study conducted among university student showed that the prevalence of BMI among the groups were normal weight 61%, underweight 27 % and overweight was 12% (Huda and Ahmad).

From this report, we can evaluate that the prevalence of underweight and obesity is variable among the elderly, adults and teenagers group. With the strong relationship between BMI and morbidity, information of BMI can be used as part of evaluation of the health burden in our population.

1.3 Overview of Nutrition and Tuberculosis

Tuberculosis has a dramatic effect on nutritional state and this has been born out in all the studies that investigated the association of body composition in affected patients. It has been found that malnourished tuberculosis patients have delayed recovery and higher mortality rates than well-nourished patients (Gupta *et al.*, 2009). Such malnutrition undoubtedly contributes to the mortality and morbidity particularly in resource poor settings. Considering the bi-directional relationship, the effect of primary malnutrition on tuberculosis

can increase frequency of occurrence and exacerbation of clinical manifestation, both at the population and clinical level. Even though the pathophysiology is still not clear, however, in addition to good anti-tuberculous therapy, such patients need a nutritional support during the treatment or recovery phase. In the developing countries, this may include medical measure to achieve nutritional support whereas in resource poor settings, nutritional intake may have more to do with equitable resource distribution and community involvement in health care (Macallan, 1999).

1.2.1 Malnutrition and immunity

Nutritional status is one of the most important determinants of treatment outcomes. It is well established that nutritional deficiency is associated with impaired immune function (Perronne, 1999). Malnutrition will cause weakening of the immune function by reducing cell mediated immunity and therefore increase susceptibility to infection (Chandra, 1991).

Malnutrition is defined as a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects on tissue/ body form (body shape, size and composition) and function and clinical outcome (Hickman and Tapsell, 2009)

General malnutrition manifests itself as low weight for height (thinness) and this condition is often co-exist with micronutrient deficiency which often referred to as protein energy malnutrition or simply as clinical malnutrition. Generalized malnutrition can cause significant impairment involving immune protection's mechanism including cell-mediated immunity, phagocytic function, antibody concentration and cytokine production.

1.2.2 Malnutrition and Tuberculosis

The association between TB and malnutrition has long been known. TB makes malnutrition worse and malnutrition weakens immunity, thereby increasing the likelihood that latent TB will develop into active disease (Van Lettow *et al.*, 2004). Unfortunately, few studies have been designed to examine the relationship between nutrition and the incidence of TB or its severity. It is very difficult to determine accurately what the nutritional status of individuals with active TB was before the onset of the disease, making it impossible to determine whether malnutrition led to advancement of the disease or in reverse theory (Cegielski and McMurray, 2004).

1.2.3 Body Mass Index (BMI) and Tuberculosis (TB)

Several studies showed that patients with active TB are more likely to have low body mass index (BMI=wt(kg)/ht(m^2)) compared to healthy individuals (Van Lettow *et al.*, 2004, Harries *et al.*, 1988, Paton *et al.*, 2004). World Health Organization (WHO) has classified nutritional status based on BMI as shown (table 1).

During active TB, catabolic processes that cause wasting usually begin before the patient is diagnosed; therefore more is known about nutritional status at the time of diagnosis than of the wasting process *per se* (Macallan, 1999). As with HIV infection, at the time of diagnosis the metabolic rate or resting energy expenditure is increased, resulting in increased energy needs to meet the basic demands for body function. At the same time, energy intakes are likely to decline as a result of illness-associated anorexia (Macallan *et al.*, 1998). This combination of conditions results in weight loss with eventual wasting if energy intakes are not increased or energy expenditure decreased. Utilization of amino acids and protein synthesis may be inhibited due to the presence of pro-inflammatory cytokines.

Several nutritional parameters are worse among newly diagnosed TB patients compared to healthy controls:

1) In a study of patients with active TB in the United Kingdom, BMI, muscle mass and subcutaneous fat stores were 13%, 13%, and 20% lower, respectively, in those with TB compared with healthy age, sex and ethnic matched controls (Onwubalili, 1988).

2) Similarly, in a study conducted in Malawi, these same parameters were 20% (BMI), 35% (muscle mass) and 19% (subcutaneous fat) less in subjects with active TB with a larger decrease in muscle mass than among the United Kingdom patients (Harries *et al.*, 1988)

3) In Indonesia, the mean BMI of patients with active TB recently admitted for treatment was 20% lower than in controls (BMI of 18.5 ± 3.2 vs. 21.9 ± 2.8 in male, 17.8 ± 3.1 vs. 21.9 ± 3.5 in female patients vs. controls respectively, $p<0.01$). 66% of patients had a BMI <18.5 (6 times more frequent than in controls). In addition, weight, skin-fold thickness, mid-upper arm circumference (MUAC), fat mass, and fat free mass were all significantly lower in those with active TB (Karyadi E *et al.*, 2000).

4) In an Ethiopian study of 155 patients with active TB (81 HIV-negative and 74 TB/HIV co-infected) and 31 controls, BMI < 18.5 was common (65.4% of TB patients, 71.6% of TB/HIV co-infected), and severe malnutrition (BMI< 16) was more common in those co-infected (Kassu *et al.*, 2005).

5) Wasting is associated with increased mortality in those with active TB. In a study of 1,181 newly diagnosed TB patients in rural Malawi, 57% were underweight (BMI<18.5), including 21% with BMI < 16.0. A BMI <17.0, indicating moderate to severe malnutrition, was associated with a two-fold increased risk of early death (Zachariah *et al.*, 2002). Advanced lung disease was associated with low BMI and fat mass in another Malawian study (Van Lettow *et al.*, 2004).

Classification	BMI (kg/m²) Principal cut-off points
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00-16.99
Mild thinness	17.00-18.49
Normal range	18.50-24.99
Overweight	≥25.00
Obese	≥30.00

Table1 International classification of adult underweight,overweight, and obesity according to BMI

Source: Adapted from WHO, 2004

1.2.4 Nutritional status and adverse drug reactions

The most effective anti-tuberculosis therapy is a combination of isoniazid, rifampicin and pyrazinamide for 8 weeks, followed by isoniazide and rifampicin for a further 4-7 months (Bass Jr *et al.*, 1994). Despite the development of this powerful regime, the treatment of tuberculosis continues to be a problem in patients who do not tolerate the drugs (Schaberg *et al.*, 1996). This regime is associated with significant adverse drug reactions (ADRs). An adverse drug reactions is any undesirable effect of a drug beyond its anticipated therapeutic effects occurring during clinical use (Asscher *et al.*, 1995). Common ADRs reported from previous trial include skin rash and prutritus, hepatitis, nausea/ vomiting, thrombocytopenia, influenza- like illness, athralgia and neuropsychiatric symptoms (Forget and Menzies, 2006).

Predicting the risk factors for adverse drug reactions to first-line TB therapy can assist in identifying patient who required proper monitoring to prevent potential morbidity, hospitalization and mortality. Previous studies shown that female sex, age> 60 years, Asian birth, low body mass index/ malnutrition and Human Immunodeficiency Virus (HIV) infection have been suggested to be associated with an increased incidence of ADRs to first-line TB medications (Yee *et al.*, 2003). Malnutrition will result in decreased drug clearance so that increased the plasma level and subsequently increased the risk of ADRs. (Walter-Sack and Klotz, 1996).

1.2.5 Nutritional treatment of tuberculosis

Nutritional supplementation may help to improve outcome in tuberculosis patients. A study found that nutritional counseling to increase energy intake combined with provision of supplements, when started during the initial phase of tuberculosis treatment produced a significant increase in body weight, total lean mass and physical function after 6 weeks. In the same study, patients in the nutritional supplementation group continued to show a greater increase in body weight than control subjects during later follow-up (Paton *et al.*, 2004).

Vitamins and mineral can play important role in treatment of tuberculosis. One trial showed that vitamins C and E were effective in improving immune responses to tuberculosis when given as adjuvant to multidrug tuberculosis therapy (Safaryan *et al.*, 1990). The supplementation with vitamin A and zinc improved the effectiveness of the anti-tuberculosis drugs in the first two months. The improved outcome was indicated by the higher number of patients with sputum negative for bacilli and significantly lower mean lesion area in the lungs (Karyadi *et al.*, 2002).

Nutritional supplementation may represent a novel approach for fast recovery in tuberculosis patients. In addition, raising nutritional status of population may prove to be an effective measure to control tuberculosis in underdeveloped areas of world.

2 PURPOSE OF THE STUDY

Tuberculosis is pandemic globally and the incidence is rising. According to WHO 2010/2011 TB Global Facts Update, about 1.7 million people died from TB in 2009 and TB among the three greatest causes of death among women 15 to 44 years old. Based on the data, Malaysia is one of the high burden country of tuberculosis. Predicting clinical outcomes among TB patients receiving anti-TB treatment under Directly Observed Treatment, Short course (DOTS) strategy helps in recognizing cases that are more likely to fall in the treatment failure group.

In Malaysia, a routine procedure used for diagnosing new PTB cases is sputum smear microscopy. The approach in which every suspected TB case should submit 3 sputum specimens for smear microscopy examination. Persistent smear positive at the end of 2nd month has been cited as one of the predictor for treatment failure (Jeremiah, 2009).

The adverse effects of anti-tuberculosis is a potentially serious issues of the currently antituberculosis antituberculosis chemotherapeutic regimens. The new regimen is divided into 2 months of intensive phase and 4 months of continuation phase. In this regimen drugs are given to patients in a fix dose combination (FDC) of 4 drugs (streptomysin,rifampicin, isoniazid, pyrazinamide or ethambutol) during the 2 months of intensive phase and 2 drugs in aFDC (rifampicin, isoniazid) during the 4 month of continuation phase . In general, anti-TB drugs are effective and most TB patients are cured. However, it is a challenge that some patients will develop anti-tuberculosis drug induced reactions after starting the regimes. Various studies in different settings worldwide have tried to identify factors that may be associated with adverse drug reactions with anti-tuberculosis, however the underlying mechanisms and the factors predisposing to its development are not clearly understood.

Beside the increase cases of HIV positive patients among PTB cases, other risk factors that were observed for developmenting of active tuberculosis are immunosuppress people such as Diabetis Mellitus, chronic kidney failure and low BMI. In general, low BMI has a strong relationship with risk of tuberculosis and high BMI has been shown to be protective against tuberculosis (TB) among HIV negative individuals, as well as against disease progression and mortality among those with HIV.

Since the association between low BMI and development TB is well recognised (Tverdal, 1986, Leung *et al.*, 2007, Maro *et al.*, 2010), this study may have identified the use of BMI to predicts clinical outcomes of PTB, so that this relatively simple measurement can be used for clinical benefit especially in resource limited setting. With this objective in mind, the present study was aimed at clarifying the association of the BMI with the clinical outcomes of PTB patients and subsequently help in improving the treatment outcomes among PTB patients.

3 OBJECTIVES

3.1 General Objective

To determine the association of Body Mass Index (BMI) and clinical outcomes among PTB patients in Hospital Universiti Sains Malaysia (HUSM).

3.2 Specific Objectives

3.2.1 To examine the association between baseline BMI and sputum conversion at the end of 2 months after initiation of anti-tuberculosis treatment in smear positive sputum patients.

3.2.2 To examine the association between baseline BMI and weight gain after 2 months of initiation of anti-tuberculosis treatment.

3.2.3 To examine the association of baseline BMI and adverse drug reactions in PTB patients during intensive phase of anti-tuberculosis treatment.

4 METHODOLOGY

4.1 Study Population

The study was conducted in Hospital Universiti Sains Malaysia (HUSM), Kubang Kerian, Kelantan from May 2010 to May 2011. The source population for this study will be all the cases who were notified as pulmonary TB in HUSM and at least 6 months on anti tuberculosis therapy.

4.2 Inclusion and Exclusion Criteria

Inclusion criteria :

- Pulmonary Tuberculosis patients recruited at the Respiratory Clinic, Hospital Universiti Sains Malaysia (HUSM)
- Age 15 to 65 years old.

Exclusion criteria :

- Patients with extrapulmonary TB alone.
-Human Immunodeficiency Virus patients
- Pregnant women
- Terminal illnesses (from tuberculosis and any other severe diseases which unlikely to survive within 48 hours).
- Not willing to participate.

4.3 Estimated Sample Size

Sample size was calculated using PS- Power and sample size calculation software version 3.0.43 with two proportion formula.

a) Sputum conversion rate (Su *et al.*, 2011)

   The proportion of patients in normal group who had sputum conversion was 0.70 and among low BMI group was 0.30. 95% confidence interval was targetted to be 0.05 with power of the study was 80 %.

   Estimated sample size by software : 20 x 2 = 40 samples

b) Adverse drug reactions (Tan *et al.*, 2007)

   The proportion of patients in normal group who had adverse drug reactions was 0.30 and among low BMI group was 0.53. 95% confidence interval was targetted to be 0.05 with power of the study was 80 %.

   Estimated sample size by software : 76 x 2 = 156 samples

   From this calculation, estimated sample size for this study was 156 samples.

4.4 Sampling Method

All PTB patients who were notified in HUSM from May 2010 to May 2011 that fulfill the criteria were recruited in this study. Simple sampling technique was used to recruit the patients.

4.5 Research Tools

Patients who were registered as pulmonary TB in our institution between May 2010 till May 2011 were identified from the respiratory clinic. The patient's notes were reviewed with regards to inclusion and exclusion criteria. A structured questionnaire and record form were used to gather information on basic demoghraphic data, risk factors and type of TB. Weight of the patient upon diagnosis was gained from TB file and subsequent follow-up with digital weighing scale. Height was measured with the patient standing upright and looking straight ahead using tape measure. All patients gived written consent to participate in the study.

Data for the clinical outcomes (sputum conversion, weight gain and adverse drug reactions) gathered and observed during the study duration. For the sputum conversion and weight gain, data will be collected at 2 months of treatment and data for adverse drug reactions will be gathered at 6 months duration of treatment. Only sputum positive patients will be included in the data analysis of sputum conversion outcome.

4.6 Statistical Analysis

Data entries and analyses of results will be done using the SPSS for Windows (version 18.0, SPSS Inc., Chicago) statistical software package.

The demographic data were analyzed using descriptive statistics and reported as mean, standard deviation and percentages.

Association between BMI and clinical outcomes was analyzed by using simple and multivarite analysis.

P-value <0.05 is a significant value.

4.7 Definition of Terms

1) Pulmonary Tuberculosis (PTB) (WHO 2009)

PTB refers to a case of TB involving the lung parenchyma with or without extrapulmonary TB.

2) Clinical Outcomes of Pulmonary TB

Sputum conversion (Malaysia CPG, 2nd edition,2002)

Smear positive response :

Achievement of conversion of initial smear positive patient to a smear negative sputum at the end of 2 months of the anti-TB treatment.

Smear negative response :

Persistent sputum smear positive at the end of 2 months of the anti-TB treatment.

Adverse drug reactions (Chhetri *et al.*, 2008)

An undesirable response associated with the use of anti-TB drugs. Some common ADRs due to anti-tuberculous drugs are drug induced hepatitis, skin rashes, opthalmic involvement, hearing impairement, peripheral neuropathy, pancreatitis, ototoxicity, hyperuricaemia and hypersensitivity reactions.

Drud induced hepatitis (Yee *et al.*, 2003)

Hepatitis was defined as liver transaminase more than three times higher than the upper limit of normal in the presence of symptoms such as anorexia, nausea, vomiting or abdominal pain, or transaminases more than five times the upper limit of normal without symptoms. Episodes of hepatitis were considered drug induced if transaminases were normal before therapy,

increased during therapy, and returned to normal after discontinuation of anti-TB.

3) Body Mass Index (BMI): (WHO,2004)

It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2)

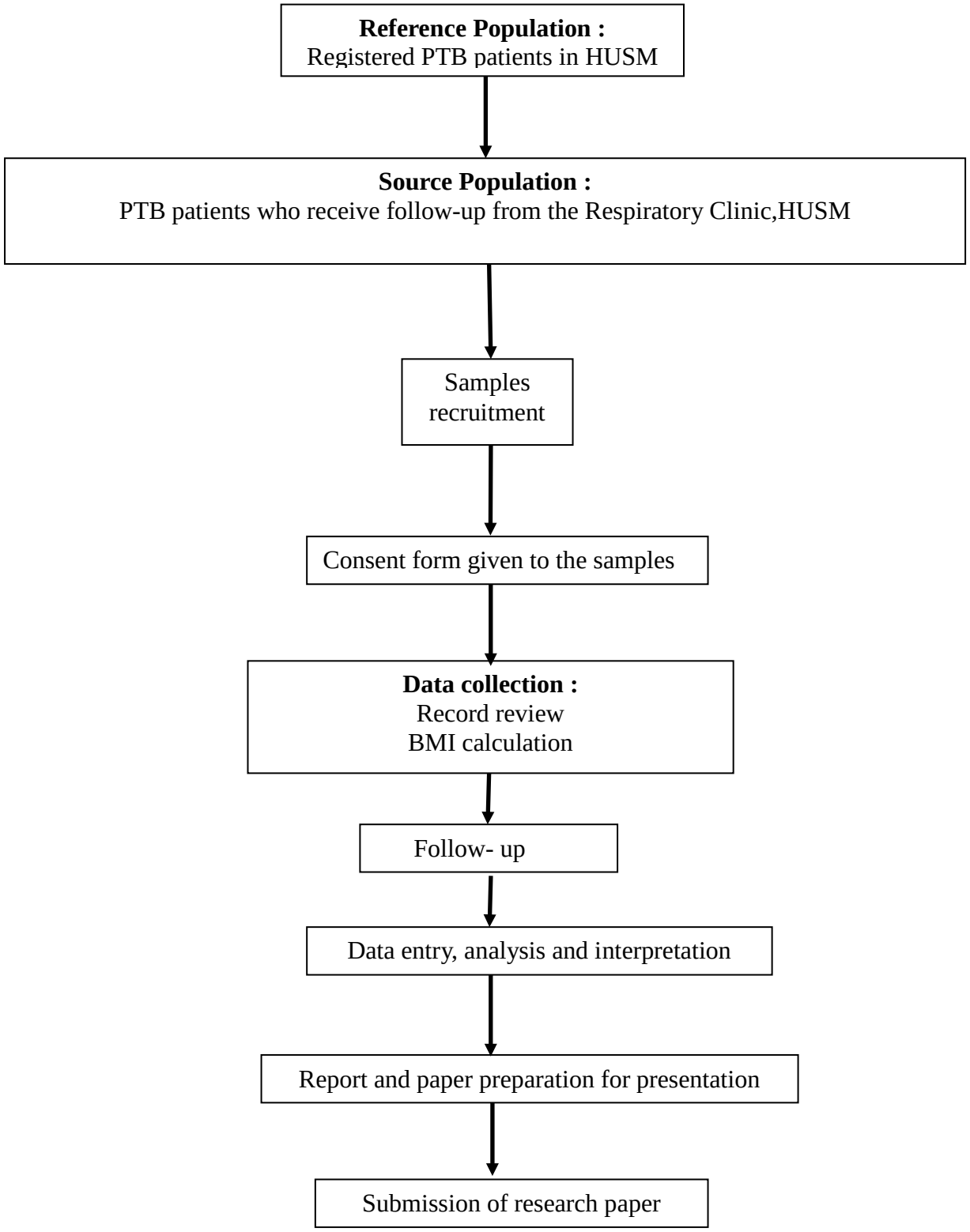
Obesity: ≥ 30.00 kg/m^2

Overweight:≥25.00 kg/m^2

Normal BMI:18.50-24.99 kg/m^2

Underweight :<18.50 kg/m^2

4.8 Flow Chart



5 RESULTS AND DATA ANALYSIS

5.1 Characteristic of the study population

During the study period, a total of 127 patients were recruited for this study. The total of estimated sample size (156) cannot be recruited due to time constraint.

The mean age of presentation was 44.74 ± 17.38 years. The study population had male predominant (53.1%) and Malay's ethnic contributed to the highest proportion of the study subjects (96.9%). A quarter (26.6%) of patients did not have formal education level and 36.7% had either primary or secondary education's level. Other than that, patient had background of college or university level, 25.0% and 10.9% respectively.

Majority of patients were newly diagnosed pulmonary tuberculosis which contributes to 96.1% (n=123) and only 3.1% (n=4) were reactivation of pulmonary tuberculosis. From this, there were 63.3% (n=81) pulmonary smear positive, 35.2% (n=45) pulmonary smear negative and 0.8% (n=1) miliary tuberculosis.

Most of the patients did not have any risk factors or co-morbidities, while others had comorbidities which were diabetes mellitus 17.2% (n=22), hypertension 2.3% (n=3) , hepatitis B 0.8% (n=1) and others 3.1% (n=4). Chronic obstructive pulmonary disease (COPD) and chronic lung disease were included in the others. However there were 18 patients who had comorbidities more than 1 in which combination of diabetis mellitus, hypertension and end stage renal failure.

Majority of patient were non-smokers, 63.3% (n=81) while others, 35.9% (n=46) were smokers.

Table 2: Study population demoghraphic (n=127)

Variables	frequencies,n (%)	Mean	Standard Deviation
Age		44.74	17.383
Race			
Malay	124(96.9)		
Chinese	1(0.8)		
others	2(1.6)		
Gender			
Male	68(53.1)		
Female	59(46.1)		
Education			
no formal education	34(26.6)		
primary/secondary school	47(36.7)		
college	32(25.0)		
university	14(10.9)		
Smoking status			
smoker	46(35.9)		
non smoker	81(63.3)		
Type of pulmonary tuberculosis			
smear positive	81(63.3)		
smear negative	45(35.2)		
miliary	1(0.8)		

table 2 continued

Status of pulmonary tuberculosis			
new	123(96.1)		
reactivation/ relapse	4(3.1)		
Co-morbidities			
nil	79(61.3)		
Hypertension	3(2.3)		
Hepatitis B/C	1(0.8)		
Diabetis mellitus	22(17.2)		
Others	4(3.1)		
>1	18(14.1)		
BMI status (baseline)		19.50	3.88
Obese	2(2.0)		
Overweight	10(7.4)		
Normal	50(41.2)		
Underweight	65(49.3)		