Delay in the Diagnosis and Treatment of New Smear-Positive Pulmonary Tuberculosis in Khartoum State, Sudan; Patient's or Health System Phenomenon?

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Table of contents

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To my family

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To the new Sudan

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List of abbreviations

AFB	Acid Fast Bacilli
AIDS	Acquired Immunodeficiency Syndrome
ARI	Annual Risk of Infection
BCG	Bacilli Calmette-Guerin
DALY	Disability Adjusted Life Year
DOTS	Directly Observed Treatment Strategy
HIV	Human Immunodeficiency Virus
IUATLD	International Union against Tuberculosis and Lung Disease
NGO	Non-Governmental Organization
NSP	New Smear-Positive
NTP	National Tuberculosis Programme
PHC	Primary Health Care
SCC	Sudan Council of Churches
SD	Standard Deviation
SNTP	Sudan National Tuberculosis Programme
SPSS	Statistical Package of Social Science
TB	Tuberculosis
TBMU	Tuberculosis Management Unit
WHO	World Health Organization

Abstract

Delay in the Diagnosis and Treatment of New Smear-Positive Pulmonary Tuberculosis in Khartoum State, Sudan; Patient's or Health System Phenomenon

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Background and Objectives: delay in the diagnosis and treatment of new smear-positive tuberculosis may complicate the course of disease, increase the risk of tuberculosis transmission in local domestics and community, and hamper the efforts of disease control. This study aimed to determine the magnitude of the total pre-treatment, patients, and health system periods among newly diagnosed smear-positive pulmonary tuberculosis patients in Khartoum State, Sudan. **Setting**: The study was conducted in the primary health care facilities of Khartoum State and Sudan Council of Churches. A total of 17 tuberculosis management units constituted the site of our study. **Design**: a cross-sectional multistage descriptive and analytical design survey was conducted in Khartoum State from August 20 to October 25, 2003. A semi-structured questionnaire was used for interviewing newly diagnosed smear-positive TB cases within a period of 5 weeks from their starting of treatment. **Results**: a total of 253 new smear-positive TB cases were recruited to this study. The median patient-period was 21 days (µ 33.9 days). There were no significant associations between patient's demographic and socio-economic characteristics and patient-period. Furthermore, there were no significant associations between patient's delay and most of the symptoms of onset and presentation. However, patient-period was influenced by patients' evaluation of their symptoms, and perceived accessibility difficulties. The median health system period was 21 days (µ 32.9 days). The health system period was influenced by patient's choice between medical providers and TBMU and by the number of visits to medical providers. The median total pre-treatment period was 53 days (µ 66.8 days), and about 59% of the study population had pre-treatment period of more than one and half month. There were no gender differences in the magnitude of pre-treatment periods. However, gender differences were related to TBMU-period and frequencies of performing TB diagnostic investigations, reaching TB diagnosis, and prescribing anti-TB treatment by medical providers. **Conclusions**: the total pre-treatment period was almost equally divided between the patients and the health system. Increase pubic awareness about tuberculosis with emphasis on severity of symptoms; dissemination of information about the available TB services in terms of locations of TBMU, free access to diagnosis and treatment, and efficacy of anti-TB treatment; establishment of a clear policy that regulates the relation between different health care facilities and formal TB services (TBMUs) will be successful measurement to decrease the delay in the diagnosis and treatment of tuberculosis and will enhance better TB control.

Annex I
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Annex II
Questionnaire

Delay in the diagnosis and treatment of new smear-positive pulmonary tuberculosis in Khartoum State

Respondent number: ☐☐

Date of filling the questionnaire: ……/……/2003

1. Age: …………….. Years
2. Sex: Male ☐ Female ☐
3. Educational level *(number of years in formal education):*
   < 3 years ☐ 3-6 years ☐ 6-12 years ☐ > 12 years ☐
4. Duration of residence in the district:
   < 1 year ☐ 1-3 years ☐ > 3 years ☐
5. Occupation: ………………………………………………………………………………..
6. Family monthly income:
   < 260,000 LS ☐ 260-520,000 LS ☐ > 520,000 LS ☐
7. Number of persons sharing the same house with you:
   <3 persons ☐ 3-7 persons ☐ > 7persons ☐
8. Distance from home to this health centre (TBMU). *(walking in minutes)*
   < 15 ☐ 15-30 ☐ > 30 ☐

9. What are the first complaints that you had experienced, which you think were related to your current illness?

Cough	☐	Loss of weight	☐
Sputum production	☐	Chest pain	☐
Fever	☐	Haemoptysis	☐
Night sweat	☐	Tiredness/ fatigue	☐

Other symptoms (specify) ☐ ……………………………………………

10. Which of these symptoms urged you to seek medical care? ………………………………

11. Have you tried self-medications? Yes ☐ No ☐

12. If yes, what type of medications you had tried? ……………………………………………..

13. Had you suspected having tuberculosis? Yes ☐ No ☐

14. Had you have any previous knowledge about TB? Yes ☐ No ☐

15. What was the time period between the onset of your symptoms and your 1st visit to a medical provider? ……………………………weeks

16. If this period was more than 3 weeks, what do you think the reasons for such long period?
…………………………………………………………………………………………………..

17. Before reaching your current TB centre, what type of medical providers you had consulted?

Private provider ☐ Public provider ☐ Pharmacist ☐ Others (specify) ☐

18. How many medical providers you had consulted? ……………………………..

19. How many visits did you carry to those providers? ……………………………….

20. What investigations (if any) that were performed by those providers?

Sputum ☐ X-ray ☐ Others ☐

21. What was the diagnosis, if any? ……………………………………………………………..

22. What Type of medications you received, if any? ……………………………………………….

23. If anti-TB drugs, had you started these medications? ……………………………….…

24. How did you reach this TB centre?

Referred by my medical provider ☐ Advised by a relative or a friend ☐

Came on my own ☐ Others (specify) ☐

25. If been referred by a medical provider, how many days it took you to reach this TB centre? ……………………………………………………………………………………….

26. If more than 2 days, what were the reasons behind this delay?
……………………………………………………………………………………………….

27. How long it took you to reach this TB centre from your very first visit to a medical provider? ……………..…………………………………………

28. Which of the following investigations was/were performed in this TB centre?

Sputum ☐ X-ray ☐ Others ☐

29. How long it took from your first presentation in this TB centre until they requested sputum examination? ………………………………………………………………….

30. How long it took from request of sputum examination until you got the sputum results?

....

31. If the period between requesting sputum examination and result collection was more than 3 days, what did you think was the reason behind such long period?
…………………………………………………………………………………………………

32. Date of performing sputum examination (from lab. Register book): ..…………………….

33. Grading of sputum (Lab. Register) scanty ☐ +1 ☐ +2 ☐ +3 ☐

34. Date of registration (from district register book): …………………………………………..

35. Date of start of treatment (from patient treatment card): ………………………………….

32. If the period between collection of sputum result and initiation of treatment was more than one day, what do you think was the reason behind such delay?

…………………………………………………………………………………………

CONSENT FORM

Introduction:

My name is … currently, I am studying International Community Health in Norway and this research is part of my study. I am interviewing both men and women to study delay in the diagnosis and treatment of new smear-positive tuberculosis in Khartoum state.

Confidentiality and consent:

First of all you are not obligated to participate in this study. In other words, you are completely free to accept or to refuse participating in this study. This means that your situation as a patient in this TB unit will not be affected by any means in case of your participation or refusal.

As I mentioned before, this study is about measuring the magnitude of delay in the diagnosis and treatment of tuberculosis. Also we are trying to understand the factors that lead to delayed initiation of treatment for TB patients. So in the case of your participation, I'm going to ask you some questions, some of them are personal like your age and your education, and so. Some question will be about your disease. These questions are too general but we, my assistant and I, will ensure complete confidentiality of your answers. Your name will not be written on this interview note or anywhere else, and will never be used in connection with any of the information you will tell. You do not have to answer any questions that you do not want to answer, and you may end this interview at any time you want to. However, your honest answers to these questions will help us to understand this problem and to come out with some recommendation that may be useful for the process of TB control.

I would greatly appreciate your help in responding to this interview. Would you be willing to participate?

If you agree to participate please sign here.

Respondent's signature: ……………………………………………………….

Witness's signature: …………………………………………………………..

The overall objectives of Tuberculosis control are to reduce mortality, morbidity and disease transmission, thereby reducing incidence and prevalence of the disease in the community. Identification of transmission determinants like number of incident infectious cases and durations of their infectiousness will provide solid ground for effective control. Early case detection and proper treatment will be a successful policy for TB control. Virtually, in almost all settings early detection of infectious cases had never gained its expected position in the strategies of national tuberculosis control programmes. Most of these strategies focused on passive detection and case holding. Generally, little is known about late initiation of treatment and the length of pre-treatment periods.

As tuberculosis is considered as a major health challenge in Sudan, great assistance was given through Sudan National Tuberculosis Control Programme in order to achieve prompt case detection and to secure higher treatment success. Relatively, great successes have been achieved during the last 6 years, but still there are many challenges facing TB control in Sudan. Accessibility of TB services and gender variations, securing strict case holding, role of private sector in TB control, low detection rates, late presentation of infectious cases and TB-patients health seeking behaviour represent some of the difficult challenges confronting the Sudan national tuberculosis programme.

The issue of delay in the diagnosis and treatment of tuberculosis gained a considerable attention during the last fifteen years. Many studies tried to identify the magnitudes and determinants of delay. However, little is known about delay in the Sudanese setting. Almost there was no specific study addressing the issue of delay in Sudan.

In this study we are trying to determine the magnitude of total pre-treatment period as well as the different periods that comprise the interval from onset of TB symptoms until commencing treatment. Moreover, we are trying to determine the different factors and associations that may lead to prolonging the interval to treatment initiation among new smear-positive pulmonary TB cases detected during routine practice in the TB management units in Khartoum State, Sudan.

Furthermore, we are seeking to identify gender implications related to patients' health care seeking and practices within the health system that may influence the durations of pre-treatment periods. We are aiming to come out with sound recommendations that may enhance the progress in TB control in Sudan.

Global epidemiology of tuberculosis:

Today, tuberculosis is one of the major health challenges facing the world. In the year 1993, the World Health Organization (WHO) declared tuberculosis a global emergency. It is estimated that about one-third of the world's population is infected with tuberculosis bacilli[1] and around 3 million people died annually of tuberculosis[2,3]. The annual estimation of TB cases approaches 8 million cases globally[2,4], of whom approximately 90% are in the low-income countries[1,5]. World wide, the majority of TB cases (80%) are found in 23 countries with the highest incident rates in Africa and South-East Asia[2,4].

Almost 95% of the global TB cases occurred in developing countries, 75% of whom are in their economically productive years (14-45). In addition about 98% of TB deaths happen in the developing countries[6]. Tuberculosis is considered a leading killer in our contemporary world and is one of the top ten causes of global mortality [7,8,9]. Tuberculosis account for more than one-quarter of all preventable deaths in developing countries[10,11] and also, it is considered as the single most frequent cause of death in individuals aged 15 to 49 years[12]. It has been estimated that at least 20 million peoples have died unnecessarily of tuberculosis in the past decade[5]. Many factors such as the major site of disease, delay in diagnosis and treatment and age, increase the risk of dyeing with tuberculosis[13].

In addition, an adult with TB loses on average three to four months of work time. This results in the loss of 20-30% of annual household income and, if the patient dies of TB, an average of 15 years of lost income[14].

Hans L. Reider described disease notification as the result of multiple steps in a process which incorporates: prevalence of infection, risk of disease given that infection has occurred, access of the patient to diagnosis, and notification discipline in the health care system[13]. Low notification of TB is one of the major obstacles facing tuberculosis control efforts worldwide. It has been documented that, WHO's monitoring and surveillance project has recorded 68 million TB cases since 1980, and 10 million new smear-positive cases since 1993[15]. So it seems that, the global notification rate has remained stable at about 60/100000 population since 1980, and that notification of all smear-positive cases appeared to be stable at about 40% of the estimated cases[15,16]. During the year 2000, the number of notified all tuberculosis cases was around 3.67 millions, which represents about 42% of the 8.7 millions annually estimated. Similarly, the notification rate of new smear-positive cases was 40% during the same year (1.52 millions out of 3.84 million cases) [15].

DOTS strategy has been marketed as the most powerful intervention for TB control; still it failed to solve the problem of low detection rates. The World Health Organization (WHO) estimated that only 29% of all estimated cases and 32% of estimated smear-positive cases were detected by DOTS programmes[17]. During the year 2000 only 23% of all estimated cases and 27% of estimated smear-positive cases were detected under DOTS[15].

TB Control:

The overall goal of any infectious disease control effort is to eliminate this disease. Donald Enarson has mentioned that, only smallpox elimination has been achieved globally. He describes some characteristics that facilitate smallpox elimination; an effective vaccination strategy, no natural reservoir outside humans, and no carrier state for the virus. Meanwhile, reflecting these characteristics on tuberculosis revealed that, tuberculosis is very different in terms of; availability of animal reservoir, lack of effective vaccination strategy, and most infected people carry viable bacilli for long times without symptoms[5].

Globally, efforts of tuberculosis control are facing many challenges that some of which are believed to be behind the resurgence of tuberculosis. Some of the major challenges facing TB control are: poverty and the widening gap between rich and poor in various populations, the pandemic of HIV, deteriorating access to health care for high-risk populations[18,19], inefficient case finding[20], decline in expertise in the treatment of tuberculosis among physicians trained in the post-sanitarium era[21], and lack of enthusiastic political commitments especially in developing country. Declined expertise in suspicion, diagnosis and treatment of tuberculosis among health providers is existing in both industrialized and developing countries in spite of the differences in disease prevalence. Liam CK and Tang BG mentioned that TB was not considered in most of patients in Kuala Lumpur when they first consulted their private practitioners and essential investigations such as sputum examination and chest x-ray were not often done[22,23]. Also in a study in the United States, the authors commented that TB is more efficiently managed in elderly patients than younger patients, which might be because of an increase awareness of the prevalence of the disease in this population[21].

Interventions and control strategies:

Rieder HL summarized the interventions of tuberculosis control into four major interventions:

- Treatment of tuberculosis: an intervention that focuses on two broad aims; firstly to reduce the risk of death and to restore health and curing patients; and secondly, to reduce the risk of transmission in the community.
- Prophylactic treatment that aims to prevent infection with tuberculosis bacilli from occurring.
- Vaccination with Bacilli Calmette-Guerin (BCG)
- Preventive chemotherapy[24].

Treatment intervention is the most popular method for TB control and it constitutes of two main elements: case finding and case holding[20]. In order to fulfil these components, it is so essential to maintain a high suspicion index by health providers[21], timely initiation of proper treatment, increase patient's awareness and health worker's readiness to control the spread of tuberculosis[25], and to consider the contribution of social and cultural factors in the control process[26].

We find that adoption of more than one interventional approach has been practised in some industrialized countries with low prevalence of tuberculosis as seen in the United States, where the Public-health responses have focused on interrupting the chain of transmission by treating active cases that present for care, tracing their contacts, and chemo-prophylaxis[19]. On the other hand, most of the developing countries relied on treatment intervention through passive detection and treatment of active tuberculosis cases [25].

Directly Observed Treatment Strategy (DOTS):

In the year 1993, the WHO declared tuberculosis a global emergency. Since that time the number of countries adopting the WHO/IUATLD strategy of DOTS was increasing every year. The objectives of TB control are to reduce TB mortality, morbidity and disease transmission, while preventing the development of drug resistance. The targets for global TB control ratified by the World Health Assembly, are to cure 85% of newly detected cases of sputum smear-positive TB and to detect 70% of the estimated incidence of sputum smear-positive TB[18] (*Resulution WHA44.8 of the Forty-fourth World Health Assembly*, Geneva, World Health Organization, 1991 (WHA 44/1991/REC/1), and *Resolution WHA46.36 of the Forty-sixth World Health Assebly,* Geneva, World Health Organization, 1993). Directly observed treatment short-course chemotherapy (DOTS) is believed to be the most known effective intervention for TB control. DOTS is basically a treatment intervention focusing on prompt treatment of symptomatic cases with short-course chemotherapy administered under direct observation of health workers[15]. The DOTS strategy demands: political commitment; case detection by sputum smear microscopy mostly among self-referring symptomatic patients; standard short-course chemotherapy administered under proper case management conditions including directly observed therapy; a system to ensure regular drug supplies; and a standard recording and reporting system including the evaluation of treatment outcomes[2]. The overall goal of this strategy is to reduce transmission of tuberculosis in the community through early detection of smear-positive tuberculosis cases and rapid administration of full-course treatment[27,28]. This goal is translated into; detection of at least 70% of estimated infectious cases and securing treatment success rate of 85% among detected cases[2]. When DOTS relies on passive case detection through direct smear microscopy, this reliance might be faced by: that sputum examination is not highly sensitive and should not be used to exclude a diagnosis of pulmonary tuberculosis[23]; factors influencing passive case detection such as patient motivation, diagnostic index of suspicion of health workers, and quality of lab facilities[29].

On the world Health Organization report 2003, the number of countries adopting DOTS strategy reached 155 countries[17] and that over 10 million cases were reported under DOTS programme between 1995 and 2001, of which more than 5 millions were new smear-positive cases.

In spite of great efforts to fulfil DOTS targets of 70% detection and 85% success rate, this seems to be unreachable before the year 2013[15]. This speculation came from an observation that; since 1994, DOTS programmes have been reporting an average of 133 000 additional smear-positive cases each year. So in order to reach 70% detection by the end of 2005, we have to detect an average of 330000 additional cases each year[15].

Mathematical modelling and practical experience predicted that with a case detection of 70% and success rates of 85%, there would be a decline in incidence rate of 5-10% per year in areas of low HIV prevalence[30]. Subsequently, the incidence rate will be halved in 10 years if a decline of 7% per year has been achieved as similarly seen in Peru since 1992. The immediate impact of DOTS strategy, in case of fulfilment of its targets, would be expressed in terms that countries could halve prevalence and deaths by the year 2010[15].

One of the major challenges facing TB control and DOTS strategy in particular is how to solve the dilemma of low detection rates. In the World Health Organization 2003 report the following reasons for low detection rates were classified into five nonexclusive groups:

1. The missing cases do not exist. It is possible that incidence of TB has been overestimated in some countries.

2. Patients do not present to any health facility, public or private. TB patients are bound to be missed in some countries, such as Ethiopia, where a large fraction of the population does not have access to formal health services.

3. Patients are diagnosed and treated in the private sector, and not notified to public health services (and therefore do not appear in national health statistics).

4. Patients present to the public health system, but not to DOTS programmes. In 2001, 1.4 million TB patients were reported from outside DOTS programmes, including 421

000 that were smear-positive. These figures almost certainly understate the number of patients treated by non-DOTS public health services around the world.

5. Patients present to the public health system, including DOTS programmes, but are wrongly diagnosed or not reported[17].

Active case finding and treatment of smear-positive tuberculosis:

Active case finding and treatment of smear-positive TB is another approach of treatment intervention. This kind of case finding relies on population screening for tuberculosis. Although active case finding has made only a limited contribution to reducing tuberculosis transmission in Europe, but mathematical models have suggested that it may have substantial benefits in high-prevalence countries[9]. Generally, there are two major ways of active case finding. The first method uses mass miniature radiography for population screening. This method may detect up to 90% of prevalent cases of tuberculosis. However, it needs huge investment and it is considered with a tremendously high cost[9]. The second method is symptomatic screening of patients. This method has a reasonable cost and it may detect up to 70% of the prevalent cases. The weaknesses of symptomatic screening are represented in the way to select the target groups and the methods to be used in eliciting symptoms[9].

Many criticisms have been given to active case finding, that it is costly and often leads to poor treatment compliance[25]. Moreover, active case finding is expected to be difficult on the large scale and requires the investment of extensive human and financial resources for a relatively yield of cases[27,31].

Vaccination with BCG:

The use of BCG vaccination is not considered of great epidemiological impact on TB transmission. In fact, the protective efficacy of BCG varies between 0% and 80%. This variability is influenced by differences in the prevalence of infection with environmental mycobacteria[32] and difference between BCG strains[9].

The most important benefit of BCG is that it may give protection up to 80% against disseminated tuberculosis, including tuberculosis meningitis in childhood[9,32].

Preventive therapy for contacts:

In fact, this intervention is a combination between active tracing and prophylaxis. It has been recommended as an adjuvant to DOTS. In practice, we can notice that contact investigation to identify recent infection has been limited to children within the household, which restricts the comprehensiveness of this intervention. It is believed that preventive therapy using isoniazid reduces the risk of developing disease among recently infected children by 60-80%[9]. Another positive aspect in this intervention is that; the side effects from isoniazid are expected to be rare. The utility of this intervention among adult population with latent infection is also expected to have a protective efficacy of 60-80% depending on the duration of therapy[33]. Partial uptake and compliance represent the main limitations facing such intervention[9].

TB in Sudan:

TB is one of the top priorities in the agenda of the federal ministry of health in Sudan. In 1995, tuberculosis was the 4th cause for utilization of health services. Moreover, 11.6% of hospital admissions and 16% of hospital deaths were attributed to TB[34]. The Sudan is among countries with the highest burden of TB in the East Mediterranean Region, with an annual risk of infection (ARI) of 1.8%, i.e. around 180 of all cases[34] and 90 smear-positive cases per 100,000 populations are estimated each year. A total of 40000 prevalent cases are expected annually in the whole country[35].

The National Tuberculosis Control Programme (NTP) was established in the year 1995. The Sudan-NTP adopted DOTS strategy and managed to achieve 100% service coverage in the year 2003. Although management of tuberculosis was well established in the modern health system for long time, but accurate national registry was missed. Establishment of NTP provided a reliable registry and served in reflecting the magnitude of TB in the Sudan.

The national tuberculosis programme launched a decentralization policy to integrate TB services into existing PHC facilities, aiming to increase accessibility to health care, strengthening PHC services and secure better treatment outcome[36]. This decentralization is expected to minimize time lag to diagnosis and treatment initiation and provide better chances for women to access TB services. In her article about effects of decentralization on tuberculosis services, El-Sony has concluded that decentralization was associated with changes in the profile of patients accessing services. This observation was particularly obvious among women, who changed their choice of service from referral hospital to the PHC facilities[36].

Despite decartelization of TB services, still remain problems of increasing detection rates. While the NTP in the Sudan is approaching achievement of 80% success rate, the case detection rates are still lagging behind at a rate of less than 60% of estimated cases, with the highest case notification of 26000 cases in the year 1999[37]. The following figures show treatment success rates and notified TB cases of all categories since 1995.

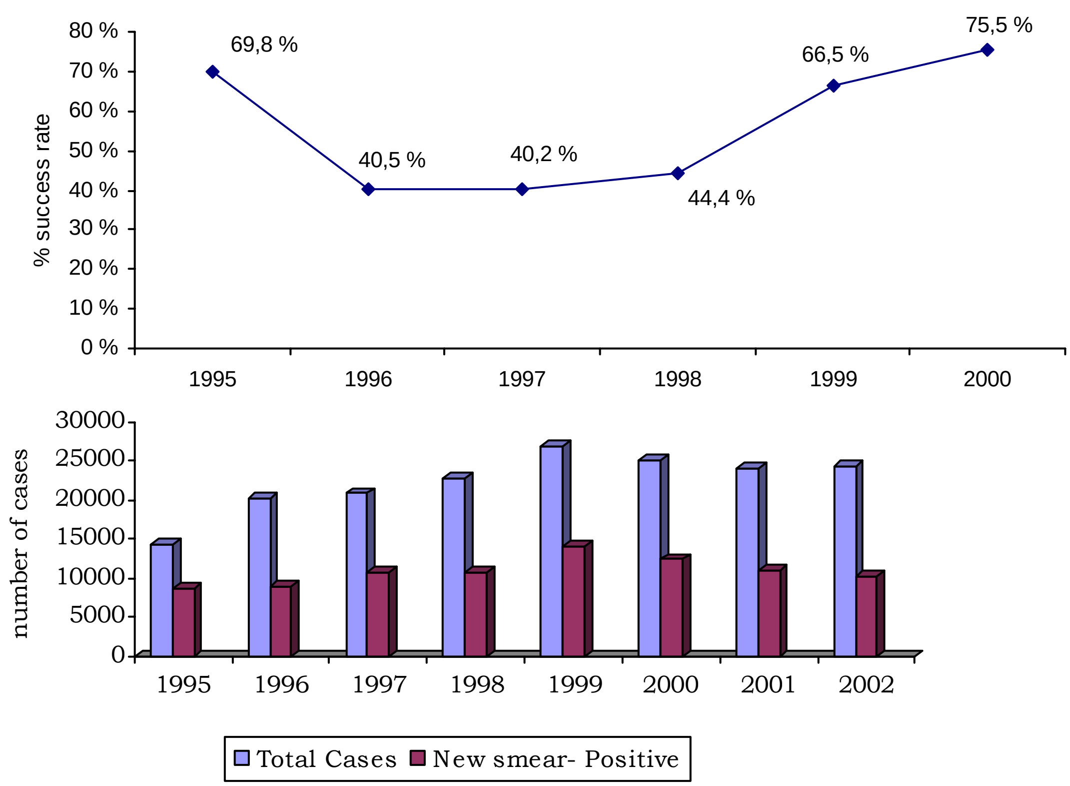


Figure (1.1): Treatment success and notification of TB cases in Sudan during the period 1995-2002[37]

TB Profile in Khartoum State:

There are three different levels organizing TB services in Khartoum State: the federal level is responsible for the large specialized teaching hospitals; the TB programme of Khartoum state is responsible for the TB services in the other general hospitals and health centers; and the Sudan council of churches (SCC) is responsible of TB services in the five displacement camps. The teaching hospitals used to be the main health facilities for case detection, but with introduction of decentralization the national tuberculosis programme focused in evacuating these hospitals and integrating TB cases into the PHC facilities aiming for better application of DOTS strategy. By the end of the year 2002, Khartoum state has been declared achieving DOTS allover i.e. each 100,000 population is covered with a diagnostic and management facility for tuberculosis (TBMU), giving a total of 59 TBMUs and 184 DOTS centers in Khartoum State[37].

It is worth to mention that, despite diagnosis and treatment of tuberculosis is available in the different sectors of the health system whether public or private, all the data for TB control are public data.

Annually, Khartoum State notifies one-third of the total notified cases in the Sudan. This high notification is explained by the population density in the State, which accounts for almost one-fifth of the total population of Sudan. The Case notification in Khartoum reached its peak during the year 1999, where it was 8749 cases. The mean case finding in this state is about 8000 case/year. The smear -positive cases accounted for 58% of all notified cases during the period between 1997 and 2002. In each quarter of a year there are almost around 1100 smear-positive cases being notified in Khartoum State.

Delay in the diagnosis and treatment of tuberculosis:

During the last two decades, several researchers were interested in studying TB patient's health seeking behaviour and the length of the pre-treatment period. Regardless of these efforts, there is no consensus on what is to be acceptable and what is to be considered as delay. The total pre-treatment period includes two levels. One is at patient's level and the other is at the health system's level. Sometimes there are no clear demarcations between these two phases of health seeking process.

Consequences of delay in the diagnosis and treatment of tuberculosis:

Many studies have focused on the consequence of delaying the diagnosis and treatment of tuberculosis. We can summarize these consequences as: patient-related outcome consequences and community related consequences. The patient-related consequences are represented in that, delay in the diagnosis and treatment might worsen the course of the disease and increase mortality. Almost all the studies agreed upon that delay might worsen the course of the disease[19,21,22,25,27,38,39,40, ,41,42, 43]. Despite the fact that most of these studies made a consensus that delay may increase the mortality especially among HIV-co-infection TB patients[22,27,39,40,41], this finding has been rejected by a study in the United States, which found no significant association between delay and mortality[21], though the authors justified to their finding that the prevalence of HIV-co-infection was low in their study sample. For example, a study from Gambia showed that the chance to die is much more increased among patients with delayed treatment of more than 8 weeks compared to other patient with lesser delays[27]. Alternatively, the same study showed no association between delay and defaulting during treatment. This finding may indicate that it is not necessary that all factors that contribute to delay will have similar contribution on case holding and compliance.

The second consequence is that delay in the diagnosis and treatment, especially of infectious cases, increases the chance of transmitting the disease to community. Hans Rieder has nominated three major factors that determine the risk of becoming exposed to TB bacilli: the number of incident infectious cases in the community; the duration of their infectiousness; and the number and nature of interactions between a case and a susceptible contact per unit of time of infectiousness[13]. Thus the risk of becoming exposed is greater if the duration of infectiousness is prolonged. It has been recognized that left untreated, a person with active pulmonary TB will infect on average 10 to 15 persons a year[6]. A clear example happened in the late 1980s and early 1990s, when many institutions in the United States experienced major nosocomial outbreak of multi-drug resistant strains with mortality rates as high as 80%[44,45,46]. Also in their study about Relation of grading of sputum smears with clinical features of tuberculosis, El-Sony and her colleagues observed that, the highest grade of smear-positivity as well as longer duration of symptoms are predictors of having a sick person in the household[47]. In addition, some studies had shown that delay in initiation treatment for more than 2 months is enough to spread the infection to the domestic contacts[19]. Furthermore, a study from Los Angeles has shown that patients exposed an average of 8 other people during medical care delay[19]. In the same way a study from St. Louis in the United States has shown that management delays resulted in an average of 23.9 employees exposed per case of TB[21]. In conclusion, we can notice the crucial importance of the pre-treatment period on both patient's treatment outcome and enhancement of transmission in the community.

Health care seeking among TB patients:

The help seeking is a very complicated process and is influenced at many levels by patient's socio-economic factors, social interactions, and the health system related factors. In practice, one can notice that this process is not merely straightforward ascending movement, but in many instants there are back and forth movement between different levels. In this review we will assume a linear ascending movement for the help seeking process. Just to simplify our presentation to some of the available literature on delay. We will discuss each level separately and at the end we will discuss the whole process of delay in the diagnosis and treatment of tuberculosis.

Health seeking behaviour should be seen as the range of activities that individuals undertake to promote and/or restore health[48]. Unfortunately, the issue of health seeking has been often ignored by modern health workers[49] and not even considered in many interventional strategies. Moreover, it is not even mentioned in widely used texts or recent reviews[50].

Some studies on tuberculosis tried to identify the motivations that lead patients to seek medical care. An interesting finding has been documented in a study in Los Angeles, which found that patients usually seek help due to their symptoms rather than as a result of screening or contact-tracing efforts[19]. Subsequently, the authors came to a conclusion that there was lack of strong relationship between need for care as evidenced by serious symptoms and the prompt of care seeking. On the other hand, Leventhal's observed that fear does not necessarily motivate health seeking[51]. So it is advisable that, health education efforts should not overstate the issue of dangerousness of TB, as this could reinforce stigma and denial, which might lead to further delay in help seeking.

Many studies have highlighted a phenomenon of multiple help seeking (shopping), which may account for delayed diagnosis and treatment initiation.

A study from Gambia showed that the median number of providers seen by the patient before starting Anti-TB treatment was 4 providers and also that females have a tendency to see more providers than males[27]. Similar multiple health seeking has been observed in India, where the average number of providers seen by the patients was 1.3 providers and the average number of visits was 2.5 visits[52]. Some researchers have tried identifying the reasons behind this multiple health seeking or shopping. They summarize these reasons as: the felt need to explore alternative providers; lack of trust in the public health services; sub-optimal health services; and financial constraints that leads to shifting from more to less expensive providers[20].

Furthermore, some studies tried to identify patient's preference between different types of providers, especially between private and public providers before starting anti-TB treatment. In Gambia the majority of patients (68%) visited governmental health centres[27], whereas in Philippines many TB suspects (53%) first approach a private doctor[20,53,54]. The later pattern was found in India, where the majority of TB patients, including people from very low-income classes, are managed within the private sector[52,55,56]. In addition, studies from other Asian countries have shown that between 34% and 82% of TB patients treated in governmental TB units have been in contact with a private physician at some time during their disease course[22]. Furthermore, many studies had pointed to a gender difference in the type of provider preferred. Females in Gambia tend to visit more government health centres than males who preferred private doctors and pharmacists[27]. In contrary, females and rural residency were significantly associated with higher likelihood of attending a private physician in India[52]. Pathania has described the reasons behind people preferring private providers as: expected to be more effective; more easily accessible; more sympathetic; and more likely to respect privacy[54]. In addition, Auer C. has suggested that the reliance of private providers on x-ray makes them more attractive to patients[20].

In conclusion, three main factors were identified as contributors to delay in health seeking: the stigmatisation effect of TB mediated through denial and concealment of TB diagnosis especially among women; the fear of high individual expenses for diagnosis and treatment (perceived barriers) especially among men; and lastly, that health facilities at lower levels did not meet people's expectations of appropriate health services in terms of resources and staff competence. Other factors influencing health seeking are represented by family structure and gender roles such as income-generation/ dependency relationship and fear of rejection, respectively[57].

Levels of delay in the diagnosis and treatment of tuberculosis:

The total pre-treatment period has been divided in almost all studies into two main periods: a period before patient's presentation to a health provider; and a period between patient first contact with a health provider until diagnosis and initiation of anti-TB treatment. Theoretically, this division seems to be clear and easy, while in real practice it comes out to be more complicated. As mentioned above, there is no straightforward ascending pattern for the process of health seeking and the two periods are much interwoven.

The aim of studding delay is not to blame any of the counterparts of the health seeking process, whether patients or the health system, but to identify the real factors that hampers early detection of cases and hence prompt treatment.

Patient's delay:

Most of the delay studies defined patient's period as the time interval between onset of symptoms and first contact with a medical care. There were some differences within this definition, and they were mainly due to different explanations and descriptions of what is meant by the health system and who represents the health system. For instant, in Gambian study, the first contact with the health system was the first contact with a health provider[27]. However the researchers use to define a health provider by; *any person* consulted by the patient about his/her sickness that gave or prescribed something for treatment. These persons include traditional healers, market drug sellers, pharmacists, village health workers, friends and relatives as well as medical staff. Alternatively, in study conducted in New York, USA, the researchers defined a medical provider as any health staff not specialist or hospital doctor[58]. In another study from Vietnam, the researchers defined medical providers as private or a hospital doctor[59]. So, these variations depend mainly on the definitions used for the health system in the different settings. Initially, it seems to be confusing to have different definitions for one category; while in fact it enriches the outcome of these studies and makes their recommendations more specific and focused.

In most situations, TB treatment is offered through the public health system. In compliance with this observation, the Gambian study introduced the diagnosing facility level to their definitions. The researchers divided the period before this diagnosing facility into patient and health provider periods. This division seems to be logical when in most studies the health provider's delay was included as patient's delay[27].

As the magnitudes of patient's delay have been considered in different settings, the shortest median of patient's delay was seen in Gambia (0.3 weeks) [27]. This short period is attributable to the definition used by researchers, when most of the time that would be accounted on the patient's period has been shifted to health providers. In contrast, median patient's delay ranged between 25 days as seen in New York and 120 days as seen in Mwanza in Tanzania[58,61]. In Tanzania and Ethiopia, 90% of the total pre-treatment was due patient's delay, whereas in Ghana and Gambia the health system delay over exceeded that of the patients. Even though median patient's delay in Ethiopia was 60 days, a considerable proportion of patients (42%) sought advice within one-month period[25]. In the Ghanaian study, the median patient's delay was half of the health system delay (4 weeks versus 8 weeks) [60].

Many factors had been examined to identify their influence on the length of patient's period. In Ethiopia, the was no significant association for patient's socio-demographic characteristics on the length of patient's period for smear-positive cases, whereas distance of more than one hour walking was associated with delay of more than one month among smear-negative cases[25]. Also there was a difference between influence of knowledge about TB on delay between smear-positive and smear-negative patients. Whereas there was no association between knowledge and delay among smear-positive cases, this association remained significant for smear-negative. In Tanzania, patients without previous knowledge about TB showed longer patient's periods than those who knew about the disease[61]. In addition, other factors such as lower levels of education and rural residency were associated with longer patient delay. Furthermore, a study from New York has identified that age between 55-64 years and difficulties in communication (primary language other than English) were associated with longer patient delays[58]. Alternatively, patient's perception on TB has its influence on the length of patient's period. This has been demonstrated in a study from Philippines, that patients, who perceived TB as harmless disease, had longer patient's delay[20]. Age was controversial, where in a study from Tanzania it shows; age above 45 years was associated with longer patient's delay[61], a study from Japan identified that patient's delay had a tendency to decrease with age[85].

Health systems' delay:

The overall health system period could be defined as the time interval from first patient consultation to a medical provider until initiation of anti-TB treatment. This definition includes different steps in the process of diagnosis and treatment and depends mainly on our definition to the health system. The problem of delay within the health system is a reflection of different dialectical relations and factors such as; prevalence of TB, accessibility of health facilities, patient's socio-demographic characteristics, symptoms on presentation, presence of refined suspicion index, infrastructures and organization of the health system. There are different definitions for health system delay among different studies, although the core concept was somehow similar. In one study from Ethiopia, the researchers defined health service delay as the time interval from first consultation until the date first diagnosis[25]. We can notice here, this definition omits the time period between diagnosis and initiation of treatment. Another definition has been used in a study in Gambia that divided the health system delay into provider and diagnosing facility delays[27]. Hereby, the health provider delay has been defined as the time from the first visit to a health provider to first presentation to a

Leprosy/TB inspector for diagnosis. This definition appears to be so broad when it includes any person consulted by the patient about his/her sickness that gave or prescribe something for treatment. These include traditional healers, market drug sellers, pharmacists, village health workers, friends and relatives as well as medical staff. While the other part of the health system delay was the diagnosing facility delay that represents the time from first presentation to a Leprosy/TB inspector until the start of specific ant-TB treatment. The existence of TB management activities within the public health sector justifies for such definition.

Many studies tried to examine delays in the health system, but very few studies have systematically examined different phases in the process of diagnosis and treatment. The total health system period could be divided into three periods: the suspicion period which covers the time period between first consultation and ordering of TB suggestive investigations or precautions; secondly, the diagnosis period which covers the time interval between ordering of suggestive investigations or precautions and reaching TB diagnosis; and lastly, the treatment period which covers the time between reaching a TB diagnosis and initiating anti-TB treatment. For example, one studies from St. Louis, USA, split the health system period into: a suspicion interval that denotes the time from admission to the first suspicion of TB (an order for respiratory isolation or submission of specimen for AFB smear or culture; and a treatment interval that depicts the time from the first suspicion of disease to initiation of treatment[21]. Lastly, in study from Canada, the authors used two overlapping definitions to describe health delays: initially missed diagnosis and delayed treatment[41]. Initially missed diagnosis has been used to describe failure to initiate respiratory isolation and/or treatment within 24 hours of admission, while delayed treatment describes the interval from admission until initiation of treatment of seven days or more.

Median health system delay was 6 days in the studies conducted in Ethiopia and St. Louis, USA, while it was 15 and 19 days in the studies in New York, Tanzania and Canada respectively[21,25,41,58,61]. In the New York study there was a significant difference in the median health system delay between smear-positive and negative cases of 6 days and 31 days respectively. Both the Gambian and

Ghanaian studies reported system delays of 8 weeks or more[27,60]. These delays in the health system even exceed patient's delays. Almost more than 95% of the delay in the health system in the Gambian study was due to health provider delay (8.3 weeks for provider delay versus 0.2 weeks for the diagnosing facility). Once more, we think that the broadness of the health provider definition is the rationale behind such long delay.

Diagnosis was initially missed in 45% of all hospitalised patients in the Canadian study, of whom 53% were smear-positive cases. Furthermore, the median interval between hospitalisation and isolation was 12.5 days among patients with delayed treatment. This finding might reflect that low suspicion index among medical staff in low-prevalence setting or it could be due to the restrict cut-off points used in this study (24 hours). Another finding from the same study was that, 30% of the patients experienced delayed treatment of more than 7 days among whom, 45% were smear-positive cases. This finding draws attention that most physicians prefer starting treatment after getting culture results. In the St. Louis study, the suspicion interval was only one day and the median treatment interval was 3 days[21]. Approximately 64% of all patients experienced treatment delay of more than one day. Besides, treatment has been delayed in 58% of all the smear-positive cases. The previous explanation about physician rely on culture result could be also true here.

The above-mentioned studies have shown some factors that may influence health system delay. In the Ethiopian study the authors found no significant association between health system delay and socio-demographic factors. Physical accessibility and infrastructures of health facilities were investigated by some studies and their relation to system's delay was identified to be significant. For example, distance of more than 30 minutes from health centre was found significant for delay of more than 15 days in the Ethiopian setting. Another factor is the female sex, which was associated with significant doctor's delay. This gender difference was attributed to female's health seeking behaviour, differences in symptoms of TB, and other cultural and socio-economic factors related to females. Unexpectedly, even in the setting of industrialized countries where females enjoy better state of affairs compared to developing counties, still there was longer system's delay for females. Delay was significantly increased among female and rural patients in the Ghanaian study[60]. Older age has been shown to be associated with initially missed diagnosis, delayed treatment and mortality in the study conducted in Canada[41].

Absence of cough, failure to perform sputum examination, not having a chest radiograph at the first medical visit, atypical manifestations of TB (negative sputum, non-cavitary chest radiograph, extra-pulmonary TB, and absence of haemoptysis) were associated with longer health system delays[21,25,41,58,60]. Longer delay for smear-negative compared to smear-positive cases was demonstrated by almost all the studies. Furthermore, in a study from Zambia; outpatient diagnosis of TB, visiting a private doctor or a traditional healer, and visiting a provider more than 6 times were associated with longer health system delay[38]. Commonly, the absence of classical manifestations of tuberculosis was not associated with the presence of overall management delays in St. Louis[21]. Female TB patients tend to report less indicative general symptoms such as fever, tiredness and anorexia. There was significant difference between males and females concerning reporting of suggestive respiratory symptoms of cough, sputum expectoration and haemoptysis. These symptoms were found more common among males than among females[62].

Total delay:

Total delay or total pre-treatment period has been considered as the sum of patient delay and health service delay, in all studies. Many studies have tried to identify factors influencing the pre-treatment period. Some of these factors such as patient's understanding of symptoms, attitudes to disease, expectations and accessibility of health services and the health system performance[47], are expected to have direct or indirect impact on the length of pre-treatment periods.

While a shorter total delay of 30 days has been shown in a study from Philippines, 20% of the patients in this study had symptoms of more than 3 months before commencing treatment[20]. Median total delays of about 2 months have been reported by studies from USA, Gambia, Zambia and Ethiopia[19,25,27,38,58]. Median total delay of 3 months or more has been reported by studies form Botswana, Ghana, and Tanzania[26,60,61]. Most of these studies reported an average of 2 months total delay, which is expected to be enough to spread infection to the domestic contacts[19]. In Ethiopia, patient's delay accounted for 90% of the total delay, whereas in Gambia the reverse was true[25,27].

There have been contradictory reports on the influence of patient's socio-economic characteristics, gender and health system factors on total delay. Age above 44 years has been found to be associated with longer total delay, as reported by the Gambian study[27]. In contrary, in a study conducted in Los Angeles, the authors reported no association between total delay and age, gender and most demographic factors[19]. Differently from the Los Angeles study, Needham DM et al (2001) identified in their study in Zambia a gender influence on total delay[38], that female sex and education for less than 9 years were significantly associated with longer delay. However the same study has reported no association between economic factors and delay. Individual perception of disease, the severity of disease, access to health services and the experience of the health personnel appeared to have influence on delay[27]. Accordingly, physical accessibility in terms of residency seems to influence the total pre-treatment period as reported by the Gambian and Ghanaian studies, that rural residence was associated with longer total delay[27,60]. Perceived barriers such as: lack of regular doctor; uncertainty where to go; cost and waiting time in the office; and fear of immigration authorities were associated with delayed total pre-treatment periods. These access barriers appear to explain more the delay than does the need for care of health status, suggesting that subgroups of the TB population are facing inequitable barriers to care[19]. Finally, beliefs in the efficacy of self-treatment and the choice of first health provider have been shown to influence total delay[19,27]. Patients who choose a hospital doctor or private doctor reported shorter delay than those visited a traditional healer or village health worker.

Lastly, some researchers thoroughly studied the contribution of social stigma on health seeking and delay. The effect of stigma was more obvious among female patients. Leslie J has suggested that due to the effect of TB on physical appearance and the social stigma attached to it, consequences of disease are likely to be more for women. Stigma may lead to delays for both sexes in seeking care, but more so for females if the physical, geographical, and economic access to health care are limited[63]. One of the reasons that might increase stigmatisation among females is the age factor. It was obvious as documented by many studies that female TB patients have lower median age than males. For example the age medians in years for female: male TB patents were 33:43, 30:36, 32.7: 34.2 in Botswana, Gambia, and Vietnam respectively[26,27,62]. The age effect on stigmatisation is bilateral i.e. for both patient and health personnel.

Gender aspects of tuberculosis:

Apart from being a global emergency, tuberculosis is also a symptom of global poverty as can be seen by the unequal distribution of both factors in the world[63]. Around 70% of a billion people living in absolute poverty are women[64]. Females are facing greater obstacles to seeking health-care and getting successful TB treatment. The issues of sex and gender have been acknowledged only recently. Before that, the impact of gender on health has been ignored and in TB control and research effort, gender was even considered unnecessarily[65]. Currently, many researchers consider TB control as a gender issue[63]. Diwan V and other researchers encouraged a gender-based approach to TB control that will assist understanding biological variations, cultural differences, and even structural violence leading to poverty, inadequate health care resources and increased risk of tuberculosis and death[63,66].

Generally, gender can be defined as; what it means to be male or female, and how that defines a person's opportunities, roles, responsibilities and relationships[67]. This definition makes gender encompassing features of males and females that are socially constructed, distinct from those features that are biologically determined (sex-linked) [68]. In other words, while sex refers to the physiological differences between men and women, gender refers to the variety of behaviours, expectations and roles that exist within a social, economical and cultural context[57,63].

Epidemiological estimations considered TB as the greatest single infectious killer of women. Tuberculosis kills more than one million women each year and around 646 million women are estimated to be infected with TB bacilli[63,69]. In the year 1998, about 750,000 women died of TB, and over three millions contracted the disease[65]. This account for about 17 million disability adjusted life years (DALY). Female mortality due TB is also considered greater than for all causes of maternal mortality[65,70]. In the developing countries, tuberculosis kills more women (aged 15-44 years) than any other infectious diseases including Malaria and AIDS[63,72]. Although the number of cases is higher among men, many researchers considered that TB case fatality rates are higher among women than among men[65,69,73]. Case fatality rates could be as much as 27-41% higher among girls and women between 5-24 years of age[65,70]. In Africa, mortality from tuberculosis is similar among young males and females[10,71]. The apparent similarity might be due to HIV-co-infection.

Globally, the prevalence of TB infection is similar between women and men until adolescence, after which it turns to be higher among males[74]. This observation is supported by epidemiological surveys that have shown similar prevalence rates and tuberculin positivity up to the age of 15 years[65,75]. After the age of 15 years the prevalence and tuberculin positivity rates are higher among males, although this difference is sometimes attenuated by the rapid progression from infection to disease among women in their reproductive age. Before the era of HIV, women in their young to early-middle ages showed this pattern of rapid progression to disease. Progression from infection to disease is as much as 130% higher among women aged between 10-44 years[65,70,74]. In addition, the BCG vaccination trial in Puerto Rico among tuberculin-positive participants showed a higher incidence of 18% among females compared to males[13].

In almost all setting it appears that female notification is one third of total TB notification. Out of all TB cases notified to WHO, the female: male ratio is 1/1.5-2.1[63,73]. Moreover, 70% more smear-positive male than female tuberculosis patients are diagnosed and notified to the WHO[63,66]. Actually, researches done in this field are insufficient to answer; why more males than females are diagnosed with TB. Studies in Malaria and Leishmaniasis have shown the same pattern of under notification[57]. A study in Thailand showed that six times as many men as women attended malaria clinics, although disease prevalence was the same in both sexes[76]. Active case finding in Colombia revealed that Leishmaniasis is to be equally prevalent among both sex, although previously it was considered twice as common in men[77].

The difference in TB-incidence rate of 2:1 is common in both developing and industrialized counties[62]. For example, this difference exists in the United State and has been considered as an explanation of higher prevalence of TB among men[13]. On the other hand, the notification rates among females aged 15-35 years was higher than among males in industrialized countries in the middle of twentieth century (1930s to 1950s). However, notification among males became higher as notification rates in these countries decreased over time[65,70,74].

The differences in incidence and prevalence of tuberculosis between women and males have been considered by not many studies. Several studies gave some explanations for this difference. Hereby, we will summarize some of the most important explanations.

- Socio-cultural and economic differences might lead to differences in the magnitude of exposure between men and women, especially after the age of 15 years, when men are expected to be more prone to higher exposure than women particularly in developing countries[78].
- There are differences in symptoms of tuberculosis between women and men. These differences might affect the suspicion index among health personnel leading to differences in the rate of investigations and eventually the rates of diagnosis[62]. A study in Vietnam reported that general unspecific symptoms such as fever, tiredness, anorexia and headache are significantly more reported by women than men. In addition, symptoms of cough, sputum expectoration and haemoptysis were statistically significant less common among female than in males[62]. Another study from Uganda showed that among the HIV-co-infected TB patients, women were younger, had lower body mass indices, and were more anaemic at the time of presentation than men[10]. The difference in reported symptoms could be due to socio-cultural or biological differences

between males and females. For example, a study from Japan suggested that the stage and extent of lung involvement be less advanced among females than among males as been demonstrated by that females have lower culture-positive rates than males[79]. This difference may lead to difference frequencies of respiratory symptoms. Some scientists and researcher suggested that males have stronger hypersensitivity to Mycobacterium[80,81,82]. A study from Japan showed that more males than female had a positive tuberculin reaction[81]. Another study in Kuwait among senior schoolchildren showed that boys have a delayed-type hypersensitivity reaction to more mycobacterial sensitins than girls as well as larger scars after BCG revaccination[82].

- The differences in notification rates between males and females could be due to under-reporting among women in low-income countries when relying on passive case finding. This suggestion was supported by a study from Nepal that showed that active case finding for tuberculosis brought more women and older people under care that would have been missed by passive case detection approach[65].

Aim:

The overall aim of this study is to determine the magnitude of the total pre-treatment period among newly diagnosed smear-positive pulmonary cases presenting to the National Tuberculosis Control Programme management units in Khartoum State.

Specific objectives:

1. To determine the magnitudes and contributions of both patient's and health system periods in the total pre-treatment period.

2. To determine the magnitudes and contributions of medical provider-and TBMU-periods in the total health system period and hence the total delay.

3. To investigate possible contributing factors that may explain delays in the diagnosis and treatment of newly diagnosed smear-positive TB patients.

4. To study the gender differences in the process of health seeking and delay among new smear-positive TB cases.

We are hoping to come up with sound recommendations and solutions that might give possibilities for better TB control in Khartoum State and the Sudan in general.

Hypothesis:

We presumed that around 80% of the newly diagnosed smear-positive TB cases in the setting of a well functioning TB programme experienced undue long pre-treatment periods of more than six weeks. Moreover, we think that, the factors that are contributing to longer health system periods are important determinants for the delays in the overall pre-treatment periods.

Design & Setting:

This study is a multistage randomized quantitative non-interventional cross-sectional study. Subsequently, a combination of both descriptive and analytical approaches has been selected to meet the main research questions and objectives.

The study has been conducted in Khartoum State, the capital of the Sudan. The total population of the state by the end of the year 2002 was found to be around 6 million. The state is divided into 7 provinces: Khartoum, Jabel Awlia, Omdurman, Karari, Ombada, Khartoum North, Sharg El Neil. Khartoum enjoyed a reasonable standard of health services compared to other parts of the country. The governmental (public) health sector consists of almost 360 functioning health units; seven large teaching hospitals (federal hospitals); 8 general hospitals (State's hospitals); 7 rural hospitals; 131 health centres; 25 primary health care centres (PHC); 161 functioning dispensaries; and 21 functioning dressing stations.

Khartoum was one among the first states in Sudan to apply DOTS strategy. By the end of the year 2002, Khartoum has been declared achieving DOTS allover i.e. one TB management unit (TBMU) for each 100,000 population. The total number of functioning TBMUs reached 59 units surrounded by almost 184 treatment centres (DOTS centres). The responsibility of the existing TB services in the state is shared by 3 different health authorities: the federal level has 11 TBMUs and 11 DOTS centres; the State ministry of health has 43 TBMUs and 168 DOTS centres; and Sudan council of churches, which is responsible about internally displaced camps, has its own 5 TBMUs and DOTS centres[34].

Khartoum has been selected to be the site of this study due to:

- Tuberculosis control enjoyed high political commitment in the state.
- Existence of well functioning TB programme in the state.
- The state established full coverage of TB services (DOTS allover).
- Almost one third of the total case notification in Sudan occurred in Khartoum state.

- The expanding private sector in the state is indistinctly involved in the process of TB control.
- Feasibility of the study area in terms of time, manpower, transport and budget.

During the course of this study, six out of the seven provinces of the state, have been selected randomly through a lottery technique; Khartoum, Jabel Awlia, Omdurman, Karari, Ombada, Sharg El Neil. In fact, we have excluded the federal hospitals from this study, when the policy of the Sudan National Tuberculosis Programme (SNTP) has been towards evacuation of tertiary referral hospitals and implementation of TB services into the PHC level. A total of 17 out of around 28 TBMUs, that score case finding higher than 10 cases per quarter, were selected from the TB centers of Khartoum State and Sudan Council of Churches (SCC) units:

a) Khartoum Province:	***d) Om Bada province:***
1. Ibrahim Malik hospital.	1. Rakha health centre.
2. El Shorta hospital.	2. Manara health centre.
3. Soba Aradi SCC health centre.	3. Andalos health centre.
	4. Salama II SCC health centre.
b) Jebel Awlia province:	***e) Sharg El Neil province:***
1. Jebel Awlia hospital.	1. Ban Jadid hospital.
2. Kalakla health centre.	2. Koko health centre.
3. Mayo farm SCC health centre.	3. Mojama' Islami health centre.
4. Eid Hussien health centre.	4. Kamboni health centre.
c) Omdurman province:	***f) Karari province:***
1. Abu Sied health centre.	1. Hara 54 health centre.

Patients and Sampling:

The total case detection of smear-positive new cases in Sudan ranged between 8761 cases in the year 1995 and 14075 cases in the year 1999, with an annual average case detection of 10923 new smear-positive cases (1995-2002) [37]. Khartoum represents the major source for case notification in Sudan, with an average case notification of new smear-positive cases of almost 4000 cases during the years 1997-2002[34]. During the period between the 1997 and 2002 the detection rates of new smear-positive cases were 60-75 cases per 100000 populations. Moreover, the new smear-positive cases comprise between 46%

and 51% of the total case detection in the state. The following table shows case detection in Khartoum state during the period 1997 to 2002 (table 3.1).

Table (3.1): Notification of new smear-positive TB-cases to all health levels in Khartoum State during the period 1997-2002

Year	New smear-positive cases	Total cases	Proportion of NSP/total cases
1997	3443	7525	46%
1998	4173	8156	51%
1999	4483	8749	51%
2000	4255	8523	50%
2001	3816	7485	51%
2002	3583	7867	46%

(Source: Sudan national tuberculosis programme 2003[37])

- NSP: new smear-positive cases.

The proportion of cases notified by TB facilities belonging to Khartoum state and SCC programmes, comprises around 16% of the total new smear-positive cases notified in the state in the year 1997. This proportion jumped to be 73% in the year 2002 due to the implemented decentralization policy of the National TB Programme. Table (3.2) shows the increment in proportions of case notification in TB facilities of Khartoum State and SCC.

Table (3.2): Summary of case notification in the facilities of Khartoum State and Sudan Council of Churches (SCC) during the period 1997-2002

Year	NSP-State centers	NSP - SCC centers	Total NSP: state + SCC	Total NSP (all facilities)	Proportion of State & SCC from total case finding
1997	138	408	546	3443	16%
1998	347	586	933	4173	22%
1999	1154	585	1739	4483	39%
2000	2109	719	2828	4255	66%
2001	2069	691	2760	3816	72%
2002	2058	564	2622	3583	73%

(Source: Sudan national tuberculosis control programme – 2003[37])

Patients:

The sample in this study consists of newly detected smear-positive pulmonary tuberculosis patients registered at the above-mentioned TB management units. The new smear-positive case was defined in this study as:

New Case: Patient who has never had treatment for tuberculosis, or who has taken anti-tuberculosis drugs for less than 1 month[17].

Smear-Positive Pulmonary Case: At least two initial sputum smear examinations (direct smear microscopy) AFB+; or one sputum examination AFB+ and radiographic abnormalities consistent with active pulmonary tuberculosis as determined by the treating medical officer; or one sputum specimen AFB+ and culture positive for *M. tuberculosis*[17].

In addition, our selection was governed by; the selected cases should be aged 15 years or above and being on treatment for less than 5 weeks. As clearly obvious, we had excluded other categories of TB patients from this study. Also we had excluded any new smear-positive case with treatment duration of more than 5 weeks to minimize problems of recall.

Generally, the overall aim behind this study was to measure the length of the pre-treatment period. On the base of research hypothesis, the proportion of those with more than 6 weeks pre-treatment period was around 80%. This estimation comes from a previous study by El Sony A., et al (2001)[47] that identified pre-treatment periods of 6-9 weeks in most of her study sample. A similar proportion was documented in Addis Ababa [25]. To calculate the sample size for this study, a margin of allowable error of ±5% was determined for this proportion, which means that, if in this study indeed 80% of the study units are found with delayed pre-treatment period, this proportion will be between 75% and 85% in the whole study population. Moreover, a confidence interval of 95% and the student formula for calculating a sample size were used to draw the sample size in this study[83].

$$N = \frac{Z^2 \times P(1-P)}{E^2}$$

N = number of observations needed

Z = 1.96 (confidence interval of 95%)

P = estimated prevalence (proportion of patient with total delay)

E = allowable error (0.05)

N=** $(1.96)^2$ $(0.80 \times 0.20) / (0.05)^2$ **= 246 study units

A total of 253 eligible patients were recruited to the study during the period between 25th of August 2003 and 30th of October 2003. These cases have been recruited to the study through a probability sampling technique. We followed a multistage sampling, as mentioned above to serve our purpose of getting a representative sample. The below stages have been followed to determine the final selection of study units:

Stage 1: we identified six out of seven provinces by simple random sampling using lottery selection.

Stage 2: in each province 1 to 4 TBMUs, with a case notification of more than 10 per quarter, had been selected by lottery technique simple randomization.

Stage 3: for each TBMU, all eligible new smear-positive cases registered during the data collection period were recruited.

Variables and definitions:

In order to measure the magnitude of delay during the course of TB diagnosis from appearance of first symptoms to initiation of treatment for new smear-positive pulmonary tuberculosis patients in this study, the following periods have been identified:

<u>Total Pre-treatment period:</u> The period from onset of symptoms to start of anti-TB treatment.

<u>Patient's period:</u> The period from onset of symptoms to the 1st contact with medical provider.

<u>Health system period:</u> The time period between first visit to a medical provider and the initiation of anti-tuberculosis treatment.

<u>Health provider-period:</u> the time interval from patient's first contact with a medical provider to presentation in the TB management unit (TBMU).

<u>TBMU-period (management unit period):</u> the time interval from patient's first presentation in the TBMU to initiation of anti-TB treatment.

The health provider (medical provider) represented any medical or paramedical personnel who received formal medical education and has a license to practice health care either within the private or the public health sectors.

Other variables that have been addressed in this research include; patient's socio-demographic characteristics; symptoms of onset; symptoms of presentation; trial of self-medications; knowledge of TB; suspicion of having TB; type and number of providers consulted before presenting to TBMU; type of investigations requested by those providers; type of diagnosis and treatment offered by providers; type of referral; distance to TBMU; type of investigation requested at the TBMU; and sputum positivity grading (see enclosed questionnaire Annex **II**).

Collection and analysis of data:

Data collection has been accomplished during a time period of two month (25th of August to 30th of October 2003). The main technique used for data collection was interviewing the eligible cases using an anonymous semi-structured questionnaire. Before starting data collection, we trained eight research assistants (6 newly graduated medical doctors and 2 medical) to participate in filling the study questionnaires. The TB district register book and the laboratory registry had been used to fill and cross-check some information such as sputum positivity grading, date of smear examination, and date of treatment initiation. The study subjects were identified in the TB registry and interviewed when they came to collect their medications. During the course of data collection we had experienced no problem of refusal; patients showed great willingness to participate in the study. The consent form attached to each questionnaire was strictly adhered to by each questionnaire-filler for each study unit. Some of the patients sign on this form while other put their fingerprints. The total number of the filled questionnaires was 267 questionnaires. Around 14 questionnaires were omitted due to lack of essential information and the difficulty of tracing their respondents. Another 46 patients were successfully rechecked for some missed information. The final number of questionnaires with high degree of reliable information was 253 questionnaires. Each research assistant used to handle his/her filled questionnaires personally. After revising each questionnaire, it was kept and filed before data entry.

Data Analysis:

The collected Data from study units had been entered into the Statistical package of social science version 11 worksheet (SPSS 11). During and after data entry, rigorous quality control checking was performed in order to ensure a high degree of completeness and internal consistency.

The use of Statistical package of social science (SPSS 11) during data processing made it easier to categorizing, coding, and summarizing the data on master sheets. Coding conventions i.e. using the same coding for common responses was followed during data processing.

The SPSS package was also used for data analysis. As most of our dependent variables were measure in a continuous scale, parametric test such as the independent-samples t-test and the one-way analysis of variance (ANOVA) were applied to determine mean differences between groups, when there was no violation for normality assumptions. Otherwise, non-parametric test such as Mann-Whitney U and Kruskal-Wallis tests were used in case of normality violation. Pearson product-moment correlation, partial correlation and Spearman’s rank order correlation were used to test correlations between the continuous dependent variables and other independent ones. Cross-tabulation and the Chi-Square test were most frequently used to examine associations between categorical variables. Furthermore, multiple regressions had been used to determine the semi-partial correlations between our independent variables with the main dependent variables rather than to determine delay predictors. The aim of using regression was to determine the unique contribution of each independent variable in the variance of the dependent variable.

Ethical consideration:

The research has been ethically cleared by the ethical committee in Norway. In addition approval for conducting this study and gathering of its data from study units was secured by the Sudan Federal ministry of health through the National Tuberculosis Control Programme and also through the department of preventive medicine in the Khartoum State Ministry of Health. Approval letters were forwarded to the medical directors of the selected health facilities. Before getting through a process of interviewing of study subject, a written consent (annex **II**) was presented to those subjects to be signed in case of willingness to participating in the study. In the case of illiterate study subjects, the research assistant in the presence of neutral witness used to read the consent form. Both the interviewee and the witness have to sign (or fingerprint) on the form. In the consent form, emphasis has been made on the following four conditions for participation:

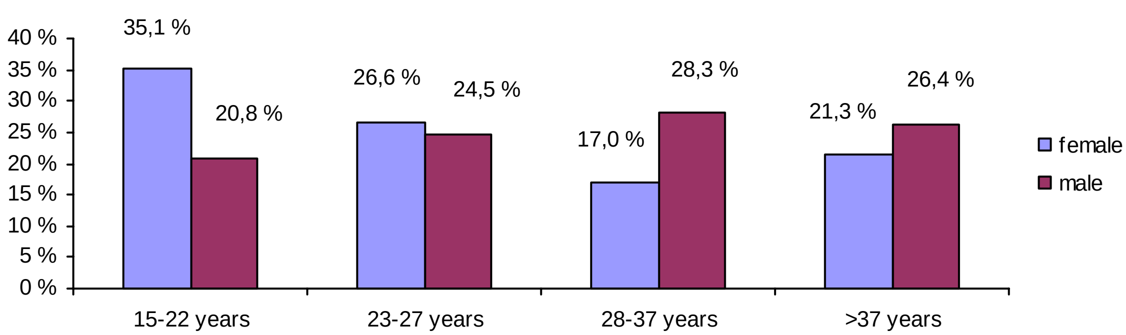
- The free will to participate or to refuse.
- The opportunity to withdraw even after signing the consent form.
- To answer or skip any question in the questionnaire.
- Confidentiality of information.

On the other hand, emphasis has been made on that subject's participation or rejection of participation in the study has no consequence on the patient's situation at the treating center. This issue was strictly elaborated for both research assistants and other health workers at the TB management units. We are glad to mention that patient's participation was due to patient's initiative rather than being a compulsory burden on patient's shoulders.

4.1 Overview of the study sample

In this study, a total of 253 new smear-positive pulmonary tuberculosis cases had been recruited to comprise the study sample. The study sample consisted of 94 female cases (37.2%) and 159 male cases (62.8%). These proportions exposed a difference in sex representation with male dominance and male to female ratio of almost 2:1. The Chi-Square goodness-of-fit test revealed significant difference in gender split in our sample (X^2 *(1) =16.70, P< 001*) that reflected that men were more likely to be notified for TB. The patients' ages ranged between 15 and 85 years. The median age was 27.0 years (mean 30.8 ± 12.35). Females showed lower median-age compared to males, 25 years (µ28.88 years ±12.45) to 29 years (µ 31.96 years ± 12.19) respectively. This difference was found not statistically significant when a two-tail t-test for independent groups was applied (*t (251) = -1.93, p > 0.05*). As shown in figure (4.1), the proportion of males tends to exceed that of females in age groups above 28 years. The Chi-Square test showed that the differences between males and females in age distribution were statistically significant (X^2 *(3) = 8.52, P = 0.036*).

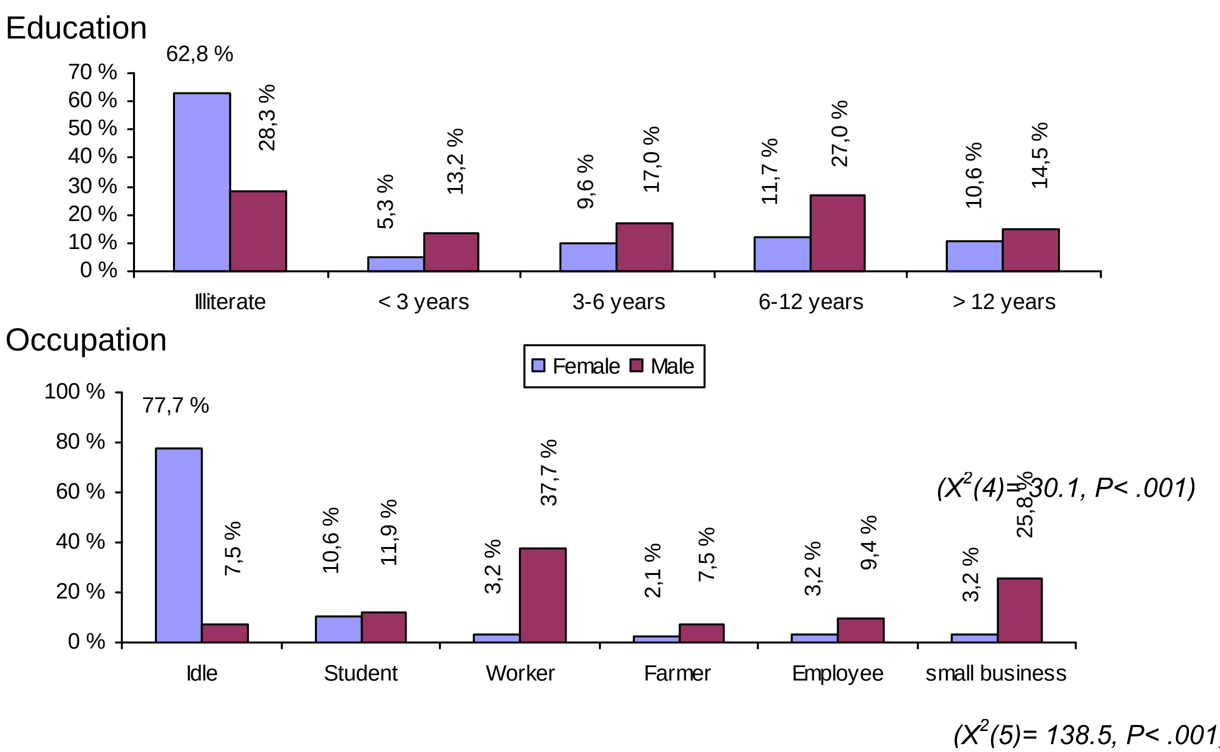
Figure (4.1): Age distribution in relation to patient's sex among 253 new smear-positive TB cases in Khartoum, August-October 2003



Among respondents, 134 patients (53%) were married, 110 patients (43.5%) were single, and 10 patients (3.6%) were either divorced or widowed. Differences in marital status among the whole study units were found statistically significant (X^2 *(2) = 222.91, P < .001*). Sixty out of ninety-four females (63.8%) were married compared to 74 males (46.5%), while 82 out of 159 males (51.6%) were single compared to 28 females (29.8%). Differences in marital status between females and males were statistically significant (*X^2 (2) = 13.14, P = .001*).

Illiteracy was found to be dominant in this population, when 104 patients (41.1%) were illiterate, 26 patients (10.3%) with less than 3 years of schooling, 36 patients (14.2%) with 3 to 6 years of schooling, 54 patients (21.3%) with 6 to 12 years of schooling, and 33 patients (13.0%) with more than 12 years of schooling. The difference in patient's educational levels was found statistically significant according to the Goodness-of-fit Chi-Square test (*X^2 (4) = 78.88, P < .001*). On testing educational levels against patient's sex, the difference was also found statistically significant as shown in figure (4.2), indicating lower female access to education.

Figure (4.2): Education levels and occupation in relation to patients' sex among 253 new smear-positive TB cases in Khartoum



Similarly, it has been found that 85 patients (one-third of the study sample) were either without income generating jobs (idles or housewives). The rest of the study units were distributed as; workers (24.9%), running small business (17.4%), students (11.5%), employees (7.1%), and farmers (5.5%). The distribution of occupation within the study sample was found to be statistically significant according to the Goodness-of-fit Chi-Square test (X^2 *(5) = 90.66*, *P< .001*). This distribution came out to be influenced with both patients' sex and level of education, since 85.9% of those without income-generating activities were females compared to only 14.1% of males and the majority of students, employees, workers and those running small businesses were found to be males. These differences were found to be statistically significant according to the Chi-Square test (figure 4.2). Also, about 57% of the illiterate patients were without income generating jobs, and 69.4% of those without income generating jobs were illiterate.

On transforming family monthly incomes into US-Dollars, the majority of patients (85.0%) claimed monthly incomes of less than 100$, while only 4.7% of the patients reported family incomes of more than 200$ per month. The goodness-of fit Chi-Square test showed that income variations were statistically significant ($X^2(2) = 304.85$, $P < .001$). Although above-mentioned approximations might be imprecise, they gave a general clue about the association between poverty and tuberculosis. In addition, most of the patients (91.7%) were coming from households with more than 3 family members and more than half of the patients (51.4%) were living in over-crowded households with more than 7 family members (X^2 *(2) = 75.99, P< .001*).

The durations of patients' residence in their localities were significantly variable (X^2 *(2) =78.39, P < .001*), most patients were living in their locality for more than 3 years (58.9%). Those who lived in the locality for less than one year represent 25.7% of the study sample. Sex has been found with no significant association with duration of living in the locality.

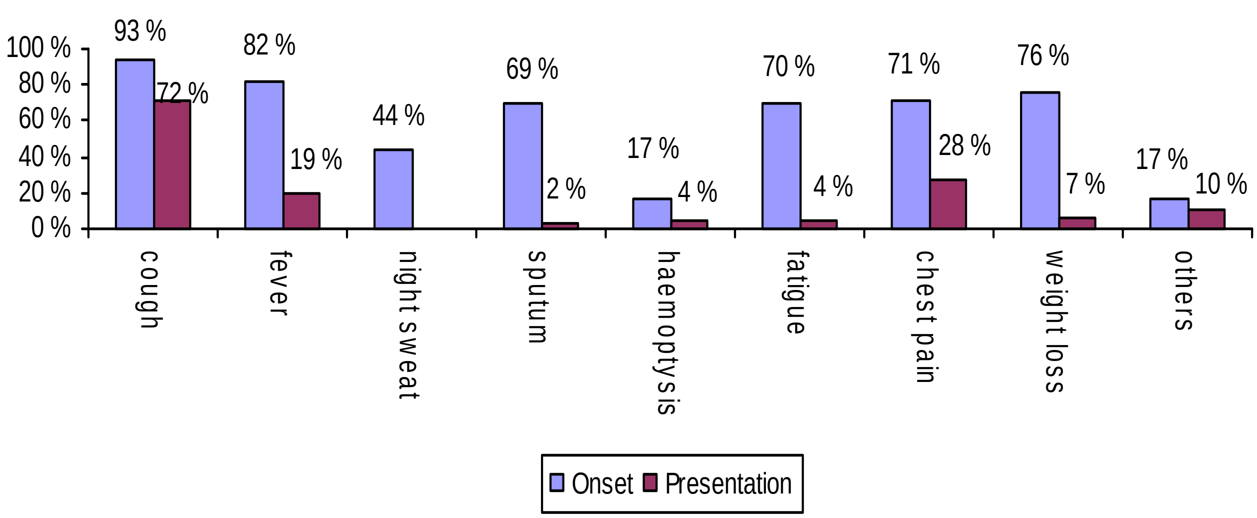
4.2 Symptoms of onset and presentation:

The patients in this study tended to report multiple symptoms of onset. Cough was the most common symptom of onset and was reported by 236 patients (93.3%), then fever was reported by 207 cases (81.8%), followed by weight loss

(76.3%), chest pain (70.8%), fatigue (70.4%), sputum production (69.2%), and night sweats (43.9%). Haemoptysis reported by only 43 patients (17%), was the least common symptom of onset. Some patients (17%) reported other non-specific symptoms such as nausea, loss of appetite, and diarrhoea. When patients were asked to nominate the most important symptom(s) that led them to seek health care, cough was the most common symptom of presentation. A total of 181 patients (71.5%) reported cough, followed by chest pain (27.7%) and fever (19.4%). Reporting of weight loss, fatigue, haemoptysis, and sputum production was 6.7%, 4.3%, 4%, and 2.4% respectively. No patient had nominated night sweating as a symptom of presentation. In addition, 9.9% of the cases nominated other non-specific symptoms.

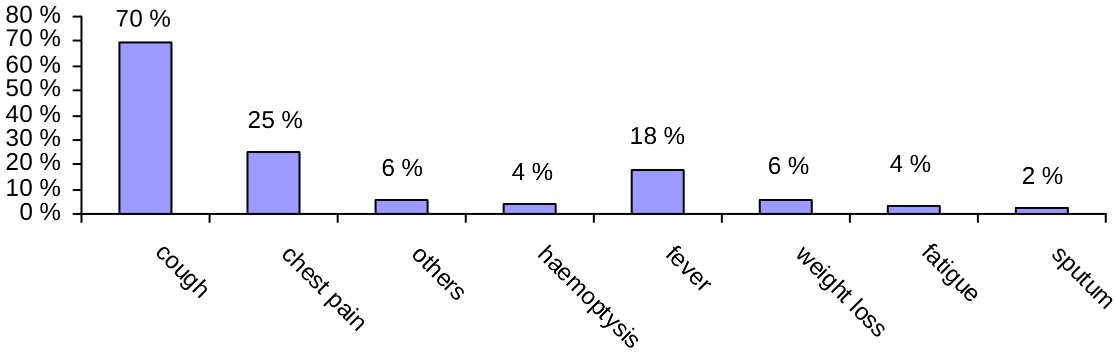
There were no major differences in symptoms of onset/presentation between female and male patients. While fatigue was the only symptom significantly more common among males than females (*P= .02*), this sex difference disappeared on presentation to health system. Fifty-eight female patients (61.7%) reported fatigue on onset compared to 120 male patients (75.5%). The following figure (4.3) shows the reported symptoms of onset and presentation among the study sample.

Figure (4.3): Symptoms of onset and presentation among 253 new smear-positive TB cases in Khartoum



On comparing the symptoms of onset with the symptoms that urged patients to seek care, cough was the most key symptom if experienced at onset to urge care seeking. This was obvious when about 70% of the patients had reported cough at onset and also at presentation (figure 4.4).

Figure (4.4): Proportions of patients who reported the same symptom for both onset and presentation



4.3 Overview of pre-treatment periods:

Firstly, I will describe different intervals comprising total pre-treatment period, then each period will be described separately. As mentioned in the methods chapter, total pre-treatment period has been divided into two main components:

1. Patient's period
2. Health system period

The health system period is sub-divided into

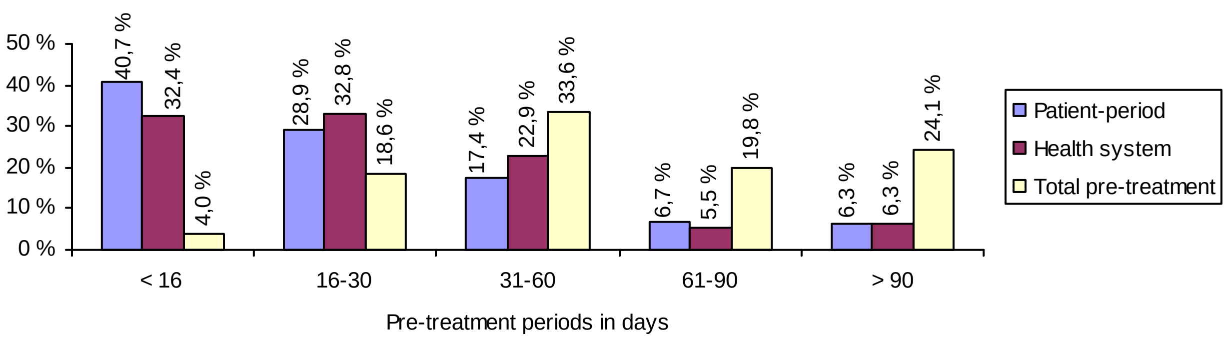
3. Medical provider's period
1. TBMU-period

Table (4.1): Parameters of pre-treatment periods among the study sample

Period		N	Mean ± SD	Median	Min	Max
Patient		253	33.85 ± 34.24	21.0	1	180
Total health System		253	32.88 ± 30.74	24.0	4	180
	Provider	217	31.88 ± 30.91	21.0	1	180
	TBMU	253	5.57 ± 06.48	4.0	0	30
Total pre-treatment		253	66.75 ± 44.19	53.0	11	205

Table (4.1) presents means, standard deviations, medians and ranges for the different periods comprising the total pre-treatment interval. It was obvious that there were great differences in scores among patients. The distribution of these scores was almost always positively skewed with few high-score values aggregating at the tails. It has been found that 103 patients (40,7%) experienced total pre-treatment less than 45 days, while 150 cases (59,3%) delayed more than one and half month. The mean total pre-treatment period among this group was 29.1 days ± 9.69 (median: 29 days). The mean total pre-treatment period among cases with delayed periods of more than 45 days was 92.6 days ± 39.77 and the median was 81days (almost three months). As shown in figure (4.5), only 57 of our cases (22.6%) had experienced total pre-treatment periods of one month or less.

Figure (4.5): Summary of the Pre-treatment periods among 253 new smear-positive TB cases in Khartoum



4.4 Patient-period:

As illustrated in table 4.1 above, the median patient's period for the overall study sample was 21 days (µ 33.85 days). In addition, 103 patients (40,7%) had consulted any kind of medical providers within a period of less than 16 days, meanwhile 23 patients (13%) delayed for more than two months (figure 4.5).

The mean patient's period among females was 35.6 days (SD 32.68) compared to 32.8 days (SD 35.19) for male patients. An independent samples t-test revealed no significant mean-difference between males and females ($t\ (251) = 0.611,\ P > .05$). Similarly, there was no significant association between patient's periods and patient's sex, as exposed by the Chi-Square test of independence. Thirty-one female patients (one-third of all female patients) and 64 male patients (40.3% of all males) experienced patient's periods of less than two weeks, whereas about one-third of female patients and 28% of males experienced periods of more than one month before contacting any medical-care facility. The means of the patient-period were 30.9, 38.3, 30.2, and 35.9 days for the age groups 15-22 years, 23-27 years, 28-37 years, and above 37 years respectively. The One-way analysis of variance (ANOVA) revealed no significant mean differences associated with age groups, as well as the Chi-Square test of independence showed no significant association between age distribution and length of patient's period (X^2 *(6) = 7.801, P> 0.05*).

Table (4.2): means and medians of patient-period in relation to patients' socio-economic patient's characteristics:

Variable	N	Mean ± SD	Median	Comment
Education				
Illiterate	104	39.05 ± 37.06	30.00	
< 3 years	26	23.42 ± 18.56	21.00	
3-6 years	36	32.08 ± 35.29	18.00	*NS (KW)*
6-12 years	54	30.44 ± 31.57	21.00	
> 12 years	33	33.18 ± 34.24	21.00	
Occupation				
Idle/housewife	85	36.38 ± 34.43	21.00	
Student	29	33.93 ± 28.14	30.00	
Worker	63	37.94 ± 40.49	21.00	
Farmer*	14	53.21 ± 47.07*	32.50	*S (KW)*
Employee*	18	15.67 ± 17.57*	10.50	
Small business	44	24. 34 ± 22.20	21.00	
Residency				
< 1 year	65	38.12 ± 38.18	30.00	
1-3 years	39	41.44 ± 39.99	25.00	*NS (KW)*
> 3 years	149	30.00 ± 30.29	21.00	
Family income				
< 100$	215	34.49 ± 33.75	21.00	
100-200$	26	25.42 ± 38.24	07.00	*NS (ANOVA)*
> 200$	12	40.58 ± 34.24	37.50	
Number of family				
< 3 members	21	43.48 ± 37.24	30.00	
3-7 members	102	32.18 ± 32.97	21.00	*NS (ANOVA)*
> 7 members	130	33.61 ± 34.74	21.00	

Significant at P<0.05
NS = No significant difference, S = Significant difference, asterisks indicate significant differences

Level of education, occupation, residency, family monthly income, and number of family members living with the patient in the same household were tested for mean differences in patient's periods by using one-way analysis of variance (ANOVA) or Kruskal-Wallis test when there were violation to homogeneity of variance in the ANOVA test. As shown in table (4.2), the only variable with significant difference was found to be patient's occupation. The Kruskal-Wallis test revealed significant differences in the ranks between different occupational categories (X^2 *(5) = 15.44, P = 0.009*). The actual difference used to be between farmer and employee patients with mean patient-periods of 53.21 and 15.67 days respectively.

Factors influencing the length of patient-period:

An ascending pattern related to level of education was observed among cases with patient's periods of less than two weeks; 29.8% of illiterates, 38.5% of those with education less than 3 years, 41.7% of those with 3-6 years education, 44.4% of those with 6-12 years education, and 45.5% of those with education more than 12 years. This pattern was lost for other patient's periods (15-30 days and more than one month). Regarding patient's periods of more than one month, higher percentages were recorded for illiterates (35.6%), 3-6 years education (33.3%), and more than 12 years education (30.3%). The Chi-Square test of independence revealed no significant relation between patient's period and level of education.

Although there was no significant association between different types of occupation and patient-period, the majority of the employee patients (72%) seemed to have shorter patient's periods of less than two weeks compared to 41% of those running small business, 40% of the workers, 38% of the students, 29% of the idle patients, and 21% of the farmers. On the other hand, only 11% of the employee patients reported delay of more than one-month, compared to 21% of those running small business, 32% of the workers, 33% of idle patients, 38% of the students, and 50% of the farmers(X^2 *(10) = 18.213, P= 0.051*). Similarly, the duration of residency in the locality has no significant association with the length of patient-period, although three-quarters of patients living in their locality for more than 3 years showed patient's periods of one month or less, while more than one-third of those living in the locality for 3 years or less showed patient's durations of more than one month. Apparently, family monthly income tended to have an association with the length of patient's period. Although we can not rely on the significance of the Chi-Square test of independence because more than 33% of the cells have expected count less than five, among the 12 patients with family income of more than 200$ per month 50% experienced periods of more than one month. Those with income 100-200$ were less likely to delay more than one month. As shown in table 4.3, distribution of patient's periods among those with family income of less than 100$ per month seems to be evenly. Although statistical significance of association between income and patient's period has been achieved, still less can be explained by income (*Cramer's V = .156)*.

Finally, the number of persons living in the same house with the patient has no significant association with the length of patient's period.

Table (4.3): The association between family income and length of patient's period

Family income/month	Patient's periods			Total	
	< 15 days	15 - 30 days	> 30 days		
< 100 $	74 34.4%	75 34.9%	66 30.7%	215 100%	
100 - 200 $	17 65.4%	4 15.4%	5 19.2%	26 100%	X^2 *(4) = 12.25, P = 0.016*
> 200 $	4 33.3%	2 16.7%	6 50.0%	12 100%	

When patients were assessed on their knowledge about TB and if they suspected having disease, 74 patients (29.2%) showed adequate knowledge about disease. Among all patients, only 36 cases (13.8%) had suspected that their symptoms might be TB.

Knowledge about TB has been strongly associated with suspicion of having the disease (Eta^2=.223), that 39.2% of patients with adequate knowledge about TB suspected having the disease, compared to only 3.4% of those without any previous adequate knowledge. The Fisher's Exact test showed a significant association between knowledge and suspicion of disease (*P< 0.001*). Also the magnitude of association was found to be moderately strong (*Φ = 0.471, sig.* <

0.001). Fascinatingly enough, there was no significant difference in the mean patient's period between: those with knowledge about disease (*μ: 31.09* ± *34.25*) and those without (*μ: 34.99* ± *34.27*); those suspected having TB (28.14 ± 28.24) and those certainly not (*μ 34.77* ± *35.08*); (*t (251) = 0.822, P> 0.05*) and (*t (251) = 1.063, P> 0.05*) respectively. In addition, the Chi-Square test of independence revealed no significant association between length of patient's periods and patients' knowledge/suspicion (see table 4.4).

Table (4.4): Associations between length of patient periods and knowledge, suspicion of TB, and trial of self-treatment

	Patient's period			
	< 15 days	15 - 30 days	> 30 days	Total
Patient's knowledge about TB				
Not adequate	61 34.1%	63 35.2%	55 30.7%	179 100%
Adequate	34 45.9%	18 24.3%	22 29.7%	74 100%
Suspicion of having TB				
No	79 36.2%	70 32.1%	69 31.7%	218 100%
Yes	16 45.7%	11 31.4%	8 22.9%	35 100%
Trial of self treatment				
No	68 42.5%	47 29.4%	45 28.1%	160 100%
Yes	27 29.0%	34 36.6%	32 34.4%	93 100%
Total	95 37.5%	81 32.0%	77 30.4%	253 100%

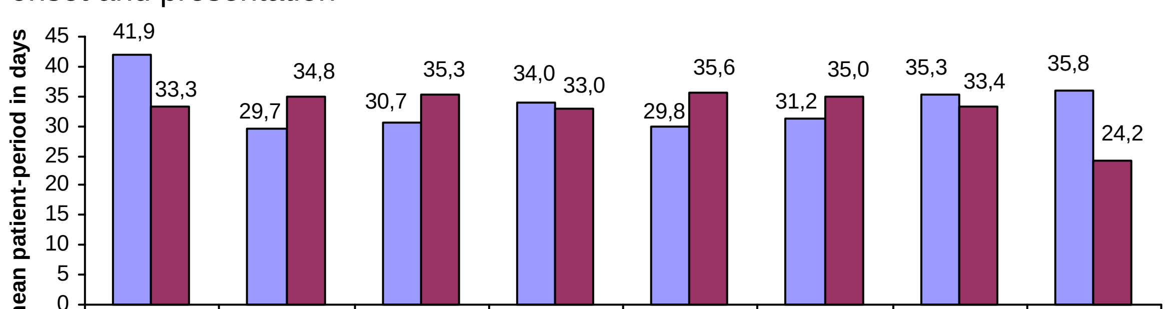
Sig. < 0.05, NS: not significant

Only 93 patients (37%) stated they had tried some sorts of self-medications before getting in touch with any health facility. Patients who had never tried any self-medication reported shorter means of patient's period (*μ 32.24* ± *35.34 days*) compared to those who tried self-treatments (*μ 36.62* ± *32.26*). This difference was found not significant according to a two-sample independent t-test (*t (251) = -.982, P>0.05*). Although 42.5% of those who tried no self-medication reported shorter patient's periods of less than two weeks compared to 29% of other category, still this difference was not significant statistically according to the Chi-

Square test of independence (see table 4.4). Among the 93 patients who tried self-medication, 37.6% of them tried herbal remedies, 41.9% cough suppressants or antibiotics, and 20.4% other traditional remedies (e.g. cauterization, cutting the uvula). Chi-Square test of independence revealed no significant association between type of self-treatment and length of patient's periods, in spite of that using antibiotics or cough suppressants was apparently associated with patient's periods of more than one month (50% of those delayed more than one month had used antibiotics or cough suppressants).

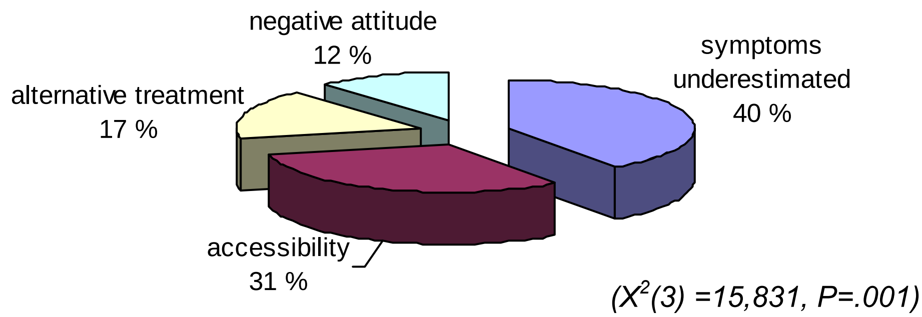
Except for patients that experienced non-specific symptoms such as nausea, diarrhoea and etc, there were no significant differences in the means of patient's period in relation to symptoms of onset. Patients who had non-specific symptoms experienced low patient-periods' means of 11days lesser than those without such symptoms. This difference was statistically significant according to the independent-sample t-test. The Chi-Square test of independence revealed statistically significant differences, since 58% of those with non-specific symptoms had patient-periods of less than two weeks, while only 18.6% of them delayed more than one month before seeking care (*X^2 (2) = 9.473, P< 0.01*). The magnitude of this association was found to be small (*Cramer's V=.194, P<.01*). This denoted that experiencing non-specific symptoms on onset was more likely to reduce the length of the interval before seeking care. On the other hand, there were no significant mean differences of patient's period for all symptoms that led patients to seek care (see figure 4.6).

Figure (4.6): mean differences of the patient's period in relation to symptoms of onset and presentation



Out of the 149 patients (58.9% of all) who experienced patient's period of more than 3 weeks, 49 patients (32.9%) evaluated their symptoms as unserious, 37 patients (24.8%) claimed accessibility difficulties (physical or financial), 36 patients (24.2%) claimed that they feared negative attitudes if diagnosed as TB, and the rest (18.1%) believed in the efficacy of alternative remedies and self-treatment. Those who feared negative attitudes reported the least mean patient's periods (39.61 ± 34.92 days), followed by those who believed in the efficacy of alternative treatment (51.74 ± 30.12 days), and those who had underestimated their symptoms (52.12 ± 27.81 days). The uppermost mean patient's period was attained by those who claimed accessibility difficulties (62.08 ± 41.31 days). The one-way analysis of variance (ANOVA) revealed an insignificant overall mean differences between these groups ($F(3) = 2.612$, $P = 0.054$), even though the Post Hoc multiple comparisons using LSD test revealed a significant mean difference of 22.47 days between patients with accessibility difficulties and those who feared of negative attitudes (*P< 0.01, 95% CI: 6.57-38.37*). Furthermore, among the 77 patients who delayed more than one month, underestimation of the seriousness of symptoms and claims of accessibility difficulties were the main patients' reasoning for such delay, compared to fearing negative attitudes and trial of alternative treatments (Figure 4.7).

Figure (4.7): Patient's reasoning for delaying more than one-month among 77 new smear-positive TB cases in Khartoum – August to October 2003



4.5 Health system periods:
4.5.1 Provider period:

A total of 217 patients (85.8% of all patients) had consulted at least a medical provider before ending at the TBMU. Among those patients, 76 cases were females (80.9% of all female patients) and 141 cases were males (88.7% of all male patients). There was no significant difference between proportions of males and females who visited medical providers.

It has been found that 144 patients (66.4%) consulted public providers only, 41 patients (18.9%) consulted only private providers, 21 patients (9.6) consulted both private and public providers, and only 11 patients (5.1%) consulted other types of providers (NGO clinic or pharmacist). The median number of providers visited by patient was 2 providers (µ 2.05 ± 1,207) and that of the number of visits was 3 visits (*µ* 3.54 ± 2.156). The minimum number of providers visited by patients was 1 provider and that of visits was 1 visit, while the maximum number of providers was 8 and that of visits was 12 visits. The One-Way ANOVA revealed significant mean differences in the number of providers and the number of visits in relation to provider's type (*F (4) = 2.956, P = .02*) and (*F (4) = 2.647, P= .03*) respectively. The lowest means were related to private and public providers, while visiting both providers was accounting for higher mean values. Post Hoc multiple comparisons using LSD test revealed a significant difference in means of number of providers between private or public and both types of providers with mean differences of -1.00 and -.88 provider respectively (*P= .002*). In addition the mean difference between the number of visits to public provider compared with visits to both providers was 1.52 visits (*P=.002*), and that between private and both providers was 1.44 visits (*P=.01*) (see table 4.5).

Table (4.5): Mean differences in number of providers visited and number of visits in respect to type of provider consulted.

	Number of providers consulted		Number of visits to providers
	N	Mean ± SD	Mean ± SD
Public provider	144	1.98 ± 1.2[a]	3.33 ± 2.1[a]
Private provider	41	1.85 ± .9[b]	3.41 ± 2.0[b]
Other providers	6	2.00 ± .9	4.17 ± 1.9
Pharmacist	5	2.40 ± 2.1	4.20 ± 3.3
Both public & private	21	2.86 ± 1.4[a,b]	4.86 ± 2.3[a,b]
Total	217	2.05 ± 1.2	3.54 ± 2.2

[a] and [b] indicate significant difference of less than .05

The median provider-period was 21 days (µ: 31.88 ± 30.91 days). The mean provider's period for females was 34.21 days ± 29.31 (median 30 days) and that for male patients was 30.62 days ± 31.78 (median 20 days). An independent-sample t-test revealed no significant mean differences related to sex (*t (215) =.816, P>0.05*). Among the 66 patients who experienced provider-periods of more than one month, the mean provider-period for the 26 female patients was 64.5±31.3 days, while that for 40 male patients was 67.8±38.09 days. The independent-sample t-test showed insignificant mean difference between male and female patients (*t (64) = -.371, P> .05*).

The Pearson correlation coefficient was used to test correlation between age and length of provider's periods, which revealed negative directional non-significant correlation (*r (217) = -.123, P> 0.05*). The age group 15-22 years (56 cases) recorded a mean provider-period of 37.63 ±36.75 days, age group 23-27 years (52 cases) recorded 33.19 ±33.92 days, age group 28-37 years (54 cases) recorded 28.70 ± 20.44 days, and patients above 37 years recorded 27.89 ± 29.81 days. Kruskal-Wallis test has been used to examine the significance of mean differences related to age, the result was found statistically insignificant (X^2 *(3) = 1.842, P>0.05*).

Although divorced and widowed patients had higher mean of provider periods, marital status has no significant impact on the means of provider-periods as elicited by one-way ANOVA (see table 4.6). Even though the One-Way ANOVA revealed no significant overall mean differences between different groups of education in relation to provider-periods, Post Hoc multiple comparison using LSD test revealed that the mean provider-period was significantly higher for patients with education of 6-12 years compared to those illiterate patients (*P=0.02*) or those with less than 3 years education (*P=0.03*) (see table 4.6).

Furthermore, the one-way analysis of variance exposed no significant overall differences between categories of occupation in relation to means of provider-period (*F (5) = 1.44, P> 0.05*), though the Post Hoc multiple comparison using LSD test revealed significant mean differences between employees and farmers (see table 4.6). Here we had transformed provider periods into natural logarithms to achieve normality of distribution and to avoid violation of homogeneity of variance.

In addition, patients who lived in their locality for more than three years showed lower mean provider-periods of 28.99 days (median: 20 days) compared to other categories. Again, the One-Way ANOVA revealed no significant difference of means between residence groups (*F (2) = 1.344, P> 0.05*) (see table 4.6). Finally, different categories of both family income and number of family members showed no significant mean differences in terms of provider-periods, although patients from smaller families (less than 3 members) showed lower mean periods (see table 4.6).

Table (4.6): means of provider-period in relation to demographic and socio-economic characteristics of study sample

	N	Mean ± SD	Median	Comments –overall test
Marital status				
single	98	33.99 ± 33.205	21.0	ANOVA:NS
married	110	29.39 ± 28.298	21.5	
divorced or widow	9	39.22 ± 36.379	25.0	
Education				
illiterate	81	26.75 ± 21.612*	21.0	ANOVA: NS
< 3 years	25	23.56 ± 25.425*	15.0	

3 to 6 years	31	31.39 ± 28.762	25.0	
6 to 12 years	49	43.84 ± 43.112*	30.0	
> 12 years	31	33.55 ± 30.847	21.0	
Occupation				
idle	68	32.74 ± 28.965	26.5	ANOVA: NS
student	27	40.48 ± 40.595	21.0	
worker	57	29.00 ± 28.489	21.0	
farmer	11	19.64 ± 16.681*	15.0	
employee	15	46.80 ± 43.005*	31.0	
small business	39	26.33 ± 25.405	20.0	
Residency				
< 1 year	56	35.63 ± 32.736	27.0	ANOVA: NS
1 - 3 years	34	36.47 ± 36.362	24.0	
> 3 years	127	28.99 ± 28.353	20.0	
Family income				
< 100 §	182	31.60 ± 29.507	21.0	ANOVA: NS
100 - 200 §	23	34.26 ± 43.881	15.0	
> 200 §	12	31.50 ± 23.972	30.0	
Family members				
< 3 persons	17	20.12 ± 12.559	18.0	ANOVA: NS
3 - 7 persons	86	30.90 ± 28.263	23.0	
> 7 persons	114	34.37 ± 34.289	21.0	
Total	217	31.88 ± 30.914	21.0	

Significance < 0.05, NS= not significant, asterisk indicate significant difference. Asterisk: Post Hoc multiple comparisons using LSD test revealed significant mean differences.

The mean provider-period seems to be shorter if classical symptoms of tuberculosis had been experienced by patients at onset. Although this observation lacked statistical significance but the means of provider-period were lower for cough, night sweats, sputum expectoration, and weight loss (table 4.7).

Table (4.7): mean differences in provider-period in relation to symptoms of onset and presentation (Independent-samples t-test with df of 215)

		Onset		Presentation	
		N	Mean ± SD	N	Mean ± SD
Cough	No	15	31.93 ± 30.459	60	35.20 ± 34.853
	Yes	202	31.87 ± 31.022 ns	157	30.61 ± 29.290 ns
Fever	No	37	26.05 ± 18.538	177	32.25 ± 32.145
	Yes	180	33.07 ± 32.797 ns	40	30.20 ± 25.024 ns
Night sweating	No	116	33.53 ± 29.724		
	Yes	101	29.97 ± 32.269 ns		

Sputum	No	62	36.23 ± 38.147	212	31.98 ± 31.153
	Yes	155	30.14 ± 27.447 ns	5	27.60 ± 19.680 ns
Haemoptysis	No	177	31.53 ± 30.617	207	31.46 ± 30.662
	Yes	40	33.42 ± 32.551 ns	10	40.40 ± 36.494 ns
Fatigue	No	60	29.72 ± 23.307	209	32.19 ± 31.305
	Yes	157	32.70 ± 33.396 ns	8	23.63 ± 16.978 ns
Chest pain	No	64	39.22 ± 36.788*	163	31.88 ± 30.122
	Yes	153	28.80 ± 27.657*	54	31.85 ± 33.486 ns
Weight loss	No	46	34.52 ± 31.973	202	31.05 ± 29.332
	Yes	171	31.16 ± 30.680 ns	15	43.00 ± 47.428 ns
Other symptoms	No	180	31.37 ± 30.793	197	30.80 ± 29.272
	Yes	37	34.35 ± 31.804 ns	20	42.50 ± 43.524 ns

ns: not significant, asterisk: significant mean difference

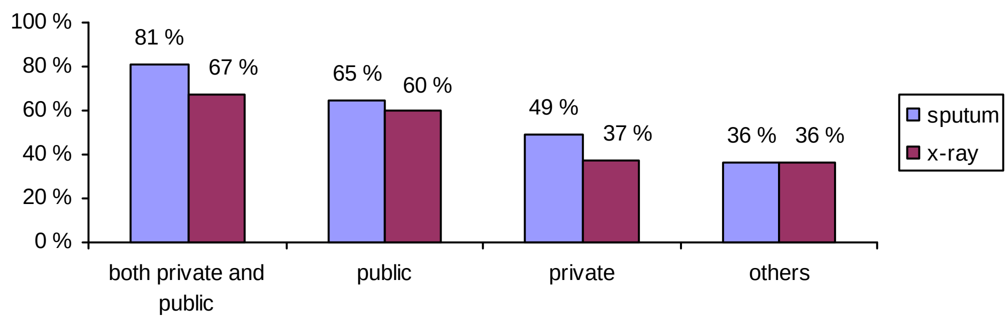
In contrary, presence of fever, haemoptysis, fatigue, and other non-specific symptoms raised the means of provider-periods. Furthermore, chest pain was the only symptom of onset with significant mean difference between groups. The independent-samples t-test revealed a significant statistical mean difference of 10.4 days between patients with chest pain at onset (28.8 days) and those without (39.2days) (*t (215)= 2.309, P= 0.02*).

Lower means of provider-period were associated with the experience of cough, fever, sputum expectoration, fatigue, and chest pain among the symptoms that urged patients to seek medical care. On the other hand, patients who experienced haemoptysis, weight loss, and non-specific symptoms showed higher means of provider-period (table 4.7).

Visiting public providers was associated with shorter mean of provider-period of 29.7 days compared to visiting private (*μ* 31.4 days), other provider (*μ* 35.8 days), pharmacist (*μ* 37.4 days), and both public and private providers (*μ* 45.1 days). The overall mean differences between groups were insignificant statistically when One-Way ANOVA has been applied (*F (4)= 1.213, P>0.05*), whereas Post Hoc multiple comparisons using LSD test revealed significant difference of 15.4 days between the means of visits to public provider and visits to both private and public providers (*P= 0.03, 95% CI 1.21-29.6*).

Regarding sputum and x-ray performance among different types of providers, there were associations between rates of performance of these investigations and type of medical provider. Visiting both public and private providers was associated with higher rates of performing sputum (81%) and x-rays (66.4%). Public providers performed sputum examination for 65.3% of their TB-suspects, while sputum was performed for 48.8% of the patients who consulted private doctors. The Chi-Square test revealed significant differences between providers in terms of sputum (X^2 *(3) = 10.10, P=.019*) and x-ray performance (X^2 *(3) = 10.03, P=.018*) (see figure 4.8). In addition, it was clearly obvious that there were no great differences in respect of ordering sputum and x-ray by each provider.

Figure (4.8): Performance of Sputum and X-ray in relation to the type of providers among 217 new smear-positive TB cases in Khartoum

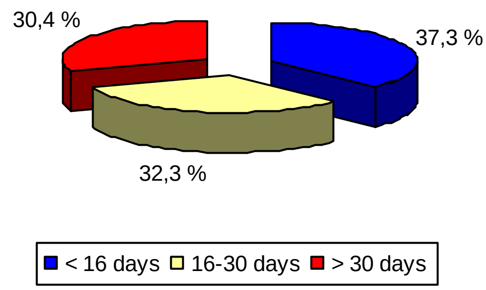


Among the 217 patients who visited medical providers before ending at TBMUs, TB diagnosis was reached for 130 cases (59.9%) and anti-TB treatment was prescribed for 111 cases (51.2%). TB diagnosis and treatment were more common for patients visiting both private and public providers (66.7% and 76.2% respectively). Public providers were more likely than private providers to reach TB diagnosis (64.6%: 46.3%) and to prescribe treatment (56.3%: 31.7%). Consulting other providers such as pharmacist or NGO clinic was associated with the lowest rates of TB-diagnosis (36.4%) and prescription of anti-TB treatment (9.1%). The Chi-Square test exposed statistically significant association between type of provider and possibilities of reaching TB diagnosis and prescribing treatment (X^2*(3) =7.39, P<.001*).

Factors associated with provider periods:

As shown in figure (4.9), the majority of patients (69.6%) who had contact with medical providers experienced provider-periods of one month or less.

Figure (4.9): magnitudes of provider-periods among 217 new smear-positive TB cases in Khartoum



Even though 40.4% of male patients had provider-periods of less than two weeks and that 30.4% of them had periods of more than one month, compared to 31.6% and 34.2% of female patients respectively, the Chi-Square test of independence revealed no significant association between sex and length of provider-periods. In addition, there was no statistically significant correlation between provider-period and the age of patient. The Pearson coefficient revealed a negative directional very weak correlation, that would indicate younger patients might experience longer provider-periods compared to older patients (*r (217) = -.123, P> .05*).

With reference to provider-periods, there were no significant associations between marital status, educational level, occupation, family monthly income, residence in the locality and number of family members in the one hand and the provider-periods in the other (see table 4.8).

Table (4.8): Relations between socio-economic characteristics and length of provider-period

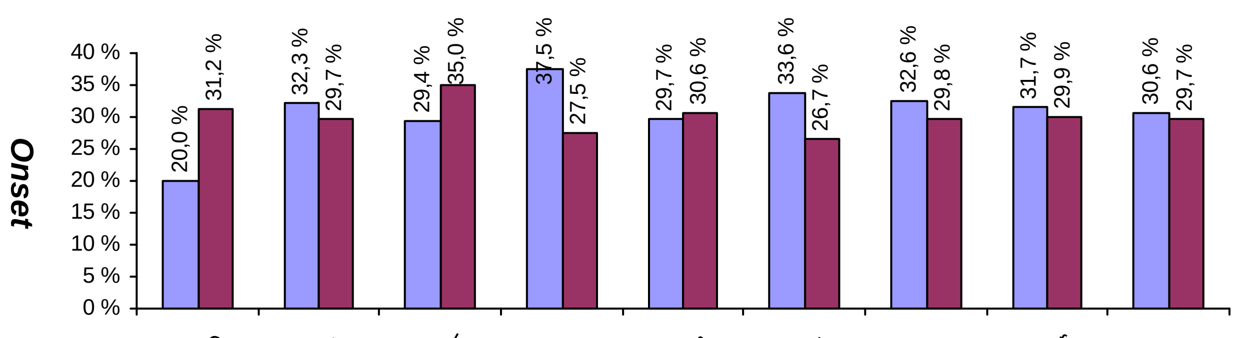
	Provider period						
Patients' characteristics	15 days or less		16 -30 days		> one month		Total
MARTITAL STATUS							
Single	35	(35.7%)	30	(30.6%)	33	(33.7%)	98
Married	43	(39.1%)	38	(34.5%)	29	(26.4%)	110
Divorced or widow	3	(33.3%)	2	(22.2%)	4	(44.4%)	9

EDUCATION							
Illiterate	30	(37.0%)	31	(38.3%)	20	(24.7%)	81
< 3 years	14	(56.0%)	7	(28.0%)	4	(16.0%)	25
3 to 6 years	12	(38.7%)	10	(32.3%)	9	(29.0%)	31
6 to 12 years	14	(28.6%)	14	(28.6%)	21	(42.9%)	49
> 12 years	11	(35.5%)	8	(25.8%)	12	(38.7%)	31
OCCUPATION							
Idle/housewife	23	(33.8%)	23	(33.8%)	22	(32.4%)	68
Student	11	(40.7%)	6	(22.2%)	10	(37.0%)	27
Worker	19	(33.3%)	22	(38.6%)	16	(28.1%)	57
Farmer	6	(54.5%)	4	(36.4%)	1	(9.1%)	11
Employee	6	(40.0%)	1	(6.7%)	8	(53.3%)	15
Small business	*16*	*(41.0%)*	*14*	*(35.9%)*	*9*	*(23.1%)*	*39*
RESIDENCY							
< 1 year	20	(35.7%)	17	(30.4%)	19	(33.9%)	56
1 to 3 years	9	(26.5%)	12	(35.3%)	13	(38.2%)	34
> 3 years	52	(40.9%)	41	(32.3%)	34	(26.8%)	127
INCOME							
< 100 $	65	(35.7%)	64	(35.2%)	53	(29.1%)	182
100 to 200 $	12	(52.2%)	2	(8.7%)	9	(39.1%)	23
> 200 $	4	(33.3%)	4	(33.3%)	4	(33.3%)	12
FAMILY MEMBERS							
< 3 persons	8	(47.1%)	6	(35.3%)	3	(17.6%)	17
3 to 7 persons	31	(36.0%)	29	(33.7%)	26	(30.2%)	86
> 7 persons	42	(36.8%)	35	(30.7%)	37	(32.5%)	114
Total	81	(37.3%)	70	(32.3%)	66	(30.4%)	217

NS: not significant P value > .05

Furthermore, there was no significant influence for absence or existence of symptoms of onset and presentation on the length of provider-periods. As shown in figure (4.10), only the patients who had experienced cough and haemoptysis among their symptoms of onset, had shown greater tendency for delaying more than one-month, compared to the patients without these symptoms. On the other hand, reporting of cough and fatigue among the symptoms that urged patients to seek care, seemed to decrease the tendency for delaying more than one-month.

Figure 4.10): relations between symptoms of onset/presentation and delayed provider-periods of more than one month among 253 new smear-positive TB cases in Khartoum



On testing provider-periods against patient-periods for the 217 patients who had contacts with medical provider, there was an insignificant negative directional correlation of a very small magnitude between the two variables (*r (217) = -.092, P> 0.05*).

As shown in table (4.9) below, there were significant differences in the rates of ordering investigations (sputum and x-ray), reaching TB diagnosis, and prescribing anti-TB treatment between the male and female patients who consulted medical providers. The Chi-square test revealed that male patients were more likely to be subjected to sputum and x-ray examination, to be diagnosed as TB, and to have anti-TB prescriptions than females.

Table (4.9): gender differences in relation to performance of investigation, reaching TB diagnosis, and prescription of anti-TB treatment by medical providers

	Sex			
	Female	Male	Total	Chi-Square test
X-ray	35 46.1%	85 60.3%	120	$X^2(1)= 4.05, P= .04$

Sputum	40 52.6%	95 67.4%	135	X^2 *(1)= 4.57, P= .03*
TB-diagnosis	37 48.7%	93 66.0%	130	X^2*(1)= 6.13, P= .01*
Anti-TB treatment	32 42.1%	79 56.0%	111	X^2*(1)= 3.83, P= .05*

In more details, from the overall study sample, 62 patients (24.5%) had visited a private provider, 165 patients (65.2%) visited public provider, 7 patients (2.7%) visited pharmacists, and 6 patients (2.4%) visited other providers. Twenty-five female patients (26.6%) had visited private doctors compared to 37 male patients (23.3%). On the other hand 114 male patients (71.7%) had consulted some public providers compared to 51 female patients (54.3%). This difference shows that male patients were more likely to consult public providers than their female counterparts (X^2 *(1) = 7.92, P<.01; Phi= .177*).

Concerning the influence of type of provider visited by patient on provider-period, there were no significant differences between different types of providers, although visiting both public and private providers or visiting other providers was associated with increased likelihood to delay more than one month, compared to visiting only public or private providers. The association of longer provider-period with visiting both private and public providers was explained by the higher means of both the number of contacts and number of providers as shown in table (4.10).

Table (4.10): Relation between types of provider consulted by patients and length of provider-periods, number of providers, and number of visits to providers

Type of provider	Provider period in days			Total	µ No. of providers*	µ No. of visits*
	15 or less	16 -30	> 30			
Private	16 39.0%	15 36.6%	10 24.4%	41	1.85	3.41
Public	58 40.3%	45 31.3%	41 28.5%	144	1.98	3.33
Other (pharmacy or NGO clinic)	3 27.3%	4 36.4%	4 36.4%	11	2.18	4.18

Both private and public	4 19.0%	6 28.6%	11 52.4%	21	2.86	4.86
Total	81 37.3%	70 32.3%	66 30.4%	217		

* Significant difference in the means of providers and visits between groups

From the different factors listed in the following correlation matrix (in table 4.11), the overall provider-periods significantly correlated with the number of providers and number of visits to providers (see table 4.11).

Table (4.11): Pearson r Correlations: provider-period, number of providers consulted, number of visits to providers, sputum by provider, x-ray by provider, diagnosis by provider, and treatment by provider

	Provider-period	number of providers	number of visits	Sputum	X-ray	Diagnosis
Provider-period						
number of providers	.544**					
number of visits	.674**	.806**				
Sputum	.003	.144*	.133*			
X-ray	.050	.184**	.165*	.617**		
TB-Diagnosis	.011	.120	.153*	.914**	.626**	
Anti-TB treatment	.013	.095	.142*	.791**	.475**	.800**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Partial correlation revealed greater effect for the number of visits rather than the number of providers being consulted by patient with the following changes in correlation coefficients: number of providers from .544 to .106 that is insignificant; number of visits from .674 to .483 that is still significant. Meanwhile, the number of visits to providers was found to be significantly but weakly correlating with performance of sputum and x-ray, reaching TB diagnosis and prescribing anti-TB treatment. On the other hand, the number of providers consulted by patient was correlating weakly with performance of sputum, and x-ray, while it has no significant correlation with reaching diagnosis and prescribing treatment by providers.

In harmony with the correlation matrix showed above, table (4.12) below illustrates the association between provider-period and performance of sputum and x-ray by providers.

Table (4.12): Relation between investigation performance and provider-period:

	Provider period			
	15 days or less	16 -30 days	> one month	Total
Sputum not performed	36 44.4%	22 31.4%	24 36.4%	82 37.8%
Sputum performed	45 55.6%	48 68.6%	42 63.6%	135 62.2%
X-ray not performed	40 49.4%	31 44.3%	26 39.4%	97 44.7%
X-ray performed	41 50.6%	39 55.7%	40 60.6%	120 55.3%
Total	81	70	66	217

Sputum: X^2 *(2) = 3.766, P> 0.05* X-ray: X^2*(2) = 1.475, P> 0.05*

Finally, out of the total study sample, 56 patients (22.1%) came to the TBMU on their own, 26 patients (10.3%) were advised by some relatives or friends, and 171 patients (67.6%) were referred to TBMUs by medical providers. Those who were referred by medical providers comprised 78.8% of the patients that had consulted medical providers.

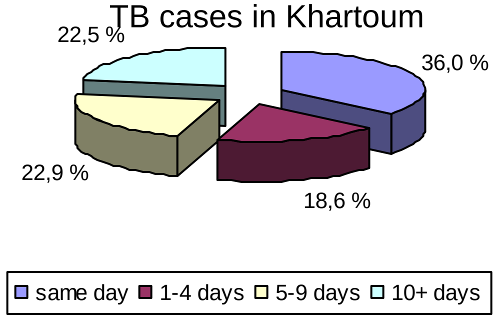
4.5.2 TBMU-PERIOD

For patients whose first contact with health services was the TBMU, it was easy to subdivide TBMU-period into: the suspicion interval which is the time period between presentation and request of TB-suggestive investigation such as sputum or x-ray; diagnosis interval as the time interval between request of sputum examination and reaching a final diagnosis of TB; and treatment interval that is the period between reaching TB-diagnosis and initiation of anti-TB treatment. In reality, there were no clear demarcations, when most patients in our sample were referred by medical providers and there were a back and forth shifts between the two levels of health system.

As mentioned-above, the mean of TBMU-period was 5.57 days (median 4 days). Suspicion periods were determined for 140 cases that were either without previous contact with medical providers or been referred by medical provider without been subjected to sputum examination or without TB diagnosis. The median of this period was 1 day (μ=2.14days±2.69). The minimum suspicion interval was 0 day (same day of presentation), while the maximum was 15 days.

One step further, the diagnosis period has been determined for 224 cases. The median diagnosis-period was 3 days (μ=3.8days±2.37: minimum 2 days, maximum 30 days). Furthermore, treatment periods were determined for all cases depending on the dates of sputum examination and treatment initiation. The median treatment period was 3 days (μ=4.7 days ± 5.29). This treatment period ranged between 0 day (same day) and 44 days after performing sputum examination. As shown in figure (4.11) more than one-third of all cases commenced treatment the same day of their presentation in the TBMU.

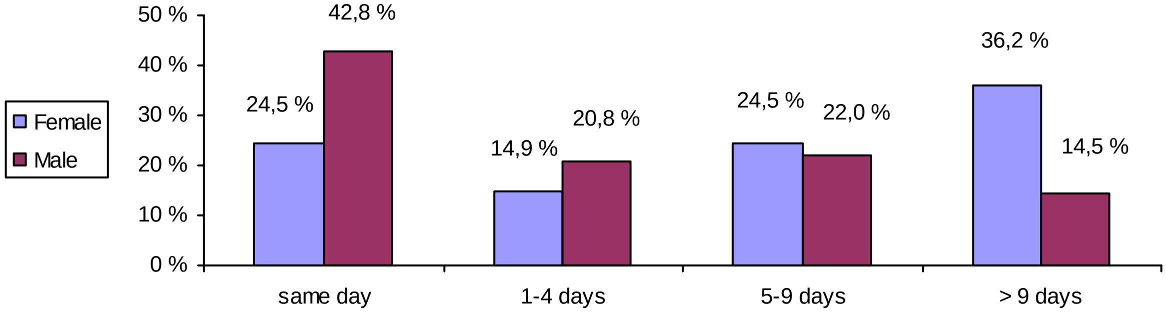
Figure (4.11): magnitudes of TBMU-period among 253 new smear-positive TB cases in Khartoum



Regarding the associations and correlations between TBMU-periods and demographic and socio-economic characteristics, age has been found without any significant correlation with TBMU-period after applying Spearman's correlation (*rho*= *.008, P>0.05*). On the other hand, the mean TBMU-period for male patients (4.32 days) was 3.35 days shorter than that for females (7.67 days). This difference has been revealed to be statistically significant difference according to the independent-samples t-test (*t (165.9) = 3.89, P< .001*) (*equal variances not assumed*).

Furthermore, the Chi-Square test revealed a significant likelihood for female patients to experience TBMU-periods of more than 9 days compared to male patients (X^2 *(3) = 19.1, P< .001*). In fact, the correlation between female sex and delayed TBMU-periods was highly significant according to Cramer's V coefficient (*.275, P< .001*) indicating females (fig (4.12)).

Figure (4.12): Gender differences in relation to length of TBMU-periods



Primarily, marital status, education and occupation had significant association with the length of TBMU-period, but after controlling for sex these associations turned to be insignificant. Moreover, the duration of residence in the locality, family income per month, and the number of persons sharing the same household with the patient were found without significant influence on the TBMU-periods.

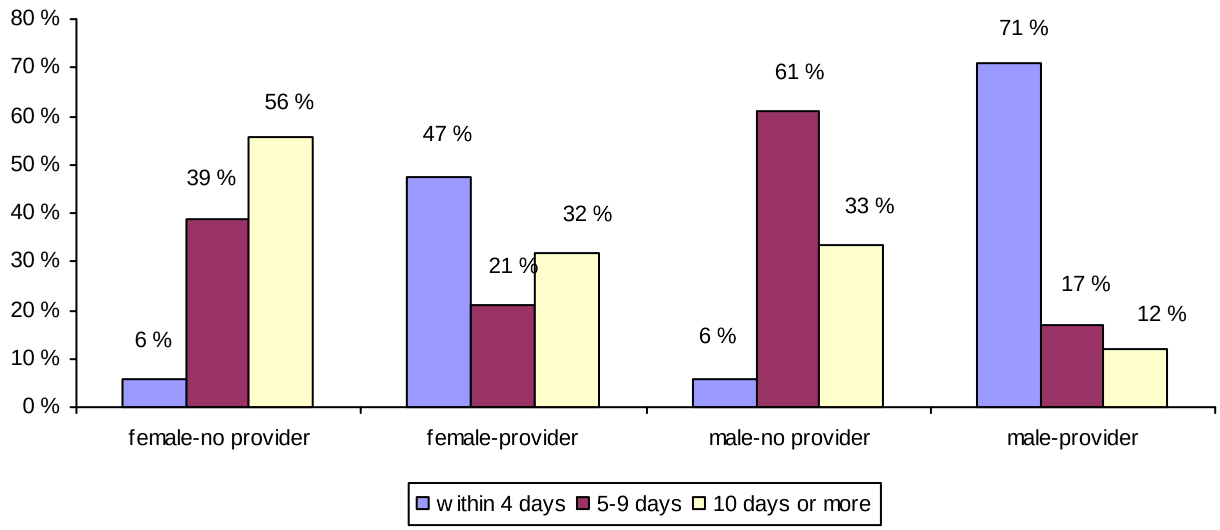
The Chi-Square tests revealed insignificant associations between TBMU-period and almost all the symptoms of onset. The only significant association was that; experiencing sputum expectoration among symptoms of onset decreased the likelihood for delaying more than 9 days in the TBMU. This was clear when about 18% patients with sputum expectoration commenced treatment after 9 days, compared to 32% of the patients without sputum expectoration. This association tended to be influenced by patient's sex and performance of sputum in the TBMU. By controlling for the later variables, the association between TBMU-period and sputum expectoration was abolished. On the other hand, reporting sputum expectoration among symptoms of presentation tended to decrease the duration in the TBMU; almost 67% of the patients with sputum symptom started treatment within 4 days in the TBMU compared to 54% of the patients without sputum. In addition, 23% of the patients without sputum delayed more than 9 days, while no patient with sputum reported this delay. The Chi-Square test exposed insignificant association between sputum and length of TBMU-period ($X^2(2) = 1.84, P > .05$).

On the contrary, presence of fatigue, weight loss, and the non-specific symptoms apparently prolonged the TBMU-period, although these associations were found not statistically significant. Although it was difficult to determine the influence of haemoptysis on the TBMU-period because of the small number of patients with haemoptysis (10 patients), 80% of the cases with haemoptysis had started treatment within 4 days compared to 54% of those without haemoptysis. About 82% of the patients who reported cough among symptoms of presentation had TBMU-periods of less than 10 days compared to 67% of the patients who experienced no cough. This difference was found to be significant (X^2 *(2) = 6.91, P= .03*), but after controlling for patient's sex and contact with medical provider this association turned to be insignificant.

Alternatively, 42% of the patients with fever had TBMU-periods of more than 10 days compared to 18% of the patients without the symptom at presentation, and 60% of the patients without fever had commenced treatment within 4 days compared to only 31% of the patients who reported fever at presentation. The Chi-Square test revealed a significant association between reporting fever and delayed TBMU-periods (X^2*(2) = 16.25, P< .001*). This association remained significant even after controlling for sex, though it was stronger among male patients (X^2*(2) = 12.34, P=.002*) than that among females (X^2 *(2) = 7.23, P= .02*). In addition, controlling for contacting a medical provider has little impact on the significance of the association between fever and delayed TBMU-periods (X^2*(2) = 15.09, P= .001*). Chest pain as a symptom of presentation had the same distracting effect as fever, although the association was confined to female patients rather than to males, when about 56% of the females with chest pain reported TBMU-periods of more than 10 days compared to 28% of those without the symptom (X^2*(2)= 6.84, P= .03*). Lastly, the Spearman's test revealed no significant correlation between TBMU-period and both patient's and provider's periods (*rho= .02 and .09 respectively, P> .05*).

A total of 136 patients (62.7%) of those who contacted any medical provider had TBMU-periods of less than 5 days, compared to only 2 patients (5.6%) without such contact. On the other hand, 41 patients with provider's contact (18.9%) delayed more than 10 days in the TBMU compared to 16 patients (44.4%) without provider's contact. Accordingly, contacting a medical provider has increased the likelihood to experience shorter periods in the TBMUs (X^2 *(2) = 40.84, P< .001*). This correlation has been found to be of a moderate magnitude (*Cramer's V =.402, P< .001 / r = -.353, P< .001*). Furthermore, this correlation remained significant even after controlling for patient's sex. The strength of the correlation was decreased for females (X^2 *(2) = 10.67, P<.01, Cramer's V= .337 / r = -.298, P< .01*) rather than for male patients (X^2 *(2) = 29.83, P<.001, Cramer's V= .433 / r = -.374, P< .001*) (fig. (4.13)).

Figure (4.13): Association between consultation of a medical provider and TBMU-period in relation to patient's sex



The proportions of patients who started treatment within 4 days after presentation in the TBMU were higher among those who visited both private and public providers, public provider only or private provider only as 81%, 67%, and 46% respectively, compared to only 27% of those who visited a pharmacy or NGO clinic. Moreover, the rank for delaying more than 10 days was 4.8% for both public and private, 16% for public only, 29% for private only, and 46% for other providers (pharmacist or NGO clinic). These differences are statistically significant (X^2*(6) = 16.58, P=.01*). Unfortunately, we couldn't rely on such differences because 33.3% of the cells have expected count less than 5 in the Chi-Square test. And for the same reason controlling for the sex variable was not possible.

In general, there was no significant difference between the patients who visited private providers and those who didn't in relation with the length of TBMU period; 101 patients (52.9%) without private provider's contact commenced treatment within 4 days compared to 37 (59.7%) patients with that contact, and 44 patients (23%) without private provider's contact delayed more than 10 days compared to 13 patients (21%) with contact. The Chi-Square test revealed no significant association between been in contact with private provider and the length of TBMU-period ($X^2(2) = .942,\ P > .05$). On the other hand, visiting public providers enhanced commencing treatment within shorter periods; 24 patients without contact with public providers (27.3%) commenced treatment within 4 days compared to 114 patients (69.1%) with that contact, and 33 patients without contact with public providers (37.5%) delayed treatment more than 10 days compared to only 24 patients (14.5%) with that contact. This association was found statistically significant ($X^2(2) = 40.73$, $P<.001$).

Partial and semi-partial correlations were applied to test the correlation between the number of providers consulted by the patient and the TBMU-period. The zero-order correlation was -.258, which is statistically significant and has a moderate magnitude. After the effect of sex, visiting public provider, and performance of sputum by providers had been partialled out, the magnitude of the correlation turned to be -.114, which represented a negative weak correlation that uniquely explained about 1% of the variance in TBMU-period.

Table (4.13): correlation matrix of X-ray by provider, Diagnosis by provider, Sputum by provider, treatment by provider, and TBMU-period (N= 253)

	TBMU period	Sputum	x-ray	diagnosis
TBMU period				
Sputum	-.564**			
x-ray	-.552**	.698**		
diagnosis	-.562**	.961**	.686**	
treatment	-.543**	.811**	.548**	.828**

** Correlation is significant at the 0.01 level (2-tailed).

The correlation matrix above (table 4.13) shows zero-order correlations between TBMU-period and whether sputum, x-ray, diagnosis, and treatment had been performed by medical providers or not. It was clearly obvious that these variables had negative correlations of strong magnitudes with TBMU-period. The strongest correlation has been attached to performing sputum by medical providers (-.564). When the effect of sputum has been partialled out: provider's diagnosis lost its significant correlation with the TBMU-period, which was highly expected since the correlation with sputum and diagnosis was almost perfect (.961); while x-ray and treatment by provider retained their significant correlations with TBMU-period (table 4.14).

Table (4.14): Correlation between TBMU-period and X-ray, diagnosis, and treatment by providers controlling for performance of sputum by providers

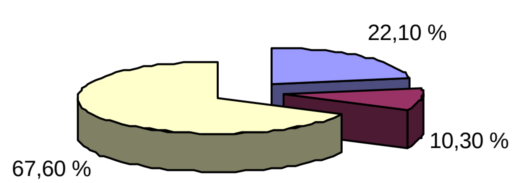
	TBMU-period	X-ray	Diagnosis
TBMU-period			
X-ray	-.268**		
Diagnosis	-.087	.080	
Treatment	-.177*	-.042	.303**

* Correlation is significant at the .05 level, ** correlation is significant at the .01 level

Similarly, the correlation between performance of sputum by providers and TBMU was tested after the effect of treatment has been partialled out; the correlation coefficient dropped from -.564 to -.252, which is still significant. Furthermore, on determining the unique contributions of sputum, x-ray, diagnosis, and treatment by provider through semi-partial correlation coefficients; x-ray (-.226) and treatment (-.146) had their significant unique independent contributions compared to sputum (-.028) and diagnosis (-.007).

As shown in figure (4.14), the majority of cases reached the TBMU because of provider's referral.

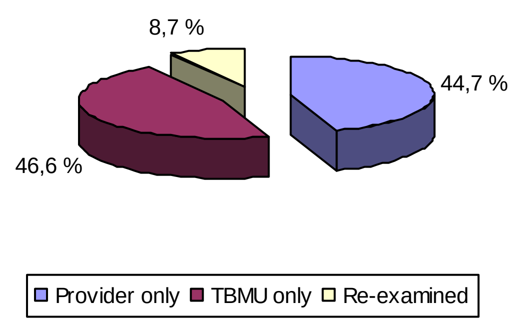
Figure (4.14): Types of referral to TBMU among 253 new smear-positive TB patients in Khartoum



The Chi-Square test of independence revealed a significant association between referral by medical providers and shorter TBMU-periods compared to other types of referral. Almost 75% of those referred by medical providers commenced treatment within 4 days compared to 23% among those advised by friends or relatives and only 12.5% of those came from their own. Moreover, longer TBMU periods was more likely to be among those advised by friends or relatives (58%) compared to 36% of self-referral and only 13% of those referred by providers ($X^2(4)= 85.74, p< .001$).

Out of the total study sample, sputum examination has been performed by providers for 135 cases (53.4%), which represented 62.2% of the patients with contact with medical providers. Only 22 cases (16.3%) of those cases had been re-examined in the TBMU. As shown in figure (4.15), sputum was examined for the first time in the TBMU for 118 cases that represented 84.3% of the 140 patients examined for sputum in the TBMU.

Figure (4.15): Performance of sputum in relation to medical providers and TBMU

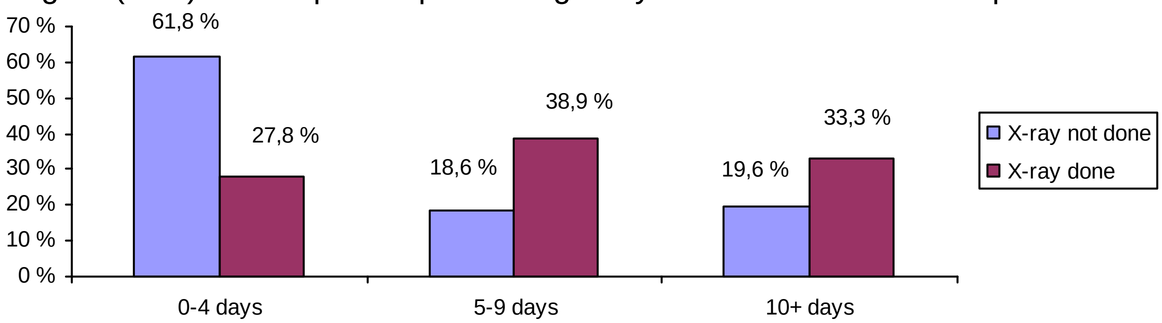


110 (97.3%) out of the 113 cases that were examined only by medical provider, commenced treatment in the TBMU within 4 days compare to 28 cases (20%) of those examined in the TBMU. Reliance of TBMU-staff on sputum results from

other medical providers was found to decrease the period in TBMU before starting treatment (*$X^2(2)$ = 151.19, P< .001 / Cramer's V=.773, P< .001*).

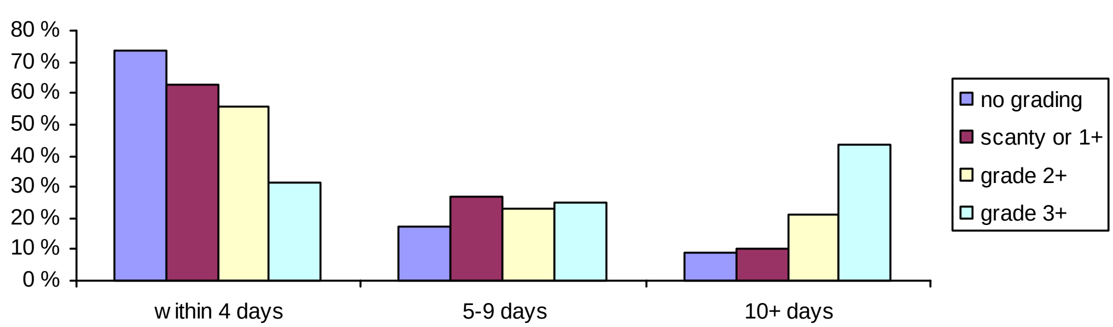
X-ray has been performed for 54 patients (21.3% of all patients) in the TBMUs. From the 199 patients without x-ray in the TBMU, 62% of them started treatment within 4 days compared to only 27.8% (15 out of 54 cases) of those who had x-ray in the TBMU. Performance of x-ray examination in the TBMU was associated with elongation of TBMU-period (*$X^2(2)$ =20.21, P< .001; Cramer's V= .283, P< .001*) (see fig 4.16).

Figure (4.16): The impact of performing x-ray in the TBMU on TBMU-period



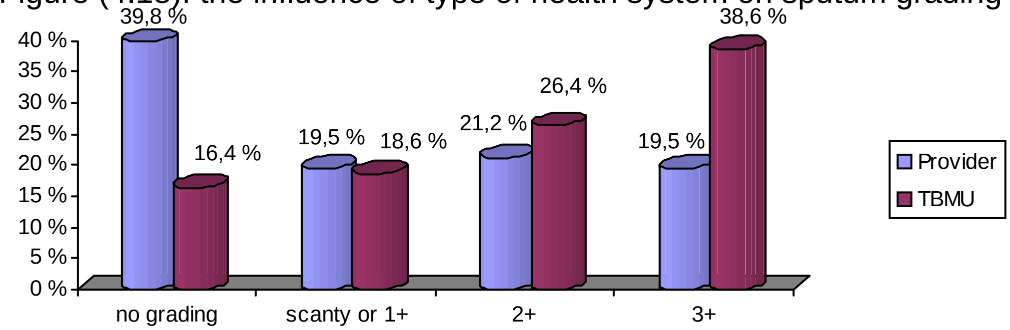
The relation between the sputum positivity grade and within 4 and 10+ days TBMU-periods seems to be a direct relation as shown in figure (4.17), that patients with higher sputum grading showed longer TBMU-periods compared to those without or lower grading. This association was statistically significant (*$X^2(6)$ = 37.31, P< .001; Cramer's V= .272, P< .001*).

Figure (4.17): Relation between sputum grades and TBMU among 253 new smear-positive TB cases in Khartoum



Another interesting finding was that; performance of sputum by providers was associated with lower grades, while higher grading was associated with performance of sputum in TBMU (X^2 *(3) = 21.1, P< .001*). The following graph shows this relation (figure 4.18).

Figure (4.18): the influence of type of health system on sputum grading

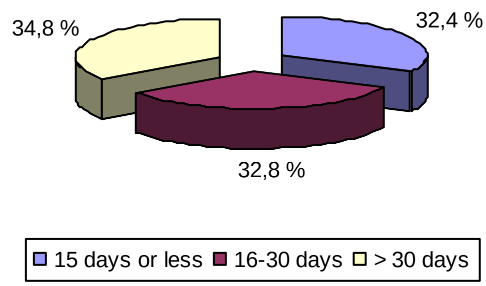


Out of the 140 cases who were subjected to sputum examination in the TBMU, 89 cases (63.5%) received their results after 3 days. About 79% of those patients claimed that this delay was due to special laboratory regulations that they have to submit one sample each morning. On the other hand, 7 patients (7.9%) referred this delay to clinic regulations and another 7.9% of the patients claimed personal reasons that led to this delay.

4.5.3 Total health system period:

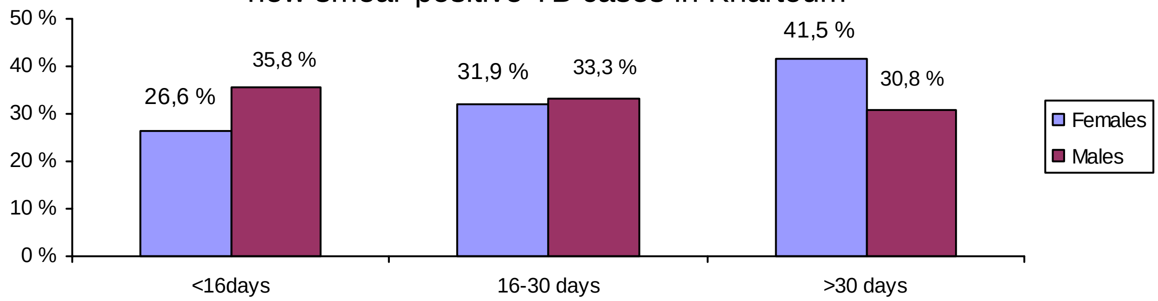
As mentioned-above, the median total health system period was 24 days (μ = 32.9 days ± 30.7) that ranged between 4 and 180 days. The distribution of total health system period was positively skewed (2.23) and the Kolmogorov-Smirnov test of normality was significant (P<.001). More than one-third of the study sample (88 cases) had total health system period of more than one month (see figure 4.19).

Figure (4.19): Total health system period for 253 new smear-positive TB patients in Khartoum



There were no significant differences in the length of total health system periods for all demographic and socio-economic variables (results not shown). Female patients tended to frequently experience delays of more than one month (41.5%) compared to their male counterparts (30.8%). This difference between males and females exists through all age groups. Figure (4.20) below shows sex differences in terms of total health system periods (X^2 *(2) = 3.53, P>.05*)

Figure (4.20): Total health system period according to patient's sex among 253 new smear-positive TB cases in Khartoum



Also, there were no significant correlations between total health system period and any of the symptoms of onset (results not shown). Similarly, the same result was obtained for symptoms of presentation. In addition, patient's trial of self-treatment, suspicion of having TB, and knowledge about TB had no significant impact on the total health system period (*r (253)= .087, P>.05*), (*r(253)= .018, P>.05*), (*r (253)=.028, P>.05*). Although there was a tendency to experience shorter health system periods whenever the patient's periods were long, still this correlation was insignificant (*r(253)= -.041, P>.05*).

The independent-samples t-test revealed statistically significant mean difference of 26.3 days between patients who consulted medical provider (µ 32.6 days ± 31.6) and those who came directly to the TBMU (µ 10.3 days ± 5.3) (*t (251)= -11.32, P<.001*). Moreover, 80.6% of the patients without contact with medical providers had total health system periods of 15 days or less, compared to only 24.4% of those with contact with medical providers (X^2*(2)= 46.9, P< .001*). Pearson product moment coefficient revealed a significant moderate relation between contact with medical providers and total health system period (*r (253)= .469, P< .001*). As shown in the correlation matrix below (table 4.15), significant correlations exist between total health system and the number of providers being visited by patient, number of visits, visiting private provider, and visiting public provider.

Table (4.15): Correlation between total health system and number of providers, number of visits, consultation of private, public, pharmacist, or other providers

	Health system period	Number of visits	Number of providers	Private	Public	Pharmacy
Health system period						
Number of visits	.690**					
Number of providers	.605**	.806**				
Private	.157*	.183*	.187*			
Public	.200*	.287**	.343**	-.375**		
Pharmacy	.099	.131*	.085	-.040	-.130*	
Other providers	.086	.075	.028	-.089	-.213*	-.026

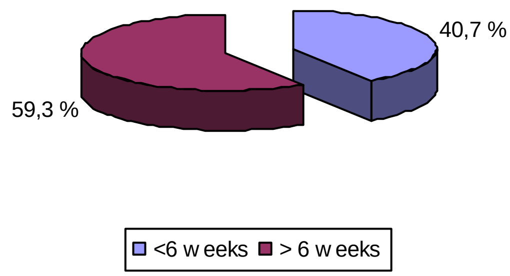
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

There were many overlaps between these independent variables in their relation with the dependent variable (total health system period). The correlation matrix in table (4.15) represents the zero-order correlations. Semi-partial correlation was applied to exclude the effect of this overlapping and to identify the unique effect of each of these variables. The most important variable that might explain variability in total health system period was found to be the number of visits to medical providers, that uniquely explained about 10% of the variance in total health system period when other variables were taken into account (r_{sp}= .31). The second important variable was whether medical provider has been consulted or not, which accounted for 4% of variance in total health system period (r_{sp}= .14). Lastly, the type of provider, if public, also shared in this correlation (r_{sp}= -.09). The correlations of number of providers and private providers with total health system were neutralized after controlling for the above-mentioned variables.

4.6 Total pre-treatment period:

The total pre-treatment period ranged between 11 and 205 days for our study sample, and the median pre-treatment period was 53 days (µ 66.8 days± 44.19). Patients who had total pre-treatment periods of less than one month constitute about 22.5% of the entire study sample, while those with periods of more than three months were about one-quarter of all patients. The majority of cases (150 cases) had pre-treatment periods of more than 6 weeks (Figure 4.21). Moreover, 60 female patients (63.8%) delayed more than 6 weeks, compared to 90 male patients (56.6%). Similarly, the proportion of delay of more than 2 months was greater among female patients (50%) than among their male counterparts (40.3%). These differences were found statistically insignificant.

Figure (4.21): Total pre-treatment periods for 253 new smear-positive TB cases in Khartoum



The patient-period was contributing to 51% of the total pre-treatment period, while the health system period contributed to 49%. The same pattern was seen among patients with total delay of more than 2 month, where 53% of this delay was patient's delay and the rest was due to the health system.

Table (4.16): Mean differences of the total pre-treatment period in relation to demographic and socio-economic characteristics

	N	Mean	SD	t/F(a)	*df*	Sig. (2-tailed)
Sex						
female	94	70.84	44,451	1.133	251	.258
male	159	64.33	44,001			
Age						
15 to 22 years	66	68.44	45.513	.428	3	.733
23 to 27 years	64	70.36	44.295			
28 to 37 years	61	61.84	40.858			
above 37 years	62	66.05	46.381			
Marital status						
single	110	69.52	45.151	1.108	2	.332
married	134	63.46	43.051			
divorced or widow	9	81.78	48.900			
Education						
illiterate	104	67.65	40.557	1.163	4	.328
<3 years	26	51.54	36.465			
3 to 6 years	36	63.31	49.166			
6 to 12 years	54	73.43	48.500			

> 12 years	33	68.70	47.158			
Occupation						
idle	85	70.11	46.353	1.278	5	.274
student	29	76.52	46.039			
worker	63	67.67	46.133			
farmer	14	71.57	43.252			
employee	18	60.11	44.079			
small business	44	53.68	34.311			
Residence in locality						
< 1 year	65	73.17	46.736	4.099	2	.018
1 to 3 years*	39	80.15	54.752			
>3 years*	149	60.44	38.802			
Family income /month						
less than 100 $	215	67.17	43.427	.701	2	.497
100 to 200 $	26	58.85	53.162			
more than 200 $	12	76.25	37.144			
Family size						
< 3 persons	21	67.00	37.342	.154	2	.857
3 to 7 persons	102	64.90	43.361			
> 7 persons	130	68.15	46.068			
Total	253					

(a) t: independent-samples t-test for dichotomous variables, F: ANOVA for more than 2 categories variables.
* Asterisks to indicate significant mean difference revealed by Post Hoc multiple comparisons using Tukey test.

There were no significant mean differences between the groups of almost all demographic and socio-economic variables with exception of duration of residence in locality. Patients who lived for more than 3 years in the locality had significantly lower mean pre-treatment periods compared to those who lived 1-3 years (Table 4.16).

Both the Pearson product moment correlation coefficient and the Chi-Square test revealed no significant association between total pre-treatment period and symptoms of onset. Cough was reported among the symptoms of onset for 96% of those with total pre-treatment period of less than 45 days and in 91% of the patients with total delay of more than 45 days. Fever was also reported in 79% of those with total pre-treatment periods of less than 45 days and in 84% of those who delayed more than 45 days. The same pattern has been observed for almost all the other symptoms of onset (results not shown).

Furthermore, the Chi-square test of independence revealed no significant association between total pre-treatment period and patient's knowledge about disease and suspicion of having TB (p> .05). On the other hand trial of self-treatment was significantly associated with pre-treatment periods of more than 6 weeks ($X^2(1) = 4.35, P=.04$), although the relation was found to be weak (*Eta .131*) (see table 4.17).

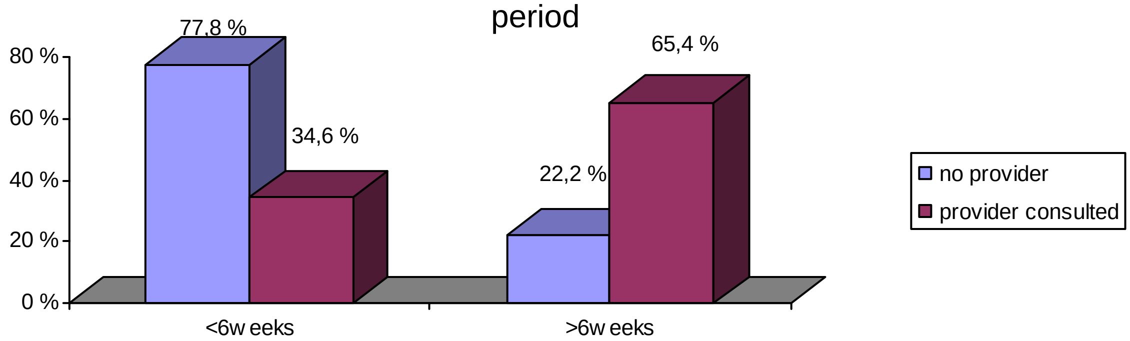
Table (4.17): Association between total pre-treatment period and patient's knowledge, suspicion and trial of self-treatment

		total pre-treatment period		
		<45 days	45 days or more	Total
Suspicion of having TB by patient	No	87	131	218
		39.9%	60.1%	100%
	Yes	16	19	35
		45.7%	54.3%	100%
Patient's knowledge about TB	No	73	106	179
		40.8%	59.2%	100%
	Yes	30	44	74
		40.5%	59.5%	100%
Trial of self treatment*	No	73	87	160
		45.6%	54.4%	100%
	Yes	30	63	93
		32.3%	67.7%	100%
	Total	103	150	253

* Asterisk indicates significant association of P<.05

As shown in figure (4.22) below, 65.4% of patients who consulted medical providers delayed beyond 6 weeks compared to 22.2% of those without previous contact with medical providers. The Chi-Square test revealed a significant association with moderate magnitude between total pre-treatment period and consultation of medical providers ($X^2\ (1) = 23.89,\ P< .001$), (*Eta .307*). Furthermore, among the 217 cases who consulted medical providers, there were no significant associations between total pre-treatment period and the type of provider being consulted by patients.

Figure (4.22): the influence of consulting medical providers on the total pre-treatment period



Both the number of providers and the number of visits were found to be significantly and moderately correlating with total pre-treatment period. The Pearson product moment correlation coefficients were found to be .441 and .326 for number of visits and number of providers respectively (*P<.001*). Partial correlation revealed that most of the correlation between number of providers and pre-treatment period is been shared with number of visits. Double control for this overlapping revealed significant partial correlation between pre-treatment period and number of visits (r=.315, P<.001), while it was insignificant between pre-treatment and number of providers (r=.008, P>.05).

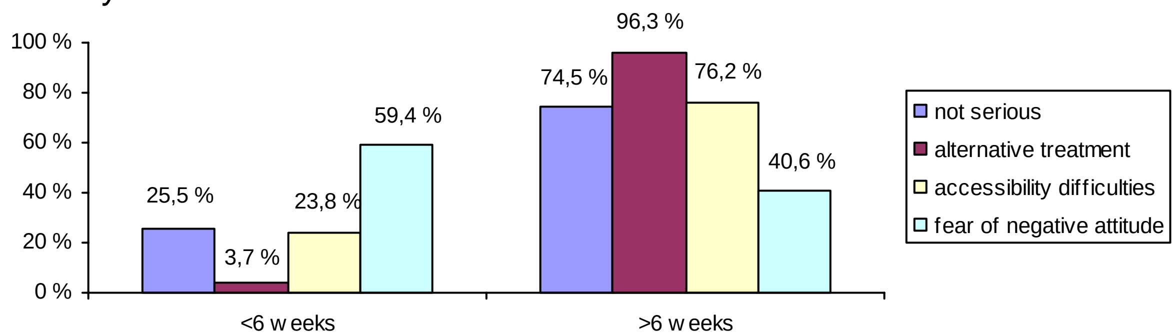
Types of investigation performed by providers (sputum, X-ray, others) had no significant association with the length of pre-treatment period. Also, there were no significant impacts for reaching a diagnosis by the provider or prescribing treatment on the length of pre-treatment period. Apparently, type of referral has been found to have a significant association with length of pre-treatment period, that 44.6% of self-referred patients delayed more than 6 weeks before starting treatment compared to 57.7% of relative or friend-referred patients, and 64.3% of patients referred by their medical provider($X^2(2)=6.80,\ P<.05$). But after controlling for consultation of medical providers, these differences disappeared and more or less about 62% of patients with different referral methods were found to have more than 6 weeks pre-treatment periods.

The Chi-Square test revealed no significant relation between the distance from patient's home to TBMU and total pre-treatment period ($X^2(2)=1.35,\ P>.05$); 66.7% of patients living 15-30 minutes far from TBMU had periods of more than 6 weeks, compared to 58.2% and 57.3% for patients living less than 15 minutes and more than 30 minutes far from TBMU respectively.

Furthermore, performance of investigations in the TBMU and sputum grades had no significant associations with the total pre-treatment period.

Finally, patient's perceived reasons for delay seemed to have great influence on the total pre-treatment period. The Chi-Square test revealed that believing in the efficacy of alternative treatment increased the likelihood of delaying more than 6 weeks, when 96% of the patients who believed in alternative remedies delayed more than 6 weeks, compared to only 40.6% of those who feared negative community attitudes. Patients who underestimated symptom's seriousness and those who claimed accessibility difficulties (financial or physical) shared almost similar proportions (75%) of delaying more than 6 weeks. The association between the above-mentioned patient's reasoning and total pre-treatment period was found statistically significant (*$X^2(3) = 44.43$, $P<.001$: Cramer's V coefficient= .419, $P<.001$*) (see figure 4.23).

Figure (4.23): the relation between total pre-treatment period and patient's reasoning for delay



4.7 Summary of Gender differences:

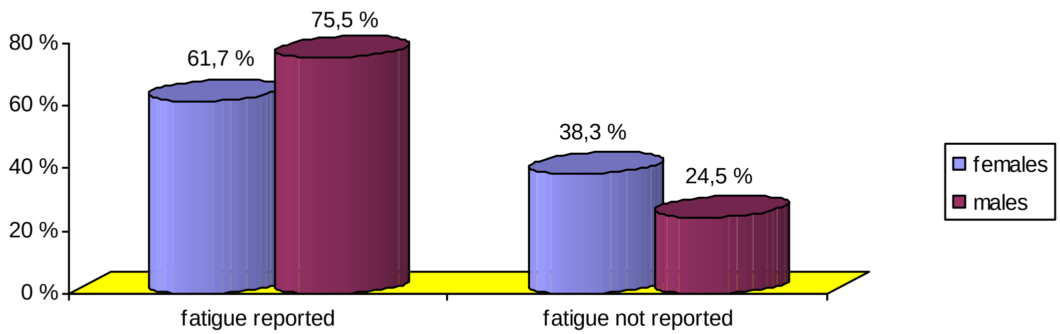
As shown in table (4.18) there was significant gender differences in terms of the age of contracting TB. Females have been found to have stronger tendency to contract TB when they were younger compared to male patients. More than one-third of the female patients under 23 years of age developed TB compared to only one-fifth of the male patients.

Table (4.18): Age distribution among male and female TB patients in Khartoum State

	Age groups in years					
	15 - 22	23 - 27	28 - 37	>37	Total	*Sig.*
Female	33 35.1%	25 26.6%	16 17.0%	20 21.3%	94	
Male	33 20.8%	39 24.5%	45 28.3%	42 26.4%	159	
Total	66 26.1%	64 25.3%	61 24.1%	62 24.5%	253	*$X^2(3)= 8.519$, $P= .036$*

Concerning the symptoms of onset and presentation, fatigue as a symptom of onset seemed to be the only symptom influenced by patient's sex. About three-quarters of the male patients reported fatigue among their symptoms of onset, compared to less than two-thirds of the female patients. This likelihood of male patients to experience fatigue was found statistically significant as shown in figure (4.24) below ($X^2(1) = 5.370, P= .02$).

Figure (4.24): gender differences in reporting fatigue among symptoms of onset



Utilization of health services:

The number of female patients who consulted a medical provider before their presentation in the TBMU was 76 cases (80.9%), while the number of males with contact with medical providers was 141 cases (88.7%). There was no significant gender variation in consultation of medical providers as revealed by the Chi-Square test ($X^2(1) = 2.966, P= .085$). The same pattern has been noticed in consultation of private providers; there was no significant difference between the two sexes, where 25 female patients (26.6%) had consulted a medical provider compared to 37 male patients (23.3%). The Chi-Square test was insignificant ($X^2(1) = .353, P= .552$). On the other hand, male patients were more likely to consult a public provider than females. The Chi-Square test showed a significant association between male sex and consultation of public providers ($X^2(1)= 7.923, P= .005$). While we found that 114 male patients (71.7%) had consulted public providers, only 51 female patients (54.3%) did the same.

Among the 217 cases who had consulted medical providers, the mean number of providers consulted by female patients was 2.01±1.2 providers, whereas that of the male patients was 2.07±1.2 providers. Similarly, the mean number of visits to medical providers was 3.58±2.21 visits for female patients and 3.52±2.14 visits for male patients. The independent t-tests for mean differences between males and females in terms of both number of providers and number of visits were statistically insignificant (*t(215)=-.34, P>.05 and t(215)=.199, P>.05* respectively). Furthermore, male patients were almost always more likely to be investigated for sputum and x-ray, to be diagnosed as TB patients, and to receive anti-TB prescription from their medical providers than female patients. The Chi-Square tests were statistically significant as shown in table (4.19) below.

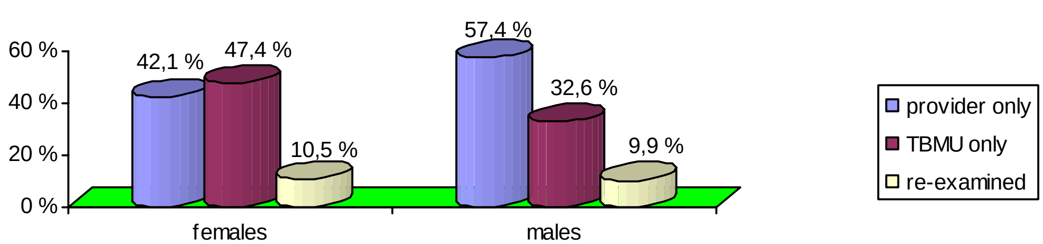
Table (4.19): Gender differences in relation to investigations, diagnosis and treatment by medical providers

	Sex			
	Female	Male	Total	*Sig.*
X-ray	35 46.1%	85 60.3%	120 55.3%	$X^2(1)= 4.046, P= .044$
Sputum	40 52.6%	95 67.4%	135 62.2%	$X^2(1)= 4.567, P= .033$
TB- Diagnosis	37 48.7%	93 66.0%	130 59.9%	$X^2(1)= 6,134, P= .013$
Anti-TB treatment	32 42.1%	79 56.0%	111 51.2%	*X2(1)= 3.831, P= .05*
Total	76 100%	141 100%	217 100%	

Table (4.19) shows that male patients were more likely to be subjected to sputum examination by their providers compared to female patients, while female patients were more likely to be subjected to sputum examination in the TBMU. The Chi-Square test revealed a significant association between female sex and performance of sputum examination in the management units; 62 females (66%) were subjected to sputum examination compared to 78 male patients (49.1%) ($X^2(1) = 6.827, P= .009$).

On comparing performance of sputum examination between medical providers and TBMU, still there was a significant difference between males and females in terms of sputum examination proportions as shown in figure (4.25) below.

Figure (4.25): Gender differences in the performance of sputum between medical providers and TBMUs



$X^2(1) = 49.75, P< .001$ $X^2(1) = 92.17, P< .001$

Although there was no significant difference between proportions of male and female patients in terms of contact with medical providers, male patients seemed more likely than females to be transferred by their providers to TBMUs. Three-quarters of the male patients were transferred by their medical providers to TBMU, compared to only 54% of the female patients. In addition, female patients seemed more likely to present to TBMU due to relative advice or from their own (46%). This difference was found statistically significant on applying Chi-Square test ($X^2(2) = 12.589$, $P = .002$).

As shown in table (4.20), there were no significant gender variations in terms of different pre-treatment periods with the exception of TBMU-period. More than one-third of the female patients delayed more than 10 days in the TBMU before starting treatment, whereas only one-fifth of the male patients experienced same delay. Moreover, more than half of the male patients started treatment within a period of 4 days or less, compared to 39% of the female patients.

Table (4.20): Gender differences in relation to pre-treatment periods

	Females	Males	Total	Sig.
Patient period *(n= 253)*				
<15 days	31 (33.0%)	64 (40.3%)	95 (37.5%)	$X^2(2) = 1.515$, $P = .469$
15 - 30 days	31 (33.0%)	50 (31.4%)	81 (32.0%)	
> 30 days	32 (34.0%)	45 (28.3%)	77 (30.4%)	
Provider period *(n= 217)*				
< 16 days	24 (31.6%)	57 (40.4%)	81 (37.3%)	$X^2(2) = 1{,}728$, $P = .422$
16 -30 days	26 (34.2%)	44 (31.2%)	70 (32.3%)	
> one month	26 (34.2%)	40 (28.4%)	66 (30.4%)	
TBMU-period *(n= 253)*				
within 4 days	37 (39.4%)	101 (63.5%)	138 (54.5%)	$X^2(2) = 18.83$, $P < .001$
5-9 days	23 (24.5%)	35 (22.0%)	58 (22.9%)	
> 9 days	34 (36.2%)	23 (14.5%)	57 (22.5%)	

Total health system *(n= 253)*				
< 16 days	25 (26.6%)	57 (35.8%)	82 (32.4%)	$X^2(2)= 3.53, P= .17$
16-30 days	30 (31.9%)	53 (33.3%)	83 (32.8%)	
> 30 days	39 (41.5%)	49 (30.8%)	88 (34.8%)	
Total pre-treatment *(n= 253)*				
<45 days	34 (36.2%)	69 (43.4%)	103 (40.7%)	$X^2(1)= 1.278, P= .258$
45 days or more	60 (63.8%)	90 (56.6%)	150 (59.3%)	

Overview:

In this study, we came to a male: female ratio of 1.7:1, which is found in compliance with the notification rates to the Sudan National tuberculosis programme and the global trend[73]. The difference between females and males in notification rates might reflect either lower access of female patients to health facilities or lower prevalence of TB among females as been suggested by Hans L. Rieder (1999). In addition, most of the literature agreed on lower prevalence and notification rates for females above the age of 15 years, which could be the case in our study[74]. Dissimilarly to Long NH, we found no significant differences in symptoms of tuberculosis between males and females that would affect the suspicion index among health personnel, although we agreed on the marked differences in performing sputum and x-ray investigation, reaching TB-diagnosis, and prescribing anti-TB treatment between males and females. Furthermore, we demonstrated that the proportions of male patients who consulted public health sector exceed that of female patients.

It was clear that TB affects younger people in Sudan, since the median age for TB patients is found to be 27 years. This finding is in consensus with the global trend that about 75% of TB cases in the developing world are in their productive age (15-49 years). In addition, we found that the proportion of females tended to exceed that of males in lower age groups (15-28 years), while that of males tended to be dominant for the age groups above 28 years. Moreover, the overall difference in mean age between females and males was statistically insignificant, the mean age for female patients (29 years) was found to be lower than that for male patient (32 years). This finding is also in consensus with the findings from, Botswana, Gambia, and Vietnam[26,27,62].

TB seems to be a disease of marginalized population that is closely linked to poverty, since 41% of our cases were illiterate, one-third of them were without income generating activities, and 85% of them came from poor households with monthly income of less than 100$. In fact, many of the literature mentioned that tuberculosis is a sign of global poverty. Furthermore, female TB patients seemed to suffer this marginalization more than male patients, since 62.8% of the female patients were found illiterate compared to only 28% of male patients, and 86% of the female patients had no income generating activities compared to 14.1% of male patients. These findings are in accordance with the World Bank announcement (1990) that 70% of a billion people living in absolute poverty are women[64].

One important finding in this study that more than 50% of the cases shared the same house with more than 7 persons and 40% of the case shared it with 3-7 persons. In addition we found that three-quarter of our patients had smear grading of 2+ or 3+. These two findings are worrisome, when there is an agreement that delay in initiation of treatment for more than 2 months is enough to spread the disease to domestic contacts[19]. Moreover, El Sony et al (2002) highlighted that highest grade of smear-positivity as well as longer durations of symptoms are predictors of having a sick person in the household.

In fact, all those conditions favour an increased the risk of becoming exposed to TB bacilli (infectiousness, duration of infectiousness, and number and nature of interactions between a case and a susceptible contact per unit time of infectiousness) exist in our situation, hence we could speculate that most of the transmission is occurring within households, which would increase the need for activation of other detection methods other than passive case finding such as contact tracing.

Patient-period:

Relying on the fact that formal TB services in Sudan are placed within the public health sector, we preferred to define patient-period as the time interval from onset of symptoms until first visit to medical provider. This definition based on a similar one used in a study from the Gambia[27] but we did some modifications concerning the way to describe a health provider. While the Gambian study considered a health provider as any person consulted by patient for her/his symptoms, we restricted our definition to private medical providers, public medical providers, pharmacists, and non-governmental organization clinics. We preferred this restriction as an elaboration for the definition of medical providers used in the studies of Sherman LF et al (1999) in New York and Long NH (1999) in Vietnam[58,59]. By sticking to this definition, any patient's contact with any non-medical healer, for example traditional healer, was considered as a part of the patient's period.

As presented in the result part, the median patient-period was found to be 3 weeks (mean 33.8 days). The median patient-period is approximately similar to that reported in New York by Sherman LF et al (1999) [58], but far lower than what reported in Tanzania[61] and Addis Ababa[25]. In addition, almost the same mean patient-period has been documented in Ghana by Lawn SD et al in 1998. Although our median of patient-period was far higher than what documented by Lienhardt C et al in Gambia[27], still this difference could be related to discrepancies in provider's definition between the two studies. Another observation was that the majority of patients in our study (69.4%) experienced periods of less than one month, which means that the greater proportion of patients reported to the health system in reasonable time compared to only 42% of the patients in the study from Addis Ababa, Ethiopia[25]. Moreover, the proportion of patients that delayed more than 90 days was found lower in our case (11%) than in Addis Ababa (22%).

Although the mean patient-period for female patients was higher than that of males by 3 days, sex has been found to be without significant influence in the mean patient-period in this study. This finding was in compliance with many studies from different settings that reported insignificant influence of most of patient's demographic characteristics on patient's delay; one example is the study from Ethiopia by Demissie M et al (1998) [25]. Similarly, our study identified no significant relation between age and patient-period. Age is considered by many researchers to be controversial, many studies failed to identify significant correlations between patients' delay and age. While in a study from Tanzania[61] age above 45 years has been correlated with longer patient's delay, on the contrary we found that there is a negative correlation between age and patient's period. Many socio-economic and cultural factors beyond the scope of our study would act peculiarly for a Sudanese setting to support this finding such as the position of elderly people in the household. In fact, the majority of TB patients shared similar socio-economic characteristics, thus no significant associations between these factors and patient's delay were expected. The only significant difference associated with higher means of patient-periods was accounted to occupation in our study; this difference was mainly between employee-patients who had shown shorter means compared to farmer patients. Existence of patient's delay difference according to residency (urban or rural) was beyond the setting of our study, which has been conducted in urban and sub-urban settings. Rural residency has been identified by some studies from Tanzania and Ethiopia as a factor affecting the length of patient-period.

The question of knowledge about disease as a factor for prompt health seeking has been addressed by many studies on delay. Wandwalo ER[61] managed to identify significant difference between patients with previous knowledge about TB and those without, while Demissie M[25] found no significant correlation between knowledge and length of patient's period among smear-positive TB cases. In our study, nevertheless knowledge about TB was highly associated with patient's interpretation for their symptoms as TB; there was no significant difference for knowing or suspecting TB and the length of patient-period. This finding is slightly confusing and with significant implications on passive case finding policies and health education, that focus mainly on dissemination of information about symptoms and signs of TB. What should be the appropriate messages that our health education programme would focus on?

In compliance with the study conducted by El Sony et al (2002)[47], we have identified that patients used to describe multiple symptoms both for onset and presentation, with the dominance of cough. Moreover, cough used to be the most stable symptom during onset and presentation. In addition, cough was nominated by almost ¾ of the patients as the symptom that urged them to seek medical care. In contrast to many literature reviews that use to couple cough with sputum expectoration (productive cough), in our study; patients tended to frequently report cough while they underreport sputum production. This finding may be explained by that spitting is not a popular social behaviour, in which case most patients would deny such a symptom. On the contrary to the findings of Long NH et al (2002)[62], that there were significant differences between males and females concerning frequencies of suggestive chest symptoms such as cough, sputum expectoration and haemoptysis, we were unable to identify any significant gender differences in this issue. On the other hand we identified a similar finding that females used to report non-specific symptoms such as fatigue more frequently than male patients did. Although fewer studies tried to identify links between symptoms of onset and the promptness of health seeking among TB patients, we found that most of the symptoms of onset and presentation are non-significantly correlated to patient's periods. Similar finding has been reported from St. Louis[42] that absence of classical manifestation of TB was not associated with overall management delay. We think that the issue of symptoms as a driving force for help seeking should not be separated from the ways patients used to evaluate and interpret their symptoms. This is because, although the majority of patients reported multiple symptoms that could be tackled by many researchers as serious symptoms, yet a considerable proportion of patients perceived their symptoms as unserious.

Although just more than one-third of patients had tried self-treatment, but about 42% of them used anti-biotic or cough suppressants to alleviate their symptoms. In general, this finding uncovered a problem of irrational use of antibiotics, which is in turn related to the drug policy in Sudan. This irrational use of medicines might give temporal relief of symptoms, but on the other hand would increase the pre-health care period as demonstrated by; about 50% of the patients who tried antibiotics or cough suppressants delayed over one month before visiting any medical facility.

Patient's perception seems to be a key factor for seeking health care, rather than symptoms, demographic and socio-economic characteristics. This observation was elicited when patients were asked to mention the reasons behind delaying health seeking: the highest means of patient-period were associated with perceived accessibility difficulties and underestimation of symptoms seriousness, while beliefs on alternative treatment and stigma were associated with lower mean periods. This finding agreed with that of Johansson E, et al (2000) [57]; that fear of high individual expenses contributes to delay in health seeking, while on the other hand it differs with theirs in concerning stigma as a delaying contributor. Our finding that underestimation of the seriousness of symptoms might contribute to delayed health seeking is in consensus with the finding from Philippines by Auer C, et al (2000)[20], that patients who perceived TB as a harmless disease had longer patient's delay. While Asch S, et al (1993)[19] suggested that patients seek care due to their symptoms rather than as a result of screening or contact tracing efforts, it seems that there are many important factors related to patients other than symptoms.

Provider-period:

As mentioned-above, we have subdivided the health system period into medical provider- and TBMU- (treating facility) periods. Unfortunately fewer studies had used the same approach. One of the studies with the same approach was the Gambian study[27], in spite of that they used different definition for a health provider. We do think that specification of this provider-period is very essential and has its own impact on the treating facility and overall health system delay. The majority of our study sample (86%) had some contacts with medical providers before ending in TB management units. This finding is similar to those from Asian countries, that TB patients contact some other health level before ending at the governmental TB centres. Also we found no difference between female and male patients in terms of contact with medical providers.

We have found the median provider period to be 21 days (3 weeks), which was far lower than that (8.3 weeks) in the Gambian study[27]. Moreover, the provider-period has accounted for 83% of total health system period in our study compared to almost 95% in the Gambian study. Also we found that less than 30% of our patients who had contact with medical provider had experienced periods of more than one month.

Sex, age and other socio-economic characteristics were found without significant influence on the overall provider-period, although female patients showed higher means of provider-period than male patients especially when periods exceed one month. This might reflect that female patients experienced undue delay related to their medical providers. A similar association of demographic and socio-economic characteristics of TB patients with the health system period has been demonstrated by Demissie M in Addis Ababa[25].

Interestingly, TB patients seem to prefer public facilities than private doctors, the majority of patients (65%) consulted public providers compared to 24.5% of patients who consulted private doctors. This finding is almost the same as what was experienced in the Gambia[27] and going against the grains of the findings from Philippines[20]. Moreover, our finding on private providers seems to be even lower than what has been mentioned by Liam and Tang (1997)[22] that about 34% to 82% of TB patients contact private physicians in some Asian countries. Furthermore, as Auer C, et al (2000)[20] had suggested that private practitioners are more attractive due to their reliance on X-ray, we had noticed that X-ray is performed much more for patients who visited public providers (61%) compared to 48% among those who visited private doctors. Although we did not test, why patients preferred public providers rather than private providers, it seems that accessibility factors play an important role in this issue. In contrary to the findings of Lienhardt C et al (1998)[27] in the Gambia that more female patients prefer visiting public health centres than male patients, the opposite was true in our case, that male patients are more likely to visit public providers than female patients. In addition, Needham DM, et al (2001)[38] observed that visiting a private provider is a factor for overall health system delay; we observed lower means of provider-period in patients who visited public facilities than those who visited private providers, although the difference in the means was not statistically significant. On the other hand, mean differences were significant between public providers and other types of providers; this may indicate lack of expertise and ability of performing investigation in the later facilities. Another important difference between public and private provider was the greater likelihood of public providers to reach a TB diagnosis more often than private providers.

The median number of providers consulted by TB patients in our sample was 2 providers, which is higher than that in India[52] (1.3 providers) and lower than that in the Gambia[27] (4 providers). Also the number of visits to providers was lower in our sample (3 visits) than that in the Gambia, and was little higher than what reported in India (2.5 visits). Additionally, male patients showed higher medians for both number of providers and number of visits compared to female patients, (2:1.5 providers and 3:2.5 visits). The number of visits to providers was found to be a crucial determinant of delayed provider-period, a finding supported by Needham DM, et al 2001, in their study from Lusaka, Zambia[38], that more than 6 visits to providers is associated with increased health system delay. The number of providers visited by patients has a moderate correlation with the length of total provider periods but has been overlapping with the number of visits.

Concerning the relation between symptoms and health system periods, Rao VK, et al 1999[21], commented that absence of characteristic manifestation of TB was not independently associated with the presence of overall delay. This comment supports our finding that; there were no significant mean differences whether these classical symptom exist or not, except for presence of chest pain as a symptom of onset, which was associated with significantly lower mean provider period.

In fact, we found no significant correlation between the provider period and patient period, although we have expected that provider period would decrease with the increase in patient-periods. The general logic of the later expectation was preserved in our study when the direction of correlation was negative. Another important observation was that there was no significant association between length of patient-period and possibility of medical provider to reach TB diagnosis, even though the proportions of patients who were diagnosed by providers as TB were greater among patients who had patient-periods of less than 2 weeks compared to those who had more than one month periods.

It was very important to observe that most of the TB patients in our sample had been referred by their medical providers (67.6%). This finding is crucial if policies to reduce the total health system period are to be established.

TBMU-period:

We preferred to use the TB management unit as patient's final destination which corresponds with the diagnosing facility that has been used by Lienhardt C et al (2001) in the study from the Gambia[27]. Instead of using diagnosing facility for TBMU, we think it would be more appropriate in our setting to use managing facility, since diagnosis might occur at other levels in the health system. The same concept had been used in many studies that concentrate on the health system delay rather than patient's delay, for example in the study from Canada[41], the study from Addis Ababa[25], and the study from St. Louis, USA[21]. The median management facility period (TBMU) in our case was 4 days (mean 5.57 days), which is higher than the Gambian[27] (.02 week), but lower than those from Ethiopia[25] (6 days) and St. Louis[21] (6 days). The median of management facility period in our case reflects that patients take reasonable periods to commence treatment and also it gives an indication on performance of unit's staff in their relation with other sectors of the health system.

The difference between our study and those conducted in the USA and Canada lay within the type of health care services, that was in our case as mainly as an ambulatory health service while in the other two settings it was hospital-based services. Such difference might complicate the process of comparison. Nevertheless, the median suspicion period as determined for 140 cases in our study was 1 day, which was the same period reported from St. Louis[21]. In addition, the treatment interval was also similar between our setting and St. Louis[21] (3 days). Likewise to the finding from Ethiopia[25], we identified that about 90% of our cases started treatment in the TBMU within 15 days. While in the study from St. Louis it was seen that 75% of the patients had overall management delay (more than 24 hours), the case was that 58.5% of our patients delayed more than one day to start treatment in the TBMU. It is worrisome to notice that about 22.5% of our cases delayed in the TBMU more than 10 days to commence treatment, which is considered as unacceptable long duration. The reasons for these delays as claimed by patients were: laboratory problems or regulations (27.7%) such as shortages in reagents, absence of laboratory personnel, and demands to collect early morning successive sputum samples; clinic regulations such as weekly appointments for referred clinic (21.7%), patient's reasons (7.9%), and temporarily lack of drugs in the centre (6.3%). The latter reason has been explained by some of the TBMU staff in the displaced camps of the SCC that they have to include all the new diagnosed cases in a list to be submitted to the SCC TB coordinator so he/she would calculate the needs of drugs and send them to that center. In my opinion, most of these reasons are avoidable and could be solved by regular monitoring and supervision from the State's TB programme.

With the exception of sex, we identified no significant influence for age, marital status, occupation, educational level, and income on the length of management facility periods. This observation is in compliance with the findings from Ethiopia, instead a study from Canada has documented a correlation between older age and initially missed diagnosis. On the other hand we identified that female patients experience longer durations in the TBMU compared to male patients. Unlike Demissie M et al (1998)[25], we identified no significant association between distance from the TBMU and TBMU-period. The justification for such finding might be related to the setting of our study. As stated above, we dealt with an urban setting of wide coverage of TB services.

Most of the studies that focus on health system delay, had managed to identify factors that are related to suspicion index among health personnel: for example the studies for Canada[41] and St. Louis[21] had identified that atypical manifestation of TB such as absence of haemoptysis are associated with overall management delay. Then again they documented that absence of characteristic manifestations of TB are not associated with an overall management delay. In our study, we found that most of the characteristic symptoms of TB have no impact on delaying TBMU periods, instead there were some symptoms such as fever and chest pain that have a distracting effect on the health personnel. Presence of fever among symptoms of presentation is more likely to be associated with delays over 10 days in the TBMU. Many health personnel perceive fever as a vague symptom that could be due to other common causes rather than TB. Another interesting finding was that; the impact of chest pain was markedly enhanced among female patients rather than male patients.

In the beginning we thought that the duration of patient's and provider periods will have their impact on raising the suspicion index among the TBMU personnel and hence decreasing the total treating facility period, but in fact, we found no significant correlation between these periods and management facility period.

The most powerful factors that determined the length of TBMU-period were: consultation of a medical provider; consultation of public provider; number of providers consulted; performance of X-ray by a medical provider; performance of sputum examination by medical provider; and type of treatment prescribed by a medical provider. All these factors worked towards shortening the TBMU-period especially if the health personnel in the TBMU will rely on the results of sputum examination performed by the medial provider, which was the case for the majority of our patients who were referred by medical providers. In fact, this observation demonstrates an unwritten policy for regulating the relation between the management units belonging to the national TB programme and other health sectors including both private and public sectors.

Unjustifiably, we found that some of the TBMU-staff insisted on performing X-rays for smear-positive TB cases, which in turn prolonged the total period in the TBMU. This correlation may be explained by x-ray imaging is not being a part of the NTP policy and thus patients have to pay imaging fees, which might be out of reach for many poor patients.

Another observation that would be difficult to explain was the relation between higher-grades of sputum smears and elongation of TBMU-periods. One explanation was that; most of the sputum results with no-grading are coming from other providers rather than TBMUs, while most of the results with higher grades were performed in the TBMUs, which will add the interval for examining sputum smears to the total period in the TBMU.

Total health system period:

As been presented in the result part, the overall median health system delay was found to be 24 days (mean 4.7 weeks), which is still lower than those experienced in Gambia[27] and Zambia[38]. In addition, almost two-thirds of our study sample has a total health system delay of less than one-month. It was interesting to notice that the mean total health system period is almost the same as the mean patient-period. In the study from Gambia and Zambia, health system delay was far greater than the patient-periods, while in the study from Ethiopia[25] the reverse was the case.

In this study and in compliance with other studies (Zambia[38], Gambia[27], and Ethiopia[25]) there were no significant associations between most of the demographic and socio-economic factors and the total health system period. Sex was mainly a powerful difference within the TBMU-period but it lost its effect on the total health system period, although the proportion of females with health system periods of more than one month was greater than that of male patients. Also, we found no significant correlations between both symptoms of onset and presentation with the total health system period. Furthermore, the negative non-significant correlation between patient's period and both provider and TBMU periods also remains for total health system period.

We have identified that consulting a medical provider and the number of visits to providers, were the most important factors associated with increased total health system period. The correlation between number of visit and delay in health system has been noted by the study from Zambia[38]; if the number of visits exceeds 6 visits then a total health system delay is highly expected.

Total pre-treatment period:

The proportion of patients who delayed more than one and half month was found to be 59.3%, which is lower than the study hypothesized ones (80%). The median total pre-treatment period was 53 days (µ 66.8 days± 44.19) in our study, which is higher than that reported by Auer C[20] in the study from Philippines, but lower than the medians of Zambia[38] (60.2 days), the Gambia[27] (62.2 days), Ethiopia[25] (64 days), and Botswana[84] (84 days). The mean total pre-treatment period was also lower than what was reported from Los Angeles by Asch S, et al[19] (74 days). In addition, about one-quarter of our cases delayed more than 3 months, which is a proportion that approaches what has been documented by Auer C, et al, in their study in the Philippines[20]. In our case, about half of the patients had delayed pre-treatment period of more than 2 months, a period that has been considered by many researchers to be sufficient for spreading the infection to domestic contacts with an average of 8 persons[19]. In this case we have to consider our findings sincerely, since a considerable proportion of our patients lived in households of more than 7 persons.

About 90% of total delay in Ethiopia[25] was due to the patient, while in the study from the Gambia [27] 90% of the delay was due to the health system, but in our case we found that the patient's period explained about 51% of the total pre-treatment period and the other 49% was attributed to the health system.

In our study we found no significant relation between the pre-treatment period and most of the demographic and socio-economic characteristics of the patients. This finding was similar to what was reported by the studies from Los Angeles[19] and the Gambia[27], although the latter identified an association between delay and age over 44 years. On the other hand a study from Zambia[38] identified a correlation between total delay and female sex and education for less than 9 years, which was not the case in our study. Both the Zambian study and ours agreed on the insignificant influence of economic factors on delaying the pre-treatment period. Moreover, we have identified lower means of pre-treatment period associated with residence in the locality for more than 3 years compared to durations of residency of 1-3 years in the locality. Also we had identified no significant association for patient's symptoms and the length of pre-treatment period.

Actually we came to the same finding as Asch C et al 1993[19]; that trial of self-treatment was associated with significant increases in the pre-treatment period.

Although longer pre-treatment periods were associated with consultation of medical providers, we found no significant association between the type of provider consulted and the total pre-treatment period. This finding was to some extent in compliance with the findings from the Gambia [27] that the choice of first provider appeared to influence the median total pre-treatment period. That was in our case the patient's choice between a medical provider and TBMU. More importantly, we found that the number of visits to medical providers before presenting to TBMU was one of the main determinants of total pre-treatment period.

Again we agreed with Asch S, et al 1993[19] that; beliefs in the efficacy of self-treatment and alternative remedies were associated with an overall delay of more than 6 weeks (almost all patients delayed beyond 6 weeks). Also that perceived barriers such as accessibility difficulties were associated with longer pre-treatment periods (3/4 of the patients delayed more than 6 weeks). In addition the individual's perception of symptoms was a crucial factor associated with delayed pre-treatment period for more than 6 weeks. This finding was supporting similar results documented in the Gambian study[27].

Gender differences:

Apart from the difference in notification rates between female and male patient, it was clearly obvious that female patients have a tendency to be diagnosed more frequently at younger ages than males. This observation was particularly valid among the age group 15-22 years, where more than one-third of the female patient aggregated compared to only one-fifth of the males. One explanation for this observation may be that females have higher progression from infection to disease than males. Many studies mentioned such faster progression from infection to disease especially among women aged 10-44 years[10,65,70,74]. On the other hand, while some studies such as those from Vietnam and Uganda had reported symptomatic differences between men and women especially that women are more likely to report unspecific symptoms such as tiredness, anorexia, and fever, we found no significant gender differences in terms of suggestive chest symptoms such as cough, sputum expectoration, and haemoptysis. Furthermore, we found that male patients are more likely to report fatigue among their symptoms of onset.

Hereby, we think that the major gender differences are represented in utilization of the health system and the practice within it. In fact we found no significant differences between males and females in their choices between medical providers and TBMUs; that almost equal proportions of males and females had consulted medical providers before presenting in the TB management units. In addition, there were no mean differences between males and females in the number of medical providers and the number of visits. This finding seems to be contradicting with that from the Gambian study; that females tended to visits more providers than males[27]. In the same context, the researchers in the Gambian study found that females are more likely to visit governmental health centres, while male patients tend to visit hospitals and private doctor. Whereas in our study we found no significant differences in the choice of private providers between males and females, male patients were more likely to consult public providers than females.

One of the interesting findings that we found was that female patients were significantly less likely to be subjected to TB-indicative investigation such as sputum examination and x-rays. Similarly, female patients were less likely to be diagnosed as TB cases and to receive anti-TB prescriptions from their providers. This likelihood was particularly obvious among younger females especially between 23 and 28 years of age, while it disappeared among women aged more than 28 years. This association might be due to medical staff's stigmatization. In other words, medical staff are well aware about the social implications of suspecting or diagnosing TB, therefore they might prefer not to request "offensive investigations" that might be suggestive to TB diagnosis especially for female suspects in their marriage age. The immediate consequence of the above observations was that female patients are more likely to be subjected to sputum investigation in the TBMUs and hence more likely to have longer TBMU-periods compared to male patients. Furthermore, although the proportions of males and females consulting medical providers were almost similar, we found that female patients were less likely to be transferred by their medical providers to TB centres.

Finally, the TBMU-period was the only period that bears a gender difference. In fact, the TBMU-period was affected by the providers' practices. For example, requesting of TB investigations (sputum or x-ray), TB diagnosis and treatment by providers were acting towards minimizing the TBMU-period. Sputum examination was less likely to be performed to females; therefore it was more frequently performed for them in the TBMU and hence extending their durations in the unit. This was holding true, when the mean TBMU-period was almost equal in males and females who had reached the TBMU without consulting any other provider.

Limitations of the study:

1. One of the major problems of multistage designs is that the study sample might not be representative of the study population. In order to overcome this limitation, we increased the number of clusters in the first stage (selection of provinces).

2. The measurements of different pre-treatment periods were depending mainly on patients' recalls, which might be imprecise and liable to recall bias. In fact, very specific measurements of the pre-treatment periods are almost impossible due to the absence of concrete patients' record. For example, to determine the onset of symptoms we have to rely on patient's memory. Actually, we were very satisfied to reach the best approximations that patients could recall.

Conclusions:

In conclusion, this study has been conducted in an urban setting that enjoys full coverage of TB services (DOTS allover). A total of 253 smear-positive pulmonary TB cases involved in this study were detected during routine passive case finding process. The distributions of demographic and socio-economic characteristics of the study sample revealed that most of the TB cases were young and of low socio-economic status. Also males were found to be more likely to contract the disease and to be notified as TB patients. However, the proportions of female patients were found to exceed that of males at younger ages. The majority of our cases were descending from sizable households with average family members of more than three persons. Cough was reported by almost all patients and sputum positivity grading of 2+ or 3+ were the most common smear findings. Almost half of the patients delayed more than two months to commence treatment. This period will cause significant spread of TB infection to domestic contacts.

Another important result was a lower reporting of sputum expectoration by TB cases on their presentation to health care facilities than what they reported at the start of their disease. This raises the possibility that the first weeks of their disease could be the most infectious.

Patients' demographic and socio-economic characteristics had no significant influence on the patient's, the total health system, or the total pre-treatment delay. Female sex was the only factor that had a negative impact on the TBMU-period. There was also a slight tendency among medical providers for lower rates of ordering essential investigations (sputum and x-ray), reaching TB diagnosis, and prescribing anti-TB treatment in females than in males.

It was found that the total pre-treatment period was almost equally shared by the TB patients and the health system. In our efforts to understand the influencing factors behind patient's delay and subsequently total delay, patients' demographic and socio-economic characteristics, symptoms, and patient's knowledge about tuberculosis were found without significant impacts on the length of those periods. However, perceived accessibility difficulties, beliefs in the efficacy of alternative treatment and self medication, and underestimation of severity of symptoms by the patients seemed to increase the length of patient's period and hence total pre-treatment period.

Another alarming observation was the influence of the irrational use of antibiotics and cough suppressants by TB suspects without medical prescriptions. These medications may offer temporarily relief of symptoms that leads to suppressing health seeking intentions. Several patients claimed using some well known anti-tuberculosis drugs such as streptomycin.

The greater proportion of the health system period was attributed to medical providers' delays. The provider's, total health system, and total pre-treatment periods were mainly influenced by patient's health seeking behaviour, which can be understood by patient's choice between types of medical providers to be consulted and patient's shopping from one provider to another. The latter phenomenon was clearly elucidated by the number of medical providers been consulted by patients and the number of visits to those providers. In addition, most of the patients who had contacts with medical providers before reaching the TBMUs preferred consulting public medical providers. In fact, most of the TB patients coming to TBMUs were referred by their medical providers.

Regarding the TBMU-period, this study uncovered the existence of refined suspicion indices among the staff of different TBMUs being involved. This was holding true, as the median suspicion period was only one day from patient's presentation to the TBMU. In addition, the performance of medical staff in these TBMUs was acceptable, since about 50% of the patients had commenced treatment within a period of 4 days. Factors such as consultation of a medical provider, the number of consulted providers, and performance of sputum and x-ray by providers worked to shorten the TBMU-period. On the other hand, a considerable proportion of the patients were unnecessary subjected to x-ray imaging besides sputum examination that was associated with extending the TBMU-period for more than 10 days. In addition, most of the patients who were delayed more than 10 days in the TBMUs attributed that delay to laboratory problems or regulations, clinic regulations (referred clinic), or temporarily lack of drugs. Moreover, symptoms such as fever and chest pain seemed to have distracting effects associated with longer TBMU-periods.

Recommendations:

1. Enhance of contact tracing (domestic contacts) as an adjuvant element to passive case detection.
2. Increase pubic awareness about tuberculosis with emphasis on severity of symptoms. Besides, dissemination of information about the available TB services in terms of locations of TBMU, free access to diagnosis and treatment, and efficacy of anti-TB treatment. Particular attention should be offered to the poor.
3. Establish of a clear policy that regulates the relation between different health care facilities and formal TB services (TBMUs). This policy should stress on early referral of TB suspects to TBMUs and should regulate TBMU's approval of TB-investigations performed by other health sectors.
4. Introduce of TB control guidelines into the medical teaching curricula for both medical and paramedical education. In addition, dissemination of information about the NTP to different medical providers should be materialized as one of the key policies of the national TB programme.
5. Improve the quality and regularity of the supervisory visits to TB management units with particular emphasis on refining the suspicion index among medical personnel, improving the quality of care, avoiding unnecessary examinations.
6. Stipulate strict drug policy; no TB drugs in pharmacies, no antibiotics without prescription.