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PREVALENCE OF PULMONARY TUBERCULOSIS AND IT'S ASSOCIATED RISK FACTORS AMONG THE POPULATION AT RISK IN BATKHELA, MALAKAND

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ABSTRACT

Tuberculosis is the most prevalent disease throughout the world. Tuberculosis (TB) is an infectious disease that most often affects the lungs. TB is caused by a type of bacterium Mycobacterium tuberculosis. This disease spreads through the air when infected people cough sneeze or spit. It also affects other organs like kidney, brain or spine. This study aims to determine the prevalence of tuberculosis, male and female ratio among district Malakand population. The sample for the present study was 302, the present study was based on questionnaire, interviews and personal interaction. A total of 302 cases were studied in which 169 (54%) were male and 139 (46%) were female. The ratio of male was higher than female. In male the prevalence of tuberculosis was 55.6% and in female the ratio was 44.4%. The common complications found associated with tuberculosis are, fever were 49.7%, night sweat 15.9%, weight loss 3%, severe cough 30.1%, coughing up blood 0.7%. Study concluded that the prevalence of disease was comparatively higher in male than female according to their ratio. Associated risk factors such as smoking, living condition, poverty, BCG vaccine play a major role in causing disease.

Keywords: *Prevalence, Pulmonary tuberculosis, Associated risk factors.*

INTRODUCTION

TUBERCULOSIS

Tuberculosis (TB) is a bacterial infection that continues to be a major global health issue, causing significant morbidity and mortality. It has been the leading cause of death worldwide. the disease has been a longstanding challenge. Around one-third of the global population is infected with Mycobacterium tuberculosis, making TB control particularly difficult. TB commonly becomes active and affects the lungs in about 75% of cases, a condition known as PTB, while the remaining 25% involve extra-pulmonary tuberculosis. The primary symptoms include a persistent cough lasting more than three weeks, fever, weight loss, chest pain and hemoptysis (coughing up blood). People with TB are either in a latent stage, where they have no symptoms and can't spread the disease, or in the active stage, where they show symptoms and the infection can affect different parts of the body (1). The 2024 report of WHO revealed that TB is the major threat to public health that killed the major population worldwide (2).

TYPES OF TUBERCULOSIS

Latent tuberculosis infection (LTBI) is when a person has the bacteria but no symptoms, no signs on an X-ray, and no evidence in lab tests. About one-third of the world's population has LTBI, with higher rates in low- and middle-income countries (51.5%) compared to high-income countries (28.1%). Active TB is more serious than LTBI because it has more bacteria and can spread to others (3).

A primary infection or a reactivation of latent tuberculosis can result in Active tuberculosis, a multiorgan illness. As a result, active TB may be either primary or reactivation TB respectively. When the immune system cannot fight off an infection with the Mycobacterium tuberculosis bacterium (MTB), primary tuberculosis develops. The reactivation of a confined mycobacterial infection is known as reactivation tuberculosis (4). Recently, the view of TB has changed from being just two stages (active or latent) to seeing it as a range of different stages of the disease (5). TB can also influence multiple body systems, including the respiratory, gastrointestinal, lympho reticular, musculoskeletal, reproductive, and central nervous systems (1).

MYCOBACTERIUM TUBERCULOSIS

Mycobacterium Tuberculosis (MTB) is a thin rod Gram-positive, non-motile, non-spore- forming, non-capsule-forming, and typically straight or slightly curved, Mycobacterium tuberculosis's genome has a significant amount of guanine (G) and cytosine (C) (61–71%).

As a slow-growing obligate aerobe, M. tuberculosis takes 16–20 hours to divide (6). It was only in the early 19th century that Robert Koch discovered *Mycobacterium tuberculosis* (MTB) is as the cause of Tuberculosis (TB), and it wasn't until the 1950s that scientists proved TB spreads through the air. Only about 10% of people who are exposed to the bacteria will develop TB. Most people who get TB develop it within 1-2 years, while others may develop it much later. About 70,000 years ago, MTB first appeared as a human pathogen in Africa. As a result of human migration, it eventually expanded outside the continent (3). It is

generally acknowledged that the earliest MTB strains were environmental mycobacteria, or smooth tubercle bacilli, which can still be isolated from immune compromised patients in some regions of east Africa, cannot infect an immune-competent host chronically and persistently, and cannot spread between people (7).

The MTB complex comprises eight subgroups of tubercle bacilli including M. tuberculosis, M. africanum, M. canettii, M. bovis, M. caprae, M. pinnipedii, M. microti, and M. mungi, with two distinct branches, dassie and oryx bacilli, and a phylogenetic tree (8).

MTB is the most well-known member of the M. tuberculosis species, infecting over one-third of the world's human population and animals with contact with humans. M. canettii and M. africanum can cause human TB and are usually isolated from African patients or ancestry. M. bovis has the broadest spectrum of host infection, affecting humans, domestic or wild bovines, and goats. M. caprae has been isolated only from goats (9).

PATHOGENESIS

TB infection happens when tiny bacteria from a person with active lung TB get into the air and are inhaled by another person. These bacteria then reach the small air sacs in the lungs (alveoli), where they are usually swallowed and destroyed by immune cells called macrophages. If the bacteria survive this defense, they begin to multiply inside the macrophages and spread to other nearby cells. Within a few weeks, the bacteria can grow in large numbers (10). It is crucial to understand the disease's pathogenesis. When M. tuberculosis grows uncontrollably in its human host, particularly in the lungs, it causes severe lung damage, leading to death due to suffocation from insufficient oxygen. This lack of oxygen occurs as lung parenchymal cells, which are responsible for oxygen exchange, are destroyed. Additionally, bronchioles become obstructed by granulomatous growths and blood released from ruptured granulomas in adjacent lung tissue. MTB is characterized by its complex, lipid-rich cell wall, which includes peptide-glycolipids (mycosides), cord factor, and sulfolipids. These components give the organism its shape, rigidity, and colonial appearance. Mycosides are similar to the O-antigens of Gram-negative bacteria, influencing seroagglutination and bacteriophage susceptibility. While the cord factor (trehalose dimycolate) and sulfolipids are toxic, their exact role in virulence remains unclear. Recent studies suggest that lipoarabinomannan plays a significant role in the bacterium's virulence. The lipid-rich outer membrane also serves as a barrier, protecting the bacterium from antimicrobial agents and the host's immune system, and preventing phagocytosis (11).

EPIDEMIOLOGY

10.6 million new TB cases were detected in 2021, up 3.6% from the year before, according to the Global TB Report 2022. Among the 30 high-burden nations is China. According to WHO estimates, China would have 780,000 new TB patients in 2021, with an incidence of 55 cases per 100,000. One the overall prevalence of tuberculosis has decreased.

by just 11% between 2015 and 2021, well short of the Global End TB Strategy's goal of a 20% decrease in TB incidence by 2020 (12).

An estimated 8.7 million TB incident cases (ranging from 8.3 million to 9 million) occurred worldwide in 2011, which translates to 125 cases per 100,000 people. Asia accounted for 59% of the anticipated cases in 2011, while Africa accounted for 26%. China (0.9 million to 1.1 million) and India (uncertainty range 2.0 million to 2.5 million) had the highest estimated incident case counts in 2011. An estimated 0.49 million of the 8.7 million incident instances involved children (0.47 to 0.51 million), whereas 2.9 million (2.6 to 3.2 million) involved women. HIV-positive individuals accounted for 1.1 million (1.0 to 1.2 million) (13). With

212.2 million people, Pakistan is currently the fifth most populous country in the world and will continue to grow. Population at the provincial and territorial levels The Pakistan Bureau of Statistics provided the statistics. Nonetheless, the population statistics derived from the most recent census, which concluded in 2017, was used as a reference and grew by 2.4%, the average annual growth rate from 1998 to 2017 (14).

DIAGNOSIS

Various tests have been developed to detect Mycobacterium tuberculosis, each offering different levels of accuracy, specificity, and practicality for clinical or research use. Tuberculosis (TB) remains a significant global health issue, affecting millions annually. Prompt and precise diagnosis is crucial for controlling the disease, but traditional TB tests often produce inaccurate results or take too long to provide conclusive answers. Furthermore, there is no fast, reliable method to distinguish between active and latent TB infections (11). The current standard diagnostic tools—such as chest x-rays, tissue cultures, tuberculin skin tests (TST), and acid-fast staining have various limitations. Chest x-rays alone are inconclusive, tissue cultures take a long time, the TST is not very specific or reliable, and acid-fast staining requires a large bacterial load in sputum to be effective. While serological tests using TB antigens are quick, they lack the necessary sensitivity. Newer methods like nucleic acid amplification are specific but can yield false positives. Immunologic tests like QuantiFERON and T-SPOT.TB, which detect IFN-γ production by TB-specific T cells after exposure to M. tuberculosis antigens, offer some advantages but still have limitations and open questions. There is a continued need for an accurate, cost-effective, and rapid diagnostic method for both active and latent TB. Recent advancements in molecular diagnostics, such as MTBDRplus, LAMP, LPA, GeneXpert, and whole genome sequencing (WGS), have improved TB diagnosis and characterization. These technologies can identify M. tuberculosis and detect mutations related to resistance against common anti-TB drugs (15).

TREATMENT

The standard treatment for drug-susceptible Mtb is highly effective in eliminating the bacteria, as long as patients fully adhere to

the regimen. This treatment includes an initial two-month phase with a four-drug combination (rifampicin, isoniazid, pyrazinamide, and ethambutol), followed by a longer continuation phase of rifampicin and isoniazid to target dormant bacteria in a latent phase. A growing concern, however, is the rise of drug-resistant strains, which can spread easily due to their low fitness cost. The World Health Organization (WHO) reported that 3.5% of new TB infections worldwide showed resistance to rifampicin and isoniazid, classifying them as multidrug-resistant tuberculosis (MDR-TB). Treating drug-susceptible MTB is already challenging, requiring 6–9 months of combination therapy under ideal conditions, and this difficulty is compounded in developing have MDR-TB. In recent years, new drugs for MTB, such as bedaquiline and delamanid, have been approved for use. These drugs have been conditionally approved by regulatory agencies, with delamanid approved by the European Medicines Agency (EMA) and bedaquiline approved by the U.S. Food and Drug Administration (FDA) for MDR-TB, and delamanid for compassionate use in XDR-TB and TDR-TB cases (16).

AIMS AND OBJECTIVES

1. To determine the prevalence of pulmonary tuberculosis in DHQ hospital Batkhela District Malakand.
2. To identify the risk factors that lead to the population at risk to disease.
3. To determine the association and clinical significance of risk factors associated with pulmonary tuberculosis

METHODOLOGY

The study employed a non-probability sampling technique and was conducted at DHQ Hospital, Batkhela. Participants were selected from individuals visiting the Tuberculosis department, where sputum smear and GeneXpert tests were performed, alongside the completion of a structured questionnaire. The study population consisted of individuals who visited the DHQ Hospital Batkhela and were considered at risk of tuberculosis. The study duration was four months, spanning from 1st August 2024 to 30th November 2024. All individuals visiting the DHQ Batkhela TB center for treatment or diagnosis, and who provided consent, were included in the study. Exclusion criteria involved individuals already diagnosed with pulmonary or extrapulmonary tuberculosis, those undergoing antibiotic treatment, and individuals at risk who did not consent to participate. The sample size for the study was 302 participants. Sputum samples were collected from at-risk individuals during the study period. Data were obtained through sputum smear testing, GeneXpert testing, and a questionnaire, enabling a thorough evaluation of TB prevalence and the contributing risk factors. Statistical analysis was carried out using descriptive statistics, with results expressed as percentages and frequencies. The findings were presented in tables and visually represented using bar graphs and pie charts. All data analyses were performed using the Statistical Package for the Social Sciences (SPSS).

RESULTS

A total of 302 individuals were included in this study, which aimed to identify the prevalence and distribution of tuberculosis (TB) within a specific population. Out of these

302 cases, 27 individuals tested positive for TB, while the remaining 275 cases were negative. The distribution of positive cases by gender and other relevant demographic factors were analyzed to identify patterns and possible risk factors associated with TB. In this study, a total of 27 individuals were diagnosed with tuberculosis (TB). The breakdown of cases by gender revealed 16 male patients and 11 female patients. A prominent trend emerged among male patients, with a significant proportion identified as smokers, suggesting that smoking may be a major risk factor for TB in this group. Additionally, a large number of the TB- positive cases were found to be living in crowded conditions, which further contributes to the risk of TB transmission and poor health outcomes. The distribution of positive cases by gender and other relevant demographic factors were analyzed to identify patterns and possible risk factors associated with TB.

Moreover, a large number of the TB-positive cases were found to be living in rural areas which indicates that these peoples do not have proper health facilities and basic needs so that's why the disease are common in these areas. Most of the people never had any formal schooling, few of them went to high school, and only a few attended a college-level education so they didn't know about the disease and its risk factors which is also consider to be the main cause of spreading of disease. As regard the monthly income 22% of the respondents had a monthly household income of less than 20,000, 48% earned PKR 40,000 to 50,000 and 30% reported a monthly income of more than PKR 60,000. regarding the knowledge on symptoms of TB,3% of the respondent mentioned weight loss, fever (49.7%), coughing with blood (0.7%) and night sweat (15.9%), severe cough (30.1%). These all are the significant factors when recorded the prevalence of TB cases.

TABLE 4.1 GENDER WISE FREQUENCY OF THE RESPONDENTS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	163	54.0	54.0	54.0
Female	139	46.0	46.0	100.0
Total	302	100.0	100.0	

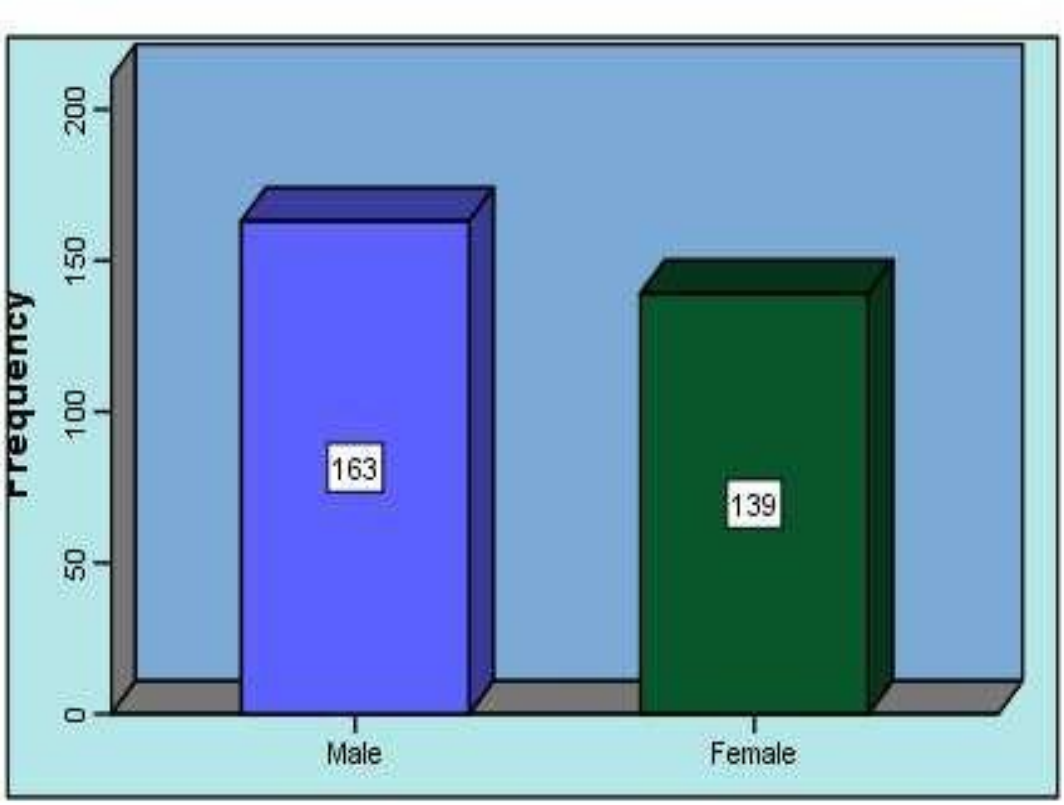

FIGURE NO, 4.1: GENDER WISE FREQUENCY OF THE RESPONDENTS

TABLE NO 4.2: EDUCATIONAL LEVEL OF THE RESPONDENTS

	Frequency	Percent	Valid Percent	Cumulative Percent
No Formal Education	134	44.4	44.4	44.4
Primary	33	10.9	10.9	55.3
Secondary	45	14.9	14.9	70.2
Higher	90	29.8	29.8	100.0
Total	302	100.0	100.0	

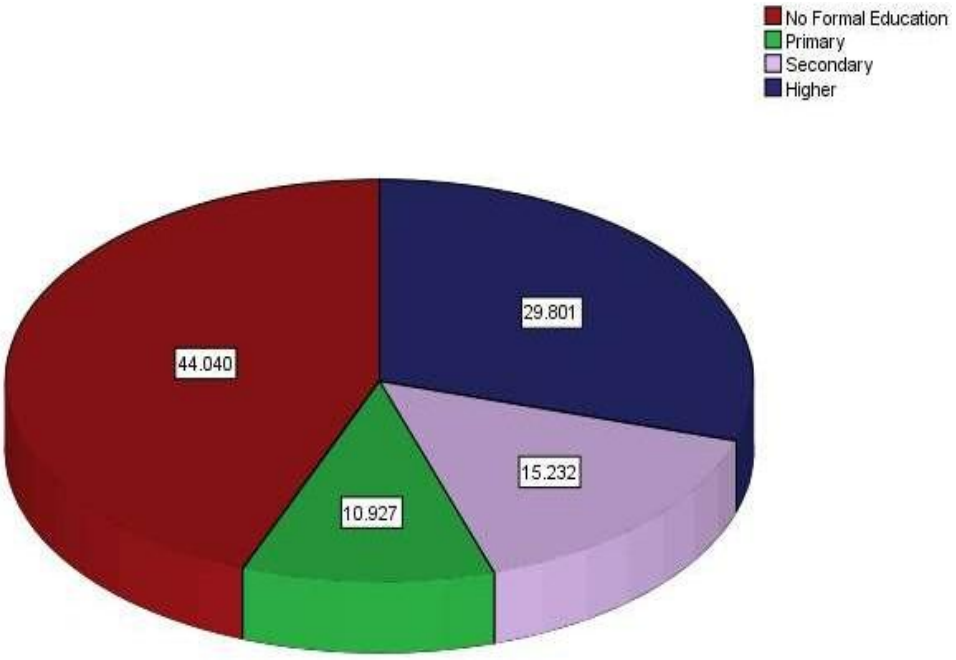

FIGURE NO 4.2 EDUCATIONAL LEVEL OF THE RESPONDENTS

TABLE NO 4.3 MARITAL STATUSES OF THE RESPONDENTS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Single	111	36.8	36.8	36.8
Married	191	63.2	63.2	100.0
Total	302	100.0	100.0	

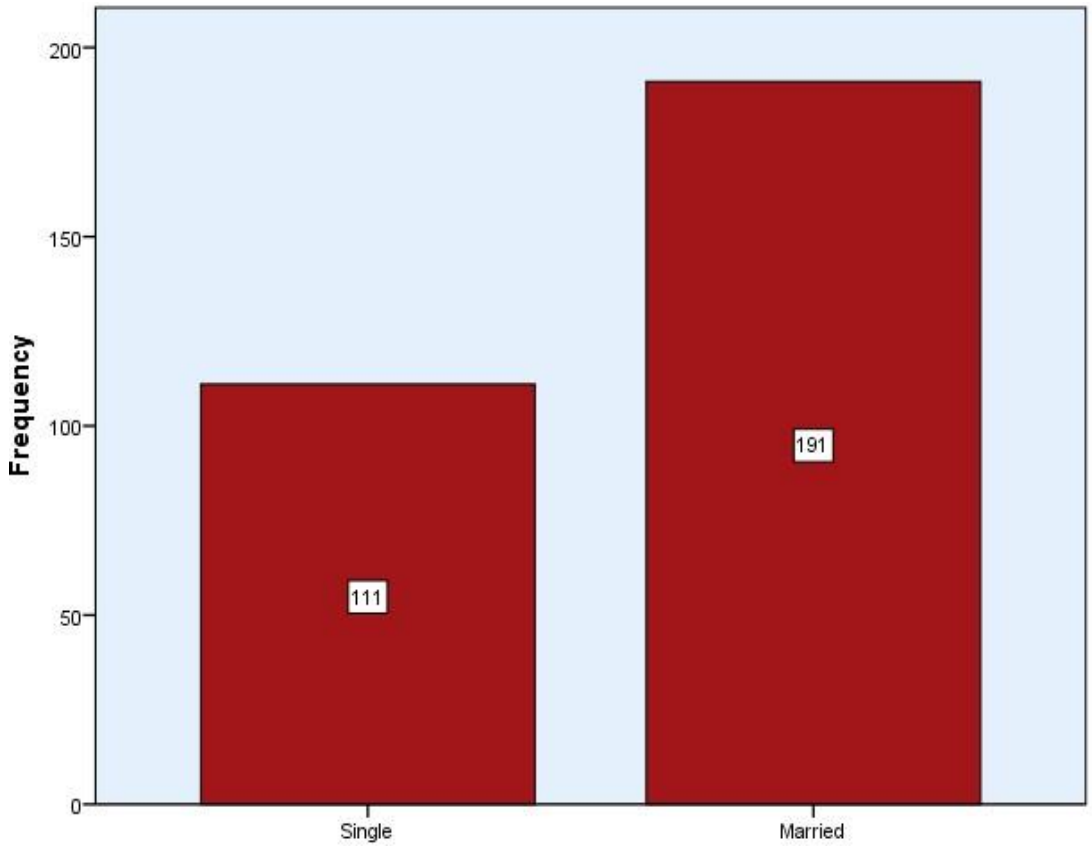

FIGURE NO, 4.3 MARITAL STATUS OF THE RESPONDENT

TABLE NO: 4.4 MONTHLY FAMILY INCOME.

	Frequency	Percent	Valid Percent	Cumulative Percent
Poor	66	21.9	21.9	22.2
Lower Middle Class	144	47.7	47.7	69.9
Upper Middle Class	91	30.1	30.1	100.0
Total	302	100.0	100.0	

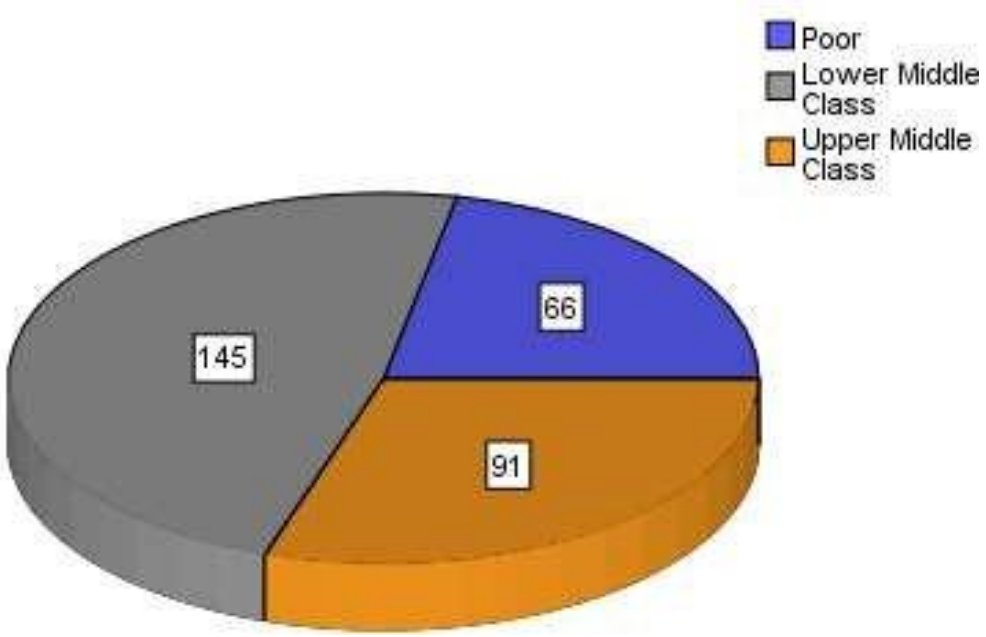

FIGURE NO: 4.4 MONTHLY HOUSEHOLD INCOME

TABLE NO: 4.5 REGIONAL DISTRIBUTION OF THE RESPONDENTS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Urban	117	38.7	38.7	38.7
Rural	185	61.3	61.3	100.0
Total	302	100.0	100.0	

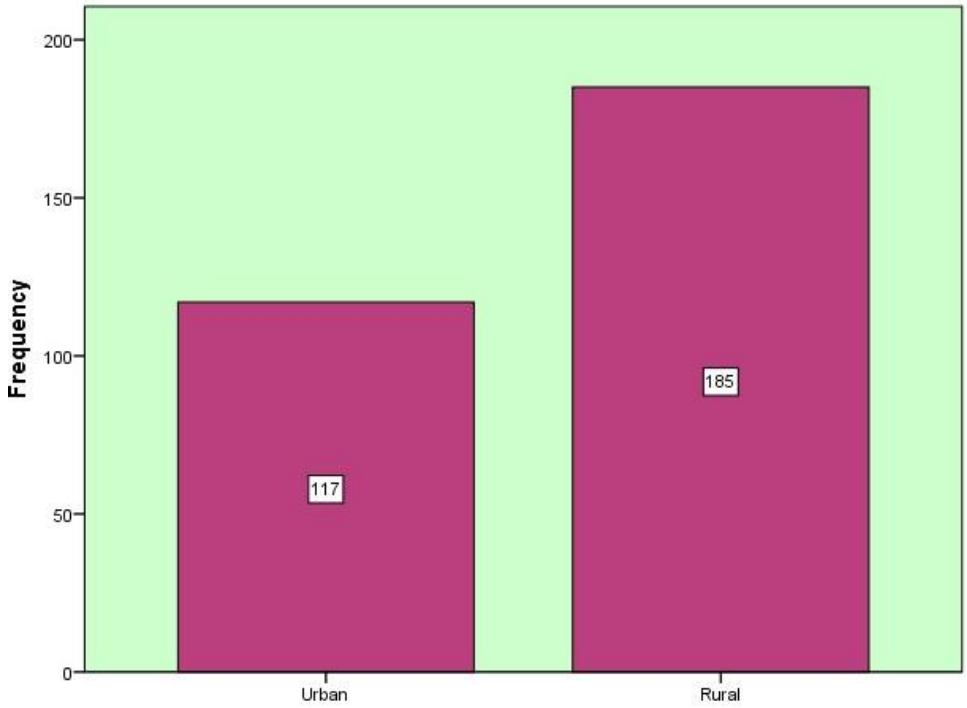

FIGURE NO: 4.5 REGIONAL DISTRIBUTION OF THE RESPONDENTS

TABLE NO: 4.6 DIAGNOSTIC STATUS OF TB.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	27	8.9	8.9	8.9
No	275	91.1	91.1	100.0
Total	302	100.0	100.0	

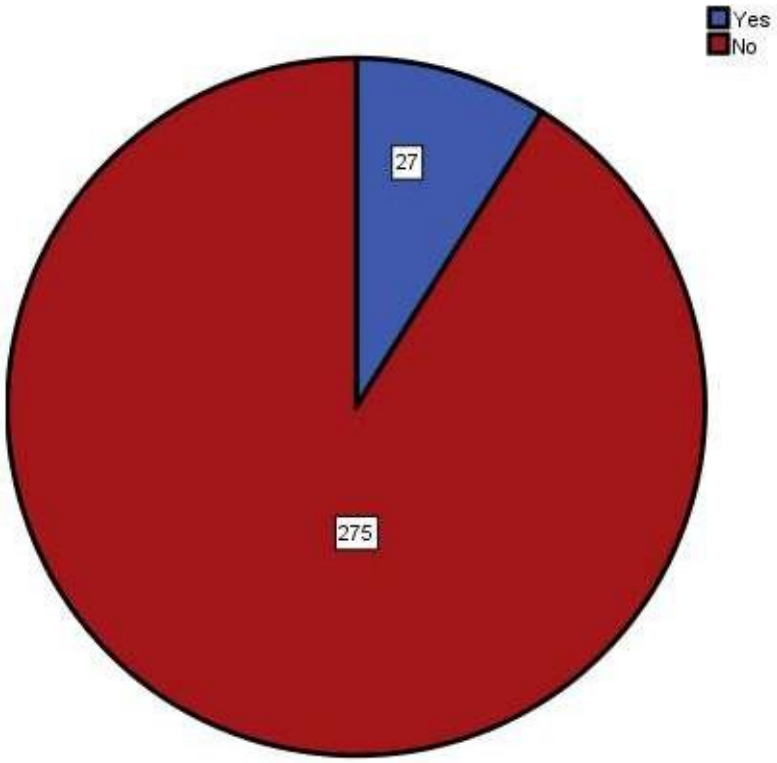

FIGURE NO: 4.6 DIAGNOSTIC STATUS OF TB

TABLE NO: 4.7 TB TREATMENT COURSE COMPLETION STATUS

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	15	5.6	5.6	5.6
No	3	1.0	1.0	6.6
NA	282	93.4	93.4	100.0
Total	302	100.0	100.0	

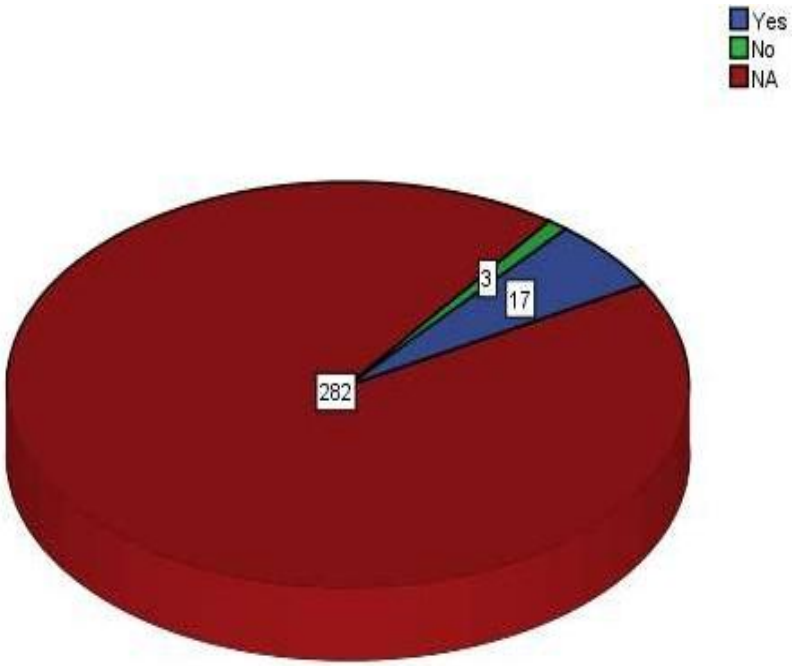

FIGURE NO: 4.7 TB TREATMENT COURSE COMPLETION STATUS

TABLE NO: 4.8 EXPERIENCING ANY SYMPTOMS IN PREVIOUS TWO WEEKS

	Frequency	Percent	Valid Percent	Cumulative Percent
Fever	150	49.7	49.7	49.7
Night Sweat	48	15.9	15.9	65.6
Unexplained weight loss	9	3.0	3.0	68.5
Coughing up blood	2	.7	.7	69.2
Severe Cough	93	30.8	30.8	100.0
Total	302	100.0	100.0	

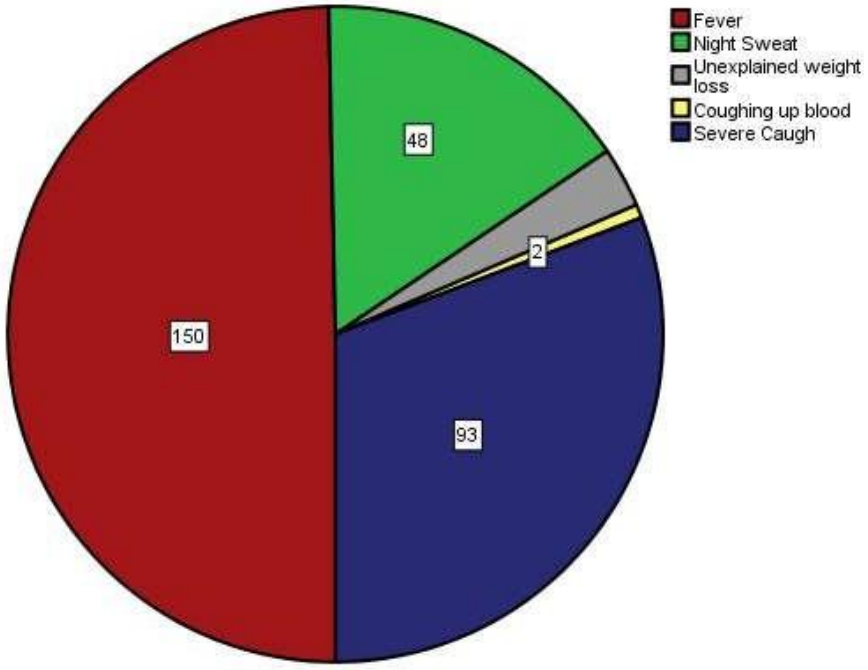

FIGURE NO : 4.8 EXPERIENCING ANY SYMPTOMS IN PREVIOUS TWO WEEKS

TABLE NO: 4.9 CLOSE CONTACT OF RESPONDENT WITH TB PATIENT

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	21	7.0	7.0	7.0
No	281	93.0	93.0	100.0
Total	302	100.0	100.0	

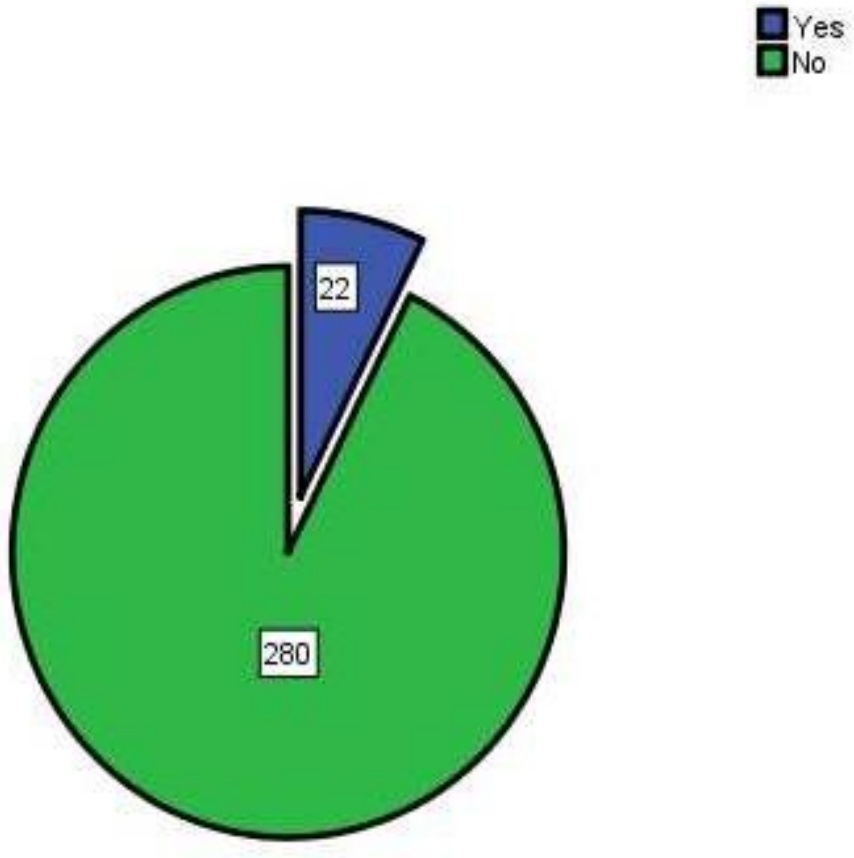

FIGURE NO: 4.9 CLOSE CONTACT OF RESPONDENT WITH TB PATIENT

TABLE NO: 4.10 BCG RECEIVING STATUS OF THE RESPONDENT

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	287	95.0	95.0	95.0
No	15	5.0	5.0	100.0
Total	302	100.0	100.0	

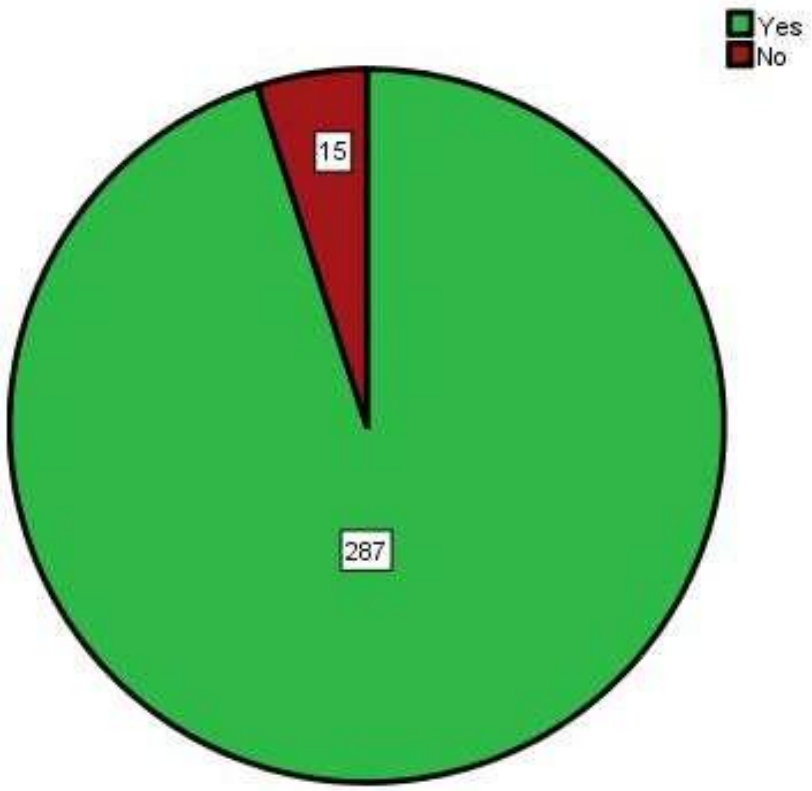

FIGURE NO: 4.10 BCG RECEIVING STATUS OF THE RESPONDENT

TABLE NO: 4.11 ANY CO MORBIDITIES IN THE RESPONDENTS

	Frequency	Percent	Valid Percent	Cumulative Percent
Kidney Disease	5	1.7	1.7	1.7
Diabetes	10	3.3	3.3	5.0
No	287	95.0	95.0	100.0
Total	302	100.0	100.0	

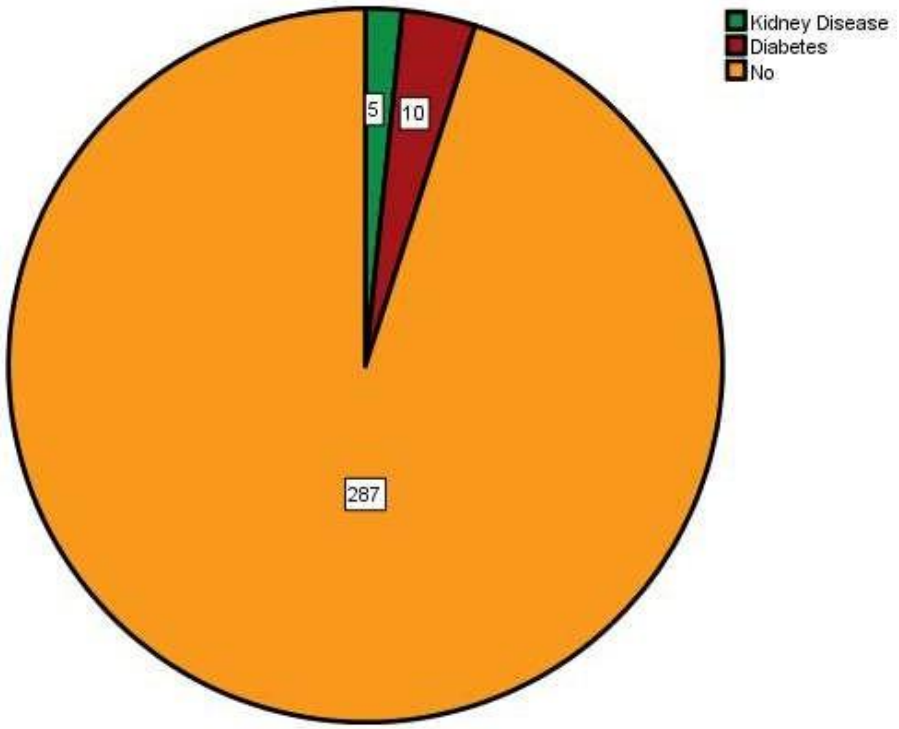

FIGURE NO: 4.11 ANY CO MORBIDITY IN THE RESPONDENTS.

TABLE NO: 4.12 SMOKING STATUS OF RESPONDENTS.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	54	17.9	17.9	17.9
No	248	82.1	82.1	100.0
Total	302	100.0	100.0	

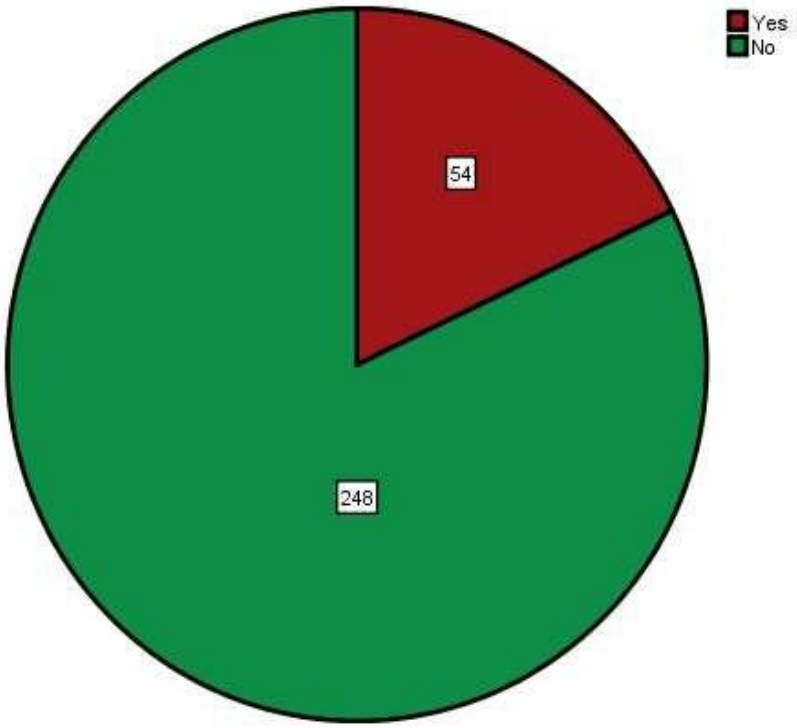

FIGURE NO: 4.12 SMOKING STATUS OF RESPONDENTS.

Table No: 4.13 Crowded living condition of Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	173	57.3	57.3	57.3
No	129	42.7	42.7	100.0
Total	302	100.0	100.0	

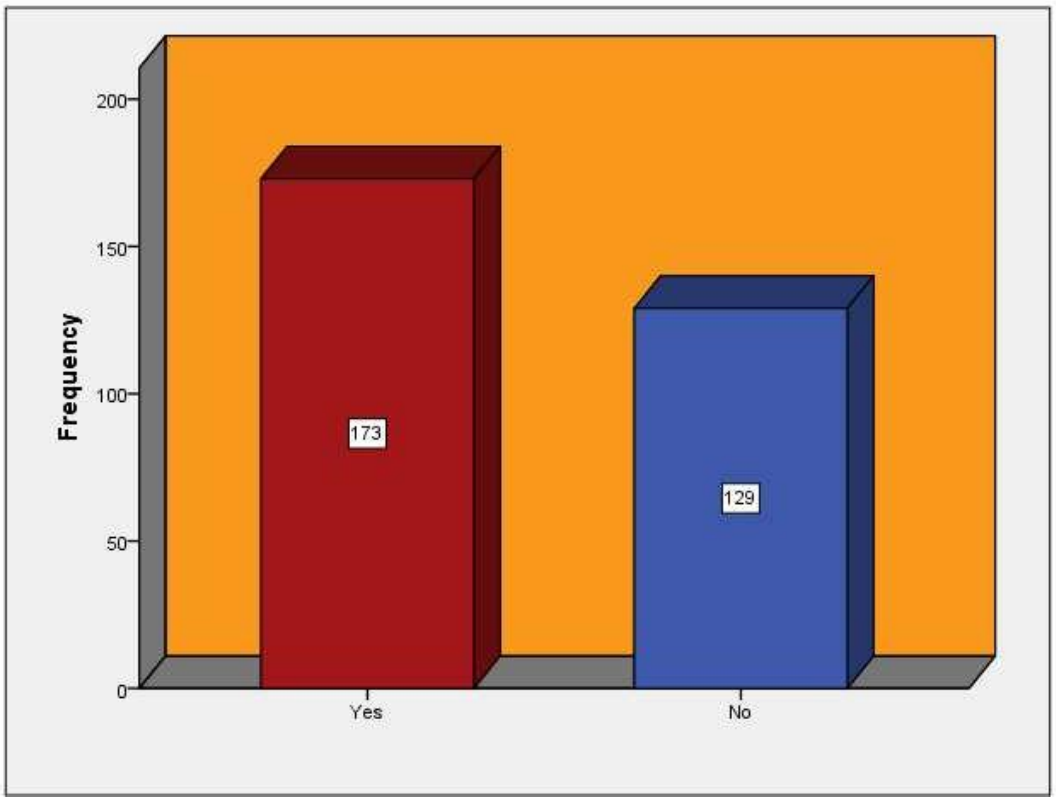

FIGURE NO: 4.13 CROWDED LIVING CONDITION OF RESPONDENTS.

DISCUSSION

In this study we collected 302 samples from the population of different areas of district Malakand to find out the prevalence of TB in these areas. The screaming is carried out in different regions of District Malakand. Among these 302 tested patients 163 were male (54%) and 139 were female (46%). Among these a total of 27 individuals were diagnosed with tuberculosis (TB) and the remaining are tested negative for tuberculosis. Among these 27 cases the male patients were (59.2%) while the female patients were (40.7%). The number of affected males were comparatively higher than the affected females (44.4%). A similar study by Muhammad Saleem *et al* 2013, stated that a total of 752 patients were registered. Of these 752 patients there were 405 males (53.85%) and 347 females (46.14%). Female were affected most frequently (43.08%) and that of males are (40.82%) the main difference in our study is males are more affected than females because of low socioeconomic status most of the male were smokers or nor yet done any BCG vaccine or belonging to crowded families (27). A similar study by Farooq Ali *et al* 2020 reported a total of 1300 suspected patients were examined in which (41.07%) were male and patients and 766 (58.92%) were female patients. Among these suspected patients 236(1815%) cases are detected positive. Out of these, (53.81%) were female patients and male were 109 (46.19%) (24). A study by Tauseef Ahmad

,*et al* 2016, a total of 736 patients of TB were registered in which the ratio of male was 46.74% and that of female was 53.26%. The overall prevalence was 40.08% in which 55.71% cases were smear positive and 15.63% were negative. Out of these 55.71% high cases of smear positive was reported in female (57.63%) the comparison shows that in our study the frequency of male was high then the above studies may be due to the exposer of male to different risk factors like overcrowding, smoking and interaction with more peoples then females we noticed that most of males are smokers and belonging to poor or middle class families which are low socioeconomic status and are the major risk factors which is related to TB (29).

Respondents of the current study experiencing different symptoms 150 (49.7%) respondents had fever 48 (15.9%) had night sweat 9 (3%) respondents experienced weight loss 2(0.7%) respondents had coughing with blood and 93 (30.8%) experiencing severe coughing. A similar study by Ghafoor A, et al. (2016) in total 131,377 person 104,631 persons were screened on symptoms in which 5,063(92.6%) complained for cough more than two weeks (25). A similar study was conducted by Nathan Kapata, *et al 2013-2014* reported cough (55.3%), night sweat (36.0%), fever (35.4%), weight loss (34.4%) respectively. (5)

In our study according to monthly family income of the respondents most of the respondents belongs to lower middle-class families 144 (47.7%), 66 (21.9%) belongs to poor families 91 (30.1%) belongs to upper middle-class families. A similar study by Mohammad Saleem, et *al* 2013 most of the patients were from poor class in which 50% of

the patients having monthly income less than PKR 4,000 per month. This result shows that most of the people belong to poor families so they don't have any basic facilities and personal hygiene to protect from the disease (27).

In our study distribution of the respondent show that most of the respondents belongs to rural area out of 302 respondents 185 (61.3 %) respondents belong to rural area while 117 (38.7%) belongs to the urban area. A study conducted by Nathan Kapata, *et al* 2013-2014 their result shows there were more rural 30,042(65.2%) than urban 16,057(34.8%) respondent. This result shows that most of respondent live in rural areas there is lack of facilities, no proper health hygiene, most of the people are poor so they don't treat the disease on time (26).

A study conducted by Mohammad Saleem,*et al* 2013 out of 44.73% patients 1.04% died of tuberculosis. The low death rate in their study shows the efficacy of the treatment. In our study the ratio of treatment is about 15 (5.6%) while those who don't treat the disease are 3(1.0%). This result shows that most of the respondent treat the disease on time (27)

Smoking is the main associated risk factor in the current study 54 (18%) of the respondents were smokers while the remaining 82 % were non-smokers. A similar study by Anna-Marie Marshall, *et al* 2017-2018 the prevalence of smoking in the TB patients screening in Pakistan was 8.3%. 0f the 13906 respondents with a non-missing smoking, 11207 had pulmonary TB. The prevalence of smoking in respondent of the TB was 25.4% (30). The comparison shows that the frequency of smoking among TB patients is high which is may be the main risk factor of TB. In our study the ratio of male is higher than female because male is more expose to external factors like overcrowding, smoking, interaction with more people than that of female and unhygienic conditions.

CONCLUSION

This study highlights significant insights into the prevalence and risk factors associated with tuberculosis (TB) within the researched population. Of the 302 respondents, 27 tested positive for TB, with a notable higher incidence among males. The study identified smoking and crowded living conditions as major risk factors contributing to the higher prevalence of TB, reinforcing the importance of these environmental and behavioral factors in TB transmission. The use of sputum smear testing and GeneXpert provided reliable diagnostic results, with GeneXpert proving to be especially useful in detecting drug-resistant strains of TB. Additionally, the questionnaire data revealed critical socio-demographic trends, including a higher susceptibility to TB in individuals with poor living conditions and tobacco use. These findings underscore the need for targeted public health interventions, particularly in high-risk groups such as smokers and individuals living in overcrowded environments. Strengthening TB awareness, improving living conditions, promoting smoking cessation, and ensuring prompt and accurate diagnosis through advanced tools like GeneXpert are essential strategies for effective

TB control. The study advocates for continued research and a multi- pronged approach to reduce TB transmission and improve outcomes for those affected by the disease.

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