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The Epidemiology of Tuberculosis in Cyprus from 2016-2022

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Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

DEKONTEE JOANNA DIGGS-NYAH

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DEKONTEE JOANNA DIGGS-NYAH

Abstract

THE EPIDEMIOLOGY OF TUBERCULOSIS IN CYPRUS FROM 2016-2022

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The aim of this study was to examine the epidemiology of tuberculosis infections in Cyprus from 2016-2022. The years between 2016-2019 were accepted as the pre-pandemic period and the years between 2020-2022 were accepted as the pandemic period in this study.

Method: This research employed a retrospective quantitative study design which involve analyzing the data of 428 patients admitted to NEU Hospital with tuberculosis symptoms between 2016-2022.

Results: The study found that the mean age of the patients was 49.58±23.27 (range 0-95 years), 56.5% (n: 242) were male and 43.5% (n: 186) were female. The proportion of TB was 9.5% (23/242) among men, it was 8.1% (15/186) among women. It is observed that TB infections increased after the onset of the COVID-19 pandemic. Accordingly, the rate of TB in the pre-pandemic period was 5.4% (12/221), and during the pandemic period, this rate was determined as 12.6% (26/207). The difference between the rate of TB in both periods was statistically significant (p=0.010)

Conclusion: The study recommends: that it would be very beneficial if regions with knowledge shortages and adverse attitudes engaged in awareness-creation initiatives, such as the dissemination of critical information about tuberculosis infection and its immunization.

Regarding prevention and control, the government should strengthen its monitoring and evaluation system and offer integrated, routine, supporting oversight at all levels.

Keywords: *tuberculosis, mycobacterium tuberculosis, epidemiology, infection,*

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LIST OF ABBREVIATIONS

HIV	Human Immunodeficiency Virus
M.TB	Mycobacterium Tuberculosis
TB	Tuberculosis
TRNC	Turkish Republic of Northern Cyprus
WHO	World Health Organization
XDR-TB	Extensively drug-resistant TB
MDGs	Millennium Development Goals
ECDC	European Centre for Disease Prevention and Control
NHANES	National Health and Nutrition Examination
NHEFS	NHANES-1 Epidemiological Follow-up Study
SES	Socioeconomic status
MDGs	Millennium Development Goals
NTPs	National TB Programmers
PTST	Positive TB Skin Test
LTBI	Latent TB infection
DOT	Directly Observed Therapy
DST	Drug susceptibility testing (DST
RIF	Resistance to rifampicin (RIF)
NEU	Near East University
HIV	Human Immunodeficiency Virus
AIDS	Acquired immunodeficiency Syndrome

CHAPTER I

Introduction

This thesis is an effort to improve our knowledge of tuberculosis epidemiology, with a focus on Cyprus, where the disease is rampant. The thesis aims to analyse the progression of TB and pinpoint its sources of transmission. Better targeting of TB control programs may be possible with a deeper knowledge of the disease's trend and its mode of transmission. There are five parts to the thesis.

Humans serve as the primary reservoir for the mycobacterium that causes TB, however other members of the *Mycobacterium tuberculosis* complex may also cause the illness on rare occasions (Ahmed et al., 2019). WHO named tuberculosis a worldwide emergency in 1993 (Aisu et al., 1995). If better prevention and control measures are not implemented, 40 million people are projected to die from tuberculosis between 2009 and 2025 (Benard, 2022).

Tuberculosis disproportionately affects the world's poor. The spread of tuberculosis infection has been successfully controlled in many regions of the globe because to better socioeconomic circumstances and the availability of effective treatments. High-risk populations in industrialized nations include the elderly, immigrants from TB hotspots, the homeless, alcoholics and drug addicts (Espinal et al, 2020).

HIV-associated immunodeficiency allows TB to progress from a latent infection to a clinically evident illness. Some types of the tuberculosis bacillus are metabolically dormant and unable to replicate inside host cells; this is what causes latent tuberculosis. In the event of CD4+T cell depletion, the proliferation of metabolically active TB bacillus forms and the emergence of clinically apparent tuberculosis are enabled by the inhibition of such processes (Yassin et al., 2022). Non-infected CD4+T cells are also negatively impacted by antibodies, certain cytokines, and autoimmune processes, leading to CD4+T lymphocyte depletion (Cook & Long, 2019).

Tuberculosis incidence and mortality rates are highest in the spring and summer. The lack of sunlight in the winter might be to blame for this. A rise in TB cases has been linked

to global warming, according to some research. The European Centre for Disease Prevention and Control (ECDC) keeps a close eye on tuberculosis's epidemiology throughout the continent. Migration from Africa and the Middle East, with Syrians making up the majority, has changed the epidemiology of tuberculosis in Europe in recent years, as stated by in an accompanying editorial (Kohl, 2022). In most cases, the increased TB risk in these migrants' home countries explains why the TB rate in Europe is higher for them than for Europeans born and raised there (Kohl, 2021).

Whether they do so legitimately or illegally, most of these migrants arrive in Cyprus annually. The vast majority of them are from developing nations where tuberculosis is rampant and poses a threat of infection and transmission to the host nation. Between 1999 and 2009, there was a rise in the number of cases of active TB identified in Cyprus, especially among non-native speakers of the language (Tagliani, Anthony, Kohl, & De, 2021).

Cyprus officially became a member of the European Union in 2004. Cyprus has seen a resurgence of tuberculosis owing to the influx of migrants and refugees from countries with high TB prevalence as a result of recent regional crises and the beneficial effects of migration on the economy. In 1999, thirty (30) people were diagnosed, the vast majority of them were Cypriots. In 2012, 59 new TB cases were reported, demonstrating a worrying trend of increasing epidemic proportions. Cypriots have a lower incidence rate than patients from other nations, according to the World Health Assembly (2017).

A research project tracked Cyprus's efforts to eradicate tuberculosis throughout time. Cyprus is an ideal location for these kind of tests because of its manageable population size (about 1 million) and high standard of medical care. Despite having completed all eight of the WHO European Region's Tuberculosis elimination priority activities, Cyprus still lacks a robust TB elimination strategy. The number of new TB cases reported per million people in Cyprus fell from 85 in 1980 to 28 at most by 2002. Concurrently, the number of reported cases fell from 24 per million people to 11 per million. The number of reported cases of tuberculosis in Cypriots decreased from 31 in 2004 to 6 in 2009, and then increased to around 7-8 per million of the population, while the number of reported

cases of tuberculosis in patients of non-Cypriot origin increased to 54 in 2009, for a rate of 9 per million (Alberto, Adrian, et al., 2018).

Recently, researchers in North Cyprus conducted a cross-sectional assessment of tuberculosis rates from 2016-2022. Two hundred and eighty-eight patient samples were analyzed. The prevalence of TB was detected in 27 (9.4%) of the samples. Distribution across time shows a dramatic rise in the number of TB-positive patients from 2016 to 2020. Over time, researchers have shown that the prevalence of tuberculosis (TB) among North Cypriots has grown marginally whereas the incidence of TB among foreign nations has increased dramatically by (18.8%) ((Hastürk, Güler, Süer, &...et al, 2022). To effectively combat TB, knowledge of the disease's epidemiology is crucial. In light of this, the purpose of this study is to examine tuberculosis prevalence in Cyprus throughout the years 2016-2022.

1.2 Research Problem

As one of the world's greatest killers, tuberculosis continues to be a major public health concern worldwide. TB has resulted in enormous human misery and economic losses. The world still faces a significant public health challenge with tuberculosis. The World Health Organization and its partners have made significant strides to better its control, although the incidence of tuberculosis has only decreased as a result of advances in TB treatment. However, between 2016 and 2022, the illness's incidence in Cyprus surged dramatically as a result of an influx of individuals from countries with a greater disease prevalence. Recently, researchers in North Cyprus conducted a cross-sectional assessment of tuberculosis rates from 2016-2022. A total of 428 samples from newly admitted patients at NEU Hospital were analyzed. The results showed that 8.9% (38/428) of the samples were positive for TB, with most of the infected patients being non-native English speakers. Distribution across time shows a dramatic rise in the number of TB-positive patients from 2016 to 2022. A rise in tuberculosis infections has been seen from the beginning of the COVID-19 epidemic.

TB prevalence among North Cypriots was shown to have grown by a little amount over the years, but TB incidence among foreign nationalities rose dramatically by 18.8% (Hastürk, Güler, Süer, &...et al, 2022). This suggests that migration has had a significant effect on tuberculosis rates in Cyprus. Furthermore, climate change has made the problem much worse. In light of this, the purpose of this research is to assess tuberculosis epidemiology in Cyprus between 2016 and 2022. This study aims to evaluate the Epidemiology of Tuberculosis in Cyprus from 2016-2022 in light of the fact that despite significant efforts by the World Health Organization and its partners to improve Tuberculosis control, the disease continues to be a major Public Health Issue worldwide.

1.3 Research Purpose

The purpose of this research is to examine the causes of tuberculosis infections in Cyprus in the years 2016-2022.

The following sub-aims may be derived from this overall purpose:

1. To assess factors responsible for the incidence of Tuberculosis during the period of 2016 – 2022
2. To identify the effect of those factors on the incidence of Tuberculosis in Cyprus
3. To find suggested solutions to Tuberculosis prevention in Cyprus

1.4 Research Significance

Researchers in related fields may find the study's findings useful in providing supporting information on the need of preventive and vigilance. This research has the potential to be useful for people who work in the public health sector in Cyprus and other tropical nations, as well as for the associations that represent these professionals.

1.5 Research Questions

This research aims to answer the following research questions:

1. What are the factors responsible for the incidence of Tuberculosis in Cyprus?
2. What are the effects of those factors on the incidence of Tuberculosis in Cyprus?
3. What impact did Covid-19 have on the incidence of Tuberculosis in Cyprus?
4. What are suggested solutions to Tuberculosis prevention in Cyprus?

1.6 Definition of Terms

Tuberculosis: It is a communicable illness caused by infection with *Mycobacterium tuberculosis*, whose main reservoir is humans, and sometimes with other *mycobacteria* in the complex.

Mycobacterium Tuberculosis: *Mycobacterium tuberculosis*, or Koch's bacillus, is a bacterium of the family *Mycobacteriaceae* that causes TB.

Infection: Is the intrusion and proliferation of microorganisms within the body. The microorganisms might be anything from bacteria and viruses to yeast and fungus. An infection may start in any part of the body and spread to others.

Epidemiology: Is the study of the factors that contribute to illness and health status in large groups of people. In epidemiology, the community serves as the patient, and its members are considered as a whole. Epidemiology is defined as the "scientific, systematic, and data-driven study of the distribution (frequency, pattern), and determinants (causes, risk factors) of health-related states and events (not just diseases) in specified populations" (Neighborhood, School, City, State, Country, Global). The prevention and treatment of health issues are another focus of this research.

1.7 Organization of the Study

Chapters were used to break up the research into five sections. Research questions and objectives are included in this section, as well as significance and scope/delimitation considerations. Chapter 2 provides an outline for the literature review of the understudy. Design, setting, population, sample size and basic methodologies; data collection equipment; data organization; and data analysis method are all covered in Chapter 3. Chapter four of this study focuses on the data presentation, analyses and results and findings of the research. Lastly, chapter five highlights the study summary, conclusion and recommendation.

CHAPTER II

Literature Review and Hypotheses Development

2.1 Introduction

This literature review sheds light on previous studies conducted by other researchers on the epidemiology of tuberculosis. It summarizes a list of studies on the topic.

2.1.1Overview of TB

TB is an airborne disease caused by the *Mycobacterium tuberculosis* (Mtb) that is spread by close contact between infected persons and is one of the top causes of mortality and disability worldwide. The bacteria responsible for tuberculosis, *Mycobacterium tuberculosis* (Mtb), is gram-positive, acid-fast, and facultative aerobic (Ankrah, 2019). Extra-pulmonary TB may affect the meninges, bones, gut, lymph nodes, joints, skin, and other tissues in addition to the lungs, which is known as pulmonary tuberculosis (Nanda, 2011). Because of congestion and a lack of air, tuberculosis may easily spread across a community (Narasimhan, 2021).

The chance of getting TB is the same for both men and women. The World Health Organization (WHO) and its partners have made tremendous progress in TB control, which has led to a decline in the disease's prevalence (Millet & Moreno, 2021). Nevertheless, TB continues to be a serious public health concern worldwide.

To now, *M. tuberculosis* has infected over a quarter of the global population, and yearly, it infects around 1% of the world's population. However, most persons who get infected with Mycobacterium tuberculosis do not become ill with the illness; in fact, 90-95% of those infected with TB exhibit no symptoms at all. It is estimated that between 1.20 and 1.45 million individuals died from tuberculosis in 2012, with 8.8 million new

cases being detected in 2010. Most of these deaths occurred in low-income countries. There have been 0.35 million new HIV infections in that time (Tiberi & Al-Abri, 2018).

Europe has had the greatest reduction in tuberculosis (TB) incidence of any WHO area, with an estimated 35.5 incident (new and relapse) cases per 100,000 in 2016 (Tagliani, Anthony, Kohl, & De, 2021). Research conducted over time shows that Cyprus has made significant strides in TB eradication. Cyprus is an ideal location for these kind of tests because of its manageable population size (about 1 million) and high standard of medical care. Despite having completed all eight of the WHO European Region's Tuberculosis eradication plan's essential activities, Cyprus lacks a comprehensive strategy to eradicate the disease. The number of new cases of tuberculosis reported per million people in Cyprus fell from 85 in 1980 to 28 at most by 2002. Concurrently, the rate of new cases per million people has dropped from 24 to 11. Among Cypriots born on the island, the rate of tuberculosis notifications dropped from 31 in 2004 to 6 in 2009, and then rose to around 7-8 per million people. Meanwhile, the rate of notifications among patients born outside of Cyprus rose to 54 in 2009, or 9 per million people (Alberto, Adrian, et al., 2018).

Recently, researchers in North Cyprus conducted a cross-sectional analysis of tuberculosis rates between 2016 and 2020. There were a total of 288 samples from patients analyzed. Positive TB tests were performed on 27 samples (or 9.4 percent). Statistics show that the number of TB-positive patients has skyrocketed between 2016 and 2020. TB prevalence among North Cypriots was shown to have grown only marginally over the years, but TB incidence among foreign nationalities rose dramatically by 18.8% (Hastürk, Güler, Süer, &...et al, 2022).

The World Health Organization (WHO) and its partners have achieved significant progress in combating tuberculosis (TB), but the illness is still a major threat to public health. The number of new cases of TB in 2016 was 10.4 million, and it claimed the lives of 1.7 million people, according to the World Health Organization. Although yearly mortality is decreasing by 3% (Alberto Matteelli et al., 2018), there are still over 400000

TB deaths among HIV-positive individuals and 1.3 million among HIV-negative people per year.

2.2 Mycobacterium Tuberculosis Effects

The respiratory system becomes affected after inhaling infectious droplets. The majority of the bacilli live in the mucus-secreting goblet cells of the upper airways, where they can't do any harm. The cilia on the surface of the cells continuously beat the mucus and any particles it has caught upward for disposal, making the mucus an effective trap for foreign substances. In the event of TB exposure, this mechanism serves as the body's initial line of defense (Burman, W., Luo, 2022). Alveolar macrophages, the most abundant of the immune effector cells present in these areas, quickly devour droplets of bacteria that evade the mucociliary pathway and arrive in the alveoli. After then, macrophages from the host's innate immune system have a shot at finishing off the invading mycobacteria and ending the infection. It is not necessary for the host to have been exposed to the invading pathogen in the past for macrophages, a kind of phagocytic cell, to mount an effective defense against it (Engle, Prihoda, & Vernon, 2022). Several mechanisms, including macrophage receptors, are involved in the uptake of the mycobacteria. The phagocytes known as macrophages can react rapidly to an infection and eliminate it, even if the host has never seen that specific pathogen before. Receptors on macrophages are part of the chain of events that leads to *mycobacterial* uptake (Weiner & Peloquin, 2022).

Lipoarabinomannan, found on *mycobacteria*, is an important ligand for a macrophage receptor. In addition to the innate immune system, the complement system aids in the engulfment of the bacterium. Mycobacteria are easier for macrophages to recognize once the complement protein C3 attaches to their cell wall. C3's opsonization (an immunological process in which particles like bacteria are targeted for removal by an immune cell known as a phagocyte) is rapid even in the air spaces of a host with no previous exposure to *M tuberculosis*. Ingestion of tuberculin by macrophages initiates a

cascade that may be inhibited, leading to latent TB, or can lead to active disease, culminating in primary progressive tuberculosis (Jackson, 2021).

It takes between 25 and 32 hours for a new generation of mycobacteria to form after being consumed by a macrophage. Macrophages release proteolytic enzymes and cytokines early in an infection in an attempt to break down the germs. This process persists regardless of whether the infection is stopped or not (Chee & Persaud, 2021). Cell-mediated immunity's T lymphocytes are attracted to the site when cytokines are released. Mycobacterial antigens are then presented to T lymphocytes through macrophages. It takes anywhere from two weeks to a year for the bacteria to proliferate to a level that triggers a cell-mediated immune response, which may be detected by a skin test (Paton, 2021).

2.4 Risk Factors of Tuberculosis

Understanding the variables that increase or decrease the likelihood of infection and illness progression is crucial for developing effective TB control measures (WHO, 2022). Social and behavioral risk factors, such as, smoking, alcohol use, and exposure to polluted indoor air, have a significant role in determining the likelihood of contracting tuberculosis after exposure. Transmission is more likely to occur in crowded, socially-mixing environments (WHO, 2022). Exposure to an infected patient might be extended due to healthcare system-related conditions such a delay in diagnosis. The progression of an infection into a disease is heavily influenced by endogenous (host-related) variables. The risk of developing an illness from HIV co-infection is highest in those who also have a condition that alters their immune response. However, depending on the HIV prevalence in a given area, the effect of this risk factor at the population level may be different. The World Health Organization (WHO) reports that diabetes, alcohol, malnutrition, cigarette smoking, and indoor air pollution all accelerate TB disease progression.

2.5 Synopsis of Risk Factors

Key risk factors are outlined below, and their visual representation in Figure 1 illustrates the primary traits that impact an individual's likelihood of developing infection and illness.

***2.5.1 Weakened Immune System*.** Most times, the immune system is able to effectively combat TB germs, but if resistance is poor, the body will not be able to establish an effective defense. A weakened immune system is a common side effect of several illnesses and treatments. Below the numbers of disease that may most likely weaken the immune system according to Dr. Mohammed Hussein, 2020.

HIV infection, diabetes, acute kidney disease, malnutrition, young or advanced age, low body weight, cancer of the neck and head.

2.5.2 Malnutrition: Factor.Research has demonstrated that micro- and macronutrient deficiencies raise the risk of tuberculosis (TB) by lowering the body's ability to fight off infections. Loss of appetite and alterations in metabolic pathways are two ways in which tuberculosis may induce malnutrition (Muwonge & Nakiyingi, 2022). BCG vaccination experiments conducted in the United States in the late 1960s provided evidence that undernourished children were twice as likely to get tuberculosis as their well-nourished peers (Muwonge & Nakiyingi, 2020).

Malnourished people had an adjusted hazard of tuberculosis that is six- to ten-fold higher, according to data from the first National Health and Nutrition Examination (NHANES-1) and the NHANES-1 Epidemiological Follow-up Study (NHEFS), both of which were performed in the United States among adults in 1982–1984. Cegielski and McMurray noted in their analysis of ecological, epidemiological, and animal research that there is evidence between malnutrition and tuberculosis (Kirenga & Ssengooba, 2020), but the risk related to particular degrees of malnutrition still needs to be determined.

2.5.3 Young Age. Infection and illness from tuberculosis (TB) are more common in children. Those exposed to a sputum smear-positive case were more likely to get the infection (60-80%) than those exposed to a sputum smear-negative source case (30-40%),

according to research. Children under the age of two are more likely to get the bacteria from a family member or close friend, while older children are more likely to contract the bacteria out in the community. The presence of a sputum-positive source case in the home is the single most significant risk factor for infection in children under the age of 10 (McAdam, 2022). The highest risk occurs in the first year after exposure, when most symptoms of the illness appear due to primary infection. There was a higher risk of sickness in children who acquired their main infection before the age of 2 or after the age of 10 (Bah, Gustafson & Warndorff, 2022). After contracting TB for the first time, the chance of dying from the disease was greatest among infants. Between the ages of 1 and 4, the risk dropped to 1%, but then increased to almost 2% between the ages of 15 and 25. In most underdeveloped nations, traditional contact inquiry procedures center on children under the age of five, but in most industrialized countries, the emphasis is on all family interactions (Lienhardt, Fielding & Sillah, 2022).

2.5.4 Diabetes.The likelihood of developing tuberculosis (TB) is higher in those with diabetes. Seventy percent of the world's diabetics now reside in poor and medium income nations, with rates rising substantially in TB-endemic regions such as India and sub-Saharan Africa. The risk of tuberculosis for people with diabetes is almost three times that of those without diabetes, according to a meta-analysis of 13 research on the topic (Shetty, Shemko, Vaz & D'souza, 2020).

Patients with diabetes may have poorer outcomes, as a prospective study by Alisjahbana et al. (2020) found that their smear-positive culture rate at the end of treatment was 22.2%, compared to only 6.9% in patients without diabetes. When compared to patients without diabetes, those with diabetes and TB had a mortality risk that was five times higher after controlling for potential confounders. Biological evidence suggests that diabetes directly suppresses both innate and adaptive immunological responses, hence promoting TB development (Shetty, Shemko, Vaz, & D'souza, 2020).

2.6 Socioeconomic and Behavioral Factors

Rapid urbanization in developing countries and individuals' socioeconomic status (SES) have both been shown to increase their susceptibility to illness. Globally and

locally, those with lower socioeconomic status are disproportionately affected by the TB burden (Galvo, Bonini, Arbex, & Mello, 2018). The aforementioned risk factors for TB (such as malnutrition, indoor air pollution, alcohol consumption, etc.) disproportionately affect those from lower socioeconomic backgrounds. People of lower socioeconomic status are more likely to live in overcrowded conditions with poor ventilation and to lack access to adequate training kitchens. Because of factors such as overcrowding, HIV/AIDS infection, and injectable drug misuse, marginalized people like inmates are at a greater risk of contracting tuberculosis. There is a correlation between lower socioeconomic status and smoking, but not with alcoholism, HIV/AIDS, or diabetes (Galvão, Bonini, Arbex & Mello, 2018).

2.7Smoking Tobacco

The association between cigarette smoking and tuberculosis (TB) has been the subject of several scientific research. Bates and colleagues meta-analyzed 24 research on the impact of smoking on tuberculosis and found that compared to non-smokers, cigarette smokers had a greater relative risk of TB illness. People with active tuberculosis are already at a higher risk of dying from smoking. Lin et al. (Silva, Muoz-Torrico & Duarte, 2018) did a meta-analysis and systematic review of the effects of smoking and indoor air pollution on TB.

2.7.1 Alcohol: Heavy alcohol use is associated with an increased chance of contracting TB. Drinking more than 40 grams of ethanol daily or being diagnosed with an alcohol use problem has been linked to a roughly threefold increase in the risk of TB, according to a meta-analysis of papers published up to 2020 undertaken by LNNROTH et al. (2020) (Davies, 2019). This meta-analysis found that booze contributed to the development of TB in around 10% of all cases and fatalities. Multiple studies have been published since then, allowing for meta-analyses to be undertaken separately on the risk factors for TB associated with alcohol use, alcohol intake (including evaluation of a threshold impact), and alcohol-related disorders. Since the effects of vaccination have been suspected for a long time and are seen for other infectious illnesses, meta-analyses

of the dose-response relationship are of particular interest. Additionally, decision makers may be guided in the direction of preventive and treatment actions for alcohol-attributable TB by using revised risk relations (RRs) (Davies, 2019).

2.7.2 Indoor Air Pollution: More than 80% of people in poor nations use solid fuels for cooking (Narasimhan, Wood, MacIntyre & Mathai, 2021). Case control studies in India and Brazil found that exposure to smoke from burning wood or biomass increased the likelihood of contracting tuberculosis. Animal studies have shown, however, that short-term exposure to wood smoke reduces macrophage phagocytic function, surface adherence, and bacterial clearance (Narasimhan, Wood, MacIntyre, & Mathai, 2021). This finding suggests that acute wood smoke may be the mechanism by which biomass smoke causes chronic lung illnesses. Large PM generated by biomass burning, such as carbon monoxide (CO), nitrogen oxide (NOx), formaldehyde, and polyaromatic hydrocarbons, may penetrate deeply into the alveoli and inflict severe damage (Narasimhan, Wood, MacIntyre, & Mathai, 2021).

2.8 Types of Tuberculosis

The bacteria *Mycobacterium tuberculosis* is responsible for the spread of TB, a potentially fatal and deadly illness. While the lungs are the most common site of TB infection, the spine, brain, and kidneys are all at risk. TB is lethal if treatment is delayed or avoided. There are eleven different forms of TB, classified by the medical profession into the pulmonary and extra pulmonary groups. Four are attributable to pulmonary TB and seven to extrapulmonary tuberculosis. Those with weakened immune systems are more likely to get extra pulmonary TB (Marais, Gie, Hesseling & Beyers, 2021).

2.8.1Pulmonary Tuberculosis

Pulmonary tuberculosis is the most frequent kind of tuberculosis. Sixty-seven percent of TB cases in the US in 2011 were limited to the lungs. Pulmonary tuberculosis patients may be contagious due to their cough and abnormal chest radiograph. Most instances of tuberculosis originate in the lungs, but the illness may also spread to other parts of the body and manifest as disseminated TB. The following are examples of the many forms of pulmonary tuberculosis (Marais, Gie, Hesseling & Beyers, 2021).

2.8.2Laryngeal TB.When tuberculosis bacteria invade the vocal cords in the throat, it is called laryngeal tuberculosis. Despite its rarity, pulmonary tuberculosis is often misdiagnosed as chronic laryngitis or laryngeal cancer. It has been shown that (Marais, Gie, Hesseling & Beyers, 2021).

2.8.3Cavitary TB.Upper lobe lung disease is called cavitary tuberculosis. Cavities, or expanded air gaps, are formed by the bacteria, which leads to gradual lung deterioration. Reactivation illness causes this kind of tuberculosis. Since *M.tuberculosis* flourishes in low-oxygen environments, the higher lobes of the lung are the ones that suffer. A productive cough, nocturnal sweats, fever, lack of appetite, and weakness are all symptoms. Hemoptysis (coughing up blood) is possible. TB empyema (pus in the pleural fluid) is caused when illness extends into the pleural space. Reference: (Kumar, Deka, Bagga, Kala & Gauthaman, 2020).

2.8.4 Miliary TB.Small nodules, like millet seeds, may be seen spread throughout the lungs and are referred to as "military" on a chest X-ray. Military tuberculosis may develop soon after the first infection. The patient has a severe illness marked by a high temperature and rapid declines in health. Chronic sickness and gradual deterioration may also result from the condition. Weight loss, chills, and fever are all possible symptoms. The first chest x-ray may be unremarkable, making diagnosis challenging. Patients with compromised immune systems and exposed youngsters are at increased risk for acquiring military TB (Alemie & Gebreselassie, 2019).

2.8.5TB Pleurisy.Rapid progression to this condition is common after infection. Pleural space (the area between the lungs and the chest wall) is invaded by a granuloma that forms at the lung's periphery. Shortness of breath (dyspnea) and severe chest discomfort that is exacerbated by taking a deep breath (Pleurisy) result from an increase in fluid volume brought on by bacterial invasion. While most cases of tuberculosis pleurisy clear up on their own, around two-thirds of people with this condition go on to develop active pulmonary TB within 5 years if they aren't treated (Alemie, & Gebreselassie, 2021).

2.9 Symptoms of Tuberculosis

TB symptoms include a persistent cough that lasts for two weeks or longer (for any length of time if HIV positive), high fever that lasts for two weeks or longer, excessive night sweats, and fast weight loss (more than 1.5 kg in a month). The most frequent sign of pulmonary TB is a productive cough, which may be followed by other systemic symptoms as fever, night sweats, or weight loss. Every patient who tests positive for a symptom must undergo further, thorough testing. Since not everyone with tuberculosis will have a cough, a high index of suspicion is required, particularly in people who are HIV positive and may only have one of the aforementioned symptoms. A patient may visit a medical professional if they are experiencing any of the following symptoms: chest pain (from pleurisy or muscular strain), difficulty breathing (from systemic lung disease or concurrent pleural effusion), wheezing (from local TB bronchitis or from external pressure on the bronchus from an enlarged lymph node), or all of the above. (E.) Boahen, 2014.

2.10 Diagnosis of Tuberculosis

TB can be detected in a person’s body by two main tests. Positive TB skin test (TST) and TB blood test (TBT). These tests are only used to confirm the presence of TB in a person’s body and does not tell whether a person has latent TB infection (LTBI) or has Active TB infection. There are many factors that contribute to an accurate diagnosis of tuberculosis, including self-presentation of people with TB symptoms to health care

facilities, a high index of TB suspicion among health care professionals, TB screening practices in health facilities, the sensitivity and specificity of the diagnostic test used, the turnaround time for delivery of laboratory results, and the ability to trace people with positive results and start them on treatment.

2.11Tuberculosis Epidemiology

Seventy-five percent of all TB cases are in the most economically productive age range (15-54), and more than 90 percent of all TB fatalities occur in the poor countries. As a result, an adult who has tuberculosis might expect to miss three to four months of work. With a TB patient's death, a family may expect to lose an average of 15 years' worth of income (Constantinides, 2022).

The likelihood of contracting tuberculosis (TB) is greatly amplified in those who are also HIV-positive (JJ, 2021). The reported incidence rates of tuberculosis in countries with high HIV prevalence doubled or tripled in the 1990s. This was especially true in sub-Saharan Africa. However, a rising global issue is the rise of multi-drug resistance due to poorly managed TB treatment programs in many nations (Talias, 2020). The death rate for HIV-positive individuals who get the XDR-TB strain that has recently emerged in rural South Africa is close to one hundred percent (Zannetos, S., & Talias, 2019).

The number of new cases of TB in 2007 was estimated by the World Health Organization (WHO) to be 9.27 million, down from 9.24 million (or 140 per 100,000 population) in 2006. Smear-positive cases increased by 44% to an estimated 4.1 million (61 per 100 000 population) out of a total estimated 9.27 million. India, China, Indonesia, Nigeria, and South Africa are the top five nations in terms of the total number of instances. Asia (including South-East Asia and the Western Pacific) accounts for 55% of all cases globally, while the African Region contributes for 31%. A very small number of instances are found in the Americas, Europe, and the Eastern Mediterranean combined. Zannetos and Talias (2019) found that 13 of the top 15 countries with the highest anticipated rates of TB incidence also had the highest rates of HIV prevalence.

There were 1,000,000 new cases of TB among children in 2017, resulting in 230,000 fatalities. Ten million people contracted tuberculosis in 2017, with an estimated 1.6 million fatalities. The World Health Organization estimates that 54 million lives were spared due to the detection and treatment of TB. One person becomes infected with tuberculosis every minute, and approximately a third of the global population has the disease. However, many people who have M. TB do not end up with the typical TB sickness. Almost all of the 8.8 million new cases and 1.45 million deaths that year were concentrated in economically weaker regions of the world. An estimated 13.7 million instances of chronic illness were actively being treated in 2007. About 0.35 million of these deaths occurred in patients who were both HIV-positive and co-infected. The number of persons with TB is believed to be as high as 14 million, with over 9 million new cases recorded in 2009. An estimated 1.3 million HIV-negative cases died in 2009, in addition to the 0.4 million deaths among TB and HIV co-infected patients. Among the 1.2 million fatalities in 2014 attributed to HIV, 0.4 million were attributable to TB in the HIV-positive population. A person's death from both TB and HIV is counted as an HIV-related death on a worldwide scale. In 2014, TB was predicted to have affected 9.6 million persons worldwide (Geser, 2022).

In 2015, women were responsible for an estimated 480,000 TB deaths and 3.2 million TB infections. One million more children were diagnosed with TB, which is believed to have resulted in the deaths of about 140,000. In 2014, there were an estimated 190,000 new cases of multidrug-resistant tuberculosis. One of the three infectious illnesses expressly recognized under the Millennium Development Goals (MDGs) because of its extensive public health effects. As a result, efforts have been more organized on a global basis, leading to significant advancements in National TB Programmers (NTPs) throughout the globe. Despite this, TB continues to be a major problem in terms of public health across the world. Roman and Gray (2020). In the early 1960s.

2.12Transmission of Mycobacterium Tuberculosis

Droplet nuclei are minute airborne droplets that are distributed by the coughing, sneezing, talking, or singing of a person infected with Mycobacterium TB in the lungs or larynx. Once breathed in, these harmful bacteria will remain in the pulmonary alveoli,

where they will be phagocytosed (engulfed and destroyed together with other bacteria and foreign bodies). Oftentimes, symptoms of the initial infection are not present. Aerosolized infectious particles may travel through the air and infect anybody who comes into contact with them. There are no more than three bacilli in a droplet nucleus. Due to the minute size of their nucleus, droplets may float in the atmosphere for a long time. Droplet nuclei with a diameter of 5um are the most infectious. About 3000 droplet nuclei are created every time you cough. Singing produces the same number of droplet nuclei in one minute as talking for five minutes (Knechel, 2019).

The largest number of droplet nuclei are produced during a sneeze, which may travel up to 10 feet. When the nuclei of infectious droplets reach the alveoli, tuberculosis occurs. When a person breathes in droplets laden air, the majority of the bigger droplets end up in the upper aerosolization respiratory system, such the nose and throat, where they are less likely to cause illness. The droplet's bacilli count, bacilli virulence, UV light exposure, air circulation, and frequency are all factors in the spread of an infection. Infection in the respiratory system follows *M. tuberculosis'* introduction into the lungs; nevertheless, the organisms may travel to other Organs, such as the lymphatics, pleura, bones/joints, or meninges, resulting in extra pulmonary Tuberculosis (Knechel, 2019).

2.13Migration & Climate Change

The peak season for TB incidence is the spring and summer months. The lack of sunlight in the winter might be to blame for this. Climate change may have a beneficial effect on the prevalence of TB, according to this evidence. M &...et al. (2016) note that the European Center for Disease Prevention and Control (ECDC) keeps a close eye on TB's epidemiology throughout Europe. According to C. Kodmon (2016), the rise in the number of cases of tuberculosis in recent years is attributable to the influx of people from Africa and the Middle East, the majority of whom are Syrians, into nations in the EU/EEA. Increased rates of tuberculosis among these migrants in Europe are usually reflective of the increased TB risk in their home countries (Tagliani, Anthony, Kohl, & De, 2021).

Whether they do so legitimately or illegally, most of these migrants arrive in Cyprus annually. The vast majority of them are from developing nations where tuberculosis is

rampant and poses a threat of infection and transmission to the host nation. Between 1999 and 2009, there was a rise in the number of cases of active tuberculosis identified in Cyprus, especially among non-native speakers of the language (Tagliani, Anthony, Kohl, & De, 2021).

Cyprus officially became a member of the European Union in 2004. Cyprus has seen a resurgence of tuberculosis owing to the influx of migrants and refugees from countries with high TB prevalence as a result of recent regional crises and the beneficial effects of migration on the economy. The majority of the thirty (30) instances recorded in 1999 were Cypriots. In 2012, 59 new cases of tuberculosis were reported, further illustrating the disease's rapid expansion. Patients from foreign nations accounted for the vast majority of these instances, whereas Cypriots made up a far smaller percentage. In 2017, there was a World Health Assembly (Bardswell, 2020).

From 1997 to 2002, the number of TB cases in Cyprus decreased by an average of 9.4 percent each year, from 46 to 20. The TB eradication criterion has practically been attained in the local population (Alberto, Adrian, &...et al, 2018), notwithstanding a recent spike in incidence among expats.

Testing and treatment for Latent Tuberculosis Infection is mandatory for individuals at risk, including those about to begin anti-TNF therapy, those on dialysis, those planning for an organ or hematological transplant, those screened for silicosis, convicts, healthcare professionals, etc. This is something that has to be done regularly (WHO, 2020).

2.14 Delayed TB Treatment and the Impact of COVID-19 on TB Prevention and Control

Among those who are HIV +, tuberculosis is the most common cause of death. Despite this, they may get antiretroviral medication (Ford N, 2016). (World Health Organization, 2018) HIV-positive patients have a 21-fold increased risk of contracting tuberculosis compared to the general population. Positive effects of isoniazid preventative treatment among HIV-positive patients have been shown in 33 separate studies and meta-analyses. Death rates from tuberculosis have dropped by 37 percent in West Africa after

six months of isoniazid therapy overseen by monitors (Daniel C, 2015). Prevention with isoniazid for more than 36 months was suggested by the World Health Organization due to the high probability of reinfection (World Health Organization, 2020).

The influence on TB incidence lags behind that on TB death for two key reasons. The first is that the number of people who die from tuberculosis rises when diagnostic and treatment services are disrupted. The second is that it takes time to affect the incidence of the growing pool of prevalent cases as more individuals with TB aren't recognized and treated. This is because of the lengthy interval between infection and the development of the illness (which may be anywhere from weeks to decades) (Petrou, 2017).

2.15Treatment and Preventing of Tuberculosis

In 2020, the World Health Organization released guidelines for the treatment and prevention of tuberculosis. "A state of persistent immune response to stimulation by M. tuberculosis antigens with no evidence of clinically manifest active TB" (WHO, 2020) is how LTBI is described in the guidelines. WHO's primary recommendation for meeting END TB Strategy goals is TB preventative therapy (TPT). This was confirmed in the September 2018 UN High-Level Meeting on Tuberculosis. The first and second pillars of the END TB Strategy provide a broader framework of preventive actions, including screening for active TB, infection control, the prevention and care of HIV and other co-morbidities and health risks, universal health care access, social protection, and the alleviation of poverty, of which TB Preventive Treatment is just one part.

LTI, as defined by World Health Organization standards, focuses on the risk of TB progression in high-risk groups, TB's epidemiology and burden, and TB's influence on public health. The World Health Organization's (WHO) unified recommendations on TB aim to improve upon preexisting protocols and emphasize new data on shorter rifamycin-containing preventative regimens based on studies published following the release of the previous 2018 version (WHO, 2020).

According to World Health Organization guidelines, LTBI is primarily concerned with the potential for progression to active TB in high-risk populations, the epidemiology

and burden of TB, and the effect of TB on public health. New evidence on shorter rifamycin-containing preventive regimens based on trials reported after the publication of the previous 2018 edition is highlighted in the WHO consolidated guidelines on tuberculosis, the primary goal of which is to improve existing protocols (WHO, 2020).

According to the 2020 recommendations, patients with HIV who are not at high risk for tuberculosis but who are receiving antiretroviral therapy should also get TB preventative medication. In addition, it specifies that pregnant women must have TB preventative therapy regardless of whether or not they have ever been treated for TB, the severity of their immunosuppression, or the presence or absence of a Latent Tuberculosis Infection test. Even though a child under 12 months old with HIV is unlikely to have active TB based on adequate clinical examination, they should nevertheless get TB preventive medication to protect themselves and others from contracting the disease. For children with HIV younger than 12 months who were born and raised in high-transmission areas, it is suggested that they be given TB preventative therapy as part of the overall HIV prevention package. Finally, all HIV-positive children who have finished treatment for tuberculosis sickness are encouraged to get TB preventive therapy (WHO, 2020).

Children under the age of five who are in close contact with someone who has bacteriologically confirmed pulmonary TB must take TB preventive treatment if that person has HIV, regardless of the results of a clinical evaluation to determine whether or not the child has active TB. Individualized risk assessment and clinical reasoning will be used to determine whether or not to provide TB preventive medication to children younger than 5 who live in the same home as certain high-risk patients with multidrug-resistant tuberculosis (WHO, 2020).

Testing and treatment for Latent Tuberculosis Infection is mandatory for individuals at risk, including those about to begin anti-TNF therapy, those on dialysis, those planning for an organ or hematological transplant, those screened for silicosis, convicts, healthcare professionals, etc. This is something that has to be done regularly. Adults and adolescents living with HIV should use the algorithms to rule out active TB illness (WHO, 2020).

To prevent tuberculosis, the World Health Organization suggests a variety of treatment plans, including 6 or 9 months of daily isoniazid, a 3-month regimen of weekly

rifapentine plus isoniazid, or a 3-month regimen of daily isoniazid plus rifampicin (WHO, 2020).

Because COVID-19 causes long-lasting damage to the respiratory system, especially the lungs, those who may have come into contact with it are at a greater risk of developing pneumonia and respiratory failure, and therefore of catching tuberculosis (TB) (Singh, Sharma, & Patel, 2012).

According to the World Bank, the number of people living in severe poverty worldwide rose by 0.3 percentage points in 2020 to around 9 percent, and another 40 million to 60 million people entered it. As a result, the TB epidemic's burden will be reduced in the long run (Lancet, 2005). Extreme poverty is a recognized contributor to the development of TB in its active form (Oxlade & Murray, 2012).

The public health measures used to halt the development of the COVID-19 epidemic, as well as the resulting health and economic catastrophe, may have far-reaching consequences for TB control and prevention. It is possible that the indirect costs of the COVID-19 pandemic, owing to poor endemic disease management, will add up to more than the direct costs. Health systems should do their best to keep providing normal care for endemic infectious illnesses, even if these services are at reduced levels compared to what they were before the pandemic (Adamide, Georgiou, Farmakas & Theodorou, 2012).

2.15Prevention, Control, and Treatment of Tuberculosis

2.15.1 TB Prevention

Tuberculosis treatment and prevention recommendations were published by the World Health Organization in 2020. "A state of persistent immune response to stimulation by M. tuberculosis antigens with no evidence of clinically manifest active TB" (WHO, 2020) is how LTBI is described in the guidelines. WHO's primary recommendation for meeting END TB Strategy goals is TB preventative therapy (TPT). The September 2018 United Nations High-Level Meeting on Tuberculosis reaffirmed this. The first and second

pillars of the END TB Strategy provide a broader framework of preventive actions, including screening for active TB, infection control, the prevention and care of HIV and other co-morbidities and health risks, universal health care access, social protection, and the alleviation of poverty, of which TB Preventive Treatment is just one part.

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Options for preventing tuberculosis include 6 or 9 months of daily isoniazid, a 3-month regimen of weekly rifapentine plus isoniazid, or a 3-month regimen of daily isoniazid plus rifampicin (WHO, 2020).

***2.15.2 TB Control*:** Although Cyprus lacks a formal TB eradication strategy, the country's TB management program is so effective that all eight priority actions for TB elimination in the WHO European Region have been completed (Sotgiu, 2021). The rate of TB notifications per million people in the nation fell from 85 in 1980 to 28 at the very least by 2002. Meanwhile, the rate of confirmed cases per million people has dropped from 24 to 11. The number of Cypriots who report having tuberculosis has decreased steadily from 31 in 2004 to 6 in 2004, and then has risen to around 7-8 cases per million population, while the number of foreign-born patients who report having tuberculosis has increased to 54 in total (9 cases per million population) in 2009 (Alberto, Adrian, &...et al, 2018).

Cyprus' success in eradicating tuberculosis may be attributed to the country's efforts in seven core locations. Commitment, TB awareness and health system capacity, drugs-resistant TB and TB/HIV co-infection management, quality laboratories and care, introduction of new tools and operational research, surveillance, and the formation of international alliances are all important aspects of TB control. The examination of impact indicators between 1995 and 2012 (World Health Organization, 2021) showed that notification of new sputum smear-positive case rates per million people.

The Pasteur Institute in Athens, Greece is the country's official reference laboratory for sputum microscopy, culture, and drug susceptibility testing (DST) for first-line anti-TB medications. There is no cost for tuberculosis testing or in-patient treatment, however a small fee is required for out-patient care. An isolated reference centre handles instances of multidrug-resistant tuberculosis, and a one-stop facility has been set up to help those who are afflicted with both HIV and TB (Voniatis, 2019).

Northern Cyprus residents of foreign origin have the highest prevalence of tuberculosis in Cyprus (Cyprus Ministry of Health., 2019). The constant influx of immigrants from countries with a high incidence of TB makes it difficult to make further progress toward maintaining a low level of M. tuberculosis transmission in the community at the present time. Therefore, further interventions are required to further TB eradication efforts throughout the nation. Innovative approaches for early and active case identification among at-risk groups, especially among migrants, and preventative therapies for those at high risk should be prioritized by the government of Cyprus. Additionally, a projected model is being implemented at the national level to evaluate the impact of various measures, such as the introduction of rapid molecular diagnostics, new drugs, and diagnostic machines that can cover the entire population of Cyprus, on the overall goal of TB eradication. Improving the current Tuberculosis Infection register by introducing methods for quality data management, electronic surveillance, and expansion. The Cyprus model shows that it is possible to keep tuberculosis rates low. Thus, continuous dedication and money may aid in the elimination of the illness. To hasten the decline in occurrence of Latent Tuberculosis Infection (LTBI), national strategies for diagnosis and interventions for treatment are required (Borgdorff & Et al, 2020).

***2.15.3 TB Treatment*:** Patients with tuberculosis should take the antibiotics isoniazid and rifampicin once day for four months, as recommended by the World Health Organization (2020). The same treatment protocol is used for TB-positive kids as it is for adults (Migliori, 2018). High-dose isoniazid and rifapentine (up to 900 mg each) should be administered once weekly for three months under directly supervised treatment, as recommended by the World Health Organization's 3HP regimen (Sterling TR, 2011). For those who are at high risk of contracting tuberculosis, this regimen is recommended instead of the standard 6-9 month isoniazid course (Centers for Disease Control and Prevention, 2020). This includes children and pregnant women who have had close contact with TB patients, HIV-positive patients, and patients with fibrotic changes detected by chest radiography. World Health Organization's revised recommendations for 2020 include using a combination of rifapentine and isoniazid for a duration of one month (World Health Organization, 2020).

Preventing, detecting (via screening), treating, monitoring, and evaluating TB infections are crucial to effective management of the illness. Proper treatment of tuberculosis illness reduces the risk of future outbreaks (World Health Organization, 2020). The public health situation will improve if more sick patients are correctly detected and given treatment (Lönnroth K, 2019; Diel R L. R., 2019). If not properly treated, tuberculosis is a potentially fatal communicable illness (World Health Organization, 2018).

2.16Impact of COVID 19 on Tuberculosis

Worldwide, COVID 19 caused significant disruption. Due to the severity of the pandemic and the reaction measures needed to combat this lethal illness, medical and economic human resources were shifted (Raymond, Thieblemont, Alran, & Faivre, 2020). There was also widespread damage to community-based international health promotion and illness prevention initiatives. In this way, tuberculosis was not an exception (Abdela, van Griensven, Seife & Enbiale, 2020).

According to research done in Spain, the Covid-19 epidemic has resulted in a decline in the number of healthcare staff regularly caring for TB patients, and most TB units have documented structural alterations. The study also found that patients had trouble getting further testing owing to changes in the family contact screening program and the cancellation or postponement of follow-up appointments. Since COVID-19 clusters frequently consist of infectious agents, this pandemic may have an even greater effect on infectious diseases, especially those affecting the lungs (Azna, Espinosa-Pereiro, Saborit, & et al., 2021).

To prevent the spread of COVID-19, the government has implemented measures including house arrest, which have altered patient treatment and had a harmful effect on their health. Outpatient visits fell in the United States at the height of the pandemic but have since recovered (Mehrotra, Chernew, Linetsky, Hatch, & Cutler, 2020).

New TB diagnoses decreased similarly in the early lockdown months and again in the recovery phase. According to international data (Kwak, Hwang, & Yima, 2020; Lai & Yu, 2020), the overall number of TB patients diagnosed in 2020 was lower than the same time in 2019. The long-term decline in TB incidence before the pandemic may provide insight into this pattern. Research, however, reveals an uptick in instances detected following the lockdown period, lending more credence to the claim that cases are on the rise. Perhaps this was a consequence of the limitations imposed during the COVID outbreak. Misdiagnosis contributes to the spread of tuberculosis in the community, and the similarities between TB and COVID-19 symptoms only make things more difficult. Azna, Espinosa-Pereiro, Saborit, et al. (2021) revealed that 24% of patients with active TB were isolated at home owing to probable COVID-2 infection (Zannetos, Zachariadou, Adamidi & Georgiou, 2018).

Isolation at home could increase the risk of spread to close relatives. One of the most effective methods for TB control to date has been the early identification, isolation, and treatment of individuals with active TB so that they may rapidly become non-infectious and prevent additional infections. However, it's possible that COVID-era regulations that mandated measures like facemask use and social isolation contributed to less TB spreading within neighborhoods. Bilateral lesions on chest radiographs were more common in patients with TB identified during the COVID-19 pandemic, suggesting more advanced illness (Azna, Espinosa-Pereiro, Saborit, et al., 2021).

That's why we need to do this research. This is because the long-term epidemiological effect of actions against COVID-19 will be best understood via investigations of TB incidence following COVID.

2.17Patient Education

Patient compliance with TB treatment may be improved by education. Providers need to provide patients specific instructions on when, how frequently, and how much of their prescription to take. Medication-related side effects and the appropriate time to seek

medical assistance should be communicated clearly to patients. It is crucial to educate patients about the outcomes they might expect from improper medication use. Patients should also be made aware of infection prevention and control procedures and the possibility that they may need to be isolated. All TB patients should be tested for HIV and counselled about prevention in all healthcare settings. Prior to any Testing being done, the patient must be informed. HIV testing and counselling are voluntary, and the patient has the option to forego them via an "opt-out screening" (smolovic M. 2012, April–June).

2.18 Drug-Resistant Tuberculosis

When it comes to combating TB, chemotherapy is unrivaled. The World Health Organization (WHO) recommends an 85% cure rate for tuberculosis (TB) when using the currently available anti-TB medications correctly. The emergence of treatment failures and the subsequent development of resistance to chemotherapy occurred early in the history of the field. The rising incidence of resistance organisms to the two medications that comprise the backbone of current short-course therapy—isoniazid and rifampicin—is of particular concern. Resistance to rifampicin (RIF) is a surrogate marker for multidrug resistance (Quy et al., 2006) and develops most often in tandem with resistance to isoniazid (INH; 90% of cases). Mutations that arise at random on chromosomes during normal cell replication are responsible for M. tuberculosis's development of drug resistance. These changes are not related to drugs and are not caused by them. A larger bacterial population increases the likelihood of a drug-resistant mutant appearing (Mermin J. 2007). Primary drug-resistant organism frequencies range from around 10-6 to 10-8, depending on the medicine in question. It is expected that 1 in 106 organisms develops resistance to isoniazid and that 1 in 108 develops resistance to rifampicin. The chances of a spontaneous mutation leading to resistance to several medications increased as the number of mutations increases.

The emergence of drug resistance is a natural process that has been amplified by human activity. The selection of multidrug-resistant organisms is facilitated by prior treatment for TB. Failure to follow instructions is a key contributor to the spread of antibiotic-resistant bacteria (Sarita et al., 2007). To counteract the inevitable formation of drug-resistant mutants due to the lengthy nature of treatment, multi-drug therapy is used.

According to the number of medications and/or types of drugs involved, resistance may be classified as single-drug, multi-drug, or poly-drug resistance (Raviglione et al., 2019).

2.19 Directly Observed Therapy (DOT)

DOT is a part of case management used to boost treatment adherence. It's the process through which a healthcare provider or other authorized person observes and records a patient taking their anti-TB medication. To treat TB illness and, if possible, latent tuberculosis infection (LTBI), DOT is the recommended core management method. DOT lessens the chances of medication resistance, treatment failure, and post-treatment relapse. Successful DOT is facilitated by good case management, which involves building rapport with the patient and removing any obstacles to taking their medication as prescribed (Thwaites, 2020).

When patients with drug-susceptible tuberculosis are closely monitored, almost all treatment regimens may be administered on an intermittent basis. Intermittent regimens are more cost-effective because they lower the total number of doses a patient must take and the total number of interactions with the healthcare practitioner or outreach worker. Drug-resistant tuberculosis requires constant close monitoring and a daily treatment plan. When it comes to treating MDR-TB, no intermittent regimens exist. DOT should be supplied twice daily if anti-TB medications for MDR-TB therapy need to be given twice daily. As shown by research (Thwaites, 2020).

2.2 Conceptual Framework

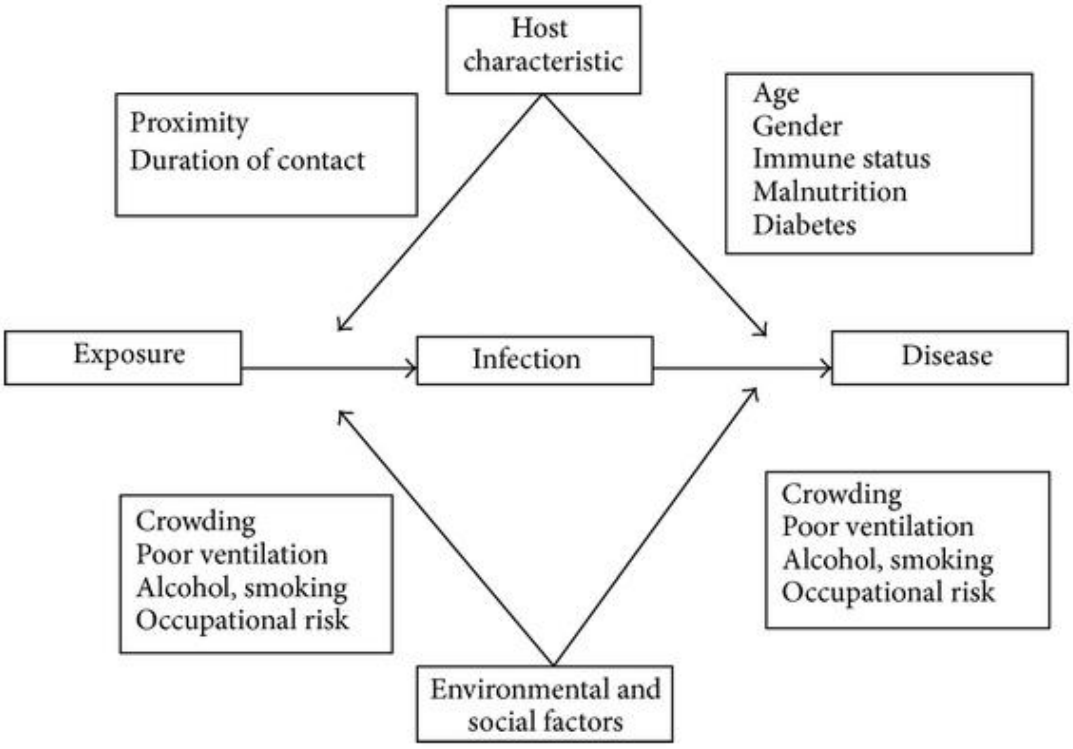


Figure 1.*Conceptual Framework (Zaidi et al., 2023).*

CHAPTER III

3.1 Research Methodology

Study objectives, demography, participant selection, and data collecting and analysis procedures are all outlined in this section. Ethical and practical concerns are also addressed, as are the study's validity and reliability.

3.2 Research Method

The study's research questions were addressed by using the quantitative research approach. The quantitative approach, as stated by (Polit, F.D. & Beck, C.T., "2004"), makes use of deductive reasoning to produce hypotheses that are then put to the test in the actual world. As a result, a quantitative research approach is necessary to investigate and evaluate TB epidemiology in Cyprus. In order to ensure that all necessary and relevant data were incorporated in the analysis, the researchers used a quantitative technique. The strengths of one strategy may help compensate for the flaws of the other, which is another compelling reason to combine the two approaches. Lisle (2011) claims that using a combination of research techniques improves the reliability of the results. The methods and equipment used to gather data are also enhanced.

3.3 Research Design

According to the literature (Joubert, Ehrlich, Katzenellenbogen, & Karim, 2007), a research design is "the systematic procedure by which a researcher attempts to address a specific research question." This research employed a retrospective study design which involve analyzing the data of 428 patients admitted to NEU Hospital with tuberculosis symptoms from 2016-2022.

3.4 Study Area

Cyprus, or more specifically the Turkish Republic of Northern Cyprus (TRNC), is an island in the eastern Mediterranean Sea, south of Turkey. It has been divided politically between Turkey (on the northern half of the island) and Greece (on the southern half)

since the late 20th century, and its population is estimated at 1,257,675 as of the most recent United Nations data for 2023.

3.5 Study Group

Populations in studies are the people or things that make up a study. The term "population" refers to the people, things, places, and actions involved in a scientific investigation. The study population were the 428 patients admitted to NEU Hospital with tuberculosis symptoms between 2016 and 2022.

3.6 Sampling & Sample

In this analysis, we reviewed and assessed samples from 428 Tuberculosis-positive patients hospitalized at the Near East University (NEU) Hospital in Nicosia, North Cyprus, between 2016 and 2022. The years 2016–2029 were considered the pre–pandemic era, whereas the years 2020–22 were considered the pandemic period. Patients gave their consent for their samples to be analyzed at the NEU micro-bacteriology lab.

3.7 Materials/ Methods

The various materials and methods were used in the preparation of the specimen that was collected from the study participants. **Tuberculosis Culture** 2.9% NALC-NaOH (Sodium citrate) and 4% of NaOH (N-acetyl-cysteine) were used to decontaminate and homogenize samples gotten from different wards of the NEU hospital. An equal amount of 5-10ml NACL-NaOH solution of each sample was mixed with a vortex for 30 sec. The tubes were kept for 15 minutes at room temperature and shaken to evenly combine mixture and then centrifuged at 3000Xg for 15 minutes forming a residue which was diluted with 2ml of phosphate buffer at (6.8=PH) and prepared with dye. The prepared solution was then cultivated on a medium called Bac *Mycobacterium* Growth Indicator Tube, and kept 6-8 weeks at 37° after which, the solution was transferred to another medium known as the Lowenstein Jensen medium and incubated at the same temp for the same length of time. Growth was seen in a positive result while it was the opposite for a negative result. **Ziehl-**

Neelsen (Acid Fast) Staining. The prepared bacteria samples were smeared on a clean sterile slide fixed by heat. Carbol fuschion was covered over the prepared smear and place over heat for about 5 minutes until the mist was formed. The slide was rinsed thoroughly with clean water until no trace of the dye was seen in the water. 3% v/v acid alcohol was applied over the smear slide for 5 minutes until the color of the smear appear pale pink. Thereafter, it was rinsed well with clean water and then cover with methylene blue for 30 seconds after which, it was placed under the light microscope at 100x oil immersion objective for examination.

3.8 Statistical Analysis

The data was analyzed using SPSS Demo Ver 22.0 (SPSS Inc., Chicago, IL, USA). Pearson Chi-Square was used to determine the statistical significance at $P<0.005$.

3.9 Ethical Approval

The research was approved by the Near East University Ethics Committee with (project no: NEU/2023/113-1725), demonstrating that the methods and instruments used were appropriate for this study and up to par with the university's requirements.

CHAPTER IV

4.1 Results

A retrospective study was conducted evaluating 428 patients admitted to NEU Hospital with tuberculosis symptoms between 2016 and 2022. About 56.5% (n: 242) of the patients were male and 43.5% (n: 186) were female, with a mean age of 49.58 ± 23.27. The years between 2016 and 2019 were accepted as the pre-pandemic period, with the years between 2020 and 2022 representing the pandemic period.

The rate of TB infections before and during the COVID-19 pandemic was also evaluated and it was found that 8.9% (38/428) of the patients were positive for TB throughout the 6-year period. The rate of TB-positive tests among men was 9.5% (23/242) and 8.1% (15/186) among women. No statistically significant correlation was found between gender and TB positivity (p=0.604).

Additionally, the mean age of male and female TB-positive patients was 43.87 ± 21.81 and 45.93 ± 23.02, respectively. Again, no statistically significant correlation was found between gender and TB positivity (p=0.782). The TB tests performed, and the results of the patients were recorded and can be seen in Table 1.

The mean age of the patients with positive TB test results was 44.68 ± 22.01 and of those with negative results was 50.06 ± 23.36. It was determined that there was no significant relationship between the two (p=0.175).

The effects of the COVID-19 pandemic on TB infections have been of great concern as there may be an increase due to decreased access to preventive healthcare and more limited treatments. The study conducted at NEU Hospital suggests that the TB

infection rate during the pandemic was equivalent to the rate seen prior to the pandemic in the pre-pandemic period.

Overall, the study at NEU Hospital demonstrated that gender did not have any correlation with the TB infection rate of patients and that the mean age of TB-positive patients was roughly 43 years old. It was also determined that the TB infection rate during the COVID-19 pandemic was like what it was prior to the pandemic, and this did not appear to be affected by gender. Further studies are needed to better understand the impact of COVID-19 on TB infection rates.

Table 1: TB tests and the positivity rates of the patients

	ARB stain*	**Quanti FERON-TB GOLD PLUS (Tbc test) N,%**	**Tuberculosisculture N,%**	***Mycobacterium tuberculosis* complex PCR N,%**
Negative	162 (91.5%)	47 (81%)	156 (94%)	25 (92.6%)
Positive	15 (8.5%)	11 (19%)	10 (6%)	2 (7.4%)
Total	177 (100%)	58 (100%)	166 (100%)	27 (100%)

*Sputum, urine, CSF, gastric fasting juice

The above table shows the results of the ARB stain, as well as the Quanti FERON-TB Gold Plus (Tb test), Tuberculosis culture, and Mycobacterium tuberculosis complex PCR. The negative findings indicate that 91.5% of those tested with the ARB stain were negative, 81% using the Quanti FERON-TB Gold Plus (Tb test) were negative, 94% with the Tuberculosis culture were negative, and 92.6% with the *Mycobacterium tuberculosis* complex PCR were negative.

The positive findings from the table note that 8.5% of those tested with the ARB stain were positive, 19% using the Quanti FERON-TB Gold Plus (Tb test) were positive, 6% with the Tuberculosis culture were positive, and 7.4% with the Mycobacterium tuberculosis complex PCR were positive.

In total, the table shows that 177 samples were tested with the ARB stain, 58 with the Quanti FERON-TB Gold Plus (Tb test), 166 with the Tuberculosis culture, and 27 with the Mycobacterium tuberculosis complex PCR.

The ARB stain seemed to detect the least amount of positive results within the group, and the Quanti FERON-TB Gold Plus (Tb test) detected more positive results than the ARB stain. The Tuberculosis culture and Mycobacterium tuberculosis complex PCR both produced positive results in similar proportions.

The results from the table show that the ARB stain was relatively effective at detecting both positive and negative results; 91.5% of those tested with the ARB stain were negative, and 8.5% were positive.

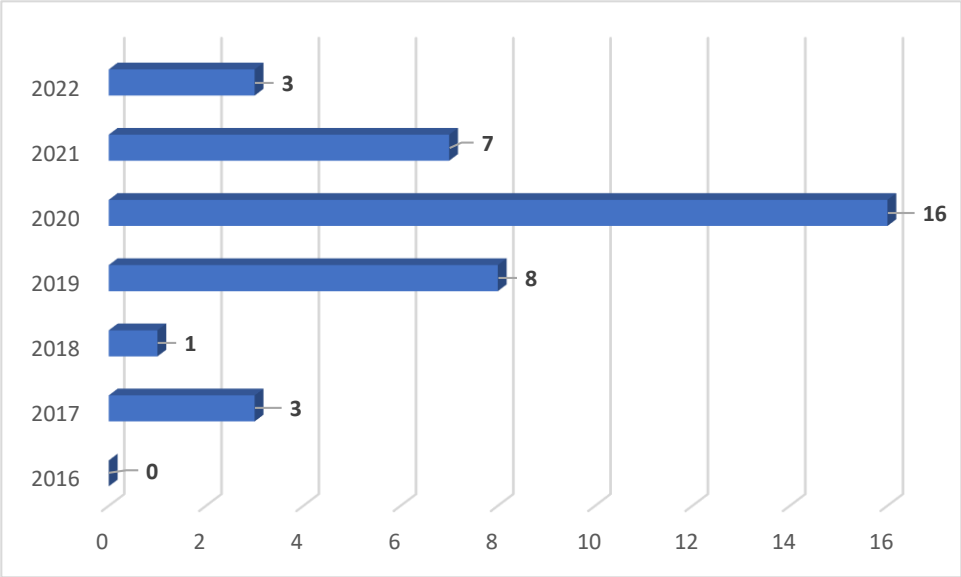
The Quanti FERON-TB Gold Plus (Tb test) was not as effective as the ARB stain, as it only detected 81% of the negative and 19% of the positive results.

The Tuberculosis culture and Mycobacterium tuberculosis complex PCR effectively detected positive and negative results; 94% of the Tuberculosis culture samples were negative, and 92.6% of the Mycobacterium tuberculosis complex PCR samples were negative.

Overall, the table shows that the different tests used to detect tuberculosis had varying levels of success, with the ARB stain being the most effective. Despite the

differences in accuracy, all tests used in the table were above the 90% mark for both positive and negative results.

Figure 2: Distribution of TB patients detected over the years (n)



The table above provides information about the number of cases reported in a certain period of time, specifically from 2016–2022. In 2016, no cases were reported. This trend of low numbers of cases continued until 2018, with only one case reported. In 2019, the number of cases significantly increased as eight cases were reported. This was followed by another increase of the number of cases in 2020 and 2021, when seven cases were reported both years. It appears that the number of cases reported in 2022 is lower than in the two previous years, as only three cases were reported in that year.

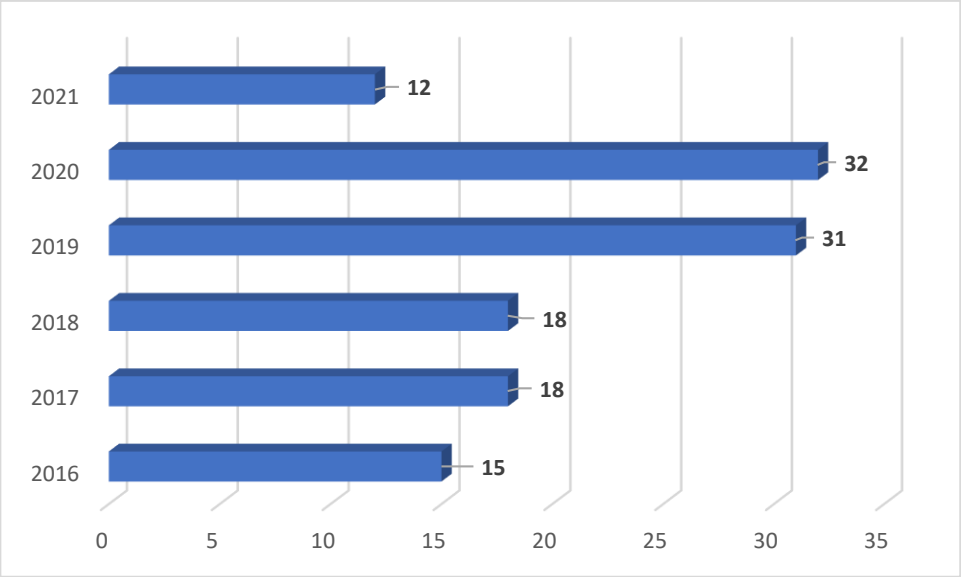
This makes it the lowest number of cases reported in that period, with the number of cases steadily increasing from 2016 to 2019 and remaining largely consistent until 2022. It could be said that this provides an overview of the fluctuations in case numbers

throughout the period in question, showing that there could be a correlation between the number of cases reported and the year in question.

Finally, this indicates that, in the period between 2016 and 2022, the number of cases reported is generally trending upwards, albeit with a decrease in the most recent year.

Overall, this table provides valuable insight into the number of cases reported in a certain period, showing an overall upward trend, but with a decrease in the most recent year.

Figure 3: Distribution of TB patients between 2016 and 2020 according to TRNC Ministry of Health data (n)



The data provided by the Turkish Republic of Northern Cyprus, Ministry of Health highlights the number of cases reported in the years 2021, 2020, 2019, 2018, 2017, and 2016. From the data, it appears that there has been a decreasing trend in the number of cases reported throughout the past five years. In 2021, 12 cases were reported while in

2020, 32 cases were reported. In 2019, 31 cases were reported, whereas, in 2018, 18 cases were reported. In 2017, 18 cases were reported, and in 2016, the lowest reported volume was 15 cases.

The decreasing trend in the number of reported cases may be due to numerous factors. These factors can be categorized into the areas of prevention, control, and treatment. Firstly, it is possible that the Northern Cyprus Ministry of Health has been implementing effective strategies for prevention and control, which may have led to a reduction in the number of reported cases. Such measures could include increased public awareness campaigns, improved sanitation practices, increased access to healthcare and preventative treatments, and better monitoring of suspected cases.

Furthermore, it is possible that the Northern Cyprus Ministry of Health has been providing improved treatments for reported cases. Treatments could include antiviral medications, antibiotics, nutritional and medical support, improved testing and diagnosis, and better access to specialized treatment. This improved level of treatment could have contributed to a reduction in the number of reported cases.

Additionally, improved levels of monitoring and tracking would have allowed the Ministry of Health to identify and track individuals who may have been exposed to a particular illness or risk factor, thus allowing them to be tested and treated quickly. It is also noteworthy to consider that the data provided by Northern Cyprus' Ministry of Health only includes reported cases. This means that in addition to an improvement in both preventative and treatment measures, it is likely that fewer people have been seeking medical care or have been reporting cases as a result of reduced poverty levels, increased education levels, improved economic conditions, and improved access to services.

Regardless of the cause, the data provided by Northern Cyprus' Ministry of Health indicates that the number of cases reported has decreased over the past five years. This may be due to improved prevention and treatment measures, increased public awareness, and improved access to services, as well as improved economic and social conditions. It is important that Northern Cyprus' Ministry of Health continue to monitor the data and trends to ensure that the incidence of reported cases continues to decrease in order to ensure that all individuals receive proper and timely care and support.

CHAPTER V

5.1Discussion

.The years between 2016-2019 were accepted as the pre-pandemic period and the years between 2020-2022 were accepted as the pandemic period in this study.

Our finding shows that the rate of TB was 9.5% (23/242) among men and 8.1% (15/186) among women. It is observed that TB infections increased after the onset of the COVID-19 pandemic. Accordingly, the rate of TB in the pre-pandemic period was 5.4% (12/221), and during the pandemic period, this rate was determined as 12.6% (26/207). The difference between the rate of TB in both periods was statistically significant (p=0.010)

This study is in line with a series of studies conducted showing that TB is more prevalent among Males as compared to females. A study conducted by Fernandez et al., (2017) shows that In terms of demographic factors, the proportion of men was significantly higher than that of females (63.6% of cases). The most common age range was between 15 and 64 years old (53.7%). Similarly, 67.0% of those diagnosed with tuberculosis in Brazil were young adult men.

In Cameroon, tuberculosis was found to affect men at a slightly higher rate (12.6%), compared to females (10.7%) this study was conducted by Ane – Anyangwe et al., (2006). Lix – X in 2013 conducted a study in which gender was also examined in tuberculosis, the study found that individuals over the age of 64 are more likely to acquire tuberculosis in the autumn (27.1%), whereas individuals aged 15 to 64 are more likely to develop the disease in the winter (53.7%). This is quite comparable to what occurred in China, where the prevalence was 15.7% in children under the age of 15 and 34.0% in people between the ages of 15 and 64, mostly during the months of winter and autumn.

According to the findings of the single-factor descriptive analysis, the reported rate of groups older than 60 years old was significantly greater than that of young people (two to three times higher), which is in line with accounts from the past (Cheng et al., 2020; Cheng et al., 2020).

Adults make up the vast majority of those who are diagnosed with tuberculosis; in 2021, adult males were responsible for 56.5% of the disease's burden, while adult females were responsible for 32.5% and minors were responsible for 11%. The five risk factors of tuberculosis—undernutrition, HIV infection, alcohol use disorders, smoking, and diabetes—are responsible for a significant number of newly diagnosed cases of the disease (WHO, 2022).

According to the 2022 Global TB report published by the World Health Organization, an estimated 10.6 million people get infected with tuberculosis (TB) in 2021, representing a 4.5% rise from 2020, and 1.6 million people pass away as a direct result of TB (including 187 000 HIV-positive persons). Between the years 2020 and 2021, there was also a 3% rise in the burden of drug-resistant tuberculosis (DR-TB), which resulted in 450 000 additional cases of rifampicin-resistant tuberculosis (RR-TB) in 2021.A rise in the number of patients getting sick with tuberculosis and drug-resistant tuberculosis has been observed for the first time in a significant amount of time (several years). The COVID-19 pandemic in 2021 has caused disruptions in a variety of services, including those related to tuberculosis (TB), but its effect on TB response has been especially severe (WHO, 2022).

The number of persons who were newly diagnosed with tuberculosis decreased from 7.1 million in 2019 to 5.8 million in 2020, according to reports. There was some improvement, with the population reaching 6.4 million in 2021, although this was still a significant drop from where it had been before the outbreak. Decreases in the reported number of TB diagnoses suggest that the number of people with undiagnosed and untreated TB has increased, leading first to an increase in the number of TB-related deaths and community transmission of infection and then, after a delay, to an increase in the number of TB cases themselves (WHO, 2022).

Between 2019 and 2020, there was a drop in the number of persons receiving treatment for both RR-TB and MDR-TB. In 2021, only 161 746 persons were said to have begun treatment for RR-TB. This represents just around one-third of those in need (WHO, 2022).

CHAPTER VI

6.1Conclusion and Recommendations

6.1.1Conclusion

Since the 1950s, tuberculosis has been widely acknowledged as a serious global health concern. A severe health issue in North Cyprus and other poor nations despite WHO's 1990s initiative to apply the DOTS approach to reduce the problem's effect. Tuberculosis (TB) has been a problem for humans for a very long time. Some crucial aspects of TB control in low-resource locations are discussed in this thesis. In conclusion, TB places a heavy financial burden on society, significantly reduces family income, has a detrimental effect on social welfare, and drains limited national resources in the process of managing the disease. When a family member dies from tuberculosis, the financial and human resources they provided are gone forever (WHO, 2022).

Despite the fact that Europe has one of the world's highest TB burdens, a lack of education on tuberculosis continues to be an issue in North Cyprus. It is crucial that in nations where tuberculosis is common, every opportunity to educate the public be taken. In accordance with the World Health Organization's (WHO) contexts approach to health promotion, schools should be considered an important channel for TB health education due to the multiplier effect an intervention of this kind is expected to have on students, their families, their communities, and others in their social networks (WHO, 2022).

There has to be consistent improvement in the degree of coordination between TB health promotion in schools and other educational institutions, and local TB control agencies and district-level CDCs. The TB education level was average. While most people had a general understanding of TB, there were significant knowledge gaps in important areas such the disease's causative agent, transmission methods, and preventative measures. The research found that there is a need for TB education at the facility and community level to address the knowledge gaps and perpetuate the existing information on the prevention and control of TB and to disseminate proper information. In order for TB patients to get support from their families and communities, they must learn to accept their diagnosis and to reveal their condition to others. Some reported practices were found to

have a detrimental effect on TB control and prevention, according to the study's findings. Health education may provide locals the tools they need to increase ventilation in their homes and see a doctor when they feel sick instead of trying to treat themselves at home, two activities that have been shown to reduce the spread of tuberculosis. Strengthening the health education approach in the TB prevention and control program is essential for correcting common myths about the disease.

6.1.2Recommendations

In light of the foregoing, the researcher suggests the following:

1. It would be very beneficial if regions with knowledge shortages and adverse attitudes engaged in awareness creation initiatives, such as the dissemination of critical information about tuberculosis infection and its immunization.
2. Expanding existing preventative facilities and establishing long-term infection control and prevention techniques are both priorities for governmental and non-governmental groups.
3. Individualized guidance and instruction based on the specific requirements of a certain population.
4. Patients and communities affected by tuberculosis might be given a leg up in the fight against the disease if they have access to the right educational programs.
5. Improve TB awareness, prevention, and treatment services.
6. Raise the bar for public education.
7. Discussion of this study's results should be coordinated between the health and education ministries.
8. Social marketing efforts should be maintained, and efforts to recruit former TB patients as peer educators to raise awareness and encourage those with the disease to seek treatment are also warranted.
9. Patients with tuberculosis should notify authorities immediately and take their medication as directed.

10. When it comes to issues of prevention and control, the government should strengthen its monitoring and evaluation system and offer integrated, routine, supporting oversight at all levels.
11. Health professionals' abilities may be strengthened if the Ministry of Health and Social Services provides them with training in patient education.
12. It is important to improve health education for disease prevention, particularly in regard to tuberculosis, HIV/AIDS, and malaria.
13. By enhancing all forms of communication for community concerns, our knowledge of epidemiology, transmission, and preventative measures would greatly improve.
14. More people should make use of the government's free screenings and medical services.
15. Public education on tuberculosis (and its origins, impact, treatment, and prevention) should be the overarching goal of the government and other institutions like non-governmental groups.

6.2Limitations of the Study

Due to time the researcher was unable to perform the confirmation (PCR) test to differentiate Tuberculosis species.

Reference

Adamide, T., Georgiou, A., Farmakas, A., & Theodorou, M. (2012). The cost of tuberculosis in Cyprus in 2009. www. pneumon. org, 25(2), 191.

Alberto Matteelli, A. R.-A. (2018). Tuberculosis elimination: where are we now? European Respiratory Review , 27.

Alemie, G. A., & Gebreselassie, F. (2019). Common types of tuberculosis and co-infection with HIV at private health institutions in Ethiopia: a cross sectional study. BMC public health, 14(1), 1-5.

Ankrah, A. O. (2016). PET/CT imaging of Mycobacterium tuberculosis infection. Clinical and Translational Imaging. Clinical and Translational Imaging, 131-144.

Bardswell, N. D. (2020). Tuberculosis in Cyprus. (Final Report.). Tubercle, 20(3).

Borgdorff MW, v. d. (2010). Progress towards tuberculosis elimination: secular trend, immigration and transmission. Eur Respir J , 339–347.

C. Kodmon, P. Z. (2016). Migration-related tuberculosis: epidemiology and characteristics of tuberculosis cases originating outside the European Union and European Economic Area, 2007 to 2013. Eurosurveillance , 12.

Centers for Disease Control and Prevention. (2020). Treatment regimens for latent TB infection (LTBI). Atlanta: (https://www.cdc.gov/tb/topic/treatment/ltbi.htm).

Constantinides, M. G. (2022). Tuberculosis in Cyprus. Tubercle, 39(1), 59-60.

Cyprus Ministry of Health. . (2014). Annual health report, Nicosia. Nicosia: Available from: http://www.moh.gov.cy/moh/moh. nsf/page09_gr/page09_gr?

Danel C, M. R. (2015). A trial of early antiretrovirals and isoniazid preventive therapy in Africa. . N Engl J Med., 808–22.

Davies, P. D. O. (2019). Risk factors for tuberculosis. Monaldi archives for chest disease, 63(1).

Diel R, L. R. (2013). Old ideas to innovate tuberculosis control: preventive treatment to achieve elimination. Eur Respir J., 785–801.

Diel R, L. R.-P. (2013). Old ideas to innovate TB control: preventive treatment to achieve elimination. . Eur Respir J , 785–801.

Ford N, M. A. (2016). TB as a cause of hospitalization and in-hospital mortality among people living with HIV worldwide: a systematic review and meta-analysis. J Int AIDS Soc. , 10.

Gautam, V. K. (2013). Primary Calvarial Tuberculosis (PCT) presenting as cold abscess of the scalp: A report of two cases. . J Dent Med Sci, 4(4),, 7-14.

Geser, A. (2022). The long-term trend in prevalence of tuberculosis infection in Cyprus. Bulletin of the World Health Organization, 30(4), 601.

Hastürk, G. &. (2022). BCG Vaccine: Necessary or Not for North Cyprus. . Annals of the Romanian Society for Cell Biology. , 542-548.

Khan MK, I. M. (2019). An Overview on Epidemiology of Tuberculosis. Mymensingh Med J., :259-266. .

Khan MK, I. M. (2019). An Overview on Epidemiology of Tuberculosis. Mymensingh Med J. , 259-266.

Kirenga, B. J., Ssengooba, W., Muwonge, C., Nakiyingi, L., Kyaligonza, S., Kasozi, S., & Okwera, A. (2020). Tuberculosis risk factors among tuberculosis patients in Kampala, Uganda: implications for tuberculosis control. BMC public health, 15(1), 1-7.

Kumar, S. V., Deka, M. K., Bagga, M., Kala, M. S., & Gauthaman, K. (2020). A systematic review of different type of tuberculosis. Eur Rev Med Pharmacol Sci, 14(10), 831-43

Lienhardt, C., Fielding, K., Sillah, J. S., Bah, B., Gustafson, P., Warndorff, D., ... & McAdam, K. (2022). Investigation of the risk factors for tuberculosis: a case–control study in three countries in West Africa. International journal of epidemiology, 34(4), 914-923.

Lönnroth K, M. G. (2015). Towards tuberculosis elimination: an action framework for low-incidence countries. Eur Respir J., 928–52.

M. Pareek, C. G. (2016). The impact of migration on tuberculosis epidemiology and control in high-income countries: a review. International Journal of Obesity, 48.

Marais, B. J., Gie, R. P., Hesseling, A. H., & Beyers, N. (2021). Adult-type pulmonary tuberculosis in children 10-14 years of age. The Pediatric infectious disease journal, 24(8), 743-744.

Matteelli, A., Rendon, A., Tiberi, S., Al-Abri, S., Voniatis, C., Carvalho, A. C. C.

Migliori, G. B. (2018). Tuberculosis elimination: where are we now?. European Respiratory Review, 27(148).

Migliori GB, S. G.-K. (2018). ERS/ECDC statement: European Union standards for tuberculosis care. Eur Respir J. , 51-52.

Millet, J. P., Moreno, A., Fina, L., Del Baño, L., Orcau, A., De Olalla, P. G., & Cayla, J. A. (2021). Factors that influence current tuberculosis epidemiology. European Spine Journal, 22, 539-548.

Mohajan, H. (2014). Tuberculosis is a fatal disease among some developing countries of the world. Munic Personal RePEe Archive, 18-31.

Nanda, K. D. (2011). A disguised tuberculosis in oral buccal mucosa. . Dental research journal, 154.

Narasimhan, P., Wood, J., MacIntyre, C. R., & Mathai, D. (2021). Risk factors for tuberculosis. Pulmonary medicine, 2013.

P. Narasimhan, J. W. (2013). Risk factors for tuberculosis . Pulm Med, Article 828939.

Paton, N. I., Ng, Y. M., Chee, C. B., Persaud, C., & Jackson, A. A. (2021). Effects of tuberculosis and HIV infection on whole-body protein metabolism during feeding, measured by the [15N] glycine method. The American journal of clinical nutrition, 78(2), 319-325.

Petrou, P. (2017). Battling Tuberculosis beyond antibiotics. Value in health regional issues, 13, 79-81.

Sakamoto, K. (2012). The pathology of Mycobacterium tuberculosis infection. Veterinary pathology. Veterinary Pathology, 49(3), 423-439.

Shetty, N., Shemko, M., Vaz, M., & D'souza, G. (2020). An epidemiological evaluation of risk factors for tuberculosis in South India: a matched case control study. The International Journal of Tuberculosis and Lung Disease, 10(1), 80-86.

Silva, D. R., Muñoz-Torrico, M., Duarte, R., Galvão, T., Bonini, E. H., Arbex, F. F., & Mello, F. C. D. Q. (2018). Risk factors for tuberculosis: diabetes, smoking, alcohol use, and the use of other drugs. Jornal Brasileiro de Pneumologia, 44, 145-152.

Solhpour A, H. M. (2007). Subphrenic abscess and recurring focal lesions due to tuberculosis in a patient with IgA deficiency. . J Infect. 2007, 54.

Sotgiu G, S. A. (2013). History of tuberculosis and drug resistance. N Engl J Med, 88–89.

Sterling TR, V. M.-S. (2011). Three months of rifapentine and isoniazid for latent tuberculosis infection. . N Engl J Med, 2155–66.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2021). Tuberculosis: epidemiology and control. Mediterranean journal of hematology and infectious diseases, 6(1).

Tagliani, E. A. (2021). Use of a whole genome sequencing-based approach for Mycobacterium tuberculosis surveillance in Europe in 2017–2019:. European Respiratory Journal, 2-5.

Voniatis, C. M. (2014). Tuberculosis elimination: dream or reality? The case of Cyprus. . European Respiratory Journal, 44(2), , 543-546.

Weiner, M., Peloquin, C., Burman, W., Luo, C. C., Engle, M., Prihoda, T. J., ... & Vernon, A. (2022). Effects of tuberculosis, race, and human gene SLCO1B1 polymorphisms on rifampin concentrations. Antimicrobial agents and chemotherapy, 54(10), 4192-4200.

WHO. (2020). WHO Consolidated Guidelines on Tuberculosis. Geneva: World Health Organization.

World Health Assembly. . (2017). Global strategy and targets for tuberculosis prevention, care, and control after 2015. Iris Institutional Respiratory For Information Sharing, 67.

World Health Organization. (2013). Report of the 13th Meeting WHO Strategic and Technical Advisory Group for Tuberculosis (STAG-TB). Document WHO/HTM/TB/2013.09. Geneva, World Health Organization, 09.

World Health Organization. (2018). Latent TB infection. Geneva: http://www.who.int/tb/areas-ofwork/preventive-care/ltbi_factsheet_2march18.pdf?ua=1.

World Health Organization. (2018). Global tuberculosis report 2018. Geneva: http:// apps.who.int/iris/bitstream/handle/10665/274453/9789241565646-eng.pdf?ua=1.

World Health Organization. (2020). WHO consolidated guidelines on tuberculosis: tuberculosis preventive treatment. . Geneva: Licence: CC BY-NC-SA 3.0 IGO Licence: CC BY-NC-SA 3.0 IGO.

Zannetos, S., Zachariadou, T., Adamidi, T., & Georgiou, A. (2018). The economic burden of tuberculosis in Cyprus. A probabilistic cost of illness study. Epidemiology, Biostatistics, and Public Health, 15(2).

Zannetos, S., & Talias, M. A. (2019). A Cost-benefit Analysis of a Proposed Immigrant Latent Tuberculosis Infection Screening Program for Cyprus. Materia Socio-Medica, 28(6), 464.

World Health Organization (27 October 2022). Tuberculosis deaths and disease increase during the COVID-19 pandemic. https://www.who.int/news/item/27-10-2022-tuberculosis-deaths-and-disease-increase-during-the-covid-19-pandemic

Cheng J, Sun YN, Zhang CY, Yu YL, Zhang H. Incidence and risk factors oftuberculosis among the elderly population in China: a prospective cohortstudy. Infect Dis Poverty. 2020;9(1):64–76.

Cheng J, Sun YN, Zhang CY, Yu YL, Tang LH, Peng H, et al. Incidence andrisk factors of tuberculosis among the elderly population in China: aprospective cohort study. Infect Dis Poverty. 2020;9(01):64–76.

Li X-X, Wang L-X, Zhang H, et al. Seasonal variations in notification of active tuberculosis cases in China, 2005–2012.PLOS ONE. 2013;8:e68102

Ane-Anyangwe IN, Akenji TN, Mbacham WF, Penlap VN,Titanji VP. Seasonal variation and prevalence of tuberculosis among health seekers in South Western Cameroon. EastAfr Med J. 2006;83:588–95

Fernandes, F. M. D. C., Martins, E. D. S., Pedrosa, D. M. A. S., & Evangelista, M. D. S. N. (2017). Relationship between climatic factors and air quality with tuberculosis in the Federal District, Brazil, 2003-2012. *Brazilian Journal of Infectious Diseases*, *21*, 369-375.

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ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi : 26.11.2020

Toplantı No : 2020/85

Proje No :1185

Yakın Doğu Üniversitesi SHYMO öğretim üyelerinden Doç. Dr. Meryem Güvenir'in sorumlu araştırmacısı olduğu, YDU/2020/85-1185 proje numaralı ve **"Bir Üniversite Hastanesi'ndeki Klinik Örneklerden *Mycobacterium tuberculosis* Saptanmasında Dört Farklı Testin Değerlendirilmesi"** başlıklı proje önerisi kurulumuzca online toplantıda değerlendirilmiş olup, etik olarak uygun bulunmuştur.

Prof. Dr. Rüştü Onur

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June 2022- Dec. 2023 : Laboratory Research Intern

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Presented Report of findings from Research work to Professors and colleagues.

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- Collecting Quantitative Data on Children between the ages of 6 to 59 months to authenticate causes of stunting wasting in this segment of the population

- Conducted Anthropometric measurement of aforementioned children

- Conducted Middle Upper Arm Circumference (MUAC) of females between 15 to 49 years to identify the malnourished nature of this segment of the population

October 2016 – November 2017 **: Research Associate**

Center for Liberia's Future

Duazon community, Margibi, Liberia, West Aricia

Key Duties & Responsibilities

- Collecting Data on Ebola Stakeholders (Survivors, Orphans, Caregivers, etc.)

- Conducting Focus Group Discussions with Affecting Stakeholders of Ebola (i.e. Survivors, Orphans, Caregivers, etc.)

- Transcribing from focus groups Discussions

LANGUAGE COMPETENCY

English: Excellent writing and speaking skills

REFERENCES

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