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Original Article

An Epidemiological Study of TB Infection before and during the COVID-19 Pandemic in Thi-Qar Province

YOUSIF GHASSAN MOHAMMED[1], Ahmed Sattar Jabbar[2], Ahmed Naji Kareem[3], Hawraa Athab Khayun[4], Sorour Khalil Mohsen[5], Azal Ahsan Fasel[6], Doha Nathom Jawda[7], Hawra Duraid Hazbar[8]

[1,2]Thi Qar University /college of science /pathology analysis, Iraq

[3]Dhi Qar University/College of Science/Department of Pathological Analysis, Iraq

[4]Dhi-Qar University, College of Science/Department of biology, Iraq

[5]Baghdad University, College of Science for Women, Department of chemistry , Iraq

[6]Dhi Qar University , College of Science, physics , Iraq

[7]University of Technology/Applied Science Department/Applied Chemistry Division, Iraq

[8]University of Basra / College of Science / Department of Pathological Analysis, Iraq

Abstract:- Tuberculosis (TB) is an airborne infectious disease caused by organisms of the Mycobacterium tuberculosis complex. Although primarily a pulmonary pathogen, M. tuberculosis can cause disease in almost any part of the bodyBased on the immunological mechanism involved, a shared dysregulation of immune responses in COVID-19 and TB has been found, suggesting a dual risk posed by co-infection worsening COVID-19 severity and favouring TB disease progression.The results of our study are as follows:Prevalence of TB Infection in Thi-Qar Province during 2022-2023 According to Infection Type .TB infection was active infection during 2022 356 (81.84%)In the same hand, high active TB infection in 2023 was active infection 433 (77.18%).Prevalence of TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections: was recorded the high TB infection in 2022 was during October.In the other hand, the high TB infection in 2023 was during July while the lowest TB infection was in September in both years.Prevalence of Active TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections:was recorded the high active TB infection in 2022 was during October, while the lowest active TB infection was in February and September. In the other hand, the high active TB infection in 2023 was during August, while the lowest active TB infection was in October. Prevalence of Active Pulmonary TB Infection According to Months of Infections: was recorded the high pulmonary active TB infection in 2022 was during May, while the lowest active pulmonary TB infection was in September . In the other hand, the high active pulmonary TB infection in 2023 was during August , while the lowest active pulmonary TB infection was in June .Prevalence of Active Out-pulmonary TB Infection:was recorded the high out-pulmonary active TB infection in 2022 was during October, while the lowest active out-pulmonary TB infection was in August. In the other hand, the high active out-pulmonary TB infection in 2023 was during July , while the lowest active out-pulmonary TB infection was in September. Prevalence of Passive TB Infection :was recorded the high passive TB infection in 2022 was during February, while the lowest passive TB infection was in both May and December Iin contrast, the high passive TB infection in 2023 were during both February and Marich,while the lowest passive TB infection was in September in addition, the study not recorded passive infection during April.The current results were noted among 435 recent TB infection during 2022, 10 (2.30%), scored recurrent TB infection, and among 571 TB infection during 2023, 12 (2.10%).

Keywords: TB Infection, COVID-19, Pandemic, Thi-Qar Province

Corresponding Author: YOUSIF GHASSAN MOHAMMED†, Thi Qar university /college of science /pathology analysis, Iraq

1.Introduction:

Tuberculosis (TB) is a contagious infectious disease caused in humans mainly by Mycobacterium tuberculosis (MTB). MTB is spread essentially through the air: when an infec- tious person coughs, sneezes, talks or spits, saliva droplets containing tubercle bacilli are projected into the air and can be inhaled by a nearby person. Indeed, tubercle bacilli enter the human body mainly through the respiratory route after inhalation of these tiny droplets expelled into the air. These particles are small enough to be able to reach the lower airways. The infection success and the development of the pulmonary form of TB (lungs are the main target of this bacterium) depend on four successive steps: phagocytosis of the bacilli, their intracellular multiplication, the latent con- tained phase of infection and finally the active lung infec- tion. These steps can progress towards different clinical.[1]

scenarios: spontaneous cure, disease, latent infection and re-activation, or re-infection. Immunosuppressed individuals are more at risk of developing active TB once infected, particularly patients with AIDS. However, none of the critical (host- or pathogen-related) determinants involved in the clinical outcome of human immunodeficiency virus (HIV)/TB co-infection is known in detail[2].

The year 2020 will probably be remembered as the 'COVID-19 (coronavirus disease) year'. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) responsible for this pandemic emerged in January/February, having originated from China in late 2019.1–3 Although COVID-19 continues to dominate both the scientific literature and the media, other communicable diseases including tuberculosis (TB) should not be neglected.[3]

Much has been written on the potential interactions between COVID-19 and tuberculosis (TB) following the World Health Organisation (WHO) declaration of COVID-19 as a Public Health Emergency of International Concern,5 initially based on assumptions, modelling6–8 and scientific evidence.[4]

The view of the WHO,7 and the specialized scientific press and newspapers[5] is that an important consequence of the COVID-19 pandemic would be a worsening of the TB epidemic globally, for a variety of reasons, such as additional pressures on health systems by COVID-19 resulting in weakening of the National TB programmes16 and the potential biological effects of the interaction of the two infections, recalling the concept of 'cursed duet' which in the past was used for TB and HIV.[6]

Both COVID-19 and TB have the capacity to stress health systems, they are airborne transmissible diseases, can be diagnosed rapidly (although implementation of rapid testing is not yet available in all settings), they cause stigma and need public awareness and cooperation to allow prevention, diagnosis and treatment to be effective. Although surveillance is able to report on TB and viral diseases separately, in the vast majority of countries the information on COVID-19 is still incomplete and information on TB do not contain many clinical and immunological parameters, which would be useful to better understand the interaction between the two diseases. Moreover COVID-19 pandemic has led to a significant fall in TB notifications.[7]

In terms of funding, although health systems can be considered relatively underfunded even in resource rich countries (a debate is ongoing in these countries on the adequacy of prevention services and on the needed number of intensive care unit beds) human and economic resources for TB are historically sub-optimal at the global level, while resources have been rapidly mobilised against COVID-19 following the wave(s) of the emergency.[8,9,10]

1.1.Mycobacterium tuberculosis difenation

Tuberculosis (TB) is a contagious infectious disease caused in humans mainly by Mycobacterium tuberculosis (MTB). MTB is spread essentially through the air: when an infec- tious person coughs, sneezes, talks or spits, saliva droplets containing tubercle bacilli are projected into the air and can be inhaled by a nearby person. Indeed, tubercle bacilli enter the human body mainly through the respiratory route after inhalation of these tiny droplets expelled into the air [11]. These particles are small enough to be able to reach the lower airways [12]. The infection success and the development of the pulmonary form of TB (lungs are the main target of this bacterium) depend on four successive steps: phagocytosis of the bacilli, their intracellular multiplication, the latent con- tained phase of infection and finally the active lung infec- tion.[13]

1.1.1.The Bacterium

Mycobacteria are nonmotile, nonsporulating, weakly gram- positive, acid-fast bacilli that appear microscopically as

straight or slightly curved rods, 1 to 4 μm in length and 0.3 to 0.6 μm wide. Mycobacteria are within the order Actinomy- cetales, which it shares with bacteria such as Corynebacterium, Nocardia, and Rhodococcus. These bacteria also express unique mycolic acids in the cell envelope that play a critical role in the structure and function of the cell wall. The waxy cell wall confers many of the unique characteristics of this genus: acid-fastness, extreme hydrophobicity, resistance to drying, acidity/alkalinity, and many antibiotics, as well as dis- tinctive immunostimulatory properties.[14]

Mtb is a member of the slow-growing pathogenic mycobac- terial species, characterized by a 12- to 24-hour division rate and prolonged culture period on agar of up to 21 days. Why Mtb grows so slowly is not well understood. Proposed mechan- isms include limitation of nutrient uptake through the highly impermeable cell wall and slow rates of RNA synthesis. 96 During experimental infections, its metabolism can shift from an aerobic, carbohydrate-metabolizing mode to one that is microaerophilic and lipid metabolizing.[15] Mycobacteria are facultative intracellular bacteria that multiply within phagocy- tic cells, particularly macrophages and monocytes. Although many mycobacterial species are environmental, Mtb is strictly parasitic.Mtb is a member of the M. tuberculosis complex, which is defined as the etiologic agents of TB in distinct hosts, and also includes M. bovis, M. africanum, M. canetti, and M. microti, with M. caprae.[16]

1.2.Transmission Of Mycobacterium tuberculosis

Tuberculosis is spread from person to person through the air by droplet nuclei, particles 1 to 5 μm in diameter that contain M. tuberculosis complex [17]. Droplet nuclei are produced when persons with pulmonary or laryngeal tuberculosis cough, sneeze, speak, or sing. They also may be produced by aerosol treatments, sputum induction, aerosolization during bronchoscopy, and through manipulation of lesions or processing of tissue or secretions in the hospital or laboratory. Droplet nuclei, containing two to three M. tuberculosis organisms ,are so small that air currents normally present in any indoor space can keep them airborne for long periods of time. Droplet nuclei are small enough to reach the alveoli within the lungs, where the organisms replicate. Although patients with tuberculosis also generate larger particles containing numerous bacilli, these particles do not serve as effective vehicles for transmission of infection because they do not remain airborne, and if inhaled, do not reach alveoli. Organisms deposited on intact mucosa or skin do not invade tissue. When large particles are inhaled, they impact on the wall of the upper airways, where they are trapped in the mucous blanket, carried to the oropharynx, and swallowed or expectorated [18].

Four factors determine the likelihood of transmission of M. tuberculosis: (1) the number of organisms being expelled into the air, (2) the concentration of organisms in the air determined by the volume of the space and its ventilation, (3) the length of time an exposed person breathes the contaminated air, and (4) presumably the immune status of the exposed individual. HIV-infected persons and others with impaired cell-mediated immunity are thought to be more likely to become infected with M. tuberculosis after exposure than persons with normal immunity; also, HIV-infected persons and others with impaired cell-mediated immunity are much more likely to develop disease if they are infected. However, they are no more likely to transmit M. tuberculosis [19].

Techniques that reduce the number of droplet nuclei in a given space are effective in limiting the airborne transmission of tuberculosis. Ventilation with fresh air is especially important, particularly in health care settings, where six or more room-air changes an hour is desirable The number of viable airborne tubercle bacilli can be reduced by ultraviolet irradiation of air in the upper part of the room [20] The most important means to reduce the number of bacilli released into the air is by treating the patient with effective antituberculosis chemotherapy (If masks are to be used on coughing patients with infectious tuberculosis, they should be fabricated to filter droplet nuclei and molded to fit tightly around the nose and mouth. Measures such as disposing of such personal items as clothes and bedding, sterilizing fomites, using caps and gowns and gauze or paper masks, boiling dishes, and washing walls are unnecessary because they have no bearing on airborne transmission.[21]

There are five closely related mycobacteria grouped in the M. tuberculosis complex: M. tuberculosis, M. bovis, M. africanum, M. microti, and M. canetti. Mycobacterium tuberculosis is transmitted through the airborne route and there are no known animal reservoirs. Mycobacterium bovis may penetrate the gastrointestinal mucosa or invade the lymphatic tissue of the oropharynx when ingested in milk containing large numbers of organisms. Human infection with M. bovis has decreased significantly in developed countries as a result of the pasteurization of milk and effective

tuberculosis control programs for cattle [22]. Airborne transmission of both M. bovis and M. africanum can also occur (14-16). Mycobacterium bovis BCG is a live-attenuated strain of M. bovis and is widely used as a vaccine for tuberculosis. It may also be used as an agent to enhance immunity against transitional-cell carcinoma of the bladder. When used in this manner, adverse reactions such as dissemination may be encountered, and in such cases M. bovis BCG may be cultured from nonurinary tract system specimens, i.e., blood, sputum, bone marrow, etc. [23].

1.3.Pathogenesis of Tuberculosis

After inhalation, the droplet nucleus is carried down the bronchial tree and implants in a respiratory bronchiole or alveolus. Whether or not an inhaled tubercle bacillus establishes an infection in the lung depends on both the bacterial virulence and the inherent microbicidal ability of the alveolar macrophage that ingests it. If the bacillus is able to survive initial defenses, it can multiply within the alveolar macrophage. The tubercle bacillus grows slowly, dividing approximately every 25 to 32 h within the macrophage. Mycobacterium tuberculosis has no known endotoxins or exotoxins; therefore, there is no immediate host response to infection. The organisms grow for 2 to 12 wk, until they reach 103 to 104 in number, which is sufficient to elicit a cellular immune response that can be detected by a reaction to the tuberculin skin test.[24,25]

Before the development of cellular immunity, tubercle bacilli spread via the lymphatics to the hilar lymph nodes and thence through the bloodstream to more distant sites. Certain organs and tissues are notably resistant to subsequent multiplication of these bacilli. The bone marrow, liver, and spleen are almost always seeded with mycobacteria, but uncontrolled multiplication of the bacteria in these sites is exceptional. Organisms deposited in the upper lung zones, kidneys, bones, and brain may find environments that favor their growth, and numerous bacterial divisions may occur before specific cellular immunity develops and limits multiplication.[26,27]

In persons with intact cell-mediated immunity, collections of activated T cells and macrophages form granulomas that limit multiplication and spread of the organism. Antibodies against M. tuberculosis are formed but do not appear to be protective.The organisms tend to be localized in the center of the granuloma, which is often necrotic.For the majority of individuals with normal immune function, proliferation of M. tuberculosis is arrested once cell-mediated immunity develops, even though small numbers of viable bacilli may remain within the granuloma. Although a primary complex can sometimes be seen on chest radiograph, the majority of pulmonary tuberculosis infections are clinically and radiographically inapparent. Most commonly, a positive tuberculin skin test result is the only indication that infection with M. tuberculosis has taken place. Individuals with latent tuberculosis infection but not active disease are not infectious and thus cannot transmit the organism. It is estimated that approximately 10% of individuals who acquire tuberculosis infection and are not given preventive therapy will develop active tuberculosis. The risk is highest in the first 2 yr after infection, when half the cases will occur. The ability of the host to respond to the organism may be reduced by certain diseases such as silicosis, diabetes mellitus, and diseases associated with immunosuppression, e.g., HIV infection, as well as by corticosteroids and other immunosuppressive drugs. In these circumstances, the likelihood of developing tuberculosisdisease is greater. The risk of developing tuberculosis also appears to be greater during the first 2-yr of life.[28,29]

HIV-infected persons, especially those with low CD4+ cell counts, develop tuberculosis disease rapidly after becoming infected with M. tuberculosis; up to 50% of such persons may do so in the first 2 yr after infection with M. tuberculosis . Conversely, an individual who has a prior latent infection with M. tuberculosis (not treated) and then acquires HIV infection will develop tuberculosis disease at an approximate rate of 5–10% per year [30].

In a person with intact cell-mediated immunity, the response to infection with the tubercle bacillus provides protection against reinfection. The likelihood of reinfection is a function of the risk of reexposure, the intensity of such exposure, and the integrity of the host's immune system. In the United States the risk of reexposure to an infectious case is low. Furthermore, in an otherwise healthy, previously infected person, any organisms that are deposited in the alveoli are likely to be killed by the cell-mediated immune response. Exceptions may occur, but in immunocompetent individuals, clinical and laboratory evidence indicates that disease produced by the inhalation of a second infecting strain is uncommon. However, reinfection has been documented to occur both in persons without recognized immune compromise and in persons with advanced HIV infection [31,32]

1.4.Disease occurring and mechanism

1.4.1.M. tuberculosis and pulmonary diseases

As the portal of bacterial entry, the lung is the most commonly affected organ during M. tuberculosis infection. The respiratory tract and the bronchoalveolar spaces represent a unique immunological compartment where diverse tissue-specific cells shape the first-line immune response to inhaled M. tuberculosis. These interactions alter the pulmonary microenvironment, which may remodel the airways and influence the development and outcomes of various pulmonary diseases.[33]

1.4.2.Chronic obstructive pulmonary disease (COPD)

COPD is characterized by airflow limitation associated with an enhanced chronic inflammatory response, both in the airway and the lung, to noxious particles or gases, such as the substances produced by tobacco smoking. Recently, epidemiological studies have provided a strong link between past history of TB and later development of chronic airflow obstruction [34]. Growing evidence argues that pulmonary TB can lead to remodeling of the lung architecture, which can be manifested as extensive fibrosis, cavitation, traction bronchiectasis, bronchostenosis, or parenchymal lung destruction. This may be a possible explanation for the development of COPD in patients with a previous history of TB. Chronic airflow obstruction is also suggested to be a sequel to active TB because of the development of bronchiectasis in patients with COPD. A common link to the pathogenesis of both conditions may lie in the destruction of the pulmonary extra-cellular matrix (ECM), which might be caused by various risk factors, such as smoking and biomass fuel exposure. In addition, human pneumonia, as another pulmonary disease that commonly occurs in TB patients (especially adolescents who have strong immunological responses), can also increase morbidity and mortality rates related to acute exacerbations of COPD [36].

1.4.2.1.Lung cancer

Both TB and lung cancer represent global threats claiming millions of lives worldwide. Clinical data show that TB and lung cancer may co-exist in some cases, and the history of TB infection is reported as a risk factor for lung cancer development [37]. As has been described, M. tuberculosis can escape host immune defenses and establish chronic and persistent inflammation. Chronic inflammatory conditions are thought to create the appropriate microenvironment for cancer development by a number of mechanisms. Specifically, the higher rate of cell turnover likely increases the risk for genetic errors to trigger carcinogenesis. For instance, various mycobacterial cell wall components may induce production of NO and ROS to cause DNA damage [38], which is implicated in inflammation-related carcinogenesis. Additionally, the enhanced cell-mediated immune responses caused by mycobacterial infection could result in the extension of pulmonary fibrosis, which could probably contribute to the development of lung scar carcinoma[39].

1.5.M. tuberculosis and autoimmune diseases (AIDs)

The development of AIDs is determined by a combination of genetic, hormonal, and environmental factors, as well as the immunological status of the individual. Mycobacterial infection is implicated as an environmental trigger to initiate AIDs. For example, intravesical administration of BCG for bladder cancer triggers systemic autoimmunity Clinical data also support the notion that M. tuberculosis may be involved in autoimmunity. For example, autoantibodies associated with AIDs, such as Wegener's granulomatosis and systemic lupus erythematosus (SLE), are detected in 40% of TB patients [40]

There are three possible mechanisms accounting for the potential development of AIDs following TB infection. The first mechanism is molecular mimicry by which the mycobacterial components incorporate an epitope that is structurally similar to that of a self-antigen. For example, M. tuberculosis heat shock protein 60 (HSP60) and HSP65 are autoantigens present in the sera of patients with AIDs .

The second mechanism is bystander activation, a state where enhanced cytokine production, such as IFN-γ and TNF-α, induces the expansion of autoreactive T cells Third, TLR-mediated signaling activation caused by M. tuberculosis infection may also be involved in the pathogenesis of AIDs.[41]

1.5.1.Sarcoidosis

Sarcoidosis, an AID with no definite proof of an infectious etiology, is characterized by the presence of non-caseating granulomas with accumulated epithelioid cells in various organs. A previous study reports that mycobacterial DNA

can be identified in sarcoidosis lesions, suggesting that mycobacteria are either the cause or at least an important cofactor in the pathogenesis of sarcoidosis. Furthermore, mycobacterial HSPs are detected with high expression in sarcoidosis tissue as well, suggesting that those proteins may also participate in the etiopathogenesis of sarcoidosis.[42]

1.5.2.SLE

is a systemic disease of unknown etiology that is characterized by autoantibodies against self-antigens, resulting in various inflammation-mediated systemic symptoms. Infections, renal failure, and cardiovascular diseases account for the majority of deaths seen in SLE patients . Several studies suggest that patients with SLE are at increased risk of reactivation and dissemination of TB due to multiple immune abnormalities and immunosuppressive therapy Meanwhile, there is also growing evidence that supports the pivotal role of mycobacterial infection in induction and exacerbation of SLE[43]

1.6.Association between TB and COVID-19

Tuberculosis (TB) which is an ancient contagious disease that mainly affects the lungs. The causative organism for this disease is a bacterium that survived over 70000 years In 1882, Robert Koch discovered the organism which is Mycobacterium Tuberculosis (2021) TB spreads by air through respiratory droplets from one to another while coughing, sneezing, singing, talking, etc[44] TB is the world's thirteenth the second leading infectious killer and leading cause of death, trailing only COVID-19 (Coronavirus Disease) but ahead of HIV/AIDS (2021)[44].

In 2021, 1.6 million individuals worldwide lost their lives to TB. Following COVID-19 (behind HIV/AIDS), TB is the second infectious killer in the world and the 13th largest cause of death overall. Globally, 10.6 million tuberculosis (TB) cases have reported in 2021. 6,400,000 males, 3,400,000 women, and 1.2,000,000 kids. TB exists in all nations and across all age groups. However, TB can have treated and controlled[45].

According to the World Health Organization (WHO), in 2020, TB infected about 10 million people and caused the death of about 1.5 million people worldwide; among them, 86% of the new cases were from the 30 high TB burden countries Bangladesh is one of those TB high-burden countries (World Health Organization. (n.d.) 2021). In Bangladesh, the reported incidence of tuberculosis per 100,000 is 221, and the fatality rate is 24 per 100,000 Pulmonary tuberculosis accounts for about 80% of all TB cases in Bangladesh. As per the Global TB Report 2020, TB is one of the significant public health concerns in Bangladesh, where 107 deaths occur from the infectious disease every day, and 987 individuals have been diagnosed with it[46].

On the other hand, COVID-19 has caused by a new coronavirus termed SARS-CoV-2, which also affects the lungs . It has first identified in Wuhan, China, in December 2019. The virus can spread from in small liquid particles an infected person's mouth or nose, when they sneeze, cough, speak, sing or breathe. These particles range in size from large respiratory droplets to tiny aerosols. It was declared a pandemic on March 11, 2020, by the WHO.. There have been 281,808,270 confirmed cases of COVID-19 reported to WHO as of January 01, 2022, with 5,411,759 deaths. On March 08, 2020, Bangladesh saw the first COVID-19 patient.

There have been 2,035,240 confirmed cases of COVID-19 in Bangladesh, with 29,423 deaths reported till October 31, 2022(CSSEGISandData). COVID-19 has emerged as one of Bangladesh's most serious public health issues.

TB and COVID-19 are the leading causes of death from infectious diseases worldwide. Both diseases have some clinical similarities that make diagnosing and treating them difficult. Research suggests that COVID-19 and TB are transmitted chiefly through respiratory droplets, with the lungs as their primary target . COVID-19 is a potential risk for tuberculosis, and co- infected patients have a worse prognosis A study shows COVID-TB patients had a 2.21- and 2.27-times higher chance of dying or developing severe COVID- 19, respectively. Though TB & COVID-19 are both major public health issues, we found only a few studies on TB and COVID-19 association. To get the best of our knowledge, we have yet to see any research on this topic in the context of Dhaka Metropolitan City. Here, we looked over the association between TB & COVID-19.Because, Although TB is an ancient infectious disease, COVID-19 is an emerging infectious disease[47].

1.7.TB during COVID-19 Pandemic

According to the World Health Organization (WHO) 2020 global Tuberculosis (TB) report, approximately one-quarter of the world population was infected with TB bacillus. It is estimated that there were 10 million new TB patients worldwide in 2019 and 1.4 million people died from TB. TB maintains its importance as one of the top 10 mortality causes in the world .In addition to this serious condition, many infectious diseases, including TB were pushed to the background because of the COVID-19 pandemic caused by SARS-CoV-2, which started in China and spread all over the world at the end of 2019. The WHO announced that there were an estimated 9.9 million people infected with TB in 2020 when the pandemic was still ongoing and 1.3 million deaths were because of TB [48].

It was predicted in a modeling study shared by the WHO that in case there is a global decrease of 25% in TB detection for 3 months with the COVID-19 pandemic, this will cause an increase of 13% in TB deaths, and a return to the TB death rates of 5 years ago would be possible globally . It was also shared that an additional 1.4 million TB deaths may be recorded to existing deaths between 2020 and 2025 as a direct result of the pandemic ording to the results of previous studies and the WHO, it was shown that the number of TB patients diagnosed in almost every country in 2020 decreased with the effects of the COVID-19 pandemic on the real-time fight against tuberculosis. As a result of the data collected by the Stop TB Partnership from 10 different global networks, significant decreases were seen in TB notifications and TB testing and diagnosis procedures in countries with a high TB burden. It has been determined that TB patients have delays in applying to health institutions. The most important reason for this is that health institutions give priority to COVID-19 patients due to the pandemic. In addition, there have been delays in the stocking processes of TB drugs and due to the lack of sufficient health personnel in the COVID-19 response units, health personnel working in TB services had to work in these areas [50]. As a result, the diagnosis, care and prevention of TB were impacted around the world. Most of the available data covers the first 6 months of the year 2020.There are relatively fewer data investigating the effects of the COVID-19 pandemic on TB patients for the second 6 months when it was expected that TB services would be restored and approximately 1 year after the restrictions began[51].

In the present study, the purpose was to evaluate the changes in the number of TB patients, the parameters of the TB patients and tuberculosis control programs in the first year of the COVID-19 pandemic in Turkey by comparing to the previous year and to define the variables of the TB patients with SARS-CoV-2 polymerase chain reaction (PCR) test results[52].

1.8.Management

Patients with possible pulmonary tuberculosis infection should be isolated in a private room equipped with a negative pressure (i.e., air is exhausted through a particulate air filter or to the outside). When handling these patients, healthcare workers are advised to wear highly efficient personal protective equipment (PPE) that are enough to filter Mtb. Moreover, patient isolation must continue until his/her sputum smears are negative for 3 consecutive times. This usually occurs after 2 to 4 weeks of drug therapy[53].

1. Drug Therapy and Approach Considerations

Because Mtb is known to be an obligate aerobe that relies mainly on its electron transport chain system, its bioenergetic profile is influenced by ETC-targeting drugs. Basically, the standard practice of managing pulmonary tuberculosis includes a four drug regimen for a full course of therapy for 6 months. The four drug regimen is composed of: rifampin, isoniazid, pyrazinamide, and streptomycin (or ethambutol). When the isolated bacterium is found to be fully susceptible, the intake of streptomycin or ethambutol can be stopped. Earlier in the millennium, there was a wide renewal of interest in the shortening of tuberculosis treatment This rooted from the immense interest in the 1970s where drugs such as pyrazinamide and rifampin actively shortened the time of therapy from 18 to 6 months. However, those attempts were affected by cost constraints and apparent toxicity increased[54].

2. Vaccine

A revolutionary discovery in the fight against Mtb happened when Calmette and Guerin developed the attenuated strain of the virus, ultimately naming it after them as the Bacille Calmette-Guerin (BCG) vaccine. Despite being highly successful in the prevention of pulmonary tuberculosis in children, the vaccine is known to pose variable effectiveness in the adult form of the disease[55].

Chapter Two the Results

Prevalence of TB Infection in Thi-Qar Province during 2022-2023 According to Infection Type

The present study was a significant difference at p. value < 0.05, between types of infection, was recorded the high TB infection was active infection during 2022 356 (81.84%), and 79 (18.16) was passive infection. In the same hand, high active TB infection in 2023 was active infection 433 (77.18%), and 128 (22.82) was passive infection, as in the Figure 4-1.

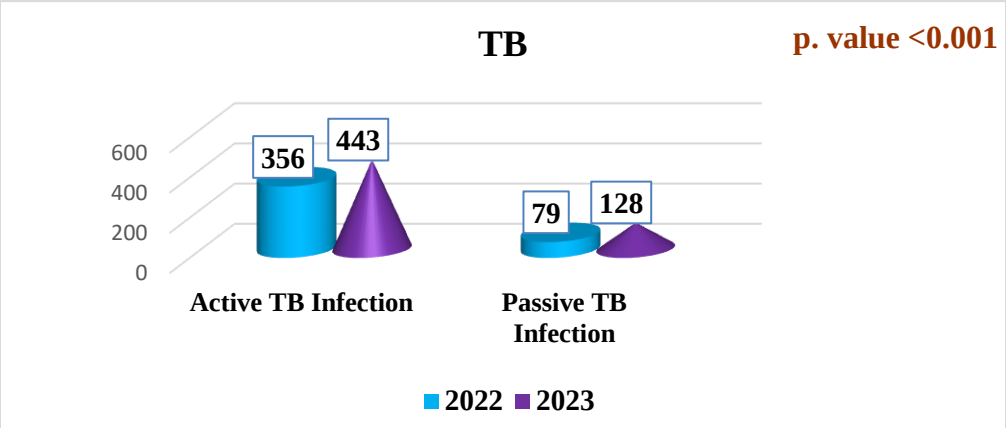

Figure 4-1: Prevalence of TB infection in Thi-Qar province during 2022-2023 according to infection type

Prevalence of TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections

The present study was a non-significant difference at p. value < 0.05, between years of infection and their months, was recorded the high TB infection in 2022 was during October 58 (13.33%), followed in November 50 (11.49%), while the lowest TB infection was in September 24 (5.52%). In the other hand, the high TB infection in 2023 was during July 86 (15.06%), followed in August 78 (13.66%), while the lowest TB infection was in September 22 (3.85%).

In addition, the high total TB infection during 2023 571 (56.76%), while during 2022 435 (43.24%), as in the Table 4-1.

Table 4-1: Prevalence of TB infection in Thi-Qar province during 2022-2023 according to months of infections

Total TB Infection						
Months	**2022**		**2023**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
January	29	6.67	47	8.23	76	7.55
February	39	8.97	55	9.63	94	9.34
Marich	37	8.51	57	9.98	94	9.34
April	29	6.67	38	6.65	67	6.67
May	37	8.51	43	7.53	80	7.95
June	34	7.82	44	7.71	78	7.75
July	41	9.43	86	15.06	127	12.62
August	26	5.98	78	13.66	104	10.35
September	24	5.52	22	3.85	46	4.57
October	58	13.33	32	5.60	90	8.95
November	50	11.49	34	5.95	84	8.35
December	31	7.13	35	6.13	66	6.56
Total	435	43.24	571	56.76	1006	100
CalX^2= 9.453 TabX^2= 19.68 DF=11 p. value 0.580						

Prevalence of Active TB Infection in Thi-Qar Province during 2023-2024 According to Months of Infections

The present study was a non-significant difference at p. value < 0.05, between years of infection and their months within active TB infection, was recorded the high active TB infection in 2022 was during October 50 (14.04%), while the lowest active TB infection was in February and September 20 (5.62%). In the other hand, the high active TB infection in 2023 was during August 71 (16.03%), while the lowest active TB infection was in October 21 (4.74%), as in the Table 4-2.

Table 4-2: Prevalence of active TB infection in Thi-Qar province during 2022-2023 according to months of infections

Active TB Infection						
Months	**2022**		**2023**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
January	22	6.18	43	9.71	65	8.14
February	20	5.62	33	7.45	53	6.63
Marich	29	8.15	35	7.90	64	8.01
April	29	8.15	28	6.32	57	7.13
May	34	9.55	36	8.13	70	8.76
June	28	7.87	35	7.90	63	7.88
July	34	9.55	66	14.90	100	12.52
August	19	5.34	71	16.03	90	11.26
September	20	5.62	19	4.29	39	4.88
October	50	14.04	21	4.74	71	8.89
November	43	12.08	30	6.77	73	9.14
December	28	7.87	26	5.87	54	6.76
Total	356	44.56	443	55.44	799	100
CalX^2= 14.6 TabX^2= 19.68 DF=11 p. value 0.201						

Prevalence of Active Pulmonary TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections

The present study was a non-significant difference at p. value < 0.05, between years of infection and their months within active pulmonary TB infection, was recorded the high pulmonary active TB infection in 2022 was during May 25 (13.74%), while the lowest active pulmonary TB infection was in September 9 (4.95%). In the other hand, the high active pulmonary TB infection in 2023 was during August 22 (13.33%), while the lowest active pulmonary TB infection was in June 9 (5.45%), as in the Table 4-3.

Table 4-3: Prevalence of active pulmonary TB infection in Thi-Qar province during 2022-2023 according to months of infections

Active Pulmonary TB Infection						
Months	**2022**		**2023**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
January	16	8.79	19	11.52	35	10.09
February	11	6.04	16	9.70	27	7.78
Marich	17	9.34	10	6.06	27	7.78
April	11	6.04	11	6.67	22	6.35

May	25	13.74	13	7.88	38	10.95
June	16	8.79	9	5.45	25	7.20
July	17	9.34	11	6.67	28	8.07
August	13	7.14	22	13.33	25	7.20
September	9	4.95	12	7.27	21	6.05
October	20	10.99	10	6.06	30	8.65
November	15	8.24	18	10.91	43	12.39
December	12	6.59	14	8.48	26	7.49
Total	182	52.45	165	47.55	347	100
$CalX^2$= 9.279 $TabX^2$= 19.68 DF=11 p. value 0.596						

Prevalence of Active Out-pulmonary TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections

The present study was a highly significant difference at p. value < 0.05, between years of infection and their months within active out-pulmonary TB infection, was recorded the high out-pulmonary active TB infection in 2022 was during October 30 (17.24%), while the lowest active out-pulmonary TB infection was in August 6 (3.45%). In the other hand, the high active out-pulmonary TB infection in 2023 was during July 55 (19.78%), while the lowest active out-pulmonary TB infection was in September 7 (2.52%), as in the Table 4-4.

Table 4-4: Prevalence of active out-pulmonary TB infection in Thi-Qar province during 2022-2023 according to months of infections

Active Out Pulmonary TB Infection						
Months	**2022**		**2023**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
January	6	3.45	24	8.63	30	6.64
February	9	5.17	17	6.12	26	5.75
Marich	12	6.90	25	8.99	37	8.19
April	18	10.34	17	6.12	35	7.74
May	9	5.17	23	8.27	32	7.08
June	12	6.90	26	9.35	38	8.41
July	17	9.77	55	19.78	72	15.93
August	6	3.45	49	17.63	55	12.17
September	11	6.32	7	2.52	18	3.98
October	30	17.24	11	3.96	41	9.07
November	28	16.09	12	4.32	40	8.85
December	16	9.20	12	4.32	28	6.19
Total	174	38.50	278	61.50	452	100
$CalX^2$= 37.48 $TabX^2$= 19.68 DF=11 p. value < 0.001						

Prevalence of Passive TB Infection in Thi-Qar Province during 2022-2023 According to Months of Infections

The present study was a significant difference at p. value < 0.05, between years of infection and their months within passive TB infection, was recorded the high passive TB infection in 2022 was during February 19 (24.05%), while the lowest passive TB infection was in both May and December 3 (3.80%). Iin contrast, the high passive TB infection in 2023 were during both February and Marich 22 (17.19%), while the lowest passive TB infection was in September 3 (2.34%); in addition, the study not recorded passive infection during April of 2022 (0.0%), as in the Table 4-5.

Table 4-5: Prevalence of passive TB infection in Thi-Qar province during 2022-2023 according to months of infections

Passive TB Infection						
Months	**2022**		**2023**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
January	7	8.86	4	3.13	11	5.31
February	19	24.05	22	17.19	41	19.81
Marich	8	10.13	22	17.19	30	14.49
April	0	0.00	10	7.81	10	4.83
May	3	3.80	7	5.47	10	4.83
June	6	7.59	9	7.03	15	7.25
July	7	8.86	20	15.63	27	13.05
August	7	8.86	7	5.47	14	6.76
September	4	5.06	3	2.34	7	3.38
October	8	10.13	11	8.59	19	9.18
November	7	8.86	4	3.13	11	5.31
December	3	3.80	9	7.03	12	5.80
Total	79	38.16	128	61.84	207	100
CalX^2= 22.42 TabX^2= 19.68 DF=11 p. value 0.021						

A Comparison between Recurrent and Recent TB Infection During 2023 to 2024

The current results were noted among 435 recent TB infection during 2022, 10 (2.30%), scored recurrent TB infection, and among 571 TB infection during 2023, 12 (2.10%), the study also, noted a non-significant difference at p. value < 0.05, as in Figure 4-2.

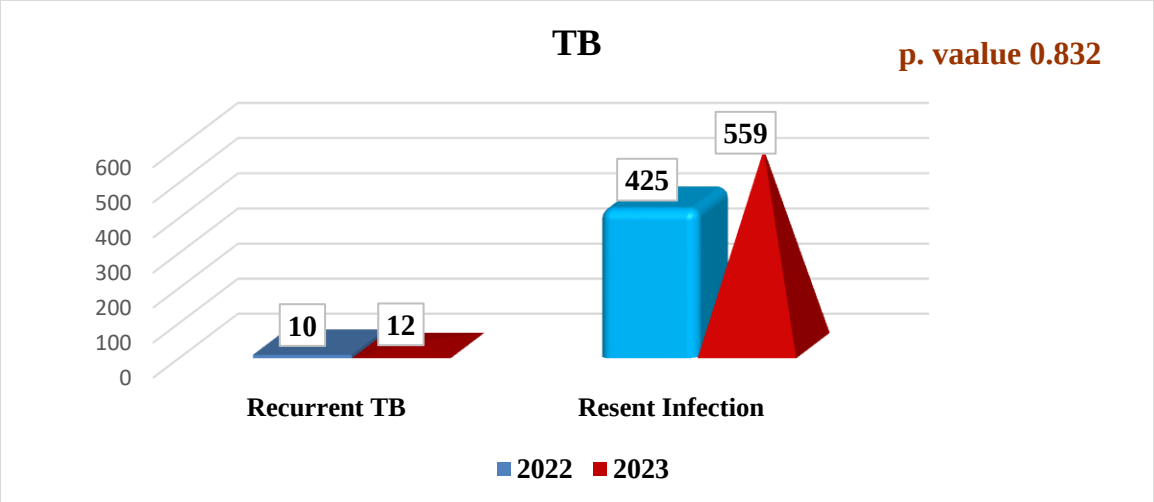

Figure 4-2: A Comparison between recurrent and recent TB infection during 2022 to 2023

Statistical Analysis

The data of the current study was statistically analysis by using SPSS version 26, based in using Chi-square at p. value < 0.05.

Discussion

The results presented indicate that tuberculosis is in Dhi Qar Governorate, which is one of the governorates of Iraq located in the south, with a population of 43 million and 324 thousand people in their last census. The number of

infected people for the years 2022-2023 for this governorate reached 1006, of which in the year 2022 (435) were infected and in the year 2023 (571). Of these, 90% were active infections and 10% were inactive infections for these two years. The percentage of infections increased in the year 2023 over the year 2022 by (13.5%), and there were relapsed cases, the number of which reached (2.29%) in the year 2022, and in the year 2023 their number reached (2.10%) case, and there are other percentages due to active tuberculosis, the percentage of which in the year 2022 was (41.83%) and in the year 2023 the percentage was (28.89%), and the cases that are inactive, including in the year 2022 (40%) and in the year 2023 (48.68%) compared to With local studies conducted, including in Baghdad Governorate[56].

Baghdad is the capital and largest city of Iraq, with an estimated population of about 8,340,710 in 2019[57]. Most tuberculosis infections were on the Rusafa side more than on the Karkh side. The number of infections in Rusafa is higher due to the increase in population and the large and crowded countryside. The results also showed that the prevalence of patients suffering from MDR-Mtb reached 11.1% of all cases of pneumonia. The results of the study in Baghdad Governorate showed that there were 75 patients with tuberculosis

Karkh side in January, February and March 2019 distributed as follows: 69 (92%) MTB patients and 6 (8%) MTB patients. While the number of tuberculosis patients in Rusafa district reached 125 patients, distributed as follows: 106 (84.8%) MTB patients and 19 (15.2%) MTB patients[58]

In April, May and June 2019 in Al-Karkh district, the results indicated that there were 63 TB patients distributed as follows: 57 patients with Mtb (90.5%) and 6 patients with MDR-MTB (9.5%). On the Rusafa side, there were 131 tuberculosis patients distributed as follows: 115 (87.8%) patients with MTB and 16 patients with MDR-MTB (12.2%). There were 37 tuberculosis patients in the Karkh side in July, August, and September 2019, distributed as follows: 65 (89%) tuberculosis patients and 8 (11%) multidrug-resistant tuberculosis patients. On the other hand, in the Rusafa side, 141 TB patients (69 males and 72 females) were registered as follows: 126 (89.3%) patients with pulmonary TB and 15 (10.7%) patients with multidrug-resistant TB[59].

In October, November and December 2019, the results were recorded for 77 TB patients (51 males and 26 females) in the Karkh region, distributed as follows: 69 (89.6%) TB patients and 8 (10.4%) MDR-Mtb-TB patients. Patients. While there were 127 tuberculosis patients on the Rusafa side, distributed as follows: 115 (90.5%) patients with pulmonary tuberculosis and 12 (9.5%) patients with multidrug-resistant tuberculosis Comparing to the study of Muhammad and 2 others from Diyala Governorate, there were sixty-one patients [67.1%] male and 20 female with an average age of 21 years, range [18.761 years] twenty healthy control groups 10 [50%] Males and 10 [50%] females, with an average age of 36.8 years and a range of 26-60 years[60].

The study shows TB is more prevalent in the age group [18-35 years] of which 18 (29.5%) patients had pulmonary TB and 11 (18.3%) patients had additional pulmonary TB.

The gender is male [61] compared to female patients of the same age group. There is no statistically significant difference - O-value of 81 between all age groups in lung and extrapulmonary[62].

The duration of the illness ranged from one month Sixty months on average Duration of symptoms [15.961] months patients [57.3%] were diagnosed with pulmonary tuberculosis, 26 patients [42.6%] 35 were found to have additional pulmonary tuberculosis, [82%] had fever and sweating, [42] patients [70%] had anorexia, and 39 patients had [65%] of weight loss, 24 patients [39.3%] had cough, 19 patients [31.1%] had diabetes, 17 patients [27.9%] had joint pain and myalgia and 17 patients [27.9%] had contact With tuberculosis patient

patients (26.7%) had hemoptysis with sputum 16

patients (24.6%) were smokers 15

A study in Basra Governorate in 2021 confirmed this. 56 TB patients were recruited for this study. Their ages ranged from 8 to 68 years, with an average of 34.7±16.6 years. 24 (42.9%) were male and 32 (57.1%) were female. Twenty-seven (48.2%) of them had pulmonary TB (24 were sputum smear positive and 3 were sputum smear negative) and 29 (51.8%) had extrapulmonary TB (mainly tuberculous lymphadenitis). Twenty-three of the 27 pulmonary TB patients had a unilateral lesion on chest X-ray, only 4 patients had bilateral lesions, five of all the pulmonary TB patients had a cavitation on chest, while the rest only had offside[63].

During the period from May 1 to October 1, 2019, 612 samples were received from patients attending the Specialized Center for Chest and Respiratory Diseases/National. Tuberculosis Reference Laboratory (NRL) in Baghdad, out of (612) samples received, 82 (13.4%) (55 samples from PTB and 27 from EPTB) were positive by smear microscopy (direct examination), while 90 (14.7%) samples (57 from PTB and 33 from EPTB) were able to be cultured on LJ media. It was noted that eight negative samples by direct examination were diagnosed by culture, and (27) samples were diagnosed only using the ZN dye, while 33 samples were positive[64].

The study in Kirkuk Governorate also confirmed that the number of participants in the study was 100 patients. Microscopic examinations of sputum samples confirmed positive results. All 100 patients (100) were examined to detect their infection with HIV. The results were negative. There was no infection associated with tuberculosis. The success rate of treatment was (90%), with (90) patients gaining recovery. The total number of deaths and interruptions to treatment was 3 (3), 7 (7) respectively.[65] There were no treatment failures. Pulmonary tuberculosis was prevalent in the age group (21-30 years, 31 patients (31), and there was a significant association between the area of settlement and tuberculosis, as the study showed that 77 patients (77) were living in the urban area. Treatment result For patients enrolled in the short-term direct treatment program it was successful. Pulmonary tuberculosis in the Zab region Nwonwu et al showed in Nigeria that cavitary lesions were the most common findings[66]. Radiological features are considered a diagnostic standard in the World Health Organization program, and they are useful in following up patients and detecting complications[67].Furthermore, there was a positive family history of pulmonary tuberculosis in 16.6% of patients.[68] Likewise, Al-Kubaisi et al showed an infection rate of 17.3% among household contacts of school children in Iraq. [69]This may be due to the presence of extended families in Al Zab District associated with overcrowding, poverty, malnutrition, and the presence of grandfathers or grandmothers who may have active pulmonary tuberculosis[70].

The results of the current study showed that the cure rate was 76.6%. Niazi et al reported that the cure rate was up to 68.6% with the traditional method of administering anti-tuberculosis drugs, but the cure rate could be increased to 83.7% when implementing a short-course regimen under direct supervision in Baghdad city.[71] The World Health Organization's global goal for tuberculosis treatment is to achieve a cure rate of 85%, and this goal has not yet been reached[72]. Undertreatment may be related to patients' unemployment, lack of family support and stimulation, comorbidity, and low level of education. A high failure rate masks the increasing number of treatment failures, increases drug resistance and reduces overall improvement in the area. Treatment failure in the current study was 3.3% which may be due to patient non-compliance or emergence of MDR-TB. Drug resistance varies widely between countries, for example. In South Africa, it ranged from 7.3% to 14.3%, but in Egypt it ranged from 0.9% to 5.1%.[73] Treatment failure is a serious problem because patients have a higher mortality rate and remain infectious for a long period of time, thus being able to transmit the disease to other individuals in the community.[74] Finally, this study recommended that greater efforts be made to identify patients with pulmonary tuberculosis, because delayed diagnosis and treatment may lead to more new cases. Implementing a directly supervised short-term treatment (DOTS) program as a strategy to increase the cure rate is valuable[75].

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