Correlation Between Demographic Factors and Tuberculosis Prevention: A Literature Review

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Abstract

Tuberculosis (TB) is a major cause of ill health in the world. The population infected by pulmonary TB worldwide estimated one-third of the population. TB is transmitted by droplets produced by infected source. The main goal of TB prevention is to prevent TB transmission other than curative purposes. The preventive behavior of pulmonary TB can be affected by several factors. This article aims to review previous studies discussing the correlation of age and gender with the prevention of pulmonary TB.

Keywords: pulmonary tuberculosis, age, gender, prevention, literature review

1. Introduction

Tuberculosis (TB) is a human disease caused by infection of *Mycobacterium tuberculosis* (*M. tuberculosis*). TB mostly affects the lungs, thus pulmonary disease becomes the most common presentation. Organ systems that are also affected are respiratory system, gastrointestinal system, lymphoreticular system, the skin, the central nervous system, the musculoskeletal system, the reproductive system, and the liver[1].

M. tuberculosis has survived in human communities from ancient time until modern time as a human pathogen without known environmental reservoirs[1]. *M. tuberculosis* is an aerobic acid-fast-rod-shaped bacterium[2]. As a droplet nuclei, *M. tuberculosis* can remain suspended in air for hours[3]. Approximately at least 10 bacilli can lead to infection. A lot of infective droplets produced through speaking or single cough or sneezing. Droplets that are inhaled by a susceptible host, will be stuck in the alveoli and finally taken up by macrophages. Patients will suffer latent TB if macrophages contain the disease. Patients will develop active TB if the macrophages fail to contain the disease. Factors that influence the risk of developing active TB are the patient's age, immunocompetence, and infection time[4]. Patients with active disease are contagious. Pulmonary TB is still a major cause of mortality and morbidity in the world. The population infected by pulmonary TB worldwide estimated one-third of the population[5].

The prevention of pulmonary TB has the main goal to treat and prevent TB relapse, as well as reducing TB transmission towards the people in the environment, especially in overcrowded and unsuitable environmental conditions. There are several factors that can affect the prevention behavior of a person towards pulmonary TB, such as the behavioral and non behavioral factors. Thus, this review will discuss about the correlation between demographical factors, especially age and gender, and TB prevention.

2. Overview of Pulmonary Tuberculosis

2.1. Epidemiology

The high presentation of death by pulmonary TB influences global effort to combat TB. These efforts yielded satisfactory results since 2000 based on an estimation of WHO that the global case rate for TB decreased by 1,5% every year. Moreover, mortality caused by pulmonary TB constantly declined. The number of mortalities caused by TB declined by 22% from 2000 to 2015. Developing countries such as India, Indonesia, China, Nigeria, Pakistan, and South Africa still have a huge number of deaths caused by TB, approximately 60% in 2015[1].

2.2. Etiology

Mycobacterium tuberculosis is an alcohol acid-fast bacillus (AAFB). The characteristics of *M. tuberculosis* are non-spore forming, non-motile, obligate-aerobic, facultative, catalase-negative, and intracellular bacteria. Because of the very bad reaction with the gram stain *M. tuberculosis* is neither gram-positive or gram-negative. The phenomenon known as “ghost cells” is when a weakly positive cell can be demonstrated on gram stain[6].

Compared to other bacteria, the organism has few unique features including the presence of some lipids in the cell wall such as mycolic acid, cord factor, and Wax-D. Several properties of *M. tuberculosis* infection influenced by the high lipid content of the cell wall are:

- Several antibiotics resistance
- Difficulty staining with Gram stain and several other stains
- Capability to live under extreme conditions such as extreme acidity/alkalinity, low oxygen situation, and intracellular survival (within the macrophage).

The most common stains that are used to diagnose TB is the Ziehl-Neelsen stain. Carbol fuchsin (pink color stain) used in the beginning of sample stained, acid-alcohol used to decolorize, using another stain usually blue-colored methylene blue for counter-stained. Sample which retains pink color of the original carbol fuchsin therefore the designation, AAFB is a positive sample[1].

2.3. Transmission

Transmission of *M. tuberculosis* is transmitted by small airborne cells called droplet nuclei. Droplet nuclei are produced by coughing, sneezing, talking or singing of a person who suffers pulmonary TB. After expectoration, droplets can live for minutes until hours in the air. TB transmission is influenced by several factors such as number of bacilli in the droplets, virulence of the bacilli, bacilli UV light exposure, designation of ventilation, and the change for aerosolization[4].

Transmission of TB happens when a source of TB produces infectious particles. Infectious particles survive in the air, and are inhaled by a susceptible person. People who are infected have a potential to develop TB disease[7]. Introduction of *M. tuberculosis* can cause infection of the respiratory system. *M. tuberculosis* can also spread to other organs, such as lymphatics, pleura, bones/joint, meninges causing extrapulmonary tuberculosis[4]. Extrapulmonary TB is significantly correlated with malnutrition in all ages group[8].

2.4. Clinical Manifestation

TB of the lung parenchyma and tracheobronchial tree is defined as Ppulmonary TB. Pulmonary TB is distinguished as primary pulmonary and post-primary pulmonary. Pulmonary TB has classic clinical features including chronic cough, sputum production, appetite loss, weight loss, fever, night sweats, and hemoptysis[9].

Primary pulmonary TB frequently occurs in childhood in countries with high TB prevalence. Meanwhile, in countries with low TB prevalence, primary pulmonary TB frequently occurs in adults. The characterization of primary pulmonary TB is local granulomatous inflammation located in the periphery of the lung and may be found together with ipsilateral lymph node involvement, called the Ghon complex. The effect of infection is usually asymptomatic but can present as an acute lower respiratory tract infection. The diagnosis of primary pulmonary TB can be shown by history of close contact with an infectious TB case and when a tuberculin skin test (TST) or blood interferon-γ release assay (IGRA) converts positive, usually 3-8 weeks after infection. Ghon complex may be visible at the chest radiograph[9].

Post primary pulmonary TB of the lungs is the general clinical manifestation in adults. Post primary pulmonary TB appears many years after exposure to an individual with infectious TB and may be instigated by interim or permanent immunological impairment. Post primary pulmonary TB mostly affect males compared to females. The common symptoms of active TB disease are fever, anorexia or decreasing appetite, weight loss, night sweats, anemia, and regular cough, generally productive of purulent and or blood-stained sputum. Localized thoracic pain together with pleural inflammation occasionally happens. Patients may experience breathlessness. Cavitating lung disease causes erosion of pulmonary blood vessels generally resulting in hemoptysis[9].

3. Prevention of Pulmonary Tuberculosis

3.1. Definition

The prevention of pulmonary TB has the main goal to treat and prevent TB relapse, as well as reducing TB transmission towards the people in the environment, especially at the family level. Family members is a subject that is prone to TB transmission because they live together with the patient, especially in overcrowded and unsuitable environmental conditions. Individual understanding and knowledge of TB, including way of transmission, dangers, and treatment will affect the preventive action by a person. The prevention behavior we should pay attention to are the use of masks, sputum and saliva management, cough etiquette, hand hygiene, medication, the health quality of home, and the prevention efforts of household contact transmission[10].

Cough etiquette can be applied by covering the mouth with elbow, tissue or handkerchief while coughing[10]. Program aimed to control TB are conducted by the government through the implementation of oral anti-tuberculosis (OAT) medications under the DOTS (Directly Observed Treatment Strategy). The five components of DOTS are the commitment of the governments to preserve control of pulmonary tuberculosis, pulmonary tuberculosis cases detection through the examination of sputum, six to eight months supervised treatment, pulmonary tuberculosis drugs routine and uninterrupted supply, and reporting system to evaluate treatment and program progress[11]. Preventive therapy (PT) and contact investigations (CI) may be effective methods for preventing the spread of TB to children. These methods are offered via community-based approaches that encourage TB-affected families as well as health care workers (HCWs)[12].

3.2. Influencing Factors

Based on an analysis conducted by Lawrence Green about human behavior based on health level in 1980, there are two main factors which influence individual and community health status such as behavioral factor and non behavioral factor. Predisposing factors includes forms of knowledge, attitudes, beliefs, religion, values, etc. The enabling factor includes the physical environment and health facilities, such as health centers, medicines, contraceptives, latrines, etc. The driving factor which is also known as a reinforcing factor includes attitude and behavior of healthcare workers as well other groups which serve as a reference or community guidelines for behavior especially in the health sector[13].

a. Knowledge

Ramadhan, et al., (2021) on his research about prevention behavior of pulmonary tuberculosis transmission in TB patients in the city of Banda Aceh and Aceh Besar state that the lower the education level, the fewer they might have good TB prevention behavior[10]. The education level is one indicator for measuring the level of development of a country. Education contributes to health behavior. Knowledge that is influenced by the level of education is one of the driving factors that play a key role in influencing someone's decision to implement a healthy lifestyle[14]. Ramadhan, et al., (2021) show that most TB patients have low education approximately 56.1%. Understanding about disease is affected by educational level. Highly educated person tends to search for as much information as possible regarding something they experienced. Information obtained will affect the person's attitude and behavior, in this case people will try to prevent TB transmission well[10].

b. Age

Ramadhan, et al., (2021) stated that people with younger age have better effort to prevent pulmonary tuberculosis than older people. People with age over 46 years and the elderly (> 66 years) are 3.2 times and 4.7 times at risk for poor behavior in TB prevention compared to age ≤ 25 years. This result shows the relation of healthy lifestyle and TB prevention effort. This phenomenon might happen because habits have become part of everyday life. When the elderly is accustomed to unhealthy lifestyles, it will be easier for them to be infected with diseases, including TB. This condition is worsened by wrong perception and the lack of the knowledge about Pulmonary TB[10].

c. Gender

Based on a research conducted by Agustina & Wahjuni (2017), shows that the most infected group is from male in infected family members compared to non-infected families. In contrast, most of the family members who were not infected were female. As for some literature which explains that a man has a greater risk of suffering from pulmonary TB disease compared to a woman. The habit of smoking and consuming alcohol which is more dominant in men than women might influence a person's body immunity. Thus men become susceptible to contracting or being exposed to a disease such as pulmonary TB[15].

d. Social Economic

The socio-economic status of a person is directly or indirectly related with the incidence of TB. For example, malnutrition, the health quality of home or living conditions and limited access to health services due to weak economy. WHO through the National Guidelines Control of Tuberculosis in 2014 stated that the people who come from weak socioeconomic conditions will be more easily infected with TB in approximately 90% of patients[15]. Socio-economic conditions are related to education level, environmental sanitation conditions, nutrition status and ability to access health services. Less family income leads to lack of purchasing ability of a person in fulfilling necessities such as food and clothing. Thus if someone is malnourished, it will affect their immune system and it can make it easier to get infected with TB Lungs [16].

4. Correlation Between Age and Prevention of Pulmonary Tuberculosis

As individuals accumulate exposures of *M. tuberculosis*, the prevalence of TB infection increases, especially throughout adolescence. Progression of TB disease is increasing among children aged 5-9 years and throughout adolescence. This is associated with immunity changes due to puberty. This change contributed to an increased risk of progression to TB among adolescent and young adults. Individual factors that may increase the risk factors for TB infection and progression in adolescence are malnutrition, immunosuppression, diabetes mellitus, obesity, smoking, and harmful alcohol use. Community factors that contributed are community prevalence of TB, overcrowded housing, schools, transit, jails/prison, and air pollution[17]. Malnutrition can result in decreased immune system thus they will be prone to TB infection. Moreover, infectious diseases may be harmful to any nutritional state[18].

The preventive behavior in adolescent can reduce TB transmission. Socialization and counseling for minimizing alcohol use are also important. Adolescents who are highly mobile with a lot of social contacts each day than young children or older adults also become an essential factor for determining prevention of pulmonary TB among adolescents. Adolescents may be easily infected by TB caused by household exposures. Nevertheless, household exposure appears smaller for adolescence than younger children. Aside from household exposures, social exposures on adolescence also contributed to risk progression for TB transmission. Adolescents tend to spend most of their time in school settings. Close contact for so long in the building that may not have good ventilation would be ideal for TB transmission. Since adolescence with pulmonary TB disease frequently have high transmission rate, schools are also an important and potential site for TB transmission in communities with low TB prevalence. Increasing proximity and duration of exposures in school can increase the risk of TB transmission[17].

5. Correlation Between Gender and Prevention of Pulmonary Tuberculosis

The prevalence of pulmonary TB is higher in male than females. The risk of pulmonary TB transmission in females increases around the time of menarche. Nevertheless, the risk of TB in females appears to peak at mid-adolescent stage compared relatively to male. The mortality caused by TB may intersect with higher vulnerability to HIV among female adolescents. Based on research conducted by Osman, et al., (2021) stated that the mortality of female adolescents is twice higher than male adolescents. Factors that may contribute to increasing susceptibility to TB among female adolescents are due to physiologic changes at menarche, higher rate of HIV infection among female adolescents, pulmonary tuberculosis associated with pregnancy, etc [19].

Another factor that results in higher cases of TB infection in females is undiagnosed TB among male adolescents. Since men tend to be careless to receive TB diagnosis and face higher mortality from interpersonal violence or other noninfectious causes[17].

Different discoveries regarding prevalence of TB transmission between female and men stated by Rokhmah (2013) that prevalence of female adolescents TB transmission is lower than man. These conditions show that at babies, children, up to early adulthood, women still have good access to proper health services. However, when entering middle and late adulthood, women do not get access to adequate health services. In fact, women who enter middle adults, especially those who are married, have burdens that she is not only concerned with her personal self, but also concerning her family, such as serving her husband and as a caregiver for their children[20].

6. Conclusion

Increased risk of TB progression is found among adolescent and young adults. This can be caused by several factors, such as malnutrition, immunosuppression, diabetes mellitus, obesity, smoking, and harmful alcohol use. Aside from household exposures, social exposures on adolescence also contributed to risk progression for TB transmission. The prevalence of pulmonary TB transmission is higher in male than females considering the access to proper health services.

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