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Physical Rehabilitation for Tuberculosis: A Review of Literature

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ABSTRACT

Background: Tuberculosis, a deadly infection affecting one-third of the global population, causes 2 million deaths annually. It presents in pulmonary and extrapulmonary forms. Physiotherapy is commonly used for PTB to overcome issues like airway clearance and muscle atrophy. **Aim:** This study aims to explore the role of physiotherapy in tuberculosis, pulmonary and extrapulmonary forms. Out of 82 selected articles, 44 were reviewed and included in the study. **Results:** The results show that physical rehabilitation is recommended for both PTB and EPTB, with EPTB cases predominantly prescribed following surgical interventions.

Keywords: Tuberculosis, Types of Tuberculosis, Pathogenesis of TB, Pathology of TB, Diagnostic procedures for Tuberculosis, Physical rehabilitation for pulmonary Tuberculosis, Extrapulmonary tuberculosis, Types of Extrapulmonary Tuberculosis, Physical rehabilitation for Extrapulmonary Tuberculosis.

Introduction

Tuberculosis (TB) stands as one of the most prevalent and perilous infections in history, experiencing a concerning surge in recent times. Its impact has extended to approximately one-third of the global population, with an alarming annual rise in new active TB cases, reaching a staggering figure of 9 million[1]. Out of the 9 million individuals impacted, nearly 2 million succumb to this infectious ailment, rendering TB the pathogen with the highest fatality rate[2].

The mortality associated with tuberculosis primarily stems from delayed diagnosis or inadequate and ineffective treatment[3]. Transmission of TB is mainly by cough droplets. TB is transmitted by small respiratory droplets that are coughed into the air by the infected person and inhaled by the host[1,4,5]. From the lungs these bacteria may travel to other sites via the bloodstream or lymphatic system and cause infection to other regions of the body[6].

Tuberculosis infection may present in two forms: pulmonary (PTB) or extra-pulmonary (EPTB), depending on the site of infection such as the pleura, gastrointestinal tract, musculoskeletal system, lymph nodes, central nervous system, meninges, etc. From among these Pulmonary TB [PTB] is the most prevalent form of the disease[7- 16]. The process through which TB bacteria inflict harm on the lungs involves triggering an immune system hypersensitivity reaction. Primarily targeting macrophages, it prompts the formation of a distinct type of granuloma characterized by dead cell accumulation and the development of cavities within the lung tissue[2, 5, 17].

The aim of this review is to examine and synthesize existing literature on the role of physical rehabilitation in managing tuberculosis (TB), particularly focusing on its impact on pulmonary function, physical capacity, quality of life, and overall recovery. By evaluating rehabilitation interventions, such as respiratory exercises, physiotherapy techniques, and exercise programs, the review seeks to provide evidence-based recommendations for improving patient outcomes during and after TB treatment.

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Method

To generate the list of articles that formed the basis of the evidence reviewed in this report, we extensively searched the published literature. The databases employed for the search included EMBASE, PubMed, and Google Scholar. The criterion for articles to be included in the search was the inclusion of the following keywords: Tuberculosis, types of tuberculosis, pathogenesis of TB, Pathology of TB, diagnostic procedures for Tuberculosis, Physical rehabilitation for pulmonary tuberculosis, extra pulmonary tuberculosis, types of extra pulmonary tuberculosis, physical rehabilitation for extra pulmonary Tuberculosis that were ultimately selected for review had to include a focus on these terms i.e Tuberculosis, Extra-pulmonary Tuberculosis, Physical rehabilitation. We further delimited the search to include literature published over the period from 2000 to 2024.

Result

A total of 76 studies were identified through a comprehensive search of the EMBASE, PubMed, and Google Scholar databases, using the predefined keywords related to tuberculosis (TB) and physical rehabilitation. After screening the articles for relevance and eligibility, 35 studies were included in the final review.

Table-1: Findings of Selected Articles.

Item	Findings
Pulmonary Tuberculosis Rehabilitation [18- 21]	Several studies emphasized the importance of respiratory exercises and pulmonary rehabilitation in improving lung function, reducing dyspnea, and enhancing the quality of life in TB patients. Pulmonary rehabilitation programs that included breathing exercises, chest physiotherapy, and aerobic conditioning showed positive results in restoring physical capacity and respiratory endurance.
Extra pulmonary Tuberculosis Rehabilitation [8,11,15, 22-24]	Studies on physical rehabilitation for extrapulmonary TB, particularly spinal TB and TB affecting the musculoskeletal system, highlighted the benefits of physical therapy interventions. These interventions included exercises targeting mobility, strength, and posture correction, significantly improving patients' functional mobility and pain management.
Overall Quality of Life and Physical Capacity, [24-26]	The reviewed articles consistently reported that physical rehabilitation contributes to enhancing the overall quality of life for TB patients. Patients who underwent structured rehabilitation programs exhibited better physical fitness, increased independence in daily activities, and faster recovery post-treatment compared to those who did not receive rehabilitation.
Emerging Approaches[27-30]	Recent studies (published after 2010) have explored the use of tele-rehabilitation and community-based rehabilitation programs, which have shown promise in delivering physical rehabilitation to TB patients in remote areas or under-resourced settings.

These studies encompassed various aspects of physical rehabilitation for both pulmonary and extra-pulmonary tuberculosis. The included studies were published between 2000 and 2024 and involved a range of populations and rehabilitation approaches. Findings of included articles were explained I table 1.

Overall, the literature supports the role of physical rehabilitation as a crucial component of TB management, particularly in mitigating the long-term physical impairments caused by both pulmonary and extrapulmonary TB. However, there is still a need for larger-scale randomized controlled trials to establish standardized protocols for rehabilitation in TB patients.

Discussion

Physiotherapy plays a crucial and well-recognized role in helping to clear secretions from the respiratory system. It is widely used for this purpose. Specifically, mechanical techniques like vibration massage are recommended to address and reduce early complications that can arise after surgical procedures for tuberculosis. Physiotherapy techniques aim to improve the patient's overall functional capacity and respiratory efficiency. In most research endeavors, notable enhancements were documented in spirometric indices, levels of oxygen saturation, and evaluations of exercise

capacity[31, 32]. Additionally, these methods aim to enhance functional capacity. Numerous studies have demonstrated significant improvements in spirometry, oxygen saturation levels, and exercise capacity as a result of these interventions.[20]

***Physiotherapy for Tuberculosis*:** Physiotherapy is one of the most common parts of the treatment plan when it comes to PTB[33]. Most of the problems in both PTB and EPTB arise from a lack of proper airway clearance and muscle atrophy that can be overcome by proper chest exercises and techniques[18].

Research indicates that functional residual volume, total lung capacity, and exercise tolerance diminish both during and post-tuberculosis infection, with these effects potentially persisting even after treatment[19]. These factors can be overcome by proper physical training and rehabilitation comprising of activities like hydrotherapy, chest exercises, etc.[20] Most of the problems in both PTB AND EPTB arise from a lack of proper airway clearance and muscle atrophy that can be overcome by proper chest exercises and techniques.[18]

It is necessary to keep in mind that the physiotherapy intervention should start early, and the exercises should be progressed and individualized according to the needs of the patient for the best results.[21]

***Physical Rehabilitation Pulmonary Tuberculosis*:** Physical therapy in pulmonary tuberculosis aims to improve overall health and quality of life. Following tuberculosis treatment, individuals may develop obstructive or restrictive impairments, which can diminish their tolerance for physical exertion.[31, 34]

Chest physical therapy remains a component of contemporary rehabilitation programs. These include exercises for breathing retraining, such as purse-lip breathing and diaphragmatic breathing, as well as methods like postural drainage, chest percussion, chest vibration, and directed cough.[32]

In a cross-sectional study done by Gilbwa Cole and colleagues in 2016, it was found that Active PTB significantly lowers both FEV1 (Forced Expiratory Volume in 1 Second) and FVC (Forced Vital Capacity), indicating both obstructive and restrictive impairments in the lungs. Even those who had PTB in the past show decreased FEV1 and FVC. Physiotherapy consisting of exercise routine, hydrotherapy massage therapy, and manipulative techniques can be used to improve lung function, functional capacity adaptive capacity, and cardio-respiratory system, and general lifestyle can be improved in a hospital for patients with pulmonary tuberculosis[20].

Typically, extended bed rest and avoiding exercise are advised for patients in the active phase of tuberculosis (TB). While refraining from intense physical activity may be warranted in certain situations, such as severe hemoptysis, this recommendation might not be necessary for cases of standard TB. During the active phase, patients can begin with light exercise, initially involving passive movements like limb stretches while in bed. This can progress to active-assisted and then active exercises. This can progress to active-assisted and then active exercises. Physical therapy should be tailored to the patient's condition, starting with gentle, slow-paced exercises, and gradually incorporating more precise and controlled movements. Eventually, resistance training can be introduced to build muscle strength by increasing repetitions or adding weights. The exercise regimen should focus on both the upper and lower limbs. When the patient's condition stabilizes, a walking test can be conducted in the hospital room or corridor, followed by stationary cycling and resistance training. The intensity of these exercises should be gradually increased based on the patient's individual tolerance. Additionally, incorporating techniques such as relaxation, posture correction, and breathing education can enhance the benefits of exercise training[33]. Before initiating exercise training, clinicians should conduct a comprehensive patient assessment and ensure optimal medical treatment, which may include bronchodilator therapy, long-term oxygen therapy, and managing any concurrent health conditions[34].

Lung TB and Children: Children are particularly vulnerable to TB if they have poor nutritional status, weakened immune systems, and live in environments with poor sanitation, such as densely populated areas with insufficient

ventilation.[35,36,37] The primary concern regarding children with Tuberculosis was recurring fever accompanied by nausea and difficulty expelling thick phlegm through coughing[18].

Chest physiotherapy involves employing techniques such as postural drainage, vibration, and percussion to eliminate phlegm from the respiratory system. The primary advantage of chest physiotherapy is its ability to promote the expulsion of secretions or sputum, thereby aiding in respiratory clearance. Chest physiotherapy is highly efficacious in clearing sputum and has the potential to decrease the respiratory rate while enhancing both ventilation and lung function.[38, 39]

Home-Based Programme for Lung TB: A pilot study was done by Shamila Manie and associates [2014] where the control group was exposed to a six-week home-based rehabilitation program. The study found significant improvement in the pulmonary function of the intervention group as compared to standard values whereas the difference in the control group and intervention group was rather low. Therefore a home-based program for PTB is not that effective and gives rather underwhelming results.[40]

***Physical Rehabilitation -Extrapulmonary Tuberculosis*:** When the Tb spreads through the Vascular system it is known as systemic miliary TB, depending upon the location of the infected area it can be classified into different types of diseases[11, 41].

Some have been discussed below:

***Central Nervous System Tuberculosis*:** Classification of CNS tuberculosis can be Intracranial like Tuberculous meningitis (TBM), Tuberculous encephalopathy, Tuberculous vasculopathy, CNS tuberculoma (single or multiple) Tuberculous Brain Abscess, or spinal like Pott's spine and Pott's paraplegia, Non-osseous spinal tuberculoma Spinal meningitis[8].

***Spinal TB*:** In case of spinal TB during preoperative, postoperative, and late postoperative up to 6 months of physical rehabilitation can be given.

Rehabilitation commenced with muscle-strengthening routines targeting specific areas such as the chest, abdomen, lower limbs, and the muscles of the Trunk and lower back show a positive result and Prompt identification and suitable medical or surgical interventions, coupled with a tailored rehabilitation regimen, can enhance the quality of life for individuals afflicted by spinal tuberculosis[15, 22].

***Intracranial TB*:** The utilization of multimodal sensory stimulation (MSS), incorporating tactile, auditory, light, and proprioceptive stimuli, aims to enhance patient arousal. MSS has the potential to enhance consciousness, aligning with advancements in our understanding of consciousness theory[23].

Passive range of motion exercises, regular repositioning, and employing air mattresses are implemented to mitigate risks associated with extended immobility. Additionally, chest physiotherapy techniques such as postural drainage, chest wall percussion, vibration, passive chest expansion exercises, and manual chest wall compression are utilized to enhance airway clearance, optimize lung expansion, and reinstate proper ventilation[23].

Improving airway clearance remains a paramount goal in managing this condition. Pulmonary rehabilitation has shown remarkable efficacy in alleviating symptoms, boosting functional autonomy, improving quality of life, and promoting self-sufficiency among tuberculosis patients. Typically, the foremost observable result in such cases is the advancement in lung function. This enhanced ventilation facilitates greater oxygen supply to the brain, fostering an optimal milieu for neurological recuperation[39].

Abdominal TB: Improvements in respiratory patterns, increased functional vital capacity, alleviation of discomfort, enhanced expansion of the chest, and elevated performance in activities of daily living (ADLs) following an intensive two-week physiotherapeutic intervention[24].

After undergoing abdominal surgery which is a common treatment plan for abdominal TB, the inclusion of chest physiotherapy as a customary component of post-operative care has been customary. The aim is to forestall or mitigate issues such as a telectasis, pneumonia, retention of sputum, and alterations in pulmonary mechanics leading to a restrictive lung pattern[25].

***Gastrointestinal TB and Others*:** In extra-pulmonary tuberculosis, any organ system can get affected and thus its diagnosis, as well as medical management including physical management, remains a difficult issue. Most types of EPTB are treated solely through drug therapy and sometimes surgery[7,10,12,13,22]. Although, physical rehabilitation remains important for the maintenance of pulmonary function post-tuberculosis[31]. Therefore, application of physical therapy for a better lifestyle post-surgery in patients with EPTB is a scope but not a contributing factor for management in active TB cases, mostly.

The primary approach to managing extrapulmonary tuberculosis (EPTB) involves anti-TB drug treatment. However, the treatment protocol for EPTB remains a contentious issue. Current guidelines typically recommend using the same regimen for both EPTB and pulmonary tuberculosis (PTB). Nevertheless, the evidence supporting this recommendation for various forms of EPTB is not as robust as the data available for PTB. The ideal duration of therapy remains a subject of debate. While a 6-month course of standard anti-TB treatment is typically deemed sufficient for most forms of EPTB, extended treatment durations are recommended for TB meningitis as well as bone and joint TB[5].

***Physical Therapy Post Tuberculosis*:** Hydro-kinesiotherapy in a therapeutic pool with hypertonic saline mineral water at 36°C for 20 minutes was utilized to enhance gait and joint mobility. Bilateral electro stimulation of the legs was employed to aid and restore movement in the lower limbs. Additionally, a nano-pulsed electromagnetic field and deep bilateral posterior thoracic oscillation were applied to stimulate the diaphragm muscle. To improve lower limb circulation and restore muscle trophicity and mobility, the treatment included a galvanic bath, bilateral knee ultrasound, cervical-dorsal lumbar drainage, lower limb lymphatic drainage, and trophic massage. The patient also benefited from generalized toning kinesitherapy, kinetic respiratory exercises, and treadmill workouts[41].

Active cycle breathing exercises (ACBT) are highly effective for several reasons. They help alleviate dyspnea (shortness of breath), enhance the patient's ability to clear phlegm, and boost physical activity levels. They also involve techniques that mobilize and remove phlegm from the airways, ensuring they remain clear and functional. Consequently, as breathing becomes easier and more effective, patients are more likely to engage in physical activities, thereby improving their overall fitness and mobility[42].

Pulmonary Rehabilitation (PR) is an affordable yet highly effective intervention that mitigates disabilities associated with chronic respiratory diseases. Its benefits are well-documented and supported by the highest level of research evidence in high-income countries[25].

There is a significant focus on examining pulmonary rehabilitation programs in the realm of chronic pulmonary diseases, with a noticeable absence of attention toward tuberculosis. There is a pressing need to establish specific guidelines tailored to tuberculosis patients, delineating the precise commencement of rehabilitation programs, personalized physical exercises, and comprehensive outcome assessment measures[21].

***Telerehabilitation and TB*:** Tele-rehabilitation is a feasible and effective method for providing physical rehabilitation to TB patients, especially in under-resourced or remote areas. It improves pulmonary function, patient adherence, and rehabilitation outcomes while reducing the need for in-person visits. Community-based rehabilitation programs focus on mobility, strength, and daily functionality, making them beneficial in low-resource settings. Tele health approaches help bridge healthcare delivery gaps for TB patients, improving access to care and overall health outcomes[4, 8].

Limitation

Physical rehabilitation for TB patients is a promising treatment, but there is a lack of high-quality evidence, standardized protocols, and a focus on pulmonary TB. Most studies only assess short-term benefits, with limited follow-up on long-term outcomes. Implementation of tele-rehabilitation and community-based rehabilitation faces challenges in low-resource settings, such as poor access to technology, lack of trained personnel, and inconsistent healthcare infrastructure. Adherence and patient engagement can be challenging, especially for long-term interventions. TB patients with multidrug-resistant TB or those co-infected with HIV face additional challenges that require more intensive management and personalized plans. Psychosocial and nutritional components are often overlooked in studies, as TB patients often experience mental health issues and malnutrition, which can hinder rehabilitation outcomes. These factors contribute to the lack of comprehensive patient care and the need for more comprehensive research and interventions.

Future Scope

Tele-rehabilitation programs are gaining popularity in remote and under-resourced areas, and future research should focus on scaling these programs globally, especially in regions with high TB prevalence. Advanced technologies like mobile health apps, VR, and AI could be used to customize and monitor patient rehabilitation remotely. Standardized rehabilitation protocols are needed for TB patients, particularly those with extrapulmonary forms. Large-scale, high-quality randomized controlled trials (RCTs) and long-term studies are needed to provide stronger evidence for the efficacy of physical rehabilitation in TB patients. Further studies are needed to explore the role of physical rehabilitation in multidrug-resistant TB (MDR-TB) and HIV co-infection. A multidisciplinary approach including mental health care and dietary interventions could enhance rehabilitation outcomes. Community-based rehabilitation models have shown promise in low-resource settings, but further research is needed to evaluate their scalability and adaptability in different cultural and socioeconomic contexts. Health policy and economic analysis should also be conducted to evaluate the cost-effectiveness of integrating physical rehabilitation into national TB control programs.

Conclusion

Physical rehabilitation is recommended for both pulmonary tuberculosis (PTB) and extrapulmonary tuberculosis (EPTB). However, in cases of EPTB, it is predominantly prescribed following surgical interventions.

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