

Risk of Becoming Ill with Pulmonary Tuberculosis in Mexico

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Tuberculosis is a contagious, communicable, curable, usually chronic disease of variable clinical presentation produced by the *Mycobacterium tuberculosis* complex. It is mainly acquired through air. It is usually systemic and affects mostly the respiratory system. It is a public health problem in countries such as Mexico; tuberculosis is one of the deadliest reemerging diseases. Since it was discovered and reported that the tubercle bacillus are the causative agents, a significant advancement was in the study and treatment of this illness, where microbiological behavior was highlighted. Although the bacillus is important, it is not enough for the development of the disease since more than 90% of those infected remain to have it as a latent infection throughout their lives. Identify the risk factors that increase susceptibility to pulmonary tuberculosis in Mexico. An electronic search of journals published in the period 2000-2013 without language restriction was conducted. 12 items which were indexed in Thomson Reuters, Elsevier, EBSCO CrossRef and Mexico were identified. In the literature review the authors agree that pulmonary Tuberculosis most often affects people with low socioeconomic status, especially if they have associated comorbidities such as HIV, DM and malnutrition, which are prevalent conditions of the Mexican society that aggravate and make more complex the profile of TB. One of the commitments in the framework of the Millennium Development Goals is to reduce the prevalence and mortality of tuberculosis, "Objective 6, 6C goal "Mexico is far from reducing TB if social determinants such as poverty are not solved, "goal 1: Eradicate extreme poverty and hunger", exclusion, poor housing conditions, among others, as well as the population prevalence of comorbidities such as HIV / AIDS and Diabetes Mellitus, otherwise Tuberculosis will continue to be the main killer disease reemerging.

Key words: Smear-positive, Risk factors, *Mycobacterium tuberculosis*, pulmonary tuberculosis.

Nowadays, we believe that diseases are the result of the interaction between genetic and environmental factors, as we announce the danger of breaking the balance that represents health, "risk factors" which must be clearly identified, well

interpreted and properly faced, to avoid as much as possible people getting sick¹.

Tuberculosis is a contagious, communicable, curable, usually chronic disease caused by the *Mycobacterium* complex; it is usually variable on its clinical presentation. Tuberculosis is transmitted from the sick to the healthy subject, mainly by contact with sick people bacilliferous enter to the organisms through inhalation of infectious material.

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Usually the disease is localized in the lungs which is the route of entry of the bacillus in 80-85% of cases, but can affect almost any organ in the human body. *M. tuberculosis* is a Gram positive bacillus, strictly aerobic, with 2-5 micron length and a diameter of 0.2 to 0.3 microns, it is stationary, and stained purplish red with Ziehl-Neelsen and once dyed resists fading, hence alcohol resistant, the bacillus is sensitive to heat; It is inactivated by heating to 680 C at pH 7. The incubation period from the time of infection until the primary lesions appear goes from 4 to 12 week. However, the risk of transmission may be lifelong when remains as a latent tuberculosis¹ infection.

The most important transmission mechanism, which causes almost all of the infections, is the airway. The *M. tuberculosis* is transmitted through droplets (droplets flügie) aerosolized that occur when a person with tuberculosis of the respiratory tract (pulmonary and / or laryngeal) does any of the following: coughing, sneezing, talking, singing and / or laughing. It has been calculated that a smear-positive patient can infect about 10-15 people per year². In the pulmonary alveoli tubercle bacilli are phagocytosed into which remain and replicate about every 25 hours. At this stage, do not kill macrophages destroy bacillus, because these are highly effective evasion mechanisms. The progress of the infection is limited only by the induction of adaptive immunity mediated by cells response (T-dependent lymphocytes), whereby any endogenous or exogenous factor favors bacillary multiplication and the onset of the disease, as is the case of primary immunodeficiency or malnutrition².

The Millennium Development Goals are the purpose of human development to be achieved in 2015, which were established in 2000 by the member countries of the United Nations. Seven Nations' aims for global TB control were set under these objectives. In this regard, tuberculosis is a disease that is maintained with high morbidity and mortality in the world, so it is for the World Health Organization (WHO), a disease of great interest, which has led to develop a specific and ambitious program; its eradication by 2050 is intended.

Tuberculosis was declared by WHO as a reemerging disease in 1993, the known disease had been controlled and no longer considered as a

public health problem, the remarkable resurgence of tuberculosis was driven by immune deficiencies in people with HIV, which increased the risk of latent *Mycobacterium tuberculosis* infections that could be an active disease transmitted to others¹. Given some conditions of the host, the infection moves from a latent development of disease in any of its clinical forms or stages. Host conditions are common to other infectious diseases; malnutrition, stigma of poverty and marginalization, which in turn are effects of the prevailing social inequality and explains the endemic tuberculosis which is also associated with specific conditions or chronic diseases such as diabetes mellitus or emerging HIV / AIDS immunosuppression.

Every year there are more than 8 million new cases and millions of deaths worldwide; TB causes more lag and orphans linked to poverty and failure of governments and civil society due to the lack of control over these issues².

The World Health Organization has published that a third part of the world population is infected with *Mycobacterium tuberculosis*, and 5-10% of those infected may develop the disease at some point in their lives. It is estimated that every second a person is infected with tuberculosis and an untreated patient infects 10 to 15 people in a single year¹.

Health inequities, ie, the differences in health status due to economic and social inequalities between individuals and populations are among the most relevant influencing facts that determine the persistence of tuberculosis in the world. This situation has been recognized by the World Health Organization (WHO, 2010), which mentioned that while all the social determinants such as poverty, exclusion, poor working conditions and housing are resolved, among others, tuberculosis continues being one of the major public health problems³.

TB is commonly found in poor clinical entities, since 95% of cases and 98% of deaths are reported in developing countries. Despite the progress made in the Region of the Americas, TB remains as a major public health problem. In 2009, there were 60% of new cases concentrated in four countries: Brazil, Peru, Haiti and Mexico^{5,6}.

TB/HIV, both have a fatal infection synergism. HIV promotes progression of a recent infection or latent tuberculosis, and TB accelerates

the evolution of HIV disease. The devastating effect of the HIV epidemics has had the greatest impact on populations with high prevalence of infection with *Mycobacterium tuberculosis*, which has also had great impact on the epidemic of tuberculosis^{7,8}.

HIV infection is the strongest for the progression of latent TB a of recent or active tuberculosis infection risk factor. The risk of progression of TB disease is 5% in people without HIV in the first 2 years and then is less than 5% the rest of their life. In people with HIV the risk goes from 5 to 15% per year, increasing to over 30% for the rest of their life⁹.

1.1 million new cases of tuberculosis and HIV infection in the world, from which 24, 000 corresponded to the Region of the Americas⁹ were estimated in 2009.

In fact, TB is the most common HIV coinfection and the risk of presenting it in HIV-negative patients is 5-10%; however, in those being HIV positive it is 50%. A third of the increase of people with tuberculosis in the world is attributed to the spread of HIV. One in every 3 people who die from AIDS has TB, and 8 to 10% of all deaths are due to HIV related TB^{10,11}.

The adverse effect of malnutrition on the immune system is a generally accepted notion. It creates an imbalance in the cascade of cellular immunity and loss of homeostasis of the individual. The extent and distribution of protein energy, malnutrition and micronutrient deficiencies in a given population depends on many factors, poverty is the main determinant underlying cause of malnutrition¹².

It is known that 90 % of the states of malnutrition in Mexico are caused by a single cause, inadequate food intake in terms of being poor or having excessive power, it is also determined by ignorance, accessibility to food and information, hunger, lack of hygiene, or by the quantity and quality of food. The relationship between malnutrition and pulmonary TB is close. Prolonged malnutrition increases opportunities to develop TB when being exposed to this infectious disease which also leads or aggravates malnutrition. The importance of being in a poor nutritional status is because disorders are triggered in many body functions such as immunity¹³.

Tuberculosis is an infectious disease that has affected humanity throughout its history; it is

today a major cause of illness and death, especially in the poorer strata of society¹⁴.

Paradoxically, a disease resulting from modernity as diabetes has a material adverse effect on the incidence and / or clinical course of tuberculosis. The association between TB and DM began to receive attention and was described during the first half of the XX century¹⁵. TB increases the chances of patients to develop DM due to the state of hyperglycemia as a result of infection and treatment outcome TB. The DM increases susceptibility to TB due to immunodeficiency to present DM¹⁶.

The clinical picture of a patient with TB -DM tends to be more severe immunosuppression by different factors such as pharmacokinetics of drugs for TB and DM¹⁷. Studies suggest that in patients with TB -DM there is a lower rate of conversion of the result of sputum from positive to negative compared with non-DM patients with TB^{18,19}.

The possibilities for people to suffer active TB can be also explained by defects in cellular immunity caused by hyperglycemia. Diabetes can reduce the response to treatment for tuberculosis; diabetes can also modify the clinical course of the infection or associate it with the presence of resistant strains²⁰.

Diabetes should be included among the determinants of the future incidence of TB. In Mexico, the prevalence of diabetes is several times greater than HIV, so exacerbating the impact of diabetes to the health system.

The Aim of this research was to identify risk factors that increase susceptibility to pulmonary tuberculosis in Mexico.

MATERIAL AND METHODS

Critical analysis based on literature review was performed in electronic magazines published during the period 2000 to 2013 without language restriction on the view that these were indexed in Thomson Reuters, Elsevier, CrossRef and EBSCO.

RESULTS

In the literature review 12 articles indexed were analyzed, the authors of such articles agree that the pulmonary Tuberculosis most often affects

people with low socioeconomic status, especially if they have associated comorbidities such as HIV, DM and malnutrition. These conditions can have considerable impact because they are not only potent factors, but can also be highly prevalent in the general population, it is important for others to note that the importance of a risk factor for public health is determined by both the strength associated as its prevalence in the population. Therefore, there is a need to conduct further research on the subject and in the assistance of poverty where even lifestyles associated with these risk factors for public health influence it as a reemerging disease.

DISCUSSION

Tuberculosis is a re-emerging disease and requires attention. As a persistent disease it continues making an impact on the health of the human population, although the increase is primarily associated with poverty and lifestyles it is also associated to chronic diseases such as diabetes and issues arising from poor nutrition, this means that its presence is unavoidable if we do not invest in changing lifestyles, improving fundamental living conditions such as alimentation. The vulnerability of people living in poverty conditions or similar lifestyles is determining for health in reducing the incidence and prevalence of the disease; situation which would cause a decline in the social economic cost for medical care at the household level and in turn the cost at public health institutions.

It is necessary to work with vulnerable populations through education from the pedagogical implementation of strategies based on the socio-constructivist approach to education also applied in health education. Human populations are vulnerable; an educational model where people participate in government decisions and who are responsible for the common good are also required²¹.

CONCLUSION

One of the commitments in the framework of the Millennium Development Goals is to reduce the prevalence and mortality of tuberculosis, "Objective 6, 6C goal "Mexico is far from reducing TB if social determinants such as poverty are not

solved, "goal 1: Eradicate extreme poverty and hunger", exclusion, poor housing conditions, among others, as well as the population prevalence of comorbidities such as HIV / AIDS and Diabetes Mellitus, otherwise Tuberculosis will continue to be the main killer disease reemerging.

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REFERENCES

1. Secretaria de Salud. Perfil epidemiológico de la TUBERCULOSIS en México. México; 2012.
2. Secretaria de Salud. Guía practica para la Atención de la TUBERCULOSIS en niños, niñas y adolescentes. México; 2007.
3. Meza Palmeros, J. A., Sánchez Pérez, H. J., Freyermuth Enciso, G., & Sánchez Ramírez, G. El gradiente socioeconómico de la mortalidad por Tuberculosis en México. *Población y Salud en Mesoamérica*. 2013; 1-15.
4. Salud, S. D., Estándares para la Atención de la Tuberculosis en México. México, 2009.
5. Los Microbios en la Red. Tuberculosis: Epidemiología de la Tuberculosis. [Internet]. *Berkeley Student Cooperative*; 2010 [citado: 2 Ago 2012]; Disponible en: <http://www.losmicrobios.com.ar/microbios/?p=428>
6. Pan American Health Organization. Tuberculosis in the Region of the Americas 2009. Regional Report. Epidemiology, Control and Financing. Washington, D.C.: *PAHO*; 2011.
7. Organización Mundial de la Salud. Objetivos de Desarrollo del Milenio [Internet]. Ginebra: *OMS*; 2012 [Citado: 2 Ago 2012]; Disponible en: http://www.who.int/topics/millennium_development_goals/es/
8. Gutiérrez Rodríguez R, Gotuzzo Herencia E. Co-infección VIH y tuberculosis [Internet].

- [Citado: 2 Jun 2012]; Disponible en: <http://www.upch.edu.pe/tropicales/telemedicinatarga/REVISION%20DE%20TEMAS/VIH-TB%20modificado.pdf>
9. Organización Panamericana de la Salud. Coinfección TB/VIH: *Guía Clínica*. Versión actualizada - 2010. Washington, D.C.: OPS; 2010.
 10. Mendoza Ticona A, Iglesias Quilca D. Tuberculosis en pacientes con VIH/SIDA. [Internet]. *Acta Méd Peruana*. 2008 [citado: 21 Mar 2012]; 25(4). Disponible en: http://www.scielo.org.pe/scielo.php?pid=S1728-59172008010000012&script=sci_arttext
 11. Organización Mundial de la Salud. Hablemos de Tuberculosis y VIH. La carga mundial de Tuberculosis y su relación con el VIH. [Internet]. Ginebra: OMS; 2012 [citado: 2012 Agosto 2]; [Citado: 17 Jul 2012]; Disponible en: http://www.who.int/tb/challenges/hiv/talking_points/es/index.html
 12. Ortega AA, Osorio PM, Barrios FP, García MS. La desnutrición y la tuberculosis: dos flagelos del subdesarrollo. A propósito de un caso atendido en Timor Leste MediSur, *Revista Electrónica de las Ciencias Médicas en Cienfuegos*. 2010; 8(2): 64-70.
 13. Núñez RG, Salinas MA, Villarreal RE, Garza EM, González RF. Riesgo nutricional en pacientes con tuberculosis pulmonar: ¿cuestión del paciente o de los servicios de salud? *Salud Pública Mex* 2000; 42:126-132.
 14. Barrios PJ, Castañón AM, Flores VM, Hernández PR. Aspectos biológicos, clínicos y epidemiológicos de la tuberculosis latente. *Salud Pública Mex* 2010; 52:70-78.
 15. Aguilar SC. Diabetes y tuberculosis: en el laberinto del subdesarrollo. *Revista de Investigación Clínica*. 2005; 57(1): 82-84.
 16. Dooley KE, Chaisson RE. Tuberculosis and diabetes mellitus; convergence of two epidemics. *Lancet Infect Dis*. 2009; 9 (12):731-46.
 17. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. *P Los Med*. 2008; 5(7):e152. doi: 10.1371/journal.pmed.0050152.
 18. Jiménez CM, Cruz HL, García GL, Ferreyra RL, Delgado SG, Bobadilla VM, et al. Associations of diabetes and tuberculosis: impact on treatment and post-treatment outcomes. *Thorax*. 2013; 68(3): 214-220.
 19. Reis SB, Locatelli R, Horta BL, Faerstein E, Sánchez MN, Reiley LW, et al. Socio demographic and clinical differences in subjects with tuberculosis with and without diabetes mellitus in Brazil-a multivariate analysis. *P Los One*. 2013; 8(4): e62604. doi:10.1371/journal.pone.0062604
 20. Ponce LA, García GM, García SM, Gomez PF, Olaiz FG, Valdespino GJ, et al. Tuberculosis and diabetes mellitus in southern Mexico. *Diabetes care*. 2004; 27: 1584-90.
 21. Ruvalcaba Ledezma JC, Cortés Ascencio SY. El contexto socioambiental y la educación para la salud en San Andrés Paxtlán, Oaxaca, México. *Revista Xihmai* 2013; 8(16): 7-28.